EUROPEAN CENTRAL BANK
EUROSYSTEM

Working Paper Series

Isabella Moder

The transmission of euro area monetary policy to financially euroised countries

No 2611 / October 2021

Abstract

This paper provides a comprehensive analysis of the interest rate pass-through of euro area monetary policy to retail rates outside the euro area, contributing to the literature on the consequences of unofficial financial euroisation and on the transmission channels of monetary policy spillovers. The results suggest that in the long run, more than one third of all euro retail rates in euroised countries of central, eastern and south-eastern Europe (CESEE) are linked to the euro area shadow rate. Compared to euro area monetary policy, the share of cointegration of the domestic monetary policy rate is lower, suggesting that domestic central banks in euroised countries with independent monetary policy can only partially control the 'euro part' of the interest rate channel. Furthermore, euro area monetary policy shocks are fast and persistently transmitted into euro retail rates outside the euro area, which constitutes an additional channel of international shock transmission.

Keywords: monetary policy transmission, international monetary policy spillovers, unofficial financial euroisation, EU integration
JEL-Classification: C22, C32, E43, E52, F42

Non-technical summary

The use of the euro is not restricted to the euro area. Instead, in a number of European countries outside of the euro area such as the economies of central, eastern and south-eastern Europe, the use of the euro is widespread. This paper deals with one particular aspect of this phenomenon, namely the denomination of bank deposits or bank loans in euro instead of the national currency. More specifically, this paper sheds light on the question to what extent the interest rates of euro deposits or euro loans in those countries are shaped by euro area monetary policy. With this focus, it aims to fill a gap in the literature that has not yet investigated this issue in a comprehensive way.

The responsiveness of interest rates on euro deposits and euro loans to euro area monetary policy is of great interest for central banks in the countries outside of the euro area. First, the behaviour of euro interest rates to euro area monetary policy is especially relevant for countries that are pursuing independent monetary policy. In case the euro interest rates were very responsive to euro area monetary policy, this might question the effectiveness of domestic monetary policy to influence financial conditions in the euro part of the banking sector. Second, if a clear response of euro retail rates to euro area monetary policy was found, this would indicate an additional channel how euro area monetary policy shapes economic conditions in its neighbouring regions that are outside of the currency union.

I employ two different empirical approaches based on a dataset of 200 time series consisting of deposit and lending rates of eight countries in central, eastern and south-eastern Europe.[1] First, I make use of a so-called cointegration test that measures the long-run co-movement between a key euro area interest rate and the respective euro lending or deposit rate, applying it to each individual interest rate in the period between January 2010 (or later depending on data availability) and June 2019. If the result of the test is positive, i.e. if a long-run relationship between those two interest rates is found, I calculate additional metrics to gather further information on the nature of the long-run co-movement. For countries that are pursuing independent monetary policy, the same exercise is conducted for the relationship between domestic monetary policy and euro lending or deposit rates in order to obtain a comparison between the responsiveness to

[1] Those countries are Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, North Macedonia, Romania and Serbia.

euro area and domestic monetary policy.

In the second part of the analysis I estimate vector autoregression (VAR) models in order to isolate the impact of euro area monetary policy shocks on euro lending or deposit rates, and to obtain further information on the dynamics of the transmission. As this type of analysis needs longer time series than the previous analysis described above, it can only be applied to the common movement of interest rates in a subset of three countries in central, eastern and south-eastern Europe.

The results suggest that euro interest rates in countries of central, eastern and south-eastern Europe respond at least as much to euro area monetary policy than they respond to domestic monetary policy. Moreover, some evidence can be found that the co-movement between euro lending and deposit rates and euro area monetary policy is higher for countries that are pegging their currency to the euro. The complementary VAR analysis confirms the immediate and persistent impact of euro area monetary policy shocks on euro lending and deposit rates. Overall, the results indicate that domestic central banks in countries with independent monetary policy can only partially control financial conditions in the euro part of their banking sectors, which makes domestic monetary policy somewhat ineffective. For countries with a fixed exchange rate regime linked to the euro the consequences seem to be less dramatic, given that domestic financial conditions are anyway linked to euro area monetary policy. The fast interest rate pass-through to euro lending and deposit rates might however constitute an additional channel of the international transmission of euro area monetary policy shocks.

1 Introduction

This paper provides a comprehensive analysis of the interest rate pass-through of euro area monetary policy to retail rates of euro loans and euro deposits *outside the euro area*. To the best of my knowledge, the cross-border pass-through of euro area monetary policy to financially euroised countries has not been systematically examined yet.

Since the seminal works on the interest rate pass-through undertaken by Cottarelli and Kourelis (1994) as well as Borio and Fritz (1995), a vast amount of research has emerged in order to estimate the interest rate pass-through in the euro area, linking changes in monetary policy and/or money market rates to changes in commercial banks' retail interest rates.

However, the use of the euro is not restricted to the euro area. Instead, in a number of European countries outside the euro area, mostly in the economies of central, eastern and south-eastern Europe (CESEE), economic agents voluntarily choose to hold a share of their deposits in euro, or take out loans in euro – a phenomenon which is called unofficial financial euroisation.[2] Unofficial financial euroisation is a common phenomenon in CESEE countries, as over 40% of total outstanding loans and more than one third of total deposits are denominated in euro instead of the national currency (see Table 1).[3]

Two main questions thus arise: First, does a relationship between euro area monetary policy and euro retail rates in unofficially euroised economies exist? Second, if such a relationship exists, to what extent can domestic monetary policy influence the euro part of the interest rate channel?

This paper is related to two strands in the literature: First, it contributes to the literature on the consequences of unofficial financial euroisation. While the discussion has focused mostly on its impact on financial stability and inflation, the implications for monetary policy effectiveness have not received much attention yet. A stronger interest rate pass-through to CESEE countries' retail rates for euro loans and deposits of euro area monetary policy compared to domestic monetary policy would indicate that domestic central banks can only partially control the euro part of the interest rate channel. This in turn would suggest adverse consequences for monetary policy effectiveness of CESEE countries that are pursuing independent monetary policy.

Second, and closely related, this paper contributes to the discussion on international spillovers

[2] Other types of unofficial euroisation include currency substitution, where the euro is used for financial transaction purposes, as well as real euroisation when prices and wages are indexed to euro.

[3] Unweighted average of CESEE countries excluding the Czech Republic and Poland where unofficial euroisation is less prevalent.

of advanced economies' monetary policy, and the respective transmission channels. Evidence for a notable interest rate pass-through of euro area monetary policy to CESEE countries' euro retail rates would indicate that an additional transmission channel of monetary policy spillovers for euroised countries exists. The presence of such a 'forex interest rate channel' would imply that euro area monetary policy directly affects the euroised share of domestic financial conditions.

There are many factors at play that could potentially shape the degree of euro area interest rate pass-through to CESEE countries. According to the literature on the determinants of the interest rate pass-through (see e.g. Sander and Kleimeier, 2004, for evidence on structural determinants of the interest rate pass-through in the euro area), characteristics of a country's banking sector such as market concentration, bank profitability or the presence of foreign banks might play a crucial role. Although those factors refer to the pass-through of domestic monetary policy, they might still be valid also in the case of the cross-border pass-through investigated in this paper, i.e. that the degree of interest rate pass-through depends on domestic CESEE country characteristics. The special nature of the cross-border pass-through might however imply that there are other - additional - factors at play, such as the institutional, economic or financial integration of a CESEE country with the euro area, or the interplay of euro area monetary policy with domestic monetary policy. Overall, given the above-mentioned considerations as well as the absence of any theoretical and empirical literature on the research questions, this paper attempts to gather first empirical evidence as a starting point for further research.

Therefore, in order to investigate whether a long-run relationship between euro area monetary policy and euro retail rates in euroised CESEE countries exists, I use two different empirical methods. First and foremost, I estimate the interest rate pass-through of a euro area shadow rate to a comprehensive dataset of 200 time series of euro retail rates in eight CESEE countries using an ARDL model in the spirit of Pesaran and Shin (1998) and Pesaran et al. (2001). To be able to compare the pass-through of euro area monetary policy with the pass-through of domestic monetary policy, the same exercise is thereafter undertaken with domestic monetary policy rates (where applicable). Lastly, to complement the evidence found in the previous steps, I investigate the dynamic impact of monetary policy shocks on the respective interest rates through employing VAR models for a subset of three countries.

The results suggest that in the long run more than one third of all euro retail rates in euroised CESEE countries are linked to euro area monetary policy. While euro retail rates in CESEE do not adjust completely to a change in the shadow rate, a deviation from the long-run

relationship is corrected by around 60% (deposit rates) and around 35% (lending rates) already within the next month. Compared to euro area monetary policy, domestic monetary policy has less influence on euro retail rates as the share of retail rates cointegrated with domestic monetary policy rates is lower. This suggests that domestic central banks in countries with independent monetary policy can only partially control the euro part of the interest rate channel. Therefore, the question arises to which extent monetary policy in those CESEE countries can lean against the 'euro area wind'. For countries with a fixed exchange rate regime linked to the euro, the consequences seem to be less dramatic, with the fast pass-through of monetary policy shocks to euro retail rates likely to constitute an additional channel of international monetary policy transmission.

Section 2 of this paper provides an overview of related literature, followed by section 3 to introduce the empirical set-up and the underlying data. Results are presented and discussed in section 4. Section 5 provides robustness checks and section 6 concludes.

2 Related literature

The traditional literature on the interest rate pass-through examines how a change in a domestic monetary policy reference rate (typically either the key policy rate or a short-term money market rate) affects domestic banks' lending or deposit rates. The outcome yields important information about the interest rate channel of monetary policy transmission, which is one of the main channels how monetary policy decisions transmit into the real economy. The 'completeness' in the interest rate pass-through (i.e. how well the transmission of monetary policy to lending or deposit rates works) is an important metric in evaluating monetary policy effectiveness and thus the ability of a central bank to stabilise short-run economic fluctuations.

Most studies on the interest rate pass-through use small-scale error correction models following the cost pricing model developed by Rousseas (1985), Winker (1999) and De Bondt (2005), where bank retail (i.e. lending and/or deposit) rates are explained by a constant markup on the pass-through of banks' marginal cost of funds, approximated by a market interest rate. Based on this model two distinct approaches have evolved in the literature: The *monetary policy approach* tests for the transmission of the key policy rate (or of an overnight or short-term money market rate as a more volatile proxy for monetary policy) to bank retail rates, covering the whole monetary policy pass-through process. On the contrary, the *cost of funds approach* matches retail

rates with money market rates of a comparable maturity to estimate the pass-through of banks' funding costs (Andries and Billon, 2016).

A large amount of literature has been dedicated to study the interest rate pass-through in Europe, see e.g. Sander and Kleimeier (2004) as well as Sørensen and Werner (2006) for the euro area on a macro level, and Gambacorta (2008) on Italian banks as an example for a micro-level analysis. According to the meta study of Andries and Billon (2016), the magnitude of the long-term pass-through has been found to be stronger for lending rates compared to deposit rates. For corporate loans, the long-run pass-through of lending rates has been estimated to be close to unity by a number of studies and thus of a higher magnitude compared to household loans. In the short-run, the empirical evidence suggests that the pass-through is incomplete, especially for household loans and deposits with short maturities. Since the onset of the financial crisis in 2008 it seems that the magnitude of the long-term pass-through has in general decreased, while cross-country heterogeneity has increased further in the euro area (see e.g. Darracq Paries et al., 2014; Hristov et al., 2014). Non-standard monetary policy measures were in general found to have contributed positively to the pass-through of euro area monetary policy, either because they helped to lower lending rates in addition to conventional instruments (von Borstel et al., 2016), or because unconventional measures helped to strengthen the pass-through of conventional monetary policy impaired by rising sovereign credit risk (Horváth et al., 2018).

A number of studies have also investigated the interest rate pass-through of domestic monetary policy in CESEE, as summarized in the meta study by Égert and MacDonald (2009). The empirical literature has found, similar to the euro area, that the most complete pass-through is present for corporate lending rates and that the most incomplete pass-through can be observed for consumer loans. For deposits, the pass-through seems to be less complete, but increases for products with higher maturities. Within the region, there exists considerable cross-country heterogeneity on the estimated pass-through coefficients. Closest to the research questions of this paper comes the work by Petrevski and Bogoev (2012), who estimate the interest rate pass-through for various lending rates of three countries in south-eastern Europe. For North Macedonia they investigate the pass-through from the EURIBOR (following the *cost of funds approach*) to lending rates in domestic currency only, but for Bulgaria and Croatia the pass-through from the EURIBOR to lending rates denominated in euro is estimated as well. The results suggest that for euro-denominated loans in Bulgaria the adjustment for long-term corporate loans is lower than for short-term corporate loans. On the other hand, no cointegrating

relationship between the EURIBOR and euro lending rates is found for Croatia.

This paper contributes to the literature on financial dollarisation/euroisation, and more specifically to the discussion on its macroeconomic consequences.[4] One strand of the literature has emphasised potentially adverse implications of dollarisation/euroisation for financial stability through adverse balance sheet effects (see e.g. Levy Yeyati, 2006; Bruno and Shin, 2015). In the presence of large foreign-currency exposures, domestic monetary policy might therefore on purpose mimic the monetary policy of the base country for financial stability considerations and thus exhibit 'fear of floating', even if it is at another stage of the business cycle (Reinhart et al., 2003; Georgiadis and Zhu, 2019). The literature has also investigated the consequences of dollarisation/euroisation for inflation, based on the observation that dollarised economies exhibit higher inflation rates due to a higher price elasticity to monetary shocks (Levy Yeyati, 2006). However, the impact of dollarisation/euroisation on the effectiveness of monetary policy, i.e. the transmission power of domestic monetary policy, has received very little attention so far. Brzoza-Brzezina et al. (2010) focus on the credit channel of monetary policy transmission in four central European countries and conclude that a rise in domestic interest rates prompts consumers to turn to foreign credit loans, as their results indicate that the volume of foreign currency loans increases at the expense of the volume of domestic currency loans following a domestic monetary tightening. With regard to the interest rate channel of monetary policy transmission, despite the fact that the loss of control has been mentioned in the literature (see e.g. Ize and Levy Yeyati, 2005), to the best of my knowledge no systematic attempt has been made so far to quantify those effectiveness losses.

Additionally, this paper is relevant in the context of the literature on international monetary policy spillovers and, more specifically, the transmission channels of monetary policy spillovers. The literature typically distinguishes between trade and financial transmission channels, see e.g. Kim (2001) for an early contribution on transmission channels of US conventional monetary policy spillovers, and Moder (2019) for recent work on spillover transmission channels of euro area non-standard monetary policy measures. With respect to financial transmission channels, overwhelming evidence has been found in the literature that US monetary policy influences global financial conditions and thus money market rates.[5] For the euro area, evidence on spillovers of

[4] On the drivers of dollarisation/euroisation, see e.g. Ize and Levy Yeyati (2003), Basso et al. (2011), Fidrmuc et al. (2013) and Brown and Stix (2015). For a discussion on regulatory policies aimed at reducing dollarisation/euroisation, see e.g. Windischbauer (2016).

[5] Related to the financial transmission channel of monetary policy shocks is the discussion on the global financial

ECB monetary policy shocks to other countries' money market rates is mixed (see e.g. Jiménez-Rodriguez et al., 2010; Moder, 2019). To the best of my knowledge however, the effects of US (euro) monetary policy shocks on dollar (euro) retail rates in dollarised (euroised) economies have not been investigated yet.

This paper therefore aims to fill two gaps in the literature: First, it examines whether unofficial euroisation constrains the effectiveness of domestic monetary policy. Second, it provides an assessment on the importance of the forex interest rate channel in transmitting spillovers of foreign monetary policy shocks.

3 Methodology

3.1 Empirical set-up

In the first step, I estimate the interest rate pass-through of the euro area monetary policy rate to a large dataset of 200 time series of euro retail rates in eight CESEE countries[6], for which the proportion of currency replacement by the euro in both deposits as well as loans is substantial.

More specifically, following Pesaran and Shin (1998) and Pesaran et al. (2001), I estimate a general Autoregressive Distributed Lag (ARDL) model for each interest rate series:

$$\Delta i_t^R = \alpha + \beta_1 i_{t-1}^R + \beta_2 i_{t-1}^M + \sum_{p=1}^{P-1} \gamma_{1p} \Delta i_{t-p}^R + \sum_{q=0}^{Q-1} \gamma_{2q} \Delta i_{t-q}^M + \Delta VIX_t + \varepsilon_t \tag{1}$$

which is another representation of the following error correction model:

$$\Delta i_t^R = \sum_{p=1}^{P-1} \gamma_{1p} \Delta i_{t-p}^R + \sum_{q=0}^{Q-1} \gamma_{2q} \Delta i_{t-q}^M + \Delta VIX_t + \beta_1 (i_{t-1}^R + \frac{\beta_2}{\beta_1} i_{t-1}^M + \frac{\alpha}{\beta_1}) + \varepsilon_t \tag{2}$$

and the error correction term is thus defined as follows:

$$EC_t = i_{t-1}^R + \frac{\beta_2}{\beta_1} i_{t-1}^M + \frac{\alpha}{\beta_1} \tag{3}$$

In the equations above i_t^R and i_t^M represent the retail rate and the euro area monetary policy rate, respectively, at time t, while Δ is the first difference operator. α denotes the constant markup, representing the risk premium, maturity premium and the banks' profit margin. In

cycle and monetary policy independence kicked off by Rey (2013).

[6] Those countries are Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, North Macedonia, Romania and Serbia.

order to control for international financial conditions that might affect both the euro area as well as the respective CESEE country I include the VIX as a measure of global financial stress. It adds the equation as a fixed regressor and is not part of the estimated long-run relationship. The associated long-run pass-through coefficient of the euro area monetary policy rate to the retail rate is given by β_2/β_1 and the speed of adjustment is indicated by the negative error correction coefficient β_1. The coefficients γ_{1p} and γ_{2q} denote the short-run adjustment dynamics towards the long-run equilibrium. The number of lags (P, Q) is determined by the Bayesian Information Criterion (BIC). Out of the five alternative representations offered by Pesaran and Shin (1998) and Pesaran et al. (2001) for ARDL models, case 2 is chosen that integrates the constant α into the error correction term and thus into the long-run relationship to represent the markup α/β_1.

ARDL models are superior to other approaches when testing for the existence of a relationship between variables in levels, since they are robust to misspecification of integration orders as the regressors do not necessarily all have to be integrated of order one (Pesaran et al., 2001). Instead, the underlying regressions can be I(0), I(1) or mutually cointegrated, which reduces the necessary degree of pre-testing and the associated uncertainty. Furthermore, estimating both short- and long-run parameters together in a single equation as is the case in the ARDL approach might help to avoid small-sample bias that occurs when estimating the long-run parameters separately in the first estimation step (Romilly et al., 2001).

Before the model is estimated, I test each series for the presence of I(2) and, if a cointegrating order of two is found, exclude it from the analysis. Subsequently the model ist estimated with a maximum of 8 lags for both variables, with insignificant lags being dropped according to the BIC. Cointegration is then tested by using the bounds test for cointegration from Pesaran et al. (2001), which is based on a standard F-test, with the critical values provided by Narayan (2004) for smaller sample sizes. The following null hypothesis of no relationship in levels is tested:

$$H_0 : \beta_1 = \beta_2 = 0 \tag{4}$$

If cointegration is found between the respective retail rate i^r and the euro area monetary policy rate i^m, the analysis continues with estimating the size of the long-run pass-through and the speed of adjustment. The estimations are tested for serial correlation and heteroskedasticity, and the model is adjusted if necessary by including more lags or by using a HAC covariance matrix adjustment to correct the value of the test statistics used for heteroskedasticity.

As discussed in section 2, the explanatory variable in the ARDL model can either represent the policy rate to test for the pass-through of monetary policy, or a money market rate with similar maturity to estimate the pass-through of funding costs to retail rates (see Sander and Kleimeier, 2004). This paper follows the first approach, since the interest lies in the international transmission of euro area *monetary policy*. Moreover, after the global financial crisis, commercial banks in CESEE countries have shifted their funding away from money markets and/or parent bank funding towards domestic (euro) deposits (reflected in the decline in loan-to-deposit ratios, see e.g. Vienna Initiative, 2019). Thus a money market rate with a similar maturity might not even represent the real funding costs banks are facing.

After estimating the same models for countries with fixed and floating exchange rate regimes, I focus on the interest rate pass-through of domestic monetary policy to euro retail rates thereafter. Out of the countries included in this paper, Albania, Hungary, Romania and Serbia follow inflation targeting regimes with managed or freely floating exchange rates, and are thus the focus of the analysis of the domestic monetary policy pass-through.[7] To this end, I again follow the procedure outlined above, except that i_t^M now represents the domestic monetary policy rate i_t^{Mdom} instead of a proxy for the euro area monetary policy rate, and that the analysis is – naturally – confined to countries with independent monetary policy, which excludes four out of the eight countries in the sample.[8]

Approaching the research questions of this paper through ARDL models provides important first evidence on the cointegration of CESEE euro retail rates and euro area monetary policy rates. However, the cointegration analysis suffers from two main shortcomings: First, and more importantly, the ARDL approach is based on a reduced-form empirical model. As market rates[9] are used as a measure for euro area monetary policy in the ARDL analysis, which are not exclusively determined by euro area monetary policy but also shaped by other factors such as economic conditions and expectations (Romer and Romer, 2004), no causal inference can be made on the impact of euro area monetary policy actions on CESEE retail rates. In addition, while the ARDL approach yields information on the short- and the long-run pass-through, it does not provide a dynamic estimate of the monetary policy transmission, i.e. after which period the long-run pass-through of monetary policy has fully materialised and for how long it persists.

[7] The remainder of the countries peg their currencies to the euro and thus do not have independent monetary policy tools at their disposal.

[8] These countries are Bosnia and Herzegovina, Bulgaria, Croatia and North Macedonia.

[9] More specifically, I use the euro area shadow rate by Wu and Xia (2016), see discussion in the next section.

Thus, to properly assess the impact of euro area monetary policy shocks and to study their dynamic transmission, I undertake another empirical analysis by employing vector autoregression (VAR) models where euro area monetary policy surprise shocks are represented by an exogenous instrument following Altavilla et al. (2019).[10] This method bears the advantage that no structural identification schemes which involve macroeconomic variables are necessary.

I first compute the first principal component of the estimated covariance matrix of all lending and deposit series for each country, respectively, in order to reduce the dimensionality of the data. Since the scales are the same (interest rates) and the variances of the respective series are similar, the covariance matrix is used to compute the first principal component. Next, I use the first principal component series as input into the following country-specific reduced-form VAR model at monthly frequency:

$$\sum_{s=0}^{p} \mathbf{B}_s \mathbf{y}_{t-s} + \mathbf{c} = \mathbf{A}_0 \mathbf{u}_t \tag{5}$$

$\sum_{s=0}^{p}$ denotes the sum of all lags p, $\mathbf{B}_s$ denotes the matrix of the estimated coefficients, $\mathbf{y}_{t-s}$ represents a vector of macroeconomic variables and $\mathbf{c}$ a vector of constants. The matrix $\mathbf{A}_0$ corresponds to the contemporaneous effect of the monetary policy shock, and the instrument used to capture the exogenous monetary policy surprise shocks in $\mathbf{u}_t$ is assumed to fulfill the necessary relevance and exogeneity assumptions (Altavilla et al., 2019).

Each country's VAR model includes a proxy for the euro area monetary policy rate, i_t^M, the domestic monetary policy rate of the respective country (if applicable), i_t^{Mdom}, the estimated first principal component series of both the lending and deposit rates, $PC1_t^{Lending}$ and $PC1_t^{Deposit}$, the VIX as an indicator for global financial stress, VIX_t, and the instrument to capture monetary policy shocks, Z_t. The domestic monetary policy rate, as well as the principal component series of the lending and deposit rates are set block exogenous to the euro area monetary policy rate and the VIX, constraining the model so that neither current nor past economic developments in the CESEE countries affect euro area monetary policy or global systemic stress. This feature introduced by Cushman and Zha (1997) has been used frequently in the literature and is well suited for modelling spillovers from large to small economies, as it helps to identify spillovers from the viewpoint of the small open economy and reduces the number of parameters to be estimated (Cushman and Zha, 1997).

[10] Unfortunately, due to data limitations (see section 3.2), this last part of the analysis can only be undertaken for a subset of three countries.

The chosen estimation procedure is Bayesian, because it is very well suited for shorter data sets. I use an independent normal-Wishart prior and obtain the scale matrix S_0 from individual AR regressions, with the hyperparameters being chosen as suggested by Dieppe et al. (2016). Estimations are carried out by employing the BEAR toolbox developed by Dieppe et al. (2016). The posterior is derived by Gibbs sampling with a total number of 10,000 iterations and a burn-in sample of 5,000 iterations. As the data enters the model in monthly frequency, I use 12 lags for the VAR analysis, thus $p = 12$.

3.2 Data

The literature following the *monetary policy approach* (see e.g. Hristov et al., 2014; Gambacorta et al., 2015) typically uses the EONIA as a proxy for euro area monetary policy. However, the EONIA has been varying only very little since it reached the effective lower bound constrained by the deposit rate in early-2016 (see figure 1), and as a consequence does not fully incorporate non-standard monetary policy measures that were introduced after the global financial crisis. Therefore, in line with the literature, I use the shadow rate by Wu and Xia (2016) as a measure for euro area monetary policy since it captures both conventional and non-standard monetary policy.[11] The shadow rate is calculated by assessing bond prices in a framework of a multifactor term structure model; and is directly comparable to the key policy rate as both interest rates are equal in conventional times. For the estimations of the pass-through of domestic monetary policy rates to euro retail rates, I use the respective domestic key monetary policy rates since overnight or short-term money market rates are not available over the time span for all countries.

Excluding two countries with relatively low loan and deposit euroisation (Czech Republic and Poland, where euro loans and deposits account for less than 15% and 10%, respectively, of the total volumes) leaves eight countries in CESEE at my disposal[12]. For each country, all publicly available statistics of euro lending or deposit rates for new business[13] that do not suffer from data gaps are used as individual input into each ARDL model. Including all available time series in the ARDL models instead of focusing on a few main statistics makes the display

[11] Besides shadow rates, the interest rate pass-through literature has also employed dummies or the Eurosystem balance sheet assets as measures for non-standard monetary policy, see e.g. von Borstel et al. (2016); Horváth et al. (2018).

[12] The respective countries are Albania, Bulgaria, Bosnia and Herzegovina, Croatia, North Macedonia, Hungary, Romania and Serbia.

[13] Series for new business as opposed to outstanding loans are used, as the former provide a much better indicator of current interest rates while the latter react with a considerable time lag given their composition.

and discussion of results challenging. Nevertheless, constraining the analysis to a few statistics instead of all available ones would come at a considerable cost as it would greatly reduce the richness of the results, given the very heterogeneous composition of available statistics across countries that are not harmonised.

Table 2 shows the decomposition of statistics for each country into lending and deposit rates. In total 200 retail rates for eight countries are analysed in this paper. The series cover interest rates of both loans and deposits to/from households and non-financial corporates, respectively, and differ in terms of sectors, currencies[14], maturity, purpose, interest rate fixation and loan amount. By far the largest number of interest rate statistics for euro loans and deposits are available for Bulgaria and Croatia, followed by Albania and Bosnia and Herzegovina. The composition of deposit versus lending rates is – with two exceptions – tilted towards lending rates, for which generally more time series are available. A list of all statistics included can be found in the appendix.

The statistics are also heterogeneous in their starting points. While data is available from January 2005 (Hungary) and January 2007 (Bulgaria and Romania), it starts much later for other countries, especially for North Macedonia (January 2015) and Albania (December 2015).[15] In order to make the series somewhat comparable without loosing too many observations, and to account for structural breaks in the time series during the global financial crisis (see e.g. Gambacorta et al., 2015), I start the estimation sample in January 2010 or later whenever the time series become available (table 2). With a monthly frequency, at most 114 observations are thus available for each estimation. All statistics are derived from the webpages of the respective national central banks.

For the VAR models I use the measure of Altavilla et al. (2019), who identify Eurosystem monetary policy surprise shocks based on intraday asset price changes around the policy decision announcement. More specifically, I use what the authors call a 'Target' surprise, which captures interest rate surprises in the context of the monetary policy decision and affects mostly the very short-end of the yield curve.[16] I again include the euro area shadow rate by Wu and Xia (2016)

[14]Some series cover interest rates of so-called euro-indexed deposits and loans. Those products are paid and technically repaid in domestic currency, but cash flows are indexed to changes in the exchange rate between the euro and the domestic currency.

[15]For Albania, all series are available from 2015, for Bosnia and Herzegovina from 2012, for Bulgaria some from 2004 and some from 2007, for Croatia from 2011, for Hungary most from 2005 and a few from 2012, for North Macedonia from 2015, for Romania from 2007 and for Serbia from 2010.

[16]The daily time series of the Target surprise are downloaded from `http://refet.bilkent.edu.tr/research.html` and aggregated to obtain monthly series.

to account for any changes in euro area monetary policy other than the Target shock, and any other developments that are reflected in the shadow rate, as well as the VIX to control for global financial stress.

For the CESEE countries' retail rates, the available statistics are separated between loan and deposit interest rates and by country to derive the series of first principal components. As the VARs are richer models compared to the ARDL models, more observations are needed. Therefore, unfortunately, the VAR analysis can only be performed for a subset of three countries (Bulgaria, Hungary and Romania) where the availability of the interest rate series from January 2007 (Bulgaria and Romania) and January 2005 (Hungary)[17] provides enough observations to obtain meaningful results.

4 Results

In the following two subsections, interest rate statistics are considered to be cointegrated with the shadow rate (or the domestic monetary policy rate) if the bounds test by Pesaran et al. (2001) yields a conclusive result at least at the 5% significance level, and if the coefficient of the long-run pass-through of the shadow rate (or domestic monetary policy rate, respectively) is found to be significant at least at the 5% level.[18] Only if cointegration is found, the long-run pass-through and the speed of adjustment are estimated (see section 3.1), which is a rather conservative approach compared to some papers in the literature that report the respective coefficients also for time series where empirical tests failed to provide evidence for cointegration.

Given the high number of coefficients estimated in the 200 ARDL models and the large heterogeneity in terms of the available statistics, the presentation of the results focuses on two metrics: the differences between lending and deposit rates on the one hand, and between countries on the other hand. For the presentation of the estimation results, I focus on the long-run pass-through and on the speed of adjustment. The estimated short-run pass-through is not always significant and thus not further discussed here.

[17] While the bulk of time series are available as of January 2005 for Hungary, five time series have to be excluded from the principal components analysis as their availability starts much later.

[18] It should be noted that the test statistic used implies that the interest rate statistics are independent from each other. In section 5 I report the results of robustness checks of adjusting the significance level for multiple testing.

4.1 Pass-through of euro area monetary policy

In total, out of 200 euro interest rate statistics tested, 77 have been found to be cointegrated with the shadow rate. In other words more than one third or 38.5% of all published euro interest rate series exhibit a long-run relationship with the shadow rate that captures euro area monetary policy measures (table 3). With no prior expectation about the outcome and in the absence of any comparable literature, the interpretation of this result is not straightforward. This is complicated by the fact that the literature on the euro area interest rate pass-through often does not report the results of cointegration tests. If the results are reported, however, they suggest that even within the euro area only a share of retail rates is cointegrated with euro area monetary policy.[19] An important metric in assessing the degree of cointegration of the euro area shadow rate with CESEE euro retail rates is thus the comparison with the pass-through of domestic monetary policy (see section 4.2).

Distinguishing by products, the percentage of deposit rates that are cointegrated with the shadow rate is considerably lower compared to the cointegration of lending rates. Moreover, the magnitude of the long-run pass-through, i.e. to what extent changes in the shadow rate are being passed through to retail rates, is stronger for lending rates compared to deposit rates (figure 2), which is in line with the findings for the euro area (Andries and Billon, 2016). Still, even for lending rates the pass-through is mostly incomplete.

The speed of adjustment is by definition negative and measures to what extent movements into disequilibrium are corrected within one period. On the contrary to the stronger pass-through found for lending compared to deposit rates, the latter seem to adjust faster to a deviation from the estimated long-run relationship, where about 60% of a deviation is already corrected within the next month compared to around 35% for lending rates (figure 2).

Grouping the results by countries (table 3) suggests that the highest share of cointegrated retail rate series is observed in North Macedonia, followed by Croatia. In both countries more than half of all euro retail rate statistics available are cointegrated with the shadow rate. On the contrary, cointegration is the lowest for euro retail rates in Serbia, Romania and Hungary. Thus, with the exception of Albania, retail rates of countries that pursue independent monetary policy appear to be cointegrated less with the shadow rate. In five out of eight countries the share

[19] For example, Bernhofer and van Treeck (2013), who use the same framework as this paper (but in a cost-of-funds approach) for 10 euro area countries between 1991 and 2009, find that the null hypothesis of no long-run level relationship can be rejected for only around half of the retail rates tested.

of cointegrated lending rates is higher compared to deposit rates. The heterogeneity across countries is also reflected in the distribution of the estimated coefficients of the cointegrated series (figure 3). The median of the estimated long-run pass-through is the lowest in Albania, and the highest in Bulgaria, Croatia and Bosnia and Herzegovina. The median of the estimated adjustment to disequilibria lies between 20% and 40% for most countries, with the exception of Albania where the adjustment happens much faster. However, keeping in mind the heterogeneity of the available statistics across countries and the variance of the estimated coefficients, the results and cross-country comparisons should be treated with caution.

4.2 Pass-through of domestic monetary policy

The second part of the analysis deals with the pass-through of domestic monetary policy to euro deposit and lending rates in CESEE countries with independent monetary policy. Table 4 displays the percentage of cointegrated series for Albania, Hungary, Romania and Serbia. In sum, the percentage of interest rate statistics cointegrated with the domestic monetary policy rate is *lower* than the percentage of interest rate statistics cointegrated with the euro area shadow rate, suggesting that domestic central banks can only partially control the 'euro' part of the interest rate channel. For Albania and Hungary, the share of euro retail rates cointegrated with the shadow rate is higher than the share of retail rates cointegrated with the domestic monetary policy, while the opposite holds true for Romania and Serbia. Looking at the individual time series, it is not necessarily the same series that are cointegrated with both the shadow rate and the domestic monetary policy rate.[20] !

Compared to the results obtained in the previous section for the euro area shadow rate, the long-run pass-through of domestic monetary policy rates appears to be higher for lending rates and relatively similar for deposit rates (figure 4). On the other hand, the speed of adjustment seems to be faster to domestic monetary policy for both deposit and lending rates as compared to the shadow rate. Like the results in the previous section, the long-run pass-through is again higher for lending rates compared to deposit rates and below unity for both, implying an incomplete long-run pass-through, and the speed of adjustment is higher for deposit rates compared to lending rates.

The estimated coefficients vary again considerably across countries, with the strongest pass-

[20] See a list of statistics in the appendix, where series are marked if they are cointegrated with the **shadow rate** and/or *domestic monetary policy rate*.

through and the fastest adjustment of/to domestic monetary policy estimated for Albania.

4.3 Response to euro area monetary policy shocks

In this subsection the previous findings based on ARDL models are complemented with additional analysis obtained from employing VAR models. More specifically, I am interested in the transmission of monetary policy shocks to euro retail rates in CESEE. In addition, a VAR analysis can indicate how long it takes for the monetary policy shock to be transmitted to euro retail rates in CESEE and how persistent the response of the retail rates is. However, as discussed in section 3.1, unfortunately only the time series of three countries (Bulgaria, Hungary and Romania) are long enough to provide enough degrees of freedom for the VAR analysis.

The outcome of the principal component analysis shows that the first principal direction already captures most of the common movement of the respective variables (figure 6), as the second principal direction is close to or below the average of the eigenvalues. Thus, using the first principal direction in the VAR analysis should be sufficient.

The impulse response functions for Bulgaria are shown in figure 7. A monetary policy target surprise shock (see discussion in section 3.2) immediately affects the principal component of the deposit and the lending rates. The impact on lending rates is initially negative, but turns positive after three months. Both the response of the deposit as well as the lending rates appear very persistent in the medium term, despite the slow fading out of the impact on the shadow rate, and are similar in size.

For Hungary the VAR model includes additionally the domestic monetary policy rate in order to control for domestic monetary policy actions (figure 8). A monetary policy target shock triggers a positive response of the domestic monetary policy rate. The responses of the principal component series of deposit and lending rates are positive from the start, which is different to the case of Bulgarian lending rates discussed above. At the same time, the responses are less persistent as they partially fade out over the period of 24 months, and they appear to be smaller overall compared to Bulgaria, which is in line with the findings from the ARDL analysis where Bulgarian retail rates were found to have the highest interest rate pass-through with the shadow rate.

In the case of Romania the VAR model again includes the domestic monetary policy rate (figure 9). The response of the domestic policy rate is positive, but smaller in size compared to Hungary. The impact on the lending and deposit rates is quite similar compared to Hungary,

with the effect of the shock on retail rates partially fading out over time and an overall smaller response compared to Bulgaria.

5 Robustness checks

One potential issue the could arise with the ARDL model analyses performed in this paper stems from the test statistic used for the analysis of the results described in sections 4.1 and 4.2, which implies 200 independent time series. However, the treatment of those 200 interest rate statistics as independent from each other can be questioned on the grounds that they might be correlated at least at country level, and potentially even across countries. This creates a multiple testing problem, where the confidence interval and the significance thresholds need to be adjusted accordingly in order to avoid a type I error (i.e. a false positive result).

In the inference of cointegration of an individual interest rate statistic in sections 4.1 and 4.2 two conditions needed to be fulfilled: First, the series passes the bounds test for cointegration developed by Pesaran et al. (2001) at least at the 5% significance level, using the critical values provided by Narayan (2004) for small data samples. Second, the coefficient of the long-run pass-through of the shadow rate (or domestic monetary policy rate) to the respective interest rate statistics is significant at least at the 5% level.

Adjusting the critical values of the bounds test for cointegration developed by Pesaran et al. (2001) (the first condition) for multiple statistics is unfortunately not straightforward and subject to future research. However, I am able to adjust the critical values of the coefficient of the shadow rate in the long-run equation (the second condition). More specifically, I adjust the confidence interval through the Bonferroni correction, which is one of the more conservative approaches to correct for multiple testing (for details see e.g. Sokal and Rohlf, 1995). Through the Bonferroni correction the confidence interval, CI, is adjusted by applying the following formula:

$$CI = 1 - \frac{\alpha}{m} \tag{6}$$

where the initial significance level, α, is divided by the number of multiple tests undertaken, m. Since 200 time series are tested, the long-run coefficient of the shadow rate therefore needs to be significant at the 0.025% level, leading to a Bonferroni-adjusted confidence interval of 99.975%.[21].

[21]The Dunn–Sidak correction, another method of correcting for multiple testing through the formula $1 - (1 -$

While testing 200 time series with unadjusted critical values suggested that 77 time series, or 38.5% were cointegrated with the shadow rate, the result does not change considerably when adjusting the critical values for multiple testing through the Bonferroni correction. In fact, 64 out of 200, or 32.0% of the euro retail rates in CESEE countries still appear to be cointegrated with the shadow rate, even when applying a conservative significance level of 0.025% (see table 5). The medians of the estimated coefficients are also broadly unchanged when adjusting the sample for multiple testing. Overall, this confirms the robustness of the results obtained earlier.

Adjusting the critical values of the interest rate pass-through of domestic monetary policy to euro retail rates by the same method with a significance level of 0.07%[22] suggests that 18.6% of all interest rate statistics are cointegrated with domestic monetary policy rates, compared to the result of 30.0% when using unadjusted critical values (see table 4). Therefore, it can be concluded that after adjusting for multiple comparisons, the pass-through of the euro area shadow rate is still more relevant than the pass-through of domestic monetary policy.

6 Conclusion

This paper provides a comprehensive analysis of the interest rate pass-through of euro area monetary policy to euro retail rates outside the euro area, and compares it with the pass-through of domestic monetary policy to euro retail rates. More specifically, two questions are addressed: First, does a relationship between the euro area shadow rate and euro retail rates in unofficially euroised economies exist? Second, if such a relationship exists, to what extent can domestic monetary policy influence the euro part of the interest rate channel?

The results suggest that in the long run, more than one third of all euro retail rates in euroised CESEE countries are linked to the euro area shadow rate as a proxy for monetary policy, and that a higher share of lending rates compared to deposit rates is cointegrated with the shadow rate. Across countries, some evidence can be found that the percentage of cointegrated retail rates is higher for countries that do not have independent monetary policy at their disposal as they peg their currency to the euro.

The estimated coefficients of the long-run pass-through suggest that euro retail rates in CESEE do not adjust completely to a change in the shadow rate, with considerable heterogeneity

$\alpha)^{\frac{1}{m}}$, yields a very similar adjusted confidence interval of 99.9744%.

[22] This is derived by $\frac{5\%}{70}$, as the total number of interest rate statistics in countries with independent monetary policy amounts to 70.

across countries. With regard to the speed of adjustment, around 60% of a deviation of the long-run relationship between the respective deposit rates and the shadow rate is corrected within the next month, while the correction is lower for lending rates at around 35%.

Investigating the pass-through domestic monetary policy suggests that euro retail rates are more likely to be cointegrated with the shadow rate than with the domestic monetary policy rate. If a long-run relationship between the euro retail rate and the domestic monetary policy rate exists, the pass-through of a domestic monetary policy change to the respective retail rate is similar or somewhat higher (for deposit and lending rates, respectively), but still incomplete. This suggests that domestic central banks in countries with independent monetary policy can only partially control the 'euro part' of the interest rate channel.

Additional evidence from a VAR analysis covering a subset of three countries (Bulgaria, Hungary and Romania) confirms the fast transmission of monetary policy target surprise shocks to euro retail rates outside the euro area, which is persistent also over the medium term.

The results of this paper are particularly relevant for CESEE countries with independent monetary policy, as they suggest some loss in monetary policy effectiveness for financially euroised countries. The question arises to what extent monetary policy in those CESEE countries can lean against the 'euro area wind', when it can only partially control parts of the domestic interest rate channel. For countries with a fixed exchange rate regime linked to the euro the consequences seem to be less dramatic, given that domestic financial conditions are anyway linked to euro area monetary policy. The fast interest rate pass-through to euro retail rates might however constitute an additional channel of the transmission of euro area monetary policy shocks as has been shown in the VAR analysis of this paper.

While this paper provides evidence of a clear link between euro area monetary policy and euro retail rates in CESEE and finds that domestic central banks can only partially control the 'euro part' of the interest rate channel, a number of questions remain for future research: First, what determines the interest rate pass-through and the estimated coefficients? Second and related to the previous question, as the analysis focuses on the post-crisis period with low interest rates and a number of non-standard monetary policy measures, do the findings of this paper apply to 'normal' times as well? Third, what can domestic (monetary) policy do to gain more control over the 'euroised' interest rate channel? Last but not least, are the findings of this paper confined to the euro area and the closely linked CESEE region, or do they also apply to US monetary policy and dollarised countries across the world?

Tables and Figures

Table 1: Unofficial financial euroisation in CESEE

Country	*Share of outstanding euro deposits in total deposits*	*Share of oustanding euro loans in total loans*
Albania	44.3%	46.4%
Bosnia and Herzegovina	33.2%	54.7%
Bulgaria	29.5%	33.7%
Croatia	51.0%	53.4%
Czech Republic	6.3%	13.2%
Hungary	16.1%	22.8%
North Macedonia	35.8%	40.4%
Poland	7.7%	10.2%
Romania	28.6%	31.5%
Serbia	61.1%	63.8%
Unweighted average	31.4%	37.0%
Unweighted average excl. Czech Republic and Poland	37.5%	43.3%

Source: Statistical annex of European Central Bank (2019). Note: Where applicable, euro-indexed deposits and loans are included. The table excludes Kosovo and Montenegro as they are unilaterally euroised without using a separate legal tender. Data as of December 2018.

Table 2: Summary of statistics

Country	*#of series*			*Sample*
		of which: deposit rates	*of which: lending rates*	
Albania	28	11	17	12/15-06/19
Bosnia and Herzegovina	26	10	16	01/12-06/19
Bulgaria	52	25	27	01/10-06/19
Croatia	41	12	29	12/11-06/19
Hungary	14	5	9	01/10-06/19
North Macedonia	11	5	6	01/15-06/19
Romania	16	9	7	01/10-06/19
Serbia	12	9	3	09/10-06/19
Sum	200	86	114	

Table 3: Interest rate pass-through of the euro area shadow rate by country

Country	*Cointegrated all rates*	*Cointegrated deposit rates*	*Cointegrated lending rates*
Albania	42.9%	63.6%	29.4%
Bosnia and Herzegovina	38.5%	20.0%	50.0%
Bulgaria	38.5%	8.0%	66.7%
Croatia	53.7%	50.0%	55.2%
Hungary	21.4%	20.0%	22.2%
North Macedonia	54.5%	60.0%	50.0%
Romania	18.8%	11.1%	28.6%
Serbia	8.3%	11.1%	0.0%
Sum	38.5%	26.7%	47.4%

Note: A series is considered to be cointegrated with the shadow rate if the test by Pesaran et al. (2001) with the critical values provided by Narayan (2004) yields a conclusive result at least at the 5% significance level, and if the long-run coefficient of the shadow rate is significant at least at the 5% significance level.

Table 4: Pass-through of the domestic monetary policy rate by country

Country	*Cointegrated all rates*	*Cointegrated deposit rates*	*Cointegrated lending rates*
Albania	39.3%	63.6%	23.5%
Hungary	14.3%	20.0%	11.1%
Romania	31.3%	22.2%	42.9%
Serbia	25.0%	22.2%	33.3%
Sum	30.0%	35.3%	25.0%

Note: A series is considered to be cointegrated with the domestic monetary policy rate if the test by Pesaran et al. (2001) with the critical values provided by Narayan (2004) yields a conclusive result at least at the 5% significance level, and if the long-run coefficient of the domestic monetary policy rate is significant at least at the 5% significance level.

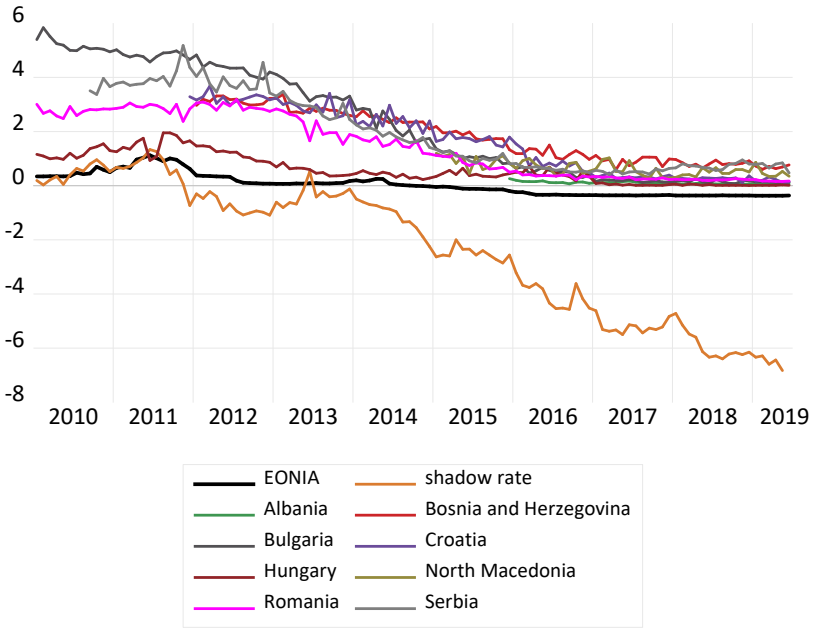
Table 5: Interest rate pass-through of the euro area shadow rate by country, adjusted for multiple testing

Country	*Cointegrated with unadjusted critical values*	*Cointegrated with adjusted critical values*
Albania	42.9%	17.9%
Bosnia and Herzegovina	38.5%	38.5%
Bulgaria	38.5%	34.6%
Croatia	53.7%	1.2%
Hungary	21.4%	14.3%
North Macedonia	54.5%	36.4%
Romania	18.8%	18.8%
Serbia	8.3%	8.3%
Sum	38.5%	32.0%

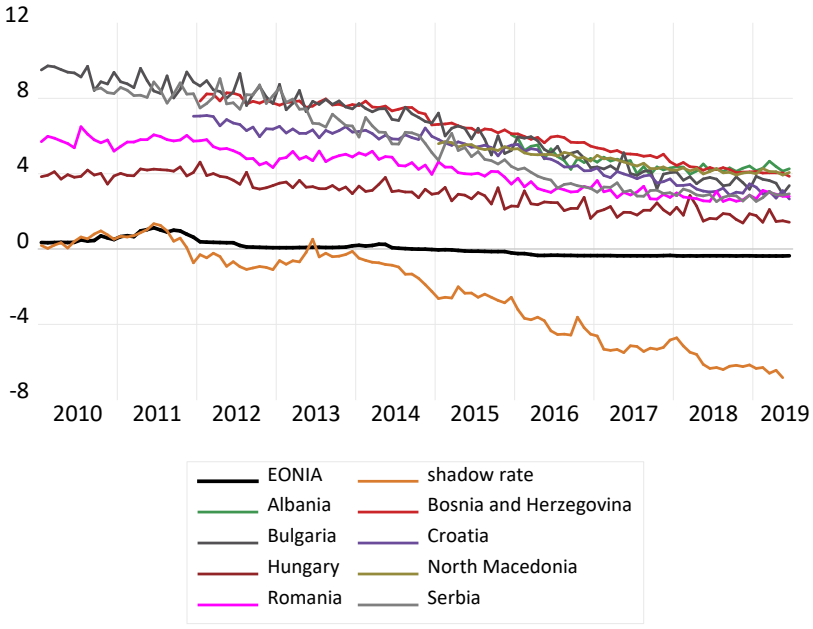
Note: A series is considered to be cointegrated with the shadow rate if the test by Pesaran et al. (2001) with the critical values provided by Narayan (2004) yields a conclusive result at least at the 5% significance level, and if the long-run coefficient of the shadow rate is significant at least at a significance level of 5% (second column) or 0.025% (third column).

Figure 1: Evolution of retail rates over time

(a) Deposit rates



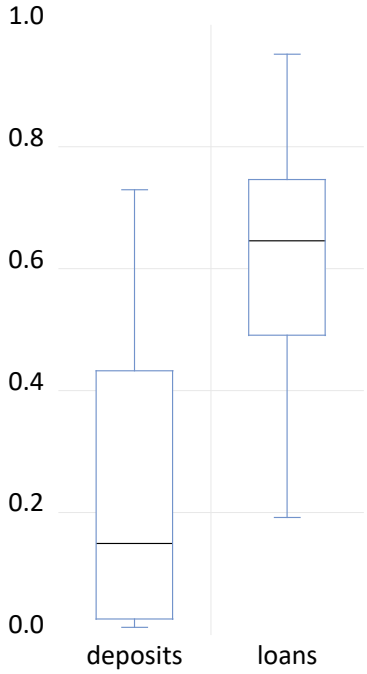
(b) Lending rates



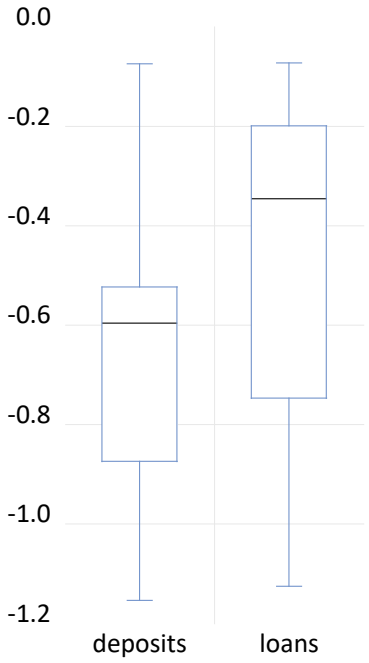
Source: Author's calculations and national central banks. Note: Lines depict the median of the respective time series listed in the Appendix.

Figure 2: Estimated coefficients of the interest rate pass-through of the shadow rate: by product

(a) Long-run pass-through



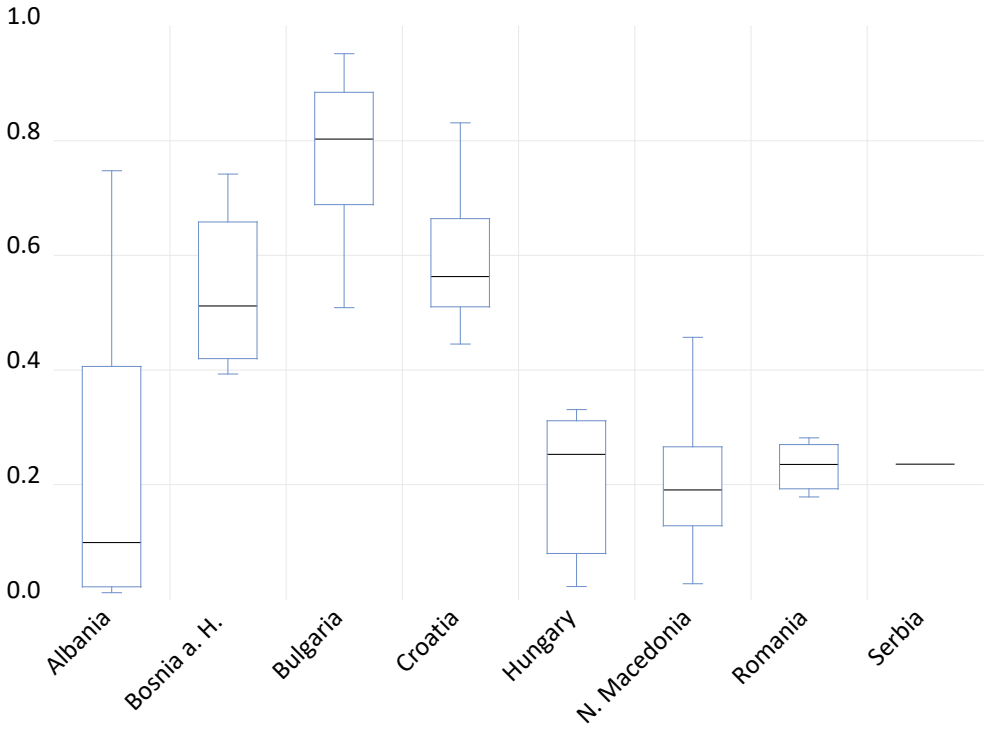
(b) Speed of adjustment



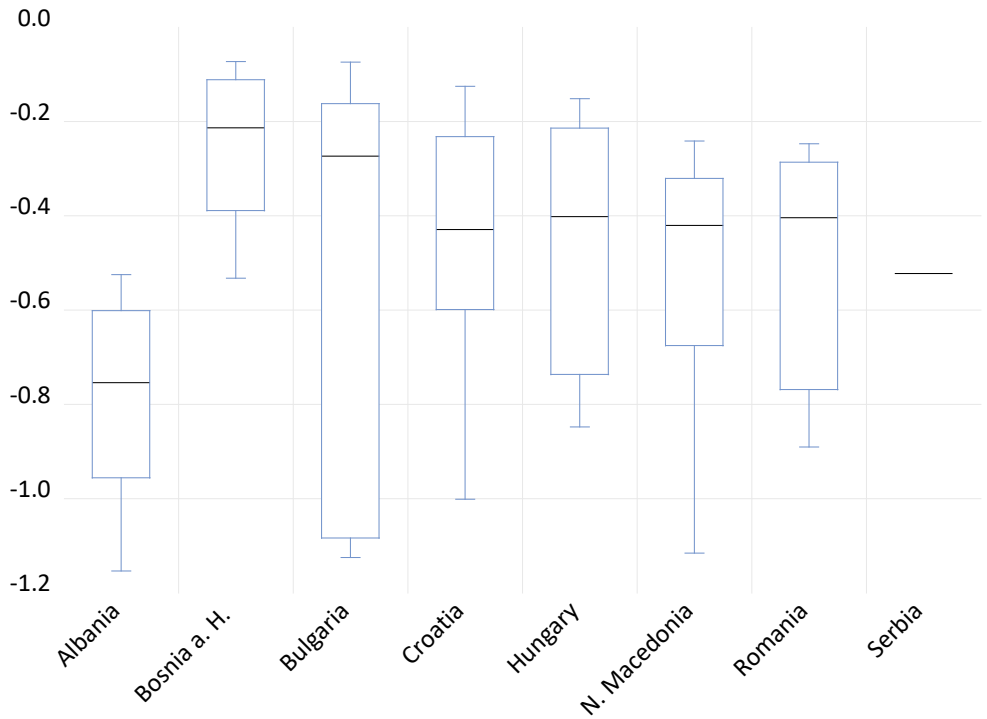
Note: Distribution of estimated coefficients in ARDL models. Distribution consists of 23 and 54 coefficients for deposit and lending rates, respectively.

Figure 3: Estimated coefficients of the interest rate pass-through of the shadow rate: by country

(a) Long-run pass-through



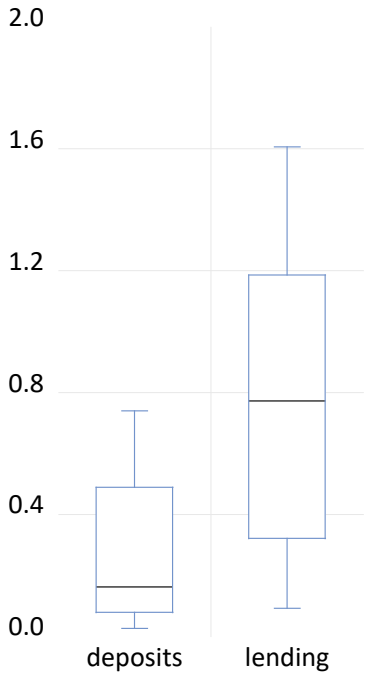
(b) Speed of adjustment



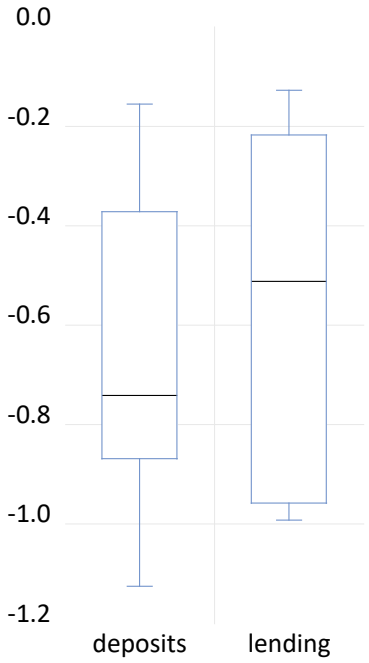
Note: Distribution of estimated coefficients in ARDL models. Distribution consists of 12, 10, 20, 22, 3, 6, 3 and 1 coefficients for each of the countries, respectively.

Figure 4: Estimated coefficients of domestic monetary policy pass-through: by product

(a) Long-run pass-through



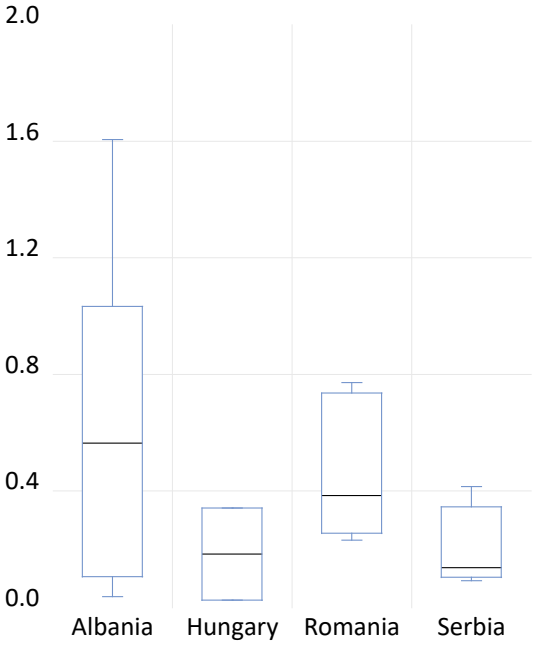
(b) Speed of adjustment



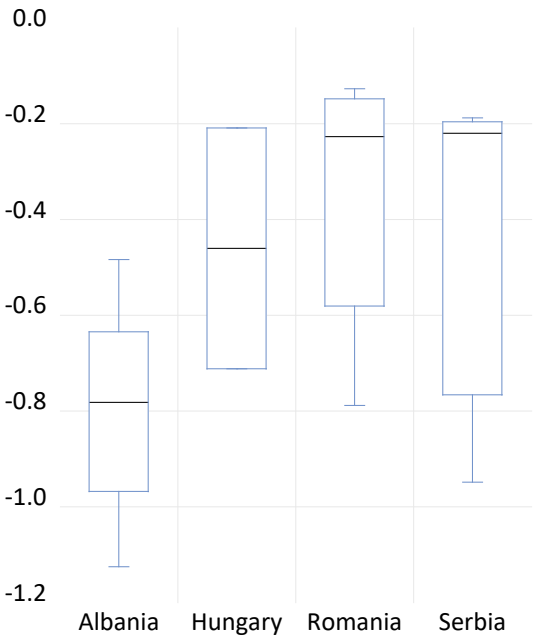
Note: Distribution of estimated coefficients in ARDL models. Distribution consists of 12 and 9 coefficients for deposit and lending rates, respectively.

Figure 5: Estimated coefficients of domestic monetary policy pass-through: by country

(a) Long-run pass-through

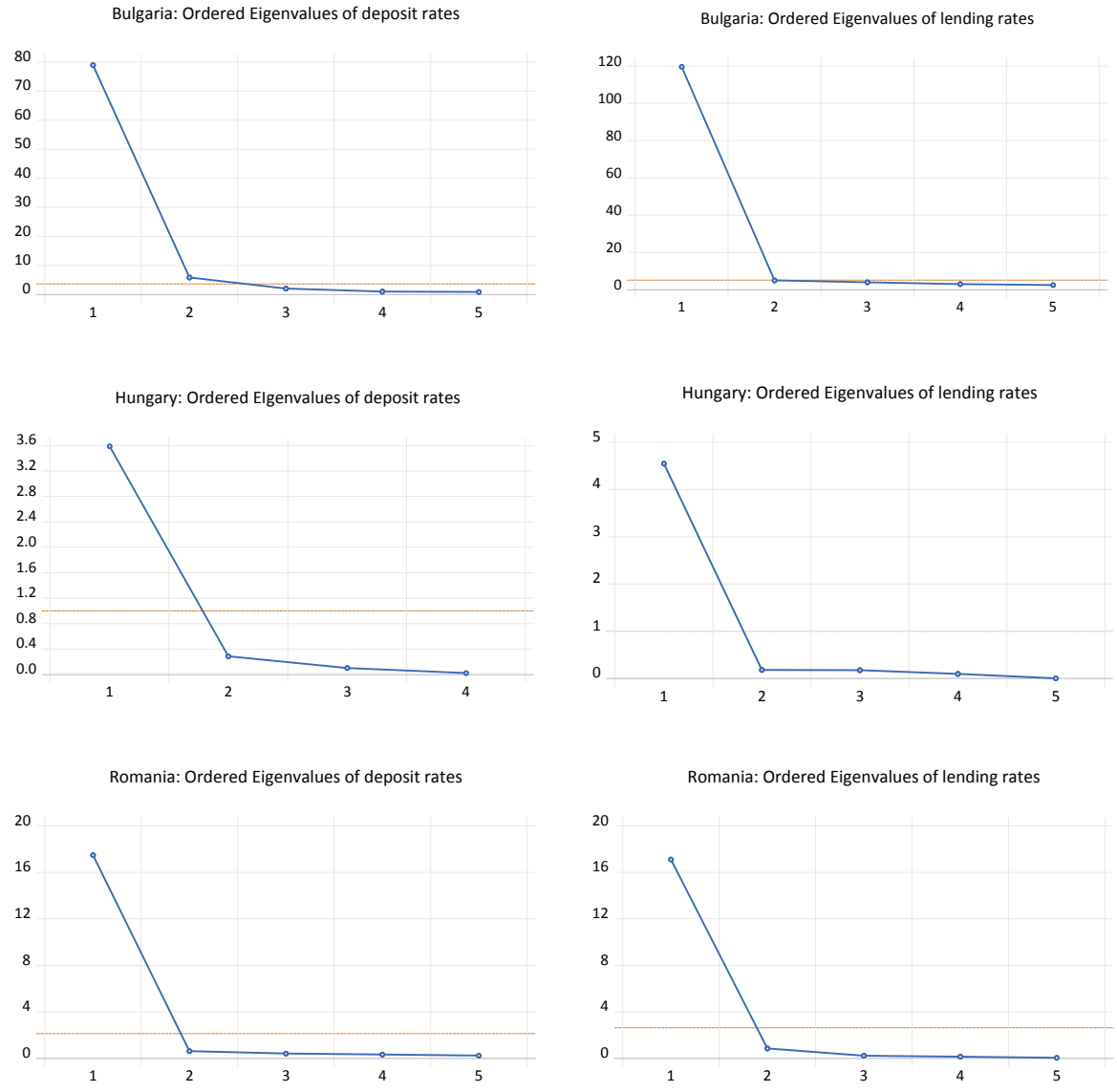


(b) Speed of adjustment



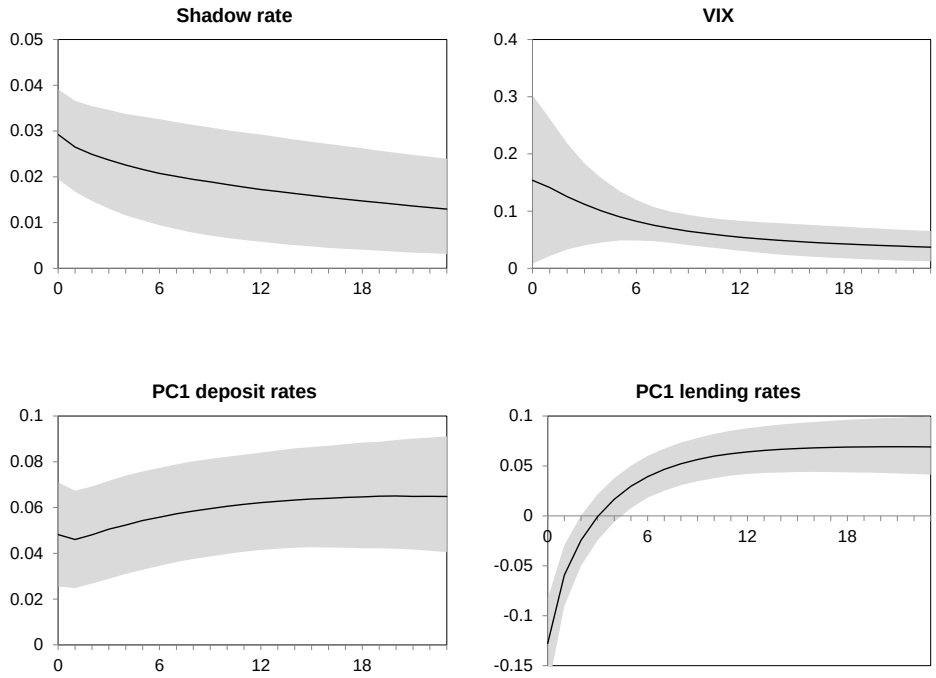
Note: Distribution of estimated coefficients in ARDL models. Distribution consists of 11, 2, 5, and 3 coefficients for each of the countries, respectively.

Figure 6: Scree plots



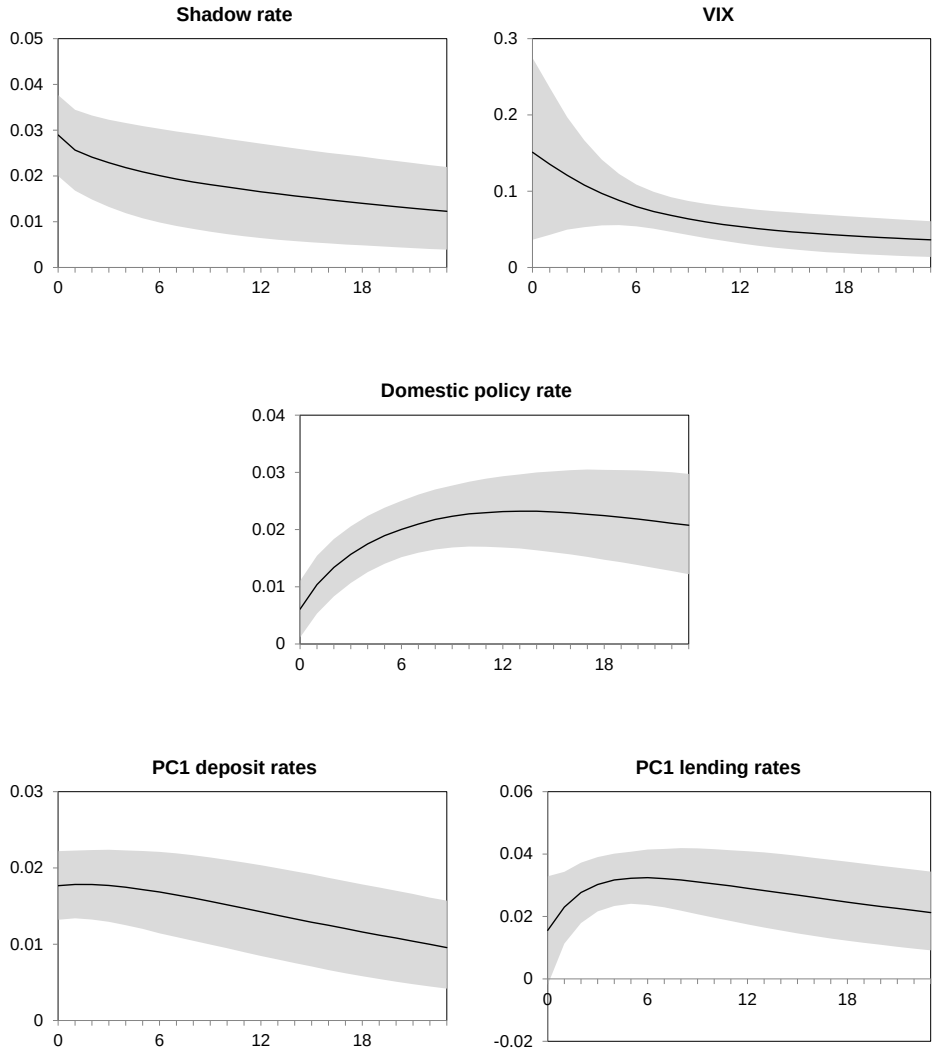
Note: Eigenvalues arranged in order of principality with the horizontal line equal to the average of the eigenvalues.

Figure 7: Bulgaria: Response to a euro area monetary policy target surprise shock



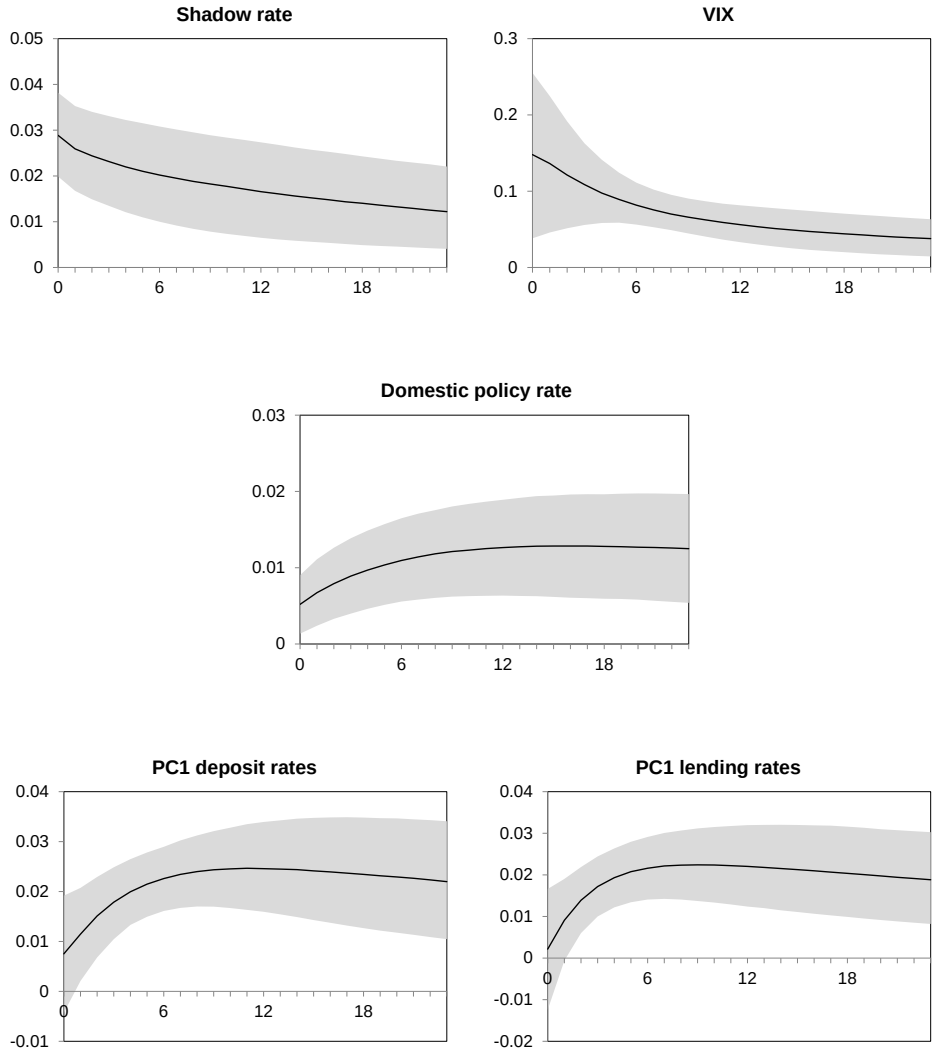
Note: Response of variables to an exogenous monetary policy target surprise shock. PC1 refers to the first principal component of the respective series. The dashed regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis absolute changes.

Figure 8: Hungary: Response to a euro area monetary policy target surprise shock



Note: Response of variables to an exogenous euro area monetary policy target surprise shock. Domestic policy rate refers to the key policy rate of the National Bank of Hungary. PC1 refers to the first principal component of the respective series. The dashed regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis absolute changes.

Figure 9: Romania: Response to a euro area monetary policy target surprise shock



Note: Response of variables to an exogenous euro area monetary policy target surprise shock. Domestic policy rate refers to the key policy rate of the National Bank of Romania. PC1 refers to the first principal component of the respective series. The dashed regions report pointwise 68 percent credibility intervals. The x-axis reports months, the y-axis absolute changes.

References

Altavilla, C., Brugnolini, L., Gürkaynak, R. S., Motto, R., and Ragusa, G. (2019). Measuring euro area monetary policy. *Journal of Monetary Economics*, 108(C):162–179.

Andries, N. and Billon, S. (2016). Retail bank interest rate pass-through in the euro area: An empirical survey. *Economic Systems*, 40(1):170–194.

Basso, H. S., Calvo-Gonzalez, O., and Jurgilas, M. (2011). Financial dollarization: The role of foreign-owned banks and interest rates. *Journal of Banking and Finance*, 35(4):794–806.

Bernhofer, D. and van Treeck, T. (2013). New evidence of heterogeneous bank interest rate pass-through in the euro area. *Economic Modelling*, 35:418–429.

Borio, C. and Fritz, W. (1995). The response of short-term bank lending rates to policy rates: A cross-country perspective. BIS Working Paper 27, Bank for International Settlements.

Brown, M. and Stix, H. (2015). The euroization of bank deposits in eastern Europe. *Economic Policy*, 30(81):95–139.

Bruno, V. and Shin, H. S. (2015). Cross-border banking and global liquidity. *Review of Economic Studies*, 82(2):535–564.

Brzoza-Brzezina, M., Chmielewski, T., and Niedźwiedzińska, J. (2010). Substitution between domestic and foreign currency loans in central Europe – do central banks matter? ECB Working Paper 1187, European Central Bank.

Cottarelli, C. and Kourelis, A. (1994). Financial structure, bank lending rates, and the transmission mechanism of monetary policy. Staff Paper 41/4, International Monetary Fund.

Cushman, D. O. and Zha, T. (1997). Identifying monetary policy in a small open economy under flexible exchange rates. *Journal of Money, Credit and Banking*, 39:433–448.

Darracq Paries, M., Moccero, D. N., Krylova, E., and Marchini, C. (2014). The retail bank interest rate pass-through: The case of the euro area during the financial and sovereign debt crisis. ECB Occasional Paper 155, Eurpean Central Bank.

De Bondt, G. J. (2005). Interest rate pass-through: Empirical results for the euro area. *German Economic Review*, 6(1):37–78.

Dieppe, A., Legrand, R., and van Roye, B. (2016). The BEAR toolbox. ECB Working Paper 1934, European Central Bank.

Égert, B. and MacDonald, R. (2009). Monetary transmission mechanism in Central and Eastern Europe: Surveying the surveyable. *Journal of Economic Surveys*, 23(2):277–327.

European Central Bank (2019). The international role of the euro. Technical report, ECB.

Fidrmuc, J., Hake, M., and Stix, H. (2013). Households' foreign currency borrowing in central and eastern Europe. *Journal of Banking and Finance*, 37(6):1880–1897.

Gambacorta, L. (2008). How do banks set interest rates? *European Economic Review*, 52(5):792–819.

Gambacorta, L., Illes, A., and Lombardi, M. J. (2015). Has the transmission of policy rates to lending rates changed in the wake of the global financial crisis? *International Finance*, 18(3):263–280.

Georgiadis, G. and Zhu, F. (2019). Monetary policy spillovers, capital controls and exchange rate flexibility, and the financial channel of exchange rates. ECB Working Paper 2267, European Central Bank.

Horváth, R., Kotlebova, J., and Siranova, M. (2018). Interest rate pass-through in the euro area: Financial fragmentation, balance sheet policies and negative rates. *Journal of Financial Stability*, 36(C):12–21.

Hristov, N., Hülsewig, O., and Wollmershäuser, T. (2014). The interest rate pass-through in the euro area during the global financial crisis. *Journal of Banking and Finance*, 48:104–119.

Ize, A. and Levy Yeyati, E. (2003). Financial dollarization. *Journal of International Economics*, 59(2):323–347.

Ize, A. and Levy Yeyati, E. (2005). Financial de-dollarization: Is it for real? IMF Working Paper WP/05/187, International Monetary Fund.

Jiménez-Rodriguez, R., Morales-Zumaquero, A., and Ègert, B. (2010). The VARying effect of foreign shocks in Central and Eastern Europe. *Journal of Policy Modeling*, 32:461–477.

Kim, S. (2001). International transmission of U.S. monetary policy shocks: Evidence from VAR's. *Journal of Monetary Economics*, 48:339–372.

Levy Yeyati, E. (2006). Financial dollarization: Evaluating the consequences. *Economic Policy*, 21(45):61–118.

Moder, I. (2019). Spillovers from the ECB's non-standard monetary policy measures on south-eastern Europe. *International Journal of Central Banking*, 15(4):127–163.

Narayan, P. K. (2004). Reformulating Critical Values for the Bounds F-statistics Approach to Cointegration: An Application to the Tourism Demand Model for Fiji. Department of Economics Discussion Papers 02/04, Monash University.

Pesaran, M. H. and Shin, Y. (1998). An autoregressive distributed-lag modelling approach to cointegration analysis. *Econometric Society Monographs*, 31:371–413.

Pesaran, M. H., Shin, Y., and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3):289–326.

Petrevski, G. and Bogoev, J. (2012). Interest rate pass-through in South East Europe: An empirical analysis. *Economic Systems*, 36(4):571–593.

Reinhart, C. M., Rogoff, K. S., and Savastano, M. A. (2003). Addicted to dollars. NBER Working Paper 10015, National Bureau of Economic Research.

Rey, H. (2013). Dilemma not trilemma: The global financial cycle and monetary policy independence. Jackson Hole Economic Symposium.

Romer, C. D. and Romer, D. H. (2004). A New Measure of Monetary Shocks: Derivation and Implications. *American Economic Review*, 94(4):1055–1084.

Romilly, P., Song, H., and Liu, X. (2001). Car ownership and use in Britain: A comparison of the empirical results of alternative cointegration estimation methods and forecasts. *Applied Economics*, 33(14):1803–1818.

Rousseas, S. (1985). A markup theory of bank loan rates. *Journal of Post Keynesian Economics*, 8(1):135–144.

Sander, H. and Kleimeier, S. (2004). Convergence in euro-zone retail banking? What interest rate pass-through tells us about monetary policy transmission, competition and integration. *Journal of International Money and Finance*, 23(3):461–492.

Sokal, R. R. and Rohlf, F. J. (1995). *Biometry: The Principles and Practice of Statistics in Biological Research. 3rd Edition*. W. H. Freeman and Company.

Sørensen, C. K. and Werner, T. (2006). Bank interest rate pass-through in the euro area – a cross country comparison. ECB Working Paper 580, European Central Bank.

Vienna Initiative (2019). Cesee deleveraging and credit monitor. Technical Report May.

von Borstel, J., Eickmeier, S., and Krippner, L. (2016). The interest rate pass-through in the euro area during the sovereign debt crisis. *Journal of International Money and Finance*, 68(C):386–402.

Windischbauer, U. (2016). Strengthening the role of local currencies in EU candidate and potential candidate countries. ECB Occasional Paper 170, European Central Bank.

Winker, P. (1999). Sluggish adjustment of interest rates and credit rationing: An application of unit root testing and error correction modelling. *Applied Economics*, 31(3):267–277.

Wu, J. C. and Xia, F. D. (2016). Measuring the macroeconomic impact of monetary policy at the zero lower bound. *Journal of Money, Credit and Banking*, 48:253–291.

Annex – list of euro retail rates

1 Albania	
1.1 Deposit rates	1.2 Lending rates
1.1.1 All sectors	1.2.1 Households
Current account	Total
Demand deposits	Overdraft
1 Month deposits	**Consuming of non durable goods**
3 Months deposits	*Consuming of durable goods*
6 Months deposits	Loans for house purchase
12 Months deposits	Other lending (loans for other purposes)
24 Months deposits	1.2.2 NFCs
36 Months deposits	Total
60 Months deposits	Overdraft
Average interest rate (for all maturities)	**Working capital**
Average interest rate with agreed maturities	Equipment loans
	Real estate loans
	1.2.3 all sectors
	Up to 6 months
	6 months-1 year
	1-3 years
	3-5 years
	Average interest rate (for all maturities)

2 Bosnia and Herzegovina	
2.1 Deposit rates	2.2 Lending rates
2.1.1 Households	2.2.1 Households
Up to 1 year maturity (indexed)	**House purchases: Floating rate and up to 1 year IRF (indexed)**
> 1 and up to 2 years maturity (indexed)	**House purchases: Floating rate and up to 1 year IRF; maturity > 1 year (indexed)**
> 2 years maturity (indexed)	House purchases: > 1 and up to 5 years IRF (indexed)
Up to 1 year maturity	**House purchases: > 5 years IRF (indexed)**
> 1 and up to 2 years maturity	House purchases: > 10 years IRF (indexed)
> 2 years maturity	Other purposes: Floating rate and up to 1 year IRF (indexed)
2.1.2 NFCs	Other purposes: Floating rate and up to 1 year IRF and maturity > 1 year (indexed)
Overnight	**Other purposes: > 1 and up to 5 years IRF (indexed)**
Up to 1 year maturity (indexed)	**Other purposes: > 5 years IRF (indexed)**
> 1 and up to 2 years maturity (indexed)	2.2.2 NFCs
Overnight (indexed)	**Up to EUR 0.25mn: Floating rate and up to 1 year IRF (indexed)**
	Up to EUR 0.25mn: Floating and up to 1 year IRF; maturity > 1 year (indexed)
	Up to EUR 0.25mn: > 1 and up to 5 years IRF (indexed)
	Up to EUR 0.25mn: > 5 years IRF (indexed)
	From EUR 0.25mn to EUR 1mn: Floating rate and up to 1 year IRF (indexed)
	EUR 0.25mn to EUR 1mn: Floating + up to 1 year IRF; maturity > 1 year (indexed)
	> EUR 1mn: Floating rate and up to 1 year IRF (indexed)

Note: Interest rates depicted in **bold**/*italics* have been found to be cointegrated at least at the 5% significance level with the **shadow rate**/*domestic monetary policy rate*.

3 Bulgaria	
3.1 Deposit rates	3.2 Lending rates
3.1.1 Households	3.2.1 Households
Agreed maturity: short-term	**Consumer loans IRF**
Agreed maturity: > 1 day up to 1 month	**Consumer loans: up to 1 year IRF**
Agreed maturity: > 1 up to 3 months	Consumer loans: > 1 and up to 5 years IRF
Agreed maturity: > 3 up to 6 months	**House purchases IRF**
Agreed maturity: > 6 up to 12 months	**House purchases: up to 1 year IRF**
Agreed maturity: > 1 up to 2 years	Other loans IRF
Agreed maturity: > 2 years	Other loans: up to 1 year IRF
Time deposits: short-term	**Consumer loans: all maturities**
Time deposits: > 1 day up to 1 month	**Consumer loans: up to 1 year maturity**
Time deposits: > 1 up to 3 months	**Consumer loans: > 1 and up to 5 years maturity**
Time deposits: > 3 up to 6 months	**Consumer loans: > 5 years maturity**
Time deposits: > 6 up to 12 months	**House purchases: all maturities**
Time deposits: > 1 up to 2 years	**House purchases: > 1 and up to 5 years maturity**
Time deposits: > 2 years	House purchases: > 5 and up to 10 years maturity
3.1.2 NFCs	**House purchases: > 10 years maturity**
Agreed maturity: short-term	Other loans: all maturities
Agreed maturity: > 1 day up to 1 month	Other loans: > 1 and up to 5 years maturity
Agreed maturity: > 1 up to 3 months	Other loans: > 5 years maturity
Agreed maturity: > 3 up to 6 months	3.2.2 NFCs
Agreed maturity: > 6 up to 12 months	**Overall IRF**
Agreed maturity: > 2 years	Up to 1mn EUR IRF
Time deposits: short-term	Up to 1mn EUR up to 1 year IRF
Time deposits: > 1 day up to 1 month	**> 1mn EUR IRF**
Time deposits: > 1 up to 3 months	**> 1mn EUR up to 1 year IRF**
Time deposits: > 3 up to 6 months	**Total: all maturities**
Time deposits: > 6 up to 12 months	**Up to 1 year maturity**
	> 1 and up to 5 years maturity
	> 5 years maturity

4 Croatia	
4.1 Deposit rates	4.2 Lending rates
4.1.1 Households	4.2.1 Households
Time deposits	**Consumer and other loans: short-term**
Time deposits: short-term	Consumer loans (indexed)
Time deposits: long-term	Consumer and other loans: short-term (indexed)
Time deposits(indexed)	**Consumer and other loans: long-term (indexed)**
Time deposits: short-term (indexed)	House purchases: short-term
Time deposits: long-term (indexed)	House purchases (indexed)
4.1.1 NFCs	**Loans for other purposes (indexed)**
Time deposits	4.2.2 NFCs
Time deposits: short-term	**Total short-term (indexed)**
Time deposits: long-term	**Total long-term (indexed)**
Time deposits (indexed)	**Up to HRK 2mn (indexed)**
Time deposits: short-term (indexed)	**Up to HRK 2mn: short-term (indexed)**
Time deposits: long-term (indexed)	Up to HRK 2mn: long-term (indexed)
	From HRK 2mn to HRK 7.5mn (indexed)
	From HRK 2mn to HRK 7.5mn: short-term (indexed)
	From HRK 2mn to HRK 7.5mn: long-term (indexed)
	Loans > HRK 7.5mn (indexed)
	Loans > HRK 7.5mn: short-term (indexed)
	Loans > HRK 7.5mn: long-term (indexed)
	Total short-term
	Total long-term
	Up to HRK 2mn
	Up to HRK 2mn: short-term
	Up to HRK 2mn: long-term
	From HRK 2mn to HRK 7.5mn
	From HRK 2mn to HRK 7.5mn: short-term
	From HRK 2mn to HRK 7.5mn: long-term
	Loans > HRK 7.5mn
	Loans > HRK 7.5mn: short-term
	Loans > HRK 7.5mn: long-term

Note: Interest rates depicted in **bold**/*italics* have been found to be cointegrated at least at the 5% significance level with the **shadow rate**/*domestic monetary policy rate*.

5 Hungary	
5.1 Deposit rates	5.2 Lending rates
5.1.1 Households	5.2.1 Households
Overnight	Bank overdrafts
Up to 1 year	5.2.2 NFCs
> 1 year and up to two years	Bank overdrafts
5.1.2 NFCs	**Floating rate and up to 1 year IRF**
Overnight	Floating rate and up to 1 year IRF; secured
Up to 1 year	*Floating rate and up to 1 year IRF; > 1mn euro*
	Floating rate and up to 1 year IRF; up to 1mn euro; secured
	Floating rate and up to 1 year IRF; up to 0.25mn EUR
	Floating rate and up to 1 year IRF; > 0.25mn EUR up to 1mn EUR
	Original maturity > 1 year

6 North Macedonia	
6.1 Deposit rates	6.2 Lending rates
6.1.1 Households	6.2.1 Households
All deposits	**All loans**
Overnight deposits	Overdraft and credit card loans
6.1.2 NFCs	**All loans (indexed)**
All deposits	6.2.2 NFCs
Overnight deposits	All loans
All deposits (indexed)	Overdraft and credit card loans
	All loans (indexed)

7 Romania		
7.1 Deposit rates		7.2 Lending rates
7.1.1 Households	7.1.3 All sectors	7.2.1 Households
Time deposits	Time deposits	All loans
Original maturity up to 1 year		***Consumer loans: floating rate and up to 1 year IRF***
Original maturity > 1 and up to 2 years		**Consumer loans: > 1 and up to 5 years IRF**
Original maturity > 2 years		7.2.2 NFCs
7.1.2 NFCs		All loans
Time deposits		Other loans up to EUR 1mn; floating rate and up to 1 year IRF
Original maturity up to 1 year		Other loans > EUR 1mn; floating rate and up to 1 year IRF
Original maturity > 1 and up to 2 years		7.2.3 All sectors
Original maturity > 2 years		All loans

8 Serbia		
8.1 Deposit rates	8.1.2 NFCs	8.2 Lending rates
8.1.1 Households	Up to 1 year (euro and indexed)	8.2.1 Households
Up to 1 year (euro and indexed)	> 1 and to 2 years (euro and indexed)	Total loans (euro and indexed)
> 1 and up to 2 years (euro and indexed)	***> 2 years (euro and indexed)***	8.2.2 NFCs
> 2 years (euro and indexed)	Total (euro and indexed)	Total loans (euro and indexed)
Total (euro and indexed)	8.1.3 All sectors	8.2.3 All sectors
	Total deposits (euro and indexed)	Total loans (euro and indexed)

Note: Interest rates depicted in **bold**/*italics* have been found to be cointegrated at least at the 5% significance level with the **shadow rate**/*domestic monetary policy rate*.

Acknowledgements

I would like to thank Konstantin M. Wacker, Philipp Harms, Aleksandra Riedl, Martin Feldkircher and an anonymous referee for helpful comments and suggestions.
The views expressed in this paper are mine and do not necessarily reflect those of the ECB or of the ESCB.

Isabella Moder
European Central Bank, Frankfurt am Main, Germany; email: isabella.moder@ecb.europa.eu

PDF ISBN 978-92-899-4864-7 ISSN 1725-2806 doi:10.2866/412266 QB-AR-21-102-EN-N