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

Gabe de Bondt, Arne Gieseck and Zivile Zekaite

Version: 26 April 2018

Abstract
This study develops a thick modelling tool for euro area real private consumption in the spirit of Granger and Jeon (2004) exploiting the euro area sectoral accounts. A large number of error correction models are estimated using the Generalised Method of Moments. Disposable income and wealth determine consumption in the long run. Income is split into labour and non-labour income and wealth into financial and non-financial wealth. Whilst the latter split is common in the literature, the differential effects of income components have been overlooked. We find that the decomposition of both income and wealth is statistically and economically important for the analysis of private consumption and out-of-sample forecasting. The model also includes a rich set of short-run determinants: interest rates including external finance premia, consumer leverage, (income) uncertainty and demographic variables as well as variables capturing Ricardian equivalence effects.

Keywords: thick modelling, private consumption, disposable income, wealth, leverage

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.

This paper has received comments from the participants of the 1st Vienna Workshop on Economic Forecasting, the WGF Work Programme Meeting held in January 2018, and the RCC4-RCC5 mini-workshop on Private Consumption in December 2017 as well as from BCA division staff.
Non-technical summary

The expansion of the euro area economy since 2013 has been largely driven by domestic demand with the greatest contributions coming from private consumption expenditure. Private consumption is the largest component of domestic demand accounting for approximately 55% of the total GDP in the euro area and, thus, one of the key variables in any macroeconomic projections exercise. Furthermore, it is itself an important driving factor behind other components of demand, notably investment and imports, as well as employment. Given its prominent role for economic activity and, in turn, relevance for policy making, this paper aims to model real consumption of the euro area households with a focus on the differential effects across components of disposable income and to provide a set of forecasts for consumption growth by applying a thick modelling approach. To the best of our knowledge, a split of disposable income into labour and non-labour components has been overlooked in the literature as yet. Moreover, our study is the first thick modelling application of private consumption in the euro area. Thick modelling considers a multiplicity of model specifications rather than a single “best” one. It keeps among a large number of model specifications those that relate to the purpose of the models and typically simply combine them by giving equal weights to the selected equations. In our case we keep those specifications that explain and forecast private consumption well using standard determinants from the consumption literature.

Private consumption is largely determined by disposable income and wealth (Fernandez-Corugedo, 2004). Nevertheless, it has been shown in the empirical literature that other determinants, such as interest rates, (income) uncertainty and consumer debt, are also important factors (Rodriguez-Palenzuela et al., 2016). In addition, many studies have looked into the differential effects of wealth components, i.e. financial and non-financial wealth, on household consumption (Sousa, 2009, Jawadi et al., 2017). However, disaggregated disposable income effects have been largely overlooked in the literature. Non-labour income of euro area households currently accounts for about half of total households’ resources. Moreover, income components are likely to have different effects on consumption and the marginal propensities to consume out of labour and non-labour income are not necessarily the same. We use both non-financial and financial quarterly euro area sector accounts data to decompose disposable income into labour and non-labour components following three alternative approaches as well as to split total wealth into financial and non-financial (mainly housing) wealth when modelling private consumption. In addition to income and wealth components, we consider a wide set of other potential determinants in the short run: interest rates, consumer indebtedness, government debt measures capturing Ricardian equivalence effects, (income) uncertainty and demographic variables. In the spirit of Granger and Jeon (2004), we generate multiple (29 thousand) single-equation error correction models for consumption
growth estimated by General Method of Moments (GMM) over the period 2001Q3 – 2017Q3. We then select a set of best performing equations by applying pre-determined in-sample and out-of-sample criteria to generate forecasts for consumption growth. Overall, the final set includes 56 equations that meet all criteria.

Two main findings emerge from our analysis. Firstly, our results show that it is of high importance to distinguish between components of income and wealth when analysing euro area private consumption. The estimated long-run elasticity of labour income is greater than that of non-labour income (alternatively, property and transfer income) in all equations and is about twice as big. However, taking into account the different ratios of consumption to labour and non-labour income, the marginal propensity to consume out of labour income is on average similar to that of non-labour income: about 80 cent versus between 71 and 83 cents. With respect to wealth components, the average long-run elasticity of financial wealth is found to be four to five times larger than that out of non-financial wealth. The average marginal propensity to consume out of financial wealth is found to be around 1 cent and 0.1 cent for non-financial wealth. The short-run estimated elasticities are also found to be larger for labour income than for non-labour income. In contrast, the relative importance of the wealth components differ in the short run compared to the long run. The average estimated short-run elasticities for non-financial wealth are up to twice of those for financial wealth. Secondly, we demonstrate the usefulness of the thick modelling approach in analysing as well as forecasting consumption. We report how the selected models from the thick modelling approach may serve to analyse consumption dynamics and the determinants behind these dynamics as well as to produce out-of-sample forecasts. Overall, out-of-sample forecasts indicate that the mean forecast and forecast range of selected models approximate actual consumption growth well over the period 2015Q4 – 2017Q3.
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. According to standard theories, private consumption is largely determined by disposable income and wealth (Fernandez-Corugedo, 2004). The empirical literature has extended this basic consumption model along two main dimensions. Firstly, short- and long-run effects of various other determinants in addition to total income and wealth have been examined in great detail. Among these alternative variables are: interest rates, measures of household and public sector indebtedness, and income uncertainty measures (Aron et al., 2012; Estrada et al., 2014). With respect to euro area countries, Rodriguez-Palenzuela et al. (2016) report evidence supportive of a negative short-run impact on consumption from increased income uncertainty, as measured by changes in the unemployment rate, and a negative long-run effect of a real deposit interest rate (see also Al-Eyd, 2006). Dees and Brinca (2013) investigate whether 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 the unemployment rate. In addition to standard determinants, Al-Eyd et al. (2006) examine demographic, confidence and Ricardian equivalence effects on consumption. 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.

Secondly, many studies have examined disaggregated wealth effects on consumption by decomposing total wealth. Several reasons may motivate a different response of households to changes in different types of wealth, including differences in the liquidity of assets, differences in the distribution of assets across income groups, and differences in the perceived persistency of changes in different types of wealth (Altissimo et al., 2005). The importance of analysing disaggregated wealth is also highlighted in Sousa (2010). He shows that financial wealth has a stronger impact on consumption than housing wealth in the US and UK. Short-run housing wealth dynamics appear more relevant than changes in financial wealth for consumption growth. Disaggregated wealth effects on private consumption in the euro area as a whole are examined in Sousa (2009). The results show that financial wealth has significant and economically important effects on consumption in the short and in the long run. With respect to gross housing wealth, the estimated long-run elasticity is much smaller but statistically significant. In addition, 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 in terms of the marginal propensity to consume across sixteen, 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
the late 1980s. While for individual European countries the housing wealth effect is stronger in about half
of countries, for the euro area as a whole financial wealth is more important. More discussion of empirical
evidence with respect to differential financial and non-financial wealth impact on consumption is provided
in Altissimo et al. (2005). Other studies approximate financial and housing wealth using stock and house
price indices. Euro area evidence for increased equity wealth effects since 1994 is reported in de Bondt
(2011). House prices are shown to be more important for consumption in the long run as compared to
stock prices for a group of euro area countries (Rodriguez-Palenzuela et al., 2016). In contrast, Jawadi et
al. (2017) do not find evidence of significant disaggregated wealth dynamic effects for the euro area.
Overall, the empirical evidence as to which wealth component is dominant in determining euro area
private consumption is mixed.

We contribute to the macro literature on private consumption in two ways. 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 (consisting mainly of housing wealth). 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. The second contribution of this
paper is the application of a thick modelling approach for euro area private consumption for the first time.
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 disposable income and
wealth components. 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. In addition, these equations can be used to
generate a set of forecasts for private consumption and help ensure a more robust projection for private
consumption growth in the euro area by providing a range of forecasts from a number of consumption
equations.

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, income
components are likely to have different effects on consumption and the marginal propensities to consume
out of labour and non-labour income are not necessarily the same. We consider three different income
splits, because it is not obvious a priori how it is best to define labour and non-labour income. This is – to
the best of our knowledge – the first empirical euro area study which examines in detail labour and non-
labour income effects on consumption and provides a comparison of disaggregated income effects.
Nevertheless, it is important to note that several central banks do take interest in income components in their macroeconomic models used for forecasting and analysis (Fagan and Morgan, 2005). We show that there are indeed differences between the two components of disposable income. Furthermore, we re-visit the relative importance of financial versus tangible wealth in determining euro area private consumption and find stronger effects with respect to financial wealth in the long run.

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. Section 3 describes the estimation results. Based on the estimation results, a more detailed assessment of past consumption dynamics is presented in Section 4. Section 5 provides a forecast evaluation based on the selected models, while Section 6 concludes.

2. Data and methodology

2.1 Data

The source for all quarterly time series for the period 1999Q1 – 2017Q3 is the European Central Bank’s Statistical Data Warehouse (SDW). Income, wealth and debt variables are taken 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 ECB’s Survey of Professional Forecasters and the 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 its extensions

Income and wealth variables are assumed to affect consumption in both the short and the long run. We use euro area sector accounts data to split real disposable income into labour (ly) and non-labour income (nly) using three alternative approaches since there is no agreed way to decompose labour and non-labour income. Furthermore, information on the shares of income taxes paid on different income types and on the shares of social security contributions paid out of income of self-employed and / or employees is scant at the area-wide level. In addition, real wealth (nominal household total wealth deflated by the private consumption deflator) is split into non-financial wealth (nfw) and financial wealth (fw), i.e. financial assets less financial liabilities).
All other determinants of private consumption that we consider are assumed to affect private consumption only in the short run (∆xi). Generally, the baseline equation for consumption growth is an error correction model presented in Equation (1):

$$
\Delta \log(c_t) = \alpha + \beta_1 \Delta \log(y_t) + \beta_2 \Delta \log(nly_{t-1}) + \beta_3 \Delta \log(fw_{t-1}) + \beta_4 \Delta \log(nfw_{t-1}) - \gamma \left( \log(c_{t-1}) - (1 - \theta_1 - \theta_2 - \theta_3) \log(y_{t-1}) - \theta_1 \log(nly_{t-1}) - \theta_2 \log(fw_{t-2}) - \theta_3 \log(nfw_{t-2}) \right) + \beta_5 \left[ \Delta x_{it-1} \right] + u_t \tag{1}
$$

where ∆ denotes quarter-on-quarter changes, γ is the error correction term (ECM) on the lagged log level of consumption, βi and θi represent short-run and long-run coefficients, respectively. With respect to the ECM, a highly statistically significant γ parameter would be consistent with the cointegrating relation in the long-run vector. Typically, the absolute value of the t-statistic is expected to be greater than 3 (Banerjee et al., 1993; Al-Eyd et al., 2006; Barrell and Davis, 2007). Note that wealth variables are lagged by one period in the short and long run 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.

### 2.3 Income and wealth components

The first and most elementary approach to decompose disposable income defines labour income as total compensation of employees minus direct taxes on income and wealth paid by households. 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/premia,
grants, donations, penalties, etc., are also included in labour income. Accordingly, non-labour income broadly matches the sum of property income and households’ gross operating surplus.

As a third and the 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 security 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 received by 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 excluding 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.

With respect to the first and second approach, labour income makes up on average 62% of total household real income in 2017Q3, compared to 59% in 1999. Consequently, the non-labour income share has declined slightly and is currently approximately 38% of the total. Regarding the third income split, labour income accounts for about half of total disposable income (52%) while property and transfer income make up 21% and 27%, respectively. In this case, labour and property income shares decreased somewhat and transfer income share increased since 1999.

As the main focus of this paper is on disaggregate income effects, we only consider one approach to split total wealth which is most commonly found in the literature. The major component of wealth has always been non-financial wealth. Its share increased from 63% to 67% of total household wealth in the euro area since 1999. Non-financial wealth, in turn, has on average related to 94% of housing wealth and the remaining 6% to other fixed assets linked to productive activity. Roughly half of housing wealth consists of dwellings and the other half of land.

**Chart 1** plots annual growth rates of total real disposable income together with its components based on the three decompositions (Panels A, B and C) as well as annual growth rates of total real wealth together with the contributions of non-financial assets and financial wealth (Panel D). Overall, the three labour income series tend to co-move over time (with correlation of annual growth rates between 0.55 and 0.85); however, they diverge over specific periods of time, notably during the Great Recession. For instance, labour income based on the second split increased during the Great Recession as it includes social
transfers paid to households, while labour income based on the third approach declined sharply as it excludes transfers paid to households but includes mixed income of self-employed. The three non-labour income series also tend to co-move over time, the correlations of annual growth rates vary between 0.36 and 0.83. Non-labour income diverged notably during the Great Recession: as the second split excludes transfers paid to households, non-labour income calculated using this definition declined most sharply.

**Chart 1. Contributions of components to income and wealth growth**

![Chart Image]

*Notes:* This chart plots annual growth rates of total real disposable income together with respective contributions from its labour and non-labour components based on the first, second and third decompositions (Panels A, B and C, respectively) during 1999Q1 – 2017Q3. Panel D plots annual growth rates of total real wealth and contributions from its financial and non-financial components.
2.4 Other short-run dynamics

Short-run determinants other than income and wealth components are grouped in five categories: (i) real interest rates and interest rate spreads, including several measures of the external finance premium; (ii) measures of consumer indebtedness (LEV); (iii) measures of government indebtedness capturing the Ricardian equivalence effects (GOV); (iv) (income) uncertainty measures; (v) other variables. Table A1 in the Appendix provides a detailed list of variables in each category.

Each estimated equation always includes one of the interest rate measures and, additionally, up to two other variables in various combinations. 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). With respect to household indebtedness, several household leverage indicators are constructed: a ratio of household loans (stock) to either households’ gross disposable income or real GDP. In addition, interest burden variables (a ratio of interest paid or net interest income to disposable income) 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. The third 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 and inflation expectations, actual inflation rate, real effective exchange rate, exchange rate volatility and real oil prices. Furthermore, we consider several measures of macroeconomic uncertainty (Bloom, 2009; Gieseck and Largent, 2016), including economic policy uncertainty, financial market uncertainty, and forecast uncertainty. 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) and of macroeconomic uncertainty in Gieseck and Largent (2016). The final category has two variables: lagged consumption growth and the old-age-dependency ratio, i.e. the share of 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).
2.5 Thick modelling and selection of equations

In order to forecast real private consumption, we follow a thick modelling approach in the spirit of Granger and Jeon (2004). A similar approach is applied by the Bundesbank (2016) for the Phillips curve. The starting point is the Generalised Method of Moments (GMM) estimation of a vast number of ECMs as in Equation (1) using data over the sample period 1999Q1 - 2017Q3. The sample period is short, but due to data constraints it is not possible to extend the sample backwards. Notwithstanding this important caveat, the short sample has the advantage that it does not contain synthetic euro area data, given that it starts with Stage Three of the Economic and Monetary Union. In addition, thick modelling considers the uncertainty stemming from both unstable parameters and model specification and is thus particularly useful for empirical applications using a short sample where model uncertainty is expected to play a role, because it does not rely on a single “best” model specification.

Among $\Delta x_i$ variables, there is always one interest rate-based measure and up to two other determinants each taken from a different category. For every equation, 5 lags of the independent and dependent variables are used as instruments. After accounting for data transformation and lags the actual estimation sample begins in late 2001, albeit it varies slightly across specifications. Typically, provided that there is a cointegrating relationship among variables in the long-run vector, an ECM equation could be estimated by the Ordinary Least Squares (OLS) (Davis and Palumbo, 2001). The GMM is chosen as an estimation method here in order to account for potential endogeneity among variables. 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).

After generating around 29 000 consumption equations, we follow a five-step selection process to filter the best ECM specifications, with first three in-sample selection criteria, followed by one out-of-sample criterion and one theoretically founded criterion:

1) all coefficients with the exception of a constant should be statistically significant at the 5% level;
2) the adjusted R-squared should be at least 0.60;
3) the P-value of the Ljung-Box Q-statistics should be above 0.05 for the lags 1-4 as well as 12, i.e. there is no residual autocorrelation a sign of model misspecification;
4) the out-of-sample root mean squared error (RMSE) should be less than 0.85 of those from a benchmark model, i.e. a forecast accuracy gain of at least 15%;
5) the estimated coefficients should have the economically correct sign to be able to tell an economic story.

Following the first three in-sample selection criteria of the selection process, 332 equations remain, around 1% of the original equations. The first income decomposition appears in 134 equations (40%), while 112 (34%) and 86 (26%) equations are based on the second and third income split, respectively. For the fourth selection criterion, equations are estimated until 2015Q3 to generate forecasts for quarterly consumption growth for all horizons between 1 and 8 quarters ahead, i.e. over the pseudo out-of-sample period spanning 2015Q4 – 2017Q3. RMSE are calculated over all horizons. For instance, if the forecast horizon is 4 quarters, the RMSE is calculated based on forecasts 1, 2, 3 and 4 quarters ahead. The ECM equations are sorted according to an average RMSE based on 8 horizons (from the smallest to the largest). In addition, the relative average RMSEs against a benchmark model are computed and only specifications with a RMSE relative to the benchmark model of less than 0.85 are selected. The benchmark is a simple ECM equation which only includes total disposable income and the two wealth components in both short and long run to explain consumption. Finally, for the list of equations with a relative RMSE below 0.85, we check whether the estimated coefficients in an equation exhibit economically correct (expected) signs. While it is agreed that higher income and wealth growth boost private consumption, the literature shows that the impact of some determinants considered here is more ambiguous. Consequently, we set priors on short-run coefficients for some variables leaving some other short-run determinants unrestricted. The next sub-section discusses these priors in more detail while the summary of expected signs for each variable is provided in Table A1 in the Appendix.

In total, we select 56 equations out of the 332 pre-selected models. With respect to income decomposition, we find that the majority of equations (31) are based on the first income split. Meanwhile, the second and third approaches feature in 12 and 13 equations, respectively. On average, the relative average RMSE with respect to the benchmark ECM is 0.79 across all equations, with the range between 0.69 and 0.85.

### 2.6 Sign priors for coefficients

In order to test whether our priors hold in a given sample for the euro area, we estimate the benchmark ECM for each determinant separately before imposing them. The estimated signs are reported in Table A1 in the Appendix. This helps to confirm the expected sign as per economic theory. With regards to real interest rates and spreads, several effects may be at work and the overall impact on consumption depends on which effect dominates (Gustafsson et al., 2017; Premik and Stanislawska, 2017). The
substitution effect implies that current consumption becomes relatively more expensive due to higher real interest rates and, thus, it is postponed to the future. The income effect acts in the opposite direction as higher real rates reduce the present value of future consumption boosting consumption for a given level of wealth. Similarly, the present value of total future wealth and income also declines as real rates rise, resulting in lower consumption (the wealth effect). In short, while higher real interest rates make it more expensive to finance consumption spending, it also encourages saving due to higher return. Similarly, the greater the wedge between the rates on mortgages or consumer loans as compared to a short rate paid on household deposits is, the lower consumption growth is expected to be. A recent study finds evidence that the substitution effect dominates in the panel of 11 euro area countries at least in the long run (Rodriguez-Palenzuela et al., 2016). Based on the estimation of the benchmark ECM for each interest rate measure, the sign of the coefficient is found to be consistently negative for the euro area. As a result, we expect to find a negative impact of real interest rates on consumption growth in our models.

The prior for the coefficient on consumer indebtedness variables is that the effect on consumption growth is negative. The ECM estimations signal that our measures of consumer indebtedness (lagged) reflect ex ante financial constraints on households spending with the estimated coefficient always being negative. Using the US household-level data, Dynan (2012) found that households with higher leverage reduced their spending more following the burst of the house price bubble. Nevertheless, it is argued by some that higher debt could also have a positive impact on consumer spending. If household debt is increasing due to higher future expected income, then consumer spending would also be increasing. See, for instance, the discussion in Albuquerque and Krustev (2015). Rodriguez-Palenzuela et al. (2016) find that the ratio of loans to disposable income has a significant and positive effect on consumption in the long-run in the selected euro area countries. For a panel of OECD countries, Estrada et al. (2014) demonstrate that while contemporaneous household debt growth has a positive impact on consumption growth, the opposite is true for lagged debt growth rates – increasing debt level affects future consumption adversely.

The third group of variables are meant to capture the Ricardian equivalence effects, hence, a worsening fiscal position is expected to have a contractionary impact on private consumption due to expectations of higher taxes in the future (Al-Eyd et al., 2006; Rohn, 2010). The majority of our proxies of government indebtedness, albeit not all, confirm that the Ricardian effects are present for the euro area as a whole. A negative effect of public debt to GDP on private consumption in the long run is reported by Rodriguez-Palenzuela et al. (2016), although the estimated coefficient is not found to be significant.

With respect to the uncertainty measures considered, we generally expect that variables indicating higher income / macroeconomic uncertainty lead to lower consumption growth as a result of increased
precautionary savings. This is confirmed by the estimated ECM equations for most of the measures considered. For instance, higher real oil prices, unemployment rate or expected unemployment as well as lower consumer confidence and economic sentiment have an adverse impact on consumption growth. Similar findings are reported in several related studies (Dees and Brinca, 2013; Estrada et al., 2014; Lahiri et al, 2016; Rodil-Marzabal and Menezes-Ferreira-Junior, 2016). Nevertheless, ambiguous effects are found with respect to changes in actual and expected inflation, in line with conflicting reporting in previous studies. Therefore, we allow for both negative and positive signs for inflation variables. 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). More discussion about inflation expectations and consumer spending or saving is provided in Premik and Stanislawksa (2017). Similarly, we allow for both signs with respect to exchange rate variables, i.e. exchange rate appreciation and its volatility as measured by a moving standard deviation.

Finally, in line with the life cycle hypothesis, we expect that an increase in the old-age-dependency ratio is expected to boost consumption as older people tend to save less (Hufner and Koske, 2010). This result is also found in the estimated benchmark ECM – the coefficient on changes in old-age-dependency ratio is positive. We do not impose any prior with respect to the coefficient on lagged consumption growth.

3. Estimation results

3.1 Long run
The key finding is that the long-run elasticities with respect to labour income and financial wealth are estimated to be larger than those for non-labour income and non-financial wealth, respectively. Regardless of how disposable income is split, the estimated long-run coefficient of labour income is greater than that of non-labour income (alternatively, property and transfer income) in all equations. This difference is also always statistically significant according to Wald tests. Table 1 summarises for all three income decompositions the average estimated long-run elasticities and marginal propensities to consume out of income and wealth components based on the 56 selected equations. It shows that the average labour income elasticity of consumption (0.56) is about twice as high as non-labour income elasticity (0.32). Based on the third decomposition, average long-run labour income elasticity is somewhat lower (0.47) but is still about twice the size of that for property (0.17) or transfer income (0.25). The labour income elasticity varies across equations between 0.50 and 0.60 with respect to the first and second decompositions and between 0.44 and 0.50 in the case of the third decomposition. Consequently, it is
important to separate between labour and other types of income when analysing income effects on private consumption since the elasticities in the long run differ substantially. The average elasticity to consume out of financial wealth is typically at least four times larger than that out of non-financial wealth. Overall, the elasticity for financial wealth amounts to 0.09 (with a range between 0.07 and 0.13), while it amounts to 0.02 (varying between 0.01 and 0.03) in the case of non-financial wealth.

In order to compare the results with other studies, the final two columns of Table 1 also report marginal propensities to consume out of income and wealth components each being calculated as a product of respective average elasticity and a ratio of average consumption level to average income / wealth component level over the sample period. On average, 80 cents are being spent out of 1 euro of labour income across all selected equations. Approximately 73 cents are spent out of 1 euro of non-labour income when income is split into two components. With regards to the three-way income split, the marginal propensities to consume out of property income and transfer income are relatively high: 83 and 71 cents, respectively. The differences in the magnitudes of MPCs of income components do not appear to be as substantial as in terms of elasticities; however, this does not necessarily imply income decomposition is not useful for consumption analysis. Meanwhile, the marginal propensity to consume out of financial wealth is substantially higher than that out of non-financial wealth based on all 56 equations (0.98 against only 0.11 euro cent).

In general, the findings with respect to wealth effects reported above are broadly in line with the literature for the euro area. Sousa (2009) finds that the long-run MPC to consume out of financial wealth is between 1.75 and 1.93 cents per euro, while the 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 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 and/or stronger bequest motives in the case of the latter (Altissimo et al., 2005). If one owns a house and lives there, households might be less inclined to sell their house and consume out of gains from higher house prices than to sell financial assets and consume out of equity price increases.
Table 1: Long-run elasticities and marginal propensities to consume

<table>
<thead>
<tr>
<th>Income decomposition (I)</th>
<th>Elasticity range</th>
<th>Average elasticity</th>
<th>MPC range</th>
<th>MPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>LY</td>
<td>0.50-0.60</td>
<td>0.55</td>
<td>72.49-88.00</td>
<td>80.67</td>
</tr>
<tr>
<td>NLY</td>
<td>0.29-0.37</td>
<td>0.32</td>
<td>63.13-79.93</td>
<td>71.03</td>
</tr>
<tr>
<td>FW</td>
<td>0.07-0.13</td>
<td>0.10</td>
<td>0.70-1.43</td>
<td>1.07</td>
</tr>
<tr>
<td>NFW</td>
<td>0.01-0.03</td>
<td>0.02</td>
<td>0.05-0.15</td>
<td>0.10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income decomposition (II)</th>
<th>Elasticity range</th>
<th>Average elasticity</th>
<th>MPC range</th>
<th>MPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>LY</td>
<td>0.53-0.59</td>
<td>0.56</td>
<td>74.98-84.26</td>
<td>79.49</td>
</tr>
<tr>
<td>NLY</td>
<td>0.31-0.33</td>
<td>0.32</td>
<td>72.05-76.07</td>
<td>74.47</td>
</tr>
<tr>
<td>FW</td>
<td>0.07-0.12</td>
<td>0.09</td>
<td>0.71-1.27</td>
<td>0.95</td>
</tr>
<tr>
<td>NFW</td>
<td>0.02-0.03</td>
<td>0.02</td>
<td>0.09-0.14</td>
<td>0.12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income decomposition (III)</th>
<th>Elasticity range</th>
<th>Average elasticity</th>
<th>MPC range</th>
<th>MPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>LY</td>
<td>0.44-0.50</td>
<td>0.47</td>
<td>73.19-82.47</td>
<td>78.19</td>
</tr>
<tr>
<td>PY</td>
<td>0.15-0.19</td>
<td>0.17</td>
<td>63.13-77.24</td>
<td>70.76</td>
</tr>
<tr>
<td>TY</td>
<td>0.22-0.27</td>
<td>0.25</td>
<td>73.37-89.90</td>
<td>83.35</td>
</tr>
<tr>
<td>FW</td>
<td>0.07-0.11</td>
<td>0.09</td>
<td>0.73-1.12</td>
<td>0.92</td>
</tr>
<tr>
<td>NFW</td>
<td>0.01-0.03</td>
<td>0.02</td>
<td>0.07-0.15</td>
<td>0.11</td>
</tr>
</tbody>
</table>

This table reports the ranges and sample averages of long-run elasticities and marginal propensities to consume out of labour (LY), non-labour (NLY), property (PY), and transfer (TY) income, financial wealth (FW) and non-financial wealth (NFW). The three panels show the estimates based on the 1st, 2nd and 3rd income decompositions, respectively. Marginal propensity to consume (MPC) is reported in euro cents (100*elasticity*C/X, where C is the average level of real consumption and X is the average level of relevant income/wealth variable over the sample 2001Q3-2017Q3).

3.2 Short run

Table 2 reports average short-run elasticities for income and wealth components as well as the ranges of the estimates across specifications. Based on the first two income decompositions, the short-run labour and non-labour income elasticities are estimated to be similar. The average short-run elasticity of consumption to labour income amounts to 0.20 in the case of the first decomposition and 0.18 using the second approach. Meanwhile, the average elasticity for non-labour income amounts to 0.16 and 0.18 for the first and second decomposition, respectively (with a range of 0.12 – 0.24). The Wald test indicates that short-run coefficients on income components are not significantly different for the majority of the equations (31 out of 43). When disposable income is decomposed using the third approach, our estimates suggest that labour income tends to be significantly more relevant in explaining short-run
consumption growth than either property income (11 out of 13 equations) or transfer income (9 out of 13 equations). The average short-run elasticity of consumption to labour income is 0.22, while for transfer income it is 0.12 and in the case of property income it is 0.06. Thus, the third income decomposition indicates that labour income may play a bigger role for consumption growth than the other types of income in the short run. This finding is in contrast to the results using the other two income splits, highlighting an equal importance for labour and non-labour income.

Table 2: Average short-run elasticities

<table>
<thead>
<tr>
<th>Income decomposition (I)</th>
<th>Elasticity range</th>
<th>Average elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LY</td>
<td>0.10-0.31</td>
<td>0.20</td>
</tr>
<tr>
<td>NLY</td>
<td>0.12-0.21</td>
<td>0.16</td>
</tr>
<tr>
<td>FW</td>
<td>0.02-0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>NFW</td>
<td>0.03-0.12</td>
<td>0.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income decomposition (II)</th>
<th>Elasticity range</th>
<th>Average elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LY</td>
<td>0.07-0.29</td>
<td>0.18</td>
</tr>
<tr>
<td>NLY</td>
<td>0.12-0.24</td>
<td>0.18</td>
</tr>
<tr>
<td>FW</td>
<td>0.02-0.07</td>
<td>0.04</td>
</tr>
<tr>
<td>NFW</td>
<td>0.03-0.11</td>
<td>0.06</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income decomposition (III)</th>
<th>Elasticity range</th>
<th>Average elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>LY</td>
<td>0.10-0.28</td>
<td>0.22</td>
</tr>
<tr>
<td>PY</td>
<td>0.04-0.09</td>
<td>0.06</td>
</tr>
<tr>
<td>TY</td>
<td>0.09-0.16</td>
<td>0.12</td>
</tr>
<tr>
<td>FW</td>
<td>0.02-0.04</td>
<td>0.03</td>
</tr>
<tr>
<td>NFW</td>
<td>0.03-0.11</td>
<td>0.06</td>
</tr>
</tbody>
</table>

This table reports the ranges and sample averages of short-run elasticities for labour (LY), non-labour (NLY), property (PY), and transfer (TY) income, financial wealth (FW) and non-financial wealth (NFW). The three panels show the estimates based on the 1st, 2nd and 3rd income decompositions, respectively.

Table 2 shows that the short-run effects of non-financial and financial wealth on consumption are similar. On average, the short-run elasticity with respect to non-financial wealth is estimated at 0.06, while that for financial wealth amounts to 0.04. In 44 of 56 equations the difference between the two coefficients is statistically insignificant according to Wald tests. Interestingly, the short-run impact of non-financial wealth
is greater than their long-run effect, while the short-run effect of financial wealth is smaller than their long-term effect. Greater effects of non-financial wealth in the short-run (than in the long-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). For instance, with respect to the UK and the US, Sousa (2010) demonstrates that households perceive financial wealth fluctuations as being transitory and thus do not necessarily have an impact on short-run dynamics in consumption whilst housing wealth changes are perceived as being more persistent. Following this argument, it appears that non-financial wealth changes, with house prices as key driver, are viewed in the euro area as so permanent that they in particular result in higher consumer spending in the short run and to a lesser extent in the long run. For a panel of 10 euro area countries, Rodil-Marzabal and Menezes-Ferreira-Junior (2016) show that short-run housing wealth effects have been significant and positive since 2000, while they have been smaller and insignificant in the long run.

Finally, regarding other short-run dynamics, several observations are of interest. Firstly, we find that among interest rate measures the changes in long-short rate spreads, i.e. the external finance premium, and 10-year government bond yield appear most often in the final set of selected equations. Lagged changes in the ratio of household loans to GDP and interest burden variable as well as loan growth are found to be included in the selected equations with respect to the second category of short-run determinants. The Ricardian effects are typically picked up by changes in the fiscal balance (budget deficit). Uncertainty measures appearing in the selected equations most frequently are the following: quarterly changes in real oil prices, real exchange rate volatility and measures of macroeconomic uncertainty.

4. **Historical analysis of driving forces of consumption**

This section demonstrates how the estimated elasticities can be used to assess the dynamics of private consumption in the euro area. The long-run contributions of income and wealth components to euro area private consumption growth in **Chart 2** are based on the average long-run elasticities from equations with the first-type income split. The chart shows that both labour and non-labour income components help to explain consumption growth in the long run. Labour income contribution is typically larger than that of non-labour income; however, the relative importance of the two components varies over time. Prior to the global financial crisis in 2007-2009, both types of income contributed positively and non-labour income played a substantial role, especially so in 2006. During the period of the Great Recession, a sharp decline in consumption growth was to a large extent due to adverse non-labour income developments. Meanwhile, labour income continued to contribute positively until 2010. Both income components acted as a drag on consumption over the period of the sovereign debt crisis in 2010 – 2012. Labour income has
become much more important than non-labour income since the start of the expansion in 2013. Only very recently non-labour income contributions increased to the level seen before 2008.

With respect to wealth, Chart 2 shows that financial wealth is the main component explaining consumption growth in the long run. While its contributions shrunk (and even turned negative) between 2008 and 2012, financial wealth has been again providing a boost to private consumption expenditure following the sovereign debt crisis. This is not the case for non-financial wealth. While contributing in a non-negligible way until 2007 and negatively in the crisis periods, non-financial asset developments do not appear to be supporting consumption growth to the same extent since 2014. Although the role of non-financial wealth may have decreased somewhat, there is some evidence of a pick-up in its contributions in the last two years. These changes in the contributions of non-financial wealth are likely to reflect house price developments, which rose markedly prior to the crisis, fell substantially in its aftermath, and started to recover recently.

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

Notes: this chart plots actual and fitted private consumption growth rates (in %) together with contributions from labour (LY) and non-labour (NLY) income as well as from financial wealth (FW) and non-financial wealth (NFW) by calendar year over the period 2002 - 2017. The contributions are calculated based on average long-run elasticities from the estimated equations with the income decomposition I (as reported in Table 1). Note that the year 2017 figures are based on the first three quarters only.

Overall, negative contributions from non-labour income and financial wealth mostly contributed to the weakness of private consumption during the Great Recession, while it was mainly labour income and, to a smaller extent, non-labour income fluctuations that explained a sharp decline in consumption during the
euro area sovereign debt crisis. During the Great Recession, the downward impact on profit mark-ups and the steep decline in asset markets dominated, while weakening inflation dampened the impact on real wages. In contrast, during the sovereign debt crisis, the impact of lay-offs was accentuated by the weakness of wage growth. The decline in house prices also dampened consumption in both crisis periods.

A broadly similar picture is depicted in Chart 3 where the decomposition of consumption growth is based on the second approach to split total income. Nevertheless, several differences should be noted. Firstly, labour income contribution is very large in 2009 as the definition of labour income includes social benefits received by households which grew strongly during the Great Recession. Secondly, non-labour income contributions appear to be relatively larger as compared to those in Chart 1, especially in 2017 (note, however, that the figure is only based on three quarters).

**Chart 3. Contributions to consumption growth based on long-run elasticities: decomposition II**

![Chart 3](chart3.png)

*Notes: this chart plots actual and fitted private consumption growth rates (in %) together with contributions from labour (LY) and non-labour (NLY) income as well as from financial wealth (FW) and non-financial wealth (NFW) by calendar year over the period 2002 - 2017. The contributions are calculated based on average long-run elasticities from the estimated equations with the income decomposition II (as reported in Table 1). Note that the year 2017 figures are based on the first three quarters only.*

Similarly, Chart 4 plots consumption growth and long-run contributions from income and wealth components based on the average elasticities when the third approach is used to decompose disposable income. Labour income now not only includes compensation of employees net of direct taxes but also self-employed income (net of taxes) and net social security contributions (negative). Firstly, labour income
contributions tend to be the largest across all income types; however, transfer income is often similarly important while it is the most important income component in 2002 and 2008 - 2009 periods. Secondly, labour income contributions are overall smaller and, unlike in Chart 2, are negative during the Great Recession period. This may be explained by sharp declines in income from self-employment (mixed income of households) around that time. Again, it is shown that since the start of the recovery labour income is the key component that explains consumption growth. Finally, the pattern in property income contributions is broadly similar to that of non-labour income in Chart 2. With respect to wealth components the picture remains the same.

**Chart 4. Contributions to consumption growth based on long-run elasticities: decomposition III**

![Chart 4](image)

Notes: this chart plots actual and fitted private consumption growth rates (in %) together with contributions from labour (LY), property (PY) and transfer (TY) income as well as from financial wealth (FW) and non-financial wealth (NFW) by calendar year over the period 2002 - 2017. The contributions are calculated based on average long-run elasticities from the estimated equations with the income decomposition III (as reported in Table 1). Note that the year 2017 figures are based on the first three quarters only.

The above charts focused mainly on the long run determinants of consumption. However, our models may also be useful to infer what drives private consumption in the short run. We pick one equation to simply illustrate how such models can be used for economic analysis. **Chart 5** plots the contributions of all explanatory variables of euro area private consumption growth based on the best performing equation among the 56 selected ones (the first income decomposition). The estimated coefficient values are reported in parentheses in the notes under the chart. Two main observations emerge from Chart 5. First, non-labour income is often at least as important a short-run driver of consumption as labour income. Second, non-financial wealth appear to have been more relevant than financial wealth in explaining...
consumption growth, especially so preceding the global financial crisis. In the pre-crisis period, the biggest positive contributions come from the growth in non-financial wealth, labour and non-labour income. Also, a declining term spread, as a proxy for external finance premium, appears to have contributed positively to consumption expenditure between 2004 and 2007, reflecting short-term interest rates increasing more than long-term interest rates. Meanwhile, higher real oil prices reduced real purchasing power of households and depressed consumption over that period. During the Great Recession, important adverse effects materialised due to changes in the term spread (as long-term rates did not decline nearly as fast as short-term interest rates did), increasing government budget deficit (in response to the crisis), declining financial wealth (reflecting falling shares prices) and non-labour income (reflecting declining profit mark-ups). The decline in consumption over the euro area sovereign debt crisis period is mainly explained by decreases in non-financial wealth (i.e. falling house prices), weak labour income (reflecting lay-offs and weak wage growth) and declines in non-labour income. Since the start of the recovery in 2013, rising financial wealth, strengthening labour income, lower oil prices (except in 2016) and, more recently, increasing non-financial wealth (all positive contributions) played an important role for the real private consumption recovery. This implies that monetary policy measures implemented over this period positively impacted consumption through income and wealth channels. In addition, a declining term spread boosted consumption considerably in 2014.

Chart 5. Contributions to consumption growth based on the best full model

Notes: this chart plots actual and fitted private consumption growth rates (in %) together with contributions from changes in: term spread measured as the difference between 10-year government bond yield and 3-m EURIBOR rate (SR=-0.22), quarter-on-quarter changes in real oil prices (SR=-0.01), quarter-on-quarter changes government budget deficit (SR=-0.001), labour (LY) (LR=0.21, LR=0.60) and non-labour income (NLY) (SR=0.17, LR=0.29), financial wealth (FW) (SR=0.03, LR=0.08) and non-financial wealth (NFW) (SR=0.09, LR=0.03), as well as contributions from the ECM term and a constant by calendar year over the period 2002 - 2017. Short-run (SR and long-run (LR) estimated coefficients of determinants are reported in parentheses.
5. Forecast evaluation

This section examines the (pseudo) out-of-sample forecasting abilities of the 56 selected ECM equations. The models are estimated until 2015Q3 and are then used to produce forecasts for 8 quarters ahead over the period 2015Q4 - 2017Q3. Chart 6 plots the mean forecast for quarterly growth rates in consumption expenditure together with actual real private consumption growth. The shaded areas denote the range between the 5th and 95th percentiles of the forecast range (darker shade) as well as the top and bottom 5% percent (lighter shade). Overall, the mean forecast broadly tracks the actual data. With the exception of the second quarter of 2016, the actual series are always within the forecast range between the lowest and highest forecast values and it also tends to fall within the middle 90% of the forecast range. The robust growth recorded in the first quarter of 2016 followed temporarily weaker consumption performance at the end of 2015 explained by weather conditions and the terrorist attacks in France (ECB, 2016a). Adverse events such as terror attacks have been shown to have negative effects on economic activity (Llussa and Tavares, 2011). The observed sharp slowdown in the second quarter of 2016 may be explained by a return to more normal growth rates in light of very strong data in the previous quarter (ECB, 2016b). The last observation falls outside the forecast range (90%) but remains within the min-max range. However, it is the most recent data point and therefore likely to get revised. The mean absolute revision of the first estimate of euro area private consumption growth has been 0.22 percentage points since 2003, with a standard deviation of 0.29 pp. Overall there have been a small bias towards upward revisions.

Chart 6. Pseudo out-of-sample consumption growth forecasts – selected equations

Notes: this chart plots quarter-on-quarter growth rates of actual real private consumption (solid line) together with the mean forecast (dashed line) based on 56 selected equations over the sample period 2015Q2-2017Q3. The darker shaded area denotes the range between the 5th and 95th percentiles of the overall forecast range while the lighter shaded areas denote the top and bottom 5% of forecast range.
It should be noted that due to the imposed sign restrictions, i.e. the fifth criterion applied in the selection process, some equations were not selected although they had better relative RMSE than some equations currently included in the set of 56. In order to understand better what implications these sign restrictions have for the generated forecasts, we produce equivalent charts for the top 30 (approximately 10% of the pre-selected 332) and top 50 equations (similar number to 56) in the list where they are sorted according to RMSE. Panel A of Chart 7 plots forecasts and ranges for the best 30 equations while Panel B for the best 50. Overall, both sets of forecast seem to perform quite similarly to the selected equations in Chart 6. Firstly, the sharp slowdown in consumption in 2016Q2 is not captured within the minimum – maximum forecast range. Secondly, the final observation does not fall in the middle 90% of forecast range (shaded area).

Across the selected 56 equations, the average RMSE based on all horizons is 0.0012 while the average relative RMSE against the benchmark ECM equals to 0.79. This compares to the average RMSE of 0.0011 for each of the two sets of best equations whereas the average relative RMSEs against the benchmark are 0.70 for the best 30 and 0.72 for the best 50 equations. According to the Diebold-Mariano forecast accuracy test, the mean forecast based on the 56 selected models is not significantly different from the mean forecasts of the best 30 and 50 equations. The null hypothesis of the test is that two forecasts have the same accuracy. The associated p-values for the test statistic based on squared errors are 0.3535 and 0.3143 for the mean forecast base don top 30 and top 50 equations, respectively (against the mean forecast based on 56 equations). In addition, the tests of equality in terms of the mean (Anova F-test) and variance (Bartlett, Levene tests) also indicate that the three mean forecast series are equal. Overall, the imposition of sign priors in order to select models is not found to be too restrictive as this does not lead to statistically different forecasts.

**Chart 7. Pseudo out-of-sample consumption growth forecasts – alternative equations**

![Chart 7](image)

*Notes: this chart plots quarter-on-quarter growth rates of actual real private consumption (solid line) together with the mean forecast (dashed line) based on best 30 (PANEL A) and best 50 (PANEL B) equations over the sample period 2015Q2-2017Q3. The darker shaded area denotes the range between the 5th and 95th percentiles of the overall forecast range while the lighter shaded areas denote the top and bottom 5% of forecast range.*
6. Conclusions

This study analyses real private consumption in the euro area for the first time on the basis of a thick modelling approach. Our thick model considers multiple error correction model specifications rather than only a single “best” one. Thick modelling is particular of use in the context of model uncertainty where it is hard to decide which model to use, which is here the case due to our short sample. All specifications incorporate the two most important macro determinants of private consumption, i.e. disposable income and wealth, in the short and long run, interest rates including external finance premia in the short run as well as two variables from a rich set of explanatory variables in the short run: consumer leverage, government indebtedness and various (income) uncertainty measures. In addition, we split total wealth into financial and non-financial wealth and disposable income into labour and non-labour income. The latter has not been addressed in the 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 as well as almost as important in the short run) and deserves a close look for forecasting private consumption. Overall, our results stress the importance to decompose not only household wealth but also disposable income for analysing private consumption as well as the usefulness of thick modelling for forecasting euro area private consumption.

Against the background of recent attempts to link micro and macro data on household income and wealth (see, among others, 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. More generally, an important avenue for future consumption research is to further improve the micro-macro link.
References


Gustafsson, P., Hesselman, M., and Lagerwall, B. (2017) How are household cashflows and consumption affected by higher interest rates?, Sveriges Riksbank, Staff Memo.


### Appendix

**Table A1. Additional short-run consumption determinants**

<table>
<thead>
<tr>
<th>Category</th>
<th>Variable name</th>
<th>Definition and tested sign ([ ])</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interest rates</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-term real interest rate</td>
<td>1) 3-m EURIBOR interest rate [- ]; 2) Deposit interest rate for households (less annual HICP inflation) [- ]</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>Long-term real interest rate</td>
<td>1) 10-year euro area government bond yield [- ]; 2) Consumption loan interest rate for households [- ]; 3) Mortgage interest rate for households (less annual HICP inflation) [- ]</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>External finance premium</td>
<td>1) Mortgage rate - deposit rate [- ]; 2) Mortgage rate - 3-m EURIBOR [- ]; 3) Consumption loan rate - deposit rate [- ]; 4) Consumption loan rate - 3-m EURIBOR [- ]</td>
<td>(+)</td>
<td></td>
</tr>
<tr>
<td>Term spread</td>
<td>10-year government bond yield - 3-m EURIBOR [- ]</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td><strong>Consumer indebtedness</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leverage ratio</td>
<td>1) Loans to households (stock) to 4-quarter moving sum of household real disposable income [- ]; 2) Loans to households (stock) to 4-quarter moving sum of real GDP (loans in real terms) [- ]</td>
<td>(+)</td>
<td></td>
</tr>
<tr>
<td>Interest burden</td>
<td>1) Real interest income paid by households to real disposable income (both numerator and denominator as 4-quarter moving sums) [- ]; 2) Real net interest income to real disposable income [- ]</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>Loan growth</td>
<td>Quarter-on-quarter growth rates in loans granted to households (in real terms) [- ]</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td><strong>Government indebtedness</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leverage ratio</td>
<td>1) Government debt (stock) to 4-quarter moving sum of real GDP [+ ]; 2) Government deficit to real GDP (both in terms of 4-quarter moving sums, multiplied by -1) [- ]</td>
<td>(+)</td>
<td></td>
</tr>
<tr>
<td>Debt growth</td>
<td>1) Quarter-on-quarter growth rates in government debt (in real terms) [+ ]; 2) Quarter-on-quarter absolute change in government deficit (in real terms, divided by -10000) [- ]; 3) Year-on-year absolute change in government deficit (in real terms, divided by -10000) [- ]</td>
<td>(+)</td>
<td></td>
</tr>
<tr>
<td>Government consumption</td>
<td>Quarter-on-quarter growth rates in real government consumption [- ]</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td><strong>Labour market</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>1) Unemployment rate [- ]; 2) EC Consumer Survey: expected unemployment over the next 12 months [- ]</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td><strong>Inflation and inflation expectations</strong></td>
<td>1) Annual HICP inflation [+ ]; 2) Annual HICP excluding energy and food inflation [- ]; 3) Survey of Professional Forecasters: expected annual inflation 1 year ahead [+ ] and 2 years ahead [+ ] 4) EC Consumer Survey: expected consumer prices over the next 12 months [+ ] (level [- ] )</td>
<td>Ambiguous</td>
<td></td>
</tr>
<tr>
<td>Survey measures</td>
<td>EC Consumer Survey: 1) consumer confidence indicator [+ ]; 2) expected financial situation over the next 12 months [+ ]; 3) expected savings over the next 12 months [+ ]; 4) general economic situation [+ ]; 5) major purchases intentions [+ ]; 6) EC economic sentiment indicator [+ ]</td>
<td>(+)</td>
<td></td>
</tr>
<tr>
<td><strong>Uncertainty</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real oil prices</td>
<td>Quarterly growth rate in real oil prices [- ]</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>Exchange rate</td>
<td>1) Quarterly real effective exchange rate against 38 trade partners [- ]; 2) Real and nominal exchange rate volatility (2-year moving standard deviation) [+ ]</td>
<td>Ambiguous</td>
<td></td>
</tr>
<tr>
<td>Macroeconomic uncertainty measures</td>
<td>1) Economic policy uncertainty [- ]; 2) Systemic stress composite indicator [- ]; 3) Financial market uncertainty [- ]; 4) Consensus disagreement (based on Consensus Economics) [- ]; 5) Forecast uncertainty [- ]; 6) Consensus aggregate uncertainty [- ]; 7) Consumer survey, standard deviation [- ]; 8) Aggregate uncertainty, mean [- ]; 9) Aggregate uncertainty, first principal component [- ]</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged consumption growth</td>
<td>First lag of quarter-on-quarter growth in private consumption [+ ]</td>
<td>Ambiguous</td>
<td></td>
</tr>
<tr>
<td>Old-age-dependency ratio</td>
<td>Population aged 65 and above to working age population [+ ]</td>
<td>Ambiguous</td>
<td></td>
</tr>
</tbody>
</table>

Notes: this table reports the summary of additional short-run dynamics included in the benchmark ECM as defined in Equation (1). The estimated preliminary sign in the benchmark ECM (based on total income and two wealth components) for each variable separately is reported in square brackets. The final column also shows the expected signs of the respective estimated short-run coefficients.