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Economic uncertainty and money demand stability in the CEECs

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Abstract

This paper aims at building a money demand function that takes account of the heterogeneities of the Central and Eastern European Countries (CEECs) in the context of European integration. We extend the traditional specification of money demand to capture the role of economic uncertainty, using the European sentiment indicator. The traditional determinants of the demand for money (real GDP, interest rate, inflation rate) are found to be significant and have the expected sign. Above this, we also find that the role of economic sentiments impact significantly the money demand: a rise of the perceived uncertainty leads to an increase in money demand due to precautionary reasons. Our results also suggest that a currency substitution effect against both euro and USD is present in the CEECs.

Keywords: money demand, economic sentiments, CEE countries, Dynamic OLS

JEL Codes: E41, E52

I. Introduction

In September 2017, in the State of the Union Address, the President of the European Commission, Jean-Claude Juncker stressed, among other topics, that the euro has to become the single currency of all the EU members countries: "*If we want the euro to unite rather than divide our continent, then it should be more than the currency of a select group of countries. The euro is meant to be the single currency of the European Union as a whole*." Even though a clear monetary integration agenda is not yet established for the non-eurozone countries, the above statement underlines the necessity that all EU countries that took the commitment to adopt the euro in the near future, go further on this path. Within this framework, the study of the money demand in Central and Eastern European Countries (CEECs) becomes a key issue.

After joining EU, six of the CEECs (namely: Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania) have committed themselves towards adopting the single currency as soon as the Maastricht convergence criteria are fulfilled. From a monetary policy perspective, adopting the euro will mean for these countries giving up to their monetary autonomy as they will follow the decisions of the European Central Bank (ECB). The IMF (2015) analyzes the role that the monetary autonomy has played in the CEECs that kept their monetary independence. This analysis shows that monetary tightening and exchange rate appreciation helped these countries to offset the credit boom in the mid-2000s and also to support the domestic demand in the aftermath of the 2008-2009 financial crisis, through monetary easing (IMF, 2015). The estimated coefficients for the money demand determinants may offer an insight regarding the appropriateness of adopting the single currency according to Fidrmuc (2009). He argues that if the estimated parameters of money demand are close to those in developed countries, this may create good preconditions for euro adoption. In this context, the study of money demand stability becomes important, as it can offer insights regarding the extent to which these countries are, or not, prepared to adopt the euro.

If we go back ten or fifteen years ago, the perspective of euro adoption has been widely seen in general as a positive factor. From the perspective of consumers or investors, the euro area membership was considered as a guarantee for macroeconomic stability and reduced risk. However, over the period 2001-2013 there was a decline in terms of the reputational value of the euro area membership among the new European Union (EU) member states (IMF, 2015). This hypothesis is strengthened by the perceptions and expectations of the citizens coming from the six CEE that are expected to join the euro area in the near future. The general

opinion about the euro adoption is mixed (Flash Eurobarometer, 2017). In Bulgaria, Romania, Hungary and Croatia, the share of those who are in favor of the euro adoption is higher than the one of those who are against, while in the Czech Republic and Poland, the situation is reversed[1]. However, only one out of the five respondents consider that their country is ready to join the Euro Area (Flash Eurobarometer, 2017, p. p.22). This idea gives rise to a further question concerning the money demand stability: can we consider that the stability of the demand for money is influenced by the attitude regarding the adoption of the euro?

The objective of this paper is to assess whether the perspective of monetary integration and the changing composition of the currency demand has influenced the stability of money demand function in the CEECs. We do not search to respond to the question of whether the CEE countries are prepared to adopt the single currency, we simply aim to investigate to what extent the degree of integration has influenced the demand for domestic money. More specifically, we want to assess the characteristics of the money demand function for the CEE countries and to investigate if it has been influenced by a specific set of determinants, besides the traditional ones.

In an original approach, we pay close attention to the question of whether the economic sentiments have played a role for money demand. We suppose that if domestic agents and consumers consider that their country is strongly influenced by the exchanges with the rest of the world, they revise their expectations regarding the future economic situation in their country according to what they observe abroad. In the context of European integration, the CEECs become more and more connected with the euro area (some channels are detailed in the following section). As a consequence, domestic economic agents tie their actions and decisions to the observed economic and political situation of their home country, but also to what happens in the euro area. From the 1990s on, the CEE countries have followed a common trend, first, during the transition period and, second, in the light of the common objective of European integration. In order to achieve the latter (i.e. their long-term objective has been the European integration) the CEECs have also adopted country specific measures.

To test the above stated hypothesis on money demand in the CEECs, we employ a panel framework and the cointegration techniques proposed by Pedroni (1999, 2004). Long run panel estimates are generated using the panel dynamic ordinary least squares (DOLS)

[1] While in Romania 64% of the respondents are in favor of introducing euro, in the Czech Republic only 29% think the same.

developed by Kao and Chiang (2000). This method has the advantage that it allows us to account for both cross-sectional dependence between individuals (the common shocks identified above) and individual heterogeneity (in the presence of country-specific policy measures). We will focus our attention on a sample of CEECs consisting of six European Union members that have not yet joined the Euro Area and of two official EU candidates.

This paper contributes to the existing money demand literature in several ways. First, it assesses the characteristics of money demand from the perspective of euro integration in the CEECs. Second, taking account of the presence of uncertainty in the light of the monetary integration, a measure of the economic sentiments is introduced in the money demand function. This is meant to capture a certain contagion effect in terms of expectations.

With these objectives set, the remainder of the paper in structured as follows. Section 2 is dedicated to the review of the papers related to the money demand analysis, with special focus on the countries belonging to Central and Eastern Europe. In Section 3 we describe the empirical model and the data that will be used to test the previous theoretical formulated hypothesis. The results and the robustness check is presented in Section 4. Our conclusions and policy implications are provided in Section 5. Lastly, a detailed description of the sample, of the variables and of the unit root tests is presented in the Appendix.

II. Literature review

The stability of money demand has been addressed in a large number of studies, being often associated to the selection of specific monetary and economic country characteristics. Among others, Dreger, Reimers, and Roffia (2007) and Bahmani and Kutan (2010) link the stability of money demand to the monetary regime choice of the CEECs. Bahmani and Kutan (2010) argue that a stable money demand function is a valuable indicator to determine the degree to which these countries are prepared to use monetary aggregates to conduct monetary policy. If the monetary policy is based on monetary aggregates targeting, the objective of fulfilling the Maastricht criteria will be feasible only if the money demand function is stable (European Central Bank Monthly Bulletin, 2011, p. p.64). According to this view, the CEECs in our sample adopted monetary policy regimes based either on inflation targeting or exchange rate targeting. This is due to the fact that the demand for money is considered to be unstable in an uncertain economic environment (as in the 1990s transition period).

To underline the role of money demand in the CEECs in the context of European integration, several arguments can be put forward. First, as the monetary analysis is the first pillar of the European Central Bank's strategy, the perspective of euro adoption gives a key role to the monetary policy in the CEECs on their Eurozone integration path. In the context of a policy aimed at maintaining price stability, monetary developments are analyzed in comparison to the evolution of prices, income or interest rates, so as to assess the driving forces that make them deviate from the expected long-term relation (ECB Monthly Bulletin 2011, 10: p.64). Monetary developments are also relevant for the countries in our sample due to their impact on price developments. Using the experience of 46 advanced and emerging economies on the time span 1950-2011, Gertler and Hofmann (2016) show that there is a stronger connection between inflation and money in emerging countries compared to advanced countries. Moreover, the inflation response to a monetary shock is found to be stronger in the highly dollarized economies, according to the empirical findings of Levy-Yeyati and Rey (2006).

Second, there are different channels through which the CEE countries are connected with the euro area, as a result of the European integration. Oros and Romocea-Turcu (2009) analyze the channels of monetary policy transmission from 1998 to 2006/2007 in six CEE countries. The transmission mechanism in Czech Republic and Romania is found to be more closely related to the one of the euro area, being dominated by the interest rate, while in Hungary and Poland, where the dominant channel of transmission is the exchange rate, the giving up of this monetary policy instrument would be more costly. For the more recent period, analyzing the impact of the unconventional ECB policies on eight south-eastern European countries, Moder (2017) identifies exports as being the main transmission channel for international spillovers. Domestic prices are affected by an expansionary unconventional monetary policy and the effect is greater in half of the countries, compared to the euro area. The integration is strongly supported by the financial channel, as a high proportion of foreign investments originates from the euro area. This, in addition to the presence of foreign banks which operate in CEE countries, facilitates the substitution of the domestic currencies with the euro. A key indicator of this substitutability is the high proportion of foreign currency denominated loans to total loans[2]. The widespread deposit euroisation may be the result of the distrust in the stability of the national currency (Brown and Stix, 2014), which in turn is the result of the unfavorable

[2] The proportion of foreign currency denominated loans exceeds 60% in Croatia and 40% in FYR Macedonia from 2006 onwards, but is decreasing slowly. In contrast, in Turkey the trend is upward, and it increases from around 40% in 2011 to over 50% in 2016. In Czech Republic and Poland the proportion is lower, fluctuating only slightly between 15-25%.

assessment of the political and institutional factors. However, we can also argue that the causal direction might be reversed, if the perspective of euro adoption becomes a certainty.

In reality, this form of substitutability is sometimes perceived as limiting the effectiveness of the monetary policy. Within this framework, some authors assess the role of the euroisation and financial development in the context of the monetary policy. For example, Georgiadis and Mehl (2016) find that, as a result of an increasingly net long in foreign currency, the monetary policy effectiveness was amplified by the exchange rate channel. In contrast to the previous results, Ma and Lin (2016) find a negative strong correlation between financial development and the effects of monetary policy on inflation and output. Beckmann et al. (2011) study the substitution between domestic and foreign loans in Czech Republic, Hungary, Poland and Slovak Republic. Their empirical results show that the two are close substitutes: this affects the central bank's ability to impose credit restrictions. Moreover, using data originating from surveys on households from Central, Eastern and Southeastern Europe (CESSE) throughout the 2007-2010 period, the authors show that the demand for foreign currency loans was not too much affected by the foreign currency depreciation associated to the crisis.

The relevance of this topic is also confirmed by the vast number of studies that address the money demand features of the euro area. Arnold and Roelands (2010) examine the stability of M3 in the euro area using quarterly data covering the period 1983-2010. They conclude that there is a robust demand for real money balances, if the real house prices are used as a proxy for wealth. They find an income elasticity of 1.5 was found during 1999-2008 for the demand for euro in the euro area. A similar value is reported by Dreger and Wolters (2015) over 1988-2013: the results reveal a stable money demand function in the context of the unconventional monetary policy measures implemented by ECB. Jawadi and Sousa's (2013) estimates for the income elasticity in the euro area are around 1.20 over the period 1980-2010. They also report a negative inflation elasticity, albeit small in magnitude: hence, they conclude that goods are a reasonable alternative to money. By means of various estimation techniques, Belke and Czudaj (2010) bring empirical support for money demand stability in the euro area, over different time spans. However, the above findings that converge towards a money demand stability are attributed by some authors (see for example Calza and Sousa (2003)) to the fact that the data is aggregated across-countries (which desynchronizes external shocks) and some money demand shocks are country specific.

In a DSGE model framework, Benchimol and Fourçans (2012) found that the role of money in the euro area has a greater impact on the short-run than on the long-run, and explains better output fluctuations when taking into consideration, to a larger extent, the risk aversion. Some instabilities in the M3 demand for the euro area are identified during the financial crisis episode for the marketable instruments, while the demand for currency in circulation, overnight deposits and short-term deposits on the long term is unaffected by this episode (Jung 2016).

A recent but rather scarce literature addresses the topic of money demand in CEE countries, either at country level (Buch (2001), Komárek and Melecky (2004), Hsieh and Hsing (2009), Vladova and Yanchev (2015)) or at cross-country level (Dreger et al. (2007), Dritsaki and Dritsaki (2012), Škare et al. (2016)). In an error-correction framework, the long-run elasticities of money demand match the theoretical expectations for Hungary and Poland, at the beginning of transition period (Buch 2001). Dritsaki and Dritsaki (2012) confirm the existence of a cointegration relationship between real money and two explanatory variables: real GDP and nominal short-term interest rate, in Romania and Bulgaria.

Some of the studies based on the CEECs focus on the role of foreign exchange in determining the currency substitution between the domestic and foreign currency. Selçuk (2003) identifies the foreign currency as a close substitute of the domestic currency for producing liquidity services in a sample comprising Czech Republic, Hungary, Poland and Turkey, among other countries. Using panel data on the period 1995-2004, Dreger et al. (2007) underline the role of the exchange rate against USD in ten countries that joined EU in May 2004, as money and its determinants are cointegrated only when this variable is included in the specification. Over a similar time span, a small and significant impact of the exchange rate against euro is also identified in six CEE countries by Fidrmuc (2009). In addition, his results are in favor of an important capital substitution in these countries.

We aim at filling a gap in the empirical literature of money demand regarding the assessment of the uncertainty that characterizes the European integration process: first, towards economic integration, and, then, towards monetary integration. To the best of our knowledge, the only paper that uses uncertainty in the money demand function in relation to the CEECs is the one of Bahmani-Oskooee et al. (2013). They augment the money demand function by including two computed GARCH measures for monetary and economic uncertainty. However, they do not specifically account for the uncertainty associated to the European integration, as the

focus is on the transition period. Therefore, our contribution to the existing money demand empirical literature is the following: we focus on the CEE countries in a panel framework, assessing how the path towards monetary integration has influenced the stability of money demand. We do this by including a measure of economic sentiments in the money demand specification.

III. Data and empirical model of money demand

The stability of money demand is investigated for a sample of eight Central and Eastern European countries. Data is collected on a quarterly basis for a period spanning from 2008Q1 to 2017Q1. The countries belong to two categories. The first one comprises the countries that joined the EU in 2004 (the Czech Republic, Hungary, Poland), 2007 (Bulgaria and Romania) and in 2013 (Croatia) and are expected to join the Euro Area in order to complete their European integration. The second one includes two official EU candidates, namely FYR Macedonia and Turkey. This second sample is restricted solely to these two countries due to the data availability for the European Sentiment Indicator. For a detailed description of the sample see *Appendix 1*.

To assess the characteristics of money demand function in CEE countries, our paper uses the model developed by Leventakis (1993). The function of money demand is derived from a two-country portfolio balance model. In this formulation, the demand for domestic currency comes from both domestic residents and non-residents. As a result, domestic currency has three types of substitutes: foreign currency, domestic and foreign bonds. The foreign currency is considered to bring liquidity for the domestic country. Specifically, in our sample, the foreign currency consists mainly of the euro and USD, as these are the main currencies that bring liquidity for the CEE countries. The market for domestic real money clears when the sum of the demand coming from both residents and non-residents equals the domestic money supply.

Following Leventakis (2003), the demand for real money is defined as a function of real income (Y), interest rate (R), inflation rate (π) and exchange rate (EX). We also include a measure of uncertainty-ESI-(described below):

$$\ln(M/P)_{it} = \alpha_i + \beta_1 lnY_{it} + \beta_2 R_{it} + \beta_3 \pi_{it} + \beta_4 lnEX_{it} + \beta_5 lnESI_{it} + \varepsilon_{it} \qquad (1)$$

where α_i is a positive constant, β_i (i=1,…5) are the long term elasticities and ε_{it} denotes the estimated residuals.

The money demand function used in this paper includes a scale variable and opportunity cost variables. The scale variable is the real GDP, in 2010 constant prices. Since we use a broader monetary aggregate, that comprises interest bearing deposits, a long-term interest rate would be preferable. However, data availability imposes restrictions on this requirement and we choose to use the deposit rate as a proxy for the interest rate. The inflation rate is computed based on consumer price index (2010=100%). Two exchange rate series are included to account for the currency substitution effect: the nominal exchange rate against euro and the nominal exchange euro against USD. By construction, an increase in the nominal exchange rate against euro and USD translates a depreciation of the domestic currency. All variables, except interest rate, are expressed in logarithms. The series for real money and real GDP were seasonally adjusted. The variables and the data sources are presented in details in *Appendix 2*.

Our measure of money demand is the real M2, where the nominal money stock was deflated by CPI. A broad measure is used for money demand as we want to focus on a wider range of assets that renders a portfolio opportunity to asset holders, besides a transaction role. Sriram (1999) argues that a broader measure of money gives more relevance to the asset motives of holding money. Empirical evidence shows that broad money seems a more adequate indicator of monetary liquidity as Gertler and Hoffman (2016) find a stronger association of inflation rate with broad money, than with narrow money.

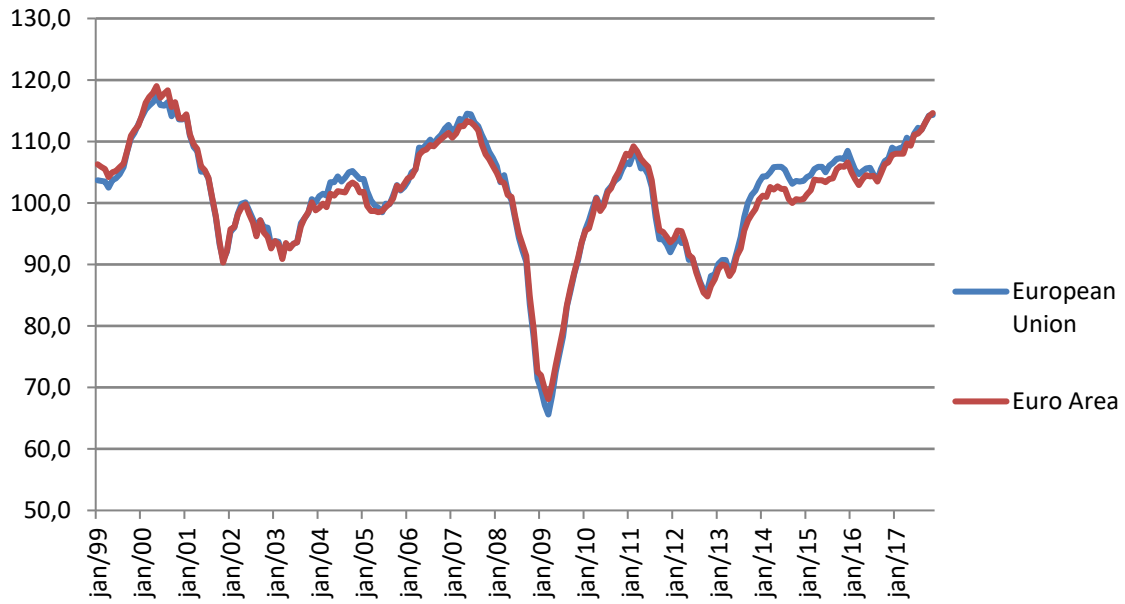
A priori, we expect positive income elasticity and negative domestic interest rate and inflation rate elasticities. The inflation rate is expected to affect negatively the demand for money as it is a measure on the return on holding goods. The sign of β_4 can be both positive or negative, depending on the magnitude of the two opposite effects following depreciation: the substitution effect and the wealth effect.

The novelty of this paper is that we account empirically for the uncertainty in CEE countries in the years preceding euro adoption. The idea that uncertainty may affect the share of wealth held as money dates back from Friedman. According to this hypothesis, an increased uncertainty determines a shift towards more liquid assets including money. The precautionary motive is invoked here. We choose to incorporate this effect by means of the European Sentiment Indicator (ESI). This indicator reflects the perceptions and the actions of a large number of economic actors. It is constructed as a composite indicator based on the confidence indicators coming from five sectors: industry, services, consumers, construction and retail trade. Values above 100 indicate an above-average economic sentiment, while values below

100 reflect a below-average perception. Largely speaking, it tracks the overall economic activity, as it aggregates the sector level confidence indicators. If we track the sentiments-expectations-decisions chain, we would expect an above average value of this indicator to be a sign of a favorable assessment of the economic activity. In other words, the greater the economic agents confidence, the lower the associated uncertainty is.

Regarding the impact of the uncertainty indicator, a priori we can expect both positive and negative coefficients. By construction, a decrease in the European sentiment indicator reflects a less favorable assessment of the future development of the economy, hence an increase in uncertainty. This could determine two opposite effects on money demand. First, it can increase the demand for money for precautionary reasons, as economic uncertainty makes economic agents more pessimistic about the future of the economy and offers an incentive to save more. This view supports Friedman's (1987) statement regarding the positive effect of an increased uncertainty on money demand, due to precautionary reasons. Second, it can decrease the demand for real money as agents choose to rebalance their portfolio by increasing the demand for real assets. Choi and Oh (2003) argue that the magnitude of the two effects (i.e. substitution effect and precautionary effect) depends on the degree of substitutability between money and other assets considered less volatile.

***Figure 1*- European Sentiment Indicator**



Source: European Commission Surveys database.

Figure 1 depicts the evolution of the European Sentiment Indicator in the European Union (EU) and the Euro Area (EA). After December 2013 the value of the indicator is above 100,

both in the EU and the EA. However, in the EU the assessment of the economic situation is more favorable than in the EA. Only recently, in November 2017, the ESI improved more in EA compared with EU, showing an increased confidence in the overall activity in this region and therefore a decline in uncertainty. The indicator has reached the highest value since June 2007 in EU and since October 2000 in EA. In our analysis we use country level values of this indicator in order to account for the overall confidence.

The fact that within these countries there are similarities regarding the level of integration, is expected to bring them closer in terms of monetary policy characteristics. Common factors among the countries in our sample are the regulatory changes and the substantial financial sector development they experienced in the last twenty years. Hence, we could expect that they have followed a common trend over the analyzed period. However, the shocks may not be distributed uniformly across these countries. Therefore, the sample does not represent a fully homogenous group. From a simple cross-country comparison, notable differences can be found with respect to the monetary policy and exchange rate regime they adopted. *Appendix 3* summarizes the main features regarding the monetary policy regime and the exchange rate strategy.

The three countries that joined EU in 2004 (the Czech Republic, Hungary and Poland) and those that joined later on (Bulgaria and Romania in 2007 and Croatia in 2013), are expected to adopt euro in the near future. Czech Republic, Hungary, Poland and Romania adopted a monetary policy regime based on inflation targeting and allow the exchange rate to float. Bulgaria and Croatia have a less autonomous monetary policy, as they tied their currency to the euro. In Bulgaria, a currency board arrangement has been in place since 1997 and the exchange rate of the Bulgarian Lev is fixed against euro. Croatia targets the nominal exchange rate of Kuna against euro.

As the purpose of our analysis is to study not only the perspective of monetary integration with respect to the Euro Area, but also the perspective of the economic integration within the European Union, two official candidates to the EU are also considered. These countries have different monetary policy regimes: while Turkey adopted an inflation targeting regime, Macedonia FYR is targeting the nominal exchange rate against euro.

IV. Empirical analysis

Panel unit root tests

The first step before empirically testing the long-run money demand is to investigate the properties of our panel data. The dimensions and the properties of our panel suggest the use of Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003) and Fisher-type tests (Maddala and Wu, 1999) in order to test the stationarity of the series.

Levin, Lin and Chu (2002) proposed unit root tests for panels of moderate size. The panel unit-root tests they propose allow for individual-specific intercepts and time trends. The unit root test is in their case based on a t-statistic obtained from a pooled cross-section time series data. The null hypothesis that each individual time series contains a unit root is tested against the alternative that each time series is stationary. The main limitations of the unit root test proposed by Levin, Lin and Chu (2002) is that when cross sectional correlation is present this test is not applicable, as it is based on the assumption of independence across individuals.

Im, Pesaran et Shin (2003) address the homogeneity issue in panel unit root testing. The procedure for dynamic heterogeneous panels proposed by Im, Pesaran et Shin (2003) is based on averaging individual ADF unit root tests statistics. The null hypothesis of the unit root test is H_0: $\beta_i=0$ for all i-individuals, with the alternative that H_1: $\beta_i<0$. This formulation allows for β_i to differ between individuals, which is a less restrictive condition in comparison to the hypothesis of Levin, Lin and Chu (2002) in which all β_i are restricted to β ($\beta_i=\beta$ for all i=1,2,…,N). Hence, instead of pooling the data, individual unit root tests are computed for each one of the N cross-section units and then they are averaged (Maddala and Wu, 1999). When the null hypothesis is rejected, this does not necessarily imply that it is rejected for all the cross-sectional units, but for a large majority.

The Fisher-type tests combine the p-values from a unit root test applied to each group in the panel using the four methods proposed by Choi (2001). Different lag lengths in the individual regressions are allowed even when the ADF test is used (Maddala and Wu, 1999). The null hypothesis to be tested is that all the panels contain a unit root. Using Monte Carlo simulation, Maddala and Wu (1999) shows that when the errors in different cross-section units are cross-correlated, the Fisher test performs better. Moreover, when T is large and N is not very large, the size distortion with the Fisher-test is small.

The countries in our dataset have experienced during the analyzed period structural changes, for catching-up with the former western European countries. In this context, we would expect a clear trend pattern in the evolution of gross domestic product and of monetary variables. To account for this effect, the tests are performed both with and without a trend. Results of the panel unit root tests in both level and first difference are provided in *Appendix 4*. The results for real money, real income and interest rate indicate that there is a unit-root in the series. For the inflation rate, exchange rates and European sentiment indicator the unit root tests give mixed results for the variables in levels. Therefore, we can conclude that all variables are stationary in first differences, which allows us to test for cointegration among these variables and to estimate the money demand function.

Cointegration

Based on the above elements regarding the properties of our data sample, we test the existence of cointegration in the panel framework using the panel cointegration tests of Pedroni (1999, 2004). He proposed a set of panel cointegration tests for non-stationary heterogenous panels with a large time dimension T and medium to large N. The test for cointegration can be applied also for unbalanced panels. It uses seven test statistics to test the null of no cointegration in non-stationary panels (Neal, 2014).

The tests statistics allow for panel heterogeneity both in the short-run dynamics and long-run slope and intercept coefficients. Common time dummies can be included so as to account for the cross sectional dependency. The seven test statistics introduced by Pedroni (1999, 2004) are residual based tests and are then adjusted so that they are distributed as N(0,1) under the null hypothesis. They can be divided into two categories: group mean statistics and panel statistics. The statistics from the first category are based on the between dimension approach average the results on individual test statistic. Panel statistics pool the autoregressive coefficients across different countries for the unit root tests on the estimated residuals and are based on the within dimension approach.

The test results related to cointegration are provided in *Table 1*. Cointegration was tested separately for each model used in the estimation, models that include one at a time the exchange rate against euro (*Model 1*), against USD (*Model 2*), the nominal effective exchange rate (*Model 3*) and the real effective exchange rate (*Model 4*). The null of no cointegration is rejected for all models by at least four out of seven statistics. This is strong evidence in favor

of long-run cointegration among variables and we can conclude that a long run money demand function exists for our sample.

***Table 1*- Pedroni (1999, 2004) Panel Cointegration Tests**

Model	***Model 1***	***Model 2***	***Model 3***	***Model 4***
Panel test statistics				
Panel v	-1.197	-0.950	-0.906	-0.748
Rho statistic	2.564***	2.167**	-2.102**	2.092**
t statistic	1.827*	1.019	0.980	0.944
ADF statistic	2.161**	2.218**	2.400***	2.351***
Group test statistics				
Rho statistic	3.511***	3.082***	2.927***	2.805***
t statistic	2.553***	1.628	1.440	1.323
ADF statistic	1.356	2.623***	2.431***	2.582***

Notes: 1). ***, ** and * reject the null of no cointegration at 1%, 5% and 10%. The statistics are distributed as N(0,1). Common time dummies and a linear time trend are included. The number of lags is determined based on AIC. The long-run variance of the residuals is computed through the Newey-West heteroskedasticity and autocorrelation-consistent method with a Bartlett kernel for which the maximum lag lenght is selected as $4(T/100)^{2/9}$. 2) The panel includes: Bulgaria, Croatia, The Czech Republic, Hungary, FYR Macedonia, Poland, Romania and Turkey.

Source: authors' computation

Dynamic OLS estimation of money demand

Once cointegration was confirmed in the previous section, the long run money demand can estimated empirically. The panel DOLS estimator proposed by Kao and Chiang (2000) provides more precise estimations than the single-equation estimator, and is fully parametric (Mark and Sul, 2003). Kao and Chiang (2000) suggest that the DOLS estimator may be more promising than OLS and Fully Modified OLS (FMOLS) estimators in estimating cointegration in a panel framework, as it works better in both homogenous and heterogenous panels.

The Dynamic OLS estimator was first introduced by Saikkonen (1991) and Stock and Watson (1993) and extended by Mark and Sul (2003) to a panel framework. The results of the Monte-Carlo simulation conducted in the paper of Mark and Sul (2003) prove that panel DOLS provides more precise estimates than single-equation DOLS. If, from an empirical point of view, the single equation cointegration estimates can be sensitive to the time span and selected individuals, panel DOLS performs better in offering more precise estimations.

This methodology uses the past (lags) and future (leads) values of the differenced explanatory variables as regressors, in order to account for the endogeneity. The DOLS estimator for the panel is obtained by running the following regression (Kao and Chiang, 2000):

$$y_{it} = \alpha_i + \gamma' x_{it} + \sum_{j=-p_i}^{p_i} \delta'_{ij} \Delta x_{i,t+j} + u_{it} \qquad (2)$$

in which y_{it} is the dependent variable, x_{it} is a vector of k independent variables and $\Delta x_{i,t+j}$ represents a vector of leads and lags of the first differences of the x_{it} variables. In this form of the specification, the cointegration vector is homogenous across individuals, being equal to $1 - \gamma'$. The error term u_{it} is independent across individuals, but may be dependent across t.

Below, we start by estimating the money demand function defined in *equation (1)* by DOLS estimator (Kao and Chiang, 2000). The basic models include as explanatory variables: the real GDP, the interest rate, the inflation rate, a proxy for the exchange rate and the European sentiment indicator. *Table 2* reports the results of panel DOLS estimator for the long run money demand function, from two benchmark models: *Model 1*, in which is included the exchange rate against euro, and *Model 2*, that uses as a proxy the exchange rate against USD.

All variables have the correct sign and are highly significant. The income elasticity of money demand is significant and slightly above unity in both specifications. The opportunity cost variables, the interest rate and the inflation rate, carry the expected negative and significant coefficient. As for the role played by the foreign currency on the demand for domestic money, we can observe the presence of the substitution effect suggested by the negative sign of the exchange rate coefficients. The coefficient of the exchange rate against euro is however higher in magnitude than the one for the exchange rate against USD, indicating a greater impact of the exchange rate fluctuations in euro on the domestic demand for money. This result is intuitive given that the process of integration in the European structures is in progress in all the countries from our sample.

The European sentiment indicator carries a negative sign in *Model 1*, as well as in *Model 2*. Therefore, as the results indicate, an increased uncertainty-reflected by a less than average value for the ESI- determine a rise of the demand for money, due to precautionary reasons. In this case, the precautionary effect dominates the substitution effect and is quite high in magnitude compared with the other determinants.

***Table 2*- Panel money demand estimations DOLS** –Benchmark models		
Dependent variable M2	*Model 1*	*Model 2*
Y	1.019***	1.007***
	(0.000)	(0.000)
R	-0.001***	-0.001***
	(0.000)	(0.000)
Π	-0.018***	-0.034***
	(0.000)	(0.000)
EX_EUR	-0.242***	
	(0.000)	
EX_USD		-0.202***
		(0.000)
ESI	-0.402***	-0.311***
	(0.000)	(0.000)
T	37	37
N	264	264

Notes: 1) ***, ** and * denotes significance at 1%, 5% and 10%. 2) Two lags and one lead were included in DOLS first differences. 3) All variables, except for the interest rate, are in logs. 4) The panel includes: Bulgaria, Croatia, Czech Republic, Hungary, FYR Macedonia, Poland, Romania, Turkey. Sample period: 2008Q1-2017Q1

Robustness Check

In the above section, we reported the results of the money demand function including a scale variable, opportunity cost variables and a variable capturing the uncertainty. Our benchmark models included each a bilateral exchange rate of the national currency against either euro or USD, as these currencies represent the main substitutes for domestic money. In this section, we choose to replace these bilateral exchange rate with the nominal effective exchange rate and the real effective exchange rate. For comparison purposes, these models include the effects of a basket of foreign currencies on domestic money demand. Two models emerge from here: *Model 3* and *Model 4*.

The results differ slightly with respect to the benchmark models (see *Table 3*). When the nominal effective exchange rate is included in the estimations we observe that the exchange rate is no longer significant. Moreover, the sign of the inflation elasticity becomes positive, indicating the presence of money illusion. In contrast, when the real effective exchange rate is included in the model, the results are similar to our benchmark model, even though the inflation rate becomes insignificant. A higher coefficient for the exchange rate elasticity is reported, while the impact of the variable that reflects the assessment of uncertainty remains robust to the benchmark models.

***Table 3*- Panel money demand estimations DOLS-**

(nominal effective exchange rate and real effective exchange rate)

Dependent variable M2	*Model 3*	*Model 4*
Y	0.906***	0.981***
	(0.000)	(0.000)
R	-0.001***	-0.001***
	(0.000)	(0.000)
Π	0.023***	-0.000
	(0.000)	(0.956)
EX_NEER	0.125	
	(0.260)	
EX_REER		-0.444***
		(0.002)
ESI	-0.233***	-0.312***
	(0.000)	(0.000)
T	37	37
N	264	264

Notes: 1) ***, ** and * denotes significance at 1%, 5% and 10%. 2) Two lags and one lead were included in DOLS first differences. 3) All variables, except the interest rate, are in logs. 4) The panel includes: Bulgaria, Croatia, Czech Republic, Hungary, FYR Macedonia, Poland, Romania and Turkey. Time period: 2008Q1-2017Q1.

Table 4 and *Table 5* report the results of extending our benchmark models by including two major economic events that may have impacted the demand for money. The first one is the global financial crisis from 2008-2010 that covers the first three year under analysis. The second is related with the change in the European Central Bank monetary policy instruments. In order to account for the switch toward unconventional monetary policies, we include a variable that captures the effect of the quantitative easing measures coming form the euro zone on the CEECs domestic money demand, starting in 2015. A dummy variable is included in the specification in both cases, and the estimations were reported again for all the four previous models.

As compared to the previous models, accounting for the effects of the crisis, does not significantly change the results (see *Table 4*). The real GDP, interest rate and inflation rate are all significant and carry the same signs. The European sentiment indicator coefficient is negative and significant in all cases, and has greater values when the effects of the crisis are taken into consideration. The crisis impacts negatively the demand for domestic money, but only when the exchange rate against euro or USD is included. The result is not surprising given that this period is characterized by increased uncertainty, economic instability and risk, which makes money holders to direct their holding into less volatile assets, such as real assets.

***Table 4*- Panel money demand estimations DOLS** (including crisis)

Dependent variable M2	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Y	1.020***	1.008***	0.986***	0.980***
	(0.000)	(0.000)	(0.000)	(0.000)
R	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
π	-0.018***	-0.037***	0.021***	-0.009**
	(0.000)	(0.000)	(0.000)	(0.030)
EX_EUR	-0.246***			
	(0.000)			
EX_USD		-0.210***		
		(0.000)		
EX_NEER			0.092	
			(0.381)	
EX_REER				-0.656***
				(0.000)
ESI	-0.551***	-0.506***	-0.266***	-0.337***
	(0.000)	(0.000)	(0.000)	(0.000)
D_CRISIS	-0.062***	-0.081***	-0.007	0.011
	(0.000)	(0.000)	(0.653)	(0.521)
T	37	37	37	37
N	264	264	264	264

Notes: 1) ***, ** and * denotes significance at 1%, 5% and 10%. 2) Two lags and one lead were included in DOLS first differences. 3) All variables, except the interest rate, are in logs. 4) The panel includes: Bulgaria, Croatia, Czech Republic, Hungary, FYR Macedonia, Poland, Romania, Turkey. Time period: 2008Q1-2017Q1.

Next, we perform the last robustness check and control for the effect of the quantitative easing (QE) measures adopted by the European Central Bank starting with 2015. *Table 5* reports very similar results. In all the specifications, the European sentiment indicator remains highly significant and negative.

***Table 5*- Panel money demand estimations DOLS** (including the effects of ECB QE)

Dependent variable M2	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Y	1.019***	1.007***	0.985***	0.977***
	(0.000)	(0.000)	(0.000)	(0.000)
R	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
π	-0.018***	-0.033***	0.018***	-0.014***
	(0.000)	(0.000)	(0.000)	(0.000)
EX_EUR	-0.241***			
	(0.000)			
EX_USD		-0.206***		
		(0.000)		
EX_NEER			0.084	
			(0.388)	
EX_REER				-0.830***
				(0.000)
ESI	-0.385***	-0.398***	-0.122**	-0.150***
	(0.000)	(0.000)	(0.026)	(0.006)
D_ECB_QE	-0.009	0.038**	-0.058***	-0.098***
	(0.598)	(0.029)	(0.001)	(0.000)

T	37	37	37	37
N	264	264	264	264

Notes: 1) ***, ** and * denotes significance at 1%, 5% and 10%. 2) Two lags and one lead were included in DOLS first differences. 3) All variables, except the interest rate, are in logs. 4) The panel includes: Bulgaria, Croatia, Czech Republic, Hungary, FYR Macedonia, Poland, Romania, Turkey. Time period: 2008Q1-2017Q1.

Lastly, we report the results for the panel money demand estimations using a different methodological approach. For this purpose, the estimations were obtained for all the four models using the Fully-Modified Ordinary Least Squares (FMOLS) estimator proposed by Phillips and Moon (1999) and Pedroni (2000). As well as the Dynamic Ordinary Least Squares (DOLS) estimator, the Fully-Modified Ordinary Least Squares (FMOLS) estimator account for endogeneity problems. But, in contrast to DOLS, the second estimator corrects for endogeneity and serial correlation to the OLS estimator nonparametrically (Kao and Chiang 2000).

***Table 6*- Panel money demand estimations FMOLS**

Dependent variable M2	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Y	1.074***	1.064***	1.090***	1.082***
	(0.000)	(0.000)	(0.000)	(0.000)
R	-0.001***	-0.002***	-0.001***	-0.001*
	(0.000)	(0.000)	(0.003)	(0.082)
π	-0.093*	0.104*	-0.134**	-0.189***
	(0.079)	(0.062)	(0.048)	(0.005)
EX_EUR	-0.027			
	(0.748)			
EX_USD		0.014		
		(0.871)		
EX_NEER			-0.154	
			(0.751)	
EX_REER				-2.036
				(0.149)
ESI	-1.804***	-2.932***	-0.437	0.247
	(0.003)	(0.000)	(0.544)	(0.743)
C	8.572***	13.643***	2.595	8.163
	(0.002)	(0.000)	(0.515)	(0.260)
N	295	295	295	295

Notes: 1) ***, ** and * denotes significance at 1%, 5% and 10%. 2) All variables, except for the interest rate, are in logs. 3) The panel includes: Bulgaria, Croatia, The Czech Republic, Hungary, FYR Macedonia, Poland, Romania and Turkey. Sample period: 2008Q1-2017Q1.

The results, reported in *Table 6,* are consistent with our benchmark models in terms of sign and significance of the real GDP, interest rate and inflation rate. By contrast, the currency substitution effect is no longer supported by the data, regardless of the proxy considered for the exchange rate. The assessment of the economic situation has significant impact on money demand only when bilateral exchange rates are considered, and the impact is surprisingly high. These results should be, however, carefully interpreted, as the FMOLS methodology

assumes cross section independence (Phillips and Moon, 1999), a requirement that is not fully met in the current analysis as the countries in our sample may be subject to common shocks.

V. Conclusions

The question of the money demand stability has gained renewed interest in the CEECs: it has an important role for the medium-term objective of price stability in the euro area. The focus is put, therefore, on the factors that are related to the context of the euro integration that may have influenced the demand for money.

This paper presents estimates on the demand for domestic real money in a sample of eight Central and Eastern European countries, using panel data for the time span 2008- 2017. The estimation is conducted using panel cointegration models. It contributes to the previous empirical money demand literature by assessing the role of sentiments on the domestic demand for money, besides the traditional determinants. Following the previous empirical studies on money demand, we started with the traditional formulation of the money demand function that includes a scale variable and opportunity cost variables.

Trying to capture the particularities of our sample in terms of monetary developments over the period under analysis, the specification of money demand function was extended by including the European sentiment indicator. This indicator is meant to capture the effects of investors' perceptions from five sectors on the overall stance of the economy. In the specification of money demand function, this indicator is a measure of the perceived uncertainty. Given that the CEE countries are on their way towards European integration (FYR Macedonia and Turkey) or towards monetary integration (Bulgaria, Croatia, the Czech Republic, Hungary, Poland and Romania) we hypothesized that the degree of uncertainty coming from the European Union or Euro Area, may significantly affect the demand for domestic money.

The results obtained from the panel DOLS estimator applied to the money demand function offered some reassuring results regarding the stability of money demand, when the degree of uncertainty was considered. Cointegration between real money and its determinants is confirmed regardless of the proxy used for the exchange rate. The income elasticity was around unity and significant in all cases. The interest rate had small, but negative effects on the demand for money, the same effect being observable also in the case of inflation rate. This outcome was expected, as the two variables capture the opportunity cost of holding money.

The currency substitution effect between the national currencies and foreign currency was confirmed for both bilateral exchange rates- against euro or against the USD-, with a smaller coefficient for the latter. As five out of the eight countries in our sample were EU members during the years covered by our analysis, we find a significant currency effect in favor of the euro.

The role of economic sentiments of money demand was found to be significant. The lower the value of the ESI indicator, the greater the perceived uncertainty is. This leads to an increase of money demand due to precautionary reasons. The robustness checks provided in the previous section, confirm the validity of the model. The results remain in line with the benchmark models, regardless of the exchange rate proxies that we use. Even when we control for the effects of the global economic and financial crisis of 2008-2010 or for the quantitative easing measures implemented by the European Central Bank, we obtain similar results.

The current research shows that the extended money demand function, that includes a variable that captures the assessment of economic uncertainty, provides a relatively good explanation for the behavior of money demand in the CEE countries. We conclude that the stability of the demand for money is indeed influenced by the changes occurred in the process of integration. Taking into consideration the consumers' and investors' assessment regarding the overall economic activity inside European Union, helps us identify a stable money demand function.

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Appendix 1- CEE countries classification (IMF)

Main group	**Group**	**Country**	**Country code**
CESEE-Central, Eastern and Southeastern Europe	European Union countries (EU)	Bulgaria	BGR
		Croatia	HRV
		Czech Republic	CZE
		Hungary	HUN
		Poland	POL
		Romania	ROU
	Non-European Union countries (non-EU)	Macedonia, FYR	MKD
		Turkey	TUR

Source: International Monetary Fund classification (for a detailed classification see: IMF (2016))

Appendix 2- Variables description and data sources

Variable	Full name	Definition	Units	Source
M2	Log of M2 monetary aggregate	Real monetary aggregate M2[a]: the nominal monetary aggregates (national definitions, in millions of national currency) were deflated by Consumer Price Index CPI (index 2010=100%); *For Montenegro annual data is extracted for Broad money (constant LCU) from World Bank.	Millions of national currency (constant prices, 2010=100%)	IFS, World Bank
Y	Log of real GDP	Gross Domestic Product, Real[a] Gross domestic product at market prices, Chained linked volumes (2010), million units of national currency, Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted).	Chained linked volumes (2010), million units of national currency	Eurostat
π	Inflation rate	This variable is defined as the rate of growth of CPI, where CPI is the Consumer Price Index (Index 2010=100%).	Percent (2010=100%)	IFS
R	Interest rate	Deposit rate	Percent per annum	IFS
EX_NEER	Log of Nominal Effective Exchange Rate	Nominal Effective Exchange Rate, Trade Partners by Consumer Price Index. An increase in this variable reflects appreciation of domestic currency against the weighted basket of currencies of its trading partners.	Index (2010=100%)	IFS
EX_REER	Log of Real Effective Exchange Rate	Real Effective Exchange Rate, Trade Partners by Consumer Price Index. An increase in this variable reflects appreciation of domestic currency against the weighted basket of currencies of its trading partners.	Index (2010=100%)	IFS
EX_EUR	Nominal exchange rate against EUR	Euro/ECU exchange rates - quarterly data	National currency, Average	Eurostat
EX_USD	Nominal exchange rate against USD	National Currency per US Dollar, Period Average	Rate	IFS
ESI	Log of European Sentiment Indicator	The European sentiment indicator (ESI) is computed as a weighted average of the balances of selected questions in five sectors surveys covered by the EU Business and Consumer Surveys Programme. The sectors are industry (weight 40%), services (30%), consumers (20%), retail (5%) and construction (5%). Seasonally adjusted data, not calendar adjusted data.	Index	Eurostat

Note: [a]) For the real monetary aggregate and real GDP the series were seasonally adjusted before estimation.

Appendix 3- Monetary and exchange rate regimes (as of October 2017)

Country	Country code	Currency	EU or EA member since…	Monetary policy regime	Exchange rate regime
European Union member countries (EU)					
BULGARIA	BGR	Bulgarian Lev (BGN)	01.01.2007	Currency board arrangement (since 1997); The Bulgarian LEV does not participate to ERM II;	fixed-currency board to euro (1.95583 levs per euro)
CROATIA	HRV	Croatian Kuna (HRK)	01.07.2013	Nominal exchange rate of the Kuna against the euro; The Croatian Kuna does not participate to ERM II;	managed-crawl-like arrangement EUR
CZECH REPUBLIC	CZE	Czech Koruna (CZK)	01.05.2004	Direct inflation targeting (since 1998);	residual-other managed arrangement
HUNGARY	HUN	Hungarian Forint (HUF)	01.05.2004	Inflation targeting system (since 2001); The Hungarian Forint does not participate to ERM II;	floating
POLAND	POL	Polish Zloty (PLN)	01.05.2004	Direct inflation targeting (since 1998); The Polish Zloty does not participate to ERM II;	floating
ROMANIA	ROU	Romanian Leu (RON)	01.01.2007	Direct inflation targeting (since 2005); The Romanian Leu does not participate to ERM II;	floating
European Union official candidate countries (non-EU)					
FYR MACEDONIA	MKD	Macedonian Denar (MKD)	n/a	Nominal exchange rate targeting against euro (since 2002)	managed-stabilized arrangement (EUR)
TURKEY	TUR	Turkish Lira (TRY)	n/a	Inflation targeting (since 2002)	floating

Source: authors' computation based on data from the sites of the National Banks and Thomson Reuters (for the exchange rates regimes)

Appendix 3- Panel unit root tests

Variable name	**IPS-test**	**IPS^{T}-test**	**ADF-Fisher test**	**ADF-Fisher^{T} test**	**PP-Fisher test**	**PP-Fisher^{T} test**	**LLC**	**LLC^{T}**
1. Levels								
M2	-1.718 (0.042)**	-1.177 (0.119)	61.746 (0.000)***	5.864 (0.989)	25.236 (0.065)*	25.830 (0.056)*	3.172 (0.999)	0.160 (0.563)
Y	-2.523 (0.005)***	-0.534 (0.296)	59.591 (0.000)***	5.896 (0.989)	59.546 (0.000)***	37.194 (0.002)***	2.319 (0.989)	-2.820 (0.002)***
π	-12.248 (0.000)***	-16.845 (0.000)***	72.435 (0.000)***	54.795 (0.000)***	271.479 (0.000)***	266.938 (0.000)***	-0.868 (0.192)	-0.023 (0.490)
R	2.059 (0.980)	-0.973 (0.165)	35.740 (0.003)***	15.465 (0.490)	10.745 (0.824)	16.060 (0.448)	0.975 (0.835)	-2.744 (0.003)***
EX_EUR	-3.349 (0.000)***	-4.593 (0.000)***	33.107 (0.007)***	75.594 (0.000)***	41.227 (0.000)***	48.359 (0.000)***	0.082 (0.532)	-0.803 (0.210)
EX_USD	-1.936 (0.026)**	-4.418 (0.000)***	22.424 (0.130)	7.638 (0.958)	29.161 (0.022)**	33.324 (0.006)***	1.824 (0.965)	-4.646 (0.000)***
EX_NEER	-0.963 (0.167)	-5.088 (0.000)***	25.206 (0.066)*	25.222 (0.066)*	13.413 (0.642)	17.803 (0.335)	2.079 (0.981)	-2.881 (0.002)***
EX_REER	-4.326 (0.000)***	-4.947 (0.000)***	39.790 (0.000)***	42.655 (0.000)***	25.589 (0.060)*	23.351 (0.104)	-0.300 (0.381)	-3.857 (0.000)***
ESI	-2.027 (0.021)**	-0.941 (0.173)	71.463 (0.000)***	80.097 (0.000)***	19.364 (0.250)	10.796 (0.821)	-2.458 (0.007)***	-6.736 (0.000)***
Variable name	**IPS-test**	**IPS^{T}-test**	**ADF-Fisher test**	**ADF-Fisher^{T} test**	**PP-Fisher test**	**PP-Fisher^{T} test**	**LLC**	**LLC^{T}**
2. First differences								
M2	-11.050 (0.000)***	-10.166 (0.000)***	90.131 (0.000)***	49.455 (0.000)***	193.517 (0.000)***	163.352 (0.000)***	-6.602 (0.000)***	-6.349 (0.000)***
Y	-13.885 (0.000)***	-16.340 (0.000)***	77.207 (0.000)***	36.507 (0.002)***	362.513 (0.000)***	382.041 (0.000)***	-8.086 (0.000)***	-10.152 (0.000)***
π	-26.098 (0.000)***	-25.409 (0.000)***	128.992 (0.000)***	70.176 (0.000)***	554.948 (0.000)***	535.904 (0.000)***	-5.998 (0.000)***	-3.092 (0.001)***
R	-11.474 (0.000)***	-10.291 (0.000)***	92.437 (0.000)***	54.352 (0.000)***	227.765 (0.000)***	194.031 (0.000)***	-6.225 (0.000)***	-4.706 (0.000)***
EX_EUR	-13.601 (0.000)***	-12.242 (0.000)***	116.206 (0.000)***	59.841 (0.000)***	344.269 (0.000)***	301.759 (0.000)***	-14.285 (0.000)***	-8.641 (0.000)***
EX_USD	-15.974 (0.000)***	-13.532 (0.000)***	116.008 (0.000)***	63.709 (0.000)***	352.865 (0.000)***	319.193 (0.000)***	-10.451 (0.000)***	-8.483 (0.000)***
EX_NEER	-12.519 (0.000)***	-11.751 (0.000)***	113.004 (0.000)***	72.148 (0.000)***	182.798 (0.000)***	157.818 (0.000)***	-10.335 (0.000)***	-6.490 (0.000)***
EX_REER	-13.489 (0.000)***	-12.272 (0.000)***	101.827 (0.000)***	53.471 (0.000)***	193.307 (0.000)***	152.556 (0.000)***	-8.714 (0.000)***	-7.256 (0.000)***
ESI	-11.729 (0.000)***	-10.388 (0.000)***	98.862 (0.000)***	44.931 (0.000)***	191.995 (0.000)***	167.269 (0.000)***	-9.457 (0.000)***	-8.739 (0.000)***

Notes: 1) ***, ** and * reject the null of unit root at 1%, 5% and 10%. 2) IPS^{T}, Fisher^{T}, LLC^{T} denotes that a time trend is included. 3) For the IPS-test the W t-bar is reported. 4) For Fisher type tests the inverse chi-squared (p) is reported. 5) For IPS test the number of lags is chosen by AIC, for Fisher test we used 4 lags. 6) The panel includes: Bulgaria, Croatia, The Czech Republic, Hungary, FYR Macedonia, Poland, Romania and Turkey.