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Can Credit Related Macroprudential Instruments Be Effective in Reducing the Correlation Between Economic and Credit Growth? Cross-Country Evidence

Abstract: The study investigates effectiveness of selected credit related macro prudential instruments in reducing the correlation between economic and credit growth in European emerging countries between 2000 and 2017. Two GMM (Generalized Method of Moments) estimators are used to empirically investigate the validity of tightening policy actions. Although greater attention to MMPs is found in both European regions the study finds some differences as well. On the level of full sample, the findings confirm our expectation about effectiveness of the selected credit related macroprudential instruments in reducing credit growth.

More specifically, the European transition countries proved to be more successful in using macroprudential tools in curbing credit growth than European post-transition countries. It is confirmed that all three employed credit related macroprudential instruments play a key role in curbing credit growth in the expansive stage of business cycle in the European transition countries. It means that a lower economic growth leads to lower effects of credit related macroprudential instruments on credit growth. However, empirical evidence from European post-transition countries shows mixed results followed by the lack of robustness of economic results, but with expected theoretical sign. In fact, introduction of CG limits and FC limits reduce the correlation between GDP growth and credit growth only in one step S-GMM estimator, while a variable of caps on debt-to-income ratio (DTI) not.

Keywords: Credit related macroprudential instruments; credit growth; European emerging countries; GMM estimators.

JEL Classification: F3, G18.

1. Introduction

Escalation of the 2008/09 financial crisis and the sovereign debt crisis in 2010 brought about significant economic pain and disruption that so many financial institutions continued to experience a few years after the onset of the crisis. The excessive bank lending boosting property prices and hit hard commercial real estate sector led to uncertainty about outlook for some of its segments. The recent financial crises have shown the importance of development of macroprudential policy for the stability of the financial system. The current regulatory framework and monetary policy, which has focused on maintaining price stability, proved to be insufficient to oversee a modern globally integrated financial system (Ganić, 2012).

The emerging European countries belong to a relatively small group of countries that pursued implementation of macroprudential policies (MPPs) in the years of before the global financial crisis and the period of extreme economic stress. However, the MPPs application is far from homogenous with some variations and selective intervention in different countries. The more one examines the MPPs the countries and regions have pursued, the clearer it becomes how different the MPPs have been. There is nexus between regulatory governance and financial stability. Ullah, Hussain, Nabi & Mubashir (2020) found a positive correlation between regulatory governance and financial stability using cross-sectional data from 55 countries.

Other interpretation for analysing the effectiveness of MPPs in transition countries come from high importance of foreign-owned banks as creditors of the private sector and their share in total banking assets. So far, the MPPs of emerging European countries have been empirically analysed on larger samples of countries, and rarely separately as a region. Although, MPPs have been used to address financial stability concerns across countries, they are still limited in terms of efficiency. The fact that MPPs are applied more in emerging European countries than elsewhere in Europe can be attributed primarily overall level of financial development in the region. Interestingly, the share of foreign ownership in the emerging Europe's banking sectors increased rapidly in 1990s and continued to expand in early 2000s. Integration in the EU market and global financial flows resulted in a wider scope of banking business operations in retail markets with the focus on risk-adjusted profitability (Ganić, 2021). The origins of foreign banks presence in transition countries lie in financial liberalization

and marked based reforms that reduced capital account regulation by promoting private credit growth. In the most of earlier empirical studies that explored effectiveness of MPPs, the focus was put on the sector level (real estate) or the financial sector level but less on investigation of effectiveness of MPPs in reducing vulnerabilities of the overall banking sector. Having in mind that the study explores 28 emerging Europe countries, it allows us to analyse the effect of tightening policy actions between Europe transition and Europe post-transition countries in different phases of the economic and financial cycles¹.

The aim of this study is to explore the effectiveness of using credit related macroprudential instruments or tightening policy actions in curbing credit growth, especially in highly euroised economies with limited monetary policy. More specifically, it aims to explore whether the selected credit related prudential instruments can be effective in reducing the correlation between economic and credit growth.

Our contribution to the existing literature is threefold. First, it tests direct effects of credit related macroprudential measures on lending dynamics using cross-country data. This research takes a deeper approach by narrowing MPPs only on credit related macroprudential instruments. Second, it compares two different European transition regions with an aim to explore whether credit growth reacts differently to diverse types of credit related macroprudential instruments and lastly, the study is novel as the scope of the study covers emerging Europe countries which other studies have not taken all together to consideration.

2. Literature review

In recent times, and especially in the aftermath of the 2008-09 financial crisis, many theoretical and empirical studies have addressed the issue of achieving and keeping long-term stability of the financial system. In fact, one important implication for region of Europe and the euro area is that preserving financial stability can no longer be a matter of one country's policy alone, let alone of the regional ones. Today, there is increasing discussion of how macroprudential measures and instruments affect cross-border operations of financial institutions and capital flows in presence of shocks and procyclicality of the financial system.

¹ European transition countries: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, Kosovo, Kyrgyz Republic, Montenegro, North Macedonia, Moldova, Russian Federation, Serbia, Tajikistan, Turkey and Ukraine.
European post-transition countries: Bulgaria, Croatia, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia.

The number of studies investigating macro prudential regulation impact in reducing lending dynamics has increased because of the rapid change in types of banking risks due to increasing vulnerabilities in the banking sectors. Studies focus either on capital requirements and reserve requirements in the banking industry or MPPs indicators as tools in hands of monetary authority to manage the procyclicality of bank credit dynamics, or both. Studies of macroprudential regulation instruments impact on reducing lending dynamics are similar in their form and execution. The theoretical background for positive impact of reserve requirements as a supplement monetary policy tool for macroeconomic purposes comes from several diverse sources (Goodfriend & Hargaves, 1983; Feinman, 1993; McKinnon, 1973). Their work shows the existence of a connection between the required reserves degree and leaning against credit. For example, some recent studies that followed capital requirements and reserve requirements (Nier et al. 2012; Montoro and Moreno, 2011; Tovar, García-Escribano & Vera Martin, 2012; Mimir, Sunel & Taşkin, 2012, Glocker & Towbin, 2012; Zhang & Zoli, 2016) showed a moderate impact in slowing credit growth.

The recent experience of three Latin America countries (Bolivia, Brazil and Peru) in pre-global crises and post-global crises time (2006-2010) reveals that employing reserve requirements can be useful to stabilize interbank rates that moderate capital flows. Tovar et al. (2012) carried out study focused on examining the impact of reserve requirements in assessing their effectiveness on credit growth in Latin America between 2003 and 2011. The study also combines reserve requirements with other macroprudential instruments. Separately viewed, reserve requirements are shown as a good instrument in slowing credit growth, especially in Brazil, Columbia, and Peru. Mimir et al. (2012) explored the role of required reserve as macroprudential policy tool and found similar conclusion in the case of Turkey. Ganić (2021) created banking stability index to measure vulnerability of the banking sector in emerging Balkan countries. The study finds that in the pre-crisis period, credit growth was accompanied by a reduction in the CAR because of the credit expansion of banks, leading to an increase in the vulnerability of the banking sector.

However, the role of traditional required reserve in reducing lending dynamics has been declining over the years. For example, the study done by Trabelsi (2022) sees macroprudential transparency as a useful tool for price stability in the time of banking crisis. On the contrary, there has been growing interest in macroprudential regulation instruments or MPPs. The procyclicality of credit is explored by some researchers as Bernanke, Gertler & Gilchris (1996) and Gersbach & Rochet (2017). The theoretical background for positive impact of holding more equity comes from several different emerging studies. The effects of im-

plementation of MPPs vary among countries. In principle, each country has its own aggregate indicator of the intensity of use of MPPs to make it easier to see the effects of macroprudential policy. Claessens, Ghosh & Mihet (2013) explored the implementation of MPPs in 48 countries. They found two macroprudential instruments: caps on debt-to-income (DTI) and loan-to-value (LTV) ratios to be highly effective in reducing vulnerabilities of the banking sector. Some other studies done by Beirne & Friedrich (2014), Cerutti, Claessens & Laeven (2017), Olszak, Roszkowska & Kowalska (2018), Cizel, Frost, Houben & Wierts (2019), Erdem, Ozen & Unalmis (2020) and others present the evidence of MPPs affecting credit growth decline.

Table 1: Summary of literature review - cross-country studies

Papers	Sample Countries and period	Methods	Conclusions
Lim et al. (2011)	49 countries (2000-2010)	Panel regression analysis	Emerging market economies with fixed exchange rate regimes or managed fluctuating exchange rates use more extensively macroprudential measures than advanced countries. Emerging markets with high capital inflows and shallow financial markets, and those with bank-centric systems, use macro prudential tools with greater frequency. In addition, macroprudential instruments can be equally effective in developed countries that have flexible exchange rate regimes.
Ostry et al. (2012)	51 EMEs (1995-2008)	Panel regression analysis	There is a significant linkage between FX-related prudential measures and a lower proportion of FX lending in total domestic bank credit. Also, the measures of capital controls are associated with a lower proportion of portfolio debt in total external liabilities. Both measures reduce the risk of foreign borrowing and lending in foreign currency.
Nier et al (2012)	21 EMEs and 15 AEs countries (2000-2011)	Panel regression analysis	The study finds that reserve and capital requirements can contribute to the slowdown in credit growth. Loan coverage by collateral value and debt-to-income ratio in emerging market countries.
Beirne & Friedrich (2014)	139 countries	Panel regression analysis	The study reveals the importance of bank structure of domestic banking systems for the effectiveness of MPPs. In fact, the authors found that a high share of non-resident loans reduces effectiveness of MPPs, whereas a high ROA has the opposite effect.
Akinci & Olmstead-Rumsey (2015)	57 advanced and emerging countries	Panel regression analysis	The authors find that housing and non-housing MPP (macro prudential policies) measures reduced credit growth rates. In fact, housing MPPs limited housing credit growth rates and house price inflation.
Zhang & Zoli (2016)	13 Asian and 33 other countries	Fixed effect dynamic panel regression	The study finds that changes in reserve requirements on local currency deposits are widely used in Asia and other regions. However, it a low presence other MPP indicators associated with credit limits, dynamic provisioning, consumer loans and capital measures was found in other regions. In addition, in Asia, they found a low presence of MPPs for reducing transactions in foreign currency and residency –based capital flow.
Bruno, Shim & Shin (2017)	12 Asia Pacific countries	Panel regression analysis	The authors found that Capital flow management policies (CFM) and bond market CFM policies were remarkably effective in curbing the growth in banking inflows.
Cerutti et al (2017)	119 countries	GMM and OLS (Ordinary Least Squares) regression	The authors find that borrowed MPPs are reduced credit growth rates and cross-border borrowing, especially in advanced countries. It also implies that MPPs can have a significant effect on credit development.
Cizel et al (2019)	40 countries	GMM estimation techniques	The study reveals that the effect of substitution caused by implementation of MPPs toward non-bank credit is stronger in economies with developed nonbank credit markets.
Erdem et al. (2020)	30 emerging and developing countries	VAR approach and GMM estimation	The study finds the contribution of selected MPPs in reducing credit growth, especially in the stage of expansive credit cycles.

Source: Author's compilation

Beirne and Friedrich (2014), Thamae, Odhiambo & Khumalo (2023) suggest that the effectiveness of MPPs strongly depends on the structure of domestic banking system (i.e. entry barriers, ownership structure, etc). Another close study to this research by Cerutti et al. (2015) concludes that macroprudential policies are used often in emerging markets with FX tools used. Extensive research has been done on MPPs related to housing sector which resulted in curbing bank credit growth (Kuttner & Shim, 2013; Zhang & Zoli, 2014; and Akinci & Olmstead-Rumsey, 2015). The results from the study by Akinci and Olmstead-Rumsey reveal that MPPs were used more actively in the post-crisis period in advanced and emerging countries as a tool for curbing bank credit growth in the housing sector.

In addition, several studies for the emerging Europe countries reached mixed or conflicted results about the effectiveness of MMPs in curbing credit growth. For example, Vandenbussche, Kongsamut & Dimova (2018) explored applying a set of MMPs in four CEE countries (Bulgaria, Serbia, Romania, and Croatia) between 2002 and 2012 and found conflicting results in boom and boost years. Dumičić (2017) explored applying MPPs in eleven CEE countries between 2000 and 2013, revealing that MPPs have been more effective in slowing credit growth in the housing retail sector rather than in the non-financial corporate sector. Similarly, Kuttner & Shim (2013) reveal that not all MPP indicators have equal and robust significant impact on credit growth. In fact, they found that only changes in one MPP indicator (debt-service-to-income gap) impact robustly on credit growth. Similarly, Galac (2010), and Vandenbussche et al. (2018) found the evidence of effectiveness of MPP indicators in building liquidity and capital buffers and their being less effective in curbing credit growth rate. In one of the latest studies for the CEE region, Pochea & Nițoi (2021) found a negative correlation between MPPs and credit growth in 11 CEE countries between 2000 and 2015. The study concludes that increase of economic growth leads to the lower effect of MPPs lending measures on credit growth.

This research differs from earlier studies because it focuses on the examination of the role of specific credit-related macroprudential instruments in reducing the correlation between economic and credit growth.

3. Methodology and research data

Three credit related macroprudential instruments: limits on DTI, FC and CG are employed to analyse their effectiveness in curbing credit growth by using cross-country data between 2000 and 2017. The study hypothesis is that the selected credit related macroprudential instruments have an inverse relationship

with credit growth and they can be effective tool in curbing credit growth in European emerging countries.

Some serious issues in econometrics may arise from estimating Equation (4). For example, a variable economic growth could be endogenous and can correlate with μ_i . In fact, it may result in endogenous phenomena. In addition, a high serial autocorrelation comes from the presence of $CGROW_{i,t-1}$. If we follow random effect model and fixed effect model, then neither of the models can handle the endogenous phenomena and serial autocorrelation. In fact, by using cross-country and macro level data our estimates can be sensitive to endogeneity issue. So, the research uses the GMM estimators (difference and the system) for robustness check and estimation developed by Arellano & Bond (1991).

More specifically, due to the lack of information on changes in the past values of persistent regressors in the empirical models, it makes their lags to be weak instrumental variables in D-GMM (difference-GMM estimator). Blundell, Griffith & Windmeijer (2002) show that D-GMM estimator of lagged dependent variable suffers from downward bias and, they recommend to include S-GMM (system-GMM estimator) as an efficient estimator to control downward bias. In addition, Arellano & Bover, (1995) find that the S-GMM employs lagged differenced terms as instruments as a better option than the lagged level terms as in D-GMM. Similarly, Blundell & Bond (1998) recommend S-GMM estimator as it provides more efficient estimates than DGMM estimator by improving precision and reducing sample bias.

The rationale for using the variables in models is to respond to the specific research needs. The GMM estimator is used to empirically examine the relevance of Credit related macro prudential instruments for lending dynamics. The initial dynamic panel model equation can be expressed as follows:

$$y_{it} = \alpha + \gamma y_{i,t-1} + x'_{it} \beta + \mu_i + \varepsilon_{it} \quad (1)$$

$i=1, 2, \dots, N$ -cross section units, $t=1, 2, \dots, T$ - time periods.

Where x_{it} denotes the value of independent variables ($K \times 1$ vector) for country "i" in year "t", β denotes a $K \times 1$ parameter vector (β_1, \dots, β_K), while α is the intercept, μ_i the time invariant component of the error term and ε_{it} is the usual error term and. To remove μ_i , it is further differentiated as follows:

$$y_{it} - y_{i,t-1} = \gamma(y_{i,t-1} - y_{i,t-2}) + (x'_{it} - x'_{i,t-1}) \beta + (\varepsilon_{it} - \varepsilon_{i,t-1}) \quad (2)$$

$i=1, 2, \dots, N, t=1, 2, \dots, T$.

The assumption of the model is that all variables are x'_{it} strictly exogenous in the sense that they are uncorrelated with any current, past and future value of ε_{is} . This condition can be expressed as follows:

$$\{x_{it} \varepsilon_{is}\} = 0, \forall s, t \quad (3)$$

Based on the previous examination of a link between credit growth and MPPs (Lim et al. 2011; Cerutti et al., 2017; Morgan, Regis & Salike, 2018; Cizel et al., 2019) the study employs a modified the dynamic panel model given as:

$$CGROW_{i,t} = \alpha + \gamma CGROW_{i,t-1} + \beta_1 GDPG_{i,t} + \beta_2 FXloans_{i,t} + \beta_3 (FC \times GDPG)_{i,t} + \beta_4 (DTI \times GDPG)_{i,t} + \beta_5 (CG \times GDP)_{i,t} + \mu_i + \varepsilon_{it} \quad (4)$$

Where i indexes the selected countries from 1...28 and t indexes years from 2000 to 2017. $CGROW_{i,t}$ denotes the value of the dependent variable, $CGROW_{i,t-1}$ is the initial level of the credit growth and lagged dependent variable, while the set of explanatory variables ((GDPG, FX loans, (FC x GDP), (DTI x GDP), and (CGG x GDP)) for country "i" in year "t", μ_i is a specific error for country "i" and the assumption is that it is $\mu_i \sim IID(0, \sigma^2\mu)$, is the usual error term for country "i" in year "t" and the assumption is that $\varepsilon_{it} \sim IID(0, \sigma^2\varepsilon)$. Three macroprudential instruments in Equation 4 are presented in a way to measure their effects in both expansionary and recessionary phases of the business cycle.

Domestic credit to private sector (% of GDP) from the World Development indicators (WDI) is used a proxy variable to measure credit growth. The model deals with the main independent variables as follows: the lagged dependent variable $CGROW_{i,t-1}$, a set of various macroprudential measures and instruments to reduce banking sector vulnerabilities (FC, DTI, CG) that are sourced from database of Cerutti et al. (2017) then GDP growth (annual %) from the World Bank (WDI) proxied to measure the real rate of change in GDP, and a variable of FX loans to total loans (IMF database) to measure changes in FX loans. The lagging credit growth was introduced to measure a level of inertia in credit movements. A variable of GDP growth is a determinant of credit growth, while a variable of FX loans measures the high proportion of FX lending in total bank credit since fixed exchange rate in most of sampled countries allows credit growth in banks through external funding (Nier et al., 2012 and Lim et al., 2011). And macro prudential variables: limits on foreign currency loans (FC), debt to income ratio (DTI), and limits on domestic currency loans (CG) are exogenous variables imposed by the national supervisor to preserve financial stability, directly or indirectly affect credit growth. They are increasingly being viewed as useful in limiting procyclicality of credit (Lim et al., 2011; Nier et al., 2012; Cerutti et al., 2017; Morgan et al., 2018). The model assumes that a credit growth rate in the past and

a stronger GDP growth appear to favour credit growth while restrictive macro-prudential policies and credit growth will be in the opposite direction.

4. Empirical results and findings

4.1. System GMM estimation

The findings on credit growth for the whole sample shown in Table 2 reveal that in both S-GMM estimators the main variables of interest (limits on FC, caps on DTI and limits on CG) are shown as statistically significant with 1% and 5% level. In model 1 for one step S-GMM and two steps S-GMM, credit growth is explained by its lag, FX loans, GDPG and FC; in Model 2 by its lag, FX loans, GDPG and DTI; in Model 3 by its lag, FX loans, GDPG and CG.

Table 2: S-GMM panel estimation results for Whole sample

	One- Step S-GMM			Two - Step S-GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CGROW (-1)	.2843877 (.1302781)**	.2889818 (.1304836)**	.2962046 (.1308319)**	.2934092 (.1318966)**	.2915333 (.1286452)**	.3176257 (.1277564)**
FX loans	.0426127 (.0353917)	.0426983 (.0368169)	.0533341 (.0371229)	.0326299 (.0453791)	.0183783 (.044501)	.027939 (.0490812)
GDPG	1.48037 (.2429898)***	1.366655 (.3384614)**	1.316422 (.3313133)***	1.491282 (.2349619)***	1.421817 (.2469119)***	1.352818 (.2489719)***
FC x GDP	-1.525286 (.5403735)***			-1.532231 (.6298266)**		
DTI x GDP		-1.210683 (.4310457)***			-1.380084 (.3665365)***	
CG x GDP			-1.195494 (.3325419)***			-1.194653 (.3448023)***
Observations	348	348	348	348	348	348
Number of groups	27	27	27	27	27	27
Sargan Test (p-value)	0.125		0.144			0.144
AR (1) (p-value) ^l	0.001	0.001	0.001	0.022	0.018	0.017
AR (2) (p-value)	0.298	0.303	0.304	0.313	0.318	0.290
Hansen test	0.240	0.512	0.313	0.240	0.512	0.313

Source: Author's calculations.

Note: standard deviation is reported in parentheses; * = p < 10%, ** = p < 5%, *** = p < 1%.

The variable GDP is shown in all three models and is highly statistically significant in determination of credit growth. The real GDP growth has a positive influ-

ence on credit growth and it implies that increase in GDP growth will amplify a country's income leading credit growth. Similarly, the coefficients of the lagged credit growth confirm the significance of this variable included in the models. The Sargan, Arellano-Bond AR (2) and Hansen tests confirm the validity of the instruments used in both S-GMM estimators. Stated specifically, the empirical findings of estimations indicate their strong and inverse relationship with credit growth or selected macro prudential measures may reduce the correlation between credit growth and GDPG. This is not surprising and is consistent with substantial number of previous studies on the related topic done by Lim et al. (2011), Nier et al. (2012), Cerutti et al. (2017) and Pochea & Nițoi (2021). Also, Table 2 documents that the empirical results impact of FX loans on credit growth are statistically insignificant in all of estimations for the whole sample.

Furthermore, the findings for European transition countries imply that GDP is statistically significant at 1%, and 5% level in all models in both S-GMM estimators (Table 3). The values of lagged variable of CGROW (-1) shows mixed results with small level of significance at 10 % level in Model 2 and Model 3 (one step S-GMM) and in Model 1 and Model 3 (two step S-GMM).

Table 3: S-GMM panel estimation results for European transition countries

	One - Step S-GMM			Two - Step S-GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CGROW (-1)	.2133769 (.1246886)	.2301202 (.127438)*	.2352666 (.1266539)*	.2005615 (.0951529)*	.2145053 (.1283535)	.2220127 (.1243727)*
FX loans	.0476456 (.0737839)	.0819621 (.0785993)	.0853384 (.0846262)	.2570708 (.3806987)	.3905337 (.6260832)	.3349741 (.5169777)
GDPG	1.625783 (.3171826)***	1.29286 (.4840136)**	1.314621 (.467130)***	1.698849 (.2888514)***	1.471253 (.381856)***	1.788697 (.471455)***
FC x GDP	-1.754321 (.4744344)***			-1.490302 (.4414038)***		
DTI x GDP		-.7405672 (.4677895)			-.1815007 (.8938576)	
CG x GDP			-1.367639 (.396539)***			-3.78407 (2.102759)*
Observations	227	227	227	227	227	227
Number of groups	17	17	17	17	17	17
Sargan Test (p-value)	0.424	0.496	0.493	0.424	0.211	0.493
AR (1) (p-value)	0.002	0.001	0.002	0.028	0.021	0.029
AR (2) (p-value)	0.426	0.384	0.449	0.492	0.469	0.823
Hansen test	0.780	0.621	0.974	0.780	0.754	0.974

Source: The author's calculations.

Note: standard deviation is reported in parentheses; * = p < 10%, ** = p < 5%, *** = p < 1%.

The variable of FC is found to be negative and statistically significant in both S-GMM estimators at the 1% level. It plays a key role in the determination of credit growth. For example, for each 1% increase in GDPG, credit growth increases by 0.21% and 0.20%, respectively, while it is offset by -1.75% (one step S-GMM) and -1.49 % (two step S-GMM) when FC limits are introduced. On the contrary, although caps on debt-to-income ratio (DTI) have expected theoretical sign, it is statistically insignificant in both S-GMM estimators. Further, a variable of CG has the expected negative sign with the theoretical literature and is statistically significant in both estimators (Model 3: one step S-GMM at 1% level) and 10% level in two step S-GMM estimator. For example, in Model 3, credit growth of 0.23% led by 1% increase in GDPG is offset by -1.36% when CG limits are introduced.

The regression results for European post-transition countries are displayed in Table 4. The lagged variable of CGROW is positive and significant in all six models. However, it seems that credit related macro prudential instruments used in European post-transition countries do not appear to be associated with lower bank credit growth in two- step S-GMM estimator.

Table 4: S-GMM panel estimation results for European post-transition countries

	One-Step S-GMM			Two -Step S-GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CGROW (-1)	.7472931 (.0371643)***	.7291794 (.0323357)***	.7396172 (.0406978)***	.7345163 (.0524659)***	.7859134 (.0539934)***	.7833045 (.0409688)***
FXloans	.004544 (.018628)	-.0007861 (.020924)	.0011223 (.0180023)	-.1194967 (.2040584)	-.2324782 (.2102707)	-.2517533 (.3613737)
GDPG	1.066539 (.3024217)***	1.293525 (.1897503)***	1.089577 (.276627)***	.9532634 (.6182856)	.7686591 (.494052)	.5483852 (.8266946)
FC x GDP	.2857646 (.7056493)			-2.93119 3.633429		
DTI x GDP		-1.395214 (.1895438)***			-1.021865 (.5813319)	
CG x GDP			-.8691233 (.156101)***			-1.730156 (.9929004)
Observations	137	137	11	137	137	137
Number of groups	11	11	11	11	11	11
Sargan Test (p-value)	0.685	0.535	0.720	0.685	0.535	0.756
AR (1) (p-value)	0.011	0.009	0.011	0.013	0.010	0.011
AR (2) (p-value)	0.157	0.151	0.141	0.459	0.184	0.189
Hansen test	0.979	0.999	0.986	0.979	0.999	0.989

Source: Author's calculations.

Note: standard deviation is reported in parentheses; * = p< 10%, **= p< 5%, ***= p< 1%.

For example, the study finds that limits on FC have no significant impact on reducing credit growth in both S-GMM estimators. More specifically, two variables: CG and DTI have expected theoretical sign and have statistically significant effects on credit growth only in one step S-GMM estimator. For each 1% increase in GDPG, credit growth increases by 0.73% while it is offset by -1.39% when FC limits are introduced. Similarly, for each 1% increase in GDPG, credit growth increases by 0.74% lead to offset by -0.86% when CG limits are introduced. Consistent with the earlier studies (Lim et al., 2011; Cerutti et al., 2017) the introduction of CG limits and FC limits are shown to reduce the correlation between GDP growth and credit growth.

4.2. Robustness check

To get more confidence in our main findings, the study applies one-step and two-step D-GMM estimators to examine the robustness of S-GMM estimates. The corresponding resultants are displayed in Table 5, Table 6 and Table 7, respectively. Considering all models, their sign and level of significance of the impact of credit related macroprudential instruments on credit growth is still the same with models discussed in Table 2 and Table 3.

Consistent with S-GMM estimates, the study's findings for the whole sample (one step and two-step D-GMM) in Table 4 are like those obtained in Table 2 (one step and two-step S-GMM). These findings are confirmed with some diagnostic tests (Sargan, Arellano-Bond AR (2) and Hansen tests) suggesting that S-GMM estimates are reliable.

Table 5: D-GMM panel estimation results for Whole sample

	One - Step D-GMM			Two - Step D-GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CGROW (-1)	.455583 (2.79)***	.440502 (2.73)***	.4600172 (2.85)***	.5346802 (6.23)***	.5553888 (5.85)***	.5636574 (7.37)***
FX loans	.1084491 (0.25)	.2100264 (0.49)	.4346876 (1.05)	-.022248 (-0.19)	.2663724 (1.34)	.2872732 (2.21)**
GDPG	4.150014 (5.01)***	3.932188 (5.09)***	3.610603 (4.88)***	3.539045 (8.08)***	3.816926 (17.54)***	3.260429 (13.06)***
FC x GDP	-5.34327 (-4.01)***			-4.87265 (-10.12)***		
DTI x GDP		-5.055508 (-3.39)***			-4.34713 (-10.81)***	
CG x GDP			-5.75703 (-3.21)***			-4.848657 (-8.87)***
Observations	316	316	316	316	316	316
Number of groups	27	27	27	27	27	27
Sargan Test (p-value)	0.287	0.453	0.256	0.287	0.453	0.256
AR (1) (p-value)	0.000	0.000	0.000	0.013	0.007	0.010
AR (2) (p-value)	0.365	0.547	0.616	0.385	0.346	0.375
Hansen test				0.565	0.601	0.682

Source: Author's calculations.

Note: standard deviation is reported in parentheses; * = p< 10%, **= p< 5%, ***= p< 1%.

Furthermore, both D-GMM estimators displayed in Table 5 for the European transition countries are more significant than those obtained in Table 2 (S-GMM estimators) because all the main variables of interests (limits on FC, caps on DTI and limits on CG) are shown as statistically significant with 1% and 5% level. In fact, policy implications discussed for the findings in Table 3 are also valid for these empirical observations in Table 6.

The estimator finds the lagged credit growth rate statistically insignificant in five out of six specifications. However, all three employed credit related macroprudential instruments play a key role in curbing credit growth in the expansive stage of business cycle in the European transition countries. Thus, our results are consistent with the empirical findings done by Lim et al. (2011), Nier et al. (2012), Cerutti et al. (2017) and Pochea & Nițoi (2021).

Table 6: D-GMM panel estimation results for European transition countries

	One- Step D-GMM			Two - Step D-GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CGROW (-1)	.0757264 (0.45)	.0627491 (0.39)	.1665672 (0.91)	.0456943 (0.69)	.0369556 (0.28)	.1415498 (2.50)**
FX loans	1.094525 (1.26)	1.053583 (1.25)	1.349034 (1.48)	1.611055 (3.06)***	2.20322 (9.72)***	1.568201 (3.81)***
GDPG	4.640632 (4.40)***	4.591602 (4.75)***	4.020512 (3.93)***	4.237544 (12.26)***	1.775482 (2.96)***	4.133408 (14.13)***
FC x GDP	-5.772736 (-3.82)***			-5.69381 (-7.56)***		
DTI x GDP		-2.943185 (-2.07)**			-8.60713 (-11.03)***	
CG x GDP			-5.188113 (-2.51)***			-4.250998 (-5.08)***
Observations	209	209	209	209	209	209
Number of groups	17	17	17	17	17	17
Sargan Test (p-value)	0.169	0.208	0.238	0.169	0.545	0.011
AR (1) (p-value)	0.001	0.001	0.001	0.051	0.023	0.509
AR (2) (p-value)	0.775	0.539	0.541	0.711	0.196	0.238
Hansen test				0.800	0.609	0.737

Source: Author's calculations.

Note: standard deviation is reported in parentheses; * = $p < 10\%$, ** = $p < 5\%$, *** = $p < 1\%$.

Table 7 reports the estimates of the credit growth under different credit related macroprudential instruments. Surprisingly, the findings of European post-transition countries are different from European transition countries and the whole sample.

The effects of some variables from the interests are not consistent with those in Table 4. For example, the outcome from Table 7 shows that in both D-GMM estimators neither limits on FC nor limits on CG are found to be statistically significant in explanation of lending dynamics.

Table 7: D-GMM panel estimation results for European post-transition countries

	One - Step D-GMM			Two - Step D-GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
CGROW (-1)	.8686213 (7.63)***	.7948225 (7.82)***	.8624432 (7.57)***	.9493713 (12.99)***	.8001394 (14.74)***	.9188207 (27.85)***
FX loans	-.0764186 (-0.47)	-.2496402 (-1.63)	-.0852992 (-0.53)	-.058291 (-0.45)	-.106465 (-0.82)	-.0520058 (-0.48)
GDPG	1.821038 (4.20)***	2.197864 (5.13)***	1.844269 (4.27)***	2.654013 (7.49)***	3.141807 (4.27)***	2.552776 (6.78)***
FC x GDP	.78516747 (0.50)			-1.288614 (0.663)		
DTI x GDP		-3.74661 (-4.25)***			-2.80686 (-2.46)**	
CG x GDP			-.1012868 (-0.05)			-1.792583 (0.435)
Observations	122	122	122	122	122	122
Number of groups	11	11	11	11	11	11
Sargan Test (p-value)	0.914	0.977	0.921	0.914	0.957	0.921
AR (1) (p-value)	0.000	0.000	0.000	0.014	0.019	0.020
AR (2) (p-value)	0.183	0.419	0.238	0.316	0.472	0.297
Hansen test				0.919	0.928	0.916

Source: Author's calculations.

Note: standard deviation is reported in parentheses; * = $p < 10\%$, ** = $p < 5\%$, *** = $p < 1\%$.

5. Conclusion

As the European regions where an application of MPPs is being increasingly used than elsewhere in the rest of Europe, it is expected that those countries are effective in reducing procyclicality in financial markets as well.

Can credit related macroprudential instruments be effective in reducing the correlation between economic and credit growth? This study finds the answer by using S/D-GMM estimators for 28 emerging Europe countries. It underlines the great relevance that MPPs have in the European emerging economies, especially in the European transition countries.

The study assesses the effectiveness and association of credit related macroprudential instruments in curbing credit growth in emerging Europe. Although greater attention to MPPs is found in both European transition and European post transition countries, the study finds some differences as well. At

the same time, the European transition countries proved to be more successful in using macroprudential tools to slow down credit growth than European post-transition countries. The findings of this study confirm our expectation that a lower economic growth leads to lower effects of credit related macroprudential instruments on credit growth. In both European regions, a country's business cycle is positively related to credit growth. Also, the interaction between GDP growth and credit implies that the effect of credit related macroprudential instruments on credit growth is more significant in European transition countries rather than European post transition countries. We specifically find mixed or inconclusive empirical results for European post transition countries followed by the lack of robustness of economic results. In fact, all variables of interest related to credit related macroprudential instruments have expected theoretical (negative) sign but different level of (in)significance. This can be explained by the fact that they might actively use some additional instruments (i.e. required reserves) in combination with credit related macroprudential instruments.

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