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Determinants of Deposit and Credit Euroization in Eastern Europe: A Bayesian Model Averaging Evidence

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Abstract

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The paper investigates the motives of deposit and credit euroisation in Eastern Europe employing Bayesian empirical methodology. We analyse a unique dataset of macroeconomic fundamentals, perception surveys, and institutional quality indicators and deal with the uncertainty in the model by Bayesian model averaging. Apart from traditional fundamental factors, strong institutions are found to be an important driver of both credit and deposit euroisation. Business regulation, corruption environment, administrative costs and country-specific risk impact borrowing and saving behaviour in EURO and should be reflected in designing de-euroisation policies in the region.

Key words

Euroization, Bayesian model averaging, currency substitution, foreign currency borrowing, institutional quality

JEL: E51, F02, P24

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Introduction

Despite the existence of national currencies, most non-Eurozone East-European countries are to some extent euroised, in that households and enterprises borrow and keep part of their savings in Euro. This phenomenon is strongly persistent in the Balkan region where the Euro is considered a stable and trustful currency. In 2012, 75 percent of bank deposits in Croatia and Serbia and 40 percent of deposits in Albania, Bosnia and Herzegovina, Bulgaria and Macedonia were denominated in the euro (Brown and Stix, 2015). Similar features can also be identified in Kosovo, Armenia and Georgia, and to a smaller degree in Latvia and Lithuania (Ivanov, Tkalec and Vizek, 2011).

The existence of a large volume of foreign currency in the economy may pose serious challenges for proper monetary policy implementation. The fact that foreign currency inflows are outside the control of the monetary authority leads to weaker monetary transmission (Ize and Yeyati, 2005). This fact also implies potential problems associated with exchange rate risk. Due to balance sheet mismatches in the banking sector, exchange rate fluctuations have the potential to create credit quality shocks in euroised economies. The implications of such shocks on bank soundness and real activity could be severe in the case of a substantial currency depreciation (Kraft, 2003). Euroisation increases financial sector fragility by exposing banks to currency risk or currency-induced credit risk (Brown and Stix, 2015). Foreign exchange interventions become less effective as well, because the greater substitutability between local and foreign currency assets weakens the portfolio channel (Daude, Levy and Nagengast, 2016).

In this paper, we explore the motives of deposit and credit euroisation in Bulgaria, Romania, Hungary, Croatia and Serbia analysing a unique dataset of macroeconomic fundamentals, institutional quality indicators and perception surveys. We are contributing to the current literature on Euro circulation in non-Eurozone economies in three ways.

The problem of the proper estimation of the demand function for the foreign currency in the domestic economy faces the problem of a lack of economic theory to specify the regressors in the model. We tackle this issue by using a Bayesian empirical framework. We reduce the uncertainty in the model specification by employing Bayesian model averaging (BMA) using the Magnus, Powell and Prüfer (2010) estimator. This approach has been widely used in empirical analyses of commercial banks' behaviour (Kapounek, 2017; Hasan, Horvath and Mares, 2016; Fidrmuc and Lind, 2017). The BMA methodology is particularly useful in the cases of a lack of an appropriate theory for specification of the model, and in the cases of the large number of regressors suggested by the literature (Koop, 2009).

Secondly, the empirical framework enables us to compile a unique dataset of deposit and credit euroisation along with a large number of potential regressors. We analyse macroeconomic factors, a perception indicator about future economic conditions, and a special emphasis is put on the indicators of institutional environment quality. This overcomes the limitations of most single-country studies analysing a narrow set of determinants (see Ivanov, Tkalec and Vizek, 2011; Chailloux, Ohnsorge and Vavra, 2010; Manjani, 2015).

Lastly, we focus on both deposit and credit euroisation in the estimation. Commonly, the literature solely analyses either the deposit (Tkalec, 2013; Stix, 2008; Brown and Stix, 2015) or credit type of euroisation (Chitu, 2013). One of the few examples looking at both types is provided by Ivanov, Tkalec and Vizek (2011).

The empirical results document that, apart from fundamental macroeconomic factors, quality of institutions impacts credit and deposit euroisation. Business regulation, corruption environment, price controls and administrative burden determine the structure of bank deposits and the credit portfolio in the national currency and EURO.

The remainder of this paper is structured as follows. Section 2 presents the structure of the dataset. Section 3 introduces the Bayesian estimator and the empirical framework. Section 4 presents the Bayesian model averaging results. The robustness of the main results is discussed in Section 5 and section 6 is the conclusion.

1 Data

Our rich country-level dataset covers five countries in Eastern Europe. We focus on non-Eurozone EU countries (Bulgaria, Romania and Hungary) and the Balkan countries (Croatia and Serbia). In overall we analyse 16 explanatory variables over the 2004Q1 – 2016Q4 period.

The dataset covers 7 macroeconomic fundamental variables (bilateral exchange rate, interest rate differential, unemployment, policy risk, deflator, M1 monetary aggregate, remittances) and an indicator of perception of households about future economic conditions.

Special emphasis is placed on indicators of institutional quality. These factors are suggested by several authors to have an impact on deposit and credit euroisation. Brzoza-Brzezina, Chmielewski and Niedźwiedzińska (2010) show that institutional features of bank lending may be an important factor influencing households' choice of currency. Kapounek (2017) finds that institutional quality related to globalisation, freedom, government spending, low corruption and low marginal tax rates

impacts bank lending. The data on institutional quality indicators in our dataset cover Business Regulations, Index of Economic Freedom, Freedom from corruption, Business Freedom, Labour Freedom, Monetary Freedom, Investment Freedom and Financial Freedom.

The dataset is compiled from various sources, including the IMF, OECD, Eurostat, national central banks and national statistical offices (see the definition of variables in Table 4 in the Appendix for a detailed description and sources of data).

Tables 5 and 6 (in the appendix) provide summary statistics and the correlation matrix. For the purposes of the empirical analysis, data are transformed into chain indices and consequently by natural logarithms.

2 Methods

Using our rich dataset, we estimate the following models:

$$credit\_eur_{ct} = \sum_{m=1}^{M} macro_{ctm} + perception_{ct} + \sum_{i=1}^{I} institutions_{ict} + \upsilon_t + \varepsilon_{ct}, \quad (1)$$

$$deposit\_eur_{ct} = \sum_{m=1}^{M} macro_{ctm} + perception_{ct} + \sum_{i=1}^{I} institutions_{ict} + \upsilon_t + \varepsilon_{ct}, \quad (2)$$

where the variable $credit\_eur$ represents credit euroisation, measured as the bank credit in the EUR/overall volume of provided credit in all currencies, in country *c*, in time *t*, $deposit\_eur$ represents deposit euroisation, measured as the commercial banks' deposits in the EUR/overall volume of bank deposits in all currencies, in country *c*, in time *t*, *macro* represent selected macroeconomic fundamentals *m*, in a country *c*, in time *t*.

The second variable, denoted by *perception*, represents a perception indicator of households about their future economic situation, in a country *c*, in time *t*. The last set of variables, *institutions*, includes determinants of institutional environment quality *i*, in a country *c*, in time *t*. Finally, we include time effects υ_t and a residual ε.

We employ a Bayesian model averaging estimator introduced by Magnus, Powell and Prüfer (2010) to fit a classical linear regression model with uncertainty about the choice of the explanatory variables. This Bayesian estimator uses conventional non-informative priors on the focus parameters and the error variance, and a multivariate Gaussian prior on the auxiliary parameters.

The statistical framework is a linear regression model of the form:

$$\mathrm{y} = \mathrm{X}_1\beta_1 + \mathrm{X}_2\beta_2 + \mathrm{u} \tag{3}$$

where *y* is an *n×1* vector of observations on the outcome of interest; the *Xj, j =1 ,2*, are *n×kj* matrices of observations on two subsets of deterministic regressors; the *βj* are *kj×*1 vectors of unknown regression parameters; and *u∼N(0,σ2*), an *n×*1 random vector of unobservable disturbances whose elements are independent and identically distributed.

The focus regressors X_1 contain explanatory variables that are preferred in the model because of theoretical reasons or other considerations about the phenomenon under investigation. The auxiliary regressors X_2 contain additional explanatory variables with lower certainty of including into the preferred model.

The BMA algorithm calculates $2k^2$ combinations to obtain to obtain an exact BMA estimate, where *k* refers to the number of explanatory variables. The unconditional BMA estimates are obtained as a weighted average of the estimates from each of the possible models in the model space with weights proportional to the marginal likelihood of dependant variable in each model.

Bayesian model averaging deals with uncertainty about the choice of the explanatory variables that is generated by the lack of a one-to-one link between theory and empirical model specification (De Luca and Magnus, 2011). The Magnus, Powell and Prüfer (2010) estimator helps in cases of the lack of appropriate economic theory for the functional model specification, since it calculates posterior inclusion probabilities for each explanatory variable to be included in the model, using the equation:

$$\lambda_i = p(M_i \mid y) = \frac{p(M_i)\,p(y \mid M_i)}{\sum_{j=1}^{I} p(M_j)\,p(y \mid M_j)}, \tag{4}$$

Where $p(M_i)$ is the prior probability of model M_i and $p(y \mid M_i)$ is the marginal likelihood of *y* given model M_i.

3 Results

Table 1 presents the results of Bayesian Model Averaging for deposit euroisation. The key BMA statistic is the posterior inclusion probability (PIP) which reflects the importance of each variable. We

follow Campos, Fidrmuc and Korhonen (2017) and select the variables with a PIP >0.5 as the determinants of euroisation for the economic interpretation of results.

Table 1: BMA estimates of deposit euroization

BMA estimates dependent variable: deposit euroization			
	Coeff.	Std. err.	PIP
constant	-0.157	0.109	1
exchange rate	-0.985	0.435	0.93
ir differential	0.002	0.020	0.1
unemployment	0.176	0.217	0.46
deflator	0.768	0.732	0.61
M1	0.178	0.338	0.36
remmitances	-0.021	0.052	0.22
perception	0.005	0.016	0.16
policy risk	-0.005	0.031	0.1
business regulation	-1.772	0.763	0.91
corruption freedom	0.057	0.342	0.1
monetary freedom	-1.527	1.746	0.58
investment freedom	-0.037	0.293	0.09
labour freedom	-0.113	0.625	0.11
financial freedom	-0.053	0.309	0.16
business freedom	-0.024	0.553	0.11
economic freedom	0.017	1.907	0.14
no of countries			5
no of observations			1498

Source: own calculations.

From a theoretical perspective, saving in a foreign currency is strongly determined by the presence of exchange rate risk. Appreciation of the national currency decreases the value of savings in the foreign currency when converted to the national currency. Our estimates (Table 1) confirm these theoretical predictions and, in line with the literature (Ivanov, Tkalec and Vizek, 2011; Brown and Stix, 2015; Tkalec, 2013), we present evidence that the bilateral exchange rate to the EURO negatively impacts the ratio of bank deposits held in EURO.

The second macroeconomic factor identified by BMA is inflation (measured by the GDP deflator) that positively impacts the ratio of deposits in EURO. The reason for that can be found in Ize and Yeyati (2005), who claim that high inflation rates, which cause real exchange rate instability, encourage investors to save in a foreign currency. In that case, saving in a foreign currency provides more stable

purchasing power. Therefore, higher inflation differentials followed by greater real exchange rate volatility lead to higher deposit euroisation.

The second set of potential determinants of deposit euroisation analysed by the BMA procedure are indicators of the quality of institutions. The business regulation indicator is constructed on the logic that the more widespread different regulations are mirrored in a lower value of the index (see Table 4 in the Appendix). The results in Table 1 indicate that lower regulation of the financial system stimulates saving behaviour in the local currency and decreases the deposits euroisation. Lower price controls, bureaucracy costs and other administrative requirements motivate saving behaviour in the local currency and decrease the ratio of deposits in EURO.

Monetary freedom, an indicator based on inflation and the presence of price controls, has a negative sign in the deposit euroisation equation. Since both inflation and price controls distort market activity, the preference of national currency over EURO in the low-inflation environment is expected.

Consequently, we analyse the determinants of credit euroisation using the same procedure (Table 2). We find a positive significant effect of unemployment on credit euroisation. The question of the effect of income on the degree of euroisation has been widely discussed in the literature (Seater, 2008; Stix, 2008) with inconclusive results. Seater (2008) predicts a connection of the level of income and currency substitution. However, the sign of the effect depends on several parameters and elasticities. Currency substitution (substitution between the national currency and the EURO) is more likely among higher-income households than lower-income households, but the sign of the effect cannot easily be predicted. Our interpretation is based on the argument that rising unemployment and the economic downturn results in higher risk in the local economy. Economic agents therefore borrow in foreign currency with lower risk.

The positive effect of the monetary aggregate M1 on credit euroisation is driven by increasing inflation expectations in the economy and therefore rising preferences in borrowing in the foreign currency. On the contrary, a stable inflation environment is expected to reduce the volume of provided credit in EURO (Lin and Ye, 2013). Policy risk, measured as the spread on 10-year government bonds to German bonds, has the expected positive coefficient in the credit euroisation equation.

As with deposit euroisation, lower business regulation in the local economy reduces preferences for borrowing in EURO. Lower bureaucratic requirements and strong institutions reduce the preference for borrowing in a foreign currency.

Table 2: BMA estimates of credit euroization

BMA estimates dependent variable: credit euroization			
	Coeff.	Std. err.	PIP
constant	-0.018	0.064	1.00
exchange rate	0.082	0.199	0.22
ir differential	-0.014	0.033	0.23
unemployment	0.531	0.100	1.00
deflator	0.116	0.288	0.21
M1	0.237	0.176	0.70
remmitances	-0.005	0.016	0.15
perception	-0.0008	0.005	0.08
policy risk	0.059	0.058	0.64
business regulation	-1.446	0.674	0.99
corruption freedom	1.132	0.419	0.93
monetary freedom	0.141	1.097	0.15
investment freedom	0.091	0.300	0.15
labour freedom	0.060	0.460	0.12
financial freedom	-0.061	0.347	0.16
business freedom	-0.005	0.710	0.09
economic freedom	-0.018	2.346	0.10
no of countries			5
no of observations			1498

Source: own calculations.

Corruption environment has a significant negative effect on credit euroisation. The indicator is constructed on the logic that 10 indicates very little corruption and a score of 0 indicates a very corrupt government. We are therefore in line with several empirical studies (Neanidis and Savva, 2009; Nicolo, Honohan and Ize, 2005), and, from the construction of the index, we show that lower corruption does impact on short-run loan dollarisation in a negative way.

4 Robustness

The robustness of the preferred model estimated by BMA is controlled by OLS (see Janků, Kappel and Kučerová, 2015; for a suggested robustness check). Table 3 presents OLS estimates of the regressors identified by BMA with a PIP >0.5 for both deposit and credit euroisation. All results for credit and deposit euroisation are robust to the OLS check.

Table 1: Robustness of main results

explanatory variables	(1) deposit	(2) credit
exchange rate	-1.271***	
	(0.264)	
deflator	1.544***	
	(0.198)	
business regulation	-1.246***	-1.175***
	(0.170)	(0.150)
monetary freedom	-2.513***	
	(0.654)	
unemployment		0.490***
		(0.047)
M1		0.412***
		(0.061)
policy risk		0.068***
		(0.024)
corruption freedom		1.436***
		(0.162)
Constant	0.002	-0.000
	(0.025)	(0.014)
Observations	460	500
R-squared	0.873	0.987

Note: Standard errors in parentheses

Source: own calculations.

Conclusions

We present evidence of the impact of quality of institutions, macroeconomic fundamentals and perception of future economic conditions on deposit and credit euroisation in five post-transition Eastern European countries. Because of the lack of appropriate economic theory for the specification of the demand function for the EURO as a foreign currency, we estimate the empirical models by Bayesian Model Averaging using a unique manually compiled dataset.

The Bayesian estimates show that, apart from traditional macroeconomic fundamentals – exchange rate, inflation, unemployment, interest rate differential and money supply, quality of institutions impacts deposit and credit euroisation in Eastern Europe. Regulation of the business environment, corruption and the rule of law, price controls and administrative costs, impact the demand for EURO deposits and credits. The empirical results are robust to a different estimation method.

The results of this study help in understanding drivers in post-transition Eastern Europe and prove that quality of the business environment and the level of corruption should be reflected in designing de-euroisation policies in the region. Supporting the strength of institutional environment and

reducing corruption is a necessary condition for improvement of trust in the national currency and reducing incentives for saving and borrowing in EURO.

Appendix

Table 2: Definition of all analysed variables

Deflator *Eurostat* *Statistic office of Serbia* http://ec.europa.eu/eurostat/data/database	Deflator is calculated by dividing an aggregate measured at current prices by the same aggregate measured at constant prices.
Exchange rate *Eurostat* *Official websites of local central banks* http://ec.europa.eu/eurostat/data/database	Nominal bilateral exchange rate of national currency to EURO. Period average.
Interest rate differential *Eurostat* *OECD: Main Economic Indicators* *IMF International Financial Statistics* *Czech national bank official website* http://www.oecd.org/std/oecdmaineconomicindicatorsmei.htm http://ec.europa.eu/eurostat/data/database https://www.cnb.cz/docs/ARADY/HTML/index.htm http://www.imf.org/en/Data	Short-term interest rate differential (money market rates) between the local economy and the Eurozone.
M1 *IMF International Financial Statistics* *OECD: Main Economic Indicators* http://www.imf.org/en/Data http://www.oecd.org/std/oecdmaineconomicindicatorsmei.htm	Monetary aggregate M1 (narrow money) covers currency, i.e. banknotes and coins, as well as balances which can immediately be converted into currency or used for cashless payments, i.e. overnight deposits.
Policy risk *Eurostat* http://ec.europa.eu/eurostat/data/database	The 10-year maturity government bond yield spreads are calculated on the basis of averaged daily data for the government bond yield spreads relative to the government bond yield in the country selected as a benchmark for the calculation (Germany for the 10-year maturity).
Remittances *IMF Balance of Payments* http://www.imf.org/external/datamapper/datasets/BOP	Remittances in the category Current Account, Secondary income, Credit.
Unemployment *Eurostat* http://ec.europa.eu/eurostat/data/database	Seasonally adjusted unemployment rate.

Perception *Eurostat* http://ec.europa.eu/eurostat/data/database	Perception indicator from surveys conducted among households. The question being asked is "How do you expect that the financial situation of your household will develop over the next 12 months?"
Economic Freedom, Comp. of Economic Freedom Index http://www.heritage.org/index/explore	Index of economic freedom measures economic freedom based on 12 quantitative and qualitative factors, grouped into four broad categories, or pillars, of economic freedom: Rule of Law, Government Size, Regulatory Efficiency and Open Markets. Each of the subparts is graded on a scale of 0 to 100. A country's overall score is derived by averaging.
Business Freedom, Comp. of Economic Freedom Index http://www.heritage.org/index/explore	This index shows the ability to start, operate, and close a business that represents the overall burden of regulation and the efficiency of government regulations. The score is based on ten factors from the World Bank's Doing Business study.
Business regulations, Frazer Institute Economic Freedom of the World Index http://www.freetheworld.com/index.html	The index covers price controls, administrative requirements, bureaucracy costs, requirements for starting a business, extra payments (bribes) licensing restriction, and tax compliance. The more widespread different regulations are mirrored in a lower value of the index.
Financial Freedom, Comp. of Economic Freedom Index http://www.heritage.org/index/explore	Financial freedom is a measure of banking security as well as a measure of independence from government control on the scale • 100 – Negligible government influence; • 90 – Minimal government influence; • 10 – Near repressive; • 0 – Repressive.
Freedom from Corruption Comp. of Economic Freedom Index http://www.heritage.org/index/explore	The index is based on a 10-point scale in which a score of 10 indicates very little corruption and a score of 0 indicates a very corrupt government. The score for this component is derived primarily from Transparency International's Corruption Perceptions Index.
Investment Freedom, Comp. of Economic Freedom Index http://www.heritage.org/index/explore	The index evaluates the severity of restrictions related to investment including rules for foreign and domestic investment, restrictions on payments, transfers, foreign exchange and capital transactions, labour regulations, corruption, red tape, weak infrastructure, and political and security conditions.
Monetary Freedom, Comp. of Economic Freedom Index http://www.heritage.org/index/explore	Monetary freedom combines price stability (weighted average inflation for previous three years) with an assessment of price controls (a penalty up to 20% if price controls are important).
Labor Freedom, Comp. of Economic Freedom Index http://www.heritage.org/index/explore	The labor freedom is a quantitative measure that considers various aspects of the legal and regulatory

	framework of a country's labor market, including regulations concerning minimum wages, laws inhibiting layoffs, severance requirements, and measurable regulatory restraints on hiring and hours worked, plus the labor force participation rate.

Table 3: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
deposit eur.	104	0.130	0.181	-0.075	0.468
credit eur.	52	0.435	0.341	-0.295	0.813
exchange rate	88	0.038	0.066	-0.064	0.215
ir differential	87	-0.566	0.829	-2.785	1.395
deflator	84	0.180	0.139	-0.083	0.394
unemployment	88	0.059	0.382	-0.842	0.620
M1	88	0.572	0.314	-0.132	1.253
remmitances	88	0.395	0.485	-0.437	1.821
policy risk	88	0.004	0.753	-3.434	1.173
perception	87	0.350	0.704	-2.288	1.117
business reg.	80	-0.055	0.109	-0.217	0.118
economic free.	104	0.063	0.030	0	0.120
corruption free.	104	-0.007	0.069	-0.192	0.097
financial free.	104	-0.065	0.076	-0.154	0
labour free.	96	-0.015	0.035	-0.114	0.047
monetary free.	104	0.013	0.055	-0.124	0.180
investment free.	104	0.095	0.091	0	0.336
business free.	104	0.144	0.116	0	0.346

Table 4: Correlation matrix

economic f.	business f.	financial f.	labour f.	investment f.	monetary f.	corruption f.	business reg.	policy risk	perception	remmit.	M1	deflator	unemploy.	ir diff.	exchange r.	
															1	exchange r.
														1	-0.2715	ir diff.
													1	-0.358	0.6115	unemploy.
												1	0.0267	0.1494	0.2396	deflator
											1	0.914	-0.1766	-0.0839	0.1514	M1
										1	0.6955	0.7024	-0.2947	0.2119	-0.1734	remmit.
									1	0.2241	0.1618	0.3239	-0.1314	0.3618	-0.3619	perception
								1	0.2808	0.3606	0.2964	0.5364	0.1858	0.5443	0.1083	policy risk
							1	0.1788	0.0506	0.584	0.3637	0.3243	-0.6192	0.3144	-0.5197	business reg.
						1	-0.6375	-0.2878	-0.1032	-0.6906	-0.5658	-0.513	0.1206	0.0127	0.1632	corruption f.
					1	0.445	-0.5401	-0.3563	-0.2823	-0.4974	-0.2816	-0.3759	0.5945	-0.647	0.3278	monetary f.
				1	-0.0235	0.2608	0.1996	-0.2039	0.2135	0.0357	0.3447	0.2244	-0.4558	-0.1243	-0.1257	investment f.
			1	-0.2735	-0.2861	-0.0667	-0.1605	-0.0371	0.2929	-0.1881	-0.2951	-0.2686	-0.0712	0.0874	-0.3666	labour f.
		1	0.1124	-0.3479	0.4923	0.41	-0.5627	-0.2359	-0.447	-0.7504	-0.6254	-0.5775	0.5927	-0.3425	0.4757	financial f.
	1	-0.7455	-0.0978	0.5155	-0.5923	-0.5043	0.6542	0.3262	0.357	0.682	0.7809	0.7828	-0.457	0.1901	-0.1751	business f.
1	0.7149	-0.5372	-0.3047	0.6823	-0.0191	-0.1602	0.2662	0.269	0.3338	0.4838	0.8504	0.8191	-0.1423	-0.07	0.0942	economic f.

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