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Drivers of household saving in East Central European countries. A push and pull model perspective

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ABSTRACT

There is no consensus in the economics theory about the determinants of household saving. The article composes vector error correction (VEC) models to identify the determinants of household saving in the East Central European countries from 2005–2020. Its novelty is that it identifies push and pull factors in accordance with the Keynesian and neoclassical theories whose mixed approach has not been included in the methodology of relevant papers in relation with East Central European countries. The examined countries are indicated to be homogenous from macroeconomic perspective. Results confirm that household saving increases because of decreases in consumer confidence, unemployment, and inflation rates. Increases in the deposit rate and real house price index are related to these pull factors, while decreases in the official share index correlates withincreases in household saving. Results can serve as guidelines for policy makers about incentives which stimulate household saving most effectively in the region.

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Household saving; vector error correction model; panel data; push and pull factors; East central European countries

1. Introduction

Catching-up models built on internal savings can ensure a more sustainable growth path for an economy. Household saving is a more secure and predictable source than others for both businesses and state. Furthermore, household financial savings can be the source of investments, which supports a country's long-term economic growth (see, especially, Feldstein & Horioka, 1980; Mohan, 2006; Tatlıyer, 2017), high national income and well-being (Baiardi et al., 2020). In parallel, the usage of domestic financial resources instead of foreign financial resources reduces a country's vulnerability. Economic crises, like the Great Depression or the Great Lockdown and a war conflict risking the likelihood of stagflation raise the funding and financing role of domestic household saving, meanwhile, turn policy makers' and researchers' attention towards its determinants. The higher is the uncertainty, the bigger is the likelihood of precautionary saving but the lower are the consumptions and GDP growth rate (Mody et al., 2012). The Great Lockdown resulted in

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extraordinary levels of household saving (Basselier & Minne, 2021; Dossche et al., 2021; Ercolani et al., 2021). In an economic recession, household saving can secure the reliable and solid source of investments, while international funding opportunities deteriorates. Nevertheless, recessions usually bring substantial losses of wealth for households. Thus, the propensity for diversification of the individual asset portfolio would be desirable to minimise its risks (Sierminska & Silber, 2020). The phenomena mentioned above demonstrate how important it is to identify the significant determinants of household saving and, this way, to support the economic policy making at all times.

However, the determinants of household saving are not obvious and unambiguous in the academic literature. While there is a wide consensus that temporary consumption-saving can be explained by Modigliani's life-cycle hypothesis, the empirical studies in this regard involve different factors in their models to explain household saving. On this question, two main economic schools can be identified. Whilst John Maynard Keynes and his school emphasised the role of real disposable income, the neoclassical theory puts a greater emphasis on interest rates. Other scholars (see amongst Callen & Thimann, 1997; Cohn & Kolluri, 2003; Niculescu-Aron & Mihaescu, 2012; or; Palenzuela & Dees, 2016) involve other factors such as public saving, GDP growth, taxes, the unemployment rate, or inflation. The results are controversial as, for instance, Gur et al. (2011) found that neither the size of an economy, interest rate differentials, nor economic shocks can explain saving – investment relations.

Saving behaviour is determined by a complex of economic, social, demographic, and cultural factors which vary country by country. The purpose of this study is to identify which macroeconomic factors[1] affect households' saving behaviour by differentiating between pull and push factors. The study aims to explain household saving in the East Central European countries (Czechia, Hungary, Poland, Slovakia, and Slovenia). Due to the availability of quarterly data, the study examines data from the period 2005–2020. The initial hypothesis of the study is that both the Keynesian approach and neoclassical model are applicable to the East Central European countries since both income (wages) and interest rates play significant roles in determining the level of household saving in the region. The novelty of this study is that it builds an analytical model by distinguishing between push and pull factors based on the two mainstream theories by considering the macroeconomic determinants which can affect households' saving behaviour. Thus, push variables are those factors which can be linked to the Keynesian approach, and which determine the amount of households' income left over for saving. The identified push variables are the consumer confidence index, the inflation rate, and the unemployment rate. Pull variables reflect neoclassical theory and thus include those factors which can attract household savings as possible forms of investment. These factors are the deposit rate, real house price and total share price. The study also considered some other variables such as current account balance and government bond rate. However, these variables were not found to be significant. The study provides a new methodological structure for determining factors of household saving which helps us understand how to motivate household saving and thus, indirectly, the overall volume of national saving in case of exposure to domestic capital shortage and inward foreign direct investments.

The hypothesis of this study is that the volume of household savings can be stimulated positively by increasing wages, higher deposit rates and rising house and share prices, while improvement in consumer confidence, or climbing inflation and unemployment

deteriorate the households' propensity to save their income. This paper is organised as follows. In Section 2, the literature review summarises the most relevant models and empirical conclusions related to the macroeconomic determination of household saving in general and in the East Central European countries specifically. Section 3 provides the description of the methodology applied and the quality of the data analysed. Section 4 details the model creation based on vector autoregression. The empirical output of the econometric models is presented in Section 5. Finally, discussions to the empirical literature and conclusions are included in Section 6.

2. Literature review about household saving determinants

The various economic theories that have been proposed to explain the motivational drivers of household saving highlight different macroeconomic determinants. Keynesian economic theory suggests that a household's propensity to save mainly depends on its current level of disposable income and thus higher-income households would be expected to have higher saving in absolute terms. Research based on Keynesian assumption (including Duesenberry, 1949; or; Hicks, 1950) has also shown that higher-income households save a larger share of their income than lower-income ones. Keynes (1936) assumes that the motivations for saving change very slowly, so a household or individual's propensity to save is relatively stable over time. He identifies two dimensions regarding saving decisions: the propensity to consume (as income increases, consumption also increases but at a slower pace) and the liquidity preference (how much money or assets people prefer to retain in cash). He also identified the role of emotional mindsets, recognising that in times of economic stress or uncertainty people may act irrationally in their financial decisions.

In contrast, neoclassical theories (Albert Ando, Milton Friedman and Franco Modigliani) that endogenise the factors driving household saving emphasise that households face an intertemporal optimisation problem and are concerned about future consumption. The Modigliani and Ando (1963) theory of lifecycle states that a person's income changes regularly throughout his or her life and saving provides an opportunity for people to make a more comfortable transition from high-income periods to low-income periods. The change in real interest rates can significantly affect lifetime income. For instance, if it falls, it decreases the opportunity cost of current consumption relative to future consumption, so that current saving becomes less profitable than future saving. This theory suggests that the saving rate depends primarily not on the current level of income but rather on its growth rate (Deaton, 2005). Milton Friedman's (1957) permanent income theory assumes that households respond to changes in permanent income but not to changes in transitory income.

The life cycle hypothesis has been also refuted by several studies (see, especially, Campbell & Mankiw, 1989; Carroll & Summers, 1991; Deaton, 2005), who argue that saving is determined not only by income but also by other factors and point out that people do not always behave rationally. These authors argued that an individual's behaviour at a given time is determined by various, often cyclical factors. As a result of all these conclusions, a behavioural life cycle hypothesis model was developed. The clash of the two hypotheses is detailed by Kapounek et al. (2016). In the empirical application of this model, it has been confirmed that there is a positive relationship between saving and

growth regarding disposable income and real interest rates. Furthermore, they found a positive relationship between saving and economic growth, the level of economic development, financial development, and inflation. They identified a negative relationship between saving and foreign trade, capital inflows, political instability, and government debt (Crespo Cuaresma et al., 2014; Fidrmuc et al., 2013). However, the role of interest rates in the literature is ambiguous. For instance, Aizenman et al. (2016) and Masson et al. (1998) found mixed results regarding the relationship between the saving rate and the actual interest rate/nominal interest rate.

Several empirical studies have been published which examine the macroeconomic determinant factors determining household saving (see Table 1). It can be concluded that no consensus has been reached concerning the macroeconomic determinants of household saving. While for instance, Schmidt-Hebbel et al. (1992), examining developing countries, concluded that there was a positive relationship between saving and income, its growth and household consumption, and a negative relationship between saving and foreign saving and monetary affects. They found that inflation and the interest rate did not have a significant impact on savings. In contrast, Cohn and Kolluri (2003) found that, besides real disposable per capita income and public saving, changes in the real interest rate and in the rate of inflation also significantly affect household saving in the G7 countries. Levenko (2020) emphasised the role of labour income uncertainty: the level of unemployment rate and its increase affect severely the household saving. Vanlaer et al. (2020) highlighted consumers' confidence, including unemployment rate and inflation rate as determining factors. Focusing on the eurozone countries, Palenzuela and Dees (2016) added new determining factors to the classical theories, finding that loans-to-income ratio, real house prices, real share prices and real deposit rates were also significant. This finding also contradicts those of some of the literature (see e.g. Buleca & Toth, 2016) as some studies stated that GDP and unemployment rate were not significant explanatory variables.

Other studies in the literature have focused on a single country's household savings macroeconomic determinant factors (see Akram & Akram, 2016 about Pakistan; Horioka & Wan, 2007 about China; Mongale et al., 2013 on South Africa; Zhuk, 2015 on Ukraine). A comprehensive analysis of the developmental processes of the East Central European countries and the modelling of their growth prospects was carried out in detail by Benczes (2008) and by Elekes and Halmai (2013). However, only a few studies have examined the macroeconomic determinants of household saving focusing on the East Central European countries.

A common feature of these studies is that they include several different explanatory factors in their investigations. For instance, Kukk and Staehr (2017) examined 10 Central and Eastern European (CEE) countries between 1992 and 2002 and concluded that the output gap, real interest rate, inflation rate and current account balance are all significant in explaining households' saving, while the unemployment rate and changes in the real exchange rate are less important explanatory factors. Kolasa and Liberda (2015) analysed the determinants of household saving in Poland alone but compared it to OECD countries. They included various determining factors, and their conclusions are in line with those of Kukk and Staehr (2017): while real interest rate is a determining factor, unemployment rate is not. Moreover, they concluded that government and corporate saving affects the saving rates in Poland substantially more than in a typical OECD country. Niculescu-Aron

Table 1. Summary of the empirical literature on determinants of household saving.

Author	Period, countries	Methodology	Significant variables	Insignificant variables	Sources
Schmidt-Hebbel et al. (1992)	1970–1985, 10 emerging countries	OLS, fix/ random effects models	Real disposable income and its growth Household consumption Monetary assets Foreign saving	Real interest rate Inflation rate Urbanization rate	U.N. System of National Accounts
Callen and Thimann (1997)	1975–1995, 21 OECD countries	OLS, Fixed effects models	Ratio of direct taxes Gross transfers Government and corporate saving Income growth Old age dependency ratio Real interest rate (not in all cases) Consumer debt to GDP	Net transfers Private saving Inflation rate (in almost all of the cases)	OECD database, IMF WEO
Cohn and Kolluri (2003)	1960–1999, G7 countries	ECM	Real disposable income Real interest rate Government saving Inflation rate		OECD, IMF WEO databases
Palenzuela and Dees (2016)	2000–2013, Eurozone	Panel regression	Real disposable income Loans to income ratio Real house prices Real share prices Real deposit rate	GDP Unemployment rate	Eurostat
Kukk and Staehr (2017)	1995–2012, CEE countries	GMM, LSDV, bias-corrected LSDV	Output gap Real interest rate Inflation rate Current account balance	Unemployment rate Changes in the real exchange rate	Eurostat database
Kolasa and Liberda (2015)	Poland compared to OECD countries	GMM	Income and its growth Real interest rate Government and corporate savings	Terms of trade Labour productivity Unemployment rate HICP GDP volatility M2 to private income Domestic credit ratio Households' financial net wealth	OECD database
Niculescu-Aron and Mihaescu (2012)	1995–2010, 15 European countries	Fixed-country-specific effects model	Inflation rate Percentage of rural population Economic growth	Long-term interest rate Life expectancy at birth Demographic dependency ratio	Eurostat, IMF WEO, OECD
Levenko (2020)	1996–2017, 22 European countries (including V4 countries and Slovenia)	One-step system GMM	Income growth Labour income uncertainty	Credit availability Interest rates Inflation rate	Eurostat, ECB Survey of Professional Forecasters, AMECO database
Vanlaer et al. (2020)	2001–2014, 18 EU countries	Fixed- effects and Instrumental Variable estimation	Consumer confidence indicators including past and future financial situation, consumer prices, unemployment expectations		Joint Harmonised EU Consumer Survey, Eurostat, AMECO and World Bank database

Source: authors' creation based on the literature.

and Mihaescu (2012) compared the macroeconomic determinant factors of household saving between the Western European and CEE countries. They found that while the inflation rate influences household saving – similarly to Kukk and Staehr (2017) -, long term interest rates are significant only in the case of Western European countries. It is worth highlighting that unlike most of the literature, they found that higher economic growth does not necessarily increase household saving. The papers by Andrejovská and Buleca (2016) and Buleca and Toth (2016) are the closest in scope to our examined topic. However, they studied macroeconomic determinant factors of household savings in the Visegrad countries (Czechia, Hungary, Poland and Slovakia) for a shorter time period and by applying different econometric models. They confirmed the Keynesian theory's emphasis on the importance of disposable income in household savings although they did not consider the role of interest rates in it. In summary, it can be concluded that the already existing studies have found controversial results about the macroeconomic determinant factors of household saving. Moreover, only a few studies have examined these factors in the East Central European countries. This is the research gap our study would like to fill.

The above-mentioned classical theories have some drawbacks. First, most of these studies either focus on a single country, or on a group of countries, but without comparing the developed countries with the developing ones. This suggests that the samples used are inappropriate for highlighting the differences between countries at different stages of development. For this reason, the regional panel includes a group of countries which stand at similar stages of development. Second, as national aggregate statistics compose the database, this implies that the most important element of saving comes from private saving accounts (Schmidt-Hebbel et al., 1992). This can lead to data inconsistencies emerging from the different computational methods. To avoid this, East Central European countries have been selected, which are obliged to adapt the European (ESA 10) methodology. Nevertheless, it is still necessary to check the homogeneity of the group of countries included in into a panel data analysis. If heterogeneity appeared, the model fails some underlying assumptions and can lead to biases due to the possible specifics of the countries differing from each other. To investigate the homogeneity of our sample we conducted the Specification Tests of Hsiao (1986). The test was run separately based on the two groups of variables included in the analyses. According to the test results it can be established that our panel database is homogeneous in both push and pull approaches. In other words, the current panel database does not distort the results. (See the results in the appendix.) Our dataset was mainly imported from the Eurostat database, which assumes standardised computation methods. Finally, although there is a consensus regarding the importance of explanatory variables such as income and wealth for estimating household saving, other more controversial factors such as inflation, unemployment and interest rates need to be included, too, in the analysis to be able to highlight the differences better and more accurately between the saving behaviour of households (Niculescu-Aron & Mihaescu, 2012). All the possible macroeconomic explanatory factors are included in our study to obtain a clearer and whole picture, which one can use to explain the situation of households' saving in the East Central European countries.

3. Data and methodology

The primary objective of the below econometric models detailed is to determine whether there is a long-term relationship and interactions between household saving and its determining macroeconomic factors in the East Central European countries (Czechia, Hungary, Poland, Slovakia and Slovenia). We focus on these countries due to data availability. We could not find a consensus in the literature on what the exact macroeconomic determining factors of household saving are, so we included all the possible factors based on our review of the literature (see the results of Andrejovská & Buleca, 2016; Cohn & Kolluri, 2003; Palenzuela & Dees, 2016 in the literature review). In the selection of the variables, the nature of the applied methodology was also considered with a view avoiding the problems of overparameterization and of too many equations. Thus, the most important factors determining household saving used in this analysis are unemployment rate, wages and salaries, real house prices, the share index, the deposit rate, government bonds, the consumer confidence index, and the inflation rate (see Table 2). Quarterly data are applied since this allows the possible intra-year dynamics to be revealed. Finally, the government bond variable was excluded due to its strong co-movement with the deposit rate. When conducting the analysis including government bonds as well, we obtained the same results as with the previously included variables. However, in case of an increase in the interest rates of the government bonds, saving rates were found to decline.[2]

A study of the present kind cannot be found in the existing literature. This is probably due to the availability of data. Fortunately, in the recent years more macroeconomic data are published related to each separate country, so today reliable data (data from national statistical offices, central banks, and Eurostat) can be found for all the examined countries. Our main objective was to collect reliable data from all the five countries examined for the longest period possible. For this reason, we examined the period between 2005 and 2020 by using quarterly data. As the quarterly database includes crisis periods, it was reasonable to prevail Bai-Perron breakpoint test to uncover structural breaks. The Bai-Perron test results did not indicate that these crisis quarters would have been structural breakpoints. Quarterly gross household saving rates for the household sector are calculated from the GDP and its main components (output, expenditure, and income). Consumer confidence indicators, the Harmonised Index of Consumer Prices and the official share indices are averaged to quarterly data. As a result, the final sample consisted of a balanced panel of five countries with 320 observations.

We separated the variables into two groups in line with the two mainstream economic theories: push and pull variables. Push variables are those which determine the amount of households' income left over for saving. Pull variables are determined as those factors which may attract households to saving as a possible form of investment. The consumer confidence indicator, the harmonised index of consumer prices, the unemployment rate and the level of wages and salaries are identified as push variables, while the deposit rate, real house price index and the official share index are regarded as pull variables (see Table 3).

To test the stationarity of the time series, the Levin et al. (2002) panel unit root test was applied, the null hypothesis of which assumes common unit root processes. The Im et al. (2003) and the Fisher-type ADF and PP tests were also taken into

Table 2. Descriptive statistics.

Variable	Description	Mean	Std dev.	Min.	Max.	Obs.	Data source
SAV	Gross saving rate for the household sector (% of GDP) (seasonally and calendar-adjusted data)	10.03	4.97	−0.3	29.74	320	Eurostat, in case of Slovenia and Slovakia: national statistical database
CCI	Consumer confidence indicator (seasonally adjusted data)	−14.85	12.82	−56.3	5.77	320	Eurostat
DEP	Deposit rate (% per annum) (quarterly data)	1.89	1.85	0.03	9.85	320	IMF
HCIP	Harmonised Index of Consumer Prices (%)	2.26	1.84	−1.2	8.8	320	Eurostat
HOUSE	Real House Price Index, 2015 = 100	109.21	20.58	55.06	181.7	314	Eurostat
SHARE	Official share index: main index of each stock exchange (BUX, PSE, WIG, BET, SAX, SBITOP, CROBEX)	16016.29	20345.04	186.26	63865.52	319	National Banks, Investing.com
UNEMPL	Unemployment rate (15–64, total, seasonally adjusted, %)	7.86	3.38	2.01	18.29	320	Fred
WAGE	Wages and salaries (million EUR, seasonally and calendar-adjusted data)	12884.00	10579.59	2577.9	46114.6	320	Eurostat
Additional tested variables							
GOVB	Government bond rate (% per annum, quarterly data)	3.55	2.31	−0.76	10.35	320	IMF
CA	Current account balance (% of GDP)	−1.19	4.36	−17.6	10.9	320	Eurostat

The variables were selected based on the literature review. Sample period is 2005Q1-2020Q4. The additional tested variables were finally removed from the model: government bond due to strong co-movement with deposit rate; current account balance (CA) due to limited and ambiguous effects. In case of Slovakia and Slovenia, gross saving rate was calculated based on ESA 2010 methodology, seasonally and calendar-adjusted data were computed in EViews12 software. Source: Authors' creation.

Table 3. Stationarity test and push/pull variables.

Variable	Stationarity	Push/Pull
CCI	*I(1)*	Push
DEP	*I(1)*	Pull
HICP	*I(1)*	Push
HOUSE	*I(1)*	Pull
SHARE	*I(1)*	Pull
UNEMP	*I(1)*	Push
WAGE	*I(1)*	Push
GOVB	*I(1)*	Push
CA	*I(1)*	Push

Source: Authors' creation.

account. The results of these tests indicated that all of the series are integrated of order one (*I(1)*), that is, they are stationary in the first difference. Since the applied model requires all the variables to be stationary, we used the *I(1)* variables in our analysis (see Table 3).

The analysis was built on the Vector Error Correction Model and conducted based on Cholesky ordering and impulse response functions (IRFs). These analytical items are sensitive to the ordering of the variables; therefore, it was crucial to define the logical order properly. For push variables, we assumed that as the consumer confidence index changes, it can positively affect inflation rate, which may result in increasing wage claim. Higher wages are considered likely to ruin employment. Concerning the pull factors, the most logical order in the impact chain is suggested to start with house prices, then followed by share prices mirroring the trends in deposit rate.

4. Model creation

The empirical part of paper is based on the Vector Error Correction Model (VECM). In general, the model is built on the first differences between cointegrated *I(1)* variables and the lags of these variables, and the model also contains an error correction term. The VECM is a representation of the cointegrated Vector Autoregression (VAR) model which can be described by the following formula:

$$\mathrm{d}y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{p} \Gamma_i^* \mathrm{d}y_{t-1} + \varepsilon_t \tag{1}$$

where: y_t is an $\mathrm{m} \times 1$ vector of variables that are similar to a VAR, μ is an $\mathrm{m} \times 1$ vector of intercept coefficients. The dy_t is an $\mathrm{m} \times 1$ vector of the first differentiated variables in y_t; Π and Γ_i^* are m×m coefficient matrices and ε_t is an $\mathrm{m} \times 1$ error vector with contemporaneous correlation but no autocorrelation (Kilian & Lütkepohl, 2017).

The VECM establishes a relational model between economic variables and can be used to analyse the interactions between the involved variables. Each variable is expressed as an equation which contains all the other variables and their lags, including its own lagged values. If there is a change in one variable, the system adjusts towards long run equilibrium. The speed of the adjustment towards long run equilibrium is indicated by the error correction term.

To estimate a VECM one needs to determine the number of cointegrating relationships. By fixing that number we can restrict certain coefficients of the VAR model, meaning that the VECM representation can have more efficient estimates of the coefficients. As Dwyer

(2015) points out, if there are more than two variables, each with unit roots, there are at most *n-1* cointegrating vectors.

Engle and Granger (1987) established that two or more non-stationary series can have a linear combination which may be stationary. In this case, the time series is said to be cointegrated. The cointegrating equation, which is the stationary linear combination of the variables, assumes a long run equilibrium relationship among the variables. Johansen and Juselius (1990) cointegration approach is widely used to estimate the long run relationship and co-movement between variables. The test is used to determine the number of '*r*' cointegrating vectors in a set of a series and is based on two maximum likelihood ratio test statistics: namely the trace statistic and the maximum eigenvalue statistic. These tests can also provide estimates of the vectors together with estimates of the adjustment parameters. The trace statistic tests the null hypothesis of *r* cointegrating vectors against the alternative of k cointegrating relations. The latter means that none of the series are non-stationary, and a stationary VAR can be created in terms of the levels of all of the series. On the other hand, the maximum eigenvalue statistic tests the null hypothesis of *r* cointegrating vectors against $r + 1$ cointegrating vectors. In some cases, the trace statistic and the maximum eigenvalue statistic can have conflicting results (for more on this see Johansen & Juselius, 1990). In our analysis we rely on the Johansen Fisher Combined panel cointegration test. The test is an alternative approach that was proposed by Maddala and Wu (1999), and which combines tests from individual cross-sections to obtain test statistics for the entire panel. The null hypothesis of the Johansen Fisher test is that there is no cointegration. Table 4 indicates the summary of the results of the cointegration test and the normalised vectors for push variables. In more detail, the maximum eigenvalue test considers, if the largest eigenvalue is zero, where the alternative is that the next largest eigenvalue is zero (Asteriou & Hall, 2021). The test is based on a sequence of tests to determine the rank of the matrix. If the null hypothesis of the first test is rejected, we have to move on to the next step. If the null hypothesis cannot be rejected, there is no need to take any more tests into account. No cointegration exist and no more tests need to be done if the rank of the matrix is zero and accordingly the largest eigenvalue is zero (Dwyer, 2015).

To determine the number of cointegrating relations, *r*, subject to the assumptions made about the trends in the series, the process can proceed sequentially from $r = 0$ to $r=k-1$ to a total number of four cointegration equations. The first row of Table 4 tests the hypothesis of no cointegration while the second row tests the hypothesis of one cointegrating relation and the third row tests the hypothesis of two cointegrating relationship and so on. They are tested against the alternative hypotheses of full rank, that is, all series

Table 4. Johansen Fisher test for cointegration for push variables.

Trace test			Maximum eigenvalue test		
Null hypothesis	Alternative hypothesis	Test statistics	Null hypothesis	Alternative hypothesis	Test statistics
$r = 0$	$r \geq 1$	55.13*	$r = 0$	$r = 1$	29.15*
$r = 1$	$r \geq 2$	31.20*	$r = 1$	$r = 2$	22.46*
$r = 2$	$r \geq 3$	15.58	$r = 2$	$r = 3$	13.64
$r = 3$	$r \geq 4$	8.217	$r = 3$	$r = 4$	8.084
$r = 4$	$r \geq 5$	9.247	$r = 4$	$r = 5$	9.247

'*r*' stands for the number of cointegrating vectors. * Denotes rejection of the hypothesis at the 0.05 level. Source: Authors' estimation.

are stationary. The trace test indicates that the null hypothesis of no cointegration ($r = 0$) is rejected at a significance level of 5% when tested against the alternative hypothesis of one cointegrating vector ($r \geq 1$). This means that we have to move on to the next test. The null hypothesis of one cointegrating vector ($r = 1$) is again rejected based on the trace test but cannot be rejected according to the maximum eigenvalue test at a significance level of 5% (only at 10%). The null hypothesis of two cointegrating vectors ($r = 2$) cannot be rejected according to any of the tests. The trace and the maximum eigenvalue statistics yield different results although if we allow a 10% significance level, we can decide on two cointegrating equations. Based on the above conclusions, the next step is to use the VECM model instead of VAR in the case of push variables.

Regarding our pull variables, cointegration tests were also run (Table 5). The process proceeded sequentially until the total number of variables minus one, as in the previous case. Both trace test and the maximum eigenvalue test indicate the presence of two cointegrating equations at the 5% level for the household saving model. As it has been established that cointegration exists amongst our variables the next step is to use the VECM and not VAR also in the case of pull variables.

According to the VAR Lag Order Selection Criteria tests the optimal number of lags is 4. This decision was made based on the Schwarz and the Hannan-Quinn information criteria. When applying VECM we have to follow the *p-1* lag selection because VECM rewrites the VAR by differencing and loses one lag. Therefore, in the case of the push variables we set the lag number at 3. Regarding the pull variables, the selected lag number is 5 based on the same considerations.

Given that in the model everything affects everything else and in all equations the lags of each variable appear, the Γ_i^* m×m coefficient matrices (see equation 1) are difficult to interpret, especially if more variables are included in the model. Therefore, the interpretation of the coefficients is usually based on IRFs. The IRFs measure the effect of a one unit (usually one standard deviation) shock in variable *j* on variable *k, t* periods ahead. In other words, the impulse response functions show the effect of a shock to an endogenous variable on itself and on other endogenous variables. Our analyses are conducted based on Cholesky ordering. Since the IRFs are sensitive to the ordering of the variables, the model requires a well-defined logical ordering in which the most exogenous variable has to be placed in the last place. Therefore, in the case of push variables our logical order is the following: we put the consumer confidence index (CCI) in the first place. As the CCI changes, it can have an impact on consumers' behaviour, which influences the general price level. Hence the HICP is put in second place. Due to higher prices,

Table 5. Johansen Fisher test for cointegration for pull variables.

Trace test			Maximum eigenvalue test		
Null hypothesis	Alternative hypothesis	Test statistics	Null hypothesis	Alternative hypothesis	Test statistics
$r = 0$	$r \geq 1$	77.69*	$r = 0$	$r = 1$	56.80*
$r = 1$	$r \geq 2$	32.25*	$r = 1$	$r = 2$	24.67*
$r = 2$	$r \geq 3$	16.65*	$r = 2$	$r = 3$	18.84*
$r = 3$	$r \geq 4$	4.173	$r = 3$	$r = 4$	4.173

'*r*' stands for the number of cointegrating vectors. * Denotes rejection of the hypothesis at the 0.05 level. Source: Authors' estimation.

employees demand higher wages, but higher wages can, supposedly, result in a lower level of employment. Ultimately, this may affect saving.

In the case of pull variables, the basis of our considerations was that, according to the continental model, households are less likely to invest in shares than to deposit their money into an interest-bearing account or buy government bonds. Investing in real estates is also popular in the examined countries. Therefore, the ordering of the pull factors is the following: first, the deposit rate can change mostly due to some economic policy measures. Based on the information that the interest rates carry, house prices and then share prices also start moving. The development in these factors attracts saving, which variable is put in the last place.

In case of the push variables the VECM model with the two cointegrating vectors can be established the following way:

$$\Pi y_{t-1} = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \\ \alpha_{41} & \alpha_{42} \\ \alpha_{51} & \alpha_{52} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{21} & \beta_{31} & \beta_{41} & \beta_{51} \\ \beta_{12} & \beta_{22} & \beta_{32} & \beta_{42} & \beta_{52} \end{bmatrix} \begin{bmatrix} Y_{1,t-1} \\ Y_{2,t-1} \\ Y_{3,t-1} \\ Y_{4,t-1} \\ Y_{5,t-1} \end{bmatrix} = \begin{bmatrix} a_{11}ec_{1,t-1} + a_{12}ec_{2,t-1} \\ a_{21}ec_{1,t-1} + a_{22}ec_{2,t-1} \\ a_{31}ec_{1,t-1} + a_{32}ec_{2,t-1} \\ a_{41}ec_{1,t-1} + a_{32}ec_{2,t-1} \\ a_{51}ec_{1,t-1} + a_{52}ec_{2,t-1} \end{bmatrix} \tag{2}$$

where α-s are elements of the adjustment speed matrix and β-s are elements of the cointegrating vector matrix.

$$\Pi y_{t-1} = \begin{bmatrix} -0.655 & -0.003 \\ -93.66 & -0.521 \\ -0.014 & -0.001 \\ -0.064 & 0.001 \\ -0.076 & -0.001 \end{bmatrix} \begin{bmatrix} 1 & 0 & 4.57 & 12.17 & 2.26 \\ 0 & 1 & -43.45 & -1960.10 & -138.88 \end{bmatrix} \begin{bmatrix} D(CCI_{t-1}) \\ D(WAGES_{t-1}) \\ D(UNEMP_{t-1}) \\ D(HICP_{t-1}) \\ D(SAV_{t-1}) \end{bmatrix}$$
$$= \begin{bmatrix} -0.655ec_{1,t-1} - 0.003ec_{2,t-1} \\ -93.66ec_{1,t-1} - 0.521ec_{2,t-1} \\ -0.014ec_{1,t-1} - 0.001ec_{2,t-1} \\ -0.064ec_{1,t-1} + 0.001ec_{2,t-1} \\ -0.076ec_{1,t-1} - 0.001ec_{2,t-1} \end{bmatrix} \tag{3}$$

where

$$ec_{1,t-1} = D(CCI_{t-1}) + 4.57 * D(UNEMP_{t-1}) + 12.17 * D(HICP_{t-1}) + 2.26 * D(SAV_{t-1}) + c) \tag{4}$$

$$ec_{2,t-1} = D(WAGES_{t-1}) - 43.45 * D(UNEMP_{t-1}) - 1960.10 * D(HICP_{t-1}) - 138.88 * D(SAV_{t-1}) + c) \tag{5}$$

where c is the intercept.

Extending the equations with the regressors of the short run coefficients, we get the specification of the vector error correction model by determining the equations of each variable included in the model.

$$\begin{aligned} CCI = & -0.655ec_{1,t-1} + 0.494 - 0.003ec_{2,t-1} - 165.7 - 0.175 * D(CCI_{t-1}) + 0.003 \\ & * D(CCI_{t-2}) - 0.105 * D(CCI_{t-3}) + 0.003 * D(WAGES_{t-1}) + 0.002 \\ & * D(WAGES_{t-2}) + 0.001 * D(WAGES_{t-3}) + 2.348 * D(UNEMP_{t-1}) \\ & + 1.999 * D(UNEMP_{t-2}) + 0.565 * D(UNEMP_{t-3}) - 0.011 * D(HICP_{t-1}) \\ & + 0.749 * D(HICP_{t-2}) - 0.087 * D(HICP_{t-3}) + 0.643 * D(SAV_{t-1}) \\ & + 0.147 * D(SAV_{t-1}) + 0.177 * D(SAV_{t-3}), 2) - 0.082 \end{aligned} \tag{6}$$

$$\begin{aligned} WAGES = & -93.66ec_{1,t-1} + 0.494 - 0.521ec_{2,t-1} - 165.7 + 49.873D(CCI_{t-1}) + \\ & 38.585 * D(CCI_{t-2}) + 13.528 * D(CCI_{t-3}) - 0.028 * D(WAGES_{t-1}) - 0.159 * \\ & D(WAGES_{t-2}) + 0.041 * D((WAGES_{t-3}) + 127.316 * D(UNEMP_{t-1}) + 56.901 * \\ & D(UNEMP_{t-2}) - 3.738 * D(UNEMP_{t-3}) + 124.405 * D(HICP_{t-1}) + 145.957 * \\ & D(HICP_{t-2}) + 91.951 * D(HICP_{t-3}) + 123.897 * D((SAV_{t-1}) + 92.807 * D((SAV_{t-2}) \\ & + 44.663 * D((SAV_{t-3}), 2) + 5.603 \end{aligned} \tag{7}$$

The model built on the pull variables, with three cointegrating equations is set up in the following way:

$$\begin{aligned} \Pi y_{t-1} &= \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \\ \alpha_{41} & \alpha_{42} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{21} & \beta_{31} & \beta_{41} \\ \beta_{12} & \beta_{22} & \beta_{32} & \beta_{42} \\ \beta_{13} & \beta_{23} & \beta_{33} & \beta_{43} \end{bmatrix} \begin{bmatrix} Y_{1,t-1} \\ Y_{2,t-1} \\ Y_{3,t-1} \\ Y_{4,t-1} \end{bmatrix} \\ &= \begin{bmatrix} a_{11}ec_{1,t-1} + a_{12}ec_{2,t-1} + a_{13}ec_{3,t-1} \\ a_{21}ec_{1,t-1} + a_{22}ec_{2,t-1} + a_{23}ec_{3,t-1} \\ a_{31}ec_{1,t-1} + a_{32}ec_{2,t-1} + a_{33}ec_{3,t-1} \\ a_{41}ec_{1,t-1} + a_{32}ec_{2,t-1} + a_{34}ec_{3,t-1} \end{bmatrix} \end{aligned} \tag{8}$$

where α-s are elements of the adjustment speed matrix and β-s are elements of the cointegrating vector matrix.

$$\begin{aligned} \Pi y_{t-1} &= \begin{bmatrix} -0.884 & 0.016 & -5.07E^{-6} \\ -1.285 & -0.216 & -5.97E^{-6} \\ -615.2 & -29.66 & -0.921 \\ -0.022 & 0.311 & -0.001 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & -0.006 \\ 0 & 1 & 0 & -6.456 \\ 0 & 0 & 1 & -400.2 \end{bmatrix} \begin{bmatrix} D(DEP_{t-1}) \\ D(HOUSE_{t-1}) \\ D(SHARE_{t-1}) \\ D(SAV_{t-1}) \end{bmatrix} \\ &= \begin{bmatrix} -0.884ec_{1,t-1} + 0.016ec_{2,t-1} - 5.07E^{-6}ec_{3,t-1} \\ -1.285ec_{1,t-1} - 0.216ec_{2,t-1} - 5.97E^{-6}ec_{3,t-1} \\ -615.2ec_{1,t-1} - 29.66ec_{2,t-1} - -0.921ec_{3,t-1} \\ -0.022ec_{1,t-1} + 0.3111ec_{2,t-1} - -0.001ec_{3,t-1} \end{bmatrix} \end{aligned} \tag{9}$$

where

$$ec_{1,t-1} = D(DEP_{t-1}) - 0.006 * D(SAV_{t-1}) + c) \tag{10}$$

$$ec_{2,t-1} = D(HOUSE_{t-1}) - 6.456 * D(SAV_{t-1}) + c) \tag{11}$$

where c is the intercept.

Extending the equations with the regressors of the short run coefficients, we get the specification of the vector error correction model by determining the equations of each variable included in the model.

$$\begin{aligned} D(DEP) = & -0.884ec_{1,t-1} + 0.068 + 0.016ec_{2,t-1} - 0.485 - 5.07E^{-6}ec_{3,t-1} - 45.22 \\ & + 0.224{*}D(DEP_{t-1} + 0.253{*}D(DEP_{t-2}) + 0.186{*}D(DEP_{t-3}) + 0.125{*}D(DEP_{t-4}) \\ & + 0.100{*}D(DEP_{t-5}) - 0.005{*}D(HOUSE_{t-1}) + 0.004{*}D(HOUSE_{t-2}) \\ & - 0.010{*}D(HOUSE_{t-3)}) - 0.001{*}D(HOUSE_{t-4}) - 0.007{*}D(HOUSE_{t-5}) - 8.991e \\ & - 06{*}D(SHARE_{t-1}) - 1.832e - 06{*}D(SHARE_{t-2}) - 1.528e - 05{*}D(SHARE_{t-3}) \\ & - 1.608e - 05{*}D(SHARE_{t-4}) - 9.177e - 06{*}D(SHARE_{t-5}) + 0.060{*}D(SAV_{t-1}) \\ & + 0.041{*}D(SAV_{t-2}) + 0.009{*}D(SAV_{t-3}) + 0.006{*}D(SAV_{t-4}) + 0.003{*}D(SAV_{t-5}) \\ & - 0.002 \end{aligned} \tag{12}$$

5. Results

The paper examined determinants of household saving and applied vector error correction (VEC) models. The novelty of the study is that it distinguished between push and pull factors of household saving based on the two mainstream (neoclassical and Keynesian) theories. Moreover, it examined these in relation to the East Central European countries, over the long term. Push variables were linked to the Keynesian approach and determined the amount of households' income left for saving (consumer confidence index, inflation rate and unemployment rate). Pull variables represented the neoclassical theory, which can motivate households to choose saving as a possible form of investment instead of other forms (such factors are reflected by the deposit rate, real house prices and the total share price). Moreover, our results support the Keynesian theory, as irrational behaviour in times of high uncertainty (Keynes, 1936; mentioned in part 2). From another perspective, the results of our study are in line with the neoclassical theory: an increase in the deposit interest rate has a positive effect on household saving with a certain time lag. This suggests that if the interest rate is higher, the households will save more for future consumption instead of present expenditures. The results of this paper additionally support Fisher's theory: if households' confidence improves, they save less from a constant disposable income (Fisher, 1930; chapter 8 and 18).

5.1. Push factors

During the interpretation of the VEC model we relied on IRFs. Those impulse responses are introduced, which show how household saving reacted to the shock of determining push factors. It is important to note that IRFs are symmetrical, which means that in case of linear estimation we can interpret both positive and negative shocks. These are independent of time and are proportional to the shock.

The general formula for the IRF considering the lag structure is the following:

$$IRF_{ij}(t) = \beta_i a_j \sum_{s=0}^{t-1} (\Gamma_j \beta_j' \alpha_i^s + \sum_{i=1}^{p-1} \Gamma_i \beta_i' \alpha_j^{s-i} \tag{13}$$

where $IRF_{ij}(t)$ is the impulse response of variable Y_i to a shock in variable Y_j at time t, $\beta_i$is the i-th row of the cointegrating vector matrix β, α_j is the j-th column of the adjustment

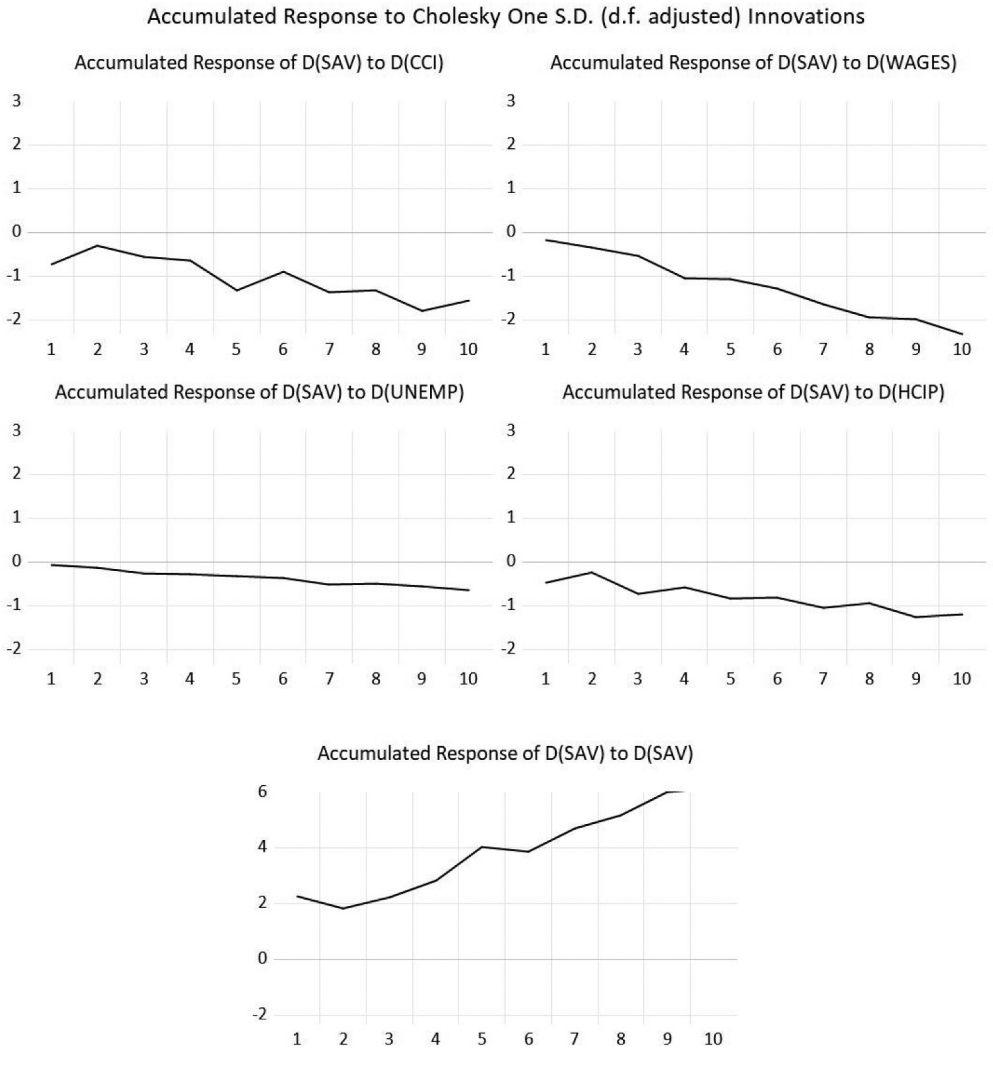

Figure 1. Impulse responses to push factors. Source: Authors' estimation.

speed matrix α, α_i^s represents the i-th i-th row of the matrix α raised to the power of s. Γ_i are the coefficient matrices corresponding to lag i.

Figure 1 shows that in response to a positive shock in the consumer confidence index, household saving rates decrease over time. The cumulative negative effect is present over the entire period examined. The decrease in household saving in the examined countries is consistent with Fisher's theory: as households' consumption increases, they save less from their incomes (if we assume that their incomes have not changed). As confidence grows, people tend to worry less about their current and future financial situation, so they are more likely to spend more money instead of saving it.[3]

In response to a positive shock in wages, the decrease in saving rates is especially strong. This can be explained by lower wages and standard of livings in East Central European countries compared to Western European economies. Saving rates decrease

over time and the total cumulative effect of the decline is felt in 2 years, after which the decrease becomes smaller but only for a short period of time. This may be explained by the fact that as people managed to achieve a higher standard of living due to higher consumption, at a certain point they are more likely to put a somewhat higher emphasis on their saving. The overall results are in line with this theoretical prediction: as people earn more and their income increases, the demand for consumption increases, thus the saving rate is likely to drop.

Our results also show that in response to a shock in the unemployment rate, the accumulated decline of saving increases over time. This suggests that as the unemployment rate increases the disposable of income of households starts to decline, as a result of which they are less able to save. Individuals or households would thus spend a higher proportion of their income on consumption or on debt repayment. On the other hand, it seems that the response of household saving rates to changes in consumer prices is also negative. This suggests that due to the higher prices, people tend to spend more and bring their purchases forward since their saving can be eroded in such an economic environment. This is also in line with the theory that a moderate level of inflation is good for the economy since it enhances consumption and thus economic growth. The estimates show that a substantial cumulative effect on household saving exists; if households have saving, they will increase them in the future.

These responses of consumption, wages and unemployment are consistent with the classical theories. If households consume more, they can save less. Moreover, in the case of an increase in wages, households bring their consumption ahead of time and save less. If the unemployment rate rises, households' saving decreases, although they may be keen to save and thus, if they can, they increase their saving. If we make some changes in the Cholesky ordering, the impulse response functions indicate only slightly different results, what demonstrates the robustness of our model.

Considering the literature, data on current account balances (CA) can be also considered as a relevant factor in identifying saving patterns. Therefore, we made additional examinations and extended our model to test whether we can identify any changes in our previous conclusions if current account balances are also included in the model.[4] The results reflected that, besides three cointegrating equations and two lags, our findings still hold. Regarding the impulse response of saving to CA we can conclude that the effects are very limited and also ambiguous. The cumulative effects fluctuate around zero, so wider conclusions cannot be drawn from them.

In each case of the push variables, a relative stable and steady unidirectional change is observable without significant deviations. This phenomenon may prove a delay effect. In other words, if there is an economic shock, a significant rearrangement in the saving happens merely after some time unit. Therefore, if the policy makers intend to stimulate the saving, they must expect a delay. This is a behavioural phenomenon.

5.2. Pull factors

The second part of our analysis focuses on the examination of the interactions between the pull factors. After establishing the cointegrating relationship between pull factors, the VECM was estimated to capture the short-term adjustments to the equilibrium (see Figure 1 and 2).

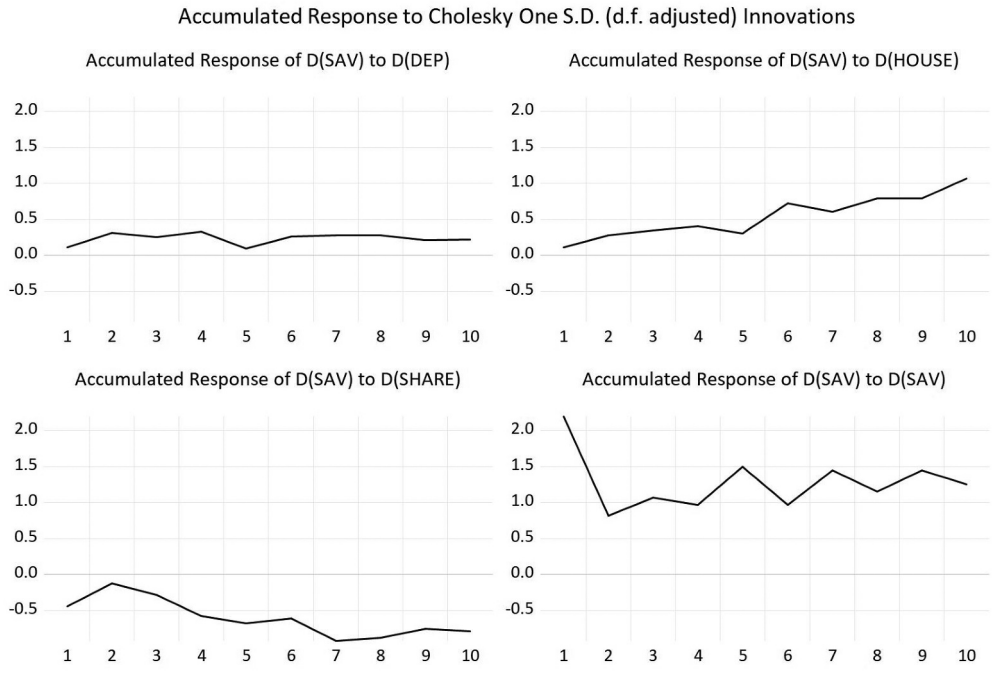

Figure 2. Impulse responses to pull factors: version 1 (lag 5 based on previous tests). Source: Authors' estimation.

The results of impulse response analysis show that household saving responds immediately to a positive impulse in real house prices in a positive way: households increase their saving if the price of real estate increases. A possible explanation for this can be that the proportion of privately owned and owner-occupied housing in East Central European countries is historically very high (Egert & Mihaljek, 2007). The effects are seen to be higher after approximately one year. This may indicate that home buying decisions are not taken immediately.

The direct response of household saving to the deposit rate is positive after a certain time lag, which indicates that an increase in the deposit rate has a positive effect on household saving. This reflects the fact that instead of current consumption, in such situations households will save for future consumption. This effect is not immediate and an increase in the deposit rate initially leads to decreases in household saving. Another reason for this may be that changes in interest rates usually exert their effect only with a time lag because of the characteristics of the normal monetary transmission mechanisms.

On the other hand, the accumulated responses of household saving to share prices are controversial, which reflects the volatility of share prices. Share prices usually increase in a favourable economic environment which is usually shown by higher consumer confidence indices. These results are in this respect in line with those for the push variables. On the other hand, equity investments in the examined countries are not as common as some other forms of saving (Cupák et al., 2021). Similarly, for the analysis of the push variables, if we change the Cholesky ordering

we obtain similar (not significantly different) results, what confirms the robustness of our model.

In case of the pull variables, similarly to the push factors there are no significant deviations in either direction. The lagging effect holds, too, which must be expected by the government when it intends to affect saving.

6. Conclusions and discussion

The novel conclusion of this study is that the impact of push factors partly contradicts the Keynesian theory, as a regional specific behaviour traceable to the development path and socio-cultural characteristics. The non-Keynesian behaviour is that as people earn more and their income increases in East Central Europe, the demand for consumption increases, thus the saving rate is likely to drop. The social-economic explanations can be numerous. First, the average income is lower in East Central European countries than in Western European economies which latter ones have a demonstration effect on formers' consumption (Cao-Pinna & Shatalin, 1979, pp. 172–184; Schuh, 2000). Thus, an increase in income will be resulted rather in increased demand for consumption than higher saving rate. Second, the financial literacy is lower in this region than in Western Europe in the sense of sophisticated individual strategy on investment portfolio, which can stem from impacts of difference in historic experiences of the market economy and its financial markets (Cupák et al., 2021).

Related to pull factors, increases in real house prices and interest rates lead to increases in household saving, while in case of share prices the impact is not evident. This can be explained by the composition of household saving and people's behaviour in the East Central European countries compared to Western Europe. People traditionally own their home instead of renting (Egert & Mihaljek, 2007). That is why their saving portfolio is less diversified than in Western Europe. Moreover, lower activity in capital market savings can be observed in this region compared to higher income countries because of previous crises and mistrust in banks and financial institutions (Beckmann, 2019). This phenomenon is related to the historical fact that post-communist past and economic transition limited the capital market experience in the analysed region. That is why Eastern consumers' saving behaviour can differ from Western countries. Overall, we have to reject the part of hypothesis regarding the linkage between household income and saving. Namely, due to regional characteristics, increase in income did not lead to expansion in household saving and, besides, the impact of share prices was not evident.

The current results related to the literature review are ambiguous in as much as the literature is also ambiguous. For instance, our results proved that the unemployment rate significantly and negatively affects households' saving, while Kukk and Staehr (2017) or Kolasa and Liberda (2015) found it to be insignificant. The results related to the inflation rate also contradict some of the theories; while we have found it significant that saving is affected negatively due to higher prices, most of the literature (including Andrejovská & Buleca, 2016; Buleca & Toth, 2016; Schmidt-Hebbel et al., 1992) found it to be insignificant. These outcomes support the New Keynesian model. This states that the higher the inflation expectations are the more the consumption boosts and, thus, the lower the households' saving is.

The results of this study may be readily applicable for forecasting and economic policy purposes. They allow analysts to predict how household saving can change in an environment where high inflation and high uncertainty dominate in a region and indicate what monetary policies can do to balance these negative effects on saving. Based on our findings, the most important economic policy recommendations are to keep the unemployment rate levels low and to reduce economic uncertainty to avoid the decrease in household saving in the examined countries. Our results support the increase in interest rates to fight against high inflation rates and to keep households' purchasing power. Finally, our results suggest that there is a necessity to diversify households' financial assets to reduce the risk of households' welfare loss in a case of an aggregate shock. The conclusion is important for the economic resilience research, too, as this knowledge helps for proactive policy making and preparation for recessions.

The main limitations of the research are related to data availability and model specification. Due to Regulation (EU) No 549/2013, most of Central and Eastern European countries do not have to measure and publish quarterly household saving data, which limited the number of the countries which could be included to the analysis. Moreover, since household saving and wages data were calculated and imported from different national statistics, using the econometric models (for instance OLS or ECM) widespread in the empirical literature, did not result in reliable outcome with acceptable statistical significance. However, the applied VECM methodology is suitable to test our hypothesis and revealed linkages between household saving and its determinant factors. Nevertheless, the VECM parameters are linear, which assumes constant parameters as another limitation, since database includes the crises years of 2008 and 2020. The linearity can limit the results (Hassouneh et al., 2012).

In terms of areas for future research, it may be worth analysing micro data on household saving in these countries and discuss how they relate to their macro-economic aggregate. Another such possibility would be to investigate whether the determinant factors are different in these countries than in the European Union as a whole or in the other countries of euro zone. During data collection we found that the methodology of data collection differs in the various countries examined. A further research direction would be to explore the impact of ESA 2010 as its objective was to improve data collection methodologies and further harmonise the national accounts. Another future research direction is to examine behavioural patterns and polarisation of household saving to determine the effects of household saving on economic growth as Kosny (2013) carried out in case of Poland. Finally, a dynamic analysis of household saving in EU countries could help to better understand the short-term impact of a crisis on household saving (for example more in-depth analysis of the housing market bubble and Covid-19).

Notes

1. Although the study focuses on macroeconomic determinants, there are numerous studies, which examines household saving from a microeconomic point of view by analysing household saving, see for instance Davutyan and Özturkkal (2016), Denizer et al. (2000), Kong and Dickinson (2016), Kosny (2020), Nwosu et al. (2020), or Pan and Wu (2020).

2. This suggest that bond interest rates do not positively affect household saving. The underlying explanation can be that in case of increasing government bond risk premiums may be higher or economic environment is unfavourable, so people do not have the opportunity to save.
3. This is also consistent with the Keynesian animal spirit theory (Keynes, 1936, chapter 12)
4. Our baseline model does not involve CA to avoid the overparameterisation problem, so we focused only the most relevant considered factors.

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Data availability statement

The data that support the findings of this study are openly available in figshare at https://doi.org/10.6084/m9.figshare.24486385.v1.

References

Aizenman, J., Yin-Wong, C., & Ito, H. (2016). *The interest rate effect on private saving: Alternative perspectives*. NBER Working Paper No. 22872. National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w22872/w22872.pdf10.3386/w22872

Akram, N., & Akram, M. I. (2016). Macro and socioeconomic determinants of savings in Pakistan. *Pakistan Business Review*, *2016*(July), 325–342.

Andrejovská, A., & Buleca, J. (2016). Regression analysis of factors influencing volume of households' savings in the V4 countries. *Mediterranean Journal of Social Sciences*, *7*(1), 213–222. https://doi.org/10.5901/mjss.2016.v7n1p213

Asteriou, D., & Hall, S. T. (2021). *Applied econometrics*. Macmillan Education.

Baiardi, D., Magnani, M., & Menegatti, M. (2020). The theory of precautionary saving: An overview of recent developments. *Review of Economics of the Household*, *18*(2), 513–542. https://doi.org/10.1007/s11150-019-09460-3

Basselier, R., & Minne, G. (2021). *Household saving during and after the COVID-19 crisis: Lessons from surveys. (economic Review, issue 3 (December))*. National Bank of Belgium.

Beckmann, E. (2019). *Household savings in Central and Southeastern Europe: How do poorer households save?*. Policy Research Working Paper 8751. World Bank, Europe and Central Asia Region. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3338188#

Benczes, I. (2008). *Trimming the sails. The comparative political economy of expansionary fiscal consolidations. A Hungarian perspective*. CEU Press.

Buleca, J., & Toth, P. (2016). Panel analysis of the influence of macroeconomic factors on the household savings. *Journal of Applied Economic Sciences*, *11*(5), 795–803.

Callen, T., & Thimann, C. (1997). *Empirical determinants of household saving: Evidence from OECD countries*. IMF Working Paper WP/97/181. International Monetary Fund, Asia and Pacific Department. https://www.imf.org/external/pubs/ft/wp/wp97181.pdf

Campbell, J. Y., & Mankiw, G. N. (1989). Consumption, income, and interest rates: Reinterpreting the time series evidence. *NBER Macroeconomics Annual*, *1989*(4), 185–216. https://doi.org/10.1086/654107

Cao-Pinna, V., & Shatalin, S. S. (1979). *Consumption patterns in Eastern and Western Europe. An economic comparative approach, a collective study*. Pergamon Press.

Carroll, C. D., & Summers, L. H. (1991). *Consumption growth parallels income growth: Some new evidence*. NBER Working Paper Series No. 3090. National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w3090/w3090.pdf103386/w3090

Cohn, R. A., & Kolluri, B. R. (2003). Determinants of household saving in the G-7 countries: Recent evidence. *Applied Economics*, *35*(10), 1199–1208. https://doi.org/10.1080/0003684032000090645

Crespo Cuaresma, J., Fidrmuc, J., & Hake, M. (2014). Demand and supply drivers of foreign currency loans in CEECs: A meta-analysis. *Economic Systems*, *38*(1), 26–42. https://doi.org/10.1016/j.ecosys.2013.09.001

Cupák, A., Fessler, P., Silgoner, M., & Ulbrich, E. (2021). Exploring differences in financial literacy across countries: The role of individual characteristics and institutions. *Social Indicators Research*, *158*(2), 409–438. https://doi.org/10.1007/s11205-021-02713-8

Davutyan, N., & Özturkkal, B. (2016). Determinants of saving-borrowing decisions and financial inclusion in a high middle-income country: The Turkish case. *Emerging Markets Finance and Trade*, *52*(11), 2512–2529. https://doi.org/10.1080/1540496X.2016.1187596

Deaton, A. S. (2005). Franco Modigliani and the life cycle theory of consumption. *SSRN Electric Journal*, *2005*(March), 1–22. https://doi.org/10.2139/ssrn.686475

Denizer, C., Wolf, H. C., & Ying, Y. (2000). *Household savings in transition economies*. World Bank Policy Research Paper WPS 2299 March, 2000. World Bank. https://doi.org/10.1596/1813-9450-2299

Dossche, M., Krustev, G., & Zlatanos, S. (2021). *Covid-19 and the increase in household savings: An update* (Economic Bulletin Boxes, Issue 5). European Central Bank.

Duesenberry, J. S. (1949). *Income, saving, and the theory of consumer behavior*. Harvard University Press.

Dwyer, G. P. (2015, March 31). *The Johansen Test for Cointegration*. Jerry Dwyer. http://www.jerrydwyer.com/pdf/Clemson/Cointegration.pdf

Egert, B., & Mihaljek, B. (2007). Determinants of house prices in Central and Eastern Europe. *Comparative Economic Studies*, *49*(3), 368–388. https://doi.org/10.1057/palgrave.ces.8100221

Elekes, A., & Halmai, P. (2013). Growth model of the new member states: Challenges and prospects. *Intereconomics: Review of European Economic Policy*, *48*(2), 124–130. https://doi.org/10.1007/s10272-013-0453-z

Engle, R. F., & Granger, C. J. (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica*, *55*(2), 251–76. https://doi.org/10.2307/1913236

Ercolani, V., Guglielminetti, E., & Rondinelli, C. (2021, June 14). *Fears for the Future: Saving Dynamics After the COVID-19 Outbreak*. Banca d'Italia Note. https://www.fiscooggi.it/sites/default/files/file/2021/06/Note_saving_EGR_14giugno2021.pdf

Feldstein, M., & Horioka, C. (1980). Domestic saving and international capital flows. *The Economic Journal*, *90*(358), 314–329. https://doi.org/10.2307/2231790

Fidrmuc, J., Hake, M., & Stix, H. (2013). Households' foreign currency borrowing in central and Eastern Europe. *Journal of Banking & Finance*, *37*(6), 1880–1897. https://doi.org/10.1016/j.jbankfin.2012.06.018

Fisher, I. (1930). *The theory of interest*. The Macmillan Company.

Friedman, M. (1957). *A theory of the consumption function*. Princeton University Press.

Gur, H. T., Erden, L., & Ozkan, I. (2011). An empirical investigation on the determinants of the saving-investment interaction. *Panoeconomicus*, *58*(3), 343–353. https://doi.org/10.2298/PAN1103343G

Hassouneh, I., von Cramon-Taubadel, S., Serra, T., & Gil, J. M. (2012). *Recent developments in the econometric analysis of price transmission*. Transparency of Food Pricing Working Paper 2. TRANSFOP.

Hicks, J. R. (1950). *A contribution to the theory of the trade cycle*. Oxford University Press.

Horioka, C. Y., & Wan, J. (2007). The determinants of household saving in China: A dynamic panel analysis of provincial data. *Journal of Money, Credit & Banking*, *39*(8), 1–20. https://doi.org/10.1111/j.1538-4616.2007.00099.x

Hsiao, C. (1986). *Analysis of panel data*. Econometric society monographs, No. 11. Cambridge University Press.

Im, K. S., Pesaran, M., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, *115*(1), 53–74. https://doi.org/10.1016/S0304-4076(03)00092-7

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inferences on cointegration - with applications to the demand for money. *Oxford Bulletin of Economics and Statistics*, *52*(2), 169–210. https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

Kapounek, S., Korab, P., & Deltuvaite, V. (2016). (Ir)rational households' saving behavior? An empirical investigation. *Procedia Economics and Finance*, *39*(1), 625–633. https://doi.org/10.1016/s2212-5671(16)30309-4

Keynes, J. M. (1936). *The general theory of employment, interest and money*. Macmillan.

Kilian, L., & Lütkepohl, H. (2017). Vector error correction models. In H. Lütkepohl (Ed.), *Structural vector autoregressive analysis* (pp. 75–108). Cambridge University Press. https://doi.org/10.1017/9781108164818.004

Kolasa, A., & Liberda, B. (2015). Determinants of savings in Poland: Are they different from those in other OECD countries? *Eastern European Economics*, *53*(2), 124–148. https://doi.org/10.1080/00128775.2015.1033276

Kong, D., & Dickinson, D. (2016). Investigating the impact of income on savings using a Chinese household level dataset. *Emerging Markets Finance & Trade*, *52*(8), 1775–1796. https://doi.org/10.1080/1540496X.2016.1181889

Kosny, M. (2013). Economic activity, saving, credit and income polarisation in Poland. *Post-Communist Economies*, *25*(4), 512–528. https://doi.org/10.1080/14631377.2013.844931

Kosny, M. (2020). Economic resourcefulness as a determinant of saving and borrowing in Poland. *Post-Communist Economies*, *32*(6), 793–812. https://doi.org/10.1080/14631377.2020.1727264

Kukk, M., & Staehr, K. (2017). Macroeconomic factors in the dynamics of corporate and household saving: Evidence from central and Eastern Europe. *Emerging Markets Finance & Trade*, *53*(11), 2585–2608. https://doi.org/10.1080/1540496X.2016.1262759

Levenko, N. (2020). Perceived uncertainty as a key driver of household saving. *International Review of Economics & Finance*, *65*(1), 126–145. https://doi.org/10.1016/j.iref.2019.10.005

Levin, A., Lin, C.-F., & Chu, C.-S. J. (2002). Unit root test in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics*, *108*(1), 1–24. https://doi.org/10.1016/S0304-4076(01)00098-7

Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics & Statistics*, *61*(S1), 631–652. https://doi.org/10.1111/1468-0084.61.s1.13

Masson, P. R., Bayoumi, T., & Samiei, H. (1998). International evidence on the determinants of private saving. *The World Bank Economic Review*, *12*(3), 483–501. https://doi.org/10.1093/wber/12.3.483

Modigliani, F., & Ando, A. (1963). The "permanent income" and "life cycle" hypothesis of saving behavior: Comparison and tests. In F. Irwin & J. Robert (Eds.), *Proceedings of the conference on consumption and saving* (pp. 533–658). University of Pennsylvania, Wharton School Finance and Commerce. https://doi.org/10.9783/9781512818444-028

Mody, A., Ohnsorge, F., & Sandri, D. (2012). *Precautionary savings in the Great recession*. IMF Working Paper WP/12/42. International Monetary Fund.

Mohan, R. (2006). Causal relationship between savings and economic growth in countries with different income levels. *Economics Bulletin*, *5*(3), 1–12.

Mongale, I. P., Mukuddem-Petersen, J., Petersen, M. A., & Meniago, C. (2013). Household savings in South Africa: An econometric analysis. *Mediterranean Journal of Social Sciences*, *4*(13), 519–530. https://doi.org/10.5901/mjss.2013.v4n13p519

Niculescu-Aron, I., & Mihaescu, C. (2012). Determinants of household savings in the EU: What policies for increasing savings? *Procedia – Social and Behavioural Sciences*, *58*, 483–492. https://doi.org/10.1016/j.sbspro.2012.09.1025

Nwosu, E. O., Anumudu, C. N., & Nnamchi, C. E. (2020). Microeconomic determinants of household savings in Nigeria. *Journal of International Development*, *32*(2), 150–167. https://doi.org/10.1002/jid.3440

Palenzuela, D. R., & Dees, S. (2016). *Savings and investment behavior in the euro area*. Occasional Paper Series No. 167. European Central Bank. https://www.ecb.europa.eu/pub/pdf/scpops/ecbop167.en.pdf

Pan, X., & Wu, W. (2020). Housing returns, precautionary savings and consumption: Micro evidence from China. *Journal of Empirical Finance*, *60*(1), 39–55. https://doi.org/10.1016/j.jempfin.2020.10.006

Schmidt-Hebbel, K., Webb, S. B., & Corsetti, G. (1992). Household saving in the developing countries: First cross-country evidence. *The World Bank Economic Review*, *6*(3), 529–547. https://doi.org/10.1093/wber/6.3.529

Schuh, A. (2000). Global standardization as a success formula for marketing in Central Eastern Europe? *Journal of World Business*, *35*(2), 133–148. https://doi.org/10.1016/S1090-9516(00)00029-8

Sierminska, E. M., & Silber, J. (2020). The diversity of household assets holding in the United States in 2007 and 2009: Measurement and determinants. *Review of Economics of the Household*, *18*(3), 599–634. https://doi.org/10.1007/s11150-019-09472-z

Tatlıyer, M. (2017). Determinants of private saving level: Evidence from Turkey. *Sosyoekonomi*, *25*(32), 149–167. https://doi.org/10.17233/sosyoekonomi.295555

Vanlaer, W., Bielen, S., & Marneffe, W. (2020). Consumer confidence and household saving behaviors: A cross-country empirical analysis. *Social Indicator Research*, *147*(2), 677–721. https://doi.org/10.1007/s11205-019-02170-4

Zhuk, M. (2015). Macroeconomic determinants of household savings in Ukraine. *Economics & Sociology*, *8*(3), 41–54. https://doi.org/10.14254/2071-789X.2015/8-3/3