DOES HOUSING WEALTH AFFECT PRIVATE CONSUMPTION IN EUROPEAN POST-TRANSITION COUNTRIES? EVIDENCE FROM LINEAR AND THRESHOLD MODELS

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ABSTRACT

This study analyzes the relationship between housing market wealth and consumption using data for 4 Central and Eastern European countries (CEEC); Bulgaria, Croatia, Estonia and the Czech Republic. We use vector error correction model and threshold error correction model in order to asses the long run and the short run responsiveness of consumption to permanent changes in housing wealth. We find evidence that supports the existence of the housing wealth effect in all four analyzed countries. Thereby in Bulgaria, Croatia, and Estonia response of consumption to housing wealth changes is characterized by threshold effects, while in the Czech Republic the wealth effect is only detected in the linear framework. Error correction model estimates suggest aggregate consumption adjusts the deviations from the long run equilibrium, however in countries where wealth effect is characterized by threshold effects this adjustment process is partial and takes place when consumption is below levels warranted by the fundamentals.

Key words: post-transition, consumption, wealth, cointegration
JEL classification: C32, D12, E21, E44

1. Introduction

In European post-transition countries private consumption is often the most important driver of aggregate demand, real economic growth and business cycles. Study of private consumption decisions is thus very important for understanding these economies. Conventional macroeconomic models of private consumption usually entail household's wealth and income. This relatively simple consumption function model is motivated by several well-known theories, including the permanent income theory by Friedman (1957), the 'life cycle' theory by Modigliani and Brumberg (1954), and Ando and Modigliani (1963).
Since the household wealth in general and housing wealth in particular do not change rapidly over the years, one can expect that the wealth effect rarely causes severe shifts in the household expenditure. However, history shows that exceptions may occur. Stock market crash in 1929 inevitably reduced consumer spending and consequently deepened the Great depression. More recently, equity market and housing boom and in the second half of the 1990s and consequent crash in 2008 have shifted significantly household's wealth and may in turn affected not just consumption expenditures, but also savings behavior. This phenomenon led to revival of interest in the impact of housing and stock market wealth on consumption.

This study models the impact of changes in housing wealth on consumption in four European post-transition countries that experienced intensive upswing and consequent slump in housing prices: Bulgaria, the Czech Republic, Croatia, and Estonia. Thereby, we use quarterly data ranging from the first quarter 1997 to the first quarter 2010 and apply vector error correction and threshold error correction models in order to differentiate linear from threshold impacts of changes in housing wealth, and to determine short run and long run marginal propensity to consume out of housing wealth.

The growing body of literature on applied nonlinear econometrics suggest many economic series and phenomena like unemployment, GDP, purchasing power parities, or industrial production contain nonlinear properties (Neftci, 1984; Falk, 1986; Bradley and Jansen, 1997). Stock market returns and house prices are also characterized by nonlinearities (Sarantis 2001; Sei-Wan and Bhattacharya, 2009; Posedel and Vizek, 2010) which in turn might imply that consumption could also behave in nonlinear fashion. Several papers thus investigate the asymmetric effect of consumption with respect to stock and housing market in developed countries (Apergis and Miller, 2006; Shirvani and Wilbratte, 2000; Chen *et al.*, 2009), but to the best of our knowledge there are no papers testing for nonlinearities in the response of consumption to housing wealth changes for post-transition countries.

Given the fact that a large body of literature offers very limited insight with regards to nonlinear properties of consumption behavior and with regards to wealth effect in European post-transition countries, the contribution of this paper is twofold. Firstly, this paper sheds more light on housing wealth effect on consumption for post-transition region, which is very important and yet insufficiently explored topic. Studying the wealth effect in European post-transition countries has great policy relevance because asset price boom and busts in the last two decades have been more pronounced in those countries (Posedel and Vizek, 2009), which may have had a pronounced impact on the most important driver of real growth in these economies - the private consumption. Secondly, this paper provides new insights into nonlinear response of consumption with respect to changes in housing wealth and income by applying threshold cointegration and threshold error correction model proposed by Enders and Siklos (2001). To the best of our knowledge this is the first paper that applies any type of

nonlinear methodology on a sample of post-transition countries. Threshold effects might characterize the response of consumption to changes in wealth due to presence of transaction costs and liquidity constraints. If transaction costs are present, households will change consumption expenditures only when wealth changes are large enough to cover incurred transaction costs. If, however, households suffer from liquidity constraints, they will not be able to borrow during the housing market slump in order to smooth out the consumption. This in turn will result in consumption expenditures reacting more strongly to declining wealth when compared to increasing wealth.

The paper is organized as follows. Section 2 presents a short overview of recent theoretical and empirical background related to the effect of different types of wealth on private consumption and summarizes the existing empirical results. Section 3 addresses the data requirements, and the econometric framework. Section 4 summarizes our main empirical results. Finally, Section 5 concludes.

2. Literature review

Research on the impact of stock and housing wealth effect on consumer expenditures is mainly focused on developed countries. Paiella (2009) analyzes the most recent empirical literature focusing both on housing market and stock market wealth effect in industrialized countries, while Poterba (2000) reviews papers exploring only the stock market effect in developed countries. Paiella (2009) concludes that in most studies there is evidence of a positive and statistically significant long run relationship between stock and house prices and consumption. She also emphasizes some differences in results across countries, and both in the size of the effect and in the nature of the channel through which housing wealth affect consumer spending. Differences generally depend on different models i.e. whether time-series or individual household-level data are used in empirical studies. For most euro-area countries the aggregate wealth effect on aggregate consumption usually varies from 1 to 5 percent using a sample of developed European countries (Labhard *et al.* 2005).

Aggregate wealth effect however does not differ between housing and stock market wealth. In the last decade more attention had been devoted to separately estimate these two wealth types, mainly for developed countries. Dvornak and Kohler (2003) analyze the influence of both stock market and housing market wealth using state level panel data for Australia. They conclude stock market wealth effect is substantially larger than housing wealth effect. Ludwig and Sløk (2004) investigate the same issue applying the cointegration panel method on data for 16 OECD countries. Their results suggest stock market wealth effect has slightly increased over time, while housing wealth effect has become more significant in the 1990s. Ludwig and Sløk also distinguish two types of countries: in countries with sound and developed market-based financial system stock market wealth effects are more pronounced than housing effects, while the opposite is true for countries with bank-based financial system.
Case *et al*. (2005) investigate the influence of both housing and stock market wealth on consumption for the U.S data and the panel of 14 OECD countries (since 1975). Unlike Dvornak and Kohler, Case *et al*. (2005) find a highly statistically significant estimate of the marginal propensities to consume (MPC) out of housing wealth, while the MPC out of stock market wealth is statistically insignificant and small for both a panel of the U.S. and the OECD countries. Carroll *et al*. (2006) results corroborate Case *et al*. findings in so far that they also provide evidence of substantially larger housing wealth effect in the U.S. The first-

quarter (immediate) MPC estimate from a dollar change in housing wealth is about 2 cents, while in the long run MPC revolves within 4 to 10 cent range.

Besides above mentioned two groups of paper, there is another group of research that focuses exclusively on housing market effect on consumption in developed countries. Empirical analyses carried out in the second half of 1990s, such as Skiner (1996) and Engelhardt (1996) find a limited and statistically weak relationship between housing price changes and consumer spending, based on micro-data in the U.S. However, in 2000s, studies like Attanasio *et al*. (2005), Bover (2005), Disney *et al*. (2002), Morris (2007), Campbell and Cocco (2007) and Sierminska and Takhtamanova (2007) differ in assessing the strength of the housing wealth effect on consumption, which may partly be due to differences in the methodologies and sample period. Campbell and Cocco (2007) estimate that a 1 percent increase in housing prices causes a 1.2 percent increase in consumption and they find a higher consumption elasticity for older age groups. Attanasio *et al.* (2005) estimate of housing price elasticity of consumption is quite smaller, it varies from 0.04 to 0.21 percent depending on the age groups. Disney *et al.* (2002) find that household MPC out of housing wealth effect varies from 0.09 to 0.14. The similar small effect one can find in Morris (2007) for the U.S. data, where the estimated MPC is between 0.01 and 0.15, while Bover (2005) analysis suggests the estimate for Spain is only 0.02 percent. Sierminska and Takhtamanova (2007) have found evidence of significant housing wealth effects for Italy, Finland and Canada, with MPC ranging between 0.10 and 0.14.

Research on wealth effect in European post-transition countries is far less scarcer. Sec and Zemčik (2007) estimate the impact of change in housing prices, rents and mortgage payments on consumer spending in the Czech Republic. Their research suggests higher house prices increase consumption of household-homeowners, but not of households-renters. Funke (2004) presents evidence of a small but statistically significant stock market wealth effect on private consumption in 16 emerging markets ranging from 0.2 – 0.4 percent, but his sample does not cover European post-transition countries.

As far as the nonlinear wealth effects on consumption are concerned, the available literature suggests both types of wealth effect exhibits nonlinear properties in developed countries. Both Shirvani and Wilbratte (2000) and Apergis and Miller (2006) suggest stock market wealth affects private consumption asymmetrically during the short-run adjustment process. More specifically, wealth reductions exhibits a stronger effect on consumption when compared to wealth increases. On the other hand Chen *et al.* (2010) suggest that durable consumption exhibits a strong threshold behavior in response to changes in house prices, with the effects being present during periods with low household liquidity. Other categories of consumption, however, do not exhibit this kind of threshold behavior.

3. Data and Methodology

The empirical literature focuses on the impact of stock market and housing wealth on consumer spending can be divided in two broad categories. The first group of studies models direct wealth effect using time-series data, while the second group of studies estimates indirect wealth effect using household-level data based on surveys.

In this paper we use the former approach, which implies rising house prices increase households' wealth which will then encourage the growth of consumption via the budget constraint. Direct wealth effect using aggregate macroeconomic data is usually evaluated

using cointegration and error correction models. This approach allows us to distinguish the long-run from the short-run links between consumption and wealth. In particular, methodology based on time-series data enables us to determine the responses of the variables that adjust after the disturbance in order to restore the long-run equilibrium, which is decisive issue in modeling wealth effects (Poterba 2000).

The aim of this study is to determine the relative importance of housing wealth for private consumption in European post-transition countries: Bulgaria, the Czech Republic, Croatia, and Estonia. In order to determine whether a long-term relationship exists between aggregate consumption on one side and income and housing wealth on the other side, we use the Johansen procedure. More precisely, we use trace and max statistics with the aim to identify the number of cointegrating vectors between the variables of interest (Johansen, 1988; Johansen, 1991). In that sense, the trace statistic is used to tests the null hypothesis that the number of (different) cointegrating vectors is less than or equal to r, where as the max statistic tests the null hypothesis that the number of (different) cointegrating vectors is equal to r against the alternative hypothesis that the number of cointegrating vectors is equal to r + 1.

As discussed in the introduction, wealth effect may demonstrate asymmetric properties in the process of adjusting the deviations from the long run equilibrium. In fact, if the adjustment is asymmetric, then Johansen test or any other cointegration test that assumes symmetric adjustment as well as corresponding error correction models are misspecified. Therefore, after testing for VAR cointegration, we proceed by testing for threshold cointegration. If threshold cointegration is established, we proceed by formulating a threshold error correction model of private consumption. If, however, Johansen cointegration exists and no threshold cointegration is found, a vector error correction model of private consumption is estimated.

Threshold cointegration method was developed by Enders and Siklos (2001). This method assumes the asymmetric adjustment in the short run and at the same time retains symmetry in the long run, which differs from Engle-Granger (or any other linear single-equation cointegration method) or Johansen model that assume symmetric behavior in the short and the long run.

First step in formulating threshold cointegration is estimation of the Engle-Granger type of model of consumption behavior in the long run. Then the disturbance term of that model (μ_t) is used to estimate the following equation (1):

$$\Delta\mu_t = I_{jt}\rho_1\mu_{t-1} + \left(1 - I_{jt}\right)\rho_2\mu_{t-1} + \varepsilon_t, \qquad j = 1,2 \tag{1}$$

where I_{1t} and I_{2t} are the Heaviside indicator functions for the TAR and the M-TAR model respectively, such that:

$$I_{1t} = \begin{cases} 1 & \text{if} \quad \mu_{t-1} \geq \tau_1 \\ 0 & \text{if} \quad \mu_{t-1} < \tau_1 \end{cases} \tag{2}$$

in the TAR case, and

$$I_{2t} = \begin{cases} 1 & \text{if} \quad \Delta\mu_{t-1} \geq \tau_2 \\ 0 & \text{if} \quad \Delta\mu_{t-1} < \tau_2 \end{cases} \tag{3}$$

in the M-TAR case. The values of the threshold are denoted by τ_1 and τ_2 and ε_t represents a sequence of IID random variables with mean zero and a constant variance.

Asymmetric adjustment is implied by different values of ρ_1 and ρ_2 so, if μ_{t-1} is positive then the adjustment is $\rho_1\mu_{t-1}$ and if μ_{t-1} has the negative sign, the adjustment is $\rho_2\mu_{t-1}$. Further, the exact nature of non-linearity maybe unknown, so it is possible to allow the adjustment to depend on the change in μ_{t-1} (i.e., $\Delta\mu_{t-1}$) rather than the level of μ_{t-1}. That specification is particularly relevant in an adjustment such that series exhibits more momentum in one direction than the other (M-TAR model). In addition, we test for threshold cointegration using TAR and M-TAR models by setting the value of the threshold τ to zero and allowing the threshold to be determined endogenously. The value of threshold τ needs to be estimated along with the parameters ρ_1 and ρ_2 using the algorithm developed by Chan (1993). In each of the four cases, depending on the type of asymmetry under consideration $(I_{1t}$ or $I_{2t})$, regression equation (1) was estimated and the null hypotheses $\rho_i = 0$ and $\rho_1 = \rho_2 = 0$ were tested. Furthermore, depending on the type of asymmetry under consideration $(\mathrm{I}_{1t}$ or $\mathrm{I}_{2t})$ and on the value of the threshold, we estimate the regression equation (1) and test the null hypotheses $\rho_i = 0$ and $\rho_1 = \rho_2 = 0$, which are direct tests of cointegration existence.[1] The empirical F statistics obtained from the latter test is compared to the critical values tabulated by Wane, Gilbert and Dibooglu (2004). Finally, we test the null hypothesis $\rho_1 = \rho_2$ using the Wald test in order to determine whether the cointegration relationship is characterized by threshold effects.[2]

Since the least squares estimates of ρ_1 and ρ_2 have an asymptotic multivariate normal distribution (Tong, 1983) and given the existence of a single cointegration vector, the error-correcting model for any variable x_{it} can be written in the form:

$$\Delta x_{it} = \rho_{1,i} I_{jt}\mu_{t-1} + \rho_{2,i}\left(1 - I_{jt}\right)\mu_{t-1} + ... + v_{i,t} \qquad j = 1,2 \qquad (4)$$

where $\rho_{1,i}$ and $\rho_{2,i}$ are the speed of adjustment coefficients of Δx_{it}, and $v_{i,j}$ is IID random variables with mean zero and a constant variance.

Despite the fact that our analysis requires data for just three variables (income, housing wealth and private consumption) for selected 4 countries that our sample is composed of, there are still several limitations related to the data availability and sample size. Firstly, due to the fact that longer house price series for other post-transition European countries were not available to the authors, other countries could not be included in the analysis. Further on, house price series are used as a proxy for housing wealth because housing wealth series and housing stock series from which one derives housing wealth series are not available for the analyzed group of countries (except Estonia). House prices were also used as a proxy for housing wealth in other studies on wealth effect on consumption including Miles (1992), Miles (1995), Girouard and Blöndal (2001), Aoki et al. (2003), and Ludwig and Slok (2004). In this paper, the data on total real aggregate consumption is used, although in the empirical literature non-durable consumption series is used as well. The advantages of using non-durable consumption are straight forward: durable consumption can be thought of as a replacement and improvement to

[1] For the tests, we used the larger of the *t* values and *F* statistics that were later denoted by Tmax and Φ both in the text and in the corresponding tables.

[2] The null hypothesis assumes linearity, while the alternative assumes threshold behaviour. Test statistics is denoted by W both in the text and in the corresponding tables.

a capital stock which opposes mainstream consumption theories which perceive consumption as a flow variable (Ludwig and Slok, 2004). Finally, we use net wage series as a proxy for income.

The series are expressed in real terms, where as net wages and house prices are deflated using the consumer price index. All series were transformed into logarithms and tested for unit roots using the Ng-Perron test (Perron and Ng, 1996). The results suggest that all series are stationary in first differences.[3] Data series for all transition countries range from Q1:1997 to Q1:2010. As evident in Appendix, where details on all series used in the analysis are displayed, house price are not homogenous across countries.

4. Empirical results

The first step in our empirical analysis is to test for the number of cointegrating vectors in VAR using trace and max statistics. Trace and max statistics, presented in Table 1 suggest that in the case of Estonia, the Czech Republic and Croatia two cointegrating vectors are found, while in the case of Bulgaria just one vector is detected.

Table 1. Johansen cointegration

Country	Bulgaria			Croatia			The Czech Republic			Estonia		
Rank	Eigen value	Trace test	Max test	Eigen value	Trace test	Max test	Eigen value	Trace test	Max test	Eigen value	Trace test	Max test
0	0.383	35.1** [0.04]	16.42 [0.26]	0.529	46.74* [0.002]	25.58* [0.017]	0.473	46.02* [0.002]	20.51 [0.087]	0.421	59.42* [0.000]	24.1** [0.028]
1	0.335	18.72 [0.08]	13.85 [0.10]	0.353	21.1** [0.036]	14.79 [0.074]	0.408	25.51* [0.009]	16.77** [0.036]	0.385	35.38* [0.000]	21.37* [0.006]
2	0.133	4.87 [0.29]	4.87 [0.29]	0.171	6.37 [0.164]	6.37 [0.164]	0.239	8.74 [0.060]	8.74 [0.060]	0.127	4.01 [0.26]	4.01 [0.26]

Note: : * significant at 1 percent level. ** significant at 5 percent level p-values in brackets; VAR for Bulgaria includes 2 lags, while a constant is included in cointegrating space; VAR for Croatia includes 2 lags, while a constant is included in cointegrating space; VAR for the Czech Republic includes 5 lags, while a constant is included in cointegrating space; VAR for Estonia includes 2 lags, while a constant is included in cointegrating space. Lag length chosen according to SBIC.
Source: Author's calculations.

After linear cointegration we test for threshold cointegration between consumption, income and housing wealth. If the results suggest threshold cointegration is present for a given country, we proceed by deriving a threshold error correction model of consumption. If, however, threshold cointegration is not present, we proceed by formulating a linear error correction model of consumption. Table 2 summarizes results from threshold cointegration estimation. Although we tested alltogether four different threshold cointegration models for each country (TAR and M-TAR with zero threshold and TAR and M-TAR with unknown threshold), in the table we present the results of the model that proved the most successful in detecting the threshold cointegration. As indicated by Φ statistics, threshold cointegration between consumption, income and housing wealth is present in Bulgaria, Croatia and Estonia. For Bulgaria, threshold cointegration is detected in M-TAR model with endogenously estimated threshold, for Croatia threshold cointegration is detected in M-TAR model with the value of the threshold set to zero, while for Estonia TAR model with endogenously estimated

[3] To conserve space we do not show the results of unit root tests here, however, they are available from the authors upon request.

threshold is the most successful in detecting cointegration. In the Czech Republic, no evidence of threshold effects is found. Moreover, in countries for which threshold cointegration is detected, W test statistics results confirm that the adjustment coefficients ρ_1 and ρ_2 differ in value, thereby confirming threshold effects.

Table 2. Threshold cointegration

Country	Bulgaria	Croatia	The Czech Republic	Estonia
Model	M-TAR	M-TAR	M-TAR	TAR
Threshold	-0.0011	0	0.00365	-0.0127
ρ_1	-0.181	-0.0015	0.17	-0.25
ρ_2	0.172	-0.463	-0.122	0.181
Tmax	2.4	-0.012	1.34	3.54
$\Phi(\rho_1 = \rho_2 = 0)$	8.89**	12.4*	3.51	11.2**
$W(\rho_1 = \rho_2)$	13.98*	12.5*	4.54**	19.6*
AR test	0.79 [0.51]	2.72 [0.06]	0.75 [0.52]	0.74 [0.57]
Number of lags of dependent variable included in the model	4	4	1	1
Number of observations	52	53	49	53

Note: ρ_1 and ρ_2 denote the adjustment parameters; p-values presented in brackets; lag length chosen according to SBIC; * - null hypothesis rejected at 1 percent significance level; ** - null hypothesis rejected at 5 percent significance level.
Source: Author's calculations.

Before proceeding to error correction model estimation, it is useful to analyse the long run elasticities of consumption expenditures with regards to income and wealth effects reported in Table 3. For the Czech Republic we report long run elasticities from the Johansen model, which were obtained by imposing normalization on the long run coefficient for consumption expenditure in the first cointegrating vector. On the other hand, for other three countries elasticities from Engle-Granger type model are reported, as residuals from that model are used for testing threshold cointegration.

Long-run elasticities of private consumption with the respect to net real wages for all analyzed countries have the expected sign, but vary substantially across countries (from 1.15 for Estonia to 2.10 for the Czech Republic. Along with the income, increases of house prices which serve as a proxy for housing wealth also boost private spending. The long run MPC out of housing wealth also differ across countries. The largest one is 0.46 (in case of the Czech Republic), although that coefficient is not statistically significant. while for the other three countries they exhibit lower, more plausible, values. Thus in Croatia and Bulgaria for every euro increase in housing wealth, consumption increases by ten cents, while in Estonia the consumption increases by four cents.[4]

[4] One must however note that MPC out of housing wealth is also not statistically significant for Estonia.

Table 3. Long run marginal propensities to consume

Country	Bulgaria	Croatia	the Czech Republic	Estonia
Cointegration model	M-TAR	M-TAR	VAR (Johansen)	TAR
Constant	-	-1.24 (0.28)*	-2.45 (0.54)*	-
Net real wage	1.63 (0.11)*	1.58 (0.11)*	2.10 (0.49)*	1.15 (0.05)*
Real house price	0.10 (0.05)**	0.10 (0.03)*	0.46 (0.33)	0.04 (0.05)

Note: * significant at 1 percent level. ** significant at 5 percent level; numbers in brackets denote standard errors.
Source: Author's calculations.

Table 4 summarizes the results of vector error correction model of private consumption for the Czech Republic and threshold error correction model of private consumption for Bulgaria, Croatia, and Estonia. All four models explain a large portion of private consumption variance and satisfy relevant diagnostic tests.
Private consumption reacts to deviations from the equilibrium in all four countries. In the Czech Republic this reaction is linear and quite weak, with consumption correcting only 9.5 percent of disequilibria in one quarter. In other three countries the reaction of consumption to deviations from equilibria is somewhat stronger and characterized by threshold effects. Namely, in all three countries the only negative discrepancies are corrected (as suggested by significant adjustment coefficient ρ_2). This in turn suggests that consumption adjusts long run disequilibrium only when actual consumption is bellow the level warranted by the fundamentals. In Bulgaria 13.5 percent of negative discrepancies are adjusted within single quarter, while in Croatia and Estonia the adjustment is much stronger, amounting to 62 and 32 percent respectively.

Lagged values of consumption are significant in Bulgaria, Croatia, and Estonia which suggests that consumption persistence is present in these countries. As far as the short run wealth effect estimates are concerned, estimated error correction models indicate that increase in house prices in Croatia, the Czech Republic, and Estonia boost private consumption. In Bulgaria there appears to be no short run effect of housing wealth on consumption. Point estimates of marginal propensities to consume out of housing wealth are in line with those for developed countries (0.14 for Croatia, 0.12 for the Czech Republic, and 0.075 - 0.11 for Estonia). Net wage rises also influence private consumption in the short run in Croatia, the Czech Republic and Estonia. In the Czech Republic and Estonia estimates of income elasticities of consumption are close to 1 (0.89 and 0.93 respectively), while in Croatia a 1 percent increase in net wage is associated with 0.19 percent rise in consumption expenditure.

Table 4. Error-correction model of private consumption – summary of estimation results

Explanatory variables	Bulgaria	Croatia	the Czech Republic	Estonia
Type of ECM	Threshold ECM	Threshold ECM	Linear VECM	Threshold ECM
ρ_1	0.036 (0.45)	0.015 (0.10)	-	-0.067 (-0.39)
ρ_2	0.135* (2.26)	-0.62* (-5.19)	-	0.32* (3.56)
Error-correction term (-1)	-	-	-0.095* (-3.92)	-
Consumption (-1)	-0.31*** (-1.86)	0.10 (0.41)	0.11 (0.67)	-0.35 (1.53)
Consumption (-2)	-0.30*** (-1.87)	0.25** (2.07)	0.06 (0.40)	-0.50** (-2.13)
Consumption (-3)	-0.02 (-0.12)	0.007 (0.52)	0.02 (0.14)	-0.35 (-1.53)
Consumption (-4)	0.074 (0.45)	-	-0.22 (-1.37)	-0.18 (-0.90)
Consumption (-5)	0.179 (1.06)	-	-	-0.27 (1.70)
Consumption (-6)	0.28*** (1.73)	-	-	-
Net real wage (-1)	0.06 (0.29)	0.60 (1.34)	-0.15 (-1.65)	0.93* (3.34)
Net real wage (-2)	-0.26 (-1.18)	0.76 (-1.65)	-0.15 (1.72)	0.14 (0.52)
Net real wage (-3)	-0.04 (0.19)	0.89*** (1.88)	0.16 (1.50)	-0.11 (-0.36)
Net real wage (-4)	-0.08 (-0.41)	-	0.19*** (1.79)	0.14 (0.50)
Net real wage (-5)	-0.035 (-0.19)	-	-	0.09 (0.35)
Net real wage (-6)	0.25 (1.21)	-	-	-
House price (-1)	0.08 (0.55)	0.14*** (1.75)	0.12** (2.19)	0.009 (0.21)
House price (-2)	0.04 (-21)	-0.04 (-0.49)	0.01 (0.12)	0.11** (2.44)
House price (-3)	-0.12 (-0.76)	0.05 (0.72)	-0.12 (-1.53)	0.078 (1.65)
House price (-4)	-0.05 (-0.33)	-	0.27* (4.47)	0.09** (2.07)
House price (-5)	0.21 (1.26)	-	-	0.075*** (1.87)
House price (-6)	0.07 (0.447)	-	-	-
Adj. R^2	0.64	0.61	0.52	0.75
RSS	0.097	0.009	9.48E-05	0.0092
AR test	0.91 [0.45]	0.83 [0.48]	0.17 [0.68]	0.38 [0.76]
ARCH test	0.33 [0.80]	0.05 [0.98]	0.13 [0.44]	0.31 [0.81]

Note: * significant at 1 percent level, ** significant at 5 percent level, *** significant at 10 percent level . Numbers in parentheses denote t-statistics; numbers in brackets denote the p-value.
Source: Author's calculations.

5. Concluding remarks

We show that private consumption in Bulgaria, Croatia, the Czech Republic and Estonia respond to changes in housing wealth in the long run and the short run. In three countries (namely Bulgaria, Croatia and Estonia) we found evidence that the response of private consumption to changes in income and housing wealth is characterized by nonlinear properties. In particular, estimates from threshold error correction model of consumption suggest the adjustment of long run deviations from equilibrium takes place only in one out of two regimes defined by the threshold value. Adjustment is thus regime specific, i.e. it is only effective when consumption is below the long run equilibrium value, while it is absent when consumption is above the equilibrium level.

As far as long run marginal propensities to consume out of housing wealth are concerned, their long run estimates for Bulgaria, Estonia, and Croatia are in line with estimates for developed economies and range from 0.04 to 0.1. In the case of the Czech Republic, the marginal propensity is quite high (0.46), but it is not statistically significant. Short run marginal propensities to consume out of housing wealth also exhibit similar values: 0.14 in the case of Croatia, 0.12 in the case of the Czech Republic and 0.075-0.11 in the case of Estonia. In Bulgarian case, there seems to be no short run relationship between housing wealth and private consumption expenditures.

The presence of relatively strong consumption persistence in Bulgaria, Croatia, and Estonia might change considerably households´ reaction to policy shocks and business cycle innovations. This feature can be particularly challenging for formulation and the effectiveness of countercyclical policy measures that work trough household spending. The fact that not just persistence, but also wealth effect is present in the behavior of consumption in post-transition European countries should also not be ignored. It suggests that housing wealth changes along with factors that form consumption persistence should be taken into consideration if the policy goal is to stabilize the level of output via consumption or to boost output via long-lasting increases in consumption.

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Appendix

Data description and sources

Bulgaria

Variable	Description	Source
Household consumption (C)	Millions of national currency, chain-linked volumes, reference year 2000	Eurostat
Wage (W)	Average nominal wages and salaries of the employees under labor contract in national currency	Bulgarian Statistical Institute
House price (HP)	Average market prices per square meter of dwellings, in national currency, total for Bulgaria	Bulgarian Statistical Institute
CPI deflator		International Financial Statistics

Croatia

Variable	Description	Source
Household consumption (C)	Millions of national currency, chain-linked volumes, reference year 2000	Eurostat
Wage (W)	Average net nominal wages of the employees in legal entities, in national currency	Croatian Central Bureau of Statistics
House price (HP)	Average market prices per square meter of dwellings, in national currency, total for Croatia	Real Estate Exchange database
CPI deflator	Derived using Consumer price index	International Financial Statistics

Czech Republic

Variable	Description	Source
Household consumption (C)	Millions of national currency, chain-linked volumes, reference year 2000	Eurostat
Wage (W)	Average gross nominal wage, in national currency	Czech Statistical Office and Eurostat
House price (HP)	Apartment price index, total for Czech Republic	Czech Statistical Office
CPI deflator	Derived using Consumer price index	International Financial Statistics

Estonia

Variable	Description	Source
Household consumption (C)	Millions of national currency, chain-linked volumes, reference year 2000	Eurostat
Wage (W)	Average nominal net wages and salaries, in national currency	Estonian Statistical Office and Eurostat
House price (HP)	Average purchase-sale price per square meter of dwelling, in national currency, Tallin	Estonian Statistical Office
CPI deflator	Derived using Consumer price index	International Financial Statistics