The international platform of Ludwig-Maximilians University's Center for Economic Studies and the Ifo Institute

Working Papers

www.cesifo.org/wp

Dollarization of Deposits in the Short and Long Run: Evidence from CESE Countries

Branko Urosevic
Ivana Rajkovic

CESIFO WORKING PAPER NO. 5745
CATEGORY 7: MONETARY POLICY AND INTERNATIONAL FINANCE
FEBRUARY 2016

An electronic version of the paper may be downloaded
- *from the SSRN website:* *www.SSRN.com*
- *from the RePEc website:* *www.RePEc.org*
- *from the CESifo website:* *www.CESifo-group.org/wp*

ISSN 2364-1428

CESifo
Center for Economic Studies & Ifo Institute

CESifo *Working Paper No. 5745*

Dollarization of Deposits in the Short and Long Run: Evidence from CESE Countries

Abstract

In this paper, we study the drivers of permanent and transitory deposit dollarization for 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 an additional empirical validation of the MVP method as the standard tool for analyzing financial dollarization. In the long run, agents make savings decisions based on the relative volatilities of inflation and nominal depreciation rates and do not take into account the interest rate spread. Somewhat different factors affect dollarization in the short rather than in the long run. Namely, apart from MVP share, transitory deposit dollarization is driven, also, by the real interest rate spread. Our results suggest that affecting dollarization through changes in the interest rate spread may have a short term impact. In the long run, however, for de-dollarization it is critical to reduce the volatility of inflation compared to the volatility of exchange rate depreciation.

JEL-codes: C330, F310, G110.

Keywords: permanent and transitory dollarization, transition economies.

Branko Urosevic
University of Belgrade
Faculty of Economics
Kamenička 6
Serbia – 11000 Belgrade
urosevic@ekof.bg.ac.rs

Ivana Rajkovic
National Bank of Serbia
Belgrade / Serbia
ivana.rajkovic@nbs.rs

The authors thank Milan Nedeljkovic, Mirjana Miletic, Jelena Maravic and participants at the National Bank of Serbia research seminar for useful comments and suggestions. Branko Urosevic gratefully acknowledges the support of the Serbian Ministry for Education and Science, grant No MNTR 179005.

1 Introduction

Many emerging market economies have a de facto dual currency system. Although they have their official currency, foreign currencies 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 mechanism and increases the vulnerability of the financial system to exchange rate fluctuations. Given its importance, a growing literature seeks to explain the causes of dollarization and study the measures needed to reduce it. In this paper, we focus on the 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 the currency structure of assets and liabilities (Alina Luca and Iva Petrova (2008); Kyriakos C. Neanidis and Christos S. Savva (2009)).

In this paper we introduce and test a Minimum Variance Portfolio (MVP) model that distinguishes between factors that determine deposit dollarization in the short run and long run. We find that in the long run, agents make savings decisions based on the relative volatilities of inflation and nominal depreciation rates and do not take into account the interest rate spread. On the other hand, in the short run, deposit dollarization is driven, also, by the real interest rate spread. 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 favor 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 an UIP condition holds) a credible inflation targeting policy combined with a floating exchange rate should result in lower dollarization.

The remainder of the paper is organized as follows. In Section 2, we discuss the literature on dollarization. In Section 3, a version of the Minimum Variance Portfolio (MVP) model of deposit dollarization with testable hypotheses is presented. Section 4 describes the data and methodology. Section 5 discusses our empirical findings. The concluding remarks and policy implications are presented in Section 6.

2 Literature Review

The determinants of dollarization have been discussed in numerous theoretical and empirical studies. 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 determining financial dollarization. Although the assumption of 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 the 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 Levi Yeyati (2003) empirically tested the relationship between financial dollarization and MVP share using a panel data set of five Latin American countries applying a 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 the determinants of deposit dollarization on a cross-sectional basis using a wider set of explanatory variables which, besides MVP share, include the 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 the credibility of macroeconomic policy and the quality of institutions negatively affect dollarization. Robert Rennhack and Masahiro Nozaki (2006) employ the GMM method to test the dynamics of deposit dollarization and obtain a high degree of persistence to dollarization (0.94) as well as a positive coefficient for 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 the exchange rate, interest rate spread and dollarization. In contrast to that 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 have created a simple unifying framework for treating dollarization in the short and the long run by extending the theoretical framework of Alain Ize and Eduardo Levi Yeyati (2003). Namely, we introduce a Minimum Variance Portfolio (MVP) model that distinguishes between the short-run and long-run determinants of dollarization of interest-bearing deposits. We have tested the model on a sample of inflation targeting countries in the Central, Eastern and South East European (CESE) region. These countries are: the Czech Republic, Hungary, Poland, Romania and Serbia. We applied 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.

We find that permanent dollarization is largely determined by MVP share, while the interest rate spread and exchange rate movements also play a substantial role in explaining the transitory component. In this way, we have combined and extended the above-mentioned two strains of literature. We also discuss the 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, the inflation rate does not have a statistically significant impact on dollarization across the sample.

To the best of our knowledge, no previous research on the determinants of dollarization employs the error-correction-based panel cointegration methods that we use. The rationale for using a panel error-correction methodology is that it is designed for panels with larger T dimension and enables us to estimate not only the relationship between variables but also the speed of convergence towards the long-run equilibrium.

3 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 Levi Yeyati's (2003) allow cross-border deposits, which is forbidden by law in countries like Serbia). Agents maximize the quadratic utility function expressed in terms of returns. Short-selling is not allowed and agents hold no cash. The 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 the deposit portfolio (r_{t+1}) which is comprised 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 the deposit portfolio. Finally, c is a measure of the 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. The expected real returns are expressed as:

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

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 the expected domestic inflation rate in period t+1 based on information up to period t and $E_t(e_{t+1})$ is the 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., the absence of foreign inflation. This assumption simplifies the model without reducing its explanatory power.

The optimal dollarization ratio (x_t^{F*}) 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. In the case when uncovered interest parity holds, which is common in the long-run[1], the expected real interest rate spread ($E_t(r_{t+1}^F - r_{t+1}^L)$) is equal to zero and 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 a no arbitrage condition in the long-run, the agents' decisions on portfolio allocations are based upon the volatility of inflation, exchange rate pass-through and the volatility of nominal depreciation rates. This is, essentially, the result of Ize and Levy Yeyati (2003). Since real interest rates are set to be equal in the long run, the agents will choose the less risky asset. If prices are stable relative to the 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, the expected real interest rate spread is different from zero, and deposit dollarization is given by Expression (3). Since the expected inflation rates are incorporated in both nominal interest rates on local-currency and foreign-currency deposits (see Equation 2), changes in the inflation rate should not influence agents' portfolio decisions (Guillermo A. Calvo and Carlos A. Vegh, (1997)). On the other hand, whenever the real interest rate differential is greater than zero (either due to changes in the nominal interest rate spread or a 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, the 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 the empirical analysis presented in Section 5. Equation 3 serves to explain the dynamics of transitory deposit dollarization for the CESE countries in our sample, while Equation 4 is the starting point for estimating the determinants of permanent deposit dollarization. We, therefore, test the following hypotheses:

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

H2: *Deposit dollarization is increasing with the 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), we test an additional hypothesis:

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

4 Data and methodology

Most of the earlier literature measures the dollarization of deposits as the ratio of foreign-currency deposits to total deposits. In this paper, and consistent with the model that we test, we measure deposit dollarization as the ratio of onshore foreign currency interest-bearing deposits to the 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 our 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: the 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 the nominal 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 of the currency structure of deposits for each country in the sample is presented in Table A1 in the Appendix.

In order to perform a separate analysis of the short-term and long-term determinants of dollarization, the time series of deposit dollarization is decomposed into permanent and transitory components applying the Beveridge–Nelson approach (1981). Beveridge-Nelson (BN) decomposition is performed under the assumption that the first difference of the logarithm of the 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. The trend component is given by:

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

[1] This is a standard assumption in the literature, given that its violation would lead to a no-arbitrage opportunity in the long-run. For the purpose of this research, the authors tested whether this assumption holds for the sample. The results are not presented here due to space limitation but are available upon request to the authors.

where μ=E[Δy_t] is the 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 historical data. The volatilities of the inflation and depreciation rates are estimated using GARCH modelling. The correlation between the nominal depreciation rates and inflation is modelled as the time-varying nominal exchange rate pass-through estimated using the 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 is the estimated time-varying short-term pass-through coefficient.

Data on the currency structure of deposits, inflation, the nominal exchange rate and interbank money market interest rates are collected from the statistics of the corresponding central banks. A list of variables and their descriptions is provided in Table A2, while summary statistics are provided in Table A3 in the Appendix.

As a preliminary step, we performed panel unit root tests. The results of the panel unit root tests (Table 1) suggest that the permanent component of dollarization share contains unit root, as well as estimated MVP share, while the transitory component of dollarization, nominal depreciation rates and volatilities of inflation and depreciation rates is stationary in level.

Table 1 Panel unit root test results

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***	14.9	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 *** indicate rejection of the null hypothesis of non-stationarity at 10%, 5% and 1% significance level, respectively.

Source: Authors' calculation

Given the non-stationarity of permanent dollarization and MVP share, we tested hypothesis H1 using panel cointegration methods based on error-correction. We applied two panel cointegration techniques (mean group estimator (MG) and pooled mean group estimator (PMG)) in order to estimate the long-run relationship between permanent dollarization and MVP. The main difference between these two methods is that the MG estimate is obtained from N separate regressions as the mean of non-weighted coefficients. This allows the long-run coefficients to differ across the panel. In contrast, the PMG method pools the data, thus restricting the slope coefficients to be the same. In addition, this method allows the short-run coefficients and error variances to differ across the panel (Hashem M. 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 estimated Equation 3 employing the Arellano – Bond dynamic panel generalized method of moments (GMM) estimator.

5 Empirical findings

5.1 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 estimated 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 applied Westerlund panel cointegration tests. We started from the error-correction model where all variables in level are assumed to be I(1). The idea was 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 (Damiaan Persyn and Joakim Westerlund 2008).

We summarize the results of the Westerlund panel cointegration tests in Table 2:

Table 2 Panel cointegration test results

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

Note: *, **, and *** indicate the rejection of the null hypothesis of no cointegration at 10%, 5% and 1% significance level, respectively. Lag length is chosen according to Akaike Information Criterion.
Source: Authors' calculations.

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

We obtained estimates of the long-run coefficients of the cointegration relationship between permanent dollarization and MVP using two different methods: PMG and MG methods. These methods are applicable in a case when the time horizon is sufficiently large so that separate regressions can be estimated (Pesaran, Shin, and Smith (1999)). As stated above, the difference between these methods is that the PMG method 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 the MG method calculates coefficients from the unweighted average of the unconstrained, fully heterogeneous model (the long-run coefficients are heterogeneous as well). The MG method provides consistent estimates of the mean of the long-run coefficients. In a case of slope homogeneity, these estimates are inefficient. The PMG method, on the other hand, provides consistent and efficient estimators under the assumption of slope homogeneity (Pesaran, Shin, and Smith (1999)). We then tested the homogeneity of estimators using the Hausman test.

We examined hypothesis H1 within the following panel cointegration model:

$$\Delta DOL\_PERM_{it} = \phi_i(DOL\_PERM_{i,t-1} - c_{0i} - c_{1i}LOG(MVP)_{it}) + b_{1i}\Delta LOG(MVP)_{it} + \varepsilon_{it} \qquad (7)$$

The estimated coefficients are presented in Table 3:

Table 3 PMG and MG estimates of the cointegration relationship between the permanent dollarization share and MVP for the 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. *Source:* Authors' calculations

The long-run coefficient c_{1i} is of primary interest for our analysis. Consistent with the theoretical model (see Section 3), the estimated coefficients of the long-run relationship between dollarization and MVP share are positive and significant in both PMG and MG specifications, suggesting a positive cointegration relationship between permanent dollarization and MVP. We find that a 10 percent increase in MVP leads to an approximately 1.0 percent increase in dollarization in the long run. This confirms the findings in Ize and Levi 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 the 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, the 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 the homogeneity of long-run coefficients, the 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 repeated regression 7, replacing this time the MVP share by its components within the following panel cointegration model:

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

The results are summarized in Table 4, and suggest that the volatility of inflation and pass-through positively affect dollarization share in the long run, while an increase in the volatility of the exchange rate reduces the level of dollarization in the long run.

Table 4 PMG estimates of the cointegration relationship between permanent dollarization share and inflation volatility, volatility of exchange rate changes and exchange rate pass-through for the 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.Log(VOL_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. *Source:* Authors' calculations

5.2 Determinants of deposit dollarization in the short run

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

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

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 the nominal monthly depreciation rate, INF is the monthly inflation rate, while MVP is, as before, the optimal dollarization share estimated according to Equation 4.

Table 5 Arellano – Bond dynamic panel GMM estimates for the 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		
	Wald $chi^2(5)$=37.88	p=0.00	Wald $chi^2(4)$=37.69	p=0.00

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

The results are summarized in Table 5 and suggest that: (i) dollarization exhibits persistence in the short run (the coefficient for the lagged dependent variable is 0.26); (ii) the nominal interest rate spread, depreciation rate and MVP have statistically significant impacts on dollarization in the short run; (iii) Consistent with H3, INF is unlikely to play a substantive role in dollarization in the short run (model 1, Table 5) which confirms findings in Calvo and Vegh (1997).

Our results confirm the findings of Honohan (2007) and Neanidis and Savva (2009) that dollarization exhibits persistence and that the 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, the 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 Equation 3. MVP has a positive and statistically significant impact on transitory dollarization, but its impact is relatively low. Namely, a 10% increase in MVP leads to just a 0.03% increase in transitory dollarization. Since the 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 the currency structure of deposits (coefficient β_5 is not statistically significant). After excluding the inflation rate from the model, the rest of the coefficients remain unchanged in sign and are statistically significant.

6 Concluding remarks

In this paper, we find that different forces drive deposit dollarization in the long and in the short run. The reason for the different behavior 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 Levi Yeyati (2003), makes a distinction between the 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, besides MVP share, agents also take into the account 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 the CESE region, permanent dollarization is positively related to MVP share and that this relationship is homogeneous for the countries in the sample. A negative and statistically significant coefficient on the error-correction term highlights the process of convergence towards the long-run equilibrium dollarization share. Transitory dollarization, on the other hand, is, in addition to MVP share, also driven by the interest rate spread and nominal exchange rate movements.

If the goal is to reduce the 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 favor 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 policy aimed at lowering the volatility of inflation combined with a floating exchange rate may yield better results.

Appendix:

Table A1 Data availability on the dollarization share

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 A2 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)	Authors' calculation
DOL_TRANS	Transitory component of deposit dollarization obtained using Beveridge-Nelson methodology (log values)	Authors' 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	Authors' calculation
VOL_DEP	Volatility of nominal depreciation calculated using GARCH and EGARCH methodology	Authors' calculation
PASS	Exchange rate pass-through calculated using Kalman Filter methodology	Authors' calculation
MVP	MVP share calculated as $\frac{VOL\,INF \times PASS}{VOL\,DEP}$	Authors' 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 A3 Summary statistics of the 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

References

Arteta, Carlos Óscar. 2002. "Exchange Rate Regimes and Financial Dollarization: Does Flexibility Reduce Bank Currency Mismatches?" FRB International Finance Discussion Paper 738.

Basso, Henrique S., Oscar Calvo-Gonzales, and Marius Jurgilas. 2011. "Financial Dollarization: The Role of Foreign-Owned Banks and Interest Rates." *Journal of Banking and Finance*, 35(4): 794-806.

Broda, Christian, and Eduardo Levi Yeyati. 2006. "Endogenous Deposit Dollarization." *Journal of Money, Credit and Banking*, 38(4): 963-988.

Calvo, Guillermo, and Carlos Vegh. 1997. "From Currency Substitution to Dollarization and Beyond: Analytical and Policy Issues." In *Essays on Money, Inflation, and Output*, ed. Guillermo Calvo, 153-175. Cambridge: MIT Press.

De Nicoló, Gianni, Patrick Honohan, and Alain Ize. 2005. "Dollarization of Bank Deposits: Causes and Consequences." *Journal of Banking and Finance*, 29(7): 1697–1727.

Fabozzi, Frank J., Petter N. Kolm, Dessislava Pachamanova, and Sergio M. Focardi. 2007. *Robust Portfolio Optimization and Management.* New Jersey: John Wiley & Sons, Inc.

Honohan, Patrick. 2007. "Dollarization and Exchange Rate Fluctuations." World Bank Policy Research 4172.

Ize, Alain, and Eduardo Levy Yeyati. 2003. "Financial Dollarization." *Journal of International Economics*, 59(2): 323–347.

Ize, Alain, and Eduardo Levy Yeyati. 2005. "Financial De-Dollarization: Is It for Real?" International Monetary Fund Working Paper 05/187.

Levy Yeyati, Eduardo. 2006. "Financial Dollarization: Evaluating the Consequences." *Economic Policy*, 21(45): 61-118.

Luca, Alina, and Iva Petrova. 2008. "What Drives Credit Dollarization in Transition Economies?" *Journal of Banking and Finance*, 32(5): 858-869.

Menkhoff, Lukas, Lucio Sarno, Maik Schmeling, and Andreas Schrimpf. 2012. "Carry Trades and Global Foreign Exchange Volatility." *The Journal of Finance*, 67(2): 681-718.

Morely, James C. 2011. "The two interpretations of the Beveridge-Nelson decomposition." *Macroeconomic Dynamics*, 15(3): 419-439.

Neanidis, Kyriakos C., and Christos S. Savva. 2009. "Financial Dollarization: Short-Run Determinants in Transition Economies." *Journal of Banking and Finance*, 33(10): 1860-1873.

Ozsoz, Emre, Erick W. Rengifo, and Dominick Salvatore. 2008. "Dollarization as an Investment Signal in Developing Countries: The Case of Croatia, Czech Republic, Peru, Slovak Republic and Turkey." Fordham Economics Discussion Paper 2008-16.

Persyn, Damiaan, and Joakim Westerlund. 2008. "Error Correction Based Cointegration Tests for Panel Data." *Stata Journal* 8(2): 232-241.

Pesaran, Hashem M., Yongcheol Shin, and Ron P. Smith. 1999. "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels." *Journal of American Statistical Association*, 94(446): 621-634.

Rennhack, Robert, and Masahiro Nozaki. 2006. "Financial Dollarization in Latin America." International Monetary Fund Working Paper 06/7.

Scheiber, Thomas, and Helmut Stix. 2009. "Euroization in Central, Eastern and Southeastern Europe – New Evidence on its Extent and Some Evidence on its Causes." OeNB Working Paper 159.

Tkalec, Marina. 2013. "Monetary Determinants of Deposit Euroization in European Post-Transition Countries." *Panoeconomicus*, 60(1): 89-101.

Winkelried, Diego, and Paul Castillo. 2010. "Dollarization Persistence and Individual Heterogeneity." *Journal of International Money and Finance*, 29(8): 1596–1618.