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Доларизација депозита у кратком и дугом року: пример земаља централне и југоисточне Европе

Ивана Рајковић и Бранко Урошевић

Dollarization of deposits in short and long run: evidence from CESE countries

Ivana Rajkovic and Branko Urosevic

Директорат за економска истраживања и статистику

НАРОДНА БАНКА СРБИЈЕ

Београд, Краља Петра 12,

Тел.: (+381 11) 3027 100

Београд, Немањина 17,

Тел.: (+381 11) 333 8000

www.nbs.rs

Directorate for Economic Research and Statistics

THE NATIONAL BANK OF SERBIA

Belgrade, 12 Kralja Petra Street,

Telephone: (+381 11) 3027 100

Belgrade, 17 Nemanjina Street,

Telephone: (+381 11) 333 8000

www.nbs.rs

Non-technical Summary

Financial dollarization of an economy weakens monetary transmission mechanism and increases vulnerability of a financial system to exchange rate depreciations. Given its importance, a growing literature seeks to explain causes of financial dollarization. In this paper, we focus on determinants of deposit dollarization. We do so for two reasons. First, domestic deposits are an important source of lending funds. In addition, significant empirical evidence documents a positive relationship between deposit and loan dollarization as a consequence of banks' hedging decisions on currency structure of assets and liabilities (Alina Luca and Iva Petrova 2008; Kyriakos C. Neanidis and Christos S. Savva 2009).

The objective of this study is to introduce and test a Minimum Variance Portfolio (MVP) model that distinguishes between short-run and long-run determinants of dollarization in five Central, Eastern and South East European (CESE) countries (Czech Republic, Hungary, Poland, Romania and Serbia). We apply panel cointegration methods to test for the determinants of long-run dollarization and Arellano – Bond dynamic panel GMM estimators to test for the determinants of short-run dollarization. Our sample comprises of countries that have inflation targeting monetary policy regime, i.e that do not use currency board or de-facto peg their currency to euro. Using monthly data over the period May 2005 – December 2013, we show that for the panel of five inflation targeting countries in CESE region, somewhat different factors influence dollarization in the short and the long run.

The advantage of panel cointegration method is that it generates consistent estimates in the long time horizon and helps determine the speed of convergence towards the long-run equilibrium. This paper also discusses the homogeneity of the long-run coefficients between dollarization and MVP share for the CESE countries in our sample, i.e. we find that long-run relationship between dollarization and MVP is positive, statistically significant and homogeneous among countries in the sample. On the other hand, in the short-run, dollarization exhibits persistence and depends on the interest rate spread, nominal exchange rate movements and MVP, while inflation rates do not have statistically significant impact on dollarization.

From the policy perspective, measures effective in the short run in reducing dollarization of an economy may not be effective in the long run. Namely, favouring local-currency deposits through interest rate spread, either through monetary or tax policy measures, may be effective, i.e. result in lower dollarization in the short run only. On the other hand, in the long run, when no arbitrage condition tends to equalize real interest rates on local-currency and foreign-currency deposits (i.e. when uncovered interest rate parity condition holds) credible inflation targeting policy combined with floating exchange rate may have higher change in lowering dollarization.

Доларизација депозита у кратком и дугом року: пример земаља централне и југоисточне Европе

Ивана Рајковић и Бранко Урошевић

Апстракт: Овај рад истражује различите детерминанте перманентне и транзиторне компоненте доларизације у земљама централне и југоисточне Европе. Резултати истраживања указују на позитивну коинтеграциону везу између перманентне компоненте доларизације и доларизације процењене методом минималне варијансе портфолија (МВП), што представља додатну емпиријску потврду МВП метода као стандардног алата за анализу финансијске доларизације у дугом року. У дугом року, агенти доносе одлуке о алокацији штедње на основу релативног волатилитета инфлације у односу на волатилитет девизног курса, не узимајући у обзир разлику у реалним каматним стопама на штедњу. Резултати анализе даље указују на то да различити фактори детерминишу доларизацију у кратком року. Доларизација у кратком року испољава персистентност и одређена је, поред МВП удела, кретањем каматног диференцијала, као и кретањем номиналног девизног курса. Овакво кретање доларизације указује на то да мере усмерене ка смањењу доларизације преко диференцијала каматне стопе имају ефекта у кратком року, док у дугом року на де-доларизацију могу утицати мере које обезбеђују релативну стабилност инфлације у односу на стабилност девизног курса.

Кључне речи: перманентна и транзиторна доларизација, транзиционе економије
JEL Code: C33, F31, G11

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Dollarization of deposits in short and long run: evidence from CESE countries

Ivana Rajkovic and Branko Urosevic

Abstract: We study drivers of permanent and transitory deposit dollarization on a sample of CESE countries using panel cointegration techniques. The results suggest that a positive cointegration relationship exists between permanent dollarization and minimum variance portfolio (MVP) share. This provides additional empirical validation of MVP method as the standard tool for analysing financial dollarization in the long run. In the long run agents make savings decisions based on relative volatilities of inflation and nominal depreciation rates and do not take into the account interest rate spread. In the short run dollarization exhibits persistence. Somewhat different factors affect dollarization in the short than in the long run. Namely, apart from MVP share, dollarization of deposits is in that case driven, also, by interest rate spread and nominal exchange rate movements. Our results suggest that affecting dollarization through change in the interest rate spread may have short term impact on dollarization. In the long run, however, for de-dollarization it is critical to reduce volatility of inflation compared to volatility of exchange rate depreciation.

Key words: permanent and transitory dollarization, transition economies
JEL Code: C33, F31, G11

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Contents:

1 Introduction

Many emerging and frontier market economies have a de-facto dual currency system. On one hand, they have their official currency. On the other, foreign currency such as dollars or euros are often used as a store of value or in issuing loans. This leads to (partial) financial dollarization. Financial dollarization of an economy weakens monetary transmission mechanisms and increases vulnerability of the financial system to exchange rate fluctuations. Given its importance, a growing literature seeks to explain causes of dollarization and study measures needed to reduce it. In this paper, we focus on determinants of deposit dollarization. We do so for two reasons. First, deposits are an important source of lending funds. In addition, significant empirical evidence documents a positive relationship between deposit and loan dollarization as a consequence of banks' hedging decisions on currency structure of assets and liabilities (Alina Luca and Iva Petrova 2008; Kyriakos C. Neanidis and Christos S. Savva 2009).

There has been large number of theoretical and empirical studies on dollarization. For our research of particular importance is the Minimum Variance Portfolio approach to dollarization by Alain Ize and Eduardo Levi-Yeyati (2003). It explains dollarization as a function of second moments of inflation and real depreciation. The authors, followed by several others (see Gianni De Nicoló, Patrick Honohan and Alain Ize 2005; Alain Ize 2006), assume that Uncovered Interest Parity (UIP) holds and state that interest rates do not play an important role in financial dollarization. Although the assumption on UIP is reasonable in the long run, in the short run there is evidence that UIP is violated (see, e.g. Lucas Menkhoff et al. 2012). Relaxing the UIP assumption, another group of authors (Diego Winkelried and Paul Castillo 2010; Henrique Basso, Oscar Calvo-Gonzales and Marius Jurgilas 2011; Marina Tkalec 2013) show that interest rate spread may, in fact, play an important role in dollarization, as well.

Empirical studies on financial dollarization apply various econometric techniques. Ize and Yeyati (2003) empirically tested the relationship between financial dollarization and MVP share using a panel data set of five Latin American countries applying fixed effect panel methodology. They also confirmed that cross-country deviations of financial dollarization are positively affected by MVP share using a sample of 46 highly dollarized economies. Note, however, that this method may generate inconsistent and biased estimates in the presence of unit root in variables. De Nicoló, Honohan and Ize (2005) modelled determinants of deposit dollarization on a cross-sectional basis using a wider set of explanatory variables that besides MVP share includes inflation rate, institutional quality variables and dummy variables for restriction on dollarization, inflation targeting, legal protections, etc. They found that dollarization is affected positively by MVP share and inflation rates and that credibility of macroeconomic policy and the quality of institutions negatively affect dollarization. Robert Rennhack and Masahiro Nozaki (2006) employ GMM method to test the dynamics of deposit dollarization and obtained high degree of persistence to dollarization (0.94) as well as positive coefficient on MVP. Tkalec (2013) applies Johansen cointegration method on a country-by-country basis for twelve European post-transition countries and finds one cointegration relationship between exchange rate, interest rate spread and dollarization. In contrast to this paper, the methodology we apply enables us to derive conclusions related to the whole sample of CESE countries, not only for individual countries.

We contribute to the literature as follows. We create a simple unifying framework for treating dollarization in the short and the long run by extending the theoretical framework of Ize and Levi-Yeyati (2003). Namely, we introduce a Minimum Variance Portfolio (MVP) model that distinguishes between short-run and long-run determinants of dollarization of interest bearing deposits. We then test the model on a sample of inflation targeting countries of Central, Eastern and South East European (CESE) region. These countries are: the Czech Republic, Hungary, Poland, Romania and Serbia. We apply panel cointegration methods to test for the determinants of long-run dollarization and Arellano – Bond dynamic panel GMM estimators to test for the determinants of short-run dollarization using monthly data over the period May 2005 – December 2013. To the best of our knowledge, no previous research on the subject determinants of dollarization employs error-correction-based panel cointegration methods that we use. The advantage of panel error-correction is that it generates consistent estimates in the case of long time horizon and estimates not only the relationship between variables but also the speed of convergence towards the long-run equilibrium.

We find that permanent dollarization is largely determined by MVP share, while in explaining transitory component, interest rate spread and exchange rate movements play a substantial role as well. In this way we combine and extend the above-mentioned two strains of literature. We discuss, also, homogeneity of the long-run coefficients between dollarization and MVP share for the CESE countries in the sample. We find that long-run relationship between dollarization and MVP is positive, statistically significant and homogeneous among countries in our sample. On the other hand, in the short-run dollarization exhibits persistence and depends on the interest rate spread, nominal exchange rate movements and MVP. Last but not least, inflation rate does not have statistically significant impact on dollarization across the sample.

An important policy implication of our results is that relevant de-dollarization measures may differ in the short and the long run. Affecting interest rate spread in order to favour local-currency deposits, either through monetary or tax policy measures, may result in lower dollarization in the shorter run. However, in the long run, when no arbitrage condition tends to equalize real interest rates on local-currency and foreign-currency deposits (i.e. when UIP condition holds) a credible inflation targeting policy combined with floating exchange rate should result in lower dollarization.

The remainder of the paper is organized as follows. In Section 2 a version of the Minimum Variance Portfolio (MVP) model of deposit dollarization with testable hypotheses is presented. Section 3 describes the data and methodology. Section 4 discusses our empirical findings. The concluding remarks and policy implications are presented in the Section 5.

2 Model and testable hypotheses

This section presents a simple version of the portfolio optimization model of deposit dollarization. In contrast to the original, it makes a distinction between determinants of deposit dollarization in the long and the short run. The starting point is the Minimum Variance Portfolio model where risk-averse agents choose to save either in local-currency or foreign-currency onshore deposits (Ize and Yeyati's (2003) allow cross-border deposits, forbidden by law in countries like Serbia). Agents maximize quadratic utility function expressed in terms of returns. Short-selling is not allowed and agents hold no cash. Agents' utility function in period t is represented by:

$$U_t = E_t(r_{t+1}) - \frac{c}{2} Var_t(r_{t+1}) \quad (1)$$

where $E_t(r_{t+1})$ stands for the expectation about the real return on deposit portfolio (r_{t+1}) that comprises of foreign-currency deposits (with weight x_t^F) and local-currency deposits (with weight (1-x_t^F)) based on the information available up to period t. Here, $Var_t(r_{t+1})$ stands for the variance of the real return on deposit. Finally, c is a measure of risk aversion of agents, assumed constant (this form of the utility function is studied, among many others, in Frank J. Fabozzi et al. 2007).

At the beginning of the period agents decide whether to save in local- or foreign-currency interest-bearing onshore deposits. Expected real returns are expressed as:

$$\begin{aligned} E_t(r_{t+1}^L) &= i_t^L - E_t(\pi_{t+1}) \\ E_t(r_{t+1}^F) &= i_t^F + E_t(e_{t+1}) - E_t(\pi_{t+1}) \end{aligned} \quad (2)$$

where i_t^L and i_t^F are nominal interest rates on the local-currency and foreign-currency deposits, respectively; $E_t(\pi_{t+1})$ is expected domestic inflation rate in period t+1 based on information up to period t and $E_t(e_{t+1})$ is expected nominal depreciation rate in period t+1 based on information available up to period t. This model also assumes constant foreign prices, i.e. absence of foreign inflation. This assumption simplifies the model without reducing its explanatory power.

The optimal dollarization ratio is obtained by maximizing the utility function with respect to $x_t^F$and is represented by:

$$x_t^{F*} = \frac{E_t(r_{t+1}^F - r_{t+1}^L)}{c\sigma_{e_{t+1}}^2} + \frac{\rho_{\pi e_{t+1}} \sigma_{\pi_{t+1}}}{\sigma_{e_{t+1}}} \quad (3)$$

Depending on the UIP assumption, two different expressions for the optimal dollarization share can be derived. If uncovered interest parity holds, expected real interest rate spread ($E_t(r_{t+1}^F - r_{t+1}^L)$) is equal to zero and the Expression (3) can be reduced to:

$$MVP_t = \frac{\rho_{\pi e_{t+1}} \sigma_{\pi_{t+1}}}{\sigma_{e_{t+1}}} \quad (4)$$

Under the assumption of no arbitrage condition in the long-run, agents' decisions on portfolio allocations are based upon the volatility of inflation (σ_π), exchange rate pass-through ($\rho_{\pi e}$) and volatility of nominal depreciation rates (σ_e). This is, essentially, the result of Ize and Levy-Yeyati (2003). Since real interest rates are set to be equal in the long run, agents will choose the less risky asset. If prices are stable relative to nominal exchange rate, it is less risky to save in local currency, and vice versa, which is in accordance with the literature.

On the other hand, in the short-run UIP does not hold (see Mehkhoff *et al*. 2012). In that case, expected real interest rate spread is different from zero, and deposit dollarization is given by Expression (3). Since expected inflation rates are incorporated in both nominal interest rates on local-currency and foreign-currency deposits (see Equation 2), changes in inflation rate should not influence agents' portfolio decisions (Guillermo A. Calvo and Carlos A.Vegh, 1997). On the other hand, whenever real interest rate differential is greater than zero (either due to changes in nominal interest rate spread or higher than expected nominal depreciation rate) foreign-currency deposits will be more attractive relative to local-currency deposits and vice versa. In the short run, optimal dollarization share differs from that in the long run and, apart from MVP share, it is explained, also, by movements in the real interest rate spread between foreign-currency and local-currency deposits. Equations 3 and 4 are the starting points for an empirical analysis presented in Section 4. Equation 3 serves to explain the dynamics of transitory deposit dollarization of CESE countries in our sample, while Equation 4 is starting point for estimating the determinants of permanent deposit dollarization. We, therefore, test the following hypotheses:

H1: *Dollarization of interest-bearing deposits is determined by MVP share in the long run i.e. there exist a positive cointegration relationship between permanent dollarization and MVP share.*

H2: *Deposit dollarization is increasing in real interest rate spread between foreign- and local-currency deposits and MVP share in the short run.*

Following Equation 2 and findings from Calvo and Vegh (1997) an additional hypothesis is tested:

H3: *Inflation rates do not affect deposit dollarization in the short run.*

3 Data and methodology

Most of the earlier literature measures dollarization of deposits as the ratio of foreign-currency deposits in total deposits. In this paper, and consistent with the model that we try to test, we measure deposit dollarization as the ratio of onshore foreign currency interest-bearing deposits to total onshore interest-bearing deposits of households and non-financial corporations. We take into the account only interest-bearing onshore deposits. Transactional deposits are excluded from the analysis since their currency structure is defined by regulatory requirements rather than by agents' optimization decisions.

Monthly data are used over the sample period May 2005 – December 2013 and for the following five CESE countries: Czech Republic, Hungary, Poland, Romania and Serbia. The panel data set contains exclusively inflation targeting countries, since Equation 3 and Equation 4 hold only in the case of non-zero volatility of exchange rate. Albania is excluded from the analysis due to the short time period for which data on the currency structure of deposits are available. The data availability on the currency structure of deposits for each country in the sample is presented in Table 1.

Table 1

In order to perform separate analysis of short-term and long-term determinants of dollarization, time series of deposit dollarization is decomposed into the permanent and transitory components applying Beveridge–Nelson approach (1981). Beveridge-Nelson (BN) decomposition is performed under the assumption that the first difference of logarithm of deposit dollarization level follows an ARMA process. The BN trend is estimated as the long-run forecast of the level of the series and the BN cycle is the difference between the level of the series and its long-run forecast. Trend component is given with:

$$BN_T = \lim_{M\to\propto} E[y_{t+M} - M\mu|\Omega_t] \quad (5)$$

where μ=E[Δy_t] is deterministic drift and Ω_t is the information set used to calculate the conditional equation (James C. Morley 2010, page 420).

Due to the lack of data on the expected inflation and depreciation rates, we estimate MVP share based on the historical data. Volatilities of inflation and depreciation rates are estimated using GARCH modelling. Correlation between the nominal depreciation rates and inflation is modelled as the time-varying nominal exchange rate pass-through estimated using Kalman Filter. We estimate the following time-varying parameter model for the exchange rate pass-through:

$$\pi_t = \alpha_t + \beta_t e_t + \phi_t \pi_{t-1} + \nu_t, \nu_t \sim N(0, R)$$
$$\Phi_t = \Phi_{t-1} + z_t, z_t \sim N(0, Q) \quad (6)$$

where $\Phi_t = \{\alpha_t, \beta_t, \phi_t\}$ and π_t stands for inflation rates, e_t for nominal depreciation rates, and β_t for the estimated time-varying short-term pass-through coefficient.

Data on currency structure of deposits, inflation, nominal exchange rate and interbank money market interest rates are collected from the statistics of corresponding central banks. The list of variables and description is provided in Table 2. Summary statistics are provided in Table 3.

Table 2

Table 3

As a preliminary step, panel unit root tests are performed. The results of panel unit root tests (Table 4) suggest that permanent component of dollarization share contains unit root, as well as estimated MVP share, while transitory component of dollarization, nominal depreciation rates and volatilities of inflation and depreciation rates are stationary in level.

Table 4

Given non-stationarity of permanent dollarization and MVP share, we test hypothesis H1 using panel cointegration methods based on error-correction. We apply two panel cointegration techniques (mean group estimator (MG) and pooled mean group estimator (PMG)) in order to estimate long-run relationship between permanent dollarization and MVP. The main difference between these two methods is that MG estimate is obtained from N separate regressions as the mean of non-weighted coefficients. This allows long-run coefficients to differ across the panel. In contrast, PMG method pools the data, thus restricting the slope coefficients to be the same. In addition, this method allows short-run coefficients and error variances to differ across the panel (Hashem Pesaran, Yongcheol Shin and Ron P. Smith 1998). The long-run homogeneity is then tested using the Hausman test.

In order to analyse the short-run dynamics of dollarization we estimate Equation 3 employing Arellano – Bond dynamic panel generalized method of moments (GMM) estimator.

4 Empirical findings

4.1 Determinants of deposit dollarization in the long run

We have previously established that permanent dollarization, the dependent variable in the equation for estimating the long-run effect, is non-stationary in level. Thus, in order to test H1 (the long-run dynamics of dollarization), we estimate panel error-correction regressions. The optimal dollarization share, i.e. MPV, is calculated as in Equation 4. It is a function of volatility of inflation, volatility of nominal depreciation rate and nominal exchange rate pass-through.

In order to test for the presence of a long-run relationship between permanent dollarization and MVP, we apply panel cointegration tests developed by Westerlund (2007). We start from the error-correction model where all variables in level are assumed to be I(1). The idea is to test for the absence of cointegration by determining whether there exists error-correction for individual panel members or for the panel as a whole (Damian Persyn and Joakim Westerlund 2008).

The results of Westerlund error-correction-based panel cointegration tests are summarized in Table 5:

Table 5

According to all four Westerlund tests, we reject the null hypothesis of no cointegration relationship between permanent dollarization and MVP. High statistical significance of P_a and P_t statistics suggests cointegration relationship for the panel as a whole.

Estimates of long-run coefficients of the cointegration relationship between permanent dollarization and MVP are obtained using two different methods: PMG and MG methods. These methods are applicable in a case when time horizon is sufficiently large so that separate regressions can be estimated (Pesaran, Shin, Smith, 1999). As stated above, the difference between these methods is that PMG assumes that long-run coefficients are equal across all panels (c_1), and allows the short-run coefficients and error variances to differ across panels, while MG method calculates coefficients from the unweighted average of the unconstrained, fully heterogeneous model (the long-run coefficients are heterogeneous as well). MG method provides consistent estimates of the mean of the long-run coefficients. In a case of slope homogeneity, these estimates are inefficient. PMG method, on the other hand, provides consistent and efficient estimators under the assumption of slope homogeneity

(Pesaran, Shin, Smith, 1999). Homogeneity of estimators is then tested using the Hausman test.

We examine the hypothesis H1 within the following panel cointegration model:

$$DOL\_PERM_{it} = c_{0i} + c_1 LOG(MVP)_{it} + u_{it}, i = 1,..,6, t = 1,2 \ldots \quad (7)$$

$$\Delta DOL\_PERM_{it} = \phi_i(DOL\_PERM_{it-1} - c_{0i} - c_1 LOG(MVP)_{it}) + b_{1i}\Delta LOG(MVP)_{it-1} + \varepsilon_{it}$$

The estimated coefficients are presented in Table 6:

Table 6

The long-run coefficient c_1 is of primary interest for our analysis. Consistent with the theoretical model (see Section 2), the estimated coefficients of long-run relationship between dollarization and MVP share are positive and significant in both MG and PMG specifications, suggesting a positive cointegration relationship between the permanent dollarization and MVP. We find that a 10 per cent increase in MVP leads to approximately 1.0 per cent increase in dollarization in the long run. This confirms the findings in Ize and Yeyati's (2003) in a more rigorous empirical setting. The coefficient on the error-correction term (ϕ_i) is negative and statistically significant in both specifications suggesting an adjustment to the long-run equilibrium. An error-correction formulation allows deviations from optimal dollarization share to be closed over time, with the speed of adjustment measured by the parameter of the error-correction term (around 0.05 in both specifications).

Our approach allows us to investigate, also, homogeneity of the long-run relationship between cointegrated variables in our sample, an issue that has, to the best of our knowledge, never been discussed in the literature on dollarization before. The homogeneity of long-run coefficients is tested using the Hausman test which tests the null hypothesis that the difference in long-run coefficients among countries in the sample is not systematic. According to the joint Hausman test, we cannot reject the hypothesis on long-run homogeneity (p-value=0.84) which indicates that PMG estimators are preferred to MG. Thus, the results of the Hausman test suggest that there exists a positive long-run relationship between dollarization and MVP which is homogeneous for all countries in the panel. While imposing homogeneity of long-run coefficients, PMG method still allows different slope coefficients and different convergence dynamics to the long-run equilibrium across countries. That, in turn, is consistent with the different level of dollarization, both actual as well as estimated MVP share across countries, i.e. different volatilities of inflation and depreciation rates and pass-through coefficients.

As a robustness check, we repeat regression 7, replacing this time MVP share by its components within the following panel cointegration model:

$$\Delta DOL\_PERM_{it} = \phi_i(DOL\_PERM_{it-1} - c_{0i} - c_1 LOG(VOL\_INF)_{it} - c_2 LOG(VOL\_DEP)_{it} - c_3 LOG(PASS)_{it}) + \\ + b_{1i}\Delta LOG(VOL\_INF)_{it-1} + b_{2i}\Delta LOG(VOL\_DEP)_{it-1} + b_{3i}\Delta LOG(PASS)_{it-1} + \varepsilon_{it} \quad (8)$$

The results are summarized in Table 7, and suggest that increase in volatility of inflation and increase in pass-through lead to increase in dollarization share in the long run, while increase in volatility of the exchange rate reduces the level of dollarization in the long run.

4.2 Determinants of deposit dollarization in the short run

Consider now the short-run dynamics. We test hypotheses H2 and H3 using the following Arellano – Bond dynamic panel GMM model:

$$DOL\_TRANS_{it} = \alpha_{0i} + \beta_1 DOL\_TRANS_{it-1} + \beta_2 IR\_SPREAD_{it} + \beta_3 DEP_{it-1} + \beta_4 MVP_{it} + \beta_5 INF_{it} + \varepsilon_{it} \quad (9)$$

where DOL_TRANS is the natural logarithm of the transitory component of dollarization, IR_SPREAD is the difference between 3M EURIBOR and respective interbank 3M money market interest rates for each country in the sample, DEP is nominal monthly depreciation rate, INF is monthly inflation rate, while MVP is, as before, optimal dollarization share estimated according to Equation 4.

Table 8

The results are summarized in Table 8 and suggest that: (i) dollarization exhibits persistence in the short-run (the coefficient for the lagged dependent variable is 0.26); (ii) changes in the nominal interest rate spread, depreciation rate and MVP have statistically significant impact on dollarization in the short run. Our results confirm the findings of Neanidis and Savva (2009) and Honohan (2007) that dollarization exhibits persistence and that depreciation rate and interest rate spread positively affect deposit dollarization. Higher depreciation rates make foreign-currency deposits more attractive relative to local-currency deposits and thus dollarization share increases (positive and statistically significant coefficient β_3). On the other hand, volatility of depreciation (incorporated into the MVP) has the opposite impact on dollarization since it makes foreign currency deposits riskier relative to local-currency deposits. Our results suggest that MVP affects deposit dollarization in the short run as well, which is in accordance with the Equation 3. MVP has positive and statistically significant impact on transitory dollarization, but its impact is relatively low. Namely, a 10% increase in MVP leads to just 0.03% increase in transitory dollarization; (iii) Consistent with H3, INF is unlikely to play a substantive role in dollarization in the short run (column 1, Table 8) which confirms findings in Calvo and Vegh (1997). Since inflation rate is incorporated in both nominal interest rates on local-currency and foreign-currency deposits, it is not expected to influence agents' decisions on currency structure of deposits. After excluding inflation rate from the model, the rest of the coefficients remain unchanged and are statistically significant.

5 Concluding remarks

In this paper, we find that different forces drive deposit dollarization in the long and in the short run. The reason for different behaviour of agents in the short and the long run is that UIP is expected to hold in the long run while it may not to hold in the short run. We use a simple version of the portfolio optimization model of deposit dollarization that, in contrast to the original model of Ize and Yeyati (2003), makes distinction between determinants of deposit dollarization in the long and the short run. When UIP holds, agents make their optimization decisions based on MVP. When UIP does not hold, agents, besides MVP share, take into the account, also, changes in the nominal interest rate spread and changes in exchange rates.

Empirical findings confirm that in the sample of five inflation-targeting countries of CESE region, permanent dollarization is positively related to MVP share and that this relationship is homogeneous for the countries in the sample. Negative and statistically significant coefficient on the error-correction term highlights the process of convergence towards the long-run dollarization share. Transitory dollarization, on the other hand, is apart from MVP share, driven, also, by interest rate spread and nominal exchange rate movements.

If the goal is to reduce dollarization of an economy, our results indicate that different measures may be effective in the short and the long run. Namely, affecting the interest rate spread in order to favour local-currency deposits, either through monetary or tax policy, may result in lower dollarization in the short run. However, in the long run, when no arbitrage condition tends to equalize real interest rates on local-currency and foreign-currency deposits, a credible inflation targeting policy combined with floating exchange rate may yield better results.

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Tables

Table 1 The data availability on the dollarization share for the base sample

Country	Data availability	Number of observations
Albania	2007:12 - 2013:12	73
Czech Republic	1997:01 - 2013:12	204
Hungary	2001:05 - 2013:12	152
Poland	1996:12 - 2013:12	205
Romania	2005:05 - 2013:12	104
Serbia	2004:01 - 2013:12	120

Table 2 Description of variables

Variable name	Variable description	Source
DOL	Share of fx interest-bearing deposits in total interest bearing deposits for households and non-financial corporations	CNB, MNB, NBP, NBR, NBS
DOL_PERM	Permanent component of deposit dollarization obtained using Beveridge Nelson-methodology (log values)	Author's calculation
DOL_TRANS	Transitory component of deposit dollarization obtained using Beveridge-Nelson methodology (log values)	Author's calculation
DEP	Nominal depreciation rate (differenced logarithm of nominal exchange rates)	CNB, MNB, NBP, NBR, NBS
INF	Monthly inflation rate (differenced logarithm of CPI or HICP)[1]	CNB, MNB, NBP, NBR, NBS
VOL_INF	Volatility of inflation calculated using GARCH and EGARCH methodology	Author's calculation
VOL_DEP	Volatility of nominal depreciation calculated using GARCH and EGARCH methodology	Author's calculation
PASS	Exchange rate pass-through calculated using Kalman Filter methodology	Author's calculation
MVP	Share of deposit dollarization calculated as $MVP=\frac{volinf*pass}{voldep}$	Author's calculation
IR_SPREAD	Difference between 3M EURIBOR and respective interbank money market interest rate	CNB, MNB, NBP, NBR, NBS, ECB

[1] Inflation rate for Serbia from May 2005 to January 2006 is estimated CPI based on available data on RPI

Table 3 Summary statistics of most important variables from May 2005 to December 2013

Country	Deposit dollarization (in %)			Monthly inflation rates (in %)			Monthly depreciation rates (in %)			*Pass-through* (in %)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Czech Republic	7.1	4.0	10.5	0.1	-0.7	1.8	-0.1	-4.4	4.7	1.8	0.0	2.9
Hungary	20.1	13.3	25.8	0.3	-0.8	2.1	0.2	-5.6	7.6	2.6	2.1	3.4
Poland	17.3	9.3	12.1	0.3	-0.5	1.2	0.0	-4.6	9.1	1.4	1.2	1.9
Romania	38.3	32.8	43.6	0.4	-0.4	2.6	0.2	-7.8	2.9	4.8	0.8	9.1
Serbia	87.1	80.5	90.1	0.6	-1.1	2.9	0.3	-3.5	6.9	13.1	0.1	22.1

Source: CNB, MNB, NBP, NBR, NBS, and authors' calculations

Table 4 Panel unit root tests

Test		DOL_PERM	DOL_TRANS	MVP	VOL_INF	VOL_DEP	INF	DEP
Levin, Lin & Chu t		-0.58	-3.40***	-0.56	-1.32*	-2.44***	-8.24***	-0.02***
Im, Pesaran & Shin		-0.90	4.98***	-1.17	-1.26*	-3.31***	-9.95***	-9.52***
Fisher type	P	15.44	36.93***	14.89	69.91***	35.46***	200.37***	179.29***
	Z	-0.88	-3.95***	-1.47	-5.92***	-3.80***	-12.72***	-11.98***
	L	-0.89	-4.11***	-1.09	-7.82***	-3.91***	-22.90***	-20.49***
	Pm	0.70	-5.10***	0.59	-11.82***	4.79***	38.45***	34.15***

Note: *, **, and *** refer to statistical significance of 10%, 5% and 1%, respectively.
Source: Author's calculation

Table 5 Panel cointegration tests

	Statistics	Value	p-value
Westerlund ECM panel cointegration tests	Gt	-1.58*	0.10
	Ga	-1.26*	0.09
	Pt	-3.61**	0.02
	Pa	-3.44**	0.03

Note: *, **, and *** refer to statistical significance of 10%, 5% and 1%, respectively. P values are given in parenthesis. Lag length is chosen according to Akaike Information Criterion. The null hypothesis is no cointegration.
Source: Author's calculations

Table 6 PMG and MG estimates of long-run relationship between permanent dollarization share and MVP for Czech Republic, Hungary, Romania, Poland and Serbia from May 2005 to December 2013. Dependent variable: permanent component of dollarization

Method	PMG		MG	
Variable	Coefficient	p-value	Coefficient	p-value
Log(MVP)	0.10***	0.00	0.13*	0.10
Error-correction term	-0.05**	0.05	-0.05**	0.02
d.Log(MVP)	0.01*	0.09	0.01*	0.09
Constant	-0.04**	0.03	-0.04**	0.17

Note: *, ** and *** refer to statistical significance of 10%, 5% and 1% respectively. P values are given in parenthesis.
Source: Author's calculations

Table 7 PMG estimates of long run relationship between permanent dollarization share and inflation volatility, volatility of exchange rate changes and exchange rate pass-through for Czech Republic, Hungary, Romania, Poland and Serbia from May 2005 to December 2013. Dependent variable: permanent component of dollarization

Method	PMG	
Variable	Coefficient	p-value
Log(VOL_INF)	0.11*	0.10
Log(VOL_DEP)	-0.04**	0.02
Log(PASS)	0.12**	0.04
Error-correction term	-0.05**	0.05
d.Log(VOL_INF)	0.01*	0.10
d.LogVOL_DEP)	-0.10**	0.05
d.Log(PASS)	0.13*	0.07
Constant	0.02**	0.05

Note: *, **, and *** refer to statistical significance of 10%, 5% and 1% respectively. P values are given in parenthesis.
Source: Author's calculations

Table 8 Arellano – Bond dynamic panel GMM estimates for Czech Republic, Hungary, Romania, Poland and Serbia from May 2005 to December 2013. Dependent variable: transitory component of dollarization

Model	(1)		(2)	
Method	Arellano-Bond dynamic panel-data estimation		Arellano-Bond dynamic panel-data estimation	
Variable	Coefficient	p-value	Coefficient	p-value
CONST	0. 021**	0.02	0.021**	0.02
$TRANS_{t-1}$	0.261***	0.00	0.260***	0.00
IR_SPREAD_t	0.152**	0.02	0.150**	0.02
DEP_{t-1}	0.002**	0.04	0.002**	0.04
$Log(MVP)_t$	0.003*	0.08	0.003*	0.08
INF_t	0.055	0.49		

Note: *, **, and *** refer to statistical significance of 10%, 5% and 1% respectively.
Source: Author's calculation

Abbreviations

CESE (Central and Southeastern Europe)

CNB (Czech National Bank)

GMM (Generalized Method of Moments estimate)

MG (Mean Group Estimate)

MNB (National Bank of Hungary (Magyar Nemzeti Bank))

MVP (Minimum Variance Portfolio)

NBP (National Bank of Poland)

NBR (National Bank of Romania)

NBS (National Bank of Serbia)

PMG (Pooled-Mean Group Estimate)

UIP (Uncovered Interest Rate Parity)