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Monetary versus Capital-Based Macroprudential Transmission - Efficiency and Effectiveness: Evidence from Central and South-Eastern European Banking Sectors[1]

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Abstract

This study has a twofold objective. The first one is an assessment of the efficiency of monetary and capital-based macroprudential policy, defined as imposing less interest costs to loan borrowers (non-financial corporations and households). The second objective of this paper is the assessment of the effectiveness of both policies defined as the degree to which each respective policy achieves the smoothing of the credit cycle to mentioned sectors. The sample used in this analysis consists of eight countries from Central and South-Eastern Europe: Croatia, the Czech Republic, Hungary, North Macedonia, Poland, Romania, Serbia and Turkiye. The data are organized as unbalanced panel on aggregate level i.e. referring to the banking sectors and overall economies, covering for the period from 2006q2 to 2019q3. The panel estimations were done by employing fixed effects OLS-SUR-PCSE approach and PMG cointegration to assess the long-term and short-term effects for the period from 2006q2 to 2017q4. Restrictiveness of both policies decreases the cycle of the loans to GDP to non-financial companies and households, in accordance with the theory. Concerning the interest rates to non-financial corporations and households, the monetary policy affects them positively to both sectors, while the capital-based macroprudential policy affects divergently as it increases the households' interest rates and decreases the non-financial companies' interest rates. Thus, the capital-based macroprudential policy yields lower interest costs to non-financial companies and restricts the lending i.e. it achieves the restrictive lending goal by implying lower interest costs.

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1. Introduction

Monetary policy adopted by the central bank controls either the interest payable on short-term borrowing or the money supply, often-targeting inflation or the interest rate to ensure price stability and general trust in the currency. Monetary policy can use its tools to stimulate economy (expansionary) or to slow short-term economic growth and lessen inflation (contractionary). The main instruments of monetary policy are short-term interest rates and bank reserves. In our paper, we use the short-term interest rates of the central bank bills in order to present the monetary policy effects.

On the other hand, macroprudential policy is the approach to financial regulation that aims to mitigate risk to the financial system as a whole. The main goal of macroprudential regulation is to reduce the risk and the macroeconomic costs of financial instability. It is recognized as a necessary ingredient to fill the gap between macroeconomic policy and the traditional microprudential regulation of financial institutions.[3] In our paper as macroprudential variables, we use: Capital adequacy ratio's cycle and the capital-based macroprudential dummies.

Monetary policy and macroprudential policies pursue different objectives and use different instruments to achieve them. The monetary policy should provide stable inflation rate as final goal, while the capital-based macroprudential policy should enhance the banking sector stability as final target. However, changes in the various instruments may be transmitted through similar channels, i.e. affect the same financial instruments or economic sectors, implying that the policies are likely to interact in a dampening or amplifying manner (Beyer at al, 2017). Despite the facts that these policies have different final targets, still they are concerning the same intermediate targets: smoothing the expansive/restrictive credit cycle by increasing/reducing the costs to borrowers (loan interest rates).

The main research question of this paper is to answer the following: which policy, whether monetary or capital-based macroprudential, contributes more effectively to smooth-out the credit cycle by imposing minimum costs to credit borrowers through the interest rates i.e. is more efficient. Therefore, this study has twofold objective. The first one is assessment of the efficiency of both policies defined as imposing less costs to loan borrowers in terms of reducing the loan interest rate or less than proportionate increase of the loan interest rate, when each respective policy operates to smoothen the expansive loans cycle to both dominant borrowing sectors i.e. non-financial corporations and households (ESRB, 2019). The second objective of this paper is assessment of the effectiveness of both policies defined as the degree to which each respective policy achieves the smoothing of the cycle of lending to non-financial corporations and households (ESRB, 2019). Thus, this paper focus on relationship between the monetary and capital-based macroprudential policies in one part, and the loan interest rates and lending on the other. The sample used in this analysis consists of eight countries from Central and South-Eastern Europe: Croatia, the Czech Republic, Hungary, North Macedonia, Poland, Romania, Serbia and Turkiye. The data are organized as unbalanced panel on aggregate level

[3] Bank of England (2009). The role of macroprudential policy. Bank of England Discussion Paper, November.

i.e. referring to the banking sectors and overall economies, covering for the period from 2006q2 to 2019q3. Restrictiveness of both policies decreases the cycle of the loans to GDP to non-financial companies and households, in accordance with the theory. Concerning the cycle of the interest rates for non-financial corporations and households, the monetary policy affects them positively to both sectors, while the capital-based macroprudential policy affects divergently as it increases the households' interest rates and decreases the non-financial companies' interest rates. Thus, the capital-based macroprudential policy yields lower interest costs to non-financial corporations and restricts the lending i.e. it achieves the restrictive lending goal by implying lower interest costs.

The overall structure of the study takes the form of six chapters, including this introductory chapter. Chapter 2 begins by laying out the theoretical dimensions of the research, and looks at how the recent literature shows evidence of this study. The third chapter is concerned with the monetary and capital-based macropudential transmission mechanism. The fourth section presents the variables and expected effects, while the fifth chapter focuses on the stylized facts. Chapter 6 analyses the econometric methodology and the last chapter addresses the econometric results. Finally, the conclusion gives a brief summary and critique of the findings.

2. Monetary and capital-based macroprudential transmission mechanism and literature overview

The monetary and capital-based macroprudential policies have different final targets. The monetary policy should provide stable inflation rate as final goal, while the capital-based macroprudential policy should enhance the banking sector stability as final target. Notwithstanding the different ultimate objectives, both policies coincide concerning the intermediate targets and those are: smoothing the expansive/restrictive credit cycle by increasing/reducing the costs to borrowers (loan interest rates).
Both policies i.e. monetary and capital-based macroprudential affect different items in the banks' balance sheet (Cecchetti and Kohler, 2014). For instance, as explained by Bernanke and Blinder (1988) the tightening monetary policy extracts the banks' reserves (assets' item) through open-market operations causing a shrinkage of the loanable funds and consequently reduction of the banks' loan supply[4]. On the other hand, the tightening capital-based macroprudential policy captures the volume of the capital (liability's item) through binding measures aimed to increase the proportion of the capital in the balance sheet. The binding capital measures may refer to increase of minimal capital requirements and change of weights that affect the risk-weighted assets. Consequently, the banks are

[4] Bernanke and Blinder (1988) assume that the central bank has full control on the banks' reserves when conducts open market policy. Namely, as the monetary policy tightens by selling securities to the banks at higher reference interest rate, it follows that the reserves of the banks (as liquid and available loanable items) decrease. The shrinkage of loanable funds, increasingly affects the loan interest rates. The critique of this assumption is that banks primarily manage their reserves guided only by their own decisions based on risk and return principle, while the central bank's monetary guidelines are of secondary importance for the placements of the reserves in securities. Therefore, the central bank's control over the banks' reserves is not full when conducting open market policy operations.

prevented to use the capital as a source for lending (Cecchetti and Li, 2008). Thus, both policies have unambiguous negative effect on the bank loan supply. The policy with higher effectiveness would be the one that dampens the expansionary lending cycle by higher degree.

However, both policies might not always have same effect on the lending interest rates. Namely, as both tightening monetary and capital-based macroprudential policies, reduce the lending capacity of the banks in terms of lower reserves and captured capital unavailable for lending, then it follows an increase in the lending interest rates in order to discourage the loan demand by non-financial corporations and households (Cecchetti and Kohler, 2014). As the sterilized reserves and captured capital are unavailable for lending, therefore high opportunity costs have been created for the banks as they lose the income from the non-realized lending. The higher opportunity costs press the lending interest rates upwards because the banks have to pay the interest to depositors and especially return to shareholders as owners of the banks' capital (Ahtik, 2010). Having in mind the previous written, both policies positively affect the lending interest rate and they coincide in the effect. The policy with higher efficiency would be the one that causes less comparative increase of the lending interest rates.

On the other hand, the tightened capital-based macroprudential policy increases the stake of the shareholders of the banks implying that they could lose more in a situation of unfavorable events. As explained by Agur (2013) and Dautovic (2019), the higher capital requirements give incentive to the shareholders to undertake less credit risk in order to avoid higher losses. Namely, the capital requirements impose to shareholders to increase their capital stake or the so-called "skin in the game" and therefore, they might lose more if unfavorable risks occur. Therefore, the possibility for experiencing higher loss by the shareholders, affects the bank to decrease the lending interest rate with an aim to improve the borrowers structure. Higher lending interest rate discourages the well-creditworthy borrowers to indebt due to higher lending costs and encourages bad-creditworthy borrowers to apply for loans because they are desperate for obtaining money. This creates the problem of adverse selection when the bank faces unfavorable loan demand, entailing high likelihood to default, even though the higher loan interest rate has potential for higher income for the bank (Stiglitz and Weiss, 1981). The rationale of Stiglitz and Weiss is that the costs of bad loans in terms of higher loan-loss provisions and non-collected loans from defaulted borrowers would be higher compared to the income from the higher loan interest rate. Therefore, as the capital macroprudential policy requires the shareholders to keep more capital in the banks, the banks would decrease the loan interest rate in order to keep the well-creditworthy borrowers in the portfolio and lend less in order to mitigate the credit risk and safeguard the capital stake of the shareholders. Thus, this brings the credit rationing theory into consideration. In terms of credit rationing prevalence, the effect of the tightened monetary policy remains direct to the banks' loan interest rates, but less than proportionate. As the central bank increases the monetary policy rate and reduces the banks' reserves as loanable assets, then consequently, the loan interest rates increase by lower degree[5] compared to the increase in the central bank policy rate and lending reduces to avoid excessive credit risk exposure. The aim of less than

[5] Unit increase of the central bank policy rate causes an increase of the lending interest rates by less than unit (less proportionate).

proportionate increase in the loan interest rates is guided by the notion not to cause the adverse selection problem and keep the well-creditworthy clients in the loan portfolio.

A large and growing body of literature has investigated the interaction between the monetary policy and capital-based macroprudential policy and their impact on different aspects of the economy. Numerous studies have attempted to explain the effect of the two policies on the credit growth, bank balance sheets, and bank's funding cost, interest rates, economic activity and other macroeconomic indicators. Most of the studies found that monetary policy and capital-based macroprudential policy have effect on the different aspect of the economy on short and long term.

The effect of the capital regulations on overall economy was highlighted by Derasmo (2018), where tighter capital regulations force banks to change their balance sheet composition, which alters the quantity and quality of credit directed to the overall economy through three channels. The first one, reducing lending-bank can increase its capital ratio by raising new equity or by slowing the lending growth. The second one is risk-taking, which means increasing capital ratio lead to reducing the risk taking. The third, competitive effects-higher capital requirements can affect regulated banks differently depending on their size. In the short run, higher capital requirements might result in a less concentrated banking industry by reducing the largest banks' share of the loan market, thereby benefiting smaller banks.

Dumicic (2018) presents assessment of the effectiveness of the macroprudential policies in CEE countries in mitigating financial stability risks associated with excessive credit growth before the global financial crisis. The variable whose behavior the model is trying to explain is credit to the private sector in CEE countries. The model results imply that macroprudential policies were more effective in slowing credit to households than credit to the non-financial corporate sector, mainly because the latter had access to nonbank and cross-border credit in addition to domestic bank credit. Nine macroprudential tools were considered: administrative limits on credit growth, capital requirements, and limits on currency mismatches, marginal reserve requirements, provisioning requirements, general reserve requirements, increased risk weights, debt-to-income ratios, and loan-to-value ratios. Growth of credit to households responds, with varying degrees of significance, to changes in administrative limits on credit growth, general reserve requirements, debt-to-income ratios, and loan-to-value ratios. Growth of credit to the non-financial corporate sector responds significantly to changes in administrative limits on credit growth, limits on currency mismatches, as well as provisioning and general reserve requirements.

On the other hand, increased capital requirements appear to have had only a temporary effect on lending in Peru. Fang at al (2018) estimations suggest that a one-percentage point increase in required capital buffers reduced lending growth by between 4 and 6 percentage points in the quarter in which it came into effect. Furthermore, over periods of six months and beyond, loan growth did not statistically differ between periods with and without capital increases.

Ramon and Straughan (2017) econometric study looks for evidence of the long and short-term implications of capital regulation at the macroeconomic level to help measure the overall impact on UK

economic activity. The estimated model shows that, in response to higher capital levels, banks increase credit spreads to private non-financial corporate (PNFCs) more than credit spreads for households in the short term. In effect, banks exploit the higher demand elasticity of the PNFC sector to reduce average risk-weights most efficiently and thereby improve capital ratios more quickly as their capital requirements increase. Over the longer term, the difference between PNFC credit spreads and household spreads is smaller than in the short run. In the simulation that was used in the final estimated model that increases in aggregate capital ratios in the UK economy slow economic activity, but the impact on household demand is different from the impact on business investment. There is also a more pronounced impact on activity in the short-term than over the long run. In addition, the authors find that monetary policy can alleviate to some extent the impact on activity, but does not completely unwind the effect of higher aggregate capital requirements.

Several studies investigate the impact of the capital requirements on the economic growth. Cause there are little direct effects, Martynova (2015) focused on the indirect effects of capital requirements on credit supply, bank asset risk, and cost of bank capital, which in turn can affect economic growth. Higher bank capital requirements may reduce bank lending, especially to the most bank dependent borrowers, such as small businesses. This may decrease economic growth. Second, higher capital requirements increase bank cost of equity, but reduce cost of debt. Higher cost of equity can be passed on to the borrowers in the form of higher lending rates. This reduces credit demand and slows down economic growth. Third, higher capital promotes financial stability by reducing bank risk-taking incentives and providing a buffer against losses. Thus, better capitalized banks lead to lower credit volatility.

Part of the literature refers to the interaction between the policies, as if it was the case of Beyer et al. (2017), who focus on the interaction and transmission mechanism between monetary policy, microprudential and macroprudential policy. The three policies pursue different objectives and use different instruments to achieve them. The authors categories the prudential policies into three broad areas: capital-based, asset-based and liquidity-based. The simulation exercise that was elaborated in this paper focuses on the interaction between monetary and capital-based macroprudential policies. The model-based simulation exercises emphasize the importance of long phasing-in arrangements regarding increases in higher capital requirements in smoothing out the impact on the business cycle and inflation and higher effectiveness of synchronized policy actions. In addition, it highlighted the importance of unconstrained monetary policy in alleviating the negative impact of stricter capital requirements, the macroeconomic benefits of stronger bank capital buffers and the long-term benefits of higher bank capital requirements vis-à-vis higher levels of bank risk.

Gambacorta and Song Shin (2016) find that bank equity is an important determinant of both the bank's funding cost and lending growth. In a cross country bank-level study, the authors find that a 1 percentage point increase in the equity-to-total assets ratio is associated with a 4 basis points reduction in the cost of debt financing and with a 0.6 percentage points increase in annual loan growth. In a bank-level study with time and firm fixed effects, the authors have found that higher bank capital

is associated with greater lending, and that the mechanism involved in this channel is the lower funding costs associated with better capitalized banks. Having in mind that increased credit is an essential ingredient in the transmission of monetary policy to the real economy, the results shed light on the importance of bank capital for the monetary policy mandate of the central bank, as well as to its mandate as the financial supervisor.

In addition to credit growth and economic activity, evidence has been found of the impact of equity capital on the interest rates. Martín-Oliver at al (2013) modelled the determinants of equity capital and the influence of its ratios on the interest rates of bank loans by using data from Spanish banks. The results show that a combination of value maximization choices and inertial earnings retentions determine equity capital and that the inertia component is more important to savings banks than to commercial banks. The authors also find that loans' interest rates increase with equity capital and the increase is higher during the adjustment period than in the steady state.

Together, these studies outline that there is interaction and transmission mechanism between monetary policy, microprudential and macroprudential policy. In same time, these policies determine the path of the credit growth, economic growth, interest rates and the economy as whole.

3. Variables and expected effects

In order to assess the relationship between the monetary and capital-based macroprudential policies on one side, and the loan interest rates and lending on the other side, the variables contained in Table 1 have been used. The countries taken in the sample are eight countries from Central and South-Eastern Europe: Croatia, the Czech Republic, Hungary, North Macedonia, Poland, Romania, Serbia and Turkiye. The data are aggregate referring to the banking sectors and overall economies and organized as unbalanced panel, covering for the period from 2006q2 to 2019q3.

Table 1: description of the variables and sources

	Dependent variables	Description	Representative of	Source
1	Interest rate on loans in domestic currency to non-financial corporations expressed as cycle in percentage points	= (interest rate on loans to non-financial corporations in domestic currency minus Hodrick-Prescott trend of interest rate on loans to non-financial corporations in domestic currency; lambda=1,600)	Interest cost to the non-financial corporations for using loans. Loan interest rate cycle distinguishes between over-charging or sub-charging the clients. This is important from aspect of the efficiency and thus positive loans interest rate cycle implies that banks overcharge the clients above the optimal trend level.	Central banks and authors' calculations
2	Non-financial corporations' loans to GDP cycle in percentage points	= (non-financial corporations' loans to GDP minus Hodrick-Prescott trend of non-financial corporations' loans to GDP; lambda=400,000 as suggesetd by BCBS (2010))	Procyclical lending has to be decreased. Therefore, this variable is important from aspect of effectiveness assessment.	International Monetary Fund, Financial Soundness Indicators Database and authors' calculations
3	Interest rate on loans in domestic currency to households expressed as cycle cycle in percentage points	= (interest rate on loans to households in domestic currency minus Hodrick-Prescott trend of interest rate on loans to households in domestic currency; lambda=1,600)	Interest cost to the households for using loans. Loan interest rate cycle distinguishes between over-charging or sub-charging the clients. This is important from aspect of the efficiency and thus positive loans interest rate cycle implies that banks overcharge the clients above the optimal trend level.	Central banks and authors' calculations
4	Households' loans to GDP cycle in percentage points	= (households' loans to GDP minus Hodrick-Prescott trend of households' loans to GDP; lambda=400,000 as suggested by BCBS (2010))	Procyclical lending has to be decreased. Therefore, this variable is important from aspect of effectiveness assessment.	International Monetary Fund, Financial Soundness Indicators Database and authors' calculations
	Independent variables	**Description**	**Representative of**	**Source**
5	Monetary policy interest rate cycle in percentage points	= (monetary policy interest rate minus Hodrick-Prescott trend of the monetary policy interest rate; lambda=1,600)	Monetary policy stance (expansionary or restrictionary)	Bank for International Settlements and authors' calculations
6	Capital adequacy ratio cycle in percentage points	= (capital adequacy rate minus Hodrick-Prescott trend of capital adequacy rate; lambda=1,600)	Proxy for capital-based macroprudential policy stance (expansionary or restrictionary)	International Monetary Fund, Financial Soundness Indicators Database and authors' calculations
7	Sum of capital-based macroprudential dummies	a simple sum of the values of binary variables for used capital-based macroprudential measures	Indicating the number of capital-based macroprudential measures used at given point in time	Cerutti et al (2015) available at https://www.imf.org/en/Publications/WP/Issues/2016/12/31/The-Use-and-Effectiveness-of-Macroprudential-Policies-New-Evidence-42791 accessed on 16.05.2020
8	Interest rate on total deposits in domestic currency expressed as cycle in percentage points	= (interest rate on total deposits in domestic currency minus Hodrick-Prescott trend of interest rate on total deposits in domestic currency; lambda=1,600)	Borrowing costs to the banks	Central banks and authors' calculations
9	Deposits to GDP cycle in percentage points	= (total deposits to GDP minus Hodrick-Prescott trend of total deposits to GDP; lambda=1,600)	Funding structure of the banks	International Monetary Fund, Financial Soundness Indicators Database and authors' calculations
10	Non-performing loans ratio cycle in percentage points	= (total non-performing loans ratio minus Hodrick-Prescott trend of total non-performing loans ratio; lambda=1,600)	Credit risk undertaken by the banks	International Monetary Fund, Financial Soundness Indicators Database and authors' calculations
11	Return on equity cycle in percentage points	= (return on equity minus Hodrick-Prescott trend of return on equity; lambda=1,600)	Profitability of the banks	International Monetary Fund, Financial Soundness Indicators Database and authors' calculations
12	Real gross domestic product growth cycle	= (annual growth of real gross domestic product minus Hodrck-Prescott trend of annual growth of real gross domestic product; lambda=1,600)	Income capacity of the economies	State Statistical Offices of the countries, central banks' database, database of the Federal Reserve Bank of St. Louis and authors' calculations
13	1 month EURIBOR cycle in percentage points	= (1 month EURIBOR minus Hodrick-Prescott trend of the 1 month EURIBOR; lambda=1,600)	Foreign interest rate transmission	European Central Bank and authors' calculations
14	Dummy for the Global Financial crisis (2008q2 to 2009q4)	1 for the period from 2008q2 to 2009q4 and 0 for the rest	Global financial crisis effect	

The variables are expressed as cycles (gaps) and that is difference between the actual variables and their Hodrick-Prescott (HP) trends. Exception is only the 7-th variable and that is the sum of the capital-based macroprudential dummy variables. The reason for expressing the dependent variables as cycles is the importance of the distance of the variable from its equilibrium level (here approximated by the HP trend[6]), because what matters for assessment of the efficiency and effectiveness is not the sole change, but the change of the variables from their equilibrium level. Additionally, the change of the

[6] Using more sophisticated econometric techniques for estimating the equilibrium level is beyond the scope of this paper and it is not necessary to be applied because it will overburden the paper. The Hodrick-Prescott technique is statistical technique for approximating the equilibrium level of the variables taken in the analysis and it is applied in other papers such as: Ceccheti and Li (2008), Jovanovic et al (2016) and also, it is suggested by Basel Committee on Banking Supervision for calculating equilibrium loans to GDP when decision on countercyclical capital buffer has to be made (BCBS, 2010). It is not perfect trend in a sense of yielding not reliable values at the end point or so-called end point bias and on that basis HP trend is usually mostly criticized.

monetary and capital-based macroprudential variables relative to their respective equilibrium levels are relevant measures for the expansionary or the restrictive stances of these policies. Moreover, support for such expressing of the variables as cycles in this paper, could be found in the referent papers by Ceccheti and Kohler, (2014) and Altunbas et al (2017). In the first paper, theory model is developed for assessing the interactions between monetary and macroprudential policies and the variables used are expressed as logarithm deviations from their steady state. In the second paper, only the monetary policy interest rate is expressed as deviation from the natural interest rate in order to differentiate the stance of the monetary policy, while the stance of the macroprudential policy is proxied by restrictive and expansionary dummy variables. Additionally, the cycle of the variables mitigates the problem of having heterogeneous trends for certain variables (upward for one country and downward for other country) across the sample, because the detrended data follow more or less stationary movement pattern[7].

Two dependent variables used in this analysis are: the cycle of the loan interest rates in domestic currency[8] to non-financial corporations and the cycle of the loan interest rates in domestic currency to households. Both cycles of the loan interest rates distinguish between over-charging and sub-charging the clients. This is important from aspect of the efficiency and thus positive lending interest rate cycle implies that banks overcharge the clients above the optimal HP trend level. Furthermore, the other two dependent variables are: the cycles of non-financial corporations' loans to gross domestic product (GDP) and households' loans to GDP as they are relevant intermediate targets for both the monetary and capital-based macroprudential policies. These variables are important from the effectiveness aspect as the expansionary/restrictive lending has to be returned at the level of the equilibrium values[9]. Differentiating between the non-financial corporations and households allows for ascertaining the influence of the monetary and capital-based macroprudential transmission on the business models of the banks.

The effect of the monetary and capital-based macropudential policies was explained in the previous section. The restrictive monetary policy stance is expected to affect positively the cycles of the loan interest rates in domestic currency to non-financial corporations and households, and negatively the respective credit cycles. The monetary policy is represented by the cycle of the referent (policy) interest rate managed by each central bank. The monetary policy interest rates taken in this analysis are

[7] The next section of the Stylized facts, ascertains that such variables are used in this paper and that is, they follow different trends across the countries. They are upward for one country and downward for other country.
[8] The interest rates on foreign currency loans and foreign currency deposits were not available for the Czech Republic. Only the interest rates on loans and deposits in local currency are available for this country. Therefore, the loan and deposit interest rates in local currency are taken for all countries in order to have consistent data across the sample.
[9] Lambda is 400,000 for calculating Hodrick-Prescott trend of the non-financial corporations' loans to GDP and households' loans to GDP as suggested by BCBS (2010). The reason for such high lambda value is smoothing the long-term trend as the credit cycle usually does not coincide with the real business cycles i.e. the credit cycle usually lasts longer compared to the real business cycles. The reason for longer lasting of the credit cycle relative to the real business cycles is that borrowers could utilize loans in real business contraction due to the previously credit lines and credit cards approved by the banks in the good times (Drehman et al (2010)).

nominal (not real policy interest rates), because the central banks provide the monetary signal by adjusting the nominal aggregates.

The restrictive capital-based macroprudential policy could ambiguously influence the loan interest rates' cycles as explained in the previous section. It depends on whether the banks try to safeguard the "skin" of the shareholders and consequently reduce the loan interest rates' cycles, or increase the loan interest rates' cycle as the captured volume of capital entails high opportunity costs in terms of keeping large and costly funding sources unavailable for lending. Unlike, the ambiguous effect concerning the loan interest rates' cycles, the tightened capital-based macroprudential policy unambiguously restricts the lending and dampens the positive lending cycle. Representatives of the capital-based macroprudential policy are: capital adequacy ratio's cycle and the sum of capital-based macroprudential dummy variables. The first variable is proxy and it is not perfect variable in a sense of distinguishing the clear effect of the capital-based macroprudential policy imposed by the policy maker and the prudential managerial decisions. Namely, the capital-based macroprudential measures imposed by the policy maker, ultimately reflect the capital adequacy rate because they are binding. Nevertheless, the banks by themselves voluntarily increase the capital adequacy rate by recapitalizing the profit, indebting with subordinated debt or issuing equity, in order to be prudent and strengthen their stability, independently from the measures imposed by the policy maker. Thus, the disadvantage of the capital adequacy rate's cycle is not distinguishing clearly, whether the capital increase is due to the measures imposed by the policy maker[10] or it is entailed by the prudent managerial decision of the banks. However, this variable allows for taking into account the change of stance and that is an increase/decrease of the capital adequacy ratio above/below the trend value clearly indicates the restrictive/expansionary stance.

The second variable is the sum of capital-based macroprudential dummy variables, indicating the measures implemented in the countries considered at given point of time. The data for the sum of capital-based macroprudential dummy variables are taken from the database created by Cerutti et al (2015)[11] and contains 12 variables in total for covering macroprudential measures targeted to banks' features (capital requirements, reserve requirements, concentration limits, limits on foreign and domestic currency loans) as well as targeted to borrowers' features (loan to value ratio and debt to income ratio). The capital-based macroprudential variables taken from Cerutti et al (2015, pp. 20) and used in this analysis are the following 4 dummy variables: *(1) time-varying/dynamic loan-loss provisioning that requires banks to hold more loan-loss provisions during upturns, (2) general countercyclical capital buffer/requirement that requires banks to hold more capital during upturns, (3) leverage ratio that limits banks from exceeding a fixed minimum leverage ratio and (4) capital*

[10] The binding capital measures may refer to increase of minimal capital requirements and change of weights that affect the risk-weighted assets

[11] 2018 update. The database is available at https://www.imf.org/en/Publications/WP/Issues/2016/12/31/The-Use-and-Effectiveness-of-Macroprudential-Policies-New-Evidence-42791 accessed on 16.05.2020. Initially, the database contained data for 119 countries up to 2013 and in 2018 the sample was broaden up to 160 countries and the data updated up to 2017. The database contains annual data and have been interpolated on quarterly level by assuming the same values throughout the quarters of the respective year.

surcharges on systemically important financial institutions (SIFI) that requires the SIFI to hold a higher capital level than other financial institutions. These four variables are pertinent for safeguarding the stability of the banking sector as they require higher capital in the banks' balance sheet as well as higher loan-loss provisions for covering the uncollected loans, which in fact is indirect capital. Additionally, these four variables smooth out the credit cycle when used as suggested by Lim et al (2011). Namely, the countercyclical capital buffer is imposed when the actual credit to GDP deviates more than 2 percentage points relative to the trend level (BCBS, 2010). With a purpose to dampen the positive credit cycle, the dynamic provisioning is also used to lean against the build-up of the positive credit cycle. Also, the imposition of minimum leverage ratio and capital surcharges for SIFI, capture the capital and consequently could not be used as a source for lending. Therefore, the choice for taking these four dummy variables is being based on their common goals for preserving the stability of the banking sector, as well as smoothing the credit cycle. Additionally, Altunbas et al (2017, pp. 20) and Boar et al (2017, pp. 75) classify these variables as capital based with primary aim of safeguarding the banking sectors' stability[12]. This aggregate dummy variable is also not perfect representative of the capital-based macroprudential policy, in a sense that it does not differentiate between restrictive or expansionary variations of the measures[13] (Cerutti et al, 2015). Thus, the sum of the capital-based macroprudential dummy variables merely implies the number of capital-based measures that were in place at given point of time. Nevertheless, the advantage of this aggregate dummy variable compared to the capital adequacy rate's cycle is that it covers the clear effect of the macroprudential measures imposed by the policy maker. In contrast, the capital adequacy rate's cycle reflects both the policy maker's measures and the prudential effect of the managerial decisions concerning the bank's capital. But, as mentioned above, the advantage of the capital adequacy rate's cycle relative to the aggregate dummy variable is that the former variable accounts for the change of the stance as restrictive or expansionary. Thus, the aggregate dummy variables of the capital-based macroprudential policy and capital adequacy rate's cycle compensate for each other's. Dumičić (2018) used such defined aggregate macroprudential dummy variable among the others, for investigating the effectiveness of the overall macroprudential measures on loans approved to corporate and household sectors. The author constructs questionnaire for direct communication with the policy makers of 11 countries (Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia – over the period from 2000q1 to 2013q3) concerning the overall macroprudential measures implemented. Moreover, Dumičić indicates the same disadvantages of this variable as noted in Cerutti

[12] It should be noted, that these papers (Altunbas et al (2017) and Boar et al (2017)) indicate that the above mentioned capital-based macroprudential measures, are primarily concerned for safeguarding the stability of the banking sector, not for smoothening of the credit cycle. According to these papers, the cycle smoothing is primarily affected by assets based macroprudential measures such as: credit growth limits, limits to banks' exposure, cap on debt service-to-income ratio and cap on loan-to-value ratio. This paper disagrees with the notion in these papers that these variables are not relevant for smoothing of the credit cycle as explained above. Moreover, Lim et al (2011) explains that these measures address cyclical smoothing of the lending as well, beside the stability objective.

[13] The next section explains that most of these capital-based measures had restrictive character (see the text concerning the figure 3).

et al (2015) and that is the inability to differentiate between restricting or relaxing variations of the measures.

In the previous section, it was explained that both policies coincide concerning the intermediate targets and those are: smoothing the expansive/restrictive credit cycle by increasing/reducing the costs to borrowers. In addition to this, such defined monetary and capital-based macroprudential variables assume the effect of one-size-fits-all principle in a sense that both policies affect various (good and bad) clients, loan types or industries across each sector. The meaning of one-size-fits-all is that given measures could be tightening for good clients for instance, although there is no need to. The monetary policy always operates by this principle as the nominal policy rate is one and could not be selectively implemented. The capital-based macroprudential measures allow for applying different capital charge per types of loans or industries, but the variables used in this paper do not encompass this differentiation and thus they are one-size-fits-all. Therefore, such defined monetary and capital-based macroprudential policies have additional joint feature concerning the mentioned principle, besides the intermediate targets and they are plausible for analyzing their effect in this paper.

Additionally, the remaining variables used in this paper, encompass the supply side on the loan market. Exception is only the GDP growth cycle as variable relevant for the demand side on the loan market as indicated by the Bernanke and Blinder (1988).

The supply side variables have appropriate effects on the banking sectors' loan interest rates as well as their potential for lending. The cycle of the deposit interest rate in domestic currency encompasses the funding cost to the banking sectors. The deposit interest rates are the prices of deposits' funding and they are built in the loan interest rate. Hence, this variable is expected to affect positively only the loans' pricing i.e. interest rates to loans of the both sectors. The deposits to GDP cycle represents the funding potential of banking sectors. An increase of the deposits to GDP cycle affects positively the banks' lending potential and leads to higher loan supply that drives down the loan interest rate, under assumption that the loan demand is unchanged. The non-performing loans (NPL) ratio cycle refers to the quality of the loan portfolio and undertaken credit risk. As the NPL ratio cycle increases, consequently the loan portfolio quality worsens resulting in higher loan-loss provisions that have to be covered by higher loan interest rates. Additionally, the banks decrease the lending in order not to add on more credit risk exposure by granting new loans and moreover, all their efforts are primarily focused on foreclosing the bad loans and preserving the liquidity. It should be mentioned that these three variables are not decomposed by non-financial corporations and households in order not to overburden the paper with more variables. For instance, it is not mandatory that households' deposits should only be used as a source for households' lending, but they can be used as a source for corporate lending as well. Also, reduction of the households' deposits will trigger an increase of the corporate loan interest rates besides the increase of the households' loan interest rates and will weaken the lending to both sectors. Likewise, deterioration of the households' NPL ratio does not necessarily mean to increase only the loan interest rates to households and reduce their lending, but this might worsen the overall

performance of the bank and also tighten the loan interest rates and lending to the corporate sector. Therefore, by using the cycles of: the total deposit interest rate in domestic currency, total deposits to GDP and the NPL ratio to the overall portfolio, the authors think that such interconnections between the sectors will be captured and the paper will not be overburden with additional variables. Furthermore, the positive movement of the return on equity (ROE) cycle improves the banks' stability and provides higher potential for lending at lower interest rates. The one-month EURIBOR cycle represents the foreign monetary transmission from the euro area. To be precise, as most of these countries are members of the European Union (EU) and the remaining are candidates for the EU, then it is very likely that one-month EURIBOR would reflect the monetary transmission of the European Central Bank to the banking sectors considered in the sample. Thus, it is expected the higher EURIBOR cycle to increase the foreign funding costs for the banks in this sample, and subsequently the lending to decrease.

The real GDP growth cycle variable is demand side variable as representative of the income capacity of the economies, while all other variables in Table 1 are affecting the lending capacity of the banks. The positive GDP growth cycle indicates that the non-financial corporations are more profitable and households earn more money. Therefore, the positive GDP growth cycle positively reflects to the creditworthiness of the both sectors and increases their potential to borrow more money from the banks. Moreover, the positive GDP growth and consequent increased creditworthiness is perceived by the banks as less potential for credit risk materialization and they reduce loan interest rates.

Finally, the dummy variable for the Global Financial Crisis should reflect the deteriorating effect of the global economic slowdown and worsened banking sector performance. The expected effect is positive on the loan interest rate cycles and negative on loans to GDP to both sectors.

4. Stylized facts

The countries included in the sample follow different monetary policy frameworks. Namely, Croatia and North Macedonia have been classified as exchange rate targeters relative to the euro currency, while the remaining countries: the Czech Republic, Hungary, Poland, Romania, Serbia and Turkiye have been following the inflation targeting frameworks (AREAER, 2018). Joint feature of all these countries is implementation of independent monetary policy by managing policy interest rates that are benchmarks for banking sectors' interest rates. Although Croatia and North Macedonia are exchange rate targeters, yet their capital mobility condition is less than perfect allowing for monetary independence (Petrevski et al, 2016), as explained by the Mundell-Fleming model of the impossible trinity (Boughton, 2003). Therefore, the eight countries included in this paper, are selected on the option for implementing independent monetary policy and having reference (monetary policy) interest rate[14]. Other South-

[14] The database on the policy interest rates published by the Bank for International Settlements (BIS) contains details about the monetary policy instruments through which the policy interest rates are managed. The details could be found on the following link https://www.bis.org/statistics/cbpol.htm?m=6%7C382%7C679 accessed on 16.05.2020.

Eastern European countries such as: Bosnia and Herzegovina, Bulgaria, Kosovo and Montenegro are not included in the sample of this paper, because their monetary strategies do not support the concept of the independent monetary policy and moreover, they do not have own policy interest rates. Namely, Bosnia and Herzegovina and Bulgaria have been pursuing currency board strategy, while Kosovo and Montenegro introduced the euro currency as legal tender. The currency board and full euroization require high capital account liberalization, and thus the central banks of these countries cannot pursue independent monetary policy through the conventional instruments like the interest rates (Petrevski et al, 2016). Moreover, Albania has been implementing the inflation targeting framework, but the data limitation concerning the non-financial corporations' loan interest rates and households' loan interest rates, has contributed this country not to be taken in the paper's sample[15].

The figure 1 below implies that central banks pursued dominantly accommodative monetary policy throughout the period considered in order to stimulate the economies after the Global Financial Crisis. The monetary policy interest rates included in figure 1 are nominal (not real policy interest rates) as indicated in the previous section, because the central banks adjust the nominal policy rates for the purpose of the monetary transmission. Both the Czech National Bank and the Central Bank of Turkiye tightened the policy interest rates. More precisely, the inflationary pressures, stemming from the labor market, were the main reason for the hike of the interest rate policy from 2017 onwards for the Czech Republic[16] (IMF, 2019). Similarly, the unpredictable inflation rate after 2011 ranging from minimum of 5% to two digits (Gürkaynak et al, 2015), contributed to tightening the monetary policy interest rate in Turkiye.

[15] The data for the lending interest rates only for newly granted loans are available from December 2015. Additionally, the archive statistics (before 2015) does not contain data for interest rates for both sectors, but only for total loans.
[16] Also, see https://www.ebf.eu/czech-republic/ accessed on 16.05.2020.

Figure 1: Monetary policy interest rate in % for the period from 2006q2 to 2019q3

Source: Bank for International Settlements and authors' calculations

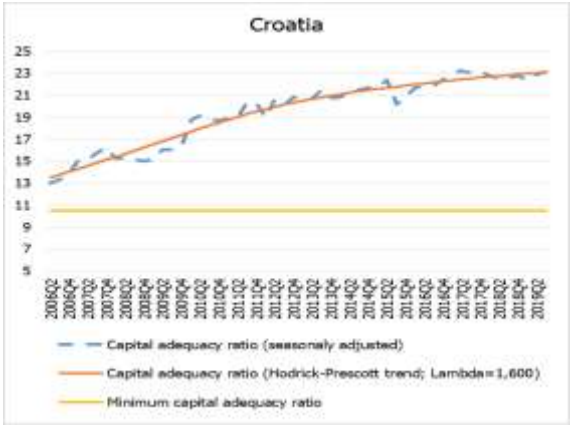
Concerning the capital-based macroprudential policy, the banking sectors are strongly capitalized in the sample considered. Namely, as the figure 2 suggests, the most of the countries have been experiencing increasing trend of the capital adequacy ratio. Exceptions are North Macedonia and Turkiye. The Macedonian banking sector records stable movement of the capital adequacy ratio, while the Turkish

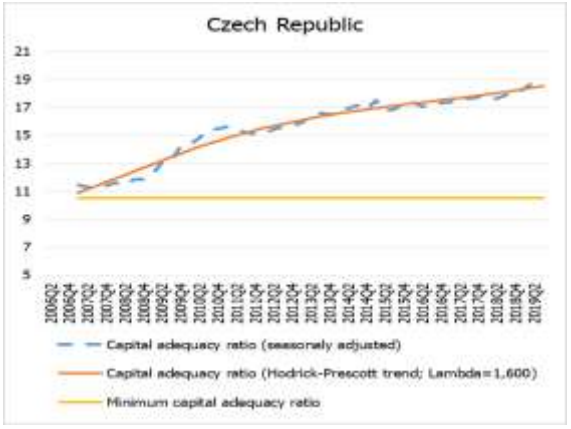
banking sector has mostly experienced declining capitalization throughout the period taken in the analysis. The limited capacity of the capital sources and moderate positive lending are the contributory factors for the stable movement of the capital adequacy ratio of the Macedonian banking sector. Namely, the main source of the capital increase of the Macedonian banks is the retained profit[17] as the profitability has been performing pretty well[18], while the potential of issued equity and capital-debt instruments is limited due to the underdeveloped stock-market. Additionally, the lending was recording moderate growth in North Macedonia after the Global Financial Crisis[19], giving positive impetus to the risk-weighted assets. Similarly, the reasons for decreasing the capital adequacy ratio of the Turkish banking sector could be located in the capital sources and lending as they affect the regulatory capital (numerator) and risk-weighted assets, denominator. Therefore, the profitability was deteriorating[20], while the loans were on increasing path and eventually the capital adequacy ratio had declining trend. However, the Turkish banks' capital adequacy improved after 2015 due to the utilization of subordinated loans and other debt instruments for increasing the capital[21]. Nevertheless, the capital adequacy ratios are well above the minimum capital adequacy ratio for all banking sectors throughout the period considered.

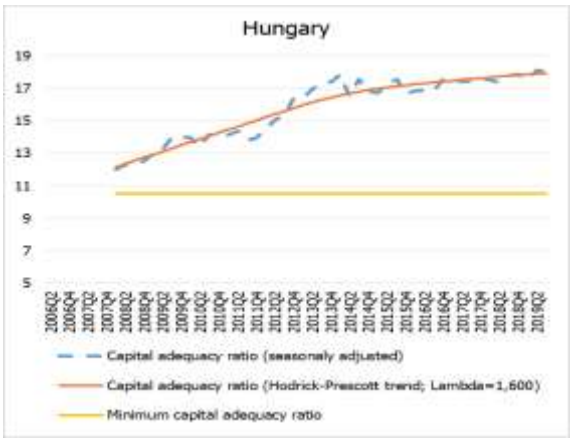
The minimum capital adequacy ratio is set to 10.5%. Mendicino et al (2018) suggest that the steady state of the capital adequacy requirement is 10.5%. This value is obtained as a sum between the minimum capital adequacy ratio of 8% and a capital conservation buffer of up to 2.5% as suggested by the Basel standards. For simplicity purposes, the minimum capital adequacy ratio has been taken as 10.5% for all banking sectors and throughout the whole period considered in this analysis, although the minimum capital requirement has been changing for some countries (Croatia, Serbia and Turkiye).

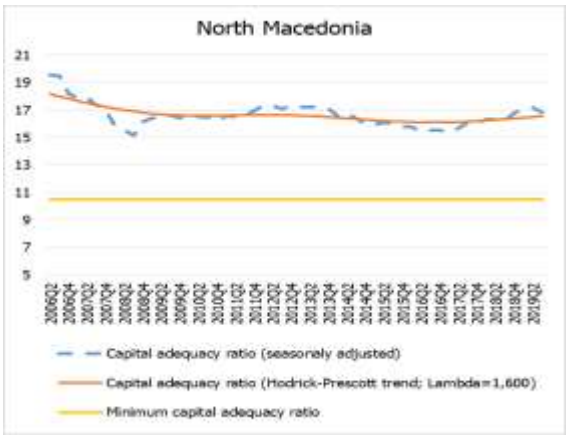
[17] See banking system reports at http://www.nbrm.mk/banking_system_reports.nspx
[18] See the figure in 11 the Appendix 1.
[19] See figure 5 below.
[20] See the figure 11 in the Appendix 1.
[21] See https://www.expertguides.com/articles/turkish-banking-system-getting-stronger/ARILGUBF accessed on 16.05.2020.

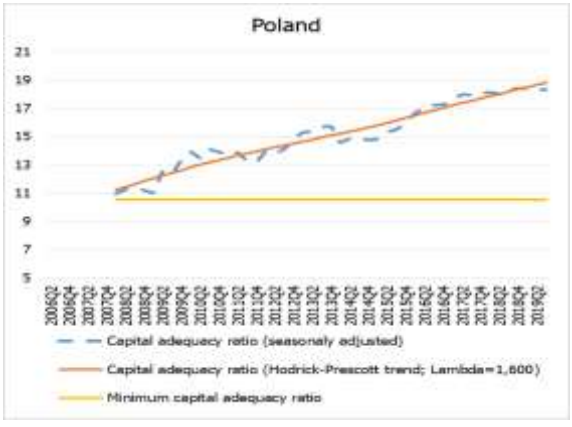
Figure 2: Capital adequacy ratio in % for the period from 2006q2 to 2019q3

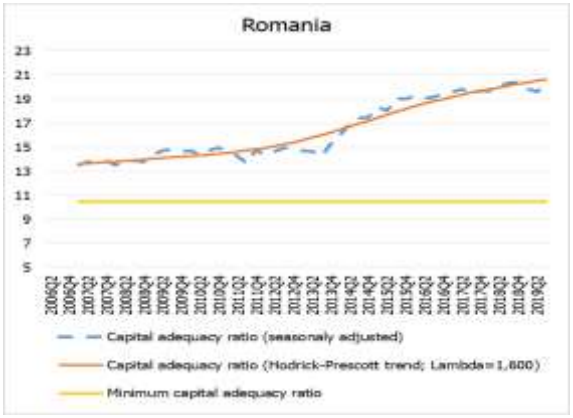


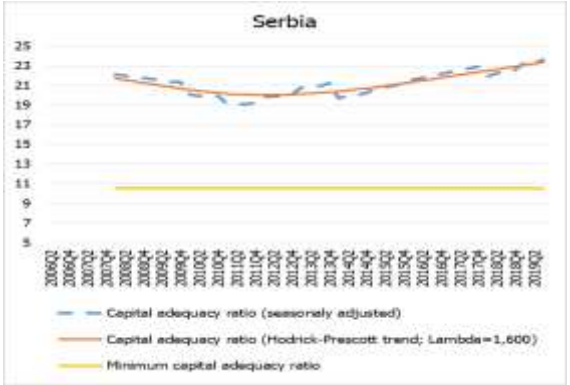


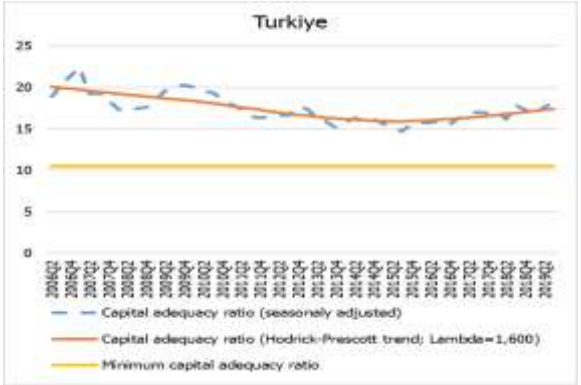












Source: International Monetary Fund, Financial Soundness Indicators Database and authors' calculations

The database from Cerrutti et al (2015), provides overview of certain macroprudential measures that were in place up to 2017[22]. The capital-based macroprudential measures have only been considered, for the purpose of this analysis. They were mentioned in the previous section, but here will be repeated in order to remind: (1) time-varying/dynamic loan-loss provisioning, (2) general countercyclical capital buffer/requirement, (3) leverage ratio and (4) capital surcharges on SIFI. The figure 3 below shows the number of capital-based macroprudential measures in the sample of this paper: Croatia used time-varying/dynamic loan-loss provisioning up to 2008 and capital surcharges on SIFI from 2016 onwards; Czech Republic implemented capital surcharges on SIFI from 2014 onwards and general countercyclical capital buffer/requirement in 2017; Hungary, North Macedonia and Poland introduced only capital surcharges on SIFI in 2017, while Romania implemented the same measure from 2016 onwards; Serbia used general countercyclical capital buffer/requirement from 2008 to 2010, while leverage ratio and capital surcharges on SIFI were implemented in 2017; finally, Turkiye used time-varying/dynamic loan-loss provisioning from 2006 onwards, leverage ratio from 2014 onwards and capital surcharges on SIFI from 2016 onwards. The deviations of the actual capital adequacy ratio from the HP trend in the figure 2, clearly distinguish between restrictive and expansionary capital-based macroprudential policy, as it was explained in the previous section.

Unlike the figure 2, Cerruti et al (2015)[23] explain that the data in figure 3 do not indicate tightening or expansionary stance, but merely that measures that have been in place during a certain period of time. Thus, check was made in other studies and databases with an aim to ascertain the intensity of the capital-based macroprudential measures. More concretely, the database by the European Systemic Risk Board (ESRB)[24] referring to the EU countries, the website of the National Bank of Serbia, the website of the National Bank of the Republic of North Macedonia, Mahmutoğlu and Ardor (2019) and Gürsoy (2016) for Turkiye were checked. The mentioned sources indicate that general countercyclical capital buffer/requirement (only for the Czech Republic) and capital surcharge on SIFI were restrictive[25] [26] for the banks in the considered countries because they required additional capital buffer. Furthermore, Lim et al (2011) provides detailed explanation concerning the macroprudential measures implemented in 49 countries. This study implies that time-varying/dynamic loan-loss provisioning had restrictive

[22] The database is available at https://www.imf.org/en/Publications/WP/Issues/2016/12/31/The-Use-and-Effectiveness-of-Macroprudential-Policies-New-Evidence-42791 accessed on 16.05.2020. Initially, the database contained data for 119 countries up to 2013 and in 2018 the sample was broaden up to 160 countries and the data updated up to 2017. The database contains annual data and have been interpolated on quarterly level by assuming the same values throughout the quarters of the respective year.

[23] It would be more useful to use step variables that increase or decrease depending on whether a given macroprudential measure is being tightened or loosened, however that is beyond the scope of the paper as it requires constructing questionnaire and surveying the macroprudential authorities by each country. Nevertheless, the authors of this paper overcome this potential problem by taking the capital adequacy cycle as explained on page 15.

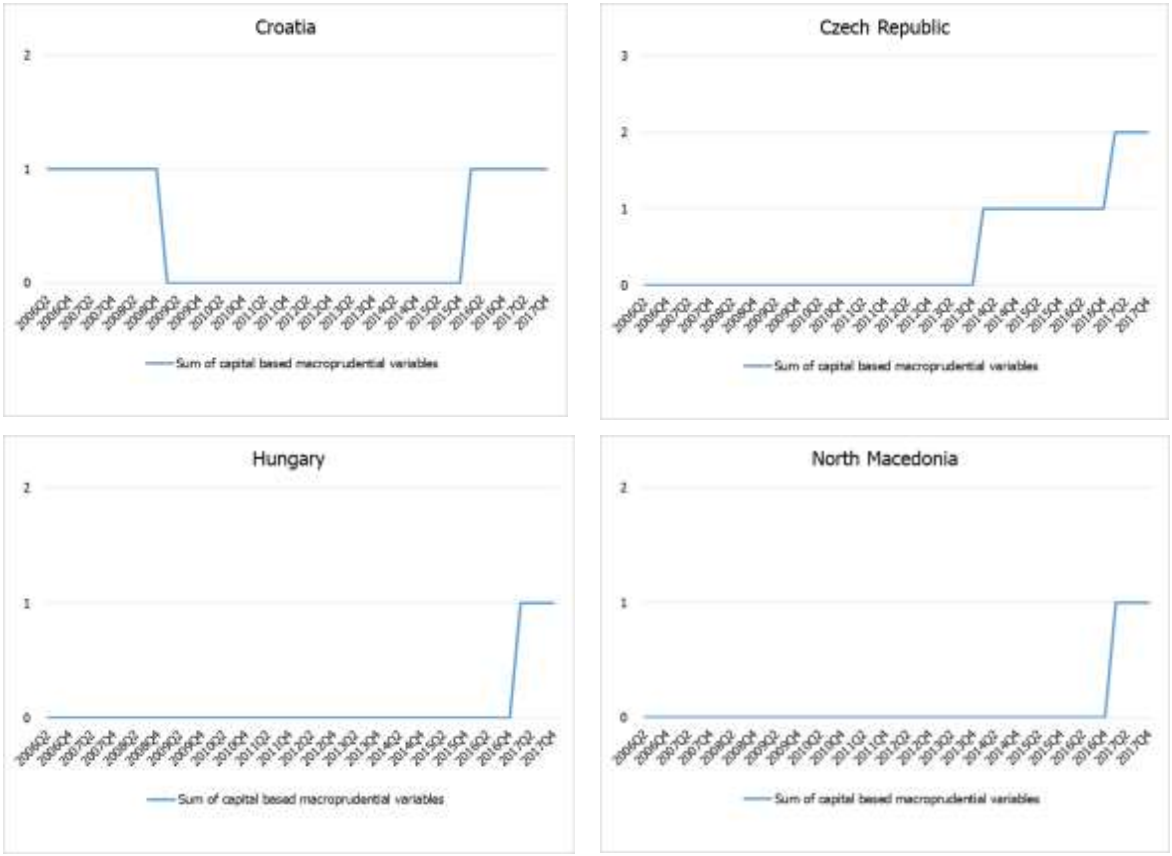
[24] Available at https://www.esrb.europa.eu/national_policy/capital/html/index.en.html accessed on 16.05.2020.

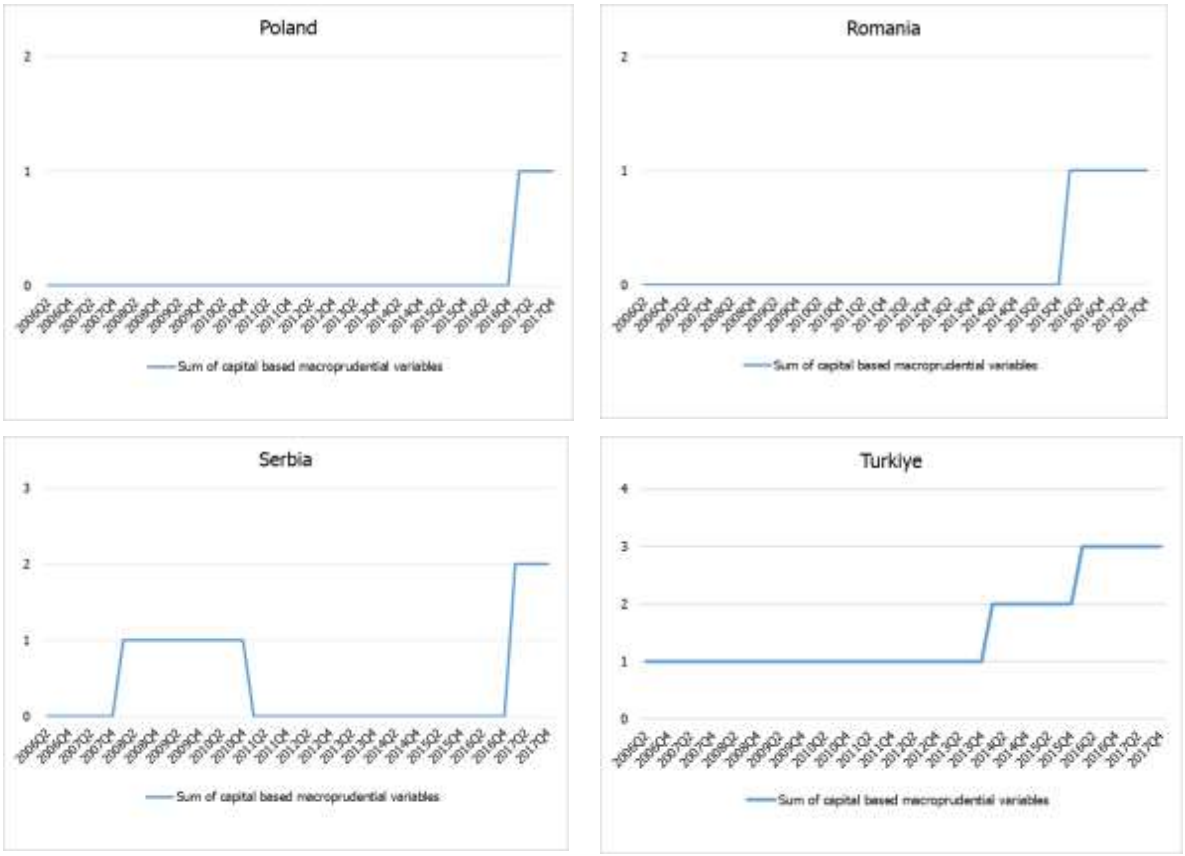
[25] Available at https://www.nbs.rs/internet/english/18/18_9/18_9_3/index.html accessed on 16.05.2020.

[26] Available at http://www.nbrm.mk/ns-newsarticle-capital-buffer-for-systemically-important-banks.nspx accessed on 16.05.2020.

character in Croatia (see Lim et al, 2011, Appendix VII on p. 74). Concerning the general countercyclical capital buffer/requirement used in Serbia from 2008 to 2010, Lim et al (2011, Appendix VII on p. 79) explains that an exposure limit for retail lending relative to Tier I capital was implemented and it restricted the lending to households acting as countercyclical capital buffer. Moreover, the National Bank of Serbia requires the banks to maintain the leverage ratio above 3% (NBS, 2018), indicating restrictiveness. Mahmutoğlu and Ardor (2019, p. 2375 and p. 2376) indicate changing intensity of the time-varying/dynamic loan-loss provisioning. This measure was restrictive for consumer loans to the households and abolished in 2016. Moreover, dynamic provisioning was selective and relaxed for other loans in Turkiye such as: export loans and loans to small and medium enterprises. Also, the authors classify the leverage ratio as restrictive measure and the floor for the Turkish banks is set at 3%. Finally, the restrictive character of the capital surcharge on SIFI in Turkiye is implied by Gürsoy (2016, p. 77). In summary, the capital-based measures in figure 3 were dominantly restrictive throughout the period considered.

Figure 3: Sum of capital-based macroprudential dummies for the period from 2006q2 to 2017q4





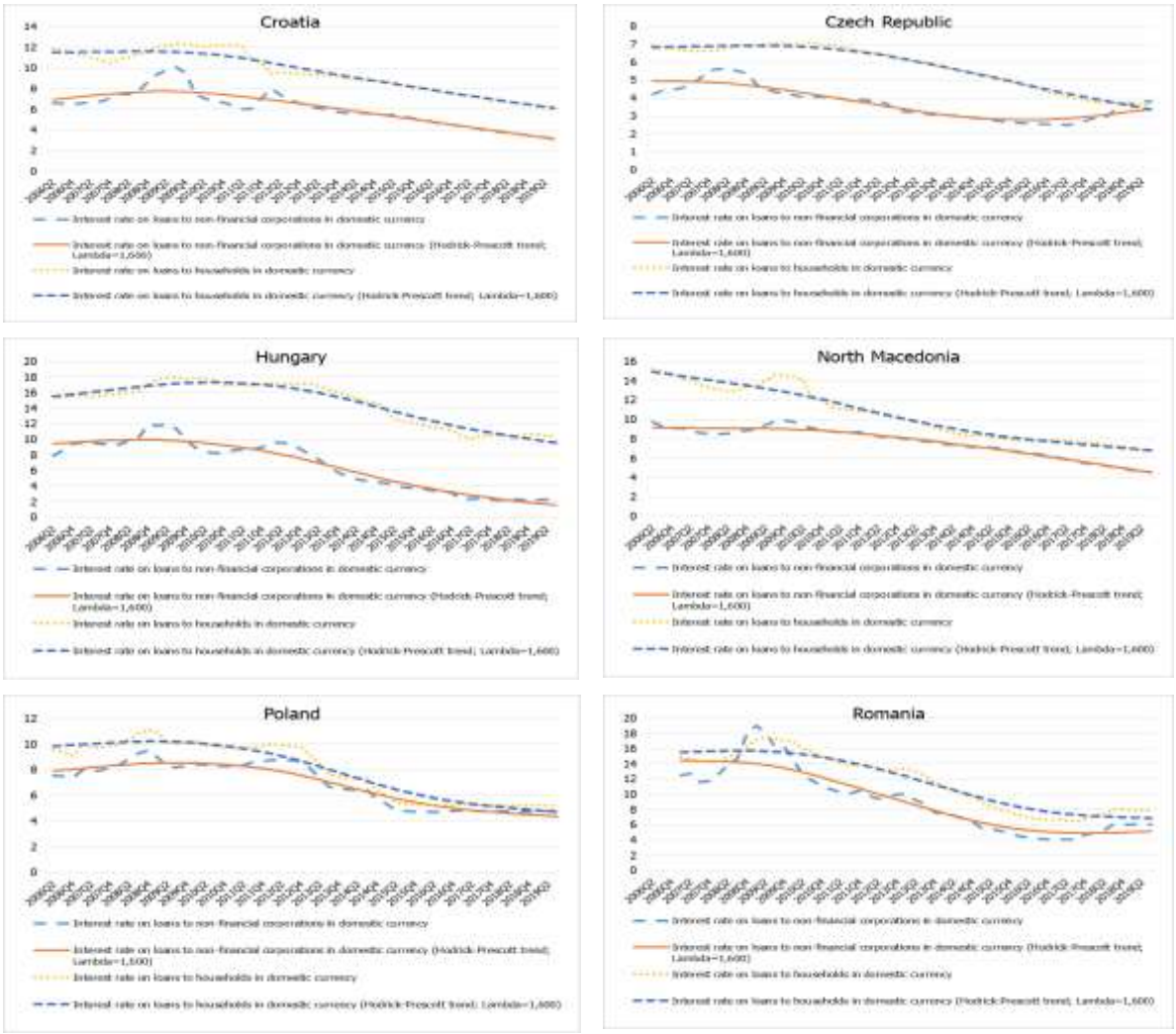
Source: Cerutti et al (2015), 2018 update. The database contains annual data and has been interpolated on quarterly level by assuming the same values throughout the quarters of the respective year.

As can be noticed from figure 4, the loan interest rates in domestic currency to non-financial corporations and households mainly follow decreasing trend for most of the countries after 2009. This downward movement probably reflects the effects of the accommodative monetary policy[27] and positive GDP growth performances[28]. Exception is Turkiye where the trend of both loan interest rates was going downwards and changed to upwards after 2012. The reason for such change in the trend of the loan interest rates in Turkiye, might be the signal given by the tightened monetary policy as a result of the volatile inflation rate after 2011 spanning from minimum of 5% to two digits (Gürkaynak et al, 2015). This implies that Turkish banks followed the recommendations from the central bank. The Czech banking sector followed the tightened monetary policy rate and increased the loan interest rates in domestic currency for non-financial corporations, while the lending rates to households kept the declining trend. Furthermore, the data in figure 4 indicate that banks over-charged the clients with high loan interest rates, as the loan interest rates are above the equilibrium level approximated by the HP trend, during the Global Financial Crisis in 2008-2009. This could be mainly attributed to the high risk-premia in the loan interest rates as the Global Financial Crisis deteriorated the creditworthiness of both companies and households and increased the credit risk potential. However, in the recent years, the actual interest rates mainly follow the HP trend and do not indicate over-charge or sub-charge.

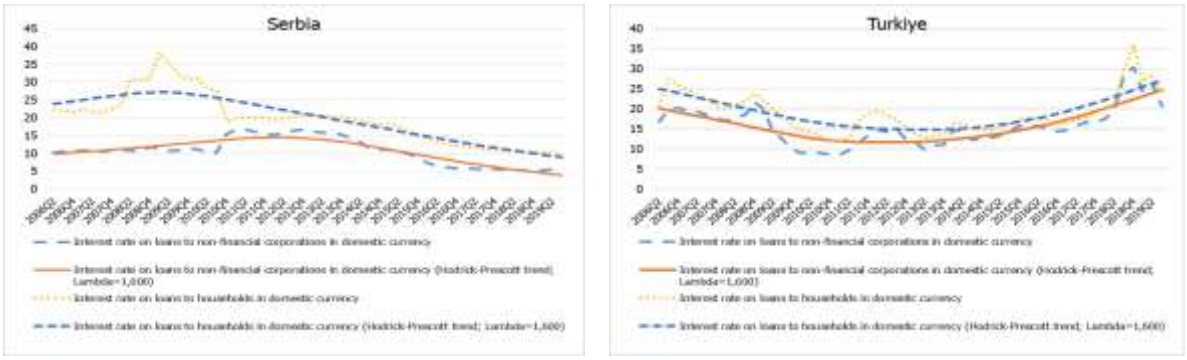
[27] See figure 1.
[28] See figure 12 in the Appendix 1.

Moreover, the loans interest rates in domestic currency to households are higher compared to the corresponding loan interest rates to non-financial corporations. Probably, this is a result of the less opportunities for the households to indebt from the other non-banking institutions unlike the corporates[29] and consequently banks take advantage to make higher profit (Dumičić, 2018). Next, banks pay higher interest rates to the deposits sources from households as they are main saving sector. Additionally, the possibility to disperse the credit risk at higher loan interest rate could also be contributory factor for the higher loan interest rates to households relative to the corporates. Namely, lending to households allows for granting smaller amount of loans to many clients by higher interest rate and consequently the risk is dispersed among many clients while the interest return is higher.

Figure 4: Interest rate on loans in domestic currency to non-financial corporations and households in % for the period from 2006q2 to 2019q3



[29] Corporations can utilize retained earnings as funding source, intercompany loans and issue securities on the stock market.



Source: Central banks and authors' calculations

Figure 5 below implies heterogeneity among the banking sectors concerning the lending trends of the non-financial corporations and households. Croatia, Hungary and Romania recorded deleveraging to both sectors, while other countries experienced upward trend, throughout the whole period. Divergent trends are noticeable for Serbia i.e. the non-financial corporations' loans reduced, while households' loans increased. Raiffeisen (2015, p. 36) states that Croatia's low economic growth and consequently accumulated systemic risks such as: *inferior lending environment, deteriorating asset quality, and shrinking cross-border funding possibilities* added by the reduced loan demand, affected the declining trend of the loans to both sectors relative to GDP. According to Raiffeisen (2016, p. 28), the following reasons contributed to deleveraging in Hungary: *corporate loans cleansing, substantial intercompany financing and the fact that large-ticket corporate loans are refinanced internationally, i.e. by non-domestic lenders* and additionally the households were paying off the loans in larger dynamic compared to newly granted loans (Raiffeisen, 2015). In Romania, there were divergent movements between loans and GDP that attributed to the low relative indicator. Namely, the economic growth was performing by higher dynamic while the low loan demand contributed to low lending growth, and eventually resulting in reduced indicator of loans to GDP (Raiffeisen, 2015 and 2016). On the other hand, it could be noticed that in the last years the actual non-financial corporations' loans to GDP and actual households' loans to GDP recorded an increase and approached the trend level for Croatia, Hungary and Romania. Serbian banking sector decreased the loans to non-financial corporations due to the high credit risk reflected into high corporate non-performing loans (NPL) ratio that peaked at 27.4% in the mid of 2014 (Raiffeisen, 2015 p. 42). The remaining countries experienced upward lending trends in both sectors on the back of the positive economic prospects and sound banking features.

It is interesting to note that Croatian, Czech, Hungarian and Polish banking sectors are more oriented in lending to households unlike the lending to non-financial corporations, as the former indicator is higher compared to the latter. Most probable reasons for this occurrence are: risk dispersion and higher return[30].

[30] Figure 4 implies that interest rate on loans in domestic currency to households are higher than the interest rate on loans in domestic currency to non-financial corporations.

Figure 5: Non-financial corporations' loans to GDP and households' loans to GDP in % for the period from 2006q2 to 2019q3

Source: International Monetary Fund, Financial Soundness Indicators Database and authors' calculations

Having in mind the above explained, it is implied that the sample is not quite homogeneous in the variable movement. More specifically, some countries have different trends for certain variables. Nevertheless, previous section explained that the variables are taken as cycles (difference between the actual variables and their HP trends) in this paper, with an aim to distinguish between the expansionary

and the restrictive stance. It should be emphasized that detrended variables follow more or less stationary pattern of movement (see Appendix 1). Thus, using the variables as cycles allows for mitigating the possible unfavorable effects of having heterogeneous trend data sample.

5. Econometric methodology

The econometric methodology should account for the features of the sample in this analysis concerning the number of cross sections (N) and time observations (T), and it is important to assess the effect of the independent variables on short run and long run. The distinction between the short-term and long-term effect is especially relevant from the aspect of the policy maker, as it should know what instruments primarily to utilize in a short run so to maintain the intermediate objective i.e. to smoothen the credit cycle with less costs to borrowers, as well as to have an overview of the long-term effects from each respective policy.

Concerning the features of the sample in this paper, it consists of limited and small number of cross sections (N=8 countries) and relatively large time period (T spans from 2006q2 to 2017q4/2019q3[31]). This paper utilizes two techniques: the first one is the Ordinary Least Squuares (OLS) method and cross-section Seemingly Unrelated Relations (SUR) with Panel-Corrected Standard Errors (PCSE), as suggested by Beck and Katz (1995) and the second technique is the Pool Mean Group (PMG) cointegration method as suggested by Pesaran and Smith (1997) and Pesaran et al (1999). Both techniques are considered as reliable when the number of cross sections is small compared to the time observations. These techniques have been applied by other studies as well. Dumičić (2018) applied the first technique while Jovanovic et al (2016) applied the second technique.

Concerning the distinction between the short-term and long-term effect of the central monetary and capital-based macroprudential policies, the OLS-SUR-PCSE methodology is designed as partial-adjustment model (PAM). Such model includes a lag of the dependent variable and allows for inertia in the long-term adjustment of the dependent variable relative to its own past value and the other independent variables. The PMG cointegration is an autoregressive distributed lag (ARDL) model that also uses lags of the variables and it accounts for the possible endogeneity issues and assess both the long-term and short-term effects. The regressions estimated by the PMG in this paper, include one lag chosen on arbitrary basis. Including one lag is reasonable as it is a period of one quarter that is long enough to encompass the transmission effects as well as not to over-parametarize the regressions with too many lags. Also, advantage of the PMG cointegration is that the variables can follow different order of integration and yet, the PMG would obtain consistent parameters for the long run and short run relationship between both stationary and non-stationary variables (Velickovski et al, 2017).

[31] The sum of capital-based macroprudential dummy variables spans from 2006q2 to 2017q4 while all other variables spam from 2006q2 to 2019q3.

Furthermore, cross section fixed effects have been used with the purpose for capturing any non-time varying country specific conditions in the OLS-SUR-PCSE method. As it was mentioned in the previous sections, the variables are taken as cycles (detrended) in order to account for: the stance of the variables, to reduce the possible unfavorable effects of having heterogeneous trend data sample and additionally the fixed effects would capture the various other characteristics[32] among the countries. The statistical significance of the error correction mechanism term (ECM) in the regressions will be considered for establishing the PMG cointegration among the variables (see Pesaran et al, 1999, p. 6), similarly applied as in Jovanovic et al (2016). The ECM term should be negative and statistically significant in order to restore the short run deviations on the path of the long run relationship. Additionally, implementing two different methodologies allows for checking the robustness of the estimated parameters.

The data are organized as unbalanced panel. Each variable has been seasonally adjusted for each country by applying Census X-12 method, with an additive season. The regressions have been estimated by including time observations up to 2017q4, as the sum of capital-based macroprudential dummy variables has shorter span compared to other variables (up to 2019q3). The restrain of the time observations in the panel estimations, is actually beneficial for obtaining consistent coefficients because the variables have been detrended with the HP trend, and thus the end-point bias has been mitigated. Unit roots tests imply different integrative characteristics, that is, some variables are stationary while others are not[33]. Nevertheless, this is not a problem for the PMG cointegration methodology.

6. Results

The results will be explained for the interest rate on loans to non-financial corporations/households in domestic currency as well as for the non-financial corporations/households' loans to GDP, respectively. The results indicate the efficiency of both monetary and capital-based macroprudential policy, that is which policy comparatively causes less costs to the borrowers in terms of the loan interest rates. Moreover, the results imply the effectiveness perceived as the scope of each policy to affect the credit cycle. The efficiency and the effectiveness are assessed on short-term and long-term basis.

6.1 Results of the OLS-SUR-PCSE methodology

Firstly, the results concerning the interest rate on loans to non-financial corporations/households will be considered in tables 2 and 3. The PAM implies relatively moderate correction[34] of the short run

[32] Different monetary strategies among the countries (exchange rate targeters and inflation targeters), different banking sectors' development level, various institutional characteristics etc.
[33] The results are not presented so to save space, but they are available upon request.
[34] Obtained as the difference between 1 and the coefficient of the lag of the dependent variable.

deviations towards long run balance of almost 1/3 (0.27 pp) per quarter on average, according to the results obtained in tables 2 and 3.

Table 2: OLS-SUR-PCSE results for the interest rate on loans to non-financial corporations in domestic currency[35]

Dependent variable	Interest rate on loans to non-financial corporations in domestic currency expressed as cycle											
Independent variables	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)
Interest rate on loans to non-financial corporations in domestic currency expressed as cycle (lagged variable (-1))	0.433*		0.728*		0.734*		0.728*		0.727*		0.728*	
Monetary policy interest rate cycle	0.050***	0.088***	0.204*	0.750*	0.191*	0.718*	0.203*	0.746*	0.193*	0.707*	0.205*	0.754*
Capital adequacy ratio cycle	-0.147**	-0.265**	-0.227*	-0.835*	-0.217*	-0.816*	-0.227*	-0.835*	-0.205*	-0.751*	-0.228*	-0.838*
Sum of capital-based macroprudential dummies	-0.054	-0.095	-0.087	-0.320	-0.129	-0.485	-0.084	-0.309	-0.091	-0.333	-0.088	-0.324
Real gross domestic product growth cycle (annual growth)	-0.005	-0.009	0.025	0.092	0.024	0.090	0.024	0.088	0.014	0.051	0.022	0.081
Interest rate on total deposits in domestic currency cycle	0.557*	0.982*										
Deposits to GDP cycle			0.005	0.018								
Non-performing loans ratio cycle					-0.078**	-0.293**						
Return on equity cycle							-0.002	-0.007				
1 month EURIBOR cycle									0.077	0.282		
Dummy for the global financial crisis (2008q2 to 2009q4)											-0.029	-0.107
Constant	0.0130	0.023	0.032	0.118	0.053	0.200	0.031	0.114	0.033	0.121	0.038	0.140
Estimation period	2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4	
Observations	345		345		345		345		345		345	
R^2	0.818		0.741		0.746		0.741		0.742		0.741	
F statistic (probability)	0.000		0.000		0.000		0.000		0.000		0.000	
Cross section	fixed		fixed		fixed		fixed		fixed		fixed	
Period	none		none		none		none		none		none	
* p<0.01 ** p< 0.05 ***p<0.1												
All specifications are estimated by employing ordinary least square (OLS), fixed effects, cross-section seemingly unrelated regressions (SUR) panel-corrected standard errors (PCSE)												

Source: Authors' calculations

[35] Columns labeled with a (1a; 2a; 3a; 4a; 5a and 6a) indicate the short-run effect of the estimated coefficients, while the columns labeled with b (1b; 2b; 3b; 4b; 5b and 6b) indicate the long-run effect.

The increase of the cycle of the monetary policy interest rate affects positively the cycle of the dependent variable in both short run and long run, and the size of the estimated coefficient is less than unit in all specifications as implied by table 2. This suggests that banking sectors increase the corporate loan interest rate with smaller dynamics (less than 1 p.p.) compared to the proportion of the given restrictive monetary signal (increase by 1 p.p.). The short run effect ranges from 0.050 pp to 0.205 pp, while the long-term effect is within the interval from 0.088 pp to 0.754 pp In contrast, the effect of the capital-based macroprudential policy is negative according to table 2. Namely, the restrictive cycle (or the positive increase) of the capital adequacy ratio reduces the interest rate on the non-financial corporations' loans, while the negative coefficient in front of the sum of the macroprudential dummy variable is statistically insignificant. Concretely, the estimated coefficients have negative sign spanning from 0.147 pp to 0.228 pp and the long-term coefficients are ranging from 0.265 pp to 0.838 pp Thus, given the signals from the monetary and the capital-based macroprudential policies, then the banking sectors adjust the corporate loan interest rate accordingly with an aim not to cause adverse selection as implied by the credit rationing theory (Stiglitz and Weiss, 1981 and Agur, 2013). Also, having in mind that the higher capital adequacy ratio means that shareholders have increased stake (skin in the game), consequently the results imply that banking sectors are becoming more credit risk averse and impose less costs to the corporate borrowers as they are trying to keep well balanced borrowers' pool (Dautović, 2019). Hence, the results imply that capital-based macroprudential policy has higher efficiency compared to the monetary policy with regards to the non-financial corporations.

Table 3: OLS-SUR-PCSE results for the interest rate on loans to households in domestic currency[36]

Dependent variable	Interest rate on loans to households in domestic currency expressed as cycle											
Independent variables	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)
Interest rate on loans to households in domestic currency expressed as cycle (lagged variable (-1))	0.747*		0.725*		0.723*		0.723*		0.725*		0.718*	
Monetary policy interest rate cycle	0.125*	0.494*	0.209*	0.760*	0.213*	0.769*	0.210*	0.758*	0.215*	0.782*	0.188*	0.667*
Capital adequacy ratio cycle	0.024	0.095	-0.011	-0.040	-0.013	-0.047	-0.007	-0.025	-0.020	-0.073	-0.0003	-0.001
Sum of capital-based macroprudential dummies	0.025	0.099	-0.038	-0.138	-0.026	-0.094	-0.019	-0.069	-0.037	-0.135	-0.029	-0.103
Real gross domestic product growth cycle (annual growth)	0.008	0.032	-0.011	-0.040	-0.011	-0.040	-0.009	-0.032	-0.006	-0.022	0.001	0.004
Interest rate on total deposits in domestic currency cycle	0.224*	0.885*										
Deposits to GDP cycle			-0.007	-0.025								
Non-performing loans ratio cycle					0.021	0.076						
Return on equity cycle							-0.020**	-0.072**				
1 month EURIBOR cycle									-0.034	-0.124		
Dummy for the global financial crisis (2008q2 to 2009q4)											0.305**	1.082**
Constant	0.006	0.024	0.029	0.105	0.023	0.083	0.022	0.079	0.029	0.105	-0.025	-0.089
Estimation period	2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4	
Observations	345		345		345		345		345		345	
R^2	0.656		0.642		0.642		0.644		0.642		0.646	
F statistic (probability)	0.000		0.000		0.000		0.000		0.000		0.000	
Cross section	fixed		fixed		fixed		fixed		fixed		fixed	
Period	none		none		none		none		none		none	
* p<0.01 ** p< 0.05 ***p<0.1												
All specifications are estimated by employing ordinary least square (OLS), fixed effects, cross-section seemingly unrelated regressions (SUR) panel-corrected standard errors (PCSE)												

Source: Authors' calculations

[36] Columns labeled with a (1a; 2a; 3a; 4a; 5a and 6a) indicate the short-run effect of the estimated coefficients, while the columns labeled with b (1b; 2b; 3b; 4b; 5b and 6b) indicate the long-run effect.

Furthermore, the results in table 3 indicate that the monetary policy has the expected positive effect within the interval from 0.125 pp to 0.215 pp for the short-term relationships and from 0.494 pp to 0.782 pp for the long-term relationships. Regarding the capital-based macroprudential policy, the short-term and long-term coefficients in front of the two representative variables are statistically insignificant in all specifications.

Comparatively seen between the sectors, the estimated coefficients of the monetary policy concerning the households' loan interest rate in table 3, are higher than the respective results in table 2 referring to the non-financial corporations. Thus, the results suggest that the monetary policy passes through higher loan interest rates to the households relative to the non-financial corporations. This is reasonable and expected as the households are mostly indebted by the banks because they have less alternatives for indebting from other sources and accordingly they could bear higher interest costs (Cerutti et al, 2015 and Dumičić, 2018). Unlike them, non-financial corporations, besides the banks, have other forms for indebting, such as the stock market or intercompany borrowing and therefore the banks have limited pass through effect as they might lose the corporate borrowers.

Concerning the other variables in tables 2 and 3, the cycle of the deposit interest rate positively affects the both sectors. The effect is reasonable as the deposit interest rate is the price that banks pay on the deposit sources.

The credit risk variable represented by the NPL ratio's cycle has unexpected negative effect to corporate loan interest rates while it is positive and statistically insignificant for the households. This implies that the banks do not pass through the higher credit risk on the corporate loan interest rates. Most probably and as implied by the credit rationing theory, the banks perceive that such an increase would trigger the adverse selection of the non-financial corporations and the banks would accordingly face losses as there is no a possibility to diversify the risk. Additionally, the positive effect of the NPL ratio on the households' loan interest rate suggests that the banks transfer the higher credit risk to the households as they usually are many clients and there is a higher chance to diversify the credit risk. However, the coefficient of the NPL ratios' cycle in table 3 is positive as expected, but it is statistically insignificant.

Furthermore, the positive cycle of the ROE decreases the cycle of the loan interest rates to households only. Additionally, the dummy variable for the Global Financial crisis has positive effect on the households' interest rates. The effects of the mentioned two variables are expected.

The results concerning the non-financial corporations' loans/households' loans to GDP will be considered in tables 4 and 5. The PAM in the both tables suggest slow correction[37] of the short-term effects towards the long-term relationship of around 0.10 pp per quarter on average. Namely, as the coefficient in front of the lagged loans to GDP is very high, it implies that the current dependent variables are highly determined by the past values. Probably, the reason for such very slow adjustment might be contributed

[37] Obtained as the difference between 1 and the coefficient of the lag of the dependent variable.

to the larger share of the long-term loans (Bogoev, 2011). Namely, the long-term loans need pretty much time to be repaid and therefore the banks are often being credit exposed. Additionally, less indebting opportunities of the households to other lenders and their dependence from the banks' lending might also be a reason for the high inertia of the loans' cycle adjustment.

Table 4: OLS-SUR-PCSE results for the non-financial corporations' loans to GDP[38]

Dependent variable	Non-financial corporations' loans to GDP cycle											
Independent variables	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)
Non-financial corporations' loans to GDP cycle (lagged variable (-1))	0.904*		0.877*		0.900*		0.895*		0.896*		0.898*	
Monetary policy interest rate cycle	0.018	0.188	0.017	0.138	-0.026	-0.260	-0.010	-0.095	-0.013	-0.125	-0.016	-0.157
Capital adequacy ratio cycle	-0.274*	-2.854*	-0.254*	-2.065*	-0.238*	-2.380*	-0.254*	-2.419*	-0.248*	-2.385*	-0.251*	-2.461*
Sum of capital-based macroprudential dummies	-0.144	-1.500	-0.136	-1.106	-0.175***	-1.750***	-0.116	-1.105	-0.117	-1.125	-0.112	-1.098
Real gross domestic product growth cycle (annual growth)	-0.017	-0.177	0.012	0.098	-0.008	-0.080	-0.007	-0.067	-0.010	-0.096	-0.004	-0.039
Interest rate on loans to non-financial corporations in domestic currency expressed as cycle	-0.083	-0.865										
Deposits to GDP cycle			0.146*	1.187*								
Non-performing loans ratio cycle					-0.110*	-1.100*						
Return on equity cycle							-0.0002	-0.002				
1 month EURIBOR cycle									0.020	0.192		
Dummy for the global financial crisis (2008q2 to 2009q4)											0.079	0.775
Constant	0.100	1.042	0.100***	0.809***	0.122**	1.22**	0.094	0.895	0.094	0.904	0.079	0.775
Estimation period	2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4	
Observations	341		341		341		341		341		341	
R^2	0.891		0.900		0.893		0.890		0.890		0.890	
F statistic (probability)	0.000		0.000		0.000		0.000		0.000		0.024	
Cross section	fixed		fixed		fixed		fixed		fixed		fixed	
Period	none		none		none		none		none		none	
* p<0.01 ** p< 0.05 ***p<0.1												
All specifications are estimated by employing ordinary least square (OLS), fixed effects, cross-section seemingly unrelated regressions (SUR) panel-corrected standard errors (PCSE)												

Source: Authors' calculations

[38] Columns labeled with a (1a; 2a; 3a; 4a; 5a and 6a) indicate the short-run effect of the estimated coefficients, while the columns labeled with b (1b; 2b; 3b; 4b; 5b and 6b) indicate the long-run effect.

The results in table 4 show that capital-based macroprudential policy affects negatively the cycle of the non-financial corporations' loans to GDP. As the cycle of the capital adequacy ratio becomes positive, then it smoothens the cycle of the corporate loans in both short run and long run. Both the short run and long run effects are negative, within the range from 0.238 pp to 0.274 pp and the range from 2.065 pp to 2.854 pp, respectively. The second macroprudential variable (sum of the capital-based macroprudential dummies) has expected negative effect on the corporate lending, but statistically significant only in the specifications 3a and 3b. Concerning the monetary policy rate, it does not have statistically significant effect on the short run and the long run coefficients.

Table 5: OLS-SUR-PCSE results for the households' loans to GDP[39]

Dependent variable	Households' loans to GDP cycle											
Independent variables	1a	1b	2a	2b	3a	3b	4a	4b	5a	5b	6a	6b
	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)	Short-run effect	Long-run effect = (short-run coefficient/(1-coefficient of the lag of the dependent variable)
Households' loans to GDP cycle (lagged variable (-1))	0.885*		0.873*		0.884*		0.889*		0.884*		0.890*	
Monetary policy interest rate cycle	-0.019	-0.165	-0.006	-0.047	-0.036***	-0.310***	-0.019	-0.171	-0.017	-0.147	-0.027	-0.245
Capital adequacy ratio cycle	-0.080***	-0.696***	-0.080**	-0.630**	-0.066	-0.569	-0.082***	-0.739***	-0.086***	-0.741***	-0.076***	-0.691***
Sum of capital-based macroprudential dummies	-0.208*	-1.809*	-0.217*	-1.709*	-0.273*	-2.353*	-0.222*	-2.000*	-0.208*	-1.793*	-0.202*	-1.836*
Real gross domestic product growth cycle (annual growth)	-0.006	-0.052	0.004	0.031	-0.006	-0.052	-0.007	-0.063	-0.004	-0.034	-0.0004	-0.004
Interest rate on loans to households in domestic currency expressed as cycle	-0.003	-0.026										
Deposits to GDP cycle			0.068*	0.535*								
Non-performing loans ratio cycle					-0.115*	-0.991*						
Return on equity cycle							0.017***	0.153***				
1 month EURIBOR cycle									-0.017	-0.147		
Dummy for the global financial crisis (2008q2 to 2009q4)											0.115	1.045
Constant	0.158*	1.374*	0.161*	1.268*	0.190*	1.638*	0.163*	1.468*	0.158*	1.362*	0.136*	1.236*
Estimation period	2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4		2006q3-2017q4	
Observations	341		341		341		341		341		341	
R^2	0.908		0.911		0.914		0.909		0.908		0.908	
F statistic (probability)	0.000		0.000		0.000		0.000		0.000		0.000	
Cross section	fixed		fixed		fixed		fixed		fixed		fixed	
Period	none		none		none		none		none		none	
* p<0.01 ** p< 0.05 ***p<0.1												
All specifications are estimated by employing ordinary least square (OLS), fixed effects, cross-section seemingly unrelated regressions (SUR) panel-corrected standard errors (PCSE)												

Source: Authors' calculations

[39] Columns labeled with a (1a; 2a; 3a; 4a; 5a and 6a) indicate the short-run effect of the estimated coefficients, while the columns labeled with b (1b; 2b; 3b; 4b; 5b and 6b) indicate the long-run effect.

Similarly as for the corporates, the results in table 5 imply negative effect of the capital adequacy ratio cycle on the households' loans to GDP. The short-term effect lies in the interval from 0.066 pp to 0.086 pp, while the long-term effect ranges from 0.569 pp to 0.739 pp The aggregated macroprudential dummies also has negative effect implying that when the capital-based measures are put in place, then the banks reduce the households lending and smoothen the credit cycle. The size of these coefficients is ranging from 0.202 pp to 0.273 pp in the short-run and from 1.709 pp to 2.353 pp in long run. The monetary policy rate has modest negative effect of 0.036 pp in short-run and 0.310 pp in long run only in the specifications 3a and 3b in table 5.

Considered from comparative aspect between the results from tables 4 and 5, the effect is reasonable concerning the capital adequacy ratio. Also, the negative coefficients for the capital adequacy ratio in tables 4 and 5 are in compliance with the corresponding negative coefficients in tables 2 and 3, giving relevance to the credit rationing and "skin in the game" theories. Thus, the results imply that given the capital increase, then the banks become more aware about the structure of the borrowers pool and the quality of the loan portfolio and they reduce the loan interest rates and smooth out the credit cycle in order not to face adverse selection problem. Additionally, the clear macroprudential effect from the aggregated capital-based dummies, is mostly negative as this variable indicates restrictive stance according to the analysis in the stylized facts section. The effect of the aggregated capital-based dummies is more significant and higher for the households compared to the non-financial corporations. This result indicates that given the capital macroprudential measures, then the banks adjust more the households' loan portfolio as they try to maintain the corporate loan portfolio, because the latter might provide funding from other sources. Regarding the monetary policy, it seems that this transmission has relatively modest effects compared to the macroprudential policy. The explanation for such result might be that the monetary policy might not always be the primary instrument of the policymakers to use, as it might have adverse effect on the costs and the credit cycle to all borrowers according to the one-size-fits-all principle. Moreover, the monetary policy interest rate might be primarily concerned about the inflation movements and exchange rate stability, as primary objectives unlike the cycles of the loan interest rates and the credit cycle, and accordingly the results are such modest. Therefore, the results from tables 2 to 5 indicate that capital-based macroprudential policy has higher efficiency in terms of lower corporate interest rates and higher effectiveness concerning the smoothing the credit cycle to both sectors, unlike the monetary policy. Such result is not a surprise, as the macroprudential policy should primarily preserve the stability of the banking sector by affecting the cycles of the loan interest rates and loans to GDP.

Finally, the effect of the remaining variables in tables 4 and 5 matches the expectations, as well. The cycles of the deposits to GDP and the NPL ratio have expected positive and negative effects on the credit cycles, respectively. The ROE cycle performs positively the cycle of the households' loans to GDP, only.

6.2 Results of the PMG cointegration methodology

The results from the PMG cointegration are presented in tables from 6 to 9. The results in these tables will be compared to the respective results in tables from 2 to 5, in order to consider their robustness. Firstly, the results for the loan interest rates will be explained in tables 6 and 7. As can be seen from both tables, the Error Correction Term (ECT) implies modest adjustment of the short-run deviations towards the long-term relationship of about 0.25 pp per quarter on average, similarly as the adjustment indicated by tables 2 and 3. The ECT term is negative and statistically significant and hence, the variables are cointegrated.

Table 6: PMG cointegration results for the interest rate on loans to non-financial corporations in domestic currency

Dependent variable	Interest rate on loans to non-financial corporations in domestic currency expressed as cycle				
Independent variables	1	2	3	4	5
Long-run equation					
Monetary policy interest rate cycle	0.355*	0.798*	0.812*	0.782*	0.809*
Capital adequacy ratio cycle	-0.248*	-0.134*	-0.159*	-0.201*	-0.171*
Sum of capital-based macroprudential dummies	-0.246*	-0.307*	-0.358*	-0.293*	-0.295*
Real gross domestic product growth cycle (annual growth)	-0.024***	-0.069*	-0.072*	-0.081*	-0.063*
Dummy for the global financial crisis (2008q2 to 2009q4)	-0.036	0.029	-0.026	0.045	0.047
Interest rate on total deposits in domestic currency cycle	0.789*				
Deposits to GDP cycle		0.031**			
Non-performing loans ratio cycle			-0.031		
Return on equity cycle				0.001	
1 month EURIBOR cycle					-0.099*
Short-run equation					
Error correction term	-0.284*	-0.278*	-0.262*	-0.263*	-0.297*
Difference of monetary policy interest rate cycle	0.232**	0.293*	0.306*	0.303*	0.287*
Difference of capital adequacy ratio cycle	0.076	0.005	-0.006	0.026	0.032
Difference of the sum of capital-based macroprudential dummies	0.122	0.019	-0.006	-0.009	-0.003
Difference of real gross domestic product growth cycle (annual growth)	-0.023	-0.049	-0.049	-0.050	-0.045***
Difference of dummy for the global financial crisis (2008q2 to 2009q4)	-0.223	-0.186	-0.206	-0.167	-0.179
Difference of interest rate on total deposits in domestic currency cycle	0.171				
Difference of deposits to GDP cycle		-0.022*			
Difference of non-performing loans ratio cycle			0.103		
Difference of return on equity cycle				0.019	
Difference of 1 month EURIBOR cycle					-0.098
Constant	0.021***	0.031	0.041	0.029	0.035
Estimation period	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4
Observations	341	341	341	341	341
* p<0.01 ** p< 0.05 ***p<0.1					

Source: Authors' calculations

The results from the long-term equation in table 6 indicate positive relation between the cycle of the monetary policy rate and the dependent variable. Similarly as in table 2, the effect is less than proportionate and that is an increase of the policy rate cycle by 1 pp causes less than unit increase of the corporate loan interest rate cycle in a range from 0.355 pp to 0.809 pp. Furthermore, both capital-macroprudential variables imply long-term negative effect on the corporate's loan pricing spanning from 0.134 pp to 0.248 pp for the capital adequacy ratio cycle and from 0.246 pp to 0.358 pp, for the aggregated capital-dummy measures. The results are in accordance with table 2. Both policies exhibit effects correspondent to the credit rationing theory (Stiglitz and Weiss, 1981 and Agur, 2013) and once again, according to the results, the capital-macroprudential transmission implies lower costs, as it contributes for lower corporate interest rates. Moreover, the size of the long-term coefficients referring to the central independent variables is similar to the size in table 2 indicating that the results are robust. Analyzed from the aspect of the short-term coefficients, the results imply that monetary policy has positive and statistically significant influence on the dependent variable. The size of the short-term coefficients in front of the monetary policy in table 6, is similar as the respective size in table 2.

Table 7: PMG cointegration results for the interest rate on loans to households in domestic currency

Dependent variable	Interest rate on loans to households in domestic currency expressed as cycle				
Independent variables	1	2	3	4	5
Long-Run equation					
Monetary policy interest rate cycle	0.559*	1.050*	0.954*	0.982*	1.076*
Capital adequacy ratio cycle	0.455*	0.165	0.214**	0.061	0.260*
Sum of capital-based macroprudential dummies	0.031	0.024	0.071	0.056	0.013
Real gross domestic product growth cycle (annual growth)	-0.026	-0.033	-0.011	-0.052	0.037
Dummy for the global financial crisis (2008q2 to 2009q4)	0.394**	0.610*	0.510*	0.603*	0.407*
Interest rate on total deposits in domestic currency cycle	0.376**				
Deposits to GDP cycle		0.039			
Non-performing loans ratio cycle			0.097***		
Return on equity cycle				-0.024	
1 month EURIBOR cycle					-0.413*
Short-run equation					
Error correction term	-0.221*	-0.209*	-0.233*	-0.212*	-0.233*
Difference of monetary policy interest rate cycle	0.0007	0.069	0.049	0.053	0.092
Difference of capital adequacy ratio cycle	-0.195	-0.146	-0.200	-0.165	-0.282
Difference of the sum of capital-based macroprudential dummies	-0.088	-0.317	-0.023	-0.024	-0.171
Difference of real gross domestic product growth cycle (annual growth)	-0.031	-0.022	-0.027	-0.024	0.014
Difference of dummy for the global financial crisis (2008q2 to 2009q4)	0.235	0.126	0.134	0.078	0.309
Difference of interest rate on total deposits in domestic currency cycle	0.120				
Difference of deposits to GDP cycle		0.042			
Difference of non-performing loans ratio cycle			0.332**		
Difference of return on equity cycle				-0.052	
Difference of 1 month EURIBOR cycle					-0.509
Constant	0.002	0.017	0.005	0.002	0.009
Estimation period	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4
Observations	341	341	341	341	341
* p<0.01 ** p< 0.05 ***p<0.1					

Source: Authors' calculations

Table 7 implies positive long-term influence of the cycle of the monetary policy on the cycle of the interest rates to households' loans within the interval from 0.559 pp to 1.076 pp The magnitude of the monetary policy's long-term effect is slightly higher compared to table 3 and once again, the monetary policy has higher effect on the households' loan interest rate relative to the effect on the corporate loan interest rate. Additionally, table 7 indicates that the cycle of the capital adequacy ratio positively affects the dependent variable. The respective long-term coefficients span from 0.214 pp to 0.455 pp, while the corresponding effect in table 3 was statistically insignificant. Thus, such estimated result in table 7, suggests that maintaining higher volume of the banks' capital is not costless, but eventually results into higher loans' interest costs to households in long run, compared to the decreasing long-term effect on the interest rates to the non-financial corporations. The rationale for such behavior is that the banks transfer such costs to the households in the long run leading to higher interest rates as they are more inelastic sector and more dependent from the banks indebting (Dumičić, 2018).

Furthermore, table 6 shows that the cycle of the real GDP growth decreases the cycle of the corporate interest rate, in the long run, implying that higher economic growth leads to less borrowing costs for the corporations. The long run coefficient of the deposit interest rate is positive in tables 6 and 7. The effect is reasonable because higher pricing of the deposits leads to higher pricing of the loans. The positive effect of the NPL ratio on the households' loan interest rate indicates that the banks transfer the higher credit risk to the households as they usually are many clients and there is a higher chance to diversify the credit risk. This premise was given in the previous section concerning the respective coefficient in table 3, but now the coefficient is statistically significant in table 7. The foreign monetary transmission represented by the cycle of the one-month EURIBOR has negative long-term effect and it is unexpected. The authors take this effect with caution and restrain to comment on it as it is against the theoretical logic.

The results concerning the non-financial corporations' loans/households' loans to GDP will be considered in tables 8 and 9. The ECT implies high inertia in the adjustment of the short-term deviations towards the long-term relationship of about 0.05 pp per quarter on average for the corporate loan portfolio, and 0.09 per quarter on average, similarly as the slow adjustment implied by tables 4 and 5. The ECT term is negative and statistically significant and the variables are cointegrated accordingly.

Table 8: PMG cointegration results for the non-financial corporations' loans to GDP

Dependent variable	Non-financial corporations' loans to GDP cycle				
Independent variables	1	2	3	4	5
Long-run equation					
Monetary policy interest rate cycle	-0.668	0.412	-5.976**	-1.152**	-0.797**
Capital adequacy ratio cycle	-3.041*	-3.059*	-2.373	-4.504*	-1.445*
Sum of capital-based macroprudential dummies	1.686**	1.390**	-4.846**	2.385***	1.144**
Real gross domestic product growth cycle (annual growth)	0.055	0.418**	-0.093	0.121	-0.134
Dummy for the global financial crisis (2008q2 to 2009q4)	-2.295**	-1.797**	17.071**	-1.126	-1.284***
Interest rate on loans to non-financial corporations in domestic currency expressed as cycle	0.102				
Deposits to GDP cycle		1.239*			
Non-performing loans ratio cycle			-2.079**		
Return on equity cycle				0.507***	
1 month EURIBOR cycle					1.815*
Short-run equation					
Error correction term	-0.049**	-0.060*	-0.024***	-0.032***	-0.068*
Difference of monetary policy interest rate cycle	-0.026	0.067	0.046	-0.002	-0.027
Difference of capital adequacy ratio cycle	-0.074	0.071	-0.190***	-0.128	-0.191
Difference of the sum of capital-based macroprudential dummies	-0.686	-0.392**	-0.522	-0.816**	-0.762
Difference of real gross domestic product growth cycle (annual growth)	-0.044	-0.012	-0.053	-0.053	-0.021
Difference of dummy for the global financial crisis (2008q2 to 2009q4)	-0.008	0.021	-0.256***	-0.020	-0.013
Difference of interest rate on total deposits in domestic currency cycle	0.180***				
Difference of deposits to GDP cycle		0.223*			
Difference of non-performing loans ratio cycle			-0.062		
Difference of return on equity cycle				-0.013	
Difference of 1 month EURIBOR cycle					-0.472*
Constant	0.055*	0.029	0.021	0.051**	0.068*
Estimation period	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4
Observations	341	341	341	341	341
* p<0.01 ** p< 0.05 ***p<0.1					

Source: Authors' calculations

Regarding the cycle of the non-financial corporations' loans to GDP, table 8 indicates negative long run effect of the monetary policy rate and capital adequacy ratio. The long-term coefficients are relatively large for both variables (negative average of 2.642 pp for the monetary policy and negative average of 3.012 pp for the capital adequacy ratio), higher compared to the respective long run coefficients in tables 4 and 5. Having in mind the previous explained, the results point out that the capital-macroprudential transmission is more effective as it has higher negative average effect on the corporate lending cycle, unlike the effect of the monetary policy. Concerning the aggregated capital-based macroprudential dummies, the long-term effect is not negative, having in mind that the dummy variables indicate restrictive macroprudential measures as implied in the previous section from figure 3. Therefore, the authors restrain from commenting such coefficients. However, the aggregated macroprudential dummies have the expected sign in the short-run relationship spanning from 0.392 pp to 0.816 pp

Table 9: PMG cointegration results for the households' loans to GDP

Dependent variable	Households' loans to GDP cycle				
Independent variables	1	2	3	4	5
Long-run equation					
Monetary policy interest rate cycle	-1.418*	-1.244*	-1.228*	-1.115*	-1.283*
Capital adequacy ratio cycle	-0.929*	-0.796**	-0.463***	-0.077	-1.010*
Sum of capital-based macroprudential dummies	-1.858*	-1.709*	-1.892*	-1.887*	-1.601*
Real gross domestic product growth cycle (annual growth)	0.053	0.111	0.041	-0.016	0.046
Dummy for the global financial crisis (2008q2 to 2009q4)	4.022*	4.310*	3.056*	3.128*	3.611*
Interest rate on loans to households in domestic currency expressed as cycle	0.101				
Deposits to GDP cycle		0.237**			
Non-performing loans ratio cycle			-0.671*		
Return on equity cycle				0.331*	
1 month EURIBOR cycle					-0.010
Short-run equation					
Error correction term	-0.090*	-0.084*	-0.107*	-0.094*	-0.097*
Difference of monetary policy interest rate cycle	0.009	0.053	-0.022	-0.078	-0.026
Difference of capital adequacy ratio cycle	-0.177***	-0.124	-0.205**	-0.203**	-0.189**
Difference of the sum of capital-based macroprudential dummies	-0.220	-0.182	-0.229	-0.249	-0.293
Difference of real gross domestic product growth cycle (annual growth)	-0.029***	-0.008	-0.020***	-0.025**	-0.015
Difference of dummy for the global financial crisis (2008q2 to 2009q4)	-0.223***	-0.267*	-0.229**	-0.204***	-0.237**
Difference of interest rate on total deposits in domestic currency cycle	0.069				
Difference of deposits to GDP cycle		0.139*			
Difference of non-performing loans ratio cycle			0.132**		
Difference of return on equity cycle				0.006	
Difference of 1 month EURIBOR cycle					-0.111
Constant	0.047***	0.040	0.075*	0.072*	0.046***
Estimation period	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4	2006q3-2017q4
Observations	341	341	341	341	341

* p<0.01 ** p< 0.05 ***p<0.1

Source: Authors' calculations

Finally, table 9 indicates that the central independent variables of interest have the expected results on the households' loans to GDP. The long-run effects of both capital-based macroprudential variables are negative and with similar size compared to the corresponding results in table 5. Additionally, the monetary policy affects negatively the dependent variable in long run with size above 1 pp, but less compared to the size of the sum of the capital-based macroprudential dummies. Moreover, the macroprudential policy has statistically significant effect in short-run, while the effect of the monetary policy is insignificant.

Thus, it seems that the results from tables 6 to 7 indicate that capital-based macroprudential policy has higher efficiency in terms of lower corporate interest rates, but the costs are being transferred to higher interest rates to the households as ultimate cost bearer. Also, tables 8 and 9 imply higher effectiveness of the macroprudential policy concerning the smoothing the credit cycle to both sectors, compared to the monetary policy, both in short-run and long run.

Furthermore, the dummy variable for the Global Financial crisis has mostly negative effect[40] in table 8, while it is positive and not in accordance with the expectations in table 9. The real GDP growth cycle has positive and statistically significant only in one specification in table 8 and it is insignificant in table 9. The remaining cycle variables such as: deposits to GDP, NPL ratio and ROE have expected positive, negative and positive effects, respectively in tables 8 and 9. Lastly, the one-month EURIBOR has positive effect on the non-financial corporations' loans to GDP. Perhaps, it would be more intuitive to comment this effect other way around. Namely, the one-month EURIBOR takes negative values as can be seen from figure 13 in the Appendix 1. Thus, as the EURIBOR decreases, then the banks constrain the foreign currency lending because the return lowers as well.

7. Conclusion

In conclusion, the efficiency and the effectiveness of both monetary and capital-based macroprudential transmission for a group of eight countries from SEE region were tested on the dominant borrowing sectors: non-financial corporations and households. For the purpose of this paper, the efficiency is defined as imposing less costs to loan borrowers in terms of reducing the loan interest rate or less than proportionate increase of the loan interest rate, when each respective policy operates to smooth-out the expansive loans' cycle to both dominant borrowing sectors i.e. non-financial corporations and households (ESRB, 2019). The effectiveness of both policies is defined as the degree to which each respective policy achieves the smoothing of the cycle of loans to non-financial corporations and households (ESRB, 2019).

[40] The positive effect of 17.071 pp in the specification 3 is very large and unexpected. Thus, it will not be commented.

Two econometric methodologies were applied (OLS-SUR-PCSE and PMG) and yield mostly similar and robust results concerning the both policies. The monetary policy increases the interest rates to non-financial corporations and households and according to the results of the paper may be considered as more costly. The capital-based macroprudential policy is less costly concerning the non-financial corporations as it decreases the interest costs, but the results from the PMG cointegration imply that ultimately the households bear higher loan interest rates. Thus, the efficiency from the macroprudential policy imposed to the corporations, is actually transferred to the households. Regarding the effectiveness, both policies smooth-out the credit cycles to both sectors.

Additionally, as the results imply, the capital-based macroprudential policy has higher effectiveness in dampening the credit cycle in both short and long run. Thus, the findings of this paper suggest that the policy maker should give priority to the capital-based macroprudential policy in order to stabilize the lending on the equilibrium trend path. Nevertheless, this does not mean that the monetary policy is ineffective, because the monetary policy also smoothens the credit cycle, but at higher costs to both sectors. However, the advantage of the capital-macroprudential policy relative to the monetary policy is that the former could be specifically designed to affect the loan interest rates and credit cycle unlike the latter. Therefore, the monetary policy should be primarily be concerned about the stable inflation and stable exchange rate, and should be used as a support to the capital-macroprudential policy to dampen the credit cycle, if the effectiveness of the macroprudential policy diminishes from some unexpected reason.

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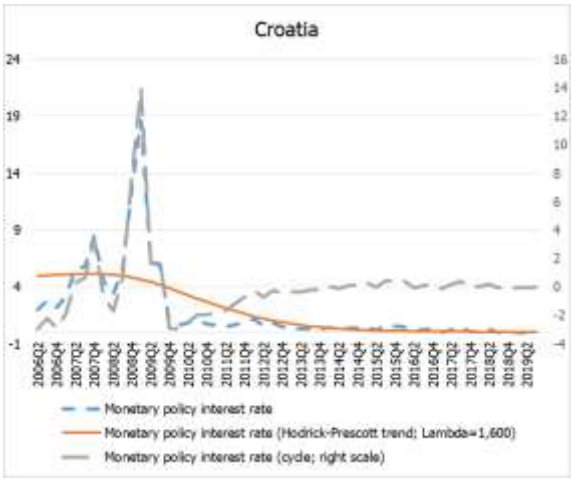
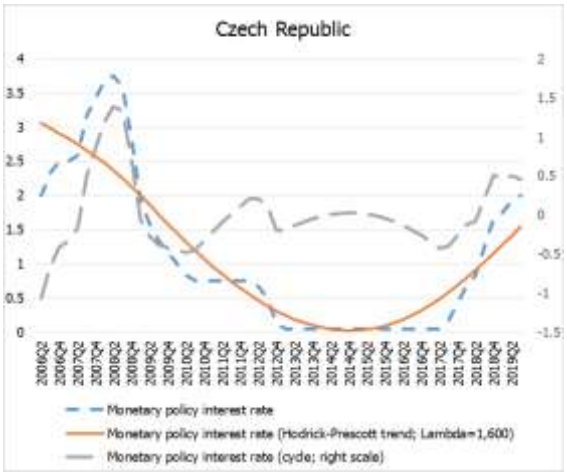
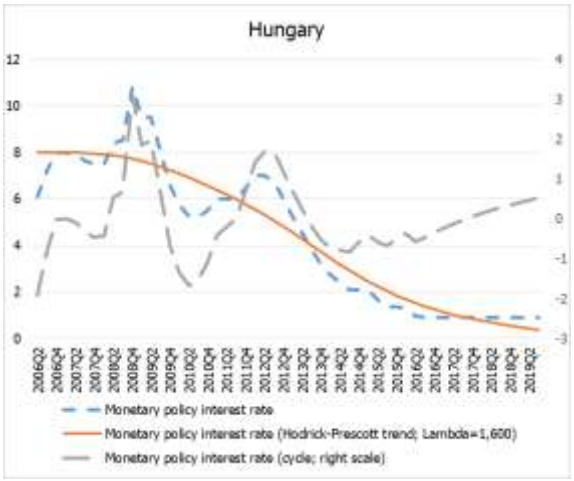
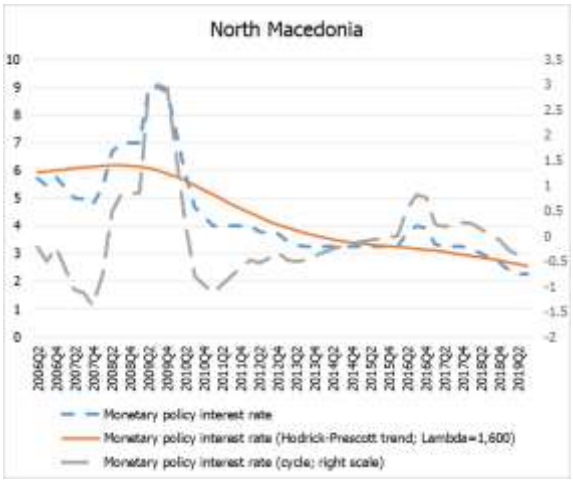
Appendix 1

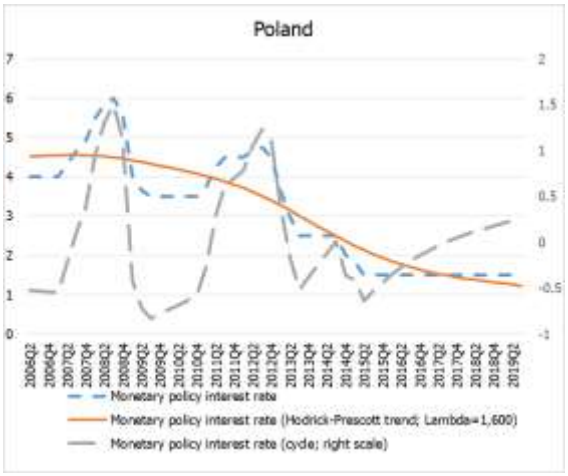
Figure 1: Monetary policy interest rate in % for the period from 2006q2 to 2019q3

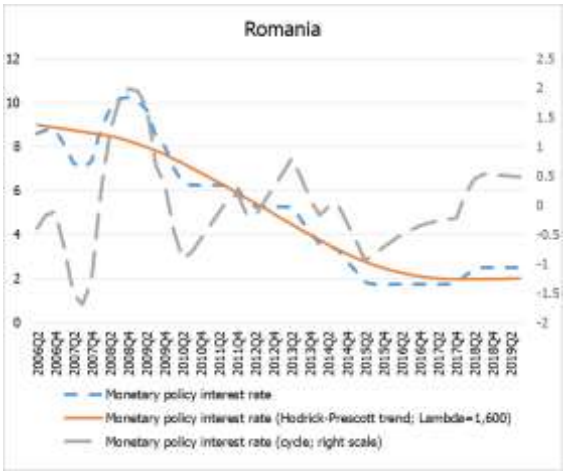


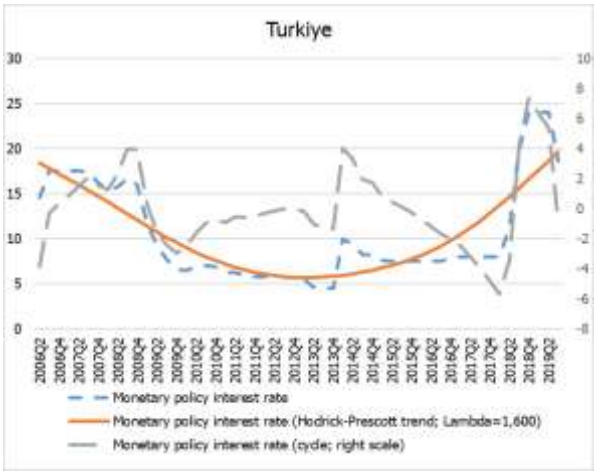






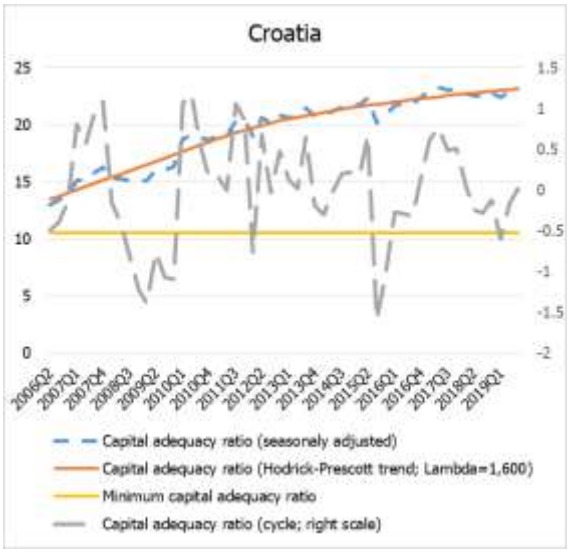


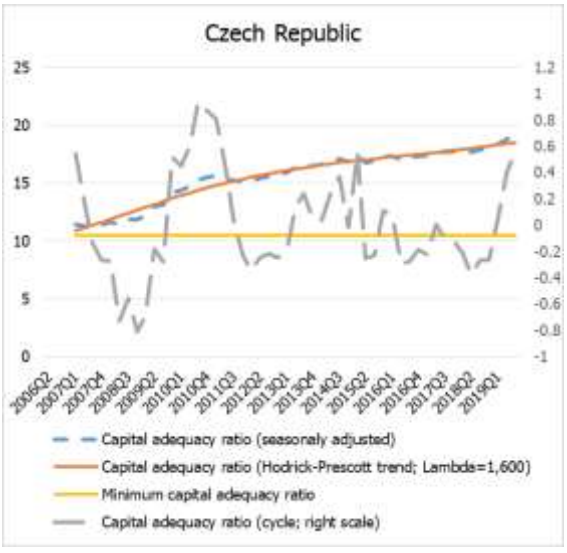


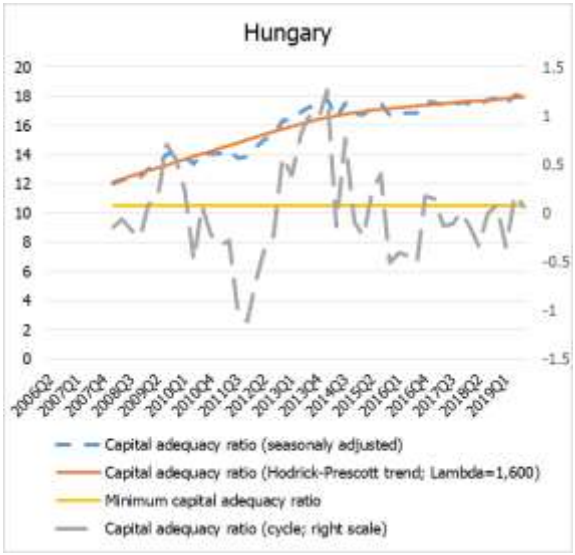


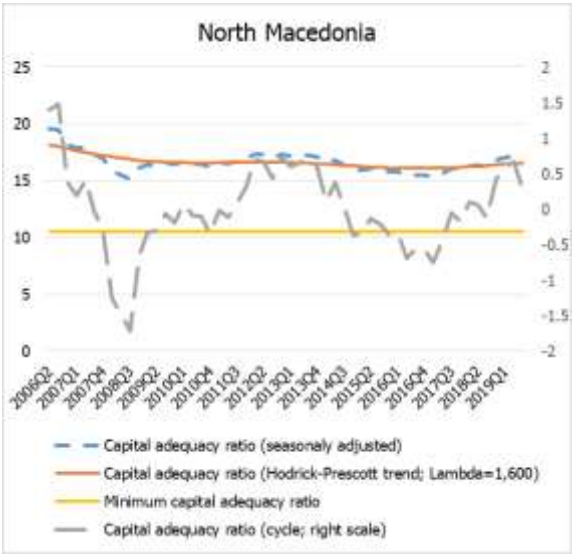
Source: Bank for International Settlements and authors' calculations

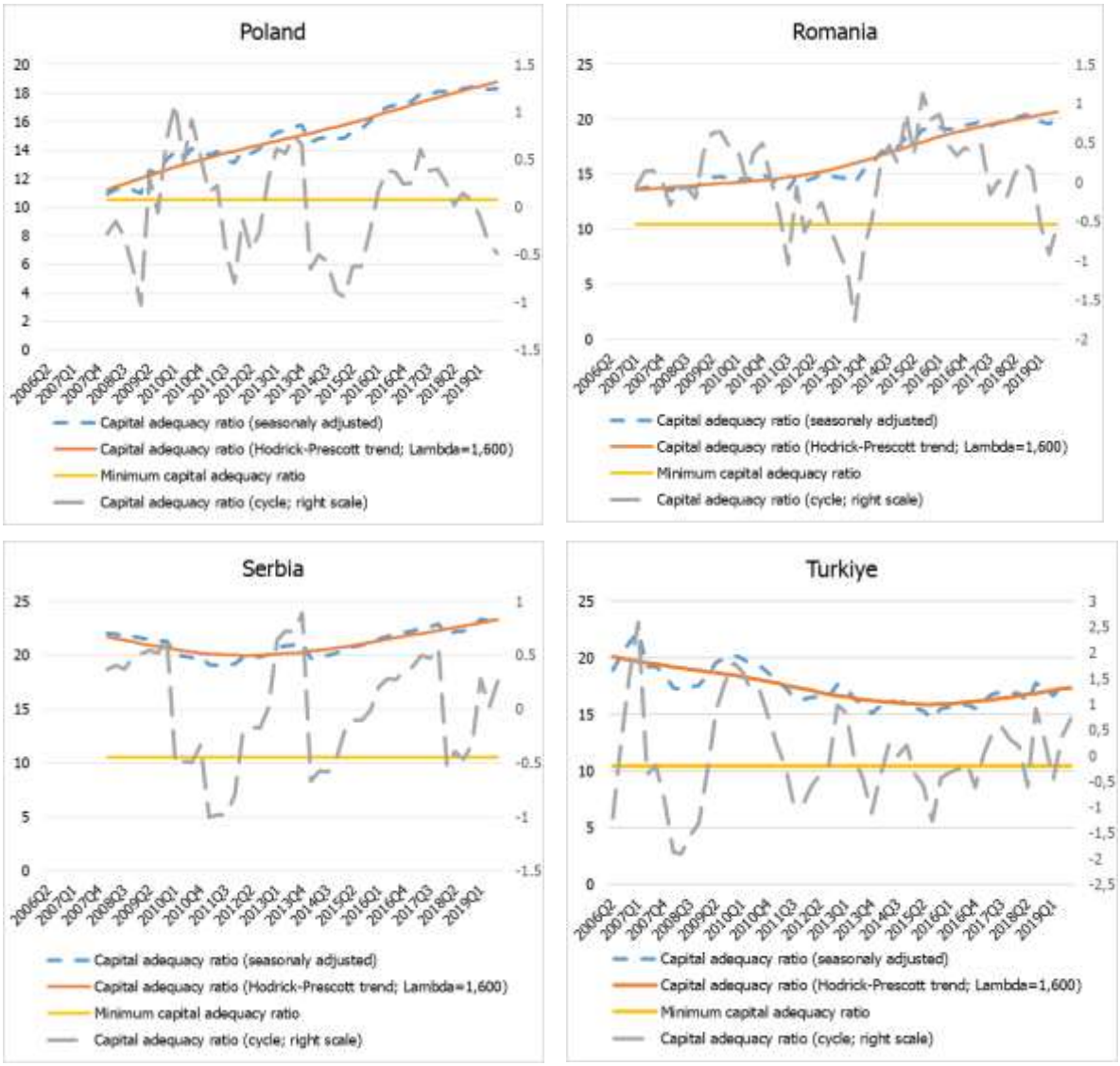
Figure 2: Capital adequacy ratio in % for the period from 2006q2 to 2019q3





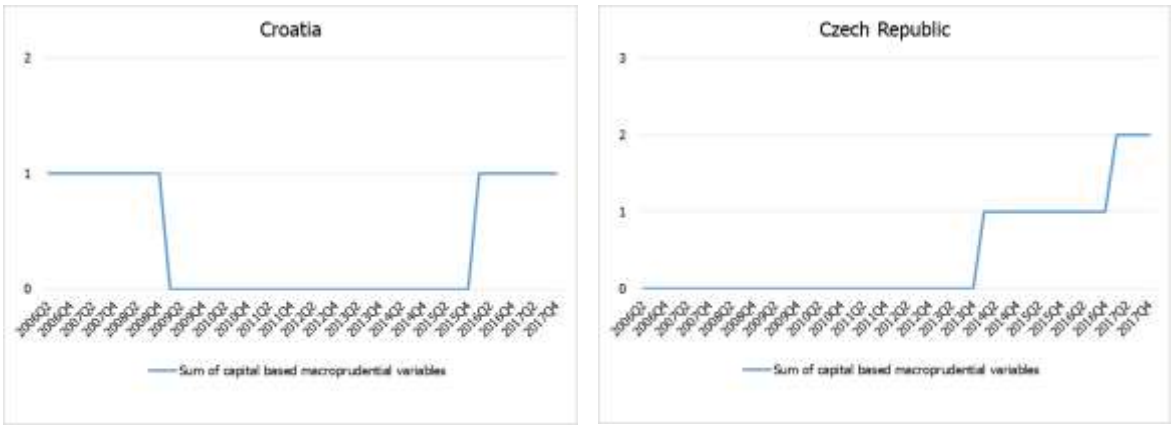


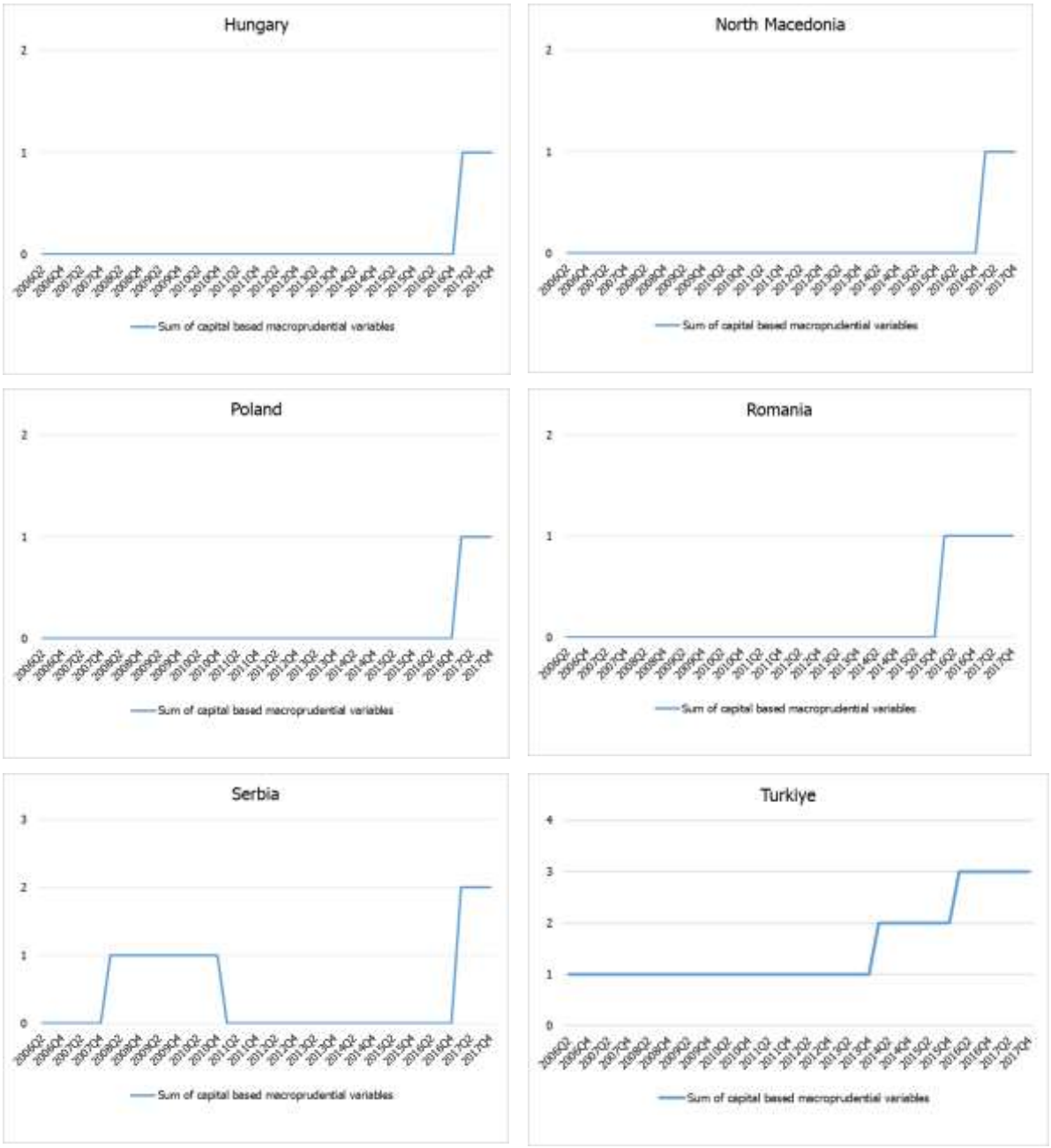




Source: International Monetary Fund, Financial Soundness Indicators Database and authors' calculations

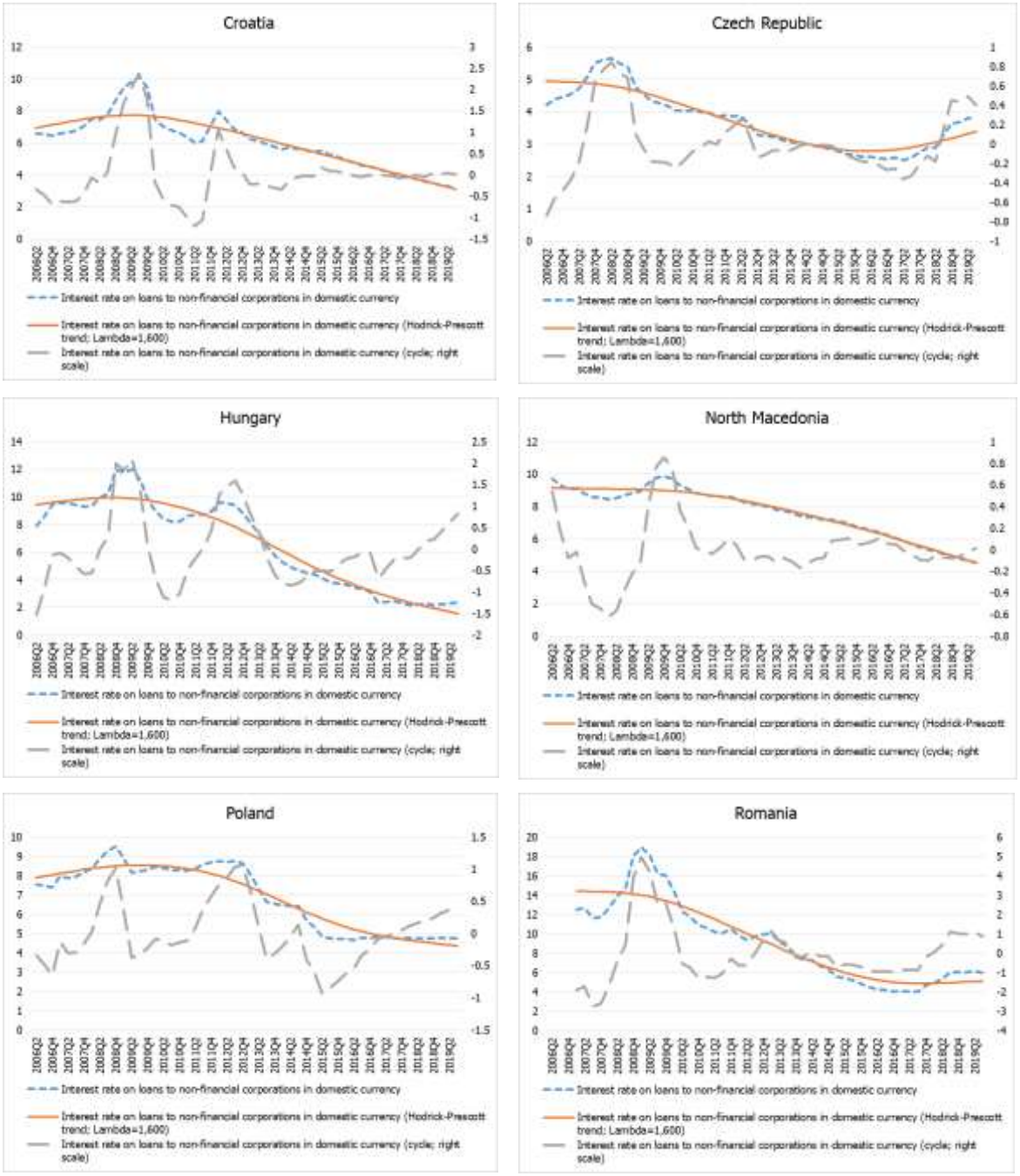
Figure 3: Sum of capital-based macroprudential dummies for the period from 2006q2 to 2017q4

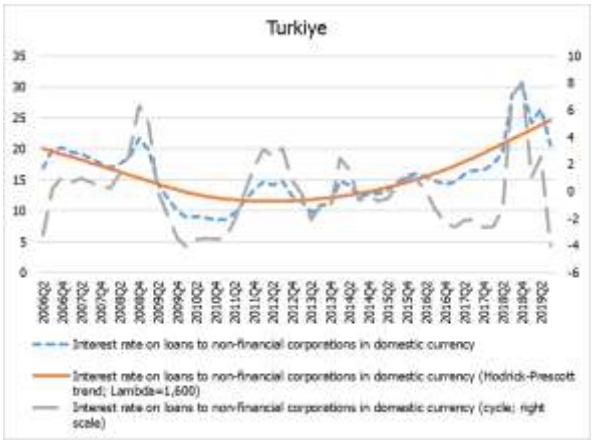




Source: Cerutti et al (2015), 2018 update.

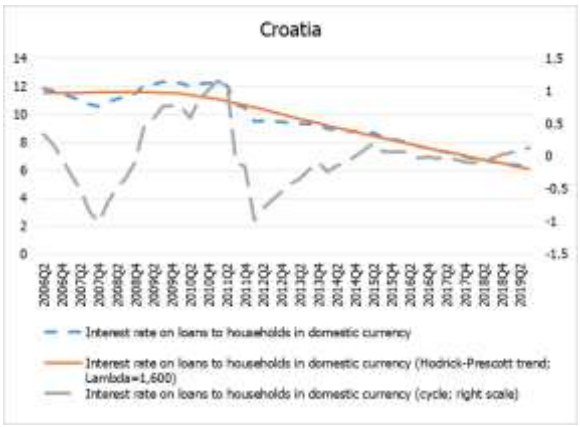
Figure 4: Interest rate on loans in domestic currency to non-financial corporations in % for the period from 2006q2 to 2019q3

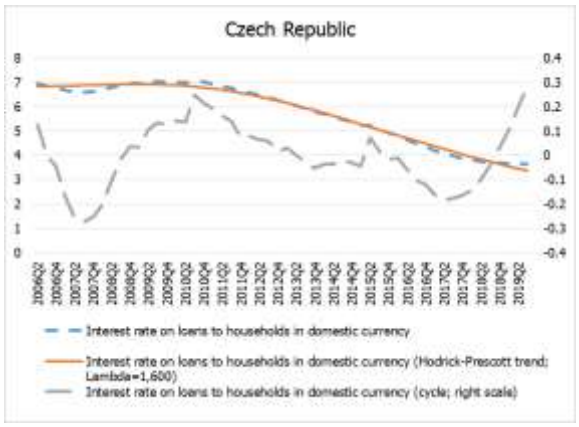


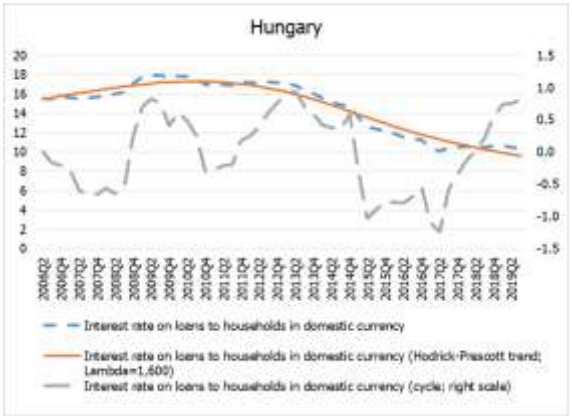


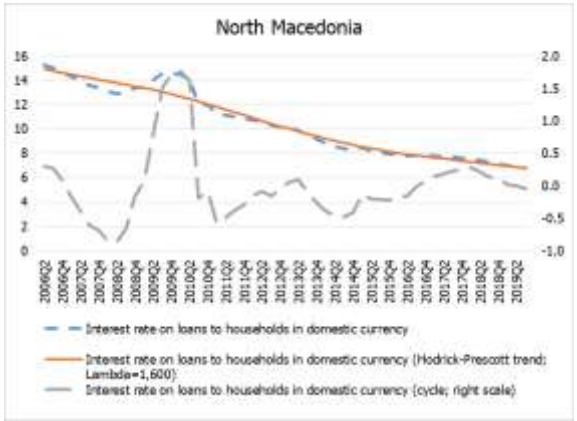
Source: Central banks and authors' calculations

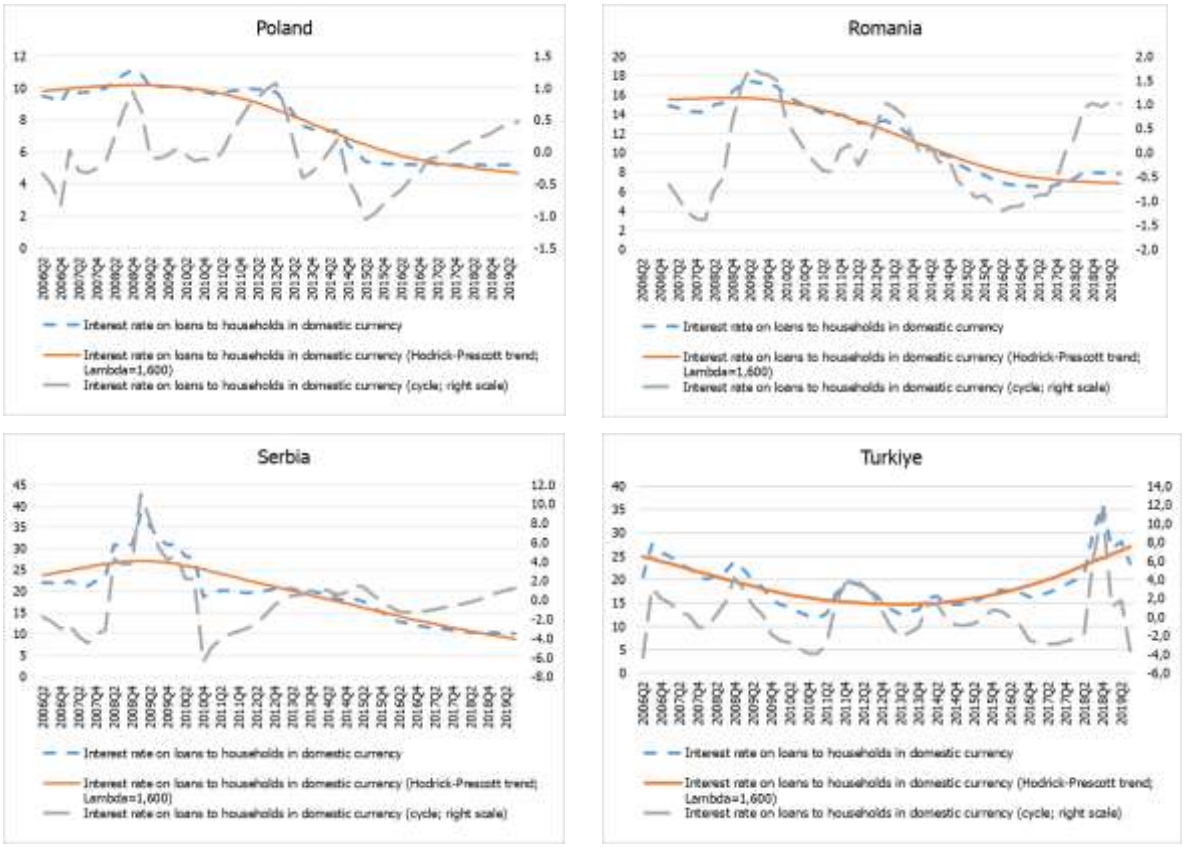
Figure 5: Interest rate on loans in domestic currency to households in % for the period from 2006q2 to 2019q3





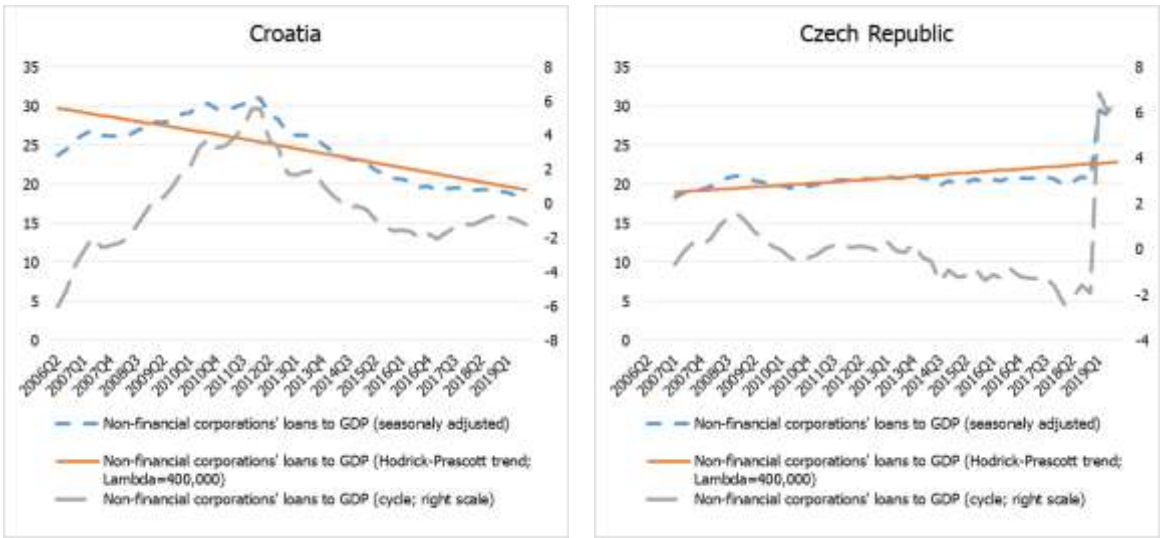


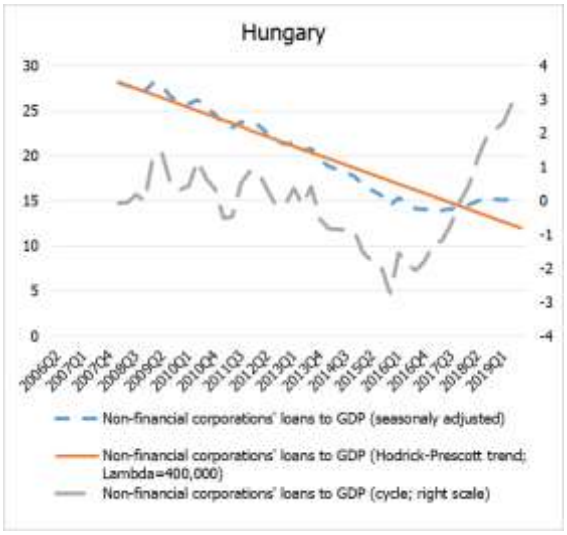


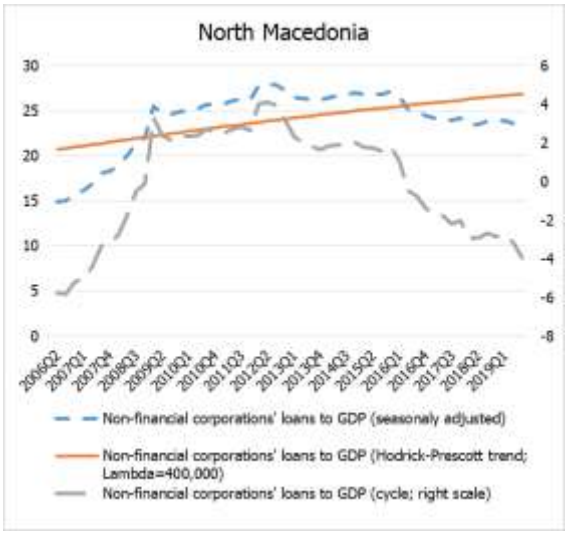


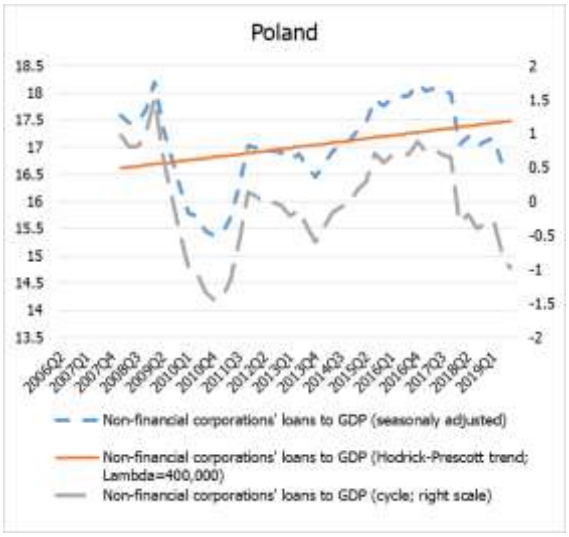
Source: Central banks and authors' calculations

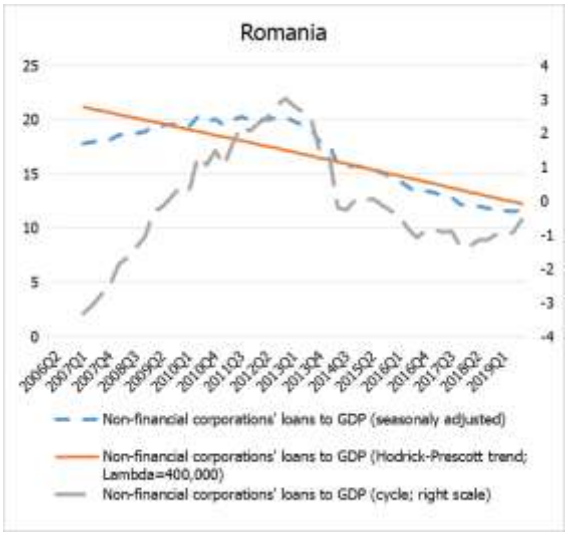
Figure 6: Non-financial corporations' loans to GDP in % for the period from 2006q2 to 2019q3

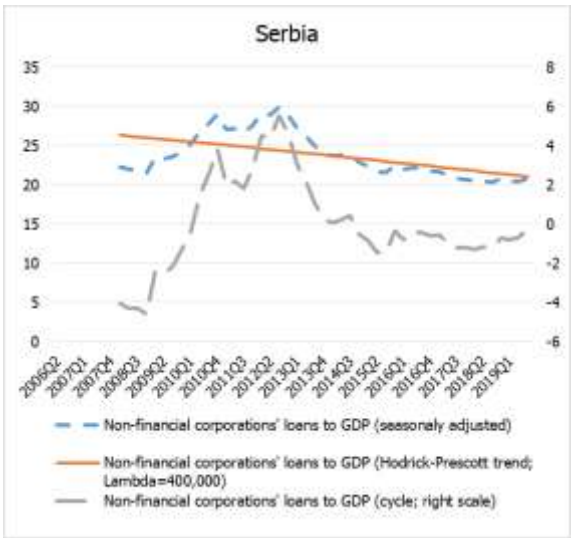


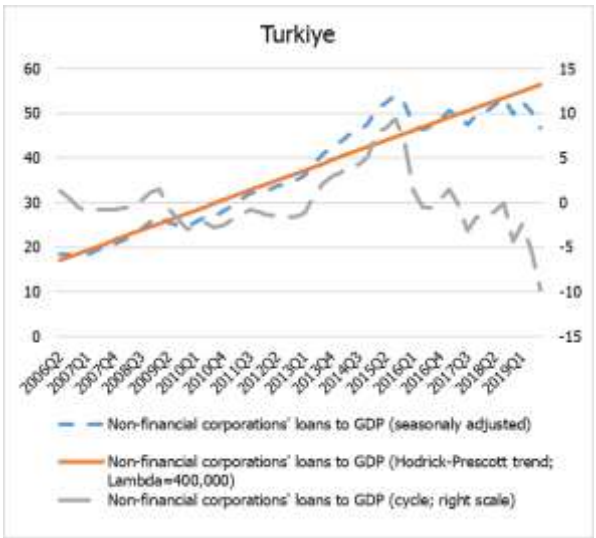






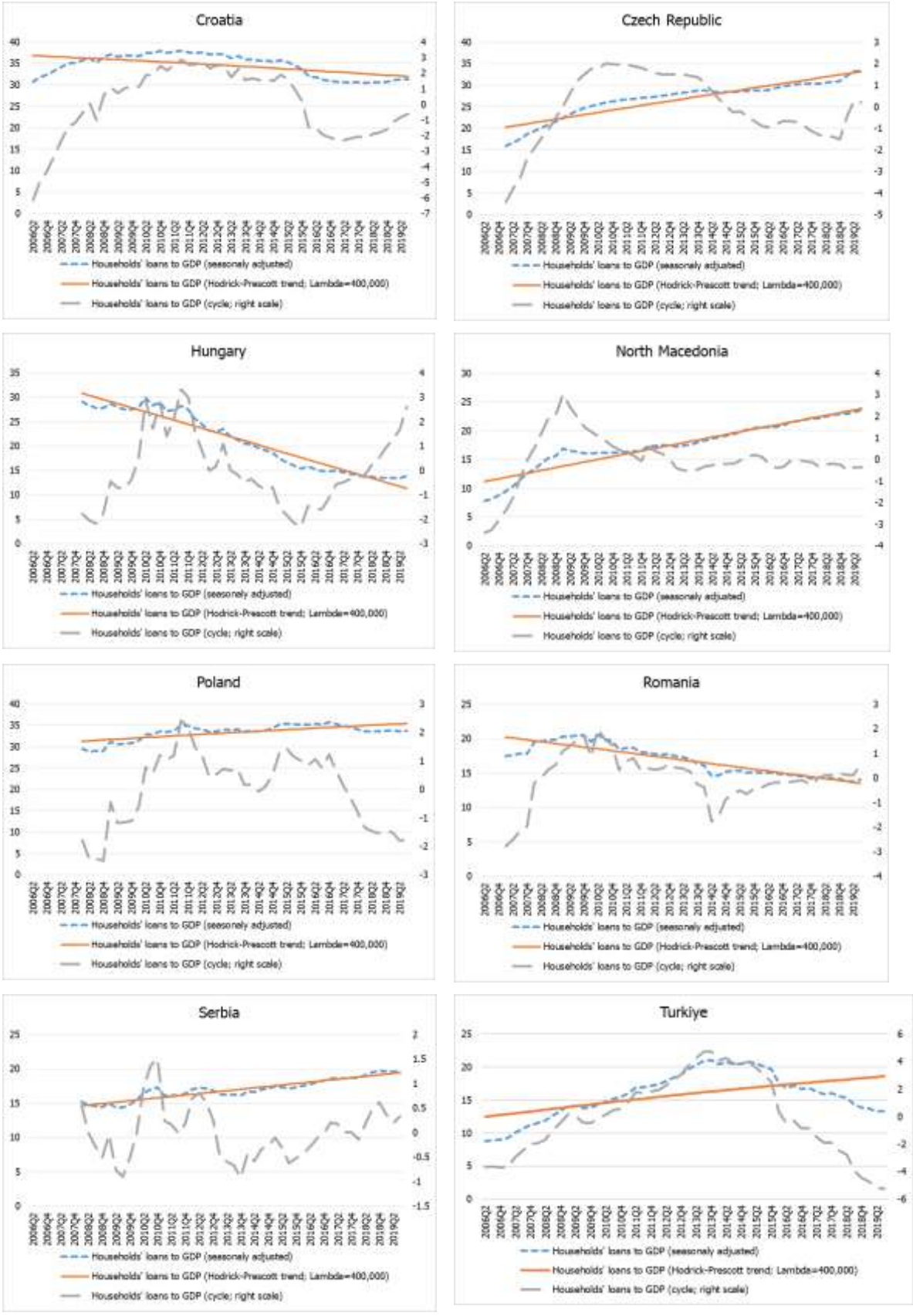






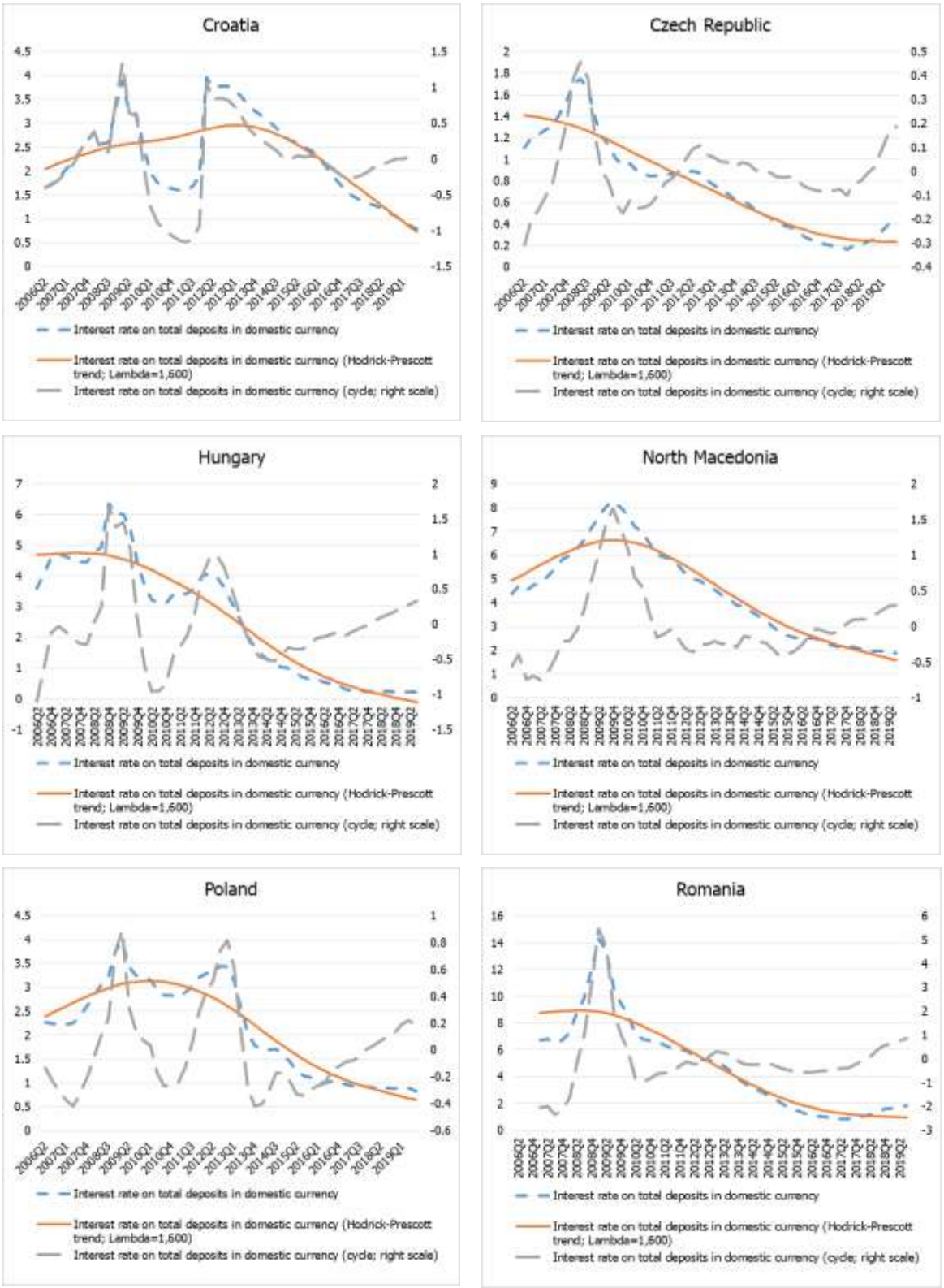
Source: International Monetary Fund, Financial Soundness Indicators Database and authors' calculations

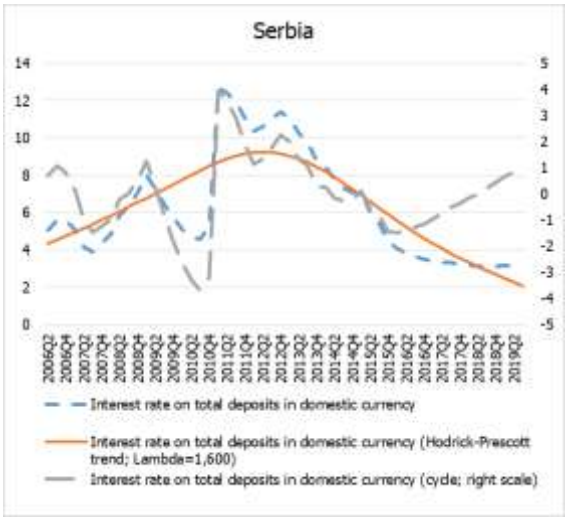
Figure 7: Households' loans to GDP in % for the period from 2006q2 to 2019q3

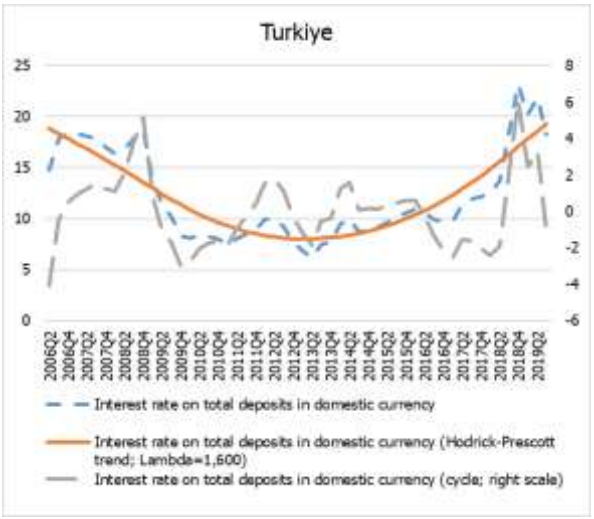


Source: International Monetary Fund, Financial Soundness Indicators Database and authors' calculations

Figure 8: Interest rate on total deposits in domestic currency in % for the period from 2006q2 to 2019q3

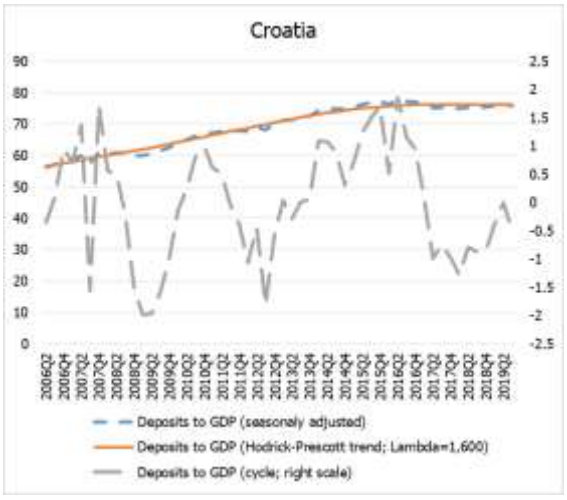


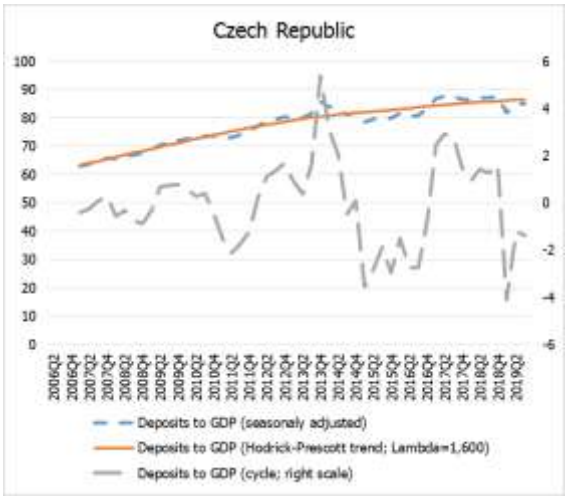


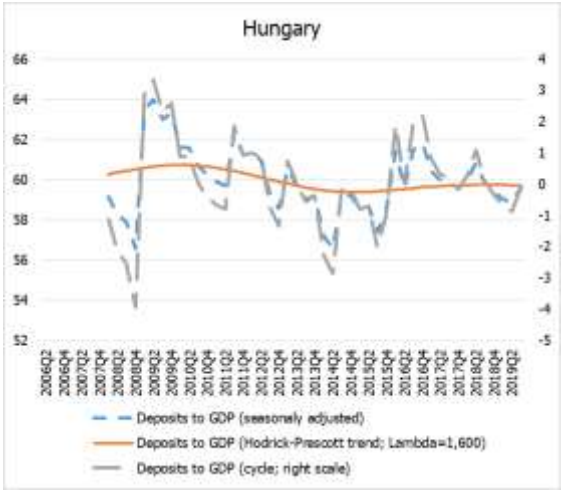


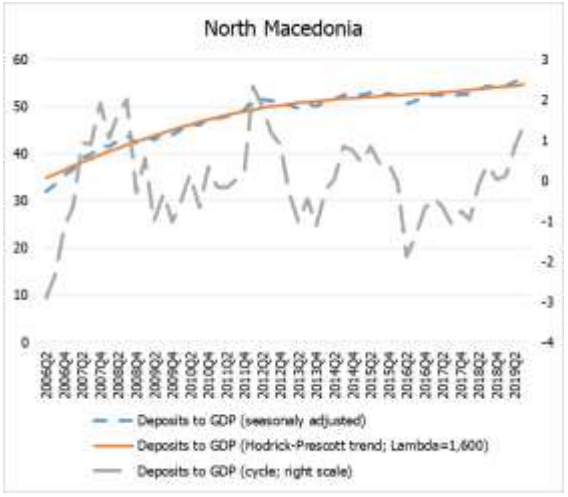
Source: Central banks and authors' calculations

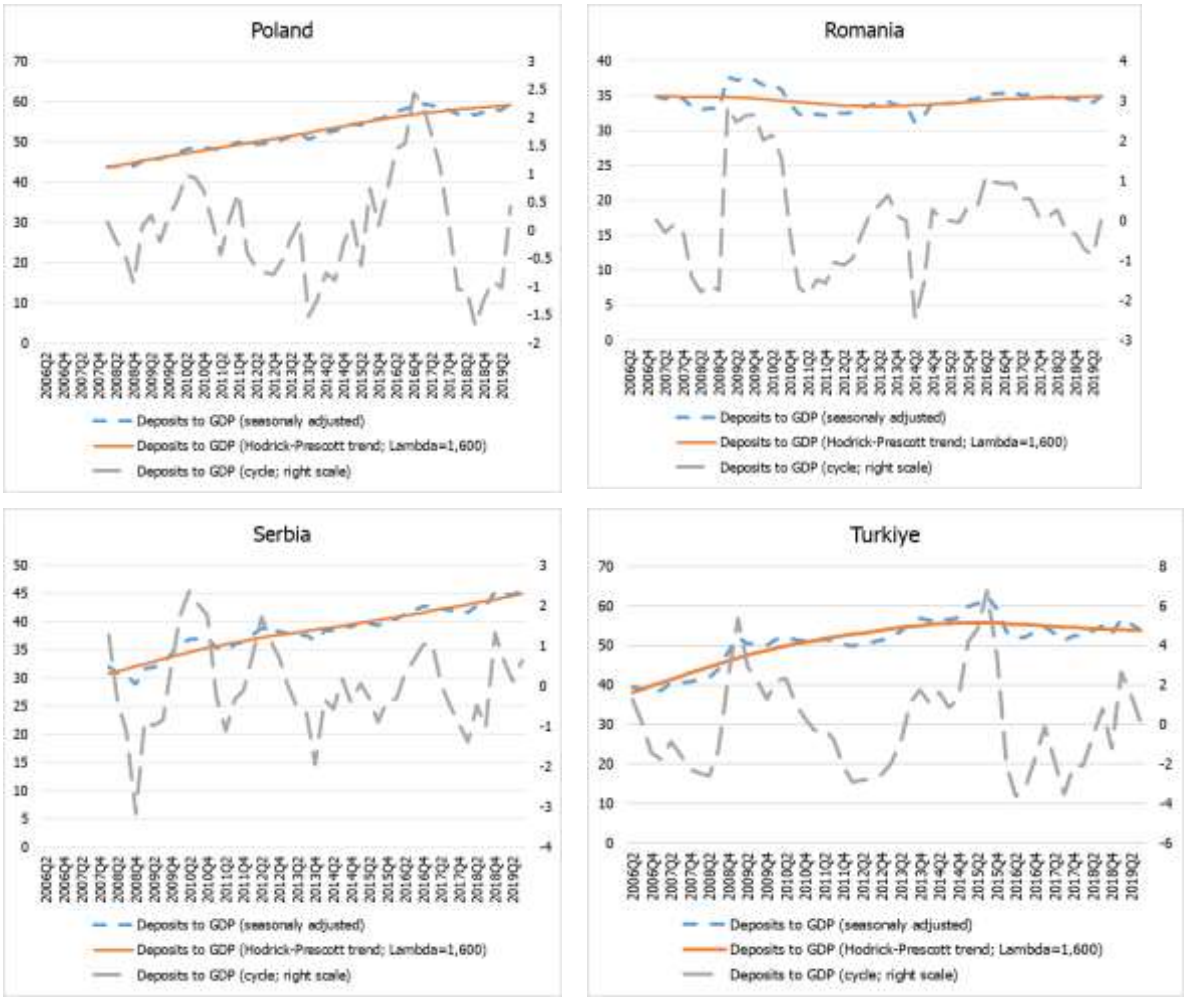
Figure 9: Deposits to GDP in % for the period from 2006q2 to 2019q3





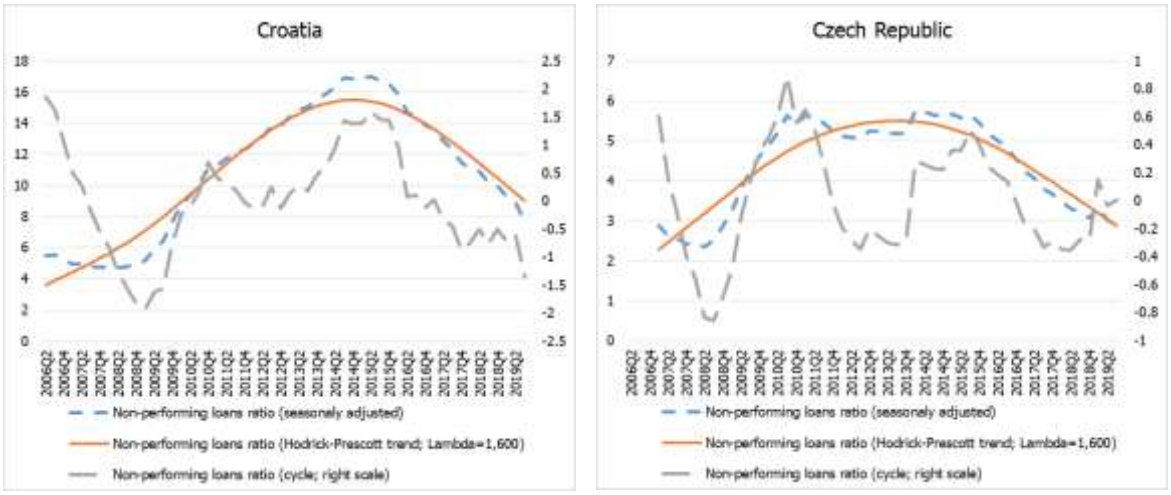


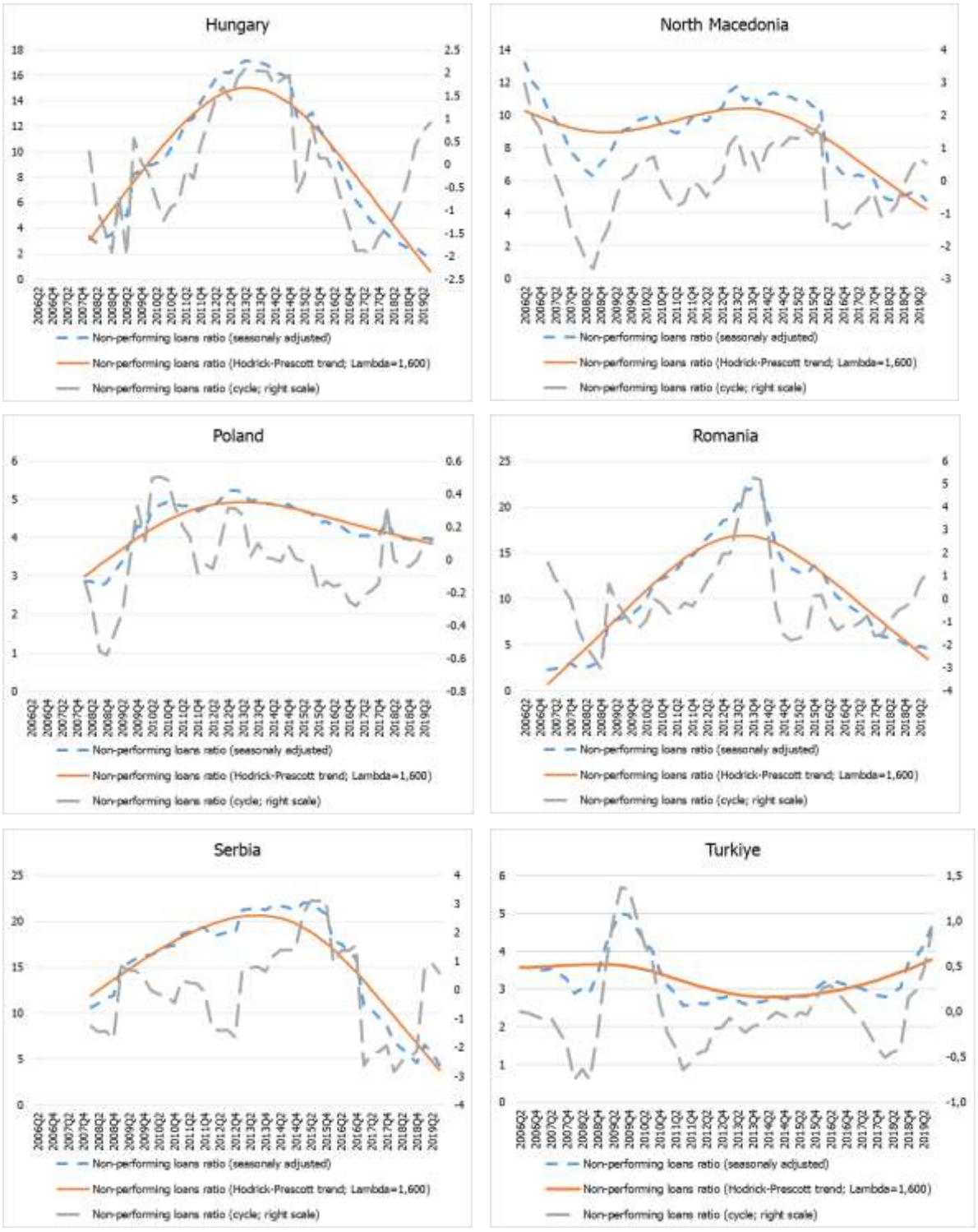




Source: International Monetary Fund, Financial Soundness Indicators Database and authors' calculations

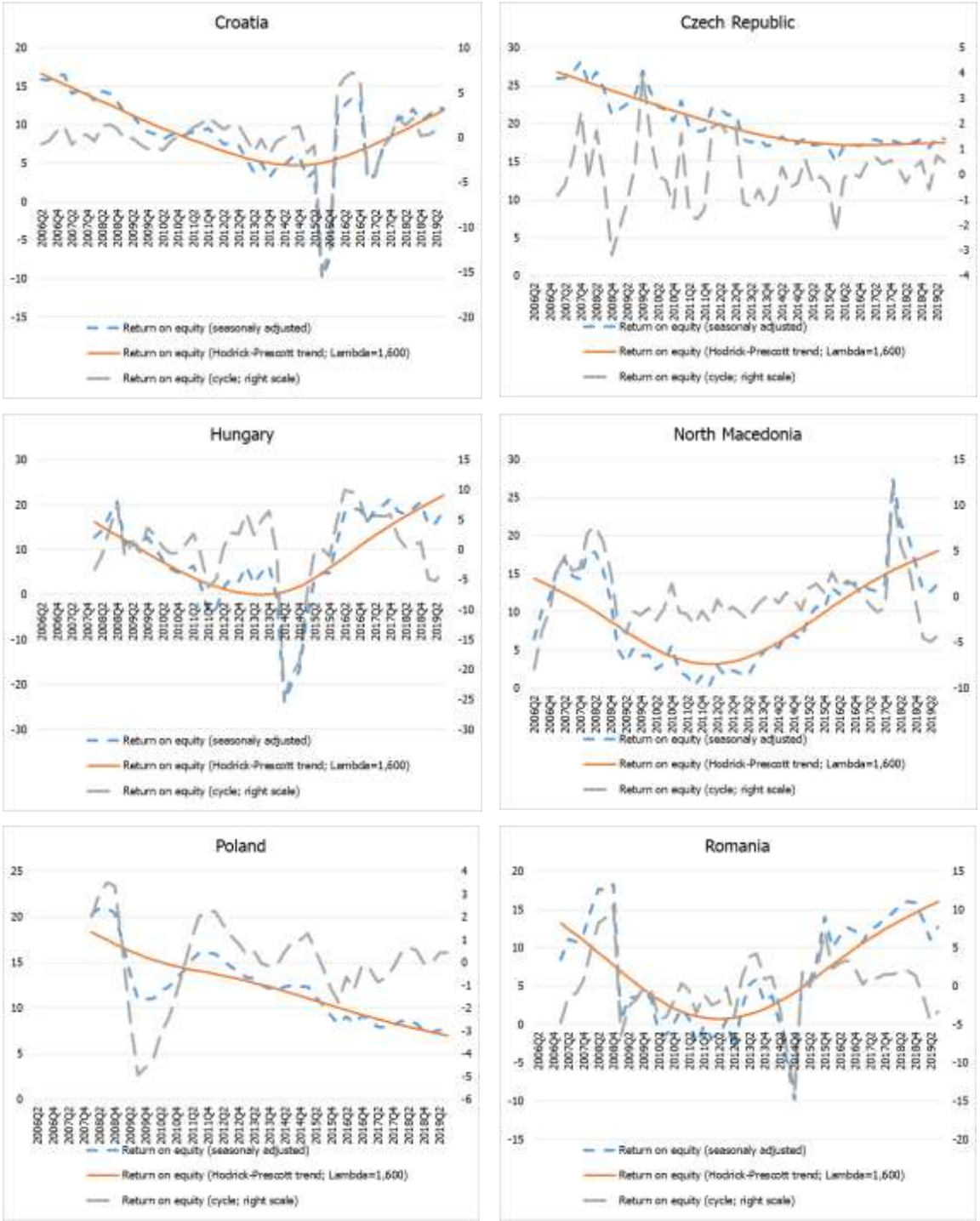
Figure 10: Non-performing loans ratio in % for the period from 2006q2 to 2019q3

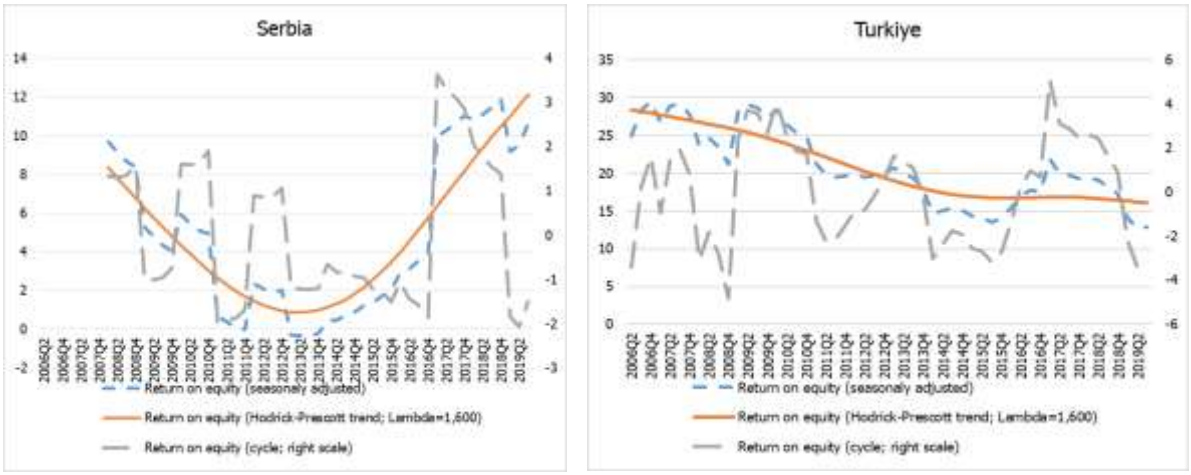




Source: International Monetary Fund, Financial Soundness Indicators Database and authors' calculations

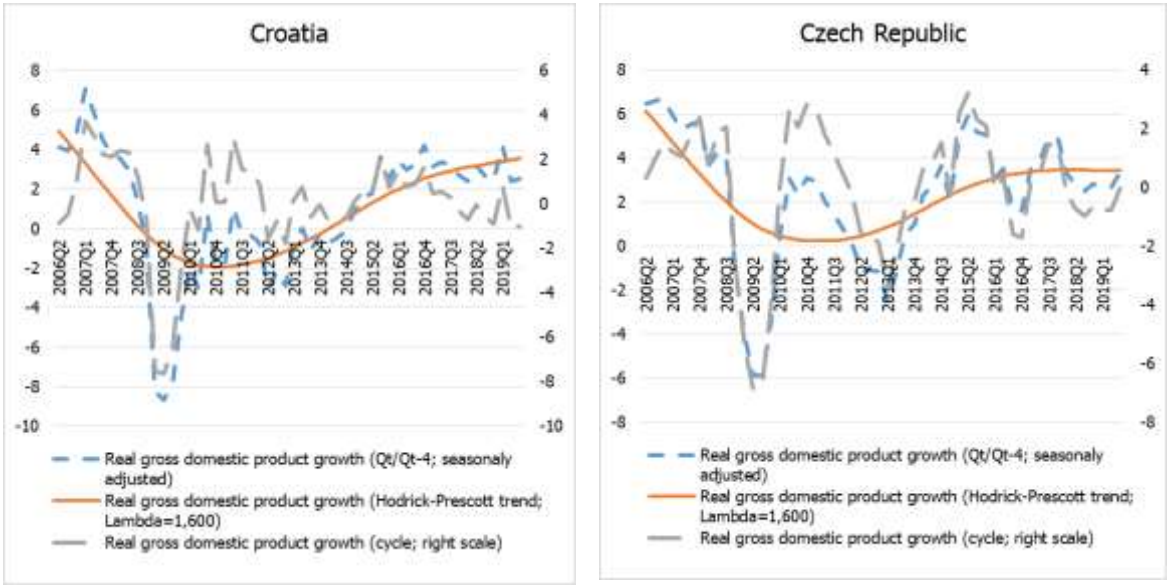
Figure 11: Return on equity in % for the period from 2006q2 to 2019q3

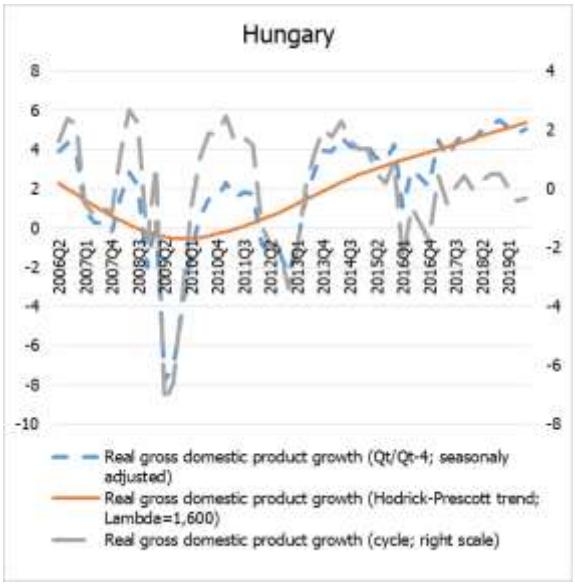


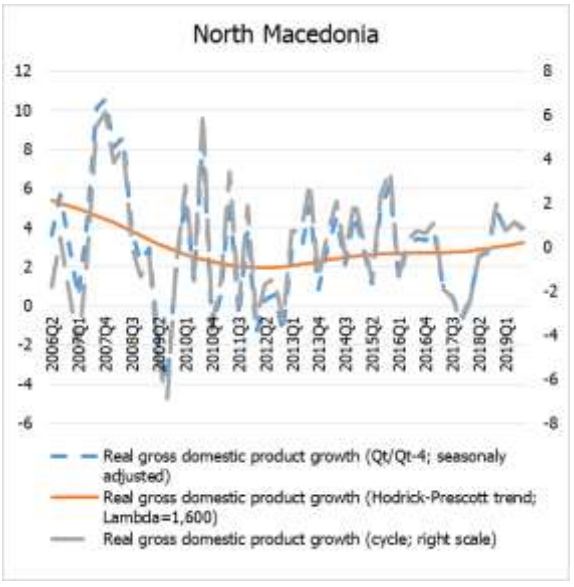


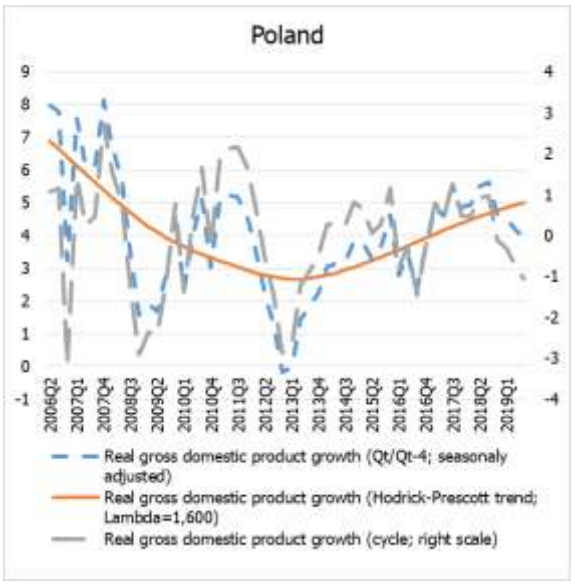
Source: International Monetary Fund, Financial Soundness Indicators Database and authors' calculations

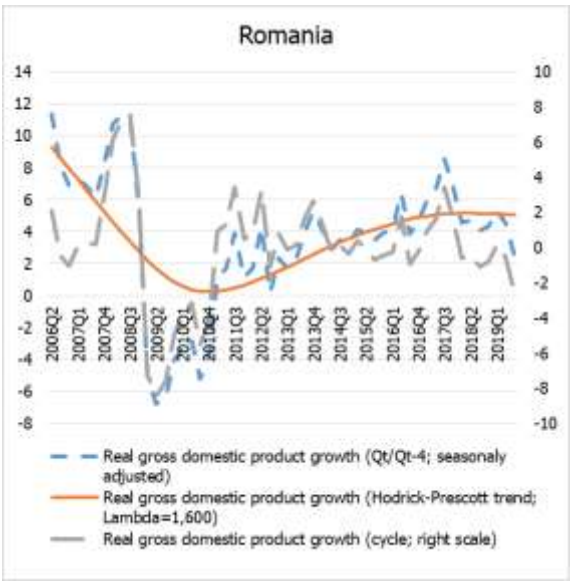
Figure 12: Real gross domestic product growth in % for the period from 2006q2 to 2019q3

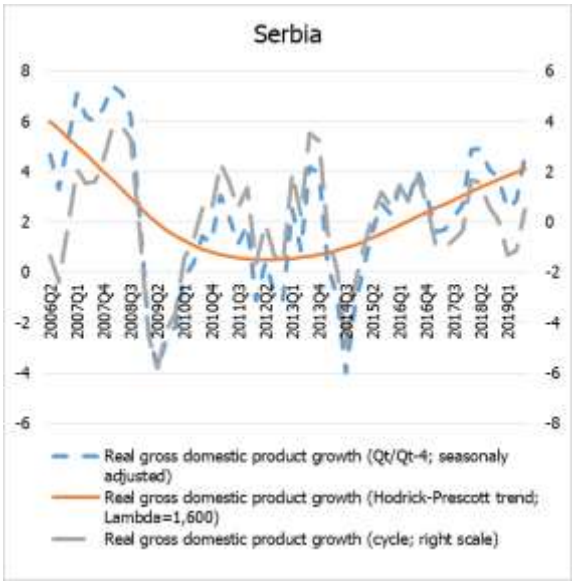


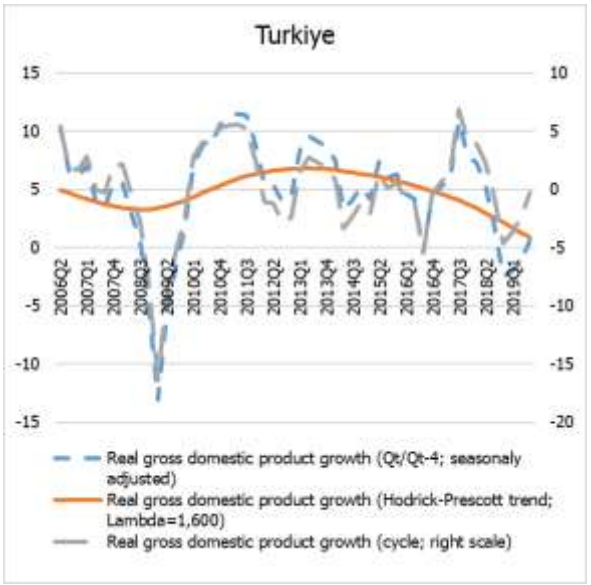

Hungary
Real gross domestic product growth (Qt/Qt-4; seasonaly adjusted)
Real gross domestic product growth (Hodrick-Prescott trend; Lambda=1,600)
Real gross domestic product growth (cycle; right scale)


North Macedonia
Real gross domestic product growth (Qt/Qt-4; seasonaly adjusted)
Real gross domestic product growth (Hodrick-Prescott trend; Lambda=1,600)
Real gross domestic product growth (cycle; right scale)


Poland
Real gross domestic product growth (Qt/Qt-4; seasonaly adjusted)
Real gross domestic product growth (Hodrick-Prescott trend; Lambda=1,600)
Real gross domestic product growth (cycle; right scale)

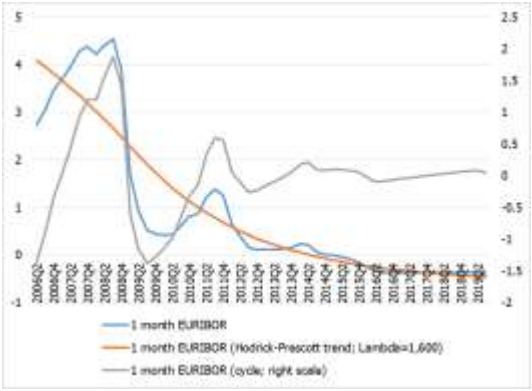

Romania
Real gross domestic product growth (Qt/Qt-4; seasonaly adjusted)
Real gross domestic product growth (Hodrick-Prescott trend; Lambda=1,600)
Real gross domestic product growth (cycle; right scale)


Serbia
Real gross domestic product growth (Qt/Qt-4; seasonaly adjusted)
Real gross domestic product growth (Hodrick-Prescott trend; Lambda=1,600)
Real gross domestic product growth (cycle; right scale)


Turkiye
Real gross domestic product growth (Qt/Qt-4; seasonaly adjusted)
Real gross domestic product growth (Hodrick-Prescott trend; Lambda=1,600)
Real gross domestic product growth (cycle; right scale)

Source: State statistical offices of the countries, central banks' database, database of the Federal Reserve Bank of St. Louis and authors' calculations

Figure 13: One-month EURIBOR in % for the period from 2006q2 to 2019q3



Source: European Central Bank and authors' calculations