INSTITUTE
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Faculty of Social Sciences
Charles University

MACROPRUDENTIAL POLICIES AND DOLLARISATION: IMPLICATIONS FOR THE FINANCIAL SYSTEM AND A CROSS-EXCHANGE RATE REGIME ANALYSIS

Fisnik Bajrami

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Institute of Economic Studies,
Faculty of Social Sciences,
Charles University in Prague

[UK FSV – IES]

Opletalova 26
CZ-110 00, Prague
E-mail : ies@fsv.cuni.cz
http://ies.fsv.cuni.cz

Institut ekonomických studií
Fakulta sociálních věd
Univerzita Karlova v Praze

Opletalova 26
110 00 Praha 1

E-mail : ies@fsv.cuni.cz
http://ies.fsv.cuni.cz

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Macroprudential Policies and Dollarisation: Implications for the Financial System and a Cross-Exchange Rate Regime Analysis

Fisnik Bajrami

Charles University, Institute of Economic Studies, Faculty of Social Sciences, Prague, Czech Republic. E-mail: fisnik.b87@gmail.com

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Abstract:
Macroprudential policy has gained prominence for promoting financial stability. In this paper, we assess the effectiveness of macroprudential policy in reducing credit growth over a 22-year period across 129 countries. Additionally, we investigate the interaction between macroprudential policy, dollarisation, and various exchange rate regimes, examining their impact on different financial stability indicators. Our findings indicate that macroprudential policy significantly reduces credit growth within a quarter of implementation, though this is not evident in the case of soft peg exchange rate regimes. Furthermore, our analysis reveals that dollarised countries exhibit superior outcomes in financial stability when compared to alternative exchange rate regimes.

JEL: E42, E52, E58
Keywords: macroprudential policy, dollarisation, exchange rate, credit growth, non-performing loans, inflation, interest rates, empirical evaluation

1 Introduction

Macroprudential policy emerged as a necessary response to the devastating impact of the global financial crisis. As Reinhart & Rogoff (2008) describe the state before the global financial crisis as being characterized by deep global financial integration, high interconnectedness across financial markets, and unjustified confidence. Excessive risk-taking and risk securitization were perceived as mitigation and "lauded" as innovation, regulatory facilitation through subprime lending, fuelling asset prices, and mortgage values reaching up to 90 per cent of the US GDP. The global financial crisis was deep, strong, and widespread. Milne (2009) explains that the nature of the financial system has evolved fundamentally, with the unavailability to meet short-term funding in unexpected losses and systemic, network and market-related risks. In such a scenario, macroprudential policy emerged as a necessity to address financial instabilities arising from excessive leveraging risks.

Monetary policy and exchange rate regimes can significantly impact financial stability. Expansionary monetary policy has the potential to increase vulnerabilities and systemic risks within the financial sector, therefore conflicting with the financial stability objective. Exchange rate regimes, on the other hand, may be susceptible to speculative attacks or limit the effectiveness of central bank interventions. The case of official dollarisation, where there is no active autonomous monetary policy, creates a distinct financial environment that has important implications for both financial stability and the application of macroprudential policy. It presents a real-life experiment with no monetary policy in place. While existing literature acknowledges these implications, it is worth noting that the literature on official dollarisation is relatively outdated, with a higher frequency of publications prior to the global financial crisis.

This paper examines the effectiveness of macroprudential policy in relation to credit growth, a key indicator of financial stability. Additionally, this study aims to analyse the implications of dollarisation, in the context of macroprudential policies and financial stability, through cross-exchange rate regime analyses, by evaluating their performance on financial indicators such as levels of non-performing loans (NPL), inflation, and interest rates. This is especially important in the post-global financial crisis landscape.

The paper draws upon 22 years of experience in macroprudential policy and dollarisation, benefiting from the utilisation of recent availability in the secondary data regarding the application of macroprudential policy. Data on such an extensive time span provides a solid foundation for assessing the long-term effects and trends in macroprudential policy and dollarisation. To accomplish its objective, the paper employs two econometric frameworks, the generalized method of moments and propensity score matching. The paper thus presents a comprehensive evaluation of the application of macroprudential policies in general, as well as through a cross-exchange rate regime examination.

Our empirical findings reveal that macroprudential policy is effective in curbing credit growth with instruments targeting borrowers and financial institutions. However, we find that the impact of individual macroprudential instruments is limited, except for reserve[1] and capital requirements, which exhibit a reduction in credit growth though on marginal statistical significance. Our analysis also reveals that macroprudential policy implementation in countries with soft peg regimes does not yield significant effects in dampening credit growth.

Interestingly, we observe that when dollarised countries implement tightening macroprudential policies they experience lower levels of non-performing loans compared to countries with other exchange rate regimes. This observation holds true across all exchange rate regimes, with the notable exception of currency unions. Moreover, dollarised countries exhibit lower inflation rates and, in some cases, lower interest rates.

This paper is structured as follows. The first chapter provides a background by introducing key concepts of macroprudential policy and its rationale for application. It also examines the implications of macroprudential policy for dollarisation and explores its interaction with exchange rate regimes and financial stability. The second chapter presents a comprehensive literature review, highlighting theoretical and empirical findings on macroprudential policy, as well as the interactions between monetary policy, macroprudential policy, exchange rates, and dollarisation. The third chapter outlines the methodology employed in this study, detailing the data and their sources, evaluation techniques and econometric models utilised. Subsequently, the fourth chapter

[1] Although reserve requirements are typically associated with monetary policy, the Integrated Macroprudential Policy database from the IMF, our primary data source, focuses on capturing policy tools, including reserve requirements, used for macroprudential purposes (Alam *et al.* 2019).

presents the research findings derived from the analysis. Finally, the paper concludes with a final chapter that discusses policy implications and addresses the limitations of the study.

2 Background

Macroprudential policy's primary objective is financial stability. This objective is attained through addressing and limiting excessive risks, vulnerabilities, and imbalances in asset price bubbles, credit growth, excessive leveraging, capital flows, and the financial system in general, through the provision of prudential measures and rules targeting liquidity, capital, and collateralization (IMF, 2013, Lim *et al*. 2011, Kuttner & Shim, 2016). Macroprudential policy presents a set of tools and guidelines that countries can enforce to improve financial stability and resilience by addressing the underlying causes of systemic risk.

In a pre-global financial crisis paper, Borio & Shim (2007) explain how the financial ecosystem was too relaxed and incompatible to manage the systemic risk posed by the financial system. Evidence shows that fluctuations within the real estate market have frequently precipitated vulnerabilities and risks in the financial system (Claessens *et al*. 2013). These market conditions generally lead to credit booms, about a third of which culminate in a financial crisis (Dell'Ariccia *et al*. 2012). Especially before the global financial crisis, there was a procyclical environment that contributed to the amplification of the crisis. Thus, enforcement of prudential rules and "regulation" followed naturally, through the inception of macroprudential policy. Although numerous prudential tools were employed prior to the global financial crisis, their consolidation, regulation, and implementation have experienced a significant increase in a post-crisis environment across all economies (Akinci & Olmsted-Rumsey 2015, Kim *et al*. 2019, Fendoglu 2017).

The literature classifies macroprudential policy tools into distinct categories. These can be grouped into (1) borrower-based measures, (2) capital and provisioning requirements, (3) alternative quantitative restrictions on financial intermediaries, (4) fiscal impositions or levies on operations or balance sheet compositions; and 5) supplementary institution-focused measures, such as accounting or compensation changes, etc. (Claessens *et al*. 2013, Cerutti *et al*. 2017, Brusserie *et al*. 2020, Boar *et al*. 2017). Though these categories may vary across literature, they can generally be classified between demand-side (1) and supply-side (2, 3, 4, and 5) credit measures. Some of the

most popular borrower-based measures include loan-to-value (LTV) and debt-to-income (DTI), debt service-to-income (DSTI).

LTV ratios present limits on the loan size compared to the value of the asset, DTI ratios limit the loan compared to the household income levels, while DSTI ratios restrict the size of debt service payments or the size of a loan in relation to a borrower's income. Whereas, countercyclical capital buffers, reserve requirements, and liquidity requirements are examples of supply-side measures. Such instruments generally present minimal provisions that financial institutions should hold either as funds, liquid assets, currency denominations, or in other forms.

Tools such as LTV, DTI limits, and countercyclical capital buffers are among macroprudential tools which aim to specifically address the accumulation of systemic risks through controlling excessive exposure of mortgage loans and asset price inflation (IMF 2013, Shim *et al*. 2013). The importance and use of these tools have been on the rise since. Galati & Moessner (2013) argue that in analogy to the interest rate policy for price stability objective of the monetary policy and automatic stabilizers of fiscal policy, policymakers should also implement specific policies for promoting financial stability objectives. Borrower-based measures such as LTV, or DTI limits are viable instruments that can be utilised for this objective.

In assessing whether macroprudential tools employed nowadays would be able to mitigate the global financial crisis, Aikman *et al*. (2019) assess that tools such as countercyclical capital buffer and debt-to-income limit would likely increase the resilience of financial institutions and reduce vulnerabilities. However, to achieve this outcome, the same study notes that authorities supervising the macroprudential policy should have a strong mandate. Such setups are not present everywhere though, particularly when referring to the mandate of the Financial Stability Oversight Council (FSOC) in the US. The definition of mandate, authority to enforce as well as the actual implementation of macroprudential tools are also highly important, however, these issues are beyond the scope of this paper. Jimenez *et al*. (2017) argue that macroprudential measures such as counter-cyclical buffer provide significant resilience attributes to prevent both build-up of credit booms during expansions and credit crunches during recessions.

Exchange rate regimes as well as monetary policy autonomy present significant implications for the financial system. On the one hand, fixed exchange rate regimes could be prone to

speculative attacks which can pose a threat to the health of the financial system as well as restrict the ability of the central bank to pursue independent monetary policy. On the other hand, uncertainties around floating rates could impact the confidence of investors in the financial system. In the extreme situation, an officially dollarised economy operates without a monetary policy at all. These conditions could have important implications for macroprudential policy (Nakatani 2020). Evidence on this topic remains largely scarce. Despite an interest in studying the interaction between monetary and macroprudential policies, examining this through exchange rate regimes is not widespread in the literature. Particularly, cases of dollarisation present ideal cases for such experiments - where monetary policy is completely absent.

3 Literature Review

3.1 Macroprudential Policy Effectiveness – Theoretical Perspective

Several authors assess the impact of macroprudential policies through theoretical models. Overall, the application of dynamic stochastic general equilibrium (DSGE) for this purpose dominates existing studies, and all studies find that macroprudential policy is effective in the prevention of vulnerabilities in the financial system. In some studies, however, such benefits present important implications for lending and macroeconomic activities. However, there are contradictory findings for the latter.

In a model with housing and collateral constraints, Rubio & Carrasco-Gallego (2014) find that macroprudential policies moderate credit booms, without dampening the real effects of the boom and lead to higher welfare. This is achieved both through coordinated and non-coordinated action between monetary and macroprudential policies. Ghilardi & Peiris (2016) argue that countercyclical macroprudential policy tools can outperform standard monetary policy Taylor's rule in stabilizing macroeconomic volatility that arises from financial crises. Through studying the effectiveness of macroprudential tools such as LTV and capital requirements in the Canadian economy, Alpanda *et al*. (2018) find that LTV limits are the most effective tools for reducing household indebtedness, followed by capital requirements, whereas the use of monetary policy for the same purpose presents a more costly option.

Mendicino *et al*. (2020) study what level of capital requirements can ensure a strong and resilient banking system through a macro-banking model and find that capital requirements reduce risk-taking and excessive bank leverage. They may be followed by contractionary economic activity and credit supply in the short run though. Korinek & Sandri (2016) argue that to protect against vulnerabilities from capital outflows and exchange rate depreciation, it is desirable to use both macroprudential policy and capital controls. Farhi & Wening (2016) suggest that monetary policy and macroprudential interventions in the financial market targeting aggregate demand externalities can generate Pareto improvements. Ma (2020) investigates the impact of macroprudential policy in a small open economy model with endogenous growth and finds that it can indeed mitigate the costs of financial crises and thus promote growth, however with the cost of slowing output growth in normal times. Analysing a model with financial frictions and a banking sector, Basto *et al*. (2019) find that the introduction of permanent LTV limits produces initially (in the short run) a decline in both borrowing and output, accompanied by lower lending levels in the long run.

3.2 Macroprudential Policy Effectiveness – Empirical Perspective

In the aftermath of the global financial crisis, the implementation and assessment of macroprudential policy have gained heightened attention. The subsequent section presents findings from an extensive range of empirical investigation literature. In essence, the literature substantiates the efficacy of macroprudential policy in the mitigation of vulnerabilities in the financial system, including ensuring safe and prudent lending and structurally healthy, sustainable lending cycles, curbing procyclical effects such as housing price inflation, and addressing other imbalances. This section follows with a review of literature on the impact of macroprudential measures on a micro-level perspective, encompassing the banking sector, and subsequently moving to a macro-level perspective, focusing on aggregate economic indicators.

The most widely used macroprudential tools are reserve requirements[2] and borrower-based measures. Overall, borrower-based tools appear more prevalent across the literature. Other highly

[2] As previously indicated reserve requirements are typically associated with monetary policy, this study examines policy tools, including reserve requirements, used for macroprudential purposes.

used instruments are capital requirements (a more microprudential measure), measures targeting liquidity risk, exposure limits, credit restrictions, borrower-based measures, tax measures, limits on foreign currency lending, profit distribution restrictions, and maturity mismatch limits (Morgan *et al*. 2019, Lim *et al*. 2011, Fendoglu 2017, Alam *et al*. 2019). Utilisation of macroprudential policies is more prevalent in emerging economies, with reserve requirement and foreign exchange-related measures more prominent, while borrower-based ones are more popular in advanced economies (Cerutti *et al*. 2017, Federico *et al*. 2014).

Studying bank-level data in 48 countries for over a decade, Claessens *et al.* (2013) find that macroprudential tools are especially successful during expansionary times. The study finds that DTI and LTV ratios, limits on foreign currency lending, and countercyclical buffers are particularly highly effective instruments. DTI and LTV limits are assessed as effective in addressing vulnerabilities in the banking system while countercyclical buffers in reducing the build-up of excessive leverage and risk of assets. This is also validated by Morgan *et al*. (2019), who claim that LTV limits contribute to a reduction in mortgage loan volume, ranging from 5 to 5.9 per cent, via channels such as the size of loans and non-performing loans. In addition, their findings indicate a noteworthy contraction of credit by limits in domestic currency measure by up to 11.6%. Studying changes in LTV limits in 65 countries for over 16 years, Nakatani (2020) finds that the application of these instruments has been successful in lowering the probability of banking crises.

Through an analysis of bank-level data from over 65 countries, Oslzak *et al*. (2018) conclude that borrower-based macroprudential instruments exhibit superior efficacy in comparison to other instruments in the mitigation of loan loss provisions procyclicality. Ahuja & Nabar (2011) also find that LTV limits have a positive impact on banking return on assets, though more pronounced for pegged exchange rate regimes and currency boards. Implementation of capital flow management instruments in 12 Asia-Pacific countries has also proven efficient in attenuating inflows toward the banking sector and bond market (Bruno *et al*. 2016). Finally, Jimenez et al. (2017) evaluate the impact of bank-level dynamic provisioning mechanisms, such as countercyclical buffers in Spain, and find that these instruments have played a pivotal role in tempering credit supply cycles,

particularly during crisis periods, marked with favourable conditions aggregate firm-level credit, employment, and firm survival effects.

Dell'Ariccia *et al*. (2012) conducted a comprehensive study of 170 countries, from the 1960s to 2010, of the efficacy of macroprudential policies in mitigating the adverse effects of economic booms. Their results reveal that macroprudential policy can significantly decrease the likelihood of a financial crisis arising as a consequence of what the authors label as a 'bad boom'. Instruments targeting the credit demand side have been found particularly effective, whereas the impact of comprehensive macroprudential policy is estimated to result in a decrease of approximately two percentage points in the credit-to-GDP ratio, thereby demonstrating effectiveness in the mitigation of credit cycle fluctuations (Fendoglu 2017).

In another comprehensive research that includes 119 countries, studying 12 macroprudential tools for more than a decade, Cerutti *et al*. (2017) find that borrower-based and financial institution-based tools have been particularly effective in emerging economies in the reduction of credit growth. Studying the use and effectiveness of 10 macroprudential instruments in 49 countries for a decade, Lim *et al*. (2011) find that almost all macroprudential instruments appear successful in reducing procyclicality, particularly in credit growth, systemic liquidity, leverage, and capital flows. The authors find that LTV limits appear particularly successful in the reduction of credit growth. The efficacy of LTV and DTI limits is confirmed in many other studies, across different regions and periods, via channels of dampening household credit, property price increase, and residential investment (Akinci & Olmsted-Rumsey 2015, Kim & Mehrotra 2022, Ahuja & Nabar 2011, Richter *et al*. 2019, Wong *et al*. 2011, Craig & Hua 2011, Vandenbussche *et al*. 2015, Zhang & Zoli 2016).

Nier & Kang (2016) state that capital buffers, limits on LTV and DSTI, and reserve requirements are all successful macroprudential policy tools for the prevention of credit growth, where enforcement of LTV limits and capital constraints are particularly effective in curbing property price inflation. However, in another study, the implementation of reserve requirements in Latin America was followed only with a moderate and transitory impact on credit growth (Tovar *et al*. 2012). Forbes *et al*. (2015) find that macroprudential regulation provides significant results in improving financial stability, particularly compared to capital-flow management measures.

Referring to experiences in Asia, Bruno & Shin (2014) analyse the implementation of capital flow measures in South Korea vis-a-vis a group of 48 countries. Their findings reveal that these macroprudential tools have enhanced resilience within the South Korean economy in the face of global dynamics. Macroprudential instruments in Asia manifested a dampening effect, albeit modest, on credit, output, and inflation over 15 years (Kim *et al*. 2019). Upon examining inflation-targeting economies within the Asia-Pacific region, Kim & Mehrotra (2018) ascertain that macroprudential policy produces a diminishing effect on credit, output, and inflation through aggregate demand channels.

Specific country experience studies such as Ostry *et al*. (2012) assess that the implementation of macroprudential policies and capital flow measures resulted in the reduction of credit growth and reduction of foreign currency lending, respectively. These results support the mitigation of external vulnerabilities. Whereas in Norway, only the introduction of sizeable countercyclical buffers (an increase of over 2.5 percentage points) produced a decrease in lending rates, thereby impacting credit growth and house prices (Akram 2014).

Wijayanti *et al.* (2020) find that in Indonesia, the tightening of macroprudential policies, specifically LTV ratios, is more effective in curbing credit growth when the credit-to-GDP gap is large. These measures were also notably successful in lowering the rate of non-performing loans. Similarly, Yao & Lu (2020) show that in New Zealand, LTV ratio adjustments resulted in a substantial 2 percentage point decrease in housing loan growth, albeit with minimal impact on non-performing loans. Dobson (2020) found comparable outcomes in Australia, where housing policy measures led to a decline in total new housing lending rates. Studying the impact of LTV ratios in Thailand, Tantasith *et al.* (2018) document a negative influence on new loans, highlighting the efficacy of macroprudential policies in modifying banks' risk-taking behaviour. Additionally, Bayangos & De Jesus (2020) examined six macroprudential policy instruments in the Philippines and concluded that the tightening of prudential policies significantly affects real bank loan commitments to borrowers.

In a recent meta-analysis, Malovana *et al.* (2022) assessed that borrower-based measures led to a decrease of 1.6 percentage points in bank credit growth, where the combined application of multiple measures produced a more pronounced effect than the use of any single measure alone.

Moreover, Araujo *et al*. (2020) find a statistically significant impact of macroprudential policy on credit, with more pronounced effects on emerging economies, with a side effect on short-term output growth. In another meta-analysis study, which examines credit registry data, Gambacorta & Murcia (2020) conclude that the implementation of macroprudential policies has demonstrated considerable efficacy in controlling credit cycles, even short-term effectiveness for specific measures, in five Latin American countries.

Despite confirmation of their impact throughout the literature, the impact of macroprudential policy instruments appears asymmetric (IMF 2012). For example, among emerging economies, LTV and DTI limits appear significant in lowering credit growth, whereas, across a larger sample, capital requirements appear to have a stronger effect when they are relaxed (during times of busts). Examining over three decades of application of macroprudential policy, Kuttner & Shim (2016) find that the introduction of DSTI limits and housing-related taxes decreases credit growth by 4-6 and 3-4 percentage points respectively. Similarly, a comprehensive study by Alam *et al*. (2019) investigating the impact of macroprudential policy in 134 countries covering over 25 years, find that tightening macroprudential policies are associated with a reduction of 0.8 percentage points on household credit growth, whereas the influence of instruments such as LTV limits, produce a decrease between 0.8-3.8 percentage points on private consumption growth. Though the impact appears non-linear, outcomes are especially pronounced when initial LTV limits are comparatively lenient.

However, the macroprudential policy appears to produce also side effects of reducing consumption levels and GDP growth in developed economies. Beirne & Friederish (2014), through an extensive investigation encompassing a sample of 139 nations, evaluate the efficacy of macroprudential policy and potential spillover effects. Their findings suggest that policy instruments addressing credit expansion, maturity mismatches, and capital requirements exhibit greater success during expansionary periods. Referring to the costs of macroprudential policy, Richter *et al*. (2019) find that LTV limits have a rather small effect on output, less so inflation, and more evident among emerging economies. IMF (2012) and Nier & Kang (2016) argue that macroprudential tools can have a significant negative impact on output growth through channels

such as a reduction in construction-related investment. Rojas *et al*. (2022) argue that an increase in the level of reserve requirements precipitates declines in GDP growth level.

On the other hand, Boar *et al*. (2017) find that the use of macroprudential policy has promoted higher output growth rates (of at least one percentage point) and less volatility. They claim that this impact is facilitated through two channels, the impact of macroprudential policy in dampening financial crises and the reduction of macroeconomic and financial volatility.

Given the relatively nascent advent of macroprudential policy implementation, the availability and accumulation of data as well as experience continues to expand. Numerous studies have drawn meaningful insights regarding the impact of macroprudential measures, even when relying on limited sample sizes, short time periods, and specific geographical contexts. Notwithstanding the existing body of evidence, further inquiry is required to determine the impact of macroprudential policy, especially within specific frameworks, such as dollarisation or alternative exchange rate regimes. As presented in the subsequent sections, such perspectives have hitherto been examined predominantly in a partial or indirect manner in selective studies. Moreover, consensus on the effectiveness of macroprudential policy and the optimal choice of instruments has yet to be established (Dell'Ariccia et al. 2012, Araujo *et al*. 2020).

Despite a growing body of literature on the impact of macroprudential policy, a number of considerable challenges persist. Foremost among these is the issue of data availability. Although significant advancements have been made in recent years - notably through the work of Alam *et al*. (2019), who have broadened access to data regarding the application of macroprudential tools - the relatively recent nature of this contribution means that many studies have yet to incorporate this source.

3.3 Interaction of Macroprudential and Monetary Policies

The objective of price stability through monetary policy does not guarantee financial stability. In fact, it may well contribute to higher macroeconomic volatility. Macroprudential policy is needed to address and mitigate vulnerabilities within the financial system (Roldan-Pena *et al*. 2016). As was well noted already, both theoretically and empirically, macroprudential measures are effective in their objective of promoting financial stability. Monetary policy can produce adverse effects on

financial stability through several channels, including the asset price channel, risk-taking and risk-shifting channels, balance sheet channel, and exchange rate channel (IMF 2012, and Nier & Kang 2016). For instance, an expansionary policy that leads to a decrease in interest rates can incentivise financial institutions to increase their lending, which in turn can encourage risky lending practices. Such expansionary monetary policy can also fuel asset prices through an increase in lending, contributing to further amplification of procyclicality. In such cases, macroprudential policy can be utilised to mitigate the effects of monetary policy.

IMF (2013) argues that in the presence of a solid macroprudential policy, potential costs of monetary policy can be mitigated, enabling better conditions for the monetary policy to conduct its price stability objective. Moreover, through examining international transmission channels, Brussiere *et al*. (2021) find that macroprudential policy can partially counterbalance the spillover effects transmitted from monetary policy from other countries. At the same time, the study argues that the topic of interaction between monetary and macroprudential policy continues to be under-examined.

Referring to the literature, studies that have, at least partially, explored the topic of interaction between monetary and macroprudential policies, present largely inconclusive findings and policy implications. Kim & Mehrotra (2022) claim that while macroprudential policy produces successful targeted interventions (e.g. dampening household debts), monetary policy presents broader effects on the economy, though the two present significant interactions. Several studies promote coordinated policy and complementary actions between the two policies (Gambacorta & Murcia 2020, Lim *et al*. 2011, Kim & Mehrotra 2018, Dell'Ariccia *et al*. 2012, Bruno *et al*. 2016). This is not always possible though as the two policies may contain conflicting objectives, particularly in cases when monetary policy objectives (i.e., inflation targeting) contribute to procyclicality through adverse effects such as credit and asset price booms. Other studies claim that the impact of macroprudential tools appears evident regardless of whether monetary policy is expansionary or contractionary (Richter *et al*. 2019, Nier & Kang 2016).

On the other hand, through studying a model with an equilibria coordination exercise, Agur (2019) finds that monetary and macroprudential policies can end up in disequilibrium, particularly when monetary policy follows leaning against the wind policy. Thus, not only coordinated action

between the two policies is preferred, but the paper suggests that the two policies are conducted in a coordinated manner and by a single authority so that potential trade-offs resulting from conflicting policies are avoided. Merging monetary and macroprudential policy within a single authority is presented as a preferred option.

The interaction between monetary and macroprudential policy is also one of the topics of this research paper. This study however looks at a different "angle" for examining this interaction. This is done by studying the impact of macroprudential policy in dollarised and other specific exchange rate regimes. This presents an opportunity to study this topic in a natural experiment, where there is no active monetary policy.

3.4 Macroprudential Policy and Exchange Rate Regime

Evidence on assessing macroprudential policies from the prism of exchange rate regimes is not widespread. Macroprudential policy may be particularly attractive to countries with extreme forms of fixed exchange rate regimes due to the fact that they have fewer monetary policy instruments available. These countries may rely more on macroprudential tools in addressing systemic risks and promoting financial stability (Claessens *et al*. 2013, Wong *et al*. 2011, N'Diaye 2009). This is confirmed by findings in the literature, according to which countries under fixed, as well as managed, exchange rate regimes utilise macroprudential tools more frequently (Lim *et al*. 2011, Ahuja & Nabar 2011)

Findings on the impact of macroprudential policy with respect to exchange rate regimes are scarce and inconclusive. Macroprudential policy appears to produce different impacts in countries with various regimes of exchange rate, monetary policy autonomy, and capital account limitations. The impact of macroprudential policies in countries with fixed exchange rate regimes appears weaker compared to floating regimes in Nakatani (2020). A similar result is obtained in a recent study by Ghosh & Kumar (2022), who find that macroprudential policy is not effective under fixed exchange regimes, whereas successful under floating ones.

On the contrary, Kim & Mehrotra (2022) find that macroprudential policy has been more impactful in countries with less flexible exchange rate regimes. Similarly, through assessing the impact of LTV and DTI limits in 49 economies, Ahuja & Nabar (2011) show that exchange rate

regimes such as fixed rates, dollarised and currency boards, were more successful in the prevention of asset price bubbles, mortgage lending, non-performing loans and return on assets. Though this study does not present conclusive aggregated findings on the impact of macroprudential policy with regard to specific exchange rate regimes, findings are nonetheless of high importance for future studies. Referring to the costs of macroprudential policy, Kim *et al*. (2019) claim that economies with more flexible exchange rate regimes tend to experience more negative shocks in terms of GDP, inflation, and credit. Finally, Lim *et al*. (2011) find that the impact of macroprudential policy does not vary with respect to the type of exchange rate regime.

3.5 Financial System, Full Dollarisation and Financial Dollarisation

Full dollarisation eliminates the role of the central bank as a lender of last resort. This monetary policy role is perceived as one of the most important in times of crisis, where authorities are expected to intervene in liquidity crises. However, the final impact of the lack of a lender of last resort instrument is not fully understood. On the positive aspect, the lack of monetary policy tools to intervene in times of crisis can eliminate moral hazard thus reducing vulnerabilities of the financial sector and increasing confidence. Berg & Borensztein (2000) argue that though dollarisation cannot mitigate completely the risk from external financial crises, it can improve market sentiment and reduce exchange rate risk, therefore lowering the likelihood and severity of crises.

Such evidence is presented in the case of Ecuador and El Salvador, where improvement in bank liquidity and asset quality has been observed with an increase in profitability, deposits, efficiency, and a decrease in nonperforming loans (Queispe and Whisler, 2006). Similarly, Hallren (2014) argues that dollarisation and currency board regimes improve financial system stability, and integration, as well as reduce inflation, with the cost of refraining from the use of monetary policy in times of crisis. Goldfajn & Olivares (2001) acknowledge that Panama presents a case with lower inflation, interest rates, and a competitive banking system, though question whether the last two are a result of dollarisation per se. Mendoza (2001) suggests that the implementation of extreme exchange rate policies such as dollarisation could facilitate the improvement of financial system

efficiency through the reduction of financial frictions. This is only presented through a theoretical model and much remains to be proved empirically.

Though many studies have assumed a positive impact between dollarisation and financial stability, there are also contrary views. Such views claim that dollarisation represents an inferior policy and the loss of lender of last resort is ultimately a negative outcome for turbulent times such as bank runs. This does not change significantly in countries with fixed exchange rate regimes, where the monetary policy autonomy is not complete and thus similar outcomes are expected (Chang & Velasco 2002 and Chang & Velasco 2000).

Not only the literature on dollarisation and its impact on the financial system is scarce, but it is also based mostly on theoretical grounds or partial evidence. Whereas the prism of macroprudential policy study use and impact on dollarised economies has not been studied.

The topic of financial dollarisation has nonetheless received more attention compared to full dollarisation. More recent studies on the impact of financial dollarisation on the financial system stability emphasize the negative correlation between the two. Examining several Caucasus and Central Asia countries, Khandelwal *et al*. (2022) find that high dollarisation levels contribute to the vulnerability of the financial system, and thus macroprudential rules such as limits on foreign exchange positions should be enforced to address these vulnerabilities. Similarly, Levy Yeyati (2021) argues that evidence, though not conclusive, suggests that financial dollarisation increases the likelihood of financial crises thus presenting costs to economic stability and public finance. Through examining 60 emerging market economies, Chitu (2012) find that dollarisation has contributed to the severity of global financial crises through channels such as loss of monetary policy autonomy and currency mismatches. A negative correlation between financial dollarisation and the health of the financial system is proclaimed throughout the literature on the topic (Guide *et al*. 2004, Levy Yeyati & Rey 2006, De Nicolo *et al.* 2003).

4 Research Methodology

The overarching aim of this paper is to primarily evaluate the impact of macroprudential policies on financial stability. This is conducted through a comprehensive examination of the experience of a large number of countries and over two decades of application of macroprudential measures.

Furthermore, the study evaluates macroprudential policy based on exchange rate regime categorisation. Secondarily, the paper the impact of dollarisation on macroprudential policy, as well as its effects on key macroeconomic and financial indicators like inflation and interest rates, in comparison to other exchange rate regimes.

The methodological framework for this paper was developed by taking into account insights from an extensive review of the literature. To test the study's hypotheses, panel data was collected from secondary sources such as the World Bank and the International Monetary Fund (IMF). This study employs two distinct analytical frameworks to quantify the impact of macroprudential policy, an approach specifically designed to yield robust and reliable results. The investigation into the impact of macroprudential policy holds substantial contemporary relevance within academic discourse, and this paper contributes to the field with the following.

Firstly, it utilises a vast database of 129 countries over a time span of 22 years (from the year 2000 to 2021), focusing on the use of macroprudential tools. Full lists of countries as well as variables and sources are provided in Appendix 2 and 3, respectively. This extensive analysis of macroprudential policy application has been enabled by the timing of the study and the invaluable contribution of Alam *et al*. (2019), who have compiled a comprehensive database of country experiences with macroprudential tools and continue to provide regular updates for the IMF. Based on this database – the Integrated Macroprudential Policy (iMaPP) database provided by the IMF, this study analyses the impact of the 16 most commonly used macroprudential tools[3].

Secondly, this study employs two distinct econometric frameworks for analysis: the two-step system Generalized Method of Moments (GMM) as proposed by Arellano & Bond (1991), and propensity score matching. The system GMM method has been extensively used in prior studies (Cerutti *et al*. 2017, Claessens *et al*. 2013, Shim *et al*. 2014, Bruno *et al*. 2016) for assessing the impact of macroprudential tools. In parallel, this research utilises propensity score matching as a complementary analytical framework, an approach endorsed by numerous investigations in the field (Forbes *et al*. 2015, Alam *et al*. 2019, Angrist *et al*. 2018). By comparing these

[3] The iMaPP presents also tools such as Reserve Requirements, typically considered a part of monetary policy. However, as noted by Alam *et al.* (2019), the database focuses on capturing the application of these tools for macroprudential purposes. Distinguishing between these uses is not always straightforward.

methodologies, we aim to conduct a more comprehensive examination of the macroprudential policy impact.

Thirdly, this research broadens its analytical scope to include the effect of macroprudential policy across various exchange rate regimes. Given that exchange rate regimes and monetary policy autonomy carry substantial implications for financial systems, they should accordingly shape both the application and effectiveness of macroprudential policy. Existing evidence suggests that the impact of macroprudential policy may vary across different exchange rate regimes. Some studies, for instance, suggest a weakened effect of macroprudential policy within fixed exchange rate regimes (Nakatani 2020, Ghosh & Kumar 2022), whereas others report contrary findings (Kim & Mehrotra 2022, Ahuja & Nabar 2011). In an effort to scrutinize this relationship further, the present study employs both system GMM and propensity score matching methodologies.

Fourthly, the research further narrows its focus on dollarised economies. In light of the relative scarcity of empirical evidence on this topic, this paper explores the efficacy of macroprudential tools in dollarised economies relative to other regimes. Given the distinctive inability of dollarised economies to utilise monetary policy, the study indirectly examines the implications of this trait on macroprudential policy. Consequently, this work contributes, rather indirectly, to the emerging literature on this topic (Brussiere *et al*. 2020, Nier & Kang 2016, IMF 2012, Kim & Mehrotra 2018).

Finally, the paper undertakes additional analyses to evaluate the performance of dollarised economies in relation to key macroeconomic and financial indicators, focusing especially on inflation and interest rates. This is achieved through a comparative assessment against other exchange rate regimes. For this concluding part of the study, the propensity score matching methodology is employed exclusively.

Access to key financial stability indicators such as credit growth rate, credi-to-GDP ratio, asset prices growth rate, household debt growth rate, and the rate of non-performing loans remains limited. To acquire data for the outcome indicator, rate of credit growth, this study utilises IMF and World Bank data sources, similar to the methodology used by Cerutti *et al*. (2017). The credit growth variable utilised for this study is derived by the calculation of annual growth rates of credit

and subsequently adjusted for inflation based on the Consumer Price Index (CPI)[4]. Whereas existing, though not as comprehensive range of data on the rate of non-performing loans acquired by the World Bank database, is also incorporated as an additional dependent variable in the propensity score matching model for dollarised countries[5]. All data on main variables have been processed and harmonised from various sources, as well as winsorized at the 5% level to reduce bias from outliers.

With respect to dollarisation, this study examines the performance of six dollarised countries: Panama, Ecuador, El Salvador, Kosovo, Montenegro, and Timor-Leste, over a 22-year period, offering an extensive timeframe for assessing dollarisation's effectiveness on financial stability and application of macroprudential policy. The choice of countries is predicated on data available from the primary sources utilised in this paper. Several exhaustive econometric tests are conducted to assess the impact of macroprudential policy and dollarisation.

The study examines macroprudential tools categorized into three major groups and investigates both the tightening and loosening experiences of these tools. The following points detail the various specifications employed in this paper:

1. Comprehensive evaluation of the impact of macroprudential policy on credit growth using a database of 129 countries with data covering 88 quarters (22 years) of macroprudential tools utilisation.

2. Evaluation of the impact of macroprudential policy on credit growth for specific exchange rate regimes. Based on the IMF's Annual Reports on Exchange Arrangements and Exchange Restrictions (AREAER) database, respective exchange rate regimes have been assigned to countries. For the purpose of this study, countries were grouped into six exchange

[4] Further information on macroprudential tools, variables and sources is provided in Appendix 4
[5] Data availability on the rate of non-performing loans is more limited compared to credit growth. Thus, the application could only be possible through propensity score matching method due to data limitation.

rate regime categories: dollarised, currency board arrangement, soft peg[6], residual[7], floating[8], and currency unions[9].

For both frameworks (1) and (2), the following tests are conducted:

a) Evaluation of tightening and loosening macroprudential measures aimed at borrowers, financial institutions, and foreign currencies on credit growth. Both system GMM and propensity score matching models were employed for these tests.

b) Evaluation of tightening and borrowing experiences, individually, for the ten most utilised macroprudential tools. Tests were conducted through the system GMM model.

3. Comparative assessment of the performance of dollarised vis-à-vis five other currency arrangement categories separately, for tightening, loosening experiences, and throughout the 22-year period of study, as well as on additional macroeconomic and financial indicators, namely inflation and interest rates.

4.1 Econometric Frameworks

It has been noted that this study primarily relies on the system GMM methodology to conduct regression analysis for assessing the efficacy of macroprudential policy measures. The choice of this evaluation method was made due to the advantages provided by system GMM in addressing the limitations of panel data regression analysis. Particularly, system GMM is designed to address endogeneity issues arising from explanatory variables and certain unobserved effects. The GMM panel regression proposed by Arellano & Bond (1991) utilises the lagged dependent variable to reduce the bias and endogeneity that could emerge from autocorrelation and heteroskedasticity. As Roodman (2009) argues, the system GMM significantly improves the efficiency of regression results in cases where, among other factors, the data involves a large number of individuals (in this case countries). The system GMM methodology proves effective when the number of individuals is larger compared to the time periods, the dependent variable is influenced by past values, there are

[6] Soft peg arrangements include the following: conventional peg, stabilized arrangement, crawling peg, and pegged exchange rate with horizontal bonds (IMF 2022).
[7] Residual arrangements are other managed arrangements – between soft pegs and floating regimes (IMF 2022).
[8] Floating arrangements include the following: floating and free-floating currency exchange rate arrangements (IMF 2022).
[9] Currency union include the following: the Eurozone and the Central African Franc Zone (IMF 2022).

linear functional relationships, and independent variables are not strictly exogenous[10]. Furthermore, the GMM methodology is complemented by additional tests, like the Sargan or Hansen test, to improve the validity of instruments and address endogeneity and bias.

System GMM is also widely popular among studies that evaluate the efficacy of macroprudential policy measures. The methodology applied in this paper predominantly draws on the significant contributions from the existing literature (Cerutti *et al*. 2017, Claessens *et al*. 2013, Alam *et al*. 2019).

In assessing the efficacy of macroprudential policy measures as well as the performance of dollarised countries in financial indicators, this study employs a complementary evaluation methodology known as propensity score matching. Based on literature findings, propensity score matching represents an alternative methodology that complements methods such as system GMM, used to assess the efficacy of macroprudential policy. This methodology is promoted by scholars such as Claessens *et al*. (2013) as a preferred alternative to control for selection bias that might arise from the GMM methodology and has been recently utilised by Alam *et al*. (2019) for evaluating the impact of macroprudential policy.

Rosenbaum & Rubin (1983) established this matching technique, which involves assigning a statistical control group that never participated in the program to a treatment group, with groups being matched based on their covariates, or characteristics. According to Heinrich *et al*. (2010), propensity score matching has become a popular method that employs algorithm computations to match the treatment and control groups based on unit characteristics. Heckman *et al.* (1998), Blundell & Costa Dias (2000), and Dehejia & Wahba (2002) have extended and improved upon this methodology.

In the specific scenario of assessing macroprudential policy measures, propensity score matching matches countries from the control group (that have not used macroprudential tools) with similar characteristics, based on the sample of the treatment group (that have used macroprudential tools). This enables us to assess how countries that have used macroprudential policy measures have performed in terms of the dependent variable compared to similar countries that have not. It

[10] System GMM analysis in this study have been conducted based in the Stata xtabond2 command, as explained in Roodman (2019).

further allows for a narrow focus on the comparative assessment between dollarisation and other exchange rate regimes, individually. Finally, propensity score matching provides a framework for assessing how dollarised countries that have used macroprudential policies (treatment group) have performed in financial indicators compared to non-dollarised countries that have also used macroprudential policies, both generally and specifically per exchange rate regime.

4.2 System GMM Framework

The first evaluation framework – the system GMM regression estimator is applied to measure the impact of macroprudential policy measures on the main dependent variable – credit growth. This study uses dummy-like variables to measure the impact of macroprudential policy, three specific categories – borrower, financial institution and foreign currency-based. The base regression equation is specified as follows:

$$Y_{i,t} = \alpha Y_{i,t-1} + \sum_{j=1}^{4} \beta_j Borr_{i,t-j} + \sum_{j=1}^{4} \gamma_j Fin_{i,t-j} + \sum_{j=1}^{4} \delta_j For_{i,t-j} + \theta GDPg_{i,t} + \vartheta \log GDPcap_{i,t} + \varphi\, infl_{i,t} + \sigma\, creditGDP_{i,t} + \omega\, exch_{i,t} + \varepsilon_{i,t}, \quad where\ j = 1,2,3\ and\ 4 \qquad (1)$$

where, $Y_{i,t}$ specifies the dependent variable – credit growth, for country i at time t, $Y_{i,t-1}$captures the lagged dependent variable, capturing the dynamic nature of credit growth by the GMM estimator. The three macroprudential grouped measures, $Borr_{i,t-j}$, , $Fin_{i,t-j}$, and $For_{i,t-j}$ are captured in four lagged periods. The remaining part of the regression function presents the five control variables for countries: $GDPg_{i,t}$ – real GDP growth rate, $\log GDPcap$ – logarithmic function of nominal GDP per capita, $infl_{i,t}$ - inflation growth rate measured by CPI, $creditGDP_{i,t}$ – credit-to-GDP ratio, and $exch_{i,t}$ – exchange rate categorisation, as well as $\varepsilon_{i,t}$ – the error term.

Our selection of control variables draws from the literature. The model is designed to capture both structural characteristics, such as nominal GDP and exchange rate, as well as dynamic variables like the real output growth rate, inflation rate, and credit growth rate. Notably, most studies in the field incorporate the real output growth rate as a control variable. Our choice of additional control variables is also influenced by existing literature, notably the works of Richter *et al*. (2019), Cerutti *et al*. (2017), and Forbes *et al*. (2015). While we considered other control

variables, such as real interest rates, they were excluded from the final model due to calibration concerns.

The choice to specify the dependent variable in lagged periods aligns with methodologies employed in prior research, such as Richter *et al*. (2019) and Akinci & Olmsted-Rumsey (2015). These studies compute the dependent variable based on a one-year lag, or four periods, deeming it a sufficient window for macroprudential policy to produce its intended effect. In line with this, our analysis incorporates results from the first to the fourth lagged quarters. Drawing from methodologies in existing literature, we assume that the influence of macroprudential policy wanes after the fourth quarter. To validate this, we performed econometric tests up to six lagged quarters. However, results for quarters beyond the fourth lacked significant findings, and thus aren't detailed in this paper.

The three macroprudential grouped policy measures are treated as count variables, in periods where a new macroprudential policy tool was enforced, the variables take the value 1 (or the sum of measures in cases where more than one policy measure is enforced). All periods are represented in quarters. The choice of variables is determined largely by literature findings on determinants of credit growth, and these variables are included to capture a range of factors that may influence the main dependent variable – credit growth. Separate regression analyses are conducted for tightening and loosening of these macroprudential measures.

Regression tests are conducted based on a two-step Arellano-Bond system GMM, where the 1st and 2nd order of Arellano-Bond tests are used to determine autocorrelation, while the Sargant-Hansen test is used to assess for endogeneity.

The second regression test is conducted to evaluate individual, most utilised, macroprudential tools. Similarly, regression tests are run both for the scenarios where macroprudential tools are tightened and loosened. The second regression equation takes the following form:

$$Y_{i,t} = \alpha\, Y_{i,t-1} + \sum_{j=1}^{4} \beta_j\, MPT_{i,t-j} + \theta GDPg_{i,t} + \vartheta\, \log GDPcap_{i,t} + \varphi\, infl_{i,t} + \sigma\, creditGDP_{i,t} + \omega\, exch_{i,t} + \varepsilon_{i,t},\ \ where\ j = 1,2,3\ and\ 4 \qquad (2)$$

The expression MPT denotes each specific macroprudential instrument k (from the list of 10 most utilised instruments), both in tightened and loosened scenarios separately, by country

experience, at quarter period t. This alteration allows us to differentiate between the impact of specific macroprudential instruments, providing a more precise estimation if specific macroprudential policies affect credit growth and by what magnitude.

Equations (1) and (2) are slightly modified into equations (3) and (4) when examining the impact of macroprudential policy measures across different exchange rate regimes. The exchange rate variable is removed from control variables since the testing is conducted separately for each exchange rate regime. Now the dependent variable – credit growth is denoted as $Y_{ei,t}$, where e represents the exchange rate regime, tested for 6 exchange rates separately. For each exchange rate regime, regression tests are conducted separately, both in instances of grouped macroprudential policy measures (borrower, financial institution and foreign currency based) as well as for specific macroprudential tools (10 most utilised instruments).

$$Y_{ei,t} = \alpha Y_{i,t-1} + \sum_{j=1}^{4} \beta_j Borr_{i,t-j} + \sum_{j=1}^{4} \gamma_j Fin_{i,t-j} + \sum_{j=1}^{4} \delta_j For_{i,t-j} + \theta GDPg_{i,t} + \vartheta \log GDPcap_{i,t} + \varphi\, infl_{i,t} + \sigma\, creditGDP_{i,t} + \varepsilon_{i,t}, \quad where\ j = 1,2,3\ and\ 4 \qquad (3)$$

$$Y_{ei,t} = \alpha\, Y_{i,t-1} + \sum_{j=1}^{4} \beta_j\, MPT_{i,t-j} + \theta\, GDPg_{i,t} + \vartheta \log GDPcap_{i,t} + \varphi\, infl_{i,t} + \sigma\, creditGDP_{i,t} + \varepsilon_{i,t}, \quad where\ j = 1,2,3\ and\ 4 \qquad (4)$$

4.3 The Propensity Score Matching Framework

The propensity score matching econometric framework is applied with several tests for the evaluation of macroprudential policy impact through a comparison between treated and control groups based on the estimation of the average treatment effect on the treated (ATET). This framework is leveraged into different scenarios. To evaluate the propensity score matching, a binary treatment is employed for distinguishing between the use of macroprudential policy tools. Countries are then matched based on values of covariate variables. Finally, the treatment (country with macroprudential measures) and control (countries with no macroprudential measures) groups are compared with regard to two outcome variables – rate of credit growth and rate of

nonperforming loans. The propensity score matching technique is particularly useful in the reduction of selection bias, allowing comparisons across similar entities that have and have not used macroprudential tools.

A basic presentation of the equation for comparing outcome variables between experiences of application of macroprudential policy measures takes the following form:

$$y = \begin{cases} y_1 \; if \; D = 1 \\ y_0 \; if \; D = 0 \end{cases} \qquad (5)$$

In equation (5), the variable y denotes the dependent variable, where two outcome variables are tested separately – credit growth and nonperforming loans. The dummy variable D denotes experiences of countries with specific macroprudential policy measures in effect – where the dummy variable takes the value of 1 when macroprudential measures are enforced and 0 otherwise. In each testing framework, the dummy variable is assigned specifically to three cases – borrower, financial institution, and foreign currency-based macroprudential measures.

The average treatment effect on the treated effect is computed through the following mathematical form:

$$ATET: E(Y_1 - Y_0 |\, p(x), D = 1) = \; E(Y_1 | p(x), D = 1) - E(Y_0 | p(x), D = \; 0) \qquad (6)$$

The propensity score matching, denoted herein as p(x), is a technique used to align or match observations from the respective sample sets of the treated and control groups[11]. This statistical technique of propensity score matching is subsequently employed to associate observations perceived as "comparable", with similar attributes based on covariates, from the treated and control groups. Upon the successful execution of this matching process, comparative analyses of the outcomes from two sample groups are calculated.

To ensure the robustness of our findings, several methods are employed for the implementation of propensity score matching. Specifically, a logit model estimates matches from each treated observation (i.e., country implementing macroprudential policy) with control observations (i.e., countries not implementing macroprudential policy) based on the following propensity scores matching methods:

1. Kernel matching;

[11] Econometric tests for propensity matching estimators have been conducted through the Stata application using the psmatch2 code (Leuven & Sianesi 2003).

2. Nearest-neighbour matching (with 1, 3, and 5 matches);

3. Radius matching (with caliper widths of 0.002, 0.02, and 0.2); and

4. Nonparametric bootstrap estimation.

These matching estimators implement a variety of alignment methodologies between the treatment and control groups. The incorporation of these matching approaches is done to mitigate potential bias and overcome potential limitations from specific techniques, thereby enhancing the validity and reliability of the derived results.

The nearest neighbour estimator presents a straightforward matching methodology in which each observation from the treated group is assigned an observation from the control group based on the matching propensity score (Rubin 1979). In the instance of one, three, and five matches, observations from the treated group are matched with one, three, and five observations, respectively, with the highest propensity score alignment.

Similarly, the radius (also referred to as caliper) matching, utilises propensity ranges, which are derived based on propensity scores, for matching of observations between treatment and control groups. This radius matching technique may serve as a viable alternative to the nearest neighbour technique, particularly in instances where the 'nearest neighbours' between the treated and control groups exhibit minimal similarity (Dehejia & Wahba 2002).

The kernel matching estimators assign weights to estimate matching by comparing each observation from the treated group against the entirety of observations within the control groups (Blundell & Costa Dias, 2005). Consequently, the outcome is compared between two groups based on matching weights, where observations that share greater weights are subject to comparison.

The first testing framework is with a full sample of 129 countries and 88 quarter periods. In this scenario, the propensity score matching is utilised to assess for differences in outcome variables (credit growth and nonperforming loans) between experiences of countries with and without the adoption of macroprudential policies over two consecutive quarters from the full sample of countries and periods.

The second testing framework was designed to examine the impact of macroprudential policies and potential differences across exchange rate regimes. Initially, a selection of units based on specific scenarios was performed, such as those experiencing macroprudential tightening. We then

introduced a dummy variable for dollarisation to evaluate its impact. The analysis was conducted across three distinct scenarios: the application of tightening measures, loosening measures, and the entire 22-year study period. Each scenario was compared against samples from five distinct exchange rate regimes to investigate differences in outcomes.

The variables used as covariates for determining the similarities between treatment and control groups are the same as control variables used in the system GMM framework, namely: real GDP growth rate, the logarithmic function of nominal GDP per capita, inflation rate measured by CPI, and credit-to-GDP ratio.

4.4 Dollarisation Impact on Macroeconomic and Financial Indicators

An alteration of the model is employed when testing for the impact of the impact of dollarisation on financial indicators. In this case, the dummy variable represents whether the country is dollarised or not while the outcome variables represent financial indicators of countries – inflation and interest rates. Finally, the group of covariates is also altered in this exercise. The covariates are slightly adjusted to suit the specific context of this analysis, including the log of GDP per capita, the log of population, GDP growth, and the log of trade.

Initially, a regression is conducted to compute propensity scores, predicting the probability of a country adopting dollarisation given its economic indicators. Following propensity score estimation, we estimate ATET to evaluate the impact of dollarisation on inflation and interest rates. This approach is conducted for the overall sample of 129 countries and 22 years, as well as for specific one-to-one comparisons with other exchange rate regimes, enabling comparisons between comparable countries dollarised and other economies. This extensive examination provides a comprehensive understanding of the impact of dollarisation on financial indicators, highlighting the broader implications of this monetary policy choice.

5 Findings

This chapter presents findings from several econometric tests. Initially, we utilise the system GMM framework to analyse the impact of variations (i.e., tightening and loosening) in three groups of

macroprudential policies and the ten most utilised macroprudential tools on one dependent variable – credit growth rate.

This chapter thus continues with a presentation of results derived from this method. We first provide a comprehensive overview of findings on the implementation and efficacy of macroprudential tools as well as for individual exchange rate regimes. This is followed by comparisons between dollarisation and other exchange rate regimes, including one-to-one evaluations through the propensity score method. We have tested two outcome variables through this framework: credit growth, our main outcome variable, and the rate of non-performing loans. The final part of this chapter focuses on the experience of dollarised countries in terms of financial indicators, particularly inflation and interest rates, compared with other exchange rate regimes.

5.1 Summary of data

Over 129 and 88 quarter periods (from the year 2000 to 2021), countries have more frequently tightened macroprudential tools than they have loosened them. Table 1 displays the frequency of adoption for both tightening and loosening macroprudential policy measures. It first categorizes them into three groups, followed by individual tools. In total, countries have enforced tightening measures 2,424 times, as opposed to 1,047 instances of loosening measures. The measures most frequently used are those targeting financial institutions. These include measures targeting liquidity risk, reserve requirements, conservation, capital requirements, and SIFI for tightening measures. In contrast, the reserve requirements measure is most frequently used among the loosening measures, followed by liquidity risk measures, capital requirements, loan loss provision, and loan-to-value ratios. Among 129 and 88 quarter periods, there have been many more experiences of countries.

Table 1. Summary statistics for application of macroprudential measures.

	Tightening		Loosening	
	Observations	Rel. Frequency	Observations	Rel. Frequency
Borrower based measures	1,825	75%	851	81%
Financial Institution based measures	434	18%	151	14%
Foreign Currency based measures	165	7%	45	4%
Liquidity	432	18%	133	13%
RR	294	12%	306	29%
Conservation	258	11%	71	7%
Capital	227	9%	108	10%
SIFI	210	9%	50	5%

LTV	177	7%	77	7%
LoanR_HH	145	6%	37	4%
LLP	129	5%	96	9%
LFX	126	5%	37	4%
DSTI	112	5%	37	4%
LVR	96	4%	16	2%
Tax	57	2%	20	2%
LoanR_Corp	55	2%	17	2%
CCB	46	2%	22	2%
LFC	39	2%	8	1%
LCG	21	1%	12	1%

We collected a substantial number of observations for our primary dependent variable, the credit growth rate. Out of a potential 11,352 observations, data for 10,557 instances was collected, equivalent to 93% of the time. The data on the credit growth rate was primarily sourced from the value of credit available in the International Financial Statistics (IFS) provided by the IMF. We then converted these values into a quarterly growth rate, which we subsequently deflated using the corresponding inflation rate. The latter was measured through the Consumer Price Index sourced from the World Bank. This substantial dataset establishes a robust basis for conducting regression analysis using the system GMM framework. However, due to data unavailability, the number of observations for the rate of non-performing loans is significantly lower, roughly half of the credit growth rate observations. Consequently, we employ the rate of non-performing loans solely within the propensity score matching framework. Summary statistics for the main variables of interest in this paper are presented in Table 2.

Table 2. Summary statistics for main variables.

	Mean	Median	Min	Max	St. Deviation	Observations
Credit growth rate	7.42	4.89	-15.93	48.24	12.90	10,528
Rate of nonperforming loans	5.93	3.66	0.08	59.76	6.89	5,748
Inflation rate (measured by CPI)	4.70	3.22	-0.92	22.02	4.88	11,004
Real interest rates	5.90	4.81	-9.59	26.33	7.26	7,524
Real GDP growth	3.59	3.76	-6.13	10.92	3.62	11,296
Nominal GDP per capita (logarithmic)	9.27	9.36	6.88	11.18	1.17	11,272
Population (logarithmic)	16.22	16.11	13.12	19.39	1.54	11,352
Trade to GDP ratio (logarithmic)	4.33	4.34	3.29	5.65	0.52	10,984

This study places considerable emphasis on the comparative analysis of different exchange rate regimes, particularly examining the experiences of dollarised economies. Data pertaining to the

various exchange rate regimes is collated and presented in Table 3. It is noteworthy that dollarised economies represent a relatively minor proportion of the data, accounting for approximately 4% of all observations. Conversely, countries operating under soft peg exchange rate regimes constitute the largest share of exchange rate regimes in the dataset, comprising over 31% of the total observations.

Table 3. Number of observations per exchange rate arrangement.

Assigned value	1	2	3	4	5	6
Currency exchange arrangement	Dollarised	Hard Pegs	Soft Pegs	Residual	Floating	Currency Union
Number of observations	444	440	3,476	1,544	3,164	2,056

5.2 General Evaluation of Macroprudential Policy Measures

We evaluated the influence of macroprudential tools on credit growth over four quarters since their inception, employing a two-step System GMM framework. Recognizing that the effects of macroprudential measures are unlikely to manifest immediately, we investigated their impact from the first to the fourth lagged quarter. Our results, outlined in Table 4, reveal that both borrower- and institution-based macroprudential policy measures significantly curb credit growth starting from the first quarter, with the effect being statistically significant at a 5% significance level. However, the influence of these measures diminishes subsequently, with no significant correlation being detected after the first lagged period onwards. This finding suggests that macroprudential measures may initially slow credit growth after their introduction, leading to a subsequent stabilization in the rate of credit growth.

Moreover, we find that measures targeting foreign currencies begin to significantly affect credit growth only after three quarters. Nonetheless, our results indicate that this impact is of lower, 10% statistical significance. Regression analysis further reveals that post-implementation of prudential measures directed at foreign currencies; credit exhibits a noticeable increase. This pattern could be attributed to the timing of these measures' introduction, with credit growth turning negative at a 10% significance level only after three quarters.

Table 4. Summary of two-step system GMM regression results on the impact of macroprudential policy.

TWO-STEP SYSTEM GMM ON MACROPRUDENTIAL POLICY IMPACT						
Evaluation of Macroprudential Policy Measures on Credit Growth						
Variable	Coeff.	S.E.	T-Stat	Coeff.	S.E.	T-Stat

Credit growth L1	0.85	0.02	49.43***[12]	0.85	0.01	61.71***
	TIGHTENING			LOOSENING		
Borrower based L1	-12.09	4.83	-2.50**	-15.93	12.95	-1.23
Borrower based L2	2.74	4.10	0.67	-8.65	10.19	-0.85
Borrower based L3	-5.24	4.44	-1.18	20.58	15.62	1.32
Borrower based L4	6.16	4.46	1.38	-19.25	13.63	-1.41
Fin. Inst. based L1	-3.42	1.33	-2.57**	1.38	1.88	0.74
Fin. Inst. based L2	0.54	1.59	0.34	4.15	2.48	1.67
Fin. Inst. based L3	1.05	1.57	0.67	-4.64	2.76	-1.68
Fin. Inst. based L4	0.60	1.66	0.36	-0.64	3.55	-0.18
For. Currency based L1	29.02	11.99	2.42**	-18.14	16.51	-1.10
For. Currency based L2	0.18	7.45	0.02	-1.19	11.85	-0.10
For. Currency based L3	-21.65	11.46	-1.89*	10.39	13.58	0.77
For. Currency based L4	-14.44	9.52	-1.52	-31.20	24.03	-1.30
GDP growth	0.33	0.06	5.97***	0.29	0.05	5.34***
Credit to GDP ratio	0.00	0.01	-0.16	0.01	0.01	1.33
Log GDP per capita	-0.10	0.17	-0.56	-1.57	0.61	-2.57**
Inflation	-0.13	0.03	-4.35***	-0.24	0.05	-5.23***
Exchange rate	-0.04	0.10	-0.42	-0.02	0.17	-0.10
AB AR(1) Test			0.000			0.000
AB AR(2) Test			0.865			0.452
Sargan Test			0.000			0.000
Hansen Test			0.036			0.017

In contrast to the significant effects seen following the tightening of grouped macroprudential measures, our regression analysis shows that relaxing these measures does not significantly impact credit growth.

Among the control variables, both GDP growth and inflation are highly significant at the 1% level in both tightening and loosening scenarios. Additionally, the log GDP per capita proves significant at the 5% level in the loosening scenario. These findings indicate that credit growth is positively correlated with the GDP growth rate and negatively correlated with inflation. Interestingly, when used as a control variable, the credit-to-GDP ratio doesn't produce any significant results in relation to the real credit growth rate in any scenario.

We performed additional regression analyses to individually assess the influence of each (ten most utilised) macroprudential policy measure on credit growth. Broadly, our findings suggest that individual macroprudential tools produce a relatively limited effect on credit growth. The exceptions are reserve and capital requirements, which effectively curb credit growth, with

[12] Statistical significant is reported as following: * represents a 10% significance level, ** represents and 5% significance, and *** represents 1% significance level.

statistical significance at 5% and 10%, respectively. The effect of reserve requirements becomes apparent four quarters post-implementation, while capital requirements show their effectiveness after two periods. Intriguingly, and in contrast to the existing literature, no other tightening macroprudential measure produces its anticipated effect when applied individually. Regarding loosening measures, we observe that relaxing loan-to-value ratios is the only action that significantly boosts credit growth, at a 5% significance level. Detailed regression results can be found in Appendix 1.

We also attempted to analyse the effect of macroprudential measures on specific exchange rate regimes using the two-step System GMM framework. This was however feasible solely for soft pegs, where the volume of data was sufficient to enable a reliable evaluation. Our results indicate that macroprudential tools might not have been successful in impacting credit growth in soft peg regimes. This aligns with the findings from Ghosh and Kumar (2022) but contradicts those of Ahuja and Nabar (2011). No significant impact on the rate of credit growth is observed among soft peg countries with the application of macroprudential policy, both when considering tightening and loosening of macroprudential tools. However, given our limited data availability for each exchange rate regime, this finding should be approached with caution. Furthermore, the number of observations for soft pegs is smaller compared to the entire sample. This discrepancy could be a factor in the lack of significance in some parameters, even when they seem to align with the broader sample.

We supplement our two-step system GMM framework with a series of regression analyses conducted using propensity score matching. The evaluation initially focuses on the impact of tightening macroprudential measures on credit growth and non-performing loans, followed by the impact of loosening measures. Even though there are fewer observations concerning non-performing loans relative to credit growth, propensity score matching facilitates the evaluation of effectiveness by allowing comparison with comparable units based on covariate characteristics. A summary of results derived from propensity score matching of tightening borrower and financial institution-based macroprudential measures can be found in Table 5, while a complete set of results is available in Appendix 1.

Upon examination of the propensity score matching results, we find a relatively high level of significance in the matching of covariates for evaluating borrower-based measures. Our analysis suggests that countries implementing borrower-based measures have experienced significantly lower levels of non-performing loans—a notable finding, given that it maintains its significance at a 1% level across four out of eight propensity score matching tests, and 5% significance level in additional two tests. We found that the rate of non-performing loans decreased by 0.72 to 2.07 percentage points when borrower-based macroprudential tools were applied. A similar reduction in non-performing loans is observed following the introduction of financial institution-based measures, although the impact is less pronounced compared to borrower-based measures. A less powerful effect is obtained when examining foreign currency-based measures on reduction of non-performing loan rates, yet significant in half of the test (with varying significance levels). However, the propensity score matching does not indicate any significant effect of the implementation of macroprudential policy measures on credit growth rates.

Table 5. Summary of propensity score matching regressions results on the impact of macroprudential policy.

MATCHING ESTIMATOR REGRESSION ON MACROPRUDENTIAL POLICY IMPACT				
Evaluation of Selected Macroprudential Policy Measures				
	BORROWER-BASED (TIGHTENING)		FINANCIAL INSTITUTION -BASE (TIGHTENING)	
Evaluation technique	**Credit Growth**	**Non- Performing Loans**	**Credit Growth**	**Non-Performing Loans**
Kernel	0.82	-6.81***	4.34***	-1.50
	(0.37)	(0.24)	(0.67)	(0.41)
NN-1	1.78*	-1.55	-0.04	-2.42**
	(0.68)	(0.51)	(1.46)	(0.86)
NN-3	2.42**	-2.15**	0.45	-3.20***
	(0.51)	(0.36)	(1.00)	(0.61)
NN-5	2.21**	-2.29**	1.24	-3.30***
	(0.47)	(0.32)	(0.89)	(0.54)
R-0.002	1.48	-3.08***	0.97	-2.94***
	(0.41)	(0.27)	(0.69)	(0.42)
R-0.02	1.80*	-4.40***	1.75	-1.98**
	(0.39)	(0.25)	(0.68)	(0.42)
R-0.2	0.58	-8.61***	4.40***	-1.52
	(0.37)	(0.24)	(0.67)	(0.41)

Bootstrap[13]	0.67	-1.63	0.14	-1.19
	(0.60)	(0.38)	(1.07)	(0.77)

Covariates	z	P>|z|	z	P>|z|
GDP growth	8.18	0.00***	5.46	0.00***
Credit to GDP ratio	3.93	0.00***	-0.19	0.85
Log GDP per capita	6.32	0.00***	-1.18	0.24
Inflation	-0.80	0.42	1.71	0.09

Notes: The table presents selected econometric results derived from the propensity score matching methodology, employed to evaluate the impact of macroprudential policies across a comprehensive sample of countries. The full set of results is presented in Appendix 1. Each specific macroprudential policy (e.g., borrower-based tightening) was assigned a dummy variable. Analyses were separately conducted for two outcome measures: credit growth rates and rates of non-performing loans. The evaluation utilised six distinct techniques: kernel, nearest neighbour matching with 1, 3, and 5 neighbours, radius matching at 0.02%, 0.2%, and 2%, and bootstrap testing. Standard errors are provided in parentheses.

5.3 Dollarisation vis-à-vis other Exchange Rate Regimes

This section provides a summary of key findings derived from a comprehensive propensity score matching framework analysis, assessing the effectiveness of macroprudential measures across dollarisation and other exchange rate regimes. Despite being a largely underexplored area, some studies hint at potential variations in the outcomes of macroprudential policy measures across different exchange rate regimes (Nakatani 2020, Ghosh & Kumar 2022, Kim & Mehrotra 2022). In addition, our study investigates the experience of dollarisation in contrast to other exchange rate regimes concerning key financial indicators.

A comprehensive analysis was undertaken to scrutinize the interaction between macroprudential measures and exchange rate regimes, thereby comparing dollarisation with other regimes. We assessed the impact of macroprudential tools on credit growth and nonperforming loans in the two quarters following their implementation. This time frame was chosen based on tests comparing the effects over one, two, and four quarters post-implementation, where a two-quarter period demonstrated the most significant impact. Initially, dollarisation is compared against all other exchange rate regimes collectively, which is then followed by separate comparisons with currency boards, soft pegs, residual, floating, and currency unions. Table 6 summarizes the results from econometric tests, while a full set of results can be found in Appendix 1.

In our examination of the impact of macroprudential tools, we tested the effects of tightening and loosening measures separately. Our analysis was constrained to these broad categories due to limited

[13] In Bootstrap the corresponding values of significance tests refer to z-values instead of t-stat

experience with the previously used three categories, such as borrower-based tools. We also conducted additional tests to assess the performance of countries with different exchange rate regimes over the entire 22-year period, which allowed us to compare it to the impact derived from specific periods of tightening and loosening macroprudential tool applications.

Our research reveals that dollarised economies implementing tightened macroprudential policies exhibit significantly lower non-performing loan rates compared both to the aggregate of all exchange rate regimes and individually to each regime, with the exception of currency unions. Interestingly, this advantage in non-performing loan rates for dollarised countries persists when assessing the impact of loosening macroprudential tools in comparison with other exchange rate regimes. However, the results are less pronounced when compared against soft pegs and residual exchange rate regimes, indicating a less robust outcome in these cases.

The observed differences in non-performing loan rates between dollarised economies and other exchange rate regimes, following the application of macroprudential policies, may indicate a more stable financial environment under dollarisation. Theories suggest that dollarisation promotes greater financial prudence by eliminating moral hazard. Results obtained also from our analysis of the 22-year period, focusing on non-performing loan rates between dollarised and non-dollarised countries, support this to some extent. Specifically, lower rates in dollarised economies are primarily observed when compared with currency board and residual regimes - to a lesser extent. This suggests that macroprudential policies are particularly effective in dollarised settings, potentially due to enhanced financial discipline.

Conversely, when comparing dollarized economies with those in currency union arrangements, we observe no significant differences in non-performing rates or credit growth across all evaluated scenarios - tightening, loosening, and the entire 22-year study period. This indicates that in terms of these financial indicators, dollarised economies and currency unions exhibit similar performance.

While tightening macroprudential measures do not significantly impact credit growth across different exchange rate regimes, loosening policies in dollarised countries show a tendency towards increased credit growth, especially when compared to floating regimes. On the other hand, when assessed over the 22-year period, dollarised countries exhibit lower credit growth rates compared to those in residual regimes and, to a lesser extent, currency board arrangements.

Table 6. Summary of propensity score matching regressions results.
Application of tightening macroprudential policy measures one-to-one comparisons.

Policy measure	Dollarisation	vs. All	vs. C. Board	vs. Soft Pegs	vs. Residual	vs. Floating	vs. C. Union
Tightening measures	Credit Growth	-[14]	-	-	-	-	-
	Non-performing loans	lower[15]	lower	lower	lower	lower	-

In our final analysis, we evaluate the performance of dollarised countries against other exchange rate regimes based on two macroeconomic and financial indicators – inflation rates (as measured by CPI) and real interest rates. The results are highly significant.

Applying propensity score matching, our findings suggest that dollarised countries consistently outperform all other exchange rate regimes in terms of inflation rates. The robustness of these findings is evident, with a 1% significance level indicating that dollarised economies have experienced lower inflation levels compared to the combined average of all other exchange rate regimes (as detailed in Table 7). On average, dollarised countries have demonstrated lower inflation rates by approximately 2 percentage points (ranging from 1.97 to 2.57, based on our results) when compared against all other exchange rate regimes.

However, the advantage of dollarisation in managing inflation appears less distinct when compared specifically against residual regimes. Though, even in this comparison, dollarisation demonstrates a marginally lower tendency in inflation rates.

Table 7. Summary of propensity score matching regressions results.
Performance on financial indicators one-to-one comparisons.

Outcome variable	vs. All	vs. C. Board	vs. Soft Pegs	vs. Residual	vs. Floating	vs. C. Union
Inflation rate	lower	lower	lower	lower tendency	lower	lower
Interest rate	-	lower	-	-	lower tendency	-

Dollarisation also exhibits favourable outcomes concerning interest rates. In general, dollarisation does not seem to yield distinct outcomes in interest rates when compared to all other

[14] Indicates no observed difference between the two exchange rate regimes.
[15] With higher or lower is defined as the difference between dollarised and respective exchange rate regimes for the specified variable. This is assessed based on the propensity score matching significance tests, in which at least 6 out of 8 tests that were conducted have produced significant results. Detailed results of econometric tests are presented in Appendix 1

exchange rate regimes. However, when compared individually, it becomes evident that dollarised countries have significantly lower interest rates than those with currency boards. Our data indicate that interest rates in dollarised countries have been lower than those in currency board economies, with a range between 2.17 and 5.36 percentage points. Moreover, there is a less pronounced but still noticeable tendency towards lower interest rates in dollarised countries when compared to those with floating rates.

6 Conclusions

This paper assessed the effectiveness of macroprudential policy in pursuit of financial stability. Furthermore, the paper explored the interactions between financial stability, macroprudential policy, dollarisation and exchange rate regimes. Our study contributes to the literature with comprehensive results by examining a large number of countries, extensive timespan of macroprudential application and dollarisation experience, as well as utilisation of two econometric frameworks.

Our empirical analyses provide important insights into the effectiveness of macroprudential measures in curbing credit growth. We find that these measures are most effective when implemented through instruments targeting borrowers and financial institutions. While macroprudential measures appear successful when applied in groups, the impact of individual measures is more limited, except for reserve and capital requirements to some extent. Furthermore, our analysis highlights the limited efficacy of macroprudential policy in soft pegs in dampening credit growth.

Interestingly, our study reveals that dollarised countries have produced superior results towards financial stability indicators in conjunction with macroprudential policies. Our findings reveal that countries that have adopted dollarisation and implemented macroprudential measures experienced lower levels of non-performing loans compared to countries with other exchange rate regimes. Comparison to currency union regimes presents an exception, with no significant difference between the two exchange rate regimes. Moreover, dollarised countries exhibit lower inflation rates and, in some cases, lower interest rates. These findings indicate that the adoption of dollarisation provides additional benefits beyond the effects achieved by the introduction of macroprudential measures.

6.1. Policy Implications

Several key policy implications can be taken from our findings. Overall, to successfully control credit growth and promote financial stability our findings highlight the importance of employing a mix of macroprudential instruments that target both borrowers and financial institutions. Our analysis shows that implementing macroprudential policies using numerous instruments improves their effectiveness.

Furthermore, our findings show that the impact of macroprudential policies is rather immediate once official, with credit growth declining within a quarter of their introduction. In addition, our findings indicate that the observed impact is not enduring over the longer term. This implies that these policies can have an immediate impact on curbing excessive credit expansion, emphasizing the necessity of timely adoption and rigorous monitoring of their effectiveness.

Furthermore, our data show that macroprudential intervention might be ineffective in countries with soft pegs. While this observation is not definitive due to data limitations, further investigation is needed. If confirmed, it could necessitate the adoption of alternative policies to improve financial stability in these exchange rate regimes.

On the contrary, the adoption of dollarisation appears to be a promising strategy for promoting financial stability. Interestingly, our research highlights the significantly positive outcomes associated with dollarised countries in terms of both macroprudential policy implementation and overall financial stability when compared to other exchange rate regimes. The observed "success" of dollarisation in terms of financial indicators prompts further inquiry into its underlying principles. One probable explanation is a lack of moral hazard that emerges due to the inability of dollarised countries to interfere in monetary policy, deterring excessive risk-taking. Another reason could be the absence of currency mismatches in dollarised economies, which may contribute to greater financial stability.

In addition, the observed outcome in financial stability associated with dollarisation could be due to the lack of monetary policy action, which is noted occasionally in the literature. Despite these findings, further research is required to properly understand the long-term ramifications and potential implications of dollarisation. The similarity in performance with currency unions underscores the importance of this inquiry, as both regimes exemplify situations with limited monetary policy

autonomy. Particularly, further research should dig deeper into the underlying mechanisms driving the positive outcomes of dollarisation and explore how policymakers can harness these advantages while addressing any associated challenges.

6.2. Research Limitations

It is important to acknowledge several limitations in this research study. To begin, using dummy variables to describe macroprudential measures results in a simplistic binary form that fails to express the frequency or intensity of these measures. As a result, significant differences in macroprudential policy implementation and efficacy among nations may be neglected. Moreover, the study assumes that the introduction of these measures indicates their implementation as well, without assessing how extensively and successfully they are applied across countries. This limitation generates possible bias as countries may differ in their implementation practices and the effectiveness of their macroprudential frameworks. Future research could incorporate qualitative or quantitative assessments to enhance the analysis and draw more accurate conclusions.

The application of macroprudential tools is often preceded by a pre-announcement, which could accelerate credit growth before the dampening effects take hold post-official enforcement. This study does not investigate these dynamics, as it is based on data from the official application of macroprudential tools. It's worth noting that the timeframe for such pre-announcements can vary.

The system GMM approach, while widely used in the literature, does not allow for assessing the effectiveness of individual exchange rate regimes (apart from soft pegs) for the application of macroprudential tools. Future studies could consider alternative econometric techniques to assess this topic or benefit once more data becomes available. Furthermore, the generalisation of findings to different countries or regions with diverse economic characteristics and institutional frameworks should be taken with caution. The study addresses endogeneity concerns through the use of the system GMM framework, which is designed to address endogeneity issues arising from explanatory variables and certain unobserved effects. On the other hand, methodological limitations of propensity score matching, although commonly used in similar studies, should also be acknowledged. This study employs propensity score matching as a complementary methodology for cross-exchange rate regime analyses.

Data availability presents another limitation of this study. Ideally, incorporating data such as housing prices or non-performing loans would have allowed for a more comprehensive assessment of macroprudential policies and exchange rate regimes. However, data for key financial stability indicators can only be accessed for a limited number of countries, particularly provided by sources such as the Bank for International Settlements (BIS) Databank. Thus, this does not apply to this study as it aimed to provide a more comprehensive analysis of macroprudential policy impact. Nevertheless, leveraging the work of Alam *et al*. (2019), who have broadened access to data regarding the application of macroprudential tools, which provides expansive access to data on macroprudential tools, enabled us to assess the policy impact for a wide range of countries.

Additionally, future research could investigate the relationship between financial dollarisation and the effectiveness of macroprudential measures. Categorizing countries based on their dollarisation levels and assessing the effects of macroprudential policies within these categories could provide deeper insights into the linkages between dollarisation, financial stability, and the effectiveness of policy tools.

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Appendix 1. Detailed Results from Econometric Tests

1 Evaluation of macroprudential tightening policy measures through two-step system GMM for the full sample of countries and for countries with soft peg exchange rate arrangement.

Two-Step System GMM - Evaluation of Macroprudential Policy Tightening Measures on Credit Growth						
	ALL EXCHANGE RATE REGIMES			SOFT PEGS		
Variable	Coeff.	S.E.	T-Stat	Coeff.	S.E.	T-Stat
Credit growth L1	0.85	0.02	49.43***[16]	0.87	0.03	27.99***
T- Borrower based L1	-12.09	4.83	-2.50**	-11.38	4.43	-2.57
T- Borrower based L2	2.74	4.10	0.67	-3.85	4.20	-0.92
T- Borrower based L3	-5.24	4.44	-1.18	8.83	5.47	1.61
T- Borrower based L4	6.16	4.46	1.38	3.48	4.32	0.81
T- Fin. Inst. based L1	-3.42	1.33	-2.57**	-2.81	1.97	-1.43
T- Fin. Inst. based L2	0.54	1.59	0.34	-2.84	2.03	-1.40
T- Fin. Inst. based L3	1.05	1.57	0.67	-0.06	1.90	-0.03
T- Fin. Inst. based L4	0.60	1.66	0.36	2.76	2.37	1.17
T- For. Currency based L1	29.02	11.99	2.42**	-13.99	10.97	-1.28
T- For. Currency based L2	0.18	7.45	0.02	13.68	10.94	1.25
T- For. Currency based L3	-21.65	11.46	-1.89*	10.09	9.58	1.05
T- For. Currency based L4	-14.44	9.52	-1.52	-22.06	13.56	-1.63
GDP growth	0.33	0.06	5.97***	0.31	0.07	4.59***
Credit to GDP ratio	0.00	0.01	-0.16	-0.01	0.01	-0.82
Log GDP per capita	-0.10	0.17	-0.56	-0.05	0.18	-0.29
Inflation	-0.13	0.03	-4.35***	-0.12	0.06	-2.00**
Exchange rate	-0.04	0.10	-0.42			
AB AR(1) Test			0.000			0.008
AB AR(2) Test			0.865			0.026
Sargan Test			0.000			0.000
Hansen Test			0.036			0.539

[16] Statistical significant is reported as following: * represents a 10% significance level, ** represents and 5% significance, and *** represents 1% significance level.

2 Evaluation of macroprudential loosening policy measures through two-step system GMM for the full sample of countries and for countries with soft peg exchange rate arrangement.

Two step system GMM - Evaluation of Macroprudential Policy Loosening Measures on Credit Growth						
	ALL EXCHANGE RATE REGIMES			SOFT PEGS		
Variable	Coeff.	S.E.	T-Stat	Coeff.	S.E.	T-Stat
Credit growth L1	0.85	0.01	61.71***	0.86	0.02	40.99***
L - Borrower based L1	-15.93	12.95	-1.23	6.71	7.83	0.86
L - Borrower based L2	-8.65	10.19	-0.85	16.05	10.43	1.54
L - Borrower based L3	20.58	15.62	1.32	-0.15	7.74	-0.02
L - Borrower based L4	-19.25	13.63	-1.41	3.81	8.50	0.45
L - Fin. Inst. based L1	1.38	1.88	0.74	-0.75	2.09	-0.36
L - Fin. Inst. based L2	4.15	2.48	1.67	0.79	2.15	0.37
L - Fin. Inst. based L3	-4.64	2.76	-1.68	0.33	2.91	0.11
L - Fin. Inst. based L4	-0.64	3.55	-0.18	3.00	4.45	0.68
L - For. Currency based L1	-18.14	16.51	-1.10	-11.86	25.30	-0.47
L - For. Currency based L2	-1.19	11.85	-0.10	6.44	20.34	0.32
L - For. Currency based L3	10.39	13.58	0.77	-28.04	25.50	-1.10
L - For. Currency based L4	-31.20	24.03	-1.30	19.46	24.56	0.79
GDP growth	0.29	0.05	5.34***	0.36	0.08	4.68***
Credit to GDP ratio	0.01	0.01	1.33	0.01	0.02	0.34
Log GDP per capita	-1.57	0.61	-2.57**	-2.08	0.96	-2.17**
Inflation	-0.24	0.05	-5.23***	-0.18	0.06	-3.08***
Exchange rate	-0.02	0.17	-0.10			
AB AR(1) Test			0.000			0.002
AB AR(2) Test			0.452			0.407
Sargan Test			0.000			0.000
Hansen Test			0.017			0.515

3 Evaluation of specific macroprudential policy measures through two-step system GMM for the full sample of countries and for countries with soft peg exchange rate arrangement.

Two-step system GMM - Evaluation of Specific Macroprudential Policy Measures on Credit Growth						
Variable	Coeff.	S.E.	T-Stat	Coeff.	S.E.	T-Stat
	TIGHTENING			LOOSENING		
Credit growth L1	0.84	0.02	46.10***	0.85	0.02	43.08***
Liquidity L1	-3.05	2.29	-1.33	-32.67	16.48	-1.98**
Liquidity L2	-2.41	7.29	-0.33	6.02	17.41	0.35
Liquidity L3	-2.96	7.06	-0.42	18.82	15.97	1.18
Liquidity L4	6.59	7.38	0.89	-19.09	23.20	-0.82
Conservation L1	-10.76	11.87	-0.91	-3.61	17.37	-0.21
Conservation L2	5.18	14.35	0.36	7.93	24.62	0.32
Conservation L3	-5.70	11.24	-0.51	-23.62	34.54	-0.68
Conservation L4	4.16	17.70	0.23	-100.64	97.13	-1.04
SIFI L1	-9.49	10.02	-0.95	15.36	17.18	0.89
SIFI L2	7.17	8.62	0.83	3.85	19.09	0.20
SIFI L3	-0.80	9.59	-0.08	-9.73	33.31	-0.29
SIFI L4	21.84	13.47	1.62	1.60	33.35	0.05
Capital L1	-11.62	14.40	-0.81	20.49	19.65	1.04
Capital L2	-18.18	10.33	-1.76*	-1.41	17.67	-0.08
Capital L3	4.50	11.31	0.40	1.94	25.90	0.08
Capital L4	5.23	12.50	0.42	-36.55	27.87	-1.31
RR L1	-10.15	11.66	-0.87	17.31	12.78	1.35
RR L2	2.48	9.59	0.26	-16.59	15.88	-1.05
RR L3	16.53	13.34	1.24	-26.95	13.30	-2.03**
RR L4	-30.22	14.09	-2.14**	7.04	10.19	0.69
GDP growth	0.38	0.09	4.26***	0.23	0.09	2.62***
Credit to GDP ratio	-0.01	0.01	-0.86	-0.01	0.01	-0.91
Log GDP per capita	-0.01	0.33	-0.04	-0.31	0.22	-1.39
Inflation	-0.14	0.04	-3.22***	-0.12	0.04	-3.08***
Exchange rate	0.01	0.16	0.06	-0.01	0.14	-0.11
AB AR(1) Test			0.001			0.003
AB AR(2) Test			0.723			0.062
Sargan Test			0.000			0.000
Hansen Test			0.024			0.034

Two-step system GMM - Evaluation of Specific Macroprudential Policy Measures on Credit Growth (Continued)

Variable	Coeff.	S.E.	T-Stat	Coeff.	S.E.	T-Stat
		TIGHTENING			LOOSENING	
Credit growth L1	0.86	0.01	60.45***	0.84	0.03	29.53***
LTV L1	-33.07	22.04	-1.50	-25.26	25.77	-0.98
LTV L2	23.53	17.24	1.37	-6.95	26.38	-0.26
LTV L3	-32.19	19.82	-1.62	68.95	32.24	2.14**
LTV L4	20.24	15.29	1.32	3.95	28.16	0.14
LoanR_HH L1	-12.85	16.63	-0.77	-10.85	31.17	-0.35
LoanR_HH L2	6.95	10.90	0.64	-40.17	42.66	-0.94
LoanR_HH L3	15.89	11.57	1.37	-102.37	57.05	-1.79
LoanR_HH L4	-14.29	10.52	-1.36	-17.21	48.15	-0.36
LLP L1	3.40	10.80	0.31	30.00	18.10	1.66
LLP L2	2.88	13.34	0.22	25.21	16.58	1.52
LLP L3	-12.39	10.19	-1.22	22.14	24.57	0.90
LLP L4	-7.54	11.13	-0.68	-35.41	43.20	-0.82
LFX L1	30.19	15.41	1.96**	-19.76	24.39	-0.81
LFX L2	-1.13	11.10	-0.10	-18.13	25.48	-0.71
LFX L3	-7.89	14.47	-0.55	-44.70	31.56	-1.42
LFX L4	-16.27	11.25	-1.45	-24.55	47.38	-0.52
DSTI L1	26.69	20.81	1.28	-34.98	28.42	-1.23
DSTI L2	-15.77	21.13	-0.75	-55.92	41.30	-1.35
DSTI L3	11.83	17.24	0.69	-42.65	35.38	-1.21
DSTI L4	8.76	18.57	0.47	-27.07	36.26	-0.75
GDP growth	0.32	0.06	4.93***	0.37	0.11	3.25***
Credit to GDP ratio	0.00	0.01	0.12	0.00	0.01	-0.09
Log GDP per capita	-0.24	0.19	-1.24	-0.17	0.38	-0.45
Inflation	-0.14	0.04	-3.71***	-0.10	0.06	-1.81*
Exchange rate	-0.06	0.10	-0.58	-0.31	0.22	-1.40
AB AR(1) Test			0.007			0.049
AB AR(2) Test			0.129			0.189
Sargan Test			0.000			0.000
Hansen Test			0.090			0.039

4 Evaluation of tightening macroprudential policy measures through propensity score matching for the full sample of countries[17]

Regression Matching Estimator Impact of Macroprudential Policy on Credit Growth and Nonperforming Loans																		
Borrower-based (Tightening)							**Financial Institution-based (Tightening)**						**Foreign Currency-based (Tightening)**					
Covariates			z		P>|z|		z		P>|z|				z		P>|z|			
GDP growth			8.18		0.00***		5.46		0.00***				8.07		0.00***			
Credit to GDP ratio			3.93		0.00***		-0.19		0.85				0.15		0.88			
Log GDP per capita			6.32		0.00***		-1.18		0.24				9.50		0.00***			
Inflation			-0.80		0.42		1.71		0.09*				9.50		0.00***			
Evaluation technique	Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	0.30	0.37	0.82	-1.65	0.24	-6.81***	2.92	0.67	4.34***	-0.62	0.41	-1.50	-0.18	0.30	-0.59	-0.62	0.22	-2.87***
NN-1	1.21	0.68	1.78*	-0.79	0.51	-1.55	-0.05	1.46	-0.04	-2.09	0.86	-2.42**	0.67	0.51	1.33	-0.53	0.41	-1.28
NN-3	1.22	0.51	2.42**	-0.77	0.36	-2.15**	0.45	1.00	0.45	-1.95	0.61	-3.20***	0.81	0.38	2.12**	-0.45	0.29	-1.55
NN-5	1.03	0.47	2.21**	-0.72	0.32	-2.29**	1.11	0.89	1.24	-1.77	0.54	-3.30***	0.76	0.36	2.09**	-0.52	0.26	-1.99**
R-0.002	0.61	0.41	1.48	-0.83	0.27	-3.08***	0.66	0.69	0.97	-1.24	0.42	-2.94***	0.19	0.32	0.60	-0.30	0.23	-1.32
R-0.02	0.69	0.39	1.80*	-1.11	0.25	-4.40***	1.18	0.68	1.75	-0.82	0.42	-1.98**	0.08	0.31	0.27	-0.38	0.22	-1.73*
R-0.2	0.21	0.37	0.58	-2.07	0.24	-8.61***	2.97	0.67	4.40***	-0.63	0.41	-1.52	-0.29	0.30	-0.96	-0.94	0.21	-4.37***
Bootstrap[18]	0.40	0.60	0.67	-0.63	0.38	-1.63	0.15	1.07	0.14	-0.92	0.77	-1.19	0.35	0.43	0.82	-0.26	0.28	-0.91

[17] Specific macroprudential policy (e.g., borrower-based tightening) was assigned a dummy variable. Analyses were separately conducted for two outcome measures: credit growth rates and rates of non-performing loans. The evaluation utilised six distinct techniques: kernel, nearest neighbour matching with 1, 3, and 5 neighbours, radius matching at 0.02%, 0.2%, and 2%, and bootstrap testing.

[18] In Bootstrap the corresponding values of significance tests refer to z-values instead of t-stat

5 Evaluation of loosening macroprudential policy measures through propensity score matching for the full sample of countries

Regression Matching Estimator Impact of Macroprudential Policy on Credit Growth and Nonperforming Loans																		
Borrower-based (Loosening)							**Financial Institution-based (Loosening)**						**Foreign Currency-based (Loosening)**					
Covariates			z		P>|z|		z		P>|z|			z		P>|z|		
GDP growth			-0.48		0.63		4.98		0.00***				-14.56		0.00***			
Credit to GDP ratio			2.57		0.01**		1.55		0.12				0.61		0.54			
Log GDP per capita			2.92		0.00***		-0.29		0.78				0.56		0.58			
Inflation			-0.93		0.35		-0.72		0.47				2.00		0.05**			
Evaluation technique	Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	-0.84	0.49	-1.71*	-2.63	0.22	-12.04***	0.99	0.81	1.22	-0.74	0.72	-1.03	0.35	0.40	0.87	-0.67	0.33	-2.05**
NN-1	0.46	0.85	0.54	-0.63	0.44	-1.43	-1.76	2.30	-0.76	-1.61	1.66	-0.97	0.14	0.91	0.15	-0.76	0.69	-1.10
NN-3	0.54	0.64	0.85	-1.22	0.39	-3.11***	0.00	1.36	0.00	-1.25	1.11	-1.13	0.43	0.66	0.66	-0.96	0.49	-1.95*
NN-5	0.29	0.63	0.46	-1.83	0.39	-4.64***	0.98	1.11	0.88	-1.09	0.95	-1.15	0.04	0.58	0.07	-1.03	0.44	-2.35**
R-0.002	0.49	0.50	0.98	-2.07	0.23	-8.92***	-1.40	0.86	-1.64	-0.85	0.74	-1.15	0.09	0.48	0.19	-1.11	0.37	-3.01***
R-0.02	0.10	0.49	0.19	-2.17	0.22	-9.78***	-0.30	0.82	-0.37	-0.54	0.72	-0.75	0.13	0.44	0.30	-0.96	0.34	-2.78***
R-0.2	-0.96	0.49	-1.97**	-2.69	0.22	-12.32***	1.03	0.81	1.27	-0.76	0.72	-1.06	-0.23	0.39	-0.58	-0.40	0.32	-1.27
Bootstrap	-1.44	0.79	-1.81*	-0.41	0.60	-0.68	-0.18	1.98	-0.09	-1.16	1.30	-0.89	0.11	0.63	0.18	-1.40	0.53	-2.63***

6 Evaluation of macroprudential policy measures through propensity score matching for dollarised vs. non-dollarised countries[19]

Regression Matching Estimator Impact of Macroprudential Policy on Credit Growth and Nonperforming Loans – DOLLARISATION VS ALL																		
TIGHTENING MEASURES							**LOOSENING MEASURES**						**ALL PERIODS**					
Covariates			z			P>|z|	z			P>|z|			z			P>|z|		
GDP growth			4.40			0.00***	7.50			0.00***			3.33			0.00***		
Credit to GDP ratio			-1.16			0.25	-1.29			0.20			-5.24			0.00***		
Log GDP per capita			-2.34			0.02**	-3.30			0.00***			-5.51			0.00***		
Inflation			-4.40			0.00***	-6.83			0.00***			-11.28			0.00***		
Evaluation technique	Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	2.00	0.67	2.99***	-2.03	0.26	-7.69***	2.61	0.81	3.23***	-3.28	0.42	-7.89***	0.75	0.66	1.13	-1.07	0.28	-3.76***
NN-1	-0.42	1.83	-0.23	-0.51	0.60	-0.86	3.33	1.66	2.01**	-2.45	1.29	-1.89*	-5.01	1.64	-3.05***	-1.14	0.68	-1.69*
NN-3	0.06	1.13	0.05	-0.78	0.47	-1.67*	1.17	1.28	0.92	-1.25	0.58	-2.15**	-4.69	1.06	-4.42***	-1.14	0.44	-2.57**
NN-5	0.15	0.99	0.15	-1.02	0.44	-2.30**	1.63	1.12	1.46	-1.98	0.66	-2.99***	-3.57	0.95	-3.76***	-1.18	0.40	-2.98***
R-0.002	2.12	0.76	2.79***	-2.93	0.43	-6.90***	4.19	1.66	2.52**	-6.28	1.36	-4.63***	-0.20	0.70	-0.29	-1.51	0.33	-4.63***
R-0.02	1.05	0.69	1.52	-2.28	0.29	-7.76***	2.13	0.93	2.30**	-3.54	0.58	-6.10***	-0.19	0.68	-0.28	-1.45	0.30	-4.78***
R-0.2	2.08	0.67	3.11***	-2.07	0.26	-7.88***	2.61	0.76	3.45***	-3.44	0.35	-9.91***	1.14	0.66	1.74*	-0.94	0.28	-3.35***
Bootstrap	-2.65	2.16	-1.23	-3.17	1.18	-2.68***	-1.59	3.01	-0.53	-2.45	2.11	-1.16	-2.43	1.37	-1.77*	-2.77	0.78	-3.57***

[19] Specific macroprudential policy (e.g., borrower-based tightening) and dollarisation was assigned a dummy variable.

7 Evaluation of macroprudential policy measures through propensity score matching for dollarised vs. currency board arrangements

Regression Matching Estimator Impact of Macroprudential Policy on Credit Growth and Nonperforming Loans – DOLLARISATION VS CURRENCY BOARD																		
TIGHTENING MEASURES							**LOOSENING MEASURES**						**ALL PERIODS**					
Covariates			z			P>|z|	z			P>|z|			z			P>|z|		
GDP growth			3.06			0.00***	5.46			0.00***			4.39			0.00***		
Credit to GDP ratio			-1.46			0.14	0.25			0.80			-3.41			0.00***		
Log GDP per capita			-4.22			0.00***	-4.35			0.00***			-9.20			0.00***		
Inflation			-1.75			0.08*	-4.03			0.00***			-1.88			0.06*		
Evaluation technique	Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	1.62	1.71	0.95	-3.71	0.95	-3.90***	3.09	2.31	1.33	-3.40	0.93	-3.66***	-2.06	1.19	-1.73*	-2.64	0.73	-3.63***
NN-1	0.93	3.49	0.27	-4.13	1.82	-2.26**	-0.47	5.05	-0.09	-3.61	1.35	-2.67***	-5.57	3.59	-1.55	-1.30	1.65	-0.79
NN-3	0.45	2.05	0.22	-3.31	1.08	-3.06***	4.07	3.20	1.27	-3.60	0.74	-4.83***	-5.21	1.99	-2.62***	-1.30	0.96	-1.35
NN-5	1.85	1.71	1.08	-3.95	0.90	-4.39***	3.12	2.74	1.14	-3.51	0.72	-4.84***	-4.42	1.73	-2.56**	-1.61	0.86	-1.87*
R-0.002	2.71	2.42	1.12	-6.96	1.34	-5.20***	8.63	3.06	2.82***	-5.11	2.02	-2.53**	17.32	4.44	3.90***	-6.25	0.98	-6.35***
R-0.02	1.82	2.08	0.87	-5.00	1.08	-4.62***	0.73	3.11	0.23	-3.19	0.94	-3.40***	-3.09	1.42	-2.17**	-1.47	0.86	-1.71*
R-0.2	4.34	1.35	3.21***	-4.49	0.73	-6.15***	4.29	1.93	2.22**	-3.56	0.76	-4.65***	1.58	1.00	1.58	-4.25	0.58	-7.31***
Bootstrap	-0.56	3.15	-0.18	-4.13	1.25	-3.31***	-3.60	3.08	-1.17	-3.61	0.88	-4.08***	-2.63	2.21	-1.19	-1.30	0.64	-2.05**

8 Evaluation of macroprudential policy measures through propensity score matching for dollarised vs. soft peg arrangements

Regression Matching Estimator Impact of Macroprudential Policy on Credit Growth and Nonperforming Loans – DOLLARISATION VS SOFT PEGS																		
TIGHTENING MEASURES							**LOOSENING MEASURES**						**ALL PERIODS**					
Covariates			z			P>|z|	z			P>|z|			z			P>|z|		
GDP growth			3.77			0.00***	5.80			0.00***			2.55			0.01**		
Credit to GDP ratio			-3.61			0.00***	-2.89			0.00***			-6.15			0.00***		
Log GDP per capita			1.82			0.07*	0.29			0.77			0.83			0.40		
Inflation			-2.78			0.01***	-5.40			0.00***			-9.31			0.00***		
Evaluation technique	Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	0.36	0.77	0.47	-1.56	0.33	-4.79***	0.94	1.24	0.76	-1.78	0.92	-1.94*	-1.01	0.72	-1.39	-0.59	0.35	-1.71*
NN-1	0.99	2.03	0.49	-2.13	0.76	-2.78***	1.06	1.93	0.55	-1.00	1.69	-0.59	-1.20	1.29	-0.92	-0.09	0.59	-0.15
NN-3	-1.55	1.27	-1.22	-1.17	0.49	-2.40**	0.88	1.28	0.69	-0.47	0.89	-0.53	-1.68	0.98	-1.72	-0.09	0.40	-0.22
NN-5	-1.98	1.16	-1.71*	-0.79	0.42	-1.87*	0.72	1.30	0.55	-1.04	0.75	-1.40	-1.56	0.88	-1.77*	-0.28	0.37	-0.75
R-0.002	-0.54	1.28	-0.42	-2.00	0.57	-3.52***	1.26	1.81	0.70	-2.41	0.97	-2.49**	-0.76	0.88	-0.86	-0.47	0.38	-1.24
R-0.02	0.10	0.81	0.13	-1.59	0.38	-4.23***	0.57	1.30	0.44	-1.40	0.61	-2.29**	-1.06	0.76	-1.39	-0.50	0.38	-1.33
R-0.2	0.79	0.75	1.06	-1.35	0.30	-4.44***	0.72	1.13	0.63	-1.94	0.81	-2.39**	-0.75	0.71	-1.07	-0.63	0.33	-1.93*
Bootstrap	-5.15	2.26	-2.28**	-2.13	1.31	-1.62	-6.85	2.77	-2.47**	-1.00	1.26	-0.79	-2.76	1.35	-2.05**	-0.94	0.67	-1.40

9 Evaluation of macroprudential policy measures through propensity score matching for dollarised vs. residual arrangements

Regression Matching Estimator Impact of Macroprudential Policy on Credit Growth and Nonperforming Loans – DOLLARISATION VS RESIDUAL																		
TIGHTENING MEASURES							**LOOSENING MEASURES**						**ALL PERIODS**					
Covariates			z		P>|z|		z		P>|z|			z		P>|z|			
GDP growth			2.87		0.00***		4.41		0.00***				0.88		0.38			
Credit to GDP ratio			-4.85		0.00***		-4.72		0.00***				-7.19		0.00***			
Log GDP per capita			4.15		0.00***		3.41		0.00***				5.06		0.00***			
Inflation			-6.63		0.00***		-5.94		0.00***				-12.33		0.00***			
Evaluation technique	Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	-0.52	1.60	-0.32	-2.09	0.84	-2.47***	-8.54	4.53	-1.88*	-2.15	2.58	-0.83	-3.39	1.31	-2.58**	-1.03	0.59	-1.74*
NN-1	-7.20	4.63	-1.55	-0.75	1.18	-0.64	-10.91	7.65	-1.43	-2.34	1.42	-1.65*	-5.95	3.11	-1.92**	-0.09	1.10	-0.08
NN-3	-1.62	2.24	-0.73	-1.57	0.77	-2.02**	-9.81	5.48	-1.79*	-2.10	0.85	-2.46**	-6.31	1.89	-3.34***	-0.09	0.67	-0.14
NN-5	-1.25	1.81	-0.69	-1.90	0.69	-2.76***	-4.61	5.06	-0.91	-2.38	0.81	-2.94***	-4.76	1.57	-3.03***	-0.26	0.58	-0.46
R-0.002	3.13	2.51	1.25	-1.77	0.92	-1.91*	-24.28	NA	NA	-9.59	NA	NA	-4.18	2.01	-2.07**	-3.64	0.78	-4.69***
R-0.02	-2.35	1.91	-1.23	-2.21	0.70	-3.15***	-9.82	5.98	-1.64	-2.72	1.11	-2.46**	-3.94	1.41	-2.79***	-1.14	0.56	-2.05**
R-0.2	-0.47	1.49	-0.32	-2.17	0.77	-2.81***	-5.58	4.45	-1.25	-2.58	2.59	-0.99	-3.73	1.19	-3.15***	-1.18	0.53	-2.23**
Bootstrap	-6.29	2.73	-2.30**	-0.75	1.13	-0.67	-5.66	3.56	-1.59	-2.34	1.27	-1.84*	-6.29	2.20	-2.85***	-0.09	0.70	-0.13

10 Evaluation of macroprudential policy measures through propensity score matching for dollarised vs. floating arrangements

Regression Matching Estimator Impact of Macroprudential Policy on Credit Growth and Nonperforming Loans – DOLLARISATION VS FLOATING																		
TIGHTENING MEASURES							**LOOSENING MEASURES**						**ALL PERIODS**					
Covariates			z			P>|z|	z			P>|z|			z			P>|z|		
GDP growth			4.93			0.00***	6.98			0.00***			3.28			0.00***		
Credit to GDP ratio			0.63			0.53	0.84			0.40			-3.62			0.00***		
Log GDP per capita			-2.87			0.00***	-2.37			0.02**			-5.11			0.00***		
Inflation			-5.27			0.00***	-6.99			0.00***			-12.47			0.00***		
Evaluation technique	Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	1.31	0.74	1.78*	-1.16	0.35	-3.35***	2.64	1.13	2.33**	-1.83	0.78	-2.34**	0.19	0.71	0.27	-0.62	0.33	-1.88*
NN-1	1.25	2.47	0.51	-1.14	0.93	-1.22	0.70	1.91	0.37	-1.23	0.78	-1.57	0.71	1.30	0.55	-0.51	0.72	-0.71
NN-3	0.39	1.55	0.25	-1.03	0.52	-1.99**	1.81	1.22	1.49	-1.41	0.68	-2.07**	0.36	0.94	0.38	-0.51	0.46	-1.09
NN-5	0.42	1.17	0.36	-1.07	0.43	-2.46**	2.38	1.11	2.13**	-1.46	0.67	-2.17**	-0.24	0.86	-0.28	-0.38	0.41	-0.94
R-0.002	2.23	1.30	1.71*	-1.23	0.52	-2.35**	3.84	1.63	2.36**	-1.63	0.67	-2.41**	0.40	0.93	0.43	0.07	0.41	0.17
R-0.02	0.90	0.88	1.02	-1.13	0.50	-2.25**	1.36	1.30	1.05	-1.30	0.56	-2.33**	0.14	0.75	0.19	-0.86	0.37	-2.33**
R-0.2	1.72	0.71	2.40**	-1.26	0.32	-3.96***	2.73	0.96	2.85***	-1.88	0.60	-3.13***	0.37	0.69	0.53	-0.27	0.31	-0.88
Bootstrap	-2.17	1.97	-1.10	-1.14	0.96	-1.19	-0.85	3.45	-0.24	-1.23	1.06	-1.16	-2.12	1.56	-1.36	-0.51	0.76	-0.67

11 Evaluation of macroprudential policy measures through propensity score matching for dollarised vs. currency unions

Regression Matching Estimator Impact of Macroprudential Policy on Credit Growth and Nonperforming Loans – DOLLARISATION VS CURRENCY UNION																		
TIGHTENING MEASURES							**LOOSENING MEASURES**						**ALL PERIODS**					
Covariates			z			P>|z|	z			P>|z|			z			P>|z|		
GDP growth			3.31			0.00	5.36			0.00				3.98			0.00***		
Credit to GDP ratio			-1.23			0.22	-2.29			0.02				-3.78			0.00***		
Log GDP per capita			-8.34			0.00	-6.30			0.00				-12.33			0.00***		
Inflation			-2.68			0.01	-5.50			0.00				-4.24			0.00***		
Evaluation technique	Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans			Credit Growth			Non- Performing Loans		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	0.36	2.10	0.17	-1.53	3.03	-0.50	3.05	2.88	1.06	-3.08	3.47	-0.89	0.90	2.62	0.35	1.39	3.08	0.45
NN-1	-1.58	4.47	-0.35	-3.48	5.35	-0.65	0.93	6.02	0.15	-2.71	4.68	-0.58	-7.66	7.64	-1.00	0.60	11.61	0.05
NN-3	1.29	2.38	0.54	-2.89	3.08	-0.94	6.05	3.85	1.57	-3.75	5.03	-0.74	-1.48	3.76	-0.39	0.60	6.50	0.09
NN-5	3.35	2.09	1.60	-2.26	2.45	-0.92	6.24	3.21	1.94*	-3.26	4.31	-0.76	0.27	2.76	0.10	0.85	4.80	0.18
R-0.002	8.91	2.12	4.21***	-21.40	6.32	-3.38***	-5.47	7.00	-0.78	-0.65	0.20	-3.31***	6.13	1.87	3.29***	-8.20	1.78	-4.61***
R-0.02	3.15	1.92	1.64	-3.83	2.26	-1.69	-3.94	4.83	-0.82	-2.12	6.22	-0.34	3.19	1.30	2.45**	-4.72	1.32	-3.57***
R-0.2	-0.25	2.27	-0.11	-1.43	3.30	-0.43	3.39	2.83	1.20	-3.02	3.41	-0.88	0.99	2.58	0.38	1.40	3.04	0.46
Bootstrap	-2.46	2.24	-1.10	-3.48	2.08	-1.68	4.11	2.42	1.70*	-2.71	2.25	-1.20	1.89	1.42	1.33	0.60	0.57	1.05

12 Evaluation of inflation and interest rates through propensity score matching for dollarised vs. other currency exchange arrangements

Regression Matching Estimator Impact of Dollarisation on Inflation and Interest Rates																		
	Dollarisation vs all						Dollarisation vs. Currency Board						Dollarisation vs. Soft Peg					
Covariates			z		P>|z|			z		P>|z|			z		P>|z|	
GDP growth			3.57		0.00***			4.64		0.00***			3.41		0.00***			
Log of population			-15.36		0.00***			-8.11		0.00***			-10.71		0.00***			
Log GDP per capita			0.72		0.47			-7.08		0.00***			2.33		0.02**			
Log of trade			0.88		0.38			1.29		0.20			-1.03		0.31			
Evaluation technique	Inflation			Interest Rates			Inflation			Interest Rates			Inflation			Interest Rates		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	-2.30	0.22	-10.35***	0.14	0.31	0.45	-2.09	0.31	-6.75***	-2.91	0.62	-4.69***	-1.99	0.24	-8.40***	-0.21	0.34	-0.63
NN-1	-2.55	0.58	-4.43***	-0.47	1.17	-0.40	-1.25	0.78	-1.60	-5.36	2.19	-2.44**	-1.38	0.48	-2.86***	0.43	1.08	0.40
NN-3	-2.55	0.37	-6.83***	-0.47	0.72	-0.66	-1.25	0.48	-2.62***	-5.36	1.28	-4.20***	-1.38	0.33	-4.22***	0.43	0.66	0.65
NN-5	-2.39	0.32	-7.39***	-0.53	0.59	-0.89	-1.46	0.40	-3.65***	-4.65	1.00	-4.65***	-1.45	0.30	-4.86***	0.38	0.57	0.68
R-0.002	-2.42	0.25	-9.51***	-0.11	0.41	-0.26	-2.40	0.44	-5.50***	-1.25	0.84	-1.48	-1.48	0.28	-5.26***	0.88	0.47	1.89*
R-0.02	-1.97	0.24	-8.24***	-0.35	0.34	-1.03	-2.53	0.28	-8.98***	-2.17	0.66	-3.30***	-1.62	0.26	-6.37***	-0.04	0.38	-0.11
R-0.2	-2.57	0.22	-11.70***	0.15	0.31	0.50	-1.70	0.29	-5.86***	-2.21	0.56	-3.92***	-2.26	0.23	-9.70***	-0.25	0.33	-0.74
Bootstrap	-0.47	0.64	-0.72	0.76	0.90	0.84	-0.30	0.40	-0.74	-2.29	1.03	-2.23**	-1.44	0.60	-2.39**	-0.63	1.22	-0.52

Regression Matching Estimator Impact of Dollarisation on Inflation and Interest Rates																		
	Dollarisation vs. Residual						Dollarisation vs. Floating						Dollarisation vs. Currency Union					
Covariates			z		P>|z|			z		P>|z|			z		P>|z|	
GDP growth			1.04		0.30			1.52		0.13			4.39		0.00***			
Log of population			-14.42		0.00***			-14.64		0.00***			-12.16		0.00***			
Log GDP per capita			5.28		0.00***			-0.78		0.44			6.79		0.00***			
Log of trade			-0.34		0.73			7.01		0.00***			-3.46		0.00***			
Evaluation technique	Inflation			Interest Rates			Inflation			Interest Rates			Inflation			Interest Rates		
	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat	Diff.	S.E.	T-stat
Kernel	-2.36	0.46	-5.09***	-0.95	0.68	-1.41	-4.68	0.44	-10.65***	-3.60	0.70	-5.15***	-1.18	0.30	-3.93***	-0.03	0.51	-0.06
NN-1	-0.40	1.87	-0.21	-2.01	3.57	-0.56	-4.96	2.16	-2.29**	-4.00	3.05	-1.31	-0.67	0.78	-0.86	0.50	1.82	0.27
NN-3	-0.40	1.07	-0.37	-2.01	2.03	-0.99	-4.96	1.24	-4.00***	-4.00	1.75	-2.29**	-0.67	0.48	-1.41	0.50	1.06	0.47
NN-5	-1.26	0.89	-1.42	-1.30	1.61	-0.81	-5.07	0.95	-5.33***	-3.94	1.31	-3.00***	-0.88	0.42	-2.09**	0.12	0.93	0.13
R-0.002	-0.95	0.68	-1.41	0.33	1.42	0.23	-7.08	0.74	-9.54***	-0.15	0.93	-0.16	-1.11	0.55	-2.02**	-1.77	1.44	-1.23
R-0.02	-2.19	0.60	-3.66***	0.28	0.93	0.30	-7.32	0.53	-13.86***	-2.29	0.92	-2.48**	-1.34	0.40	-3.31***	1.00	0.83	1.21
R-0.2	-3.69	0.36	-10.35***	-1.87	0.51	-3.68***	-3.32	0.33	-9.93***	-2.90	0.51	-5.67***	-1.09	0.27	-4.05***	0.02	0.44	0.04
Bootstrap	-4.19	0.70	-6.03***	0.57	1.99	0.29	-2.34	0.91	-2.55**	-1.61	1.44	-1.12	0.82	0.36	2.25**	-0.71	1.43	-0.50

Appendix 2. List of Countries Examined

Nr.	Country	Nr.	Country	Nr.	Country	Nr.	Country
1	Angola	34	Denmark	67	Korea, Rep.	100	Portugal
2	Albania	35	Dominican Republic	68	Kuwait	101	Paraguay
3	United Arab Emirates	36	Algeria	69	Lao PDR	102	Romania
4	Argentina	37	Ecuador	70	Lebanon	103	Russian Federation
5	Armenia	38	Spain	71	Sri Lanka	104	Saudi Arabia
6	Australia	39	Estonia	72	Lesotho	105	Sudan
7	Austria	40	Ethiopia	73	Lithuania	106	Senegal
8	Azerbaijan	41	Finland	74	Luxembourg	107	Singapore
9	Burundi	42	Fiji	75	Latvia	108	Solomon Islands
10	Belgium	43	France	76	Morocco	109	El Salvador
11	Benin	44	United Kingdom	77	Moldova	110	Serbia
12	Burkina Faso	45	Georgia	78	Mexico	111	Slovak Republic
13	Bangladesh	46	Ghana	79	North Macedonia	112	Slovenia
14	Bulgaria	47	Gambia, The	80	Mali	113	Sweden
15	Bahrain	48	Guinea-Bissau	81	Malta	114	Togo
16	Bosnia and Herzegovina	49	Greece	82	Montenegro	115	Thailand
17	Belarus	50	Hong Kong SAR, China	83	Mongolia	116	Tajikistan
18	Brazil	51	Honduras	84	Mozambique	117	United States
19	Brunei Darussalam	52	Croatia	85	Mauritania	118	Timor-Leste
20	Bhutan	53	Haiti	86	Mauritius	119	Tunisia
21	Botswana	54	Hungary	87	Malaysia	120	Turkiye
22	Canada	55	Indonesia	88	Niger	121	Tanzania
23	Switzerland	56	India	89	Nigeria	122	Uganda
24	Chile	57	Ireland	90	Netherlands	123	Ukraine
25	China	58	Israel	91	Norway	124	Uruguay
26	Cote d'Ivoire	59	Italy	92	Nepal	125	Vietnam
27	Congo, Dem. Rep.	60	Jamaica	93	New Zealand	126	Kosovo
28	Colombia	61	Jordan	94	Oman	127	Yemen, Rep.
29	Cabo Verde	62	Japan	95	Pakistan	128	South Africa
30	Costa Rica	63	Kazakhstan	96	Panama	129	Zambia
31	Cyprus	64	Kenya	97	Peru		
32	Czechia	65	Kyrgyz Republic	98	Philippines		
33	Germany	66	Cambodia	99	Poland		

Appendix 3. List of Macroprudential Policy Instruments Examined

Nr.	Policy Instrument	Abbreviation	Categorisation
1	Loan to value ratios	LTV	Borrower based measures
2	Loan restrictions Household	LoanR_HH	Borrower based measures
3	Debt service to income	DSTI	Borrower based measures
4	Liquidity	Liquidity	Financial Institution based measures
5	Reserve requirements	RR	Financial Institution based measures
6	Conservation	Conservation	Financial Institution based measures
7	Capital	Capital	Financial Institution based measures
8	Systemically important financial institutions	SIFI	Financial Institution based measures
9	Loan loss provision	LLP	Financial Institution based measures
10	Limit on leverage of banks	LVR	Financial Institution based measures
11	Tax	Tax	Financial Institution based measures
12	Loan restrictions to corporate sector	LoanR_Corp	Financial Institution based measures
13	Countercyclical buffer	CCB	Financial Institution based measures
14	Limits on credit growth	LCG	Financial Institution based measures
15	Limits on foreign exchange	LFX	Foreign Currency based measures
16	Limits on Foreign Currency	LFC	Foreign Currency based measures

Appendix 4. Variables and Sources

Variable name	Abbreviation	Definition	Source
Countercyclical buffer	CCB	Countercyclical buffer requirements for banks.	The IMF's Integrated Macroprudential Policy (iMaPP) Database
Conservation	Conservation	Capital conservation buffer requirements from banks. Including the Basel III specifications.	
Capital	Capital	Capital requirements for banks, including risk weights, systemic risk buffers, and minimum capital requirements.	
Limit on leverage of banks	LVR	Leverage ratio limit for banks.	
Loan loss provision	LLP	Loan loss provision requirements, including dynamic provisioning and sectoral provisions (e.g. housing loans).	
Limits on credit growth	LCG	Aggregate credit growth or volume limits.	
Loan restrictions Household	LoanR_HH	Subcategory of loan restrictions, targeted at household sector. Including loan limits and prohibitions, which may be conditioned on loan characteristics (e.g., the maturity, the size, the LTV ratio and the type of interest rate of loans), and other factors.	
Loan restrictions Corporate sector	LoanR_Corp	Subcategory of loan restrictions, targeted at corporate sector targeted. Including loan limits and prohibitions, which may be conditioned on lender characteristics (e.g., mortgage banks), and other factors.	
Limits on Foreign Currency	LFC	Limits on foreign currency lending.	
Loan to value ratios	LTV	Loan-to-value ratios limits, applied to residential and commercial mortgages, and other secured loans, such as for automobiles.	
Debt service to income	DSTI	Debt-service-to-income ratio and loan-to-income limits, which restrict the size of debt service payments or the size of a loan relative to income (e.g., household income).	
Tax	Tax	Taxes and levies applied to specified transactions, assets, or liabilities.	
Liquidity	Liquidity	Measures targeting mitigation of systemic liquidity and funding risks, including minimum requirements for liquidity coverage ratios, liquid asset ratios, etc.	
Limits on foreign exchange	LFX	Limits on net or gross open foreign exchange positions, limits on exposures and funding, and currency mismatch regulations.	
Reserve requirements	RR	Reserve requirements (domestic or foreign currency) for macroprudential purposes.	
Systemically important financial institutions	SIFI	Measures targeting mitigation of risks from global and domestic systemically important financial institutions (SIFIs), which includes capital and liquidity surcharges.	
Borrower based macroprudential measures	Borr	LTV+DSTI+LoanR_HH	Derived by the author based on literature review and IMF's Integrated Macroprudential Policy (iMaPP) Database
Financial Institution based macroprudential measures	Fin	CCB+ Conservation+Capital+LVR+LLP+LCG+ LoanR_Corp+Tax+Liquidity+RR+SIFI	
Foreign Currency based macroprudential measures	For	LFC+LFX	
Credit Growth rate		The data on the credit growth rate was collected primarily as the amount of credit in national currencies by countries for quarter periods. This was further processed into a growth rate of credit, which was subsequently deflated using the corresponding inflation rate.	IMF IFS: Depository Corporations Domestic Claims on Private Sector;

			and Inflation rate (measured by CPI) from World Bank WDI
Rate of nonperforming loans		Bank nonperforming loans to total gross loans. The value of nonperforming loans divided by the total value of the loan portfolio.	World Bank, World Development Indicators
Inflation rate (measured by CPI)	infl	Inflation rate by CPI presents the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be 8 or changed at specified intervals.	
Real interest rates		Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator.	
Real GDP growth	GDPg	Annual percentage growth rate of GDP at market prices based on constant local currency.	
Nominal GDP per capita (logarithmic)	logGDPcap	GDP per capita is gross domestic product divided by midyear population. Logarithmic transformation is calculated by the author.	
Credit to GDP ratio	creditGDP	Domestic credit to private sector by banks. Financial resources provided to the private sector by other depository corporations (deposit taking corporations except central banks), such as through loans, measured as a share of the gross domestic product.	
Population (logarithmic)		Midyear estimates of total population. Logarithmic transformation is calculated by the author.	
Trade to GDP ratio (logarithmic)		Trade is the sum of exports and imports of goods and services measured as a share of the gross domestic product. Logarithmic transformation is calculated by the author.	
Currency exchange arrangement	exch	Exchange rate arrangements of countries, including the de jure arrangements as described by the countries and the de facto arrangements. Categorisation into six main categories by the author based on the IMF's ten categories.	The IMF's Annual Reports on Exchange Arrangements and Exchange Restrictions (AREAER) database

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Univerzita Karlova v Praze, Fakulta sociálních věd
Institut ekonomických studií [UK FSV – IES] Praha 1, Opletalova 26
E-mail : ies@fsv.cuni.cz http://ies.fsv.cuni.cz