The implications of the wealth effect in 25 EU countries

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ABSTRACT

This article examines the long- and short-run relationship between private consumption, housing wealth, stock market wealth and income. Our study focuses on 25 EU countries classified according to their residential markets' structure, which resulted in four panels: Centre Western Europe, Northern Europe, South Europe and Eastern Europe. In order to asses this relationship empirically, we use pooled mean group estimators of dynamic heterogeneous panel data. Several conclusions can be drawn from the analysis presented in this paper. First, personal consumption, stock market wealth, housing wealth and incomes form a long-run equilibrium relationship in the four EU groups of countries. Second, the estimated long-run elasticity of personal consumption relative to income revolves around one in all the groups, as suggested by the PIH (Permanent Income Hypothesis). Third, according to the estimates from the baseline model, the long-run house wealth effect is present in all the groups

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under study, which corroborates the results of earlier studies. Fourth, the long-run financial wealth effect is present in the Northern, Centre Western European and Eastern Countries and not significant in Southern countries.

Keywords**:** asset price channel, wealth effect, CEEC, cointegration, Pooled Mean Group estimator, panel ARDL

JEL Classification **:** C23, E21, E52, F45

1. Introduction

The wealth effect is a classic subject of theoretical and empirical macroeconomics. New interest on the topic derived from the behaviour of net financial wealth and house prices in the last years, especially during the international financial crisis. This event has generated great changes in the value of financial assets and in housing prices in all economies.

There is a large body of literature that studies the effect of asset price fluctuations on private consumption and authors have used as well different econometric techniques (such as panel versus single equation models) and databases (like micro panel data and aggregate time series) to address the issue. More recently, interest in the topic has regained ground against the background of the strong connections between the macroeconomics (in particular, private consumption) and the wealth dynamics, which has led to concerns by numerous academics, central banks and governments about the potential implications of downturns in housing and equity prices (Sousa, 2010a).

Despite the wide range of studies, most of the empirical evidence refers to advanced economies and mostly to the United States, where data is more readily available. Extending the existing literature to assess the macroeconomic impact of asset price fluctuations in emerging markets may, therefore, be important as these economies are becoming a key engine of growth in the world economy. In addition, since an increasingly large number of emerging market economies is becoming financially developed, their access to financial assets and the possibility to extract equity from them has also risen, hence, amplifying the potential macroeconomic impact of domestic asset price movements[2]. This may,

[2] Held *et al.* (1999) argue that financial integration is the "extent to which the prices of, and returns to, assets are equalized between different national financial markets". Adam *et al.* (2002) also agree with this fact, saying that "financial markets are integrated when the law of one price

in turn, generate a de-synchronization of the business cycle (Rafiq and Mallick, 2008; Mallick and Mohsin, 2010) or negatively impinge on the nexus between monetary stability and financial stability (Granville and Mallick, 2009; Sousa, 2010b; Castro, 2011).

The *wealth effect* is one of the monetary channels that connects a financial crisis to the real economy. It designates the relationship between personal wealth and consumer spending. Taking into consideration the wealth effect, consumers tend to spend a bigger part of personal income in the case of their wealth increases. This fact affects the demand function and, therefore, the GDP.

It is very important to understand the behaviour of private consumption decisions in order to explain and estimate the fluctuations of economic activities in general and private aggregate consumption in particular. Traditional macroeconomic models analysing private consumption normally entail household wealth and income variables. Several well-known theories, including the permanent income theory (Friedman, 1957) and the life-cycle hypothesis (Ando and Modigliani, 1963) motivate this simple consumption function model with household income and wealth as endogenous variables. Earlier studies of wealth effect did not differentiate between financial and housing wealth effects.

holds". So, assets that produce the same cash flows should have identical returns, despite of the country of the issuer and of the asset owner. Financial openness also leads to international capital mobility (Edison *et al.* 2002). Additionally, a reduction in international transactions costs stimulates an increase in the demand for (and supply of) assets and an increase in asset prices, leading to higher cross-border diversification. Levine and Zervos (1996) show that financial liberalization results in an increase in investor participation in financial markets and in an increase in stock market liquidity. We believe that the wealth effect will be more sensitive to asset price movements due to this increase in stock market liquidity. The households could more easily covert their housing wealth into liquidity and therefore be more sensitive to asset price changes.

Because of various choices of the consumers and different asset liquidity, studies of financial and housing wealth effects were carried out.

As mentioned earlier, studies of post-transition European economies and emerging markets are surprisingly rare. We believe this is unfortunate because the level of consumption in these countries is absolutely comparable to the level of other developed countries that have already largely been studied, given the importance consumer expenditures exhibit in the European GDP development. Therefore, the main goal of this study is to explore the most important features of housing and financial (stock market) wealth effects in the emerging countries (focusing mostly on ten post-transition European countries) and in 15 other European Union countries. For families, housing represents the biggest asset, whilst financial holdings also form an important part of household asset portfolio. Though, price variations are definitely connected to consumers' net worth and therefore might substantially affect aggregate consumption.

In addition, it also has to be noted that asset markets in emerging countries are much less liquid and prone to higher transaction costs, which could in turn result in a smaller propensity to consume wealth when compared to developed countries even if any of the wealth increases in the examined period have been extremely large. Additionally, this study is important for policy makers, since, in the last two decades, asset price booms and busts had more impact on the CEE countries than on the developed ones (Posedel and Vizek, 2009) and this may had influenced the consumption spending. Furthermore, as the body of literature on the impact of wealth effects on private consumption in European post-transition countries is rather limited, this study also complements earlier findings for those countries.

Therefore, the goal of this paper is to provide new evidence on the connection between financial wealth, real wealth and household consumption in

a sample of 10 CEEC (Central and Eastern European Countries) and 15 European Union countries and to make comparisons between the countries under analysis.

The remainder of the paper proceeds as follows. In Section 2, we provide an overview of the prior literature in this field of study. In Section 3 we describe the research data and present the research methodology and the estimated results. In Section 4 we draw the conclusions and we discuss further research that would be necessary to better answer the questions raised by the article.

2. Overview of the related studies

The wealth effects on consumption have been analysed in an increasing empirical literature, beginning with the literature developed by Keynes' General Theory. The studies conclude that both financial and housing wealth effects have relevant explanatory influence on consumption.

The Permanent Income Hypothesis (Friedman, 1957) and the Life Cycle Hypothesis of Modigliani and Brumberg (1954) and Ando and Modigliani (1963) are the main origins of the analysis of fluctuations in household wealth that can influence consumption. According to these models, households spend the present discounted value of their expected lifetime revenues. Therefore, higher consumption derives from permanent changes in household incomes ('windfalls' according to Friedman, 1957), whilst transitory changes modify spending in a small extent. And the element of proportionality between consumption and permanent revenue is simply one. These theories represent a progression of views on consumer behaviour and they are the foundation for reduced-form equations relating consumption to income and wealth. The PIH analyses the relationship between consumption and income, considering permanent and transitory components. Thus, a consumer's permanent income is

influenced by their assets: physical (property), financial (shares, bonds) and human (education and experience). These influence the consumer's ability to earn income. Instinctively, a raise in current income is related to a raise in consumption only if it indicates a raise in permanent income. When the fluctuation in permanent income is considerably higher than the fluctuation in transitory income, nearly all changes in current income indicate changes in permanent income; therefore, consumption raises almost one-for-one with current income. Thus, ordinary macroeconomic models of private consumption generally require household wealth and income variables, these affecting positively the consumption. Taking this into consideration, consumption relies upon permanent income, initial wealth, life expectancy, and intertemporal preference rate.

Several researches have argued that shocks to different form of (housing and financial wealth) could make consumption respond differently. There are various reasons for considering that the effects of changes in financial and housing effects on consumption are expected to be different. The first reason is that housing is both a consumption item and an asset because house has a "dual function" (Cheng and Fung, 2008) or "dual nature" (De Veirman and Dunstan, 2008). House is also considered as a consumption good – households consume a service flow from housing by the simple fact of residing in their home. Hence, when house prices increase, the individual's wealth increases, but this could also lead to increases in the cost of housing services (Cheng and Fung, 2008). The second reason, as Pichette and Tremblay (2003) argue, is that households may consider changes in housing wealth as more permanent than variations in financial wealth. Hence, we would expect households to be more willing to raise their consumption when housing wealth increases than in the case of a raise in financial wealth. The third motive is that for the housing wealth, the "bequest

reason" could be more important, this means that households are more hesitant to trade their house. Also, households could not be attracted to react to short-term evolutions in real estate prices because they would be in favour of having in possession appreciated assets up to their death.

The fact that housing wealth can play a collateral role supports a positive relationship between consumption and housing wealth. In the case of an increase in home prices, homeowners have more collateral against which they can borrow to guarantee extra purchases of goods and services. In order to support this collateral channel of wealth effects, financial intermediaries are very important. It implies that the strength of the financial system and the degree of financial liberalization of a certain country/region affects the collateral channel of wealth effects. Countries with greater financial liberalization have more significant housing wealth effect than countries with less liberalized credit markets. Also, banks and lenders are more likely to provide with credit in the case they have sound balance sheets and good loan performance than in the event of inadequate capital relative to the losses they expect on their portfolios. This is why housing market plays an important role in the portion of lending and it makes financial institution health and credit availability vary with real estate prices as well. Rising house prices stimulate consumption, by generating more borrowing collateral and by rising the willingness of financial intermediaries to lend against a certain amount of collateral. This fact is less likely to occur in the case of financial wealth effects because financial intermediaries are generally less necessary for the consumption of earnings on these assets (Cooper and Dynan, 2016).

Cooper and Dynan (2016) also argue that the strength of the financial sector and the financial openness are very important characteristics as the collateral channel to loan households' wealth effects will be sensitive to them. Cooper and

Dynan (2016) present support upon the fact that countries with greater financial liberalization may justify the more significant housing wealth effects that describe the USA, the UK and Australia (Ahec Šonje *et al.* (2014), Barrell *et al.* (2015), Dreger and Reimers (2009), Ludwig and Sløk (2004)).

Studies analysing the impact of housing and stock market wealth on consumption use aggregate macroeconomic data, and disaggregated data. Additionally, the models that are most frequently used to analyse direct wealth effect are cointegration and error correction models (Ahec Sonje *et al*, 2014; Ceh Casni, 2016; Ciarlone, 2011; Dreger and Reimers, 2009; Ludvigson and Steindl, 1999; Mehra, 2001) which allow one to differentiate between the short run and the long run connection between consumption, income and wealth. This method decides the variables that adjust to recover the long-run stability.

Empirical studies of the wealth effect on consumption were primarily made on advanced economies. Numerous studies reveal a positive and important long-run relationship between aggregate wealth and consumption (Davis and Palumbo, 2001; Lettau and Ludvigson, 2001, 2004; Ludvigson and Steindl, 1999 for the USA; Fisher and Voss (2004) and Tan and Voss (2003) for Australia and Fernandez-Corugedo *et al.* (2003) for the UK). Bertaut, 2002; Hamburg *et al.*, 2008; Labhard *et al.*, 2005 find that wealth effects in continental European countries with developed market-based financial sectors are exceeded by Anglo-Saxon ones. Some papers argue that the financial wealth effect is more important than the housing one (Dvornak and Kohler, 2003, for Australia; Ludwig and Sløk, 2004, for 16 OECD countries; Dreger and Reimers, 2009, for 14 industrial countries; De Bonis and Silvestrini, 2012, for 11 OECD countries). The articles of Ludwig and Sløk (2004) and Carroll *et al.* (2011) show results that confirm a larger financial wealth effect in countries with market-based systems than in those with bank-based financial systems.

Nevertheless, the literature of the wealth effect lacks in studies made on emerging countries in general, and in the post-transition European countries in particular. Funke (2004) was the first author to raise this question, studying only the stock wealth effect in a panel of 16 emerging markets and he finds a small but statistically significant effect of stock wealth on consumption.

The Ahec Sonje *et al.*'s (2012) study on Bulgaria, Croatia, the Czech Republic and Estonia showed that private consumption react to movements in housing wealth in the long run and the short run. Peltonen *et al.* (2012) compares the stock and housing wealth effect in Asian and Latin American emerging countries and shows rather important and statistically significant housing and stock market wealth impact in both areas. As anticipated, the two effects are more significant for Asian countries, whilst stock market capitalizations are greater per unit of GDP than in Latin America. Ciarlone's (2011) results show both housing and financial wealth having a positive influence on consumption in the long run for 17 emerging countries from Asia and post-transitional Central and Eastern Europe. Additionally, Ciarlone (2011) finds that the elasticity of stock market prices is greatly smaller than that of real estate prices and the elasticity of housing wealth is greater in the CEE countries ones. Vizek (2011) study the relationship between consumption, stock market wealth, housing wealth and income using Johansen co-integration, vector error correction models and impulse response functions and their results suggest a long-run wealth effect in Bulgaria, Croatia and Czech Republic, with a stock market wealth effect in Bulgaria and both types of wealth effects in the other two countries.

Studies that compare emerging to developed countries are very rare. Ceh Casni's (2014) study on the wealth channel in the emerging countries (with more attention on post-transition European countries) compared it with the

developed ones. Ahec Sonje (2014) was the first to analyse and directly compare the influence of housing and stock market wealth effects on personal consumption in emerging and developed countries. Ahec Sonje *et al*'s (2014) article separates short-run and long-run wealth effects, analysing also the latest asset price boom and bust cycle. A. Ceh Casni (2016 and more recently in 2017) used the pooled mean group estimator and showed a statistically significant and positive long-run link between consumption, income and housing wealth for the selected group of countries, which is in line with LCH.

3. Methodology and results

a. Research data

The dataset used in our research consists of quarterly indices for real estate prices, real equity prices, real personal consumption and real disposable income for 10 CEE countries and for 15 other countries from the European Union for the period of 1996Q1-2018Q3. Crédit Foncier (2018) grouped European countries into four different categories according to their real estate market characteristics. We also followed this structure and analysed these 25 countries according to their residential markets' structure, which resulted in four panels: Centre Western Europe[3], Northern Europe[4], South Europe[5] and Eastern Europe[6].[7] The most important real estate markets' characteristic in the European Union is that they are very heterogeneous, different markets between

[3] **Centre Western Europe** contains five countries: Austria, Belgium, France, Germany, The Netherlands.

[4] **Northern Europe** contains six countries: Denmark, Finland, Ireland, Norway, Sweden, and United Kingdom.

[5] **South Europe** contains four countries: Greece, Italy, Portugal and Spain.

[6] **Eastern Europe** contains ten countries: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

[7] We can find more specifications of the four groups of countries in Table C1 from Appendix C.

countries, but also within them. Northern Europe are the most indebted countries on average; Centre-Western Europe contains the most of European population; in Southern Europe households are less indebted compared to the first two regions; Eastern Europe were included in the EU recently, it is where households are the least indebted and where the ratio of ownership is the highest in Europe (86%).

Bijlsma and Zwart (2013) studied the structure of the financial systems of the EU countries by applying essential element analysis on 23 indicators, like household deposits, bank credit to non-financial companies, market capitalisation of listed enterprises, the size of the banking sector, the number of initial public offerings, venture capital investment exercise, the size of foreign banking assets, bank concentration degrees, and bank profitability. Their analysis allowed them to categorize countries as more bank-based or more market-based. According to Bijlsma and Zwart (2013), countries from Northern Europe have a market-based financial system, countries from Southern Europe have bank-based financial system, the groups of Centre Western Europe has countries that have bank-based financial system (Austria and Germany) and market-based financial system (Belgium, France and The Netherlands). Eastern Europe have smaller and less developed financial systems than those in the old Member States.

As far as the data source is concerned, in our empirical analysis we used data from Eurostat Database for the indices for real estate prices, personal consumption and disposable income. The indices for equity prices were taken from the investing.com and stooq.com websites. The relevant information concerning data sources and time period for each of the 25 countries under analysis can be found in Table A1 in Appendix A.

We made a great effort to establish series as much comparable as possible and in order to compare our findings with the rest of the literature. Therefore, personal consumption and income are expressed in real[8] per capita[9] terms, in base indices (2010=100), as we can see in the Table A1 of Appendix A. Moreover, data on personal consumption and income are taken from the Eurostat Database in order to be more homogeneous among the countries, in comparison to the same data taken from national statistics websites for each country. Data on real estate and equity price indices are deflated using the Consumer Price Index that were used to deflate data on consumption and income as well. We then expressed the variables used in our study in logarithms (i.e. base indices (2010=100) are recomputed to logarithms, in this way, the parameter estimates are explained as the elasticity of consumption to changes in income, financial and housing wealth). Additionally, we seasonally adjusted the variables with the X-12-ARIMA method.

Considering the broad coverage of this study, we had to deal with a number of data limitations. First, data on housing and financial wealth are not available for all the countries in the panel, so we used real estate and equity price indices as proxy variables for housing and financial wealth, respectively. In a number of other studies regarding the two wealth effects, such as Ludwig and Sløk (2004), Labhard *et al.* (2005), Case *et al.* (2005), Carroll *et al.* (2011) and Ciarlone (2011) to name a few, price indices were also used as proxy variables for housing and financial wealth. We are fully aware that the real estate price index is not the most suitable proxy for changes in housing stock and housing wealth over a long-time span, but due to the fact that emerging countries

[8] Personal consumption and income were deflated using the Consumer Price Index from Eurostat.

[9] In order to express variables in per capita terms we used quarterly total country population from Eurostat.

generally do not publish housing stock statistics, we are forced to use this proxy in order to carry out our analysis. Nevertheless, the use of real estate price index could be interesting in itself when analysing the wealth channel, the one responsible for transmitting the changes in the monetary policy to asset values, this affecting the consumer expenditure on nondurable goods and services, something to which this study aims to contribute from an empirical point of view.

Second, our data is for total aggregate consumption, so we are not able to distinguish between the consumption of durable and non-durable goods. Even though conventional consumption theories apply to the flow of consumption, durable consumption can be considered a replacement and addition to capital stock, so the approach in some studies is to use only non-durable consumption (Lettau and Ludvigson, 2004). However, a drawback of this approach might be that the total (aggregate) consumption also includes expenditures on housing services, even though durable consumption goods are primarily spent on mortgage refinancing.

b. Research methodology and estimation results

Recent dynamic panel data literature emphasizes panels in which both the number of time series observations (T) and the number of groups (N) are somewhat large and/or in the same order of magnitude (Ahec Sonje *et al.*, 2014). Therefore, the usual practice would be to either estimate separate N regressions and calculate means of coefficients (so called MG estimator[10]) or to pool data and assume that slope coefficients and error variances are identical (DFE

[10] The MG estimator allows the intercepts, slope coefficients and error variances to differ across groups.

estimator[11]). In this paper we use an intermediate procedure called the Pooled Mean Group Estimator (PMG), which relies on both: pooling and averaging the coefficients. Also, we consider the case where regressors follow unit root process (for details refer to Pesaran *et al.*, 1999). Thereby, our estimator allows intercepts, short-run coefficients and error variances to differ across countries but restricts the long-run coefficients to be the same across countries. Our choice in this is strongly founded in theory, since the long-run income elasticity of consumption should be equal to one in all countries, despite their institutional or cultural differences, or saving rates would be falling or rising indefinitely. There are often good reasons to expect that the long-run relationship between variables is similar across countries due to budget constraints, arbitrage conditions or common technologies. Apart from that, not imposing equality of short-run coefficients allows for a dynamic specification; more precisely, the number of lags included may differ across countries.

The permanent income hypothesis (Friedman, 1957) and the life-cycle hypothesis (Ando and Modigliani, 1963) both motivate the choice of our model, a rather straightforward model of an aggregate consumption function that includes household (labour) income and wealth as the only components. Gali (1990) provides a theoretical foundation for a common trend approach between four macroeconomic aggregates in a consumption function. This approach has subsequently been applied in numerous empirical analyses employing cointegration (either in time series or panel data settings) as a preferred method when testing for the influence of wealth on personal consumption using macroeconomic data.

[11] The DFE estimator restricts the coefficients of the cointegrating vector to be equal across all panels and sets the speed of adjustment coefficient and the short-run coefficients to be equal, leaving the intercepts to vary across countries.

Taking into account all previous considerations, we first examine the statistical properties of our data and test if the series of interest are I(1) and indeed cointegrated in the long run.

Table 1: Panel unit root tests results

Test	Null hypothesis	*p*-Values			
		Personal consumption	**Housing wealth (HPI)**	**Stock market wealth (SMI)**	**Income**
		Variables in level			
Im-Pesaran-Shin (2003)	All panels contain unit roots	0.2364	0.9992	0.1341	0.0937
Fisher	All panels contain unit roots	0.1830	0.9886	0.2534	0.2360
		Variables in first difference			
Im-Pesaran-Shin (2003)	All panels contain unit roots	0.0000	0.0000	0.0000	0.0000
Fisher	All panels contain unit roots	0.0000	0.0000	0.0000	0.0000

Note: max lags used is four. *(Source: author's calculation in Stata 13.1)*

According to the relevant literature, panel-based unit root tests have higher power than unit root tests based on individual time series. In that sense, we performed the first-generation unit root tests: Im-Pesaran-Shin (Im *et al.*, 2003) and Fisher ADF (Maddala and Wu, 1999; Choi, 2001) and CIPS (2007) second generation panel unit root test. All unit root tests we employ entail a constant and a trend in order to avoid all dynamics being forced into the lags of the endogenous variable.

Tables 1 and 2 summarize the panel unit root test results for the four variables of interest. The results from Table 1 suggest that all variables (personal consumption, income, housing wealth and stock market wealth) contain a unit root, which in turn means that these variables could form a cointegrating relationship among each other in the long run. The variables are stationary in first difference according to the tests from Table 1.

Table 2: First- and second-generation panel unit root tests results

	Maddala and Wu test (1999)	**CIPS (2007) test**
Variables in level		
Income	0.169	0.971
Consumption	0.543	0.180
HPI	0.995	0.997
SMI	0.184	0.232
Variables in first difference		
Income, Consumption, HPI, SMI	0.000	0.000

Note: max lags used is four. *(Source: author's calculation in Stata 13.1)*

The results of the first- and second-generation unit root tests from Table 2 show that the unit root null hypothesis cannot be rejected for the variables under analysis in level. The transformation of the variables of interest into first difference then makes it possible to reject this hypothesis, meaning that the variables are stationary in first difference.

Table 3: Panel cointegration test results

Test	**Null hypothesis**	**Statistics**		***p*-values**
Kao	No cointegration	Panel ADF		0.0116
Pedroni	No cointegration	Panel ADF	ν	0.0108
			ρ	0.0009
			t	0.0000
			adf	0.0338
		Group ADF		
			ρ	0.0274
			t	0.0000
			adf	0.0412
Westerlund	No EC	G_t		0.0022
		G_a		0.0112
		P_t		0.0033
		P_a		0.0001

Note: The null hypothesis of the three co-integration tests is that the estimated equation is not co-integrated. H_0 is rejected if p-value is less than 0.05. *(Source: author's calculation in Eviews 10SV and Stata 13.1)*

As the focus of this research is on the long-run relationship between personal consumption, stock wealth, housing wealth and income approximated by wages cannot be consistently estimated if all single variables have a unit root, unless they are cointegrated in the long-run.

For that reason, the next step of our empirical analysis is to perform panel cointegration tests. Several panel cointegration tests were carried out, namely, both residual-based ones (Kao, 1999; Pedroni, 1999, 2004) and likelihood-based ones (Maddala and Wu, 1999). The results of the performed panel cointegration tests are summarized in Table 3 for the panel allowing for cross-sectional dependence. Accordingly, we can conclude that personal consumption, stock market wealth, housing wealth, and income are indeed cointegrated in the long run in all four groups of countries.

Since the analysis has shown that all the variables of interest are cointegrated in the long run, the next step of our empirical analysis is to estimate the following simplified personal consumption equation:

$$cons_{it} = \gamma_{0i} + \gamma_{1i} income_{it} + \gamma_{2i} hpi_{it} + \gamma_{3i} smi_{it} + \varepsilon_{it} \quad (1)$$

i = 1, 2, …, N; t = 1, 2, …,T

where $cons$ is the real per capita personal consumption, smi is the index of stock prices, hmi is the index of real estate prices and $income$ is the real per capita compensation of employees. The error term capturing the effects of unexpected shocks to personal consumption is denoted by ε_{it}, while the

subscripts i and t denote country and time, respectively. As theories of aggregate consumption (Friedman, 1957; Ando and Modigliani, 1963) suggest that γ_{1i}=1, and since γ_{1i} and γ_{2i} are coefficients next to housing and financial wealth parameters, respectively, we would expect both of them to be different from zero (Pesaran *et al.*, 1999). Since we have proven that the four variables are I(1), and all the variables are cointegrated, ε_{it} is an I(0) process for all i.

The model given in Eq. (1) can be written as an autoregressive distributed lag — ARDL $(p, q_1, \ldots, q_k)$ model:

$$cons_{it} = \delta_i + \gamma_i cons_{i,t-1} + \beta_{10i} income_{it} + \beta_{11i} income_{i,t-1} + \beta_{20i} hmi_{it} + \beta_{21i} hmi_{i,t-1} + \beta_{30i} smi_{it} + \beta_{31i} smi_{i,t-1} + \eta_{it}, \quad (2)$$

If, in our case, all the variables of interest are I(1), and all of them are cointegrated, the error term is an I(0) process for all the countries in the sample (i). Statistically speaking, cointegrated variables show great responsiveness to any deviation from long-run equilibriums, so an error-correction re-parametrization can be employed:

$$\Delta Cons_{it} = \phi_i * \left(cons_{i,t-1} - \gamma_{0i} - \gamma_{1i} smi_{i,t} - \gamma_{2i} hmi_{i,t} - \gamma_{3i} income_{i,t}\right) - \beta_{11i} \Delta smi_{it} - \beta_{21i} \Delta hmi_{it} - \beta_{31i} \Delta income_{it} + \eta_{it} \quad (3)$$

where $\phi_i = -(1 - \gamma_i), \gamma_{0i} = \frac{\delta_i}{1-\gamma_i}, \gamma_{1i} = \frac{\beta_{10i}+\beta_{11i}}{1-\gamma_i}, \gamma_{2i} = \frac{\beta_{20i}+\beta_{21i}}{1-\gamma_i}, \gamma_{3i} = \frac{\beta_{30i}+\beta_{31i}}{1-\gamma_i}$ (4)

The error-correcting speed of adjustment term is given by ϕ_i and we anticipate it to be statistically significant and less than zero, therefore indicating personal consumption variations in the short-run adjustment in reaction to permanent shocks to the economy. A negative adjustment is an essential requirement for a long-run balance link to exist between the variables.

We will use the following estimator of an error-correction representation of the ARDL model: the PMG estimator (Pesaran *et al.*, 1999) which is especially attractive when estimating the consumption function because it assumes homogeneous long-run coefficients, allowing the short-run dynamic specifications to differ from country to country.

Table 4 presents the main results of our model. According to Table 4 it is not possible to reject the hypothesis of poolability of long-run coefficients (the p-value for the PMG estimator is significant for the two out of three analysed variables, respectively) for all the four panels. It can be concluded that the PMG estimator is efficient under the null hypothesis.

Table 4 shows that the adjustment coefficients for all four panels have the correct negative sign and are statistically significant, this means that cointegration between the variables does indeed exist in all four groups. The estimated long-run elasticity of personal consumption relative to income revolves around one in all the country groups, as suggested by the PIH. All four groups present a statistically significant and positive effect of housing wealth on consumption, with a higher coefficient in the Northern countries and the lowest in the Eastern countries. The estimates suggest the presence of a financial wealth effect in the Northern, Centre Western and Eastern European countries. In the Southern Europe the financial wealth effect coefficient is statistically insignificant.

Table 4: Baseline model of personal consumption for all four panels

Variable	**Centre Western Europe ARDL (1,1,1,1)**	**Northern Europe ARDL (1,1,1,1)**	**South Europe ARDL (1,1,1,1)**	**Eastern Europe ARDL (1,1,1,1)**
# of obs.	422	476	323	642
Speed of adjustment ϕ_i	-0.121 (0.010) [0.083]	-0.106 (0.000) [0.028]	-0.122 (0.038) [0.059]	-0.104 (0.000) [0.021]
Long-run coefficients				
Income	1.147 (0.000) [0.163]	0.947 (0.000) [0.044]	1.090 (0.000) [0.138]	1.0621 (0.000) [0.054]
HPI	0.197 (0.025) [0.051]	0.242 (0.000) [0.041]	0.173 (0.016) [0.072]	0.168 (0.000) [0.039]
SMI	0.030 (0.034) [0.013]	0.035 (0.000) [0.008]	-0.0247 (0.137) [0.017]	0.0238 (0.039) [0.012]
Short-run coefficients				
Income	0.555 (0.009) [0.212]	0.512 (0.000) [0.141]	0.357 (0.045) [0.178]	0.469 (0.000) [0.075]
HPI	0.047 (0.044) [0.023]	-0.008 (0.695) [0.019]	0.281 (0.035) [0.133]	-0.073 (0.561) [0.125]
SMI	-0.143 (0.334) [0.148]	-0.007 (0.070) [0.004]	0.005 (0.168) [0.004]	0.014 (0.301) [0.013]
Log likelihood	1756.871	1851.17	1210.851	2164.119
Hausman test for poolability of countries	0.176	0.465	0.354	0.295

Note: The estimates are performed using the PMG estimator by Pesaran *et al.* (1999); panel ARDL (p, q_1, q_2, q_3) model; all equations include a constant term; standard errors are in brackets, *p*-values are found in parenthesis. Hausman test PMG denotes the test for long-run homogeneity and the values found in the table are *p*-values. *(Source: author's calculations in Stata 13.1)*

In the short-run, we find significant results for the Northern Europe (income), Centre Western Europe (income and housing wealth effect), South Europe (income and housing wealth effect) and Eastern Europe (income and stock market wealth effect).

In order to choose the most appropriate estimator, we employ the Hausman test of long-run homogeneity of coefficients[12]. According to Table 4, in all four panels the homogeneity restriction is not rejected by the data, this fact implies that the PMG estimator is appropriate. We can observe that it is not possible to reject the hypothesis of poolability of long-run coefficients (the p-value of the Hausman test being 0.056, 0.340, 0.650 and 0.075 for the four panels, respectively). In this case, the PMG estimator is efficient under the null hypothesis and preferable to the MG estimator.

We can conclude that, in the long run, personal consumption is responsive to changes in housing wealth (the effect being positive) and more pronounced in both Northern and Centre Western European countries. We can notice that there are not significantly differences among the results for the four

[12] The MG estimator gives consistent estimates of the mean of the long-run coefficients, but in the case of the slope homogeneity assumption holding, the coefficients will be inefficient. In the case of homogeneous long-run coefficients, the PMG and DFE estimators are consistent and efficient (Pesaran *et al.*, 1999).

groups of countries. The housing wealth effect results are in line with the existing literature. Bertaut (2002), Carroll *et al* (2011) find that the housing wealth effect is more pronounced in market-based countries (in our case Northern Europe with a stock market capitalisation as fraction of GDP of 55.5% according to Table C1 from Appendix C). Ciarlone (2011) and Rodil-Marzabal and Mendez-Ferreira-Junior (2016) find a more pronounced housing wealth effect than the financial wealth effect in a panel of Emerging Asian countries and CEEC, and for 10 Eurozone countries, respectively.

Looking at the stock market index results, we find similar results as those of Ahec Sonje *et al* (2014), Bampinas *et al* (2017), Bertaut (2002), Carroll *et al* (2011), Case *et al* (2001), Ludwig and Slok (2004) for whom the financial wealth effect is positive and more pronounced in developed market-based countries than in bank-based countries. In our case the financial wealth effect is more pronounced in Northern Europe where the countries have market-based financial system and in Centre Western Europe with market-based and bank-based financial system. Peltonen *et al* (2012) also find quantitatively larger financial wealth effect in countries with high level of financial development.

In the case of Eastern European countries, we found a positive and greater housing wealth effect than a financial one. This is in line with the existing literature, Ciarlone (2011), Caporale and Sousa (2016) finding also greater housing wealth effect. Vizek (2011) finds similar results for Czech Republic and Estonia, where both wealth effects are significant, and the housing wealth effect being greater than the financial one, for the period 1996-2010. It is also the group that presents the smaller housing and financial wealth effects, of all four groups under study. We believe the cause of the housing wealth effect having a less pronounced effect of consumption than in the other three groups

of countries could be the bigger transaction expenses that hinder conversion of housing wealth into liquidity that can be consumed. As mentioned in Section 2, Cooper and Dynan (2016) suggest than countries with greater financial liberalization have more significant housing wealth effect, which is not the case of CEEC.

c. Robustness tests

The model used in our study is subject to two robustness checks and the results can be seen in the table 5 below.

Table 5: Comparison between PMG, DOLS and FM-OLS methods

Variable		PMG	DOLS	FMOLS
Centre Western Europe ARDL (1,2,1,1)	Income	1.147 (0.000)	0.420 (0.000)	0.537 (0.000)
	HPI	0.197 (0.025)	0.120 (0.000)	0.082 (0.000)
	SMI	0.030 (0.034)	0.017 (0.044)	0.021 (0.019)
Northern Europe ARDL (1,1,2,1)	Income	0.947 (0.000)	0.618 (0.000)	0.870 (0.000)
	HPI	0.242 (0.000)	0.125 (0.038)	0.345 (0.000)
	SMI	0.035 (0.000)	0.070 (0.000)	0.062 (0.000)
South Europe ARDL (1,2,1,1)	Income	1.090 (0.000)	0.428 (0.001)	0.939 (0.001)
	HPI	0.173 (0.016)	0.462 (0.000)	0.382 (0.000)
	SMI	-0.0247 (0.137)	-0.120 (0.103)	-0.082 (0.160)
Eastern Europe ARDL (1,1,1,1)	Income	1.0621 (0.000)	0.642 (0.000)	0.947(0.000)
	HPI	0.168 (0.000)	0.002 (0.025)	0.048 (0.001)
	SMI	0.0238 (0.039)	0.031 (0.000)	0.019 (0.000)

(Source: author's calculation in Stata 13.1)

According to Table 5, estimates of the three variables in the four groups of countries under analysis confirm the results that we had in the case of the PMG method and have the same sign for the three methods.

The income coefficients are all significant and positive for the four groups of countries. The housing price indices are all significant and positive for all groups of countris. The stock market coefficient is significant in Centre Western, Northern and Eastern Europe and not significant in South Europe.

4. Conclusions and discussion on further research

Several conclusions can be drawn from the analysis presented in this paper. First, as suggested by the results of the cointegration tests and the PMG procedure, it is evident that personal consumption, stock market wealth, housing wealth and incomes form a long-run equilibrium relationship in the four EU groups of countries. Furthermore, the error-correction model estimates for these countries indicate that when the equilibrium relationship is disturbed by a shock, personal consumption adjusts in order to bring the economy back into the steady state.

Second, the estimated long-run elasticity of personal consumption relative to income revolves around one in all the country groups, as suggested by the PIH.

Third, according to the estimates from the baseline model, the long-run house wealth effect is present in all the four groups (with a more pronounced effect in Northern and Centre Western countries), which corroborates the results of earlier studies. This means that these countries are more vulnerable to

further adverse developments in the housing sector, should the contraction in real house prices continue at the recently observed rates. Fourth, the long-run financial wealth effect is more present in the Northern, Centre Western and Eastern European Countries and not significant in the Southern Countries.

Fifth, the significant results in the short run are the following; income in all the groups, housing wealth effect in Centre Western and Southern European Countries and financial wealth effect in Eastern Europe.

As the further possible research concerns, one method would be to analyse the wealth effect in the above countries according to their financial system characteristics. Another method would be to compare the countries already in the euro area and those who are intended to enter it, the research will lighten, in this way, the reflection on the monetary policy management in a context of economic and monetary union. For policy makers, this further research could show the advantages of the efforts made for reforms that develop the degree of financial evolution. With the help of these models, stock returns are more predictable, and thus could generate a lower risk premium. And as a consequence, they provide a business environment that facilitates private investment and, eventually, long-term growth.

Another possible further research would be to pay attention to other variables that would explain the differences of the relative size of the financial versus housing wealth effect, i.e. the borrowing collateral role of housing wealth, the within-country differences driven by groups' age, the differential concentration of housing and financial wealth across countries, etc.

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Appendix A.

Our data is composed of four variables. Housing price index, personal consumption and compensation of employees were taken from Eurostat. Personal consumption and income were deflated using the Consumer Price Index from Eurostat. In order to express variables (income, consumption, housing and equity price indices) in per capita terms we used quarterly total country population from Eurostat. Real per capita personal consumption and real per capita income were expressed in indices (2010=100). Table A1 shows data range and the fourth variable and its source, real equity price index for all the countries under analysis.

Table A1: Data range and data sources for real equity index

Country	Data range	Real equity price index (SMI), in €
Austria	2000Q1-2018Q3	ATX, Investing.com
Belgium	2001Q1-2018Q3	BFX, Investing.com
Bulgaria	1996Q1-2018Q3	SOFIX, Investing.com
Czech Republic	1999Q1-2018Q3	PX, Investing.com
Denmark	2002Q1-2018Q3	OMXC20, Investing.com
Estonia	2000Q1-2018Q3	Tallin SE General, Investing.com
Finland	1996Q1-2018Q3	OMXH25, Investing.com
France	1996Q1-2018Q3	CAC40, Investing.com
Hungary	1998Q1-2018Q3	BUMIX, Investing.com
Germany	1996Q1-2018Q3	DAX, Investing.com
Greece	1996Q1-2018Q3	ATG, Investing.com
Ireland	1997Q1-2018Q3	ISEQ, Investing.com
Italy	1998Q1-2018Q3	FTMIB, Investing.com
Latvia	2000Q1-2018Q3	OMXRGI, Investing.com
Lithuania	2000Q1-2018Q3	OMXVGI, Investing.com
Norway	1996Q1-2018Q3	OSEAX, stooq.com
Poland	2000Q1-2018Q3	WIG20, stooq.com
Portugal	1996Q1-2018Q3	PSI 20, Investing.com
Romania	2000Q1-2018Q3	BET, Investing.com
Slovakia	2002Q1-2018Q3	SAX, Investing.com
Slovenia	2005Q1-2018Q3	SBITOP, Investing.com

Spain	1996Q1-2018Q3	IBEX 35, Investing.com
Sweden	1996Q1-2018Q3	SSMI, Investing.com
The Netherlands	1996Q1-2018Q3	AEX, Investing.com
United Kingdom	1996Q1-2018Q3	FTSE 100, Investing.com

Source: Author's creation

Appendix B.

Table B1 shows the information fit criteria that were used in order to select the best PMG model for each group of countries, by calculating the AIC and BIC[13] information criteria for several significant specifications. We can observe that the distribution of delays is ARDL (1,1,1,1) in the case of Centre Western Europe, ARDL (1,1,1,1) in the case of Northern Europe, ARDL (1,1,1,1) in the case of South Europe, and ARDL (1,1,1,1) in the case of Eastern Europe.

Table B1: Selecting the best PMG specification

Group of countries	**Specifications of the model**	**Information criteria**	
		AIC	BIC
Centre Western Europe	***ARDL (1,1,1,1)***	***-3499.74***	***-3471.43***
	ARDL (1,1,2,1)	-3475.01	-3446.76
	ARDL (1,1,1,2)	-3468.07	-3439.84
Northern Europe	***ARDL (1,1,1,1)***	***-3686.34***	***-3653.02***
	ARDL (1,1,2,1)	-3669.36	-3636.11
	ARDL (1,1,1,2)	-3649.19	-3615.97
South Europe	***ARDL (1,1,1,1)***	***-2409.70***	***-2387.04***
	ARDL (1,2,1,1)	-2388.94	-2366.29
	ARDL (1,1,1,2)	-2364.11	-2341.51
Eastern Europe	***ARDL (1,1,1,1)***	***-4312.24***	***-4276.52***
	ARDL (1,1,1,2)	-4297.15	-4257.02
	ARDL (1,1,2,1)	-4293.09	-4253.00

(Source: author's calculation in Stata 13.1)

[13] AIC and BIC stand for Akaike information criterion and Bayesian information criterion, respectively. Both are estimators of the relative quality of statistical models for a given set of data.

Appendix C.

Table C1: Groups' characteristics

Characteristic	Centre Western Europe	Northern Europe	South Europe	Eastern Europe
Average GDP per capita[14]	39601.93	50586.6	24593.74	14295.89
Average percentage of GDP of total European GDP (%)	46.3	25.61	21.1	8.4
% of European population	37	18	25	20
Compensation of employees (average percentage of GDP)[15]	49.8	45.1	41.5	44
Average % of owners (%)	62.8	68.2	75.2	85.1
Average % of renters (%)	37.8	31.4	24.7	15.7
Average % of outstanding mortgage loans (%)	45	34	18	3
% of outstanding mortgage loans per gross available income (%)	65	97	51	30
Outstanding mortgage loans per household non-financial wealth[16] (%)	15	21	10	16
Stock market capitalisation as fraction of GDP (%)[17]	45.2	55.5[18]	36.9	12.3[19]

[14] Source: Eurostat for 2018. Calculations made by the author.
[15] Idem.
[16] On average in Europe, non-financial wealth (mainly made up of real estate assets) accounts for 55% of total household wealth.
[17] Data is taken from World Bank for 2017 for Centre Western and Southern Europe.
[18] The value is computed for 2011 from Bijlsma and Zwart (2013) for lack of data for 2017.
[19] Idem.

Household financial assets as fraction of GDP	2.2	2.1	1.8	0.8
Size of banking sector as fraction of GDP	3.8	5.3	2.9	1.1

Note: The averages for percentage of owners, of renters, for outstanding mortgage loans, for outstanding mortgage loans per gross available income, for outstanding mortgage loans / household non-financial wealth were calculated by the author taking the data from Crédit Foncier (2018) and Bijlsma and Zwart (2013). (*Source: Author's creation)*