Universidade de Brasília
Faculdade de Administração, Economia, Contabilidade e Gestão Pública
Departamento de Economia

Credit Growth, Inflation-Targeting and the Role of Macroprudential Policies: Does Targeting Matter?

Bruna Fernandes Guimarães

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Crescimento do Crédito, Metas de Inflação e as Políticas Macroprudenciais: Qual a Influência do Regime de Metas?

Bruna Fernandes Guimarães

Dissertação de Mestrado submetida ao Programa de Pós-Graduação em Economia da Universidade de Brasília como parte dos requisitos necessários para obtenção do grau de Mestre.

Orientador: Prof. Dr. Daniel Oliveira Cajueiro
Coorientador: Prof. Dr. Regis Augusto Ely

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“If I were the rain...
That binds together the Earth and the sky,
whom in all eternity will never mingle...
Would I be able to bind two hearts together?”
(Tite Kubo)

Abstract

This work examines how macroprudential policies and a formal, single-country inflation-targeting regime jointly affect credit growth in both advanced economies (AE) and emerging and developing economies (EMDE). We construct a dataset spanning from 2005 to 2021, comprising 38 countries, and build a net macroprudential policy index by aggregating 17 different instruments. Leveraging a panel of quarterly credit stock growth across three borrowing sectors—households, government, and the general non-financial sector—we employ fixed-effects regressions to assess the timing and magnitude of macroprudential policy changes, while also accounting for monetary policy stances and real GDP growth.

This research findings show that macroprudential tightening exerts a statistically significant negative impact on credit growth, with the strongest and most immediate effects observed in lending targeted at households. Inflation-targeting frameworks, particularly in EMDE, exhibit a consistently lower baseline credit growth, and also feature a faster transmission channel for the effects of macroprudential policy instruments. However, this pattern appears to be more muted for government borrowing, where macroprudential effects are less pronounced and show weaker statistical significance. In comparison to recent articles, this research offers new evidence on how inflation-targeting mediates the potency and speed of macroprudential policies across heterogeneous economies and borrowing sectors, as well as how an inflation-target regime itself affects credit growth. These insights underscore that a stable monetary policy environment can complement macroprudential tightening, particularly in countries more exposed to economic volatility.

Keywords: Macroprudential Policy; Inflation Targeting; Monetary Policy; Financial Stability; Credit Growth.

Resumo

Este trabalho examina como as políticas macroprudenciais e um regime formal de meta de inflação de país único afetam conjuntamente o crescimento do crédito tanto em economias avançadas (AE) quanto em economias emergentes e em desenvolvimento (EMDE). Construímos um conjunto de dados que abrange de 2005 a 2021, contemplando 38 países, e elaboramos um índice líquido de política macroprudencial agregando 17 instrumentos diferentes. Valendo-nos de um painel de crescimento trimestral do estoque de crédito em três setores tomadores — famílias, governo e o setor não financeiro em geral — empregamos regressões com efeitos fixos para avaliar o momento e a magnitude das mudanças nas políticas macroprudenciais, ao mesmo tempo em que levamos em conta a postura da política monetária e o crescimento do PIB real.

Os resultados deste trabalho apontam na direção de que um aperto macroprudencial exerce um impacto negativo significativo sobre o crescimento do crédito, com efeitos mais fortes e imediatos observados no crédito às famílias. Regimes de meta de inflação, particularmente em EMDE, apresentam um crescimento de crédito consistentemente menor e uma transmissão mais rápida das medidas macroprudenciais. Contudo, esse padrão é menos pronunciado no endividamento governamental, onde os efeitos macroprudenciais são mais tênues e com significância estatística mais fraca. Em comparação com estudos recentes, esta pesquisa traz evidências inéditas de como a meta de inflação medeia a eficácia e a velocidade das políticas macroprudenciais em economias e setores tomadores de empréstimo heterogêneos, tal como os efeitos de um regime de metas de inflação sobre o crescimento do crédito. Essas interpretações dos resultados destacam que um ambiente monetário estável pode complementar o aperto macroprudencial, especialmente em países mais expostos à volatilidade econômica.

Palavras-chave: Política Macroprudencial; Metas de Inflação; Política Monetária; Estabilidade Financeira; Crescimento do Crédito.

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1 Introduction

Over the last decades, the topic of macroprudential policy has achieved significant traction on the debates around the policymaking arsenal used by the central banks. This lead to an overreaching increase in their usage (and importance) for both advanced economies and emerging markets alike. Before the 2007-2008 global financial crisis, many emerging markets were already vastly utilizing macroprudential policy tools to complement traditional monetary policy and circumvent external shocks.

However, after the crisis, there was substantial development in the creation of institutional arrangements for the usage of macroprudential policies in most countries of the world. The main challenges include evaluating policy effectiveness and understanding the interaction between macroprudential and other financial stability policies, such as fiscal and monetary policies. The relationship between macroprudential and monetary policy is complex, with potential conflicts due to their different primary objectives, as side effects from monetary policy can significantly impact financial stability (Revelo et al., 2020 (Revelo; Lucotte; Pradines-Jobet, 2020)).

The European Systemic Risk Board (ESRB/2013/1 (European Systemic Risk Board, 2013)) outlines five intermediate objectives for macroprudential policy: (i) mitigate and prevent excessive credit growth and leverage; (ii) mitigate and prevent excessive maturity mismatches and market iliquidity; (iii) limit direct and indirect exposure concentrations; (iv) limit the systemic impact of misaligned incentives to reduce moral hazard; and (v) enhance the resilience of financial infrastructures. These objectives are designed to serve as steps toward achieving robust financial stability (Revelo et al., 2020 (Revelo; Lucotte; Pradines-Jobet, 2020)). Research on the effectiveness of macroprudential policy tools is relatively nascent and has offered limited guidance for policy decisions thus far. Nevertheless, recent years have seen a notable surge in attempts to address these gaps. Advances have been made in incorporating macroprudential policy into theoretical models. Additionally, there is a growing body of empirical research examining the impact of various macroprudential tools on key variables, including credit quantities and prices, asset prices, the magnitude of financial cycles, and financial stability (Galati and Moessner, 2018 (Galati; Moessner, 2018)).

Another topic that has gained great traction on the last few decades is the inflation-targeting regimes. Initially developed and adopted in 1989 at New Zealand frameworks quickly spread to both advanced economies and emerging markets, fundamentally reshaping the way monetary policy is conducted in those countries, and providing a meaningful tool in achieving structural breaks in inflation. Under an inflation-targeting, the monetary authority has to commit to a publicly announced inflation target, and, to use the policy instruments (usually, primarily the monetary policy interest rate) to influence the inflation results within

a delimited target range, usually with some type of tolerance to one or both sides. This policy framework, from a theoretical stand-point, aims to anchor inflation expectations. Through anchoring expectations, it may achieve an structural break in inflation, and then reducing uncertainty and fostering stability (Svensson, 1997 (Svensson, 1997); Bernanke et al., 1998 (Posen; Laubach; Mishkin, 1998)).

In the last decades, there have being a significant amount of empirical studies that aimed to evaluate the effectiveness of an inflation-targeting regime in achieving lower inflation, stabilizing output and promoting transparency in monetary policy decision-making (Mishkin, 2011 (Mishkin, 2011); Hammond, 2012 (Hammond, 2012)).

Nonetheless, the interplay of an inflation-targeting regime and macroprudential policy remains a growing area of interest, given that the inflation-targeting regime anchors the policy to a specific objective. Furthermore, there are relevant recent works, like (Revelo et al., 2020 (Revelo; Lucotte; Pradines-Jobet, 2020)), that points to the need of monetary policy and macroprudential action to be done in tandem to achieve the objective of curbing credit growth. This raises the question on whether having a formal inflation-targeting regime may or may not have influence in the capabilities of macroprudential policy action on affecting credit growth.

Against this background, the present research examines how macroprudential tightening or loosening affects domestic credit growth and whether a formal inflation-targeting regime modulates these effects. A panel dataset was constructed covering 38 countries (advanced and emerging) from 2005 to 2021, encompassing quarterly observations on three categories of domestic credit—households, the general non-financial sector, and general government. In addition, a net macroprudential policy index was developed by aggregating 17 distinct policy tools to capture the "tightening" or "loosening" stance of monetary authorities each quarter.

This study contributes to the literature in three primary ways. First, detailed sector-level credit data are analyzed to illuminate heterogeneous responses to macroprudential measures across households, firms, and the public sector. Second, a formal single-country inflation-targeting indicator is incorporated and interacted with the macroprudential policy index, thereby capturing distinct dynamics in advanced versus emerging economies. This approach clarifies how inflation-targeting both anchors baseline credit growth—particularly in EMDE—and amplifies (or moderates) the effects of macroprudential tightening. Third, multiple lag structures are employed in the fixed-effects regressions to identify both immediate and delayed policy impacts.

The main results indicate that macroprudential tightening exerts a robust negative influence on credit growth, with the strongest and most immediate impact observed in household lending. In EMDE, specifically, having an inflation-targeting regime correlates with lower baseline credit growth while also accelerating the transmission of macroprudential

policy. Government credit displays a less consistent pattern, suggesting potential institutional or market frictions unique to public-sector borrowing. These findings extend the work of Cerutti et al. (2017 (Cerutti *et al.*, 2016)) and Revelo et al. (2020 (Revelo; Lucotte; Pradines-Jobet, 2020)), offering new evidence that inflation-targeting can function both as a stabilizing force for credit expansion and as a facilitator of macroprudential effectiveness—especially in economies prone to boom-bust cycles.

The remainder of this work is organized as follows. Section 2 reviews the relevant literature on macroprudential policies and inflation-targeting frameworks. Section 3 details the data and the construction of the net macroprudential policy index. Section 4 outlines the econometric strategy, including baseline and interaction models. Section 5 presents the empirical findings for each credit sector, while Section 6 addresses limitations, such as data constraints and potential endogeneity of policy instruments. Finally, Section 7 concludes by highlighting policy implications for different groups of economies and proposing avenues for future research.

2 Literature Review

Traditional monetary policy, with an emphasis on interest rate adjustments, sometimes are quite insufficient in the mission of addressing challenges like asset bubbles, what has over the time lead to a broader adoption of macroprudential policies. As a result, various countries have established institutional frameworks for the usage of macroprudential tools, providing central banks with more options to ensure financial system stability, reduce systemic risk, and prevent financial contagions. Policies that limit banks' risk exposure and enhance liquidity requirements, such as the mandate for risk-weighted capital coverage, for example, can be effective in enhancing financial stability and mitigating lending risks. Studies like Lorencic and Festic (2022 (Lorenčič; Festić, 2022)) and Claessens (2015 (Claessens, 2015)) provide evidence that while these policies can bolster financial stability, they may also constrain credit growth and introduce borrowing restrictions, leading to countercyclical effects. The literature suggests that macroprudential measures help control credit creation and risk-taking during economic expansions, thereby reducing the banking sector's procyclicality. There are also intricate dynamics between monetary and macroprudential policies, as there are potential overlapping impacts on credit availability and economic activity. Therefore, there is also an important discussion on how these policies can either complement or interfere with each other, affecting the primary objectives of financial stability and economic management.

On the other hand, studies like Revelo et al (2020) (Revelo; Lucotte; Pradines-Jobet, 2020) and Revelo et al (2022) (Revelo; Levieuge, 2022) highlight scenarios where monetary policy and macroprudential policy action work synergistically and when they can be in conflict, arguing that this coordination may be necessary for the proper effectiveness of stability objectives. This interplay is crucial for policymakers to consider, as it can influence the overall effectiveness of financial regulation and economic management strategies. When looking particularly at the real estate market, since it is largely imperfect and susceptible to credit expansion, it is particularly vulnerable to financial bubbles. When addressing the literature on macroprudential policies, a fundamental starting point is the efforts to measure their effectiveness. Cerutti et al. (2017) (Cerutti; Claessens; Laeven, 2017) highlight in their study a negative and statistically significant relationship between real credit growth and the Macroprudential Policy Index (MPI) at $t-1$, suggesting that macroprudential measures can mitigate credit expansion. The authors observed this effect using both Ordinary Least Squares (OLS) and Generalized Method of Moments (GMM) regressions, noting stronger effects in the GMM regression. Regarding the control variables, credit growth at $t-1$ demonstrated persistence in subsequent credit developments. Economic growth positively affected credit growth, whereas banking crises and high interest rates had a retractive effect on credit growth, albeit with a smaller impact than the MPI index. The authors noted that, in developing

economies compared to advanced ones, the negative relationship between the MPI index and credit growth is more pronounced. This could be due to a greater reliance on macroprudential policies and possibly more robust and developed financial systems in advanced economies, which offer more financing alternatives.

When examining open versus closed economies, macroprudential policies appear more effective in relatively closed economies. In economies that are relatively more open, these policies still have a significant effect, but they are comparatively less effective, likely due to greater access to non-bank or overseas financing alternatives. Focusing on the types of macroprudential measures, those affecting the credit taker, such as limits on Loan-to-Value (LTV) ratios and Debt-to-Income (DTI) ratios, were effective in reducing credit growth, particularly household credit, as observed in various countries. Limits on foreign currency transactions and reserve requirements were particularly effective in emerging markets and developing countries, capable of curbing various types of credit growth. Dynamic provisioning, leverage, countercyclical requirements, and fiscal measures showed varying effects on credit growth and real estate prices across different markets. Moreover, measures affecting financial institutions also showed a negative association, particularly in emerging and more closed economies. Concerning economic sectors, the authors found significant reductions in mortgage credit growth due to measures aimed at the credit taker, both in emerging and advanced economies. However, the impact on corporate credit was negative but weaker than that observed for mortgage credit. For general credit, the combination of credit takers (using both LTV and DTI caps) as well as their intersection (using either LTV or DTI caps) showed significant effects on credit growth, without clear complementarities between the two measures. The authors conclude that the effectiveness of macroprudential measures varies with the income level, degree of financial openness of the economy, and the types of measures implemented. Measures focused on credit takers, such as limits for LTV and DTI, have a universal impact, while other measures, like limits on foreign currency, have a more pronounced effect in specific contexts, such as in emerging economies. In summary, the results underscore the importance of tailoring macroprudential measures to the specific circumstances of each country, considering both economic characteristics and financial system features.

Chiang and Chen (2023 (Chiang; Chen, 2023)) present a case study of the implementation of macroprudential policies in Taiwan, where loan-to-value (LTV) ratios were implemented in the real estate market between 2010 and 2016. Previously, the real estate market in Taiwan had been experiencing a significant upward trend, largely attributed to credit expansion and intrinsic characteristics of the real estate market. In response, the Central Bank adopted limits on the loan-to-value (LTV) ratio as its primary tool to address the scenario, applying it selectively to the real estate market in Taipei. The policy was designed to be implemented in stages, each making the limits more restrictive for different districts

in Taipei and New Taipei. The authors pointed to the effectiveness of the policy. However, while macroprudential policies can effectively address direct targets such as housing bubbles, they may also lead to unintended consequences, including spillovers to unregulated markets. The mixed outcomes underscore the importance of considering both the intended and unintended effects of macroprudential policies. Effective communication and cooperation among stakeholders are crucial to internalizing potential externalities and ensuring the overall stability of the financial system.

In 1989, New Zealand first adopted what came to be known as inflation targeting regime. Following what issued was an structural break in inflation, that had averaged nearly 12 percent in 1988, 1987 and 1986, and was brought down to an average of 3 percent in the three years following the adoption of the new regime (Bhalla et al, 2023). After New Zealand's adoption, various countries trailed the same path. Initially, it was followed by advanced economies like Canada and the United Kingdom, but then it was sought after by emerging markets as a tool for better inflation control, being adopted in the 1990s by economies like Brazil and Colombia.

In simplified terms, inflation targeting can be summarized as regime where a Central Bank follows an explicit and previously announced target for the inflation rate, and price stability is pursued and an explicit objective by the monetary authority. The main instrument used for this objective are interest rates. In that sense, an inflation-targeting Central Bank will change their stance on interest rates based on the inflation behavior. The so called "early adopters" of inflation targeting managed an widespread success in the objective of dropping average inflation, however, that is not the only thing that came with these new type of monetary policy stance, particularly, Bhalla et al (2023) cites four benefits of adopting an inflation target regime: lower inflation, stable inflation, better growth performance, lower sacrifice ratio Inflation targeting has been more widely adopted in the decades following it's first implementation, on the other hand, macroprudential policy instruments significantly rose in importance and usage in the last decades, so understanding the relationship between an inflation target regime and the behavior of credit growth, as well as how it relates to macroprudential policy effects.

Bhalla et al (2023 (Bhalla; Bhasin; Loungani, 2023)) list the following countries as having adopted a formal inflation target regime:

Table 2.1 – Adoption of Inflation Targeting by Country and Year

No.	Country	Year of IT Adoption
1	New Zealand	1989
2	Canada	1991
3	United Kingdom	1992
4	Australia	1993
5	Sweden	1993
6	Czech Republic	1997
7	Israel	1997
8	Poland	1998
9	Brazil	1999
10	Chile	1999
11	Colombia	1999
12	South Africa	2000
13	Thailand	2000
14	Mexico	2001
15	Norway	2001
16	Indonesia	2005
17	Turkey	2006
18	United States	2012
19	Japan	2013
20	Argentina	2016

However, it is important to note that Argentina's adoption was just a brief 25 months experiment that did not result in any meaningful break in the inflation series. Authors like Cachanosky and Mazza (2019 (Cachanovsky; Mazza, 2021)) pointed that the short-lived adoption in Argentina failed for a multiple reasons, such as a series of government decisions that undermined credibility in the newly adopted regime, as well as deep-rooted structural

inconsistencies and external shocks. Since the short-lived experiment was not able to produce an structural break in inflation, and also was smaller than the usual 36 month benchmark for these type of policy implementation, in the context of this work, we won't consider Argentina an inflation targeting country, and we chose to not remove it from the model altogether to not suffer from low variability.

It is also important to note that in this work, Eurozone countries will not be classified as inflation-targeting nations because the European Central Bank (ECB), which conducts monetary policy for these countries, does not consider itself as following an inflation-targeting regime. According to them, the ECB does not adhere to a conventional inflation-targeting framework. While the ECB aims to maintain price stability with an asymmetric 2% inflation target (something that changed in 2021, to a symmetric target) over the medium term, its mandate encompasses broader economic objectives beyond solely controlling inflation. This multifaceted approach distinguishes the ECB's strategy from that of traditional inflation-targeting central banks, thereby justifying the exclusion of eurozone countries from this classification in our analysis. The Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), a publication produced by the International Monetary Fund (IMF) that tracks the exchange rate and trade regimes of all the IMF country members, doesn't classify the Eurozone countries as inflation-targeting countries, classifying their singular monetary policy framework as "Other". They provide a brief explanation on the parameters and objectives of the ECB: "To maintain price stability is the primary objective of the Eurosystem and of the single monetary policy for which it is responsible. This is stated in the Treaty on the Functioning of the European Union, Article 127(1). "Without prejudice to the objective of price stability, the Eurosystem will also support the general economic policies in the Community with a view to contributing to the achievement of the objectives of the Community." These include a "high level of employment" and "sustainable and non-inflationary growth." Price stability is defined as an inflation rate below but close to 2% over the medium term." (APAER, IMF, 2019 (International Monetary Fund, 2019)). Some works, as Belkhir et al. (2023 (Belkhir *et al.*, 2023)) consider the Eurozone countries as inflation-targeting countries for the context of their analysis, others like Bhalla et al (2023 (Bhalla; Bhasin; Loungani, 2023)) exclude then from the group. For that reason, we can safely define that, within the approach of this work, the definition of inflation-targeting country is that of the single country formally declared inflation-targeting regime.

Concerning the relationship between an inflation-targeting regime and the effectiveness of policies in maintaining financial stability, Belkhir et al. (2023 (Belkhir *et al.*, 2023)) discusses if having and inflation-targeting regime has any impact in the capability of macroprudential policy measures undermining systemic risk. When investigating how inflation targeting regimes influence the effectiveness of policies in maintaining financial stability, Belkhir et al. (2023 (Belkhir *et al.*, 2023)) discusses the impacts of macroprudential policies

and inflation targeting on bank systemic risk. The research looks into bank-level data from 45 countries over the course of almost two decades and finds that a lot of macroprudential policy tools, like DSTI, LTV limits and capital requirements, have a better chance of reducing systemic risk in countries that have an inflation-targeting regime. That is, an inflation-targeting regime can enhance the effectiveness of macroprudential tools by providing a credible and stable policy framework, thereby reducing uncertainties regarding monetary policy directions.

This credibility boost helps improve the risk profiles of banks. For instance, employing an inflation target may enhance the impact of policies such as capital requirements and liquidity constraints by offering clear signals about future monetary actions, which aids banks in better preparing for potential financial stresses. The authors note that, in some cases, these policies can conflict, particularly when macroprudential measures designed to curb systemic risks increase the volatility of inflation and output, potentially clashing with the goals of monetary policy. Conversely, synergies exist when both sets of policies are aligned in controlling credit growth and enhancing financial stability. However, the article highlight that the effectiveness varies by the type of macroprudential policy tool and the specific economic and institutional context of the countries.

3 Data

The dataset built for this analysis is comprised of 38 countries, between advanced economies and emerging and developing economies, namely:

Table 3.1 – List of Advanced and Emerging Economies

Advanced Economies	Emerging and Developing Economies
Australia	Argentina
Austria	Brazil
Belgium	Chile
Canada	Colombia
Czechia	Hungary
Denmark	India
Finland	Indonesia
France	Mexico
Germany	Poland
Greece	South Africa
Hong Kong SAR	Thailand
Ireland	Türkiye
Israel	
Italy	
Japan	
Korea	
Luxembourg	
Netherlands	
New Zealand	
Norway	
Portugal	
Spain	
Sweden	
Switzerland	
United Kingdom	
United States	

Note: Advanced and Emerging economies featured in the dataset

Credit stock data utilized in this study is sourced from the Credit to the Non-Financial Sector series (Bank for International Settlements, 2024), maintained by the Bank for International Settlements (BIS). The dataset in question features quarterly sectorial credit stock, measured in domestic currency and valuated at market values. The dataset provides sectorial credit data as well, for this work, the data sectorial data employed are:

- Credit to the General Non-Financial Sector, which is the overall total credit stock for the entire non-financial sector.
- Credit directed at Households, which also includes non-profit institutions serving households.
- Credit directed at the general government, which comprises central state and local government and social security funds, but excludes public enterprises.

The data on credit to the government has a more restricted sample, featuring only 28 countries, which are:

Table 3.2 – List of Advanced and Emerging Economies

Advanced Economies	Emerging and Developing Economies
Australia	Chile
Austria	Hungary
Belgium	Poland
Canada	Türkiye
Czechia	
Denmark	
Finland	
France	
Germany	
Greece	
Ireland	
Israel	
Italy	
Japan	
Korea	
Luxembourg	
Netherlands	
Norway	
Portugal	
Spain	
Sweden	
Switzerland	
United Kingdom	
United States	

Note: Advanced and Emerging economies featured in the dataset

As for the macroprudential policy data, it originates from the International Monetary Fund's (IMF) Integrated Macroprudential Policy (iMaPP) Database (International Monetary Fund,), developed originally by Alam et al. (2019) (Alam *et al.*, 2019), which contains 17 macroprudential policy variables recorded in the following format:

- -1 if there is loosening action.
- 0 if there is no action.
- +1 if there is a tightening action.

The variables featured in the dataset refer to the following macroprudential policy

instruments:

- 1 – Countercyclical Buffers (CCB): Requirements for banks to maintain a countercyclical capital buffer.
- 2 – Conservation: Requirements for banks to maintain a capital conservation buffer, including the one established under Basel III.
- 3 - Capital Requirements: Capital requirements for banks, which include risk weights, systemic risk buffers, and minimum capital requirements. Countercyclical capital buffers and capital conservation buffers are captured in their sheets respectively and thus not included here.
- 4 - Leverage Limits (LVR): A limit on leverage of banks, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures (e.g., Basel III leverage ratio).
- 5 - Loan Loss Provisions (LLP): Loan loss provision requirements for macroprudential purposes, which include dynamic provisioning and sectoral provisions (e.g. housing loans).
- 6 - Limits on Credit Growth (LCG): Limits on growth or the volume of aggregate credit, the household-sector credit, or the corporate-sector credit by banks, and penalties for high credit growth.
- 7 – Loan Restrictions (LoanR): Loan restrictions, that are more tailored than those captured in "LCG". They include 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), bank characteristics (e.g., mortgage banks), and other factors.
- 8 - Limits on Foreign Currency (LFC): Limits on foreign currency (FC) lending, and rules or recommendations on FC loans.
- 9 - Limits on the Loan-to-Value Ratio (LTV): Limits to the loan-to-value ratios, including those mostly targeted at housing loans, but also includes those targeted at automobile loans, and commercial real estate loans.
- 10 - Limits on the Debt-Service-to-Income Ratio (DSTI): Limits to the debt-service-to-income ratio and the loan-to-income ratio, which restrict the size of debt services or debt relative to income. They include those targeted at housing loans, consumer loans, and commercial real estate loans.
- 11 - Tax Measures Taxes and levies applied to specified transactions, assets, or liabilities, which include stamp duties, and capital gain taxes.
- 12 – Liquidity Requirements: Measures taken to mitigate systemic liquidity and funding risks, including minimum requirements for liquidity coverage ratios, liquid asset ratios, net stable funding ratios, core funding ratios and external debt restrictions that do not distinguish currencies.
- 13 - Limits on the Loan-to-Deposit Ratio (LTD): Limits to the loan-to-deposit (LTD) ratio and penalties for high LTD ratios.

- 14 - Limits on Foreign Exchange Positions (LFX): Limits on net or gross open foreign exchange (FX) positions, limits on FX exposures and FX funding, and currency mismatch regulations.
- 15 – Reserve Requirements (RR)*: Reserve requirements (domestic or foreign currency) for macroprudential purposes. Please note that this category may currently include those for monetary policy as distinguishing those for macroprudential or monetary policy purposes is often not clear-cut. A subcategory of reserve requirements is provided for those differentiated by currency (FCD), as they are typically used for macroprudential purposes.
- 16 – SIFI: Measures taken to mitigate risks from global and domestic systemically important financial institutions (SIFIs), which includes capital and liquidity surcharges.
- 17 – Other: Macroprudential policy instruments not featured in the above categories.

As for the controls, the dataset chosen for the Gross Domestic Product (GDP) is the Real, Seasonally Adjusted Quarterly GDP in Domestic Currency series provided by the IMF's International Financial Statistics (International Monetary Fund, 2024). The data utilized for the nominal monetary policy rates is sourced from the Central Bank Policy Rates series maintained by the BIS (Bank for International Settlements,), which is a unique dataset in the sense that the BIS collaborates with the national monetary authorities across the countries to source the policy rate that "better reflects" the nominal monetary policy stance from the Central Banks. The dataset analyzed in this research spans from the first quarter of 2005 to the fourth quarter of 2021.

Looking at the data for the number of macroprudential policy action taken across time by the 38 countries in the sample data, spanning from 2005 to 2021, we see that there is an overall increase in policy action after 2009, which is expected. After that, we consistently see not only an overall increase in baseline changes in macroprudential policy instances, but also yearly peaks of macroprudential policy action in the first quarters of the year, which is keen in showing the growing reliance and usage of these policies across all 38 countries. Something else that is relevant is the overall dominance of tightening macroprudential policy actions, especially after 2010, a dominance that only changes – and, in fact, reverses – in 2020. As for the number of countries taking any type of macroprudential policy action, we see again an upward trend that is particularly clear after 2009, and here we see an overall larger number of countries taking any macroprudential policy action in the first quarter of each year, but a sustained higher number of countries taking action at any point. As for the average number of instruments actually used, we that there is actually an overall stability across time, however, we again see peaks at the first quarters. Moreover, after the highest average registered in 2020, we see a sharp drop in instruments used in 2021.

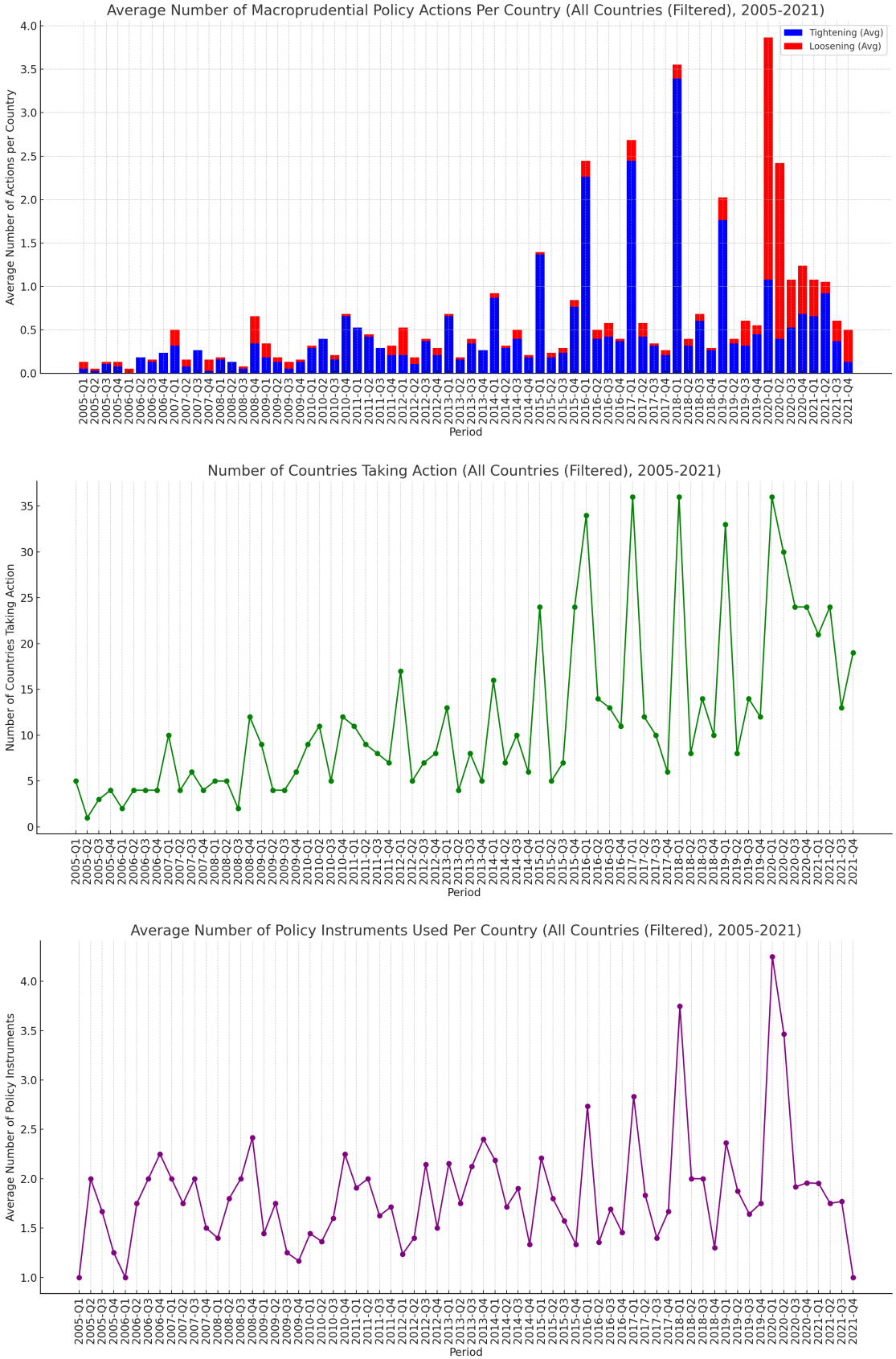

Figure 3.1 – All 38 Economies

Now if we split the sample between countries that have a formal, single-country,

inflation-targeting regime, at that point in time, and those that do not have one, we can see the overall pattern and shape is retained between both in the graph showing the number of actions overtime. Looking at the graph for countries without inflation-targeting, it has slightly higher average peaks in a single quarter, while the countries with inflation-targeting, at the same periods, which were of exceptional action for all countries, have a slightly lower average peak. The graphs have a similar pattern of active spikes, such as the big run-ups in tightening around 2015 to 2017, as well as the loosening wave around 2019 and 2020. Both have a relatively close number of actions at earlier periods, however, around 2013 the non-targeting group start having the larger peaks in overall number of actions. As for the number of countries taking action, there is a pattern that, especially at 2012 an onwards, non-targeting countries have higher spikes and lower dips, while the group of targeting countries have a more consistent usage overall. That can be also said about quarter-to-quarter swings, to which the inflation-targeting group seen less prone to, having a similar pattern across the years, just more smoothly. That is, the timing of surges and slowdowns ally between the two groups. Additionally, for the average number of instruments used, we see somewhat similar ups and downs over time, and we start to see more fluctuation after 2008, which corresponds to the more widespread usage of macroprudential policies as a whole. The graph for non-targeting countries features slightly higher peaks, and more discrepant peaks at some points than the targeting-countries, however, again, non-targeting countries shows larger swings, where targeting countries in a somewhat narrower band.

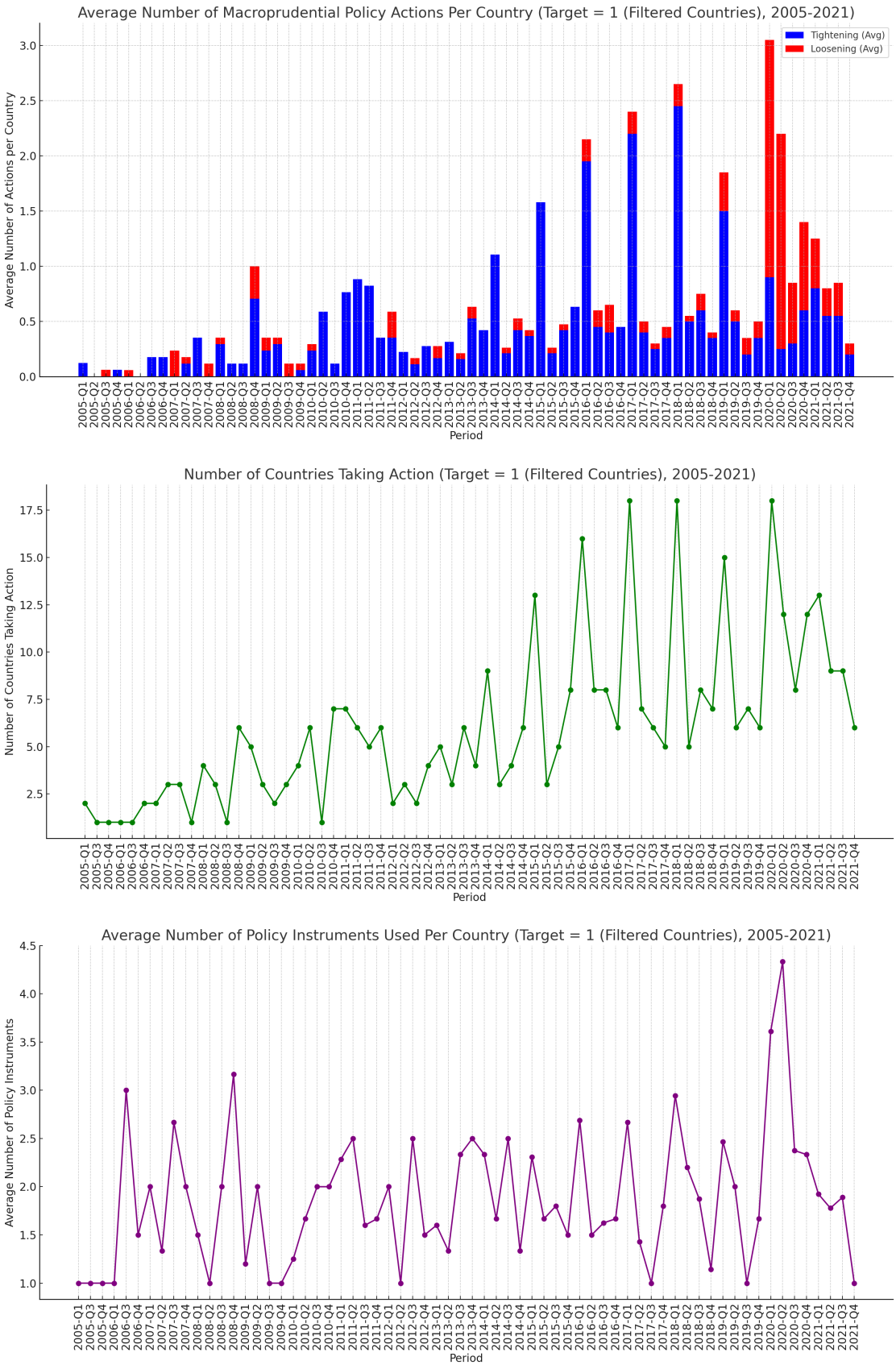

Figure 3.2 – Inflation-Targeting Countries

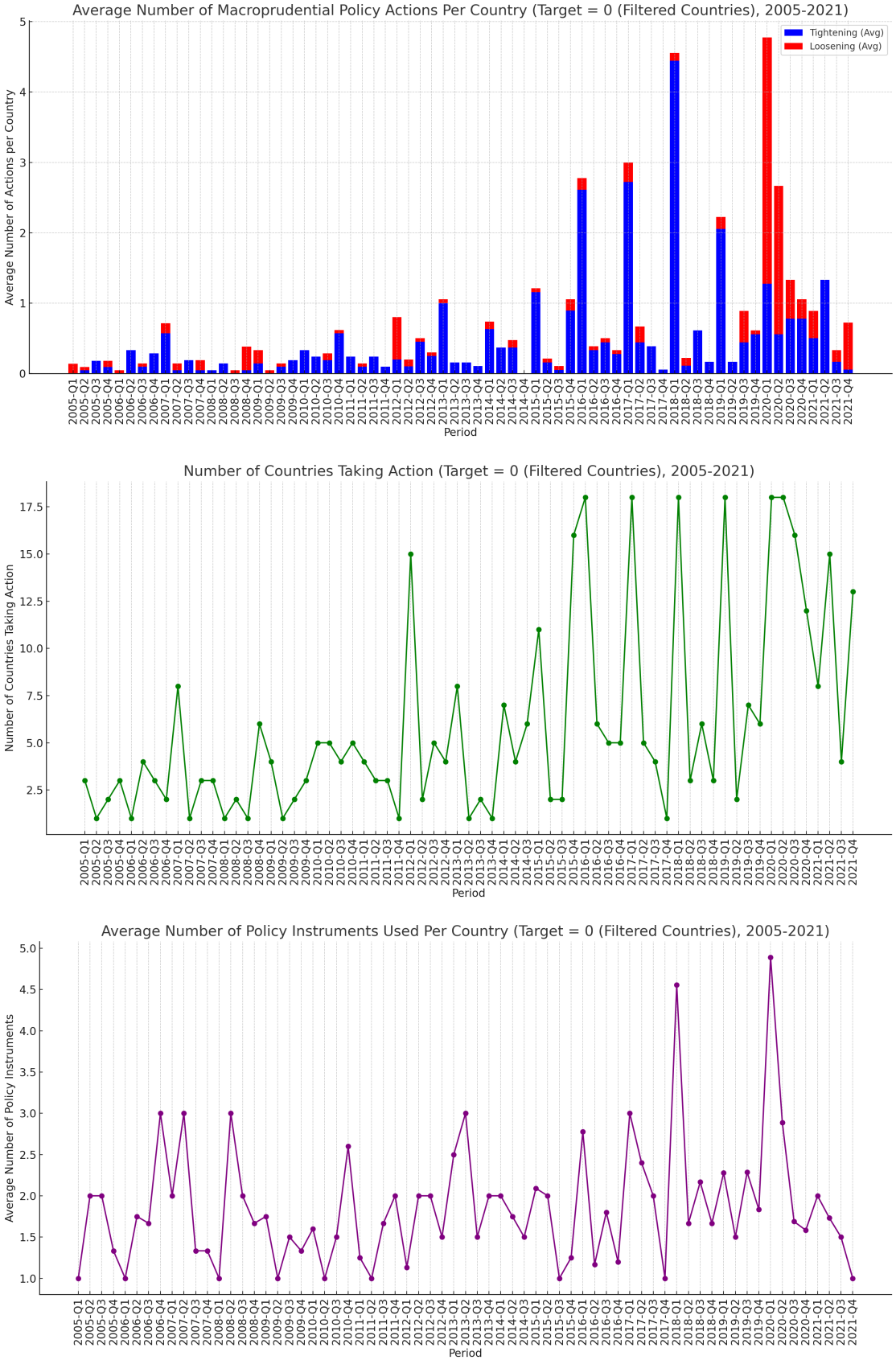

Figure 3.3 – Non-Inflation-Targeting Countries

Authors like Revelo et al (2020) (Revelo; Lucotte; Pradines-Jobet, 2020) and Cerutti

(2017) (Cerutti; Claessens; Laeven, 2017) argue that there are relevant differences in the effects of macroprudential policy between advanced economies and emerging and developing economies. Considering that, we can split the data into four groups: inflation-targeting advanced economies, non-targeting advanced economies, inflation-targeting emerging and developing economies and non-targeting emerging and developing economies.

Looking into the graphs for the inflation-targeting advanced economies, the average number of instruments used is relatively low up until 2009, and the same can be said about the number of countries taking action and the number of actions taken. However, there is a very active usage of macroprudential policy post-2008, with a great prevalence of tightening actions. There are relevant spikes at the later years, highlighting the overall pattern of higher reliance on macroprudential policy instruments, which can also be seen on the upward trend of the number of countries taking action at each period. There is also a relevant rise in loosening actions after 2020. One relevant aspect to consider for this group is the inclusion of Japan and the United States in the later years, as they are one of the last to have their Central Banks declaring as inflation targeting central banks. As seen before, most actions are concentrated in the first quarter of each year, and post 2010 there is a overall higher usage of macroprudential policies, as well as a particularly strong presence of tightening action up until 2020, and the change in behavior should be credited to action taken in consideration of the particular circumstances of the COVID-19 pandemic, which merited unusual responses by the monetary authorities. As for the average number of policy instruments used by country, we actually see a more stable pattern, with some peaks, and the highest at 2020, but there are earlier peaks as well.

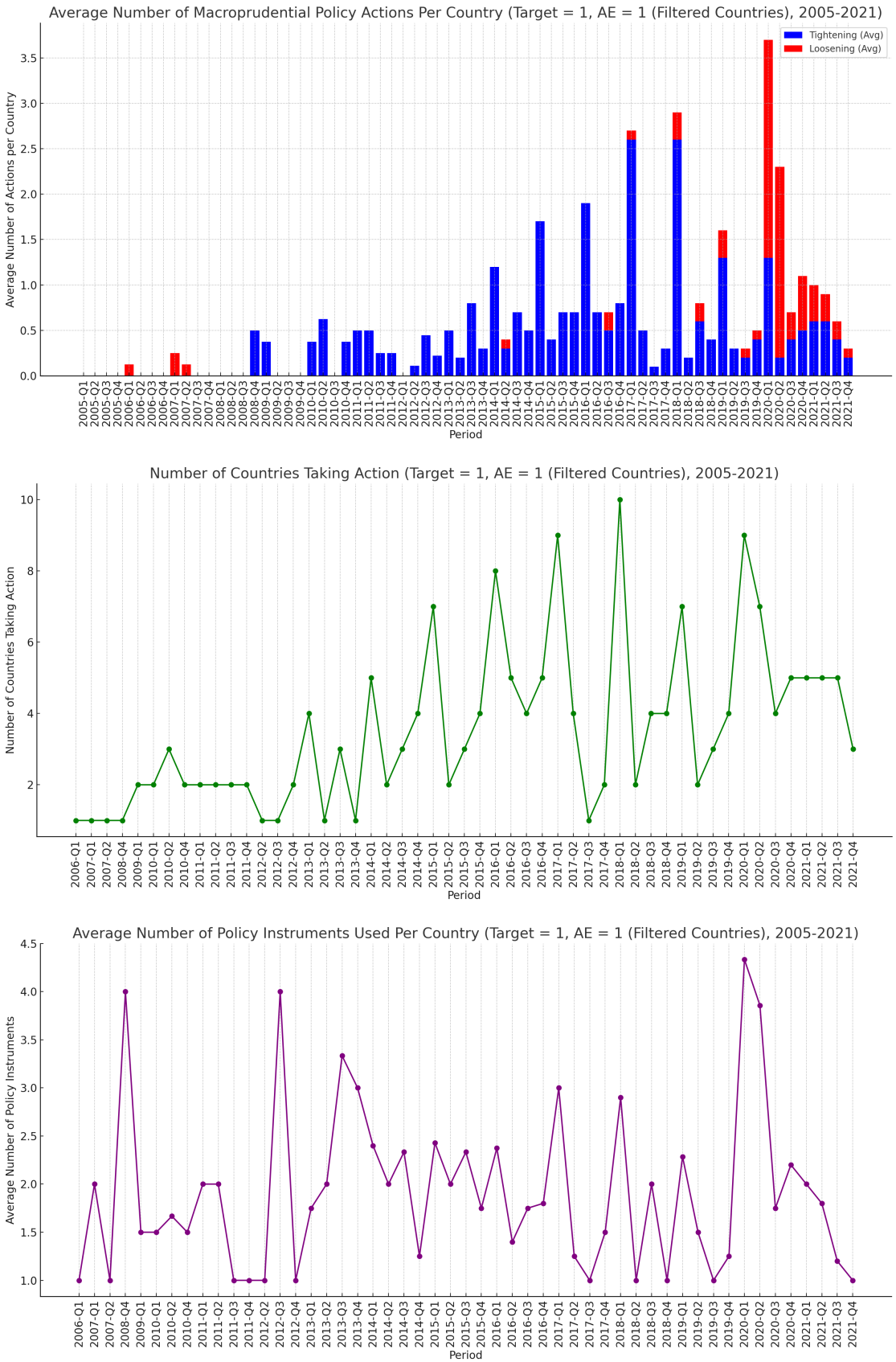

Figure 3.4 – Advanced Economies, Inflation-Targeting

As for the group consisting of advanced, non-inflation-targeting economies, the groups

shows the largest number of total actions in a single period, both on average and in absolute numbers. The largest peaks being dominated by advanced economies with monetary authorities that do not consider themselves inflation targeting Central Banks, highlights that these authorities might rely more on alternative instruments, such as macroprudential policy instruments. It is also important to mention the "over-representation" of European countries in the Eurozone in that group, because of their special circumstances of the usage of macroprudential policies.

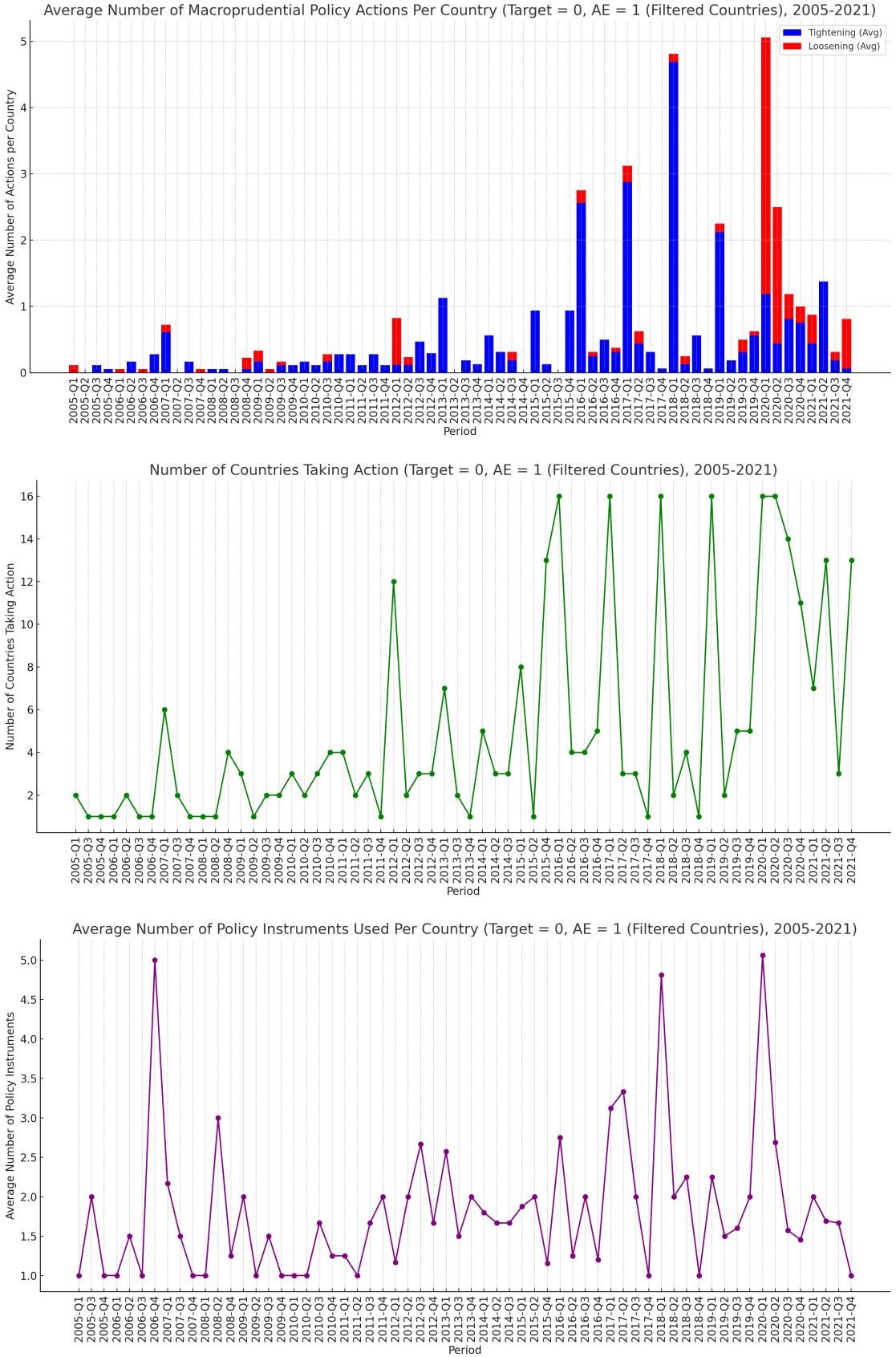

Figure 3.5 – Advanced Economies, Non-Inflation-Targeting

The Eurozone countries are part of what is called the Single Supervisory Mechanism

(SSM), it is a framework designed for banking supervision, as well as one of the key pillars of the EU Banking Union. The SSM is composed of the ECB itself as well as the national competent authorities appointed by the respective countries. The SSM supervises the banking system in all the Eurozone countries as well as countries in what is called a close cooperation regime with the ECB (currently, only Bulgaria). The ECB has the responsibility of directly supervising significant banks and works as an oversight authority over the national supervisory authorities for the less significant banks, and enforces a harmonized set of rules and practices for financial regulation across all participant countries.

Under these circumstances, the traditional monetary policy is under control of the European Central Bank. However, macroprudential policy was relegated to the national authorities in the SSM, albeit regulated by the European Systemic Risk Board. A decision that came because of the perceived need of a more tailored approach of this type of policy, something that would not be well perceived by a supra-national authority (Boh et al., 2017 (Boh et al., 2017); European Systemic Risk Board, 2014 (European Systemic Risk Board, 2014)). In their directives, the European Systemic Risk Board highlighted that the national authorities should define a clear ultimate objective for the macroprudential policies implemented by the Eurozone countries, and notify the ECB before implementing or changing national measures. They are also requested to designate a national macroprudential authority, which can be a single institution or a board of relevant authorities. That designated authority is advised to identify and monitor financial stability; have the power to obtain data and information for the regulated financial sector and the ability to set or recommend the necessary macroprudential policy instruments and which action shall be taken with the usage of those instruments.

Even so, the ECB, under the SSM system, share some responsibilities with the national authorities. The ECB can raise objections to the changes reported by the national authorities, but they also can enforce macroprudential measure requirements for the instruments that are included in EU legislation, for example, they can request a specific capital buffer requirement, and if the national authority has enforced a lower, they must rise it to meet the ECB measure (Boh et al., 2017 (Boh et al., 2017)).

When taking that context in consideration, it is important to highlight that the Eurozone countries may have a higher overall usage of macroprudential policy that is a result of both the shared responsibility with the ECB and the fact that the national authorities may have a further reliance on then in response to the non-avaibility of traditional monetary policy instruments for the national governments. Some recent works even highlight the fact that, post-2008, the ECB used most accommodative monetary policy, while many national authorities introduced tighter macroprudential policy measures (Meuleman and Vennet, 2022 (Meuleman; Vennet, 2022)), which is also evident in our data for the advanced and non-inflation targeting economies, with a strong prevalence of tightening actions prior to

2020. Other relevant aspect that need consideration is the particularly large number of countries taking action when compared to the other groups, especially in later years.

Something to consider for these groups is the higher reliance post-2008 on quantitative easing, especially for the advanced economies. The rose on usage on macroprudential policy as not only a means to prevent forms of systemical risk alone, but also as a countermeasure to quantitative easing, as countries sought a way to influence aggregate demand without the inherent risk of traditional expansion of monetary policy. Authors as Woodford (2016 (Woodford, 2016)) advocated that combining quantitative easing with appropriate macroprudential policies could have an expansionary effect on aggregate demand without increasing financial stability risks, and that kind of motivation could be one of the reasons behind the higher reliance on macroprudential policy designs, particularly for inflation targeting advanced economies.

As for the inflation-targeting emerging and developing economies, there is a relevant difference: slightly more macroprudential policy action prior to 2010. As well as the presence of more frequent loosening action than the other two groups, prior to 2019. Another relevant difference is the lesser drop observed from 2020 to 2021, when compared to the advanced economies. Highlighting not exactly a stronger reliance in the sense of the largest number of overall actions, as the average peaks present for both the advanced economies groups are higher, but a more consistent usage of macroprudential policy, with less variability. This could be a result of these economies being more susceptible to financial cycles, but also because of a more established framework being already in place in those countries. The number of countries taking action starts to have consistent higher peaks, especially at the first quarters, after 2014, something that is consistent with the advanced economies with an inflation-target, but in contrast to the earlier start of more countries taking action seen by the non-targeting advanced economies group, probably relating to the reasons discussed before.

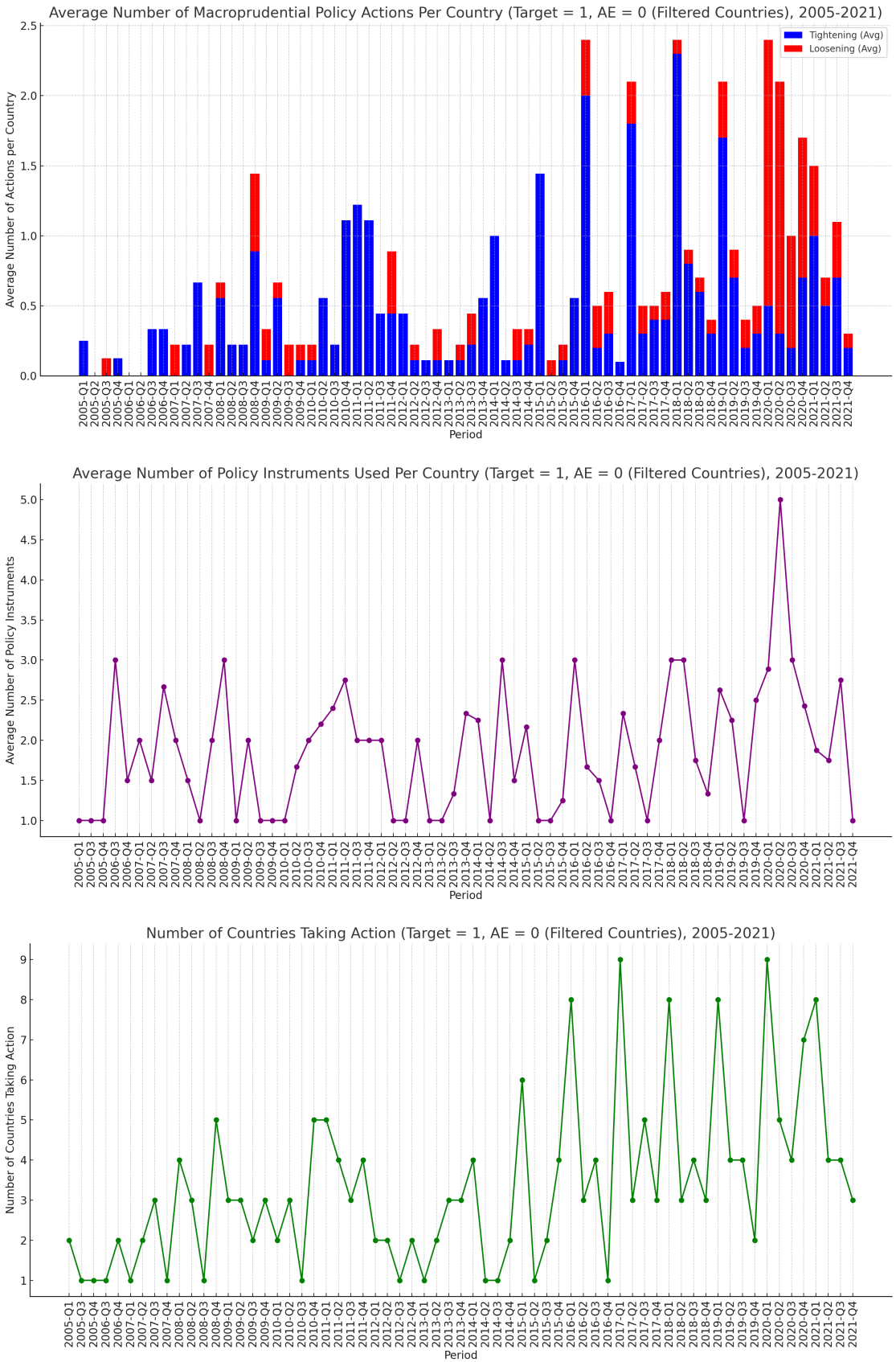

Figure 3.6 – Emerging and Developing Economies, Inflation-Targeting

Finally, for the non-targeting emerging and developing economies, we see again a

relevant spike around 2010 and a more frequent usage in earlier years, with strong episodic surges post-2013. The overall pattern is close to their targeting counterpart, as in having a relatively more active macroprudential policy action prior to 2010, but also rising significantly after that, however, it does differ from the inflation-targeting EMDEs in having less frequent peaks but also having a higher magnitude achieved in it's peaks. It is interesting to note the pattern that both non-targeting groups have higher peaks of average macroprudential policy action in each period. Other interesting thing to note is that the non-targeting EMDEs is the group that has the largest peak of average number of instruments used per country. As for the number of countries taking action, the behavior is relatively erratic, because of the the significantly smaller sub-sample, which should also be taken into account when drawing conclusions from the other results for this group.

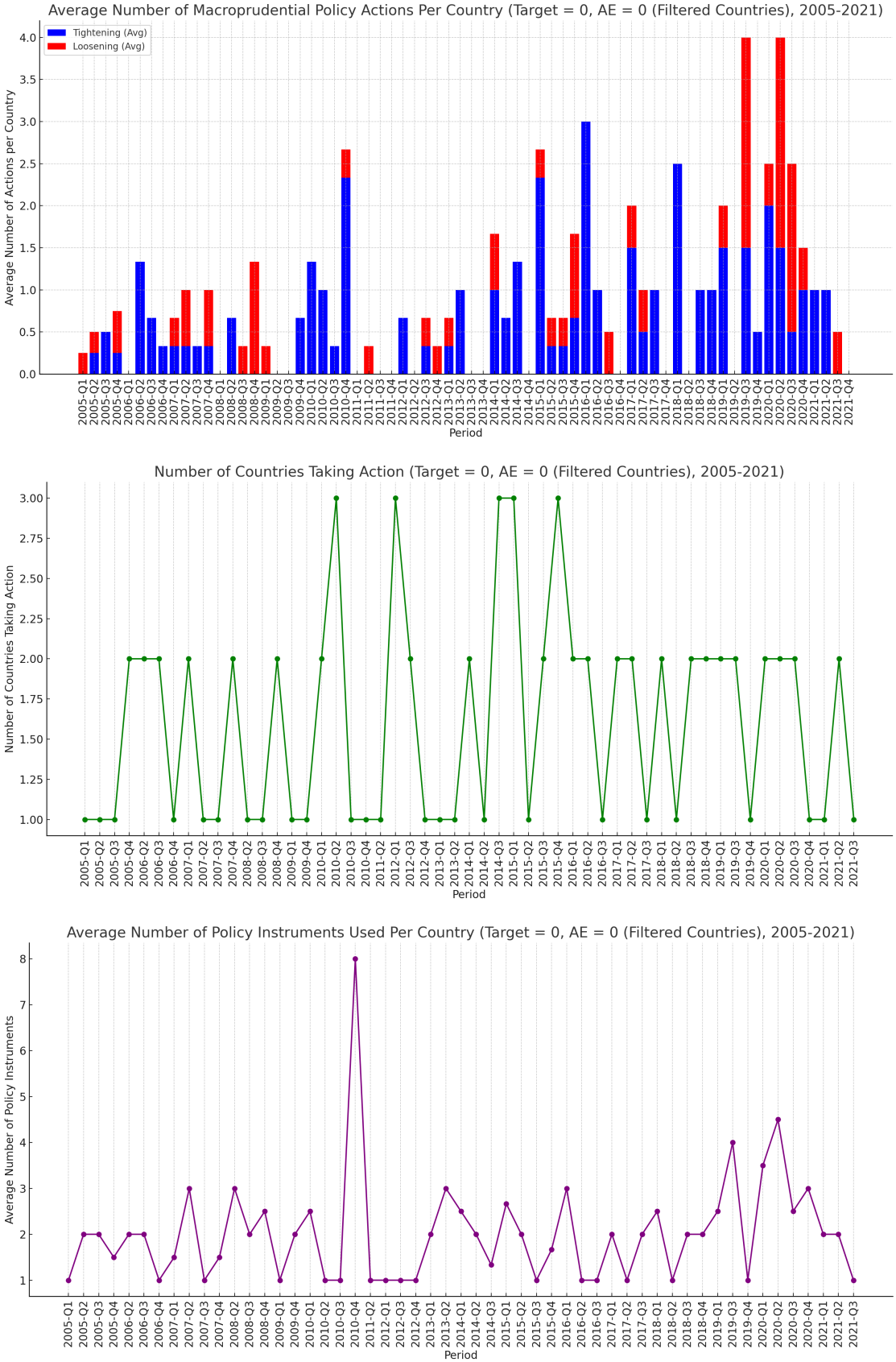

Figure 3.7 – Emerging and Developing Economies, Non-Inflation-Targeting

4 Methodology

The core of the analysis provided in this research is accomplished with three econometric models. All models detailed in this session uses a fixed-effects approach to deal with the cross-country panel data. Revelo et al. (2020 (Revelo; Lucotte; Pradines-Jobet, 2020)) highlight that a fixed-effects setup is standard when investigating policy impacts in a cross-country panel, ensuring that comparisons happen "within" each country across time rather than "between" countries with structurally different risk profiles, as well as accounting for the structural differences between the lenders. To comprehensively capture the nuances of the effects macroprudential policy and a formal, single country inflation-targeting regime may have on credit growth, a step-by-step modeling strategy is adopted. The models differ between themselves in regards to the inclusion of interaction terms.

The study adopts a fixed-effects panel regression model to control for unobserved heterogeneity across countries, similar to the approach used by Revelo et al. (2020) (Revelo; Lucotte; Pradines-Jobet, 2020) and Alam et al (2019) (Alam *et al.*, 2019) to assess the effects of macroprudential policies on credit growth. This model is well-suited for analyzing the impacts of policy changes on credit growth while accounting for inherent differences between countries and lenders. The inclusion of lagged terms of the macroprudential policy index allows for the examination of the temporal dynamics and potential delayed effects of these policies on credit growth.

The first specification is meant to allow us to analyze the effects that an inflation-targeting regime and macroprudential policy have, individually, on credit growth. Then, the analyzes proceeds by progressively incorporating interaction terms. First, a two-way interaction to capture whether the effects of an inflation-targeting regime on credit growth differs between advanced economies and emerging and developing economies. This interaction allows for an additional level of group analysis on baseline effects on credit growth.

Following that, a three-way interaction is included in the model, to explore how macroprudential policy effects itself might operate differently between both the development groups and the monetary policy regime groups. This final interaction allows for a net effect analysis of the macroprudential policy effects, measured through the coefficients accompanying a macroprudential policy index. By comparing results across these models, it is possible to assess both the robusteness of the results and the specific conditions under which macroprudential policy exerts stronger or weaker effects on credit growth, as well as it's relationship with a formal, single country, inflation-targeting regime.

4.1 Macroprudential Policy Index

The model will be estimated using a macroprudential policy index, proposed originally by Revelo et al. (2020) (Revelo; Lucotte; Pradines-Jobet, 2020). The index is structured as follows:

$$\text{PruC}_{i,t} = \sum_{a} x_{a,i,t}$$

That is, the index directly sums the macroprudential policy stance across all seventeen tools measured in the dataset. In this context, a larger positive value would be associated a more restrictive policy stance, and a larger negative value reflects a more accomodative stance. This index, then, captures the net intent on macroprudential policy stance.

that article, as well as Akinci and Olmstead-Rumsey (2018 (Akinci; Olmstead-Rumsey, 2018)) and Cerutti et al. (2016) (Cerutti *et al.*, 2016) have used cumulative or net indexes for multiple instruments. This approach is devised as a means to avoid focusing on a single tool and to gauge the synergy of all macroprudential policy measures being put at work by the monetary authorities. In their study, Revelo et al. (2020) (Revelo; Lucotte; Pradines-Jobet, 2020) highlight that $\sum_a x_{a,i,t}$ is particularly effective in indicating the stance of macroprudential policy, as it is the most explicit indicator if the wanted objective is to get a clear picture of the overall evolution of macroprudential policy action.

Cerutti et al. (2016) (Cerutti *et al.*, 2016) proposed a macroprudential policy indicator that includes nine instruments, namely: specific capital buffers related to real estate credit (CB REC); specific capital buffers related to consumer credit (CB CC); other specific capital buffers (CB OS); capital requirements (CAPREQ); concentration limits (CONC); limits on interbank exposures (IBEX); loan-to-value ratios (LTV); reserve requirements for deposit accounts denominated in local currency (RRLC); and reserve requirements for deposit accounts denominated in foreign currency (RRFC). In total, the dataset provides seventeen instruments. This research, however, will employ versions of the indexes that encompass all macroprudential policies listed in the Integrated Macroprudential Policy Database originally developed by Alam et al (2019) (Alam *et al.*, 2019), including countercyclical capital buffers (CCB), capital conservation buffers (CCoB), leverage ratio requirements (LRR), loan loss provision requirements (LLPR), limits on credit growth (LCG), loan restrictions (LoanR), limits on foreign currency lending (LFCL), debt-service-to-income and loan-to-income ratios (DSTI), transaction, asset, or liability taxes (TALT), liquidity coverage ratios (LCR), loan-to-deposit ratios (LTDR), foreign exchange exposure limits (FXEL), measures for systemically important financial institutions (SIFI), and other macroprudential measures (OMP).

It is also relevant to highlight that the iMaPP Database, developed by Alam et al. (2019) (Alam *et al.*, 2019), includes sectorial indicators for some particular macroprudential policy

instruments. This work will develop the macroprudential policy indexes using the sectorial indicators instead of the main indiators for the respective sectors. These indicators are:

- Capital requirements, for the general non-financial sector and for households.
- Limits on growth of aggregated credit, for the general non-financial sector and for households.
- Loan restrictions, for households.

4.2 Model 1: Baseline Specification

The baseline model, without interactions, is specified as follows:

$$\textbf{For each } \ell \in \{1,2,3,4\}: \quad \begin{aligned} \text{CreditGrowth}_{s,i,t} &= \alpha^{(\ell)} + \beta^{(\ell)}\,\text{PruC}_{i,t-\ell} + \gamma^{(\ell)}\,\text{Policy}_{i,t-1} \\ &+ \delta^{(\ell)}\,\text{GDP}_{i,t-1} + \kappa_1^{(\ell)}\,2008_t + \kappa_2^{(\ell)}\,2020_t \\ &+ \theta^{(\ell)}\,\text{Target}_{i,t} + \mu_i^{(\ell)} + \epsilon_{i,t}^{(\ell)}. \end{aligned}$$

Where:

- $CreditGrowth_{s,i,t}$ represents the year-over-year growth on credit stock. That is, growth change in credit for sector s in country i at time t.
- $\text{PruC}_{i,t-\ell}$ denotes the macroprudential policy index for country i at time t lagged by ℓ periods.
- $\text{Policy}_{i,t-1}$ is the nominal monetary policy rate issued by the Central Banks, lagged by one period.
- $\text{GDP}_{i,t-1}$ is the year-over-year quarterly real gross domestic product, seasonally adjusted, growth, lagged by one period.
- 2008_t is a dummy variable capturing the 2008 global financial crisis. It is equal to 1 if the year is 2008 or 2009, and 0 otherwise.
- 2020_t is a dummy variable capturing the 2020 COVID pandemic early years. It is equal to 1 if the year is 2020 or 2021, and 0 otherwise.
- $\text{Target}_{i,t}$ is a dummy variable indicating whether country i has an inflation targeting regime at period t.
- μ_i are country-specific fixed-effects.
- $\epsilon_{i,t}$ is the error term.

The analyzes, in regards to credit stock growth, will encompass three different sectors: the general non-financial sector, households and non-profit institutions serving households and, lastly, general government, which includes central and local government entities, as well as social security funds, but excludes State-Owned Enterprises.

The overreaching thesis presented by Revelo et al (2020 (Revelo; Lucotte; Pradines-Jobet, 2020)) revolves arround the need for synergy between monetary policy and macroprudential policy stances for the desired effectiveness of the instruments. Taking that into consideration, it is plausible to consider that having an inflation-targeting regime might, in some shape or form, have influence on credit growth as well as in the effects that the changes in macroprudential policy stances provide. The adhesion to an inflation-targeting regime by the monetary authority could possibly restrain the capacity of said authority to "dance the tango in harmony", as coined by Revelo, but it could also possibly signify a better structured financial system or even more credibility for the monetary authority, as well as different institutional and governance frameworks for price stability, leading to a more stable credit growth outlook overall. Taking these possibilities into consideration, the inclusion of our target dummy aims to help provide answers as to how having a inflation targeting regime influences credit growth, from a baseline level, for the different sectors analyzed, as there might be different responses across the board.

The inclusion of the nominal monetary policy stance as a control is in accordance to what Revelo et al. (2020) (Revelo; Lucotte; Pradines-Jobet, 2020) discuss, as in how an accommodative monetary policy might offset the credit-restraining effects of macroprudential tightening or, conversely, reinforce them when monetary policy also becomes restrictive. For the inclusion of real GDP growth, as in Revelo et al. (2020) (Revelo; Lucotte; Pradines-Jobet, 2020) and in Cerutti et al. (2017) (Cerutti; Claessens; Laeven, 2017), controlling for real economic activity is standard practice when testing for policy effects on credit. Without itas a control, there are risks of conflating cyclical upswings with the impact of macroprudential policy stances.

As for the inclusion of controls for the relevant crisis years, Revelo et al. (2020) (Revelo; Lucotte; Pradines-Jobet, 2020) emphasize that credit developments during crisis periods can deviate from typical behavior, so these variables help isolate extraordinary changes. The authors also note that ignoring major crisis episodes could bias the estimated effect of macroprudential or monetary tools. Considering the time frame selected for this study, from 2005 to 2021, the inclusion of controls for the global 2008 financial crisis and the COVID pandemic can be seen as a necessary measure for the objectives of this analyzes.

Finally, in regards of the inclusion of multiple lag structures in the model, macroprudential policy instruments, and even traditional monetary policy, generally is perceived with a delayed effects, for example, due to existing contracts delaying the responses in bank lending. By testing multiple lag lengths, it is possible to pinpoint how quickly (or slowly) the macroprudential policy stance changes are manifested in credit growth. Works like Revelo et al. (2020 (Revelo; Lucotte; Pradines-Jobet, 2020)) and Cerutti (2017 (Cerutti; Claessens; Laeven, 2017)) showed that three to four quarter lags can be strongly significant for macroprudential impacts on credit growth.

All in all, this baseline model aims to provide insights on the effects of both macroprudential policy and an inflation-targeting regime on credit growth.

4.3 Model 2: Two-Way Interaction (Advanced Economies and Inflation Targeting)

The second model is differentiated from the first one by the addition of an interaction between $Target_{i,t}$ and AE_i, a new dummy included in this specification. Which is as follows:

$$\textbf{For each } \ell \in \{1,2,3,4\}:$$

$$\begin{aligned}\text{CreditGrowth}_{i,t} &= \alpha^{(\ell)} + \beta^{(\ell)}\,\text{PruC}_{i,t-\ell} + \gamma^{(\ell)}\,\text{Policy}_{i,t-1} \\ &+ \delta^{(\ell)}\,\text{GDP}_{i,t-1} + \kappa_1^{(\ell)}\,2008_t + \kappa_2^{(\ell)}\,2020_t \\ &+ \theta^{(\ell)}\,\text{Target}_{i,t} + \rho^{(\ell)}\Big(\text{AE}_i \times \text{Target}_{i,t}\Big) \\ &+ \mu_i^{(\ell)} + \epsilon_{i,t}^{(\ell)}.\end{aligned}$$

Here, AE_i is a dummy variable that is equal to 1 if the country i is an advanced economy and equal to 0 otherwise. The other variables here follow the same description as in the previous specification. Works like Cerutti et al. (2016 (Cerutti *et al.*, 2016)), Akinci and Olmstead-Rumsey (2018 (Akinci; Olmstead-Rumsey, 2018)) and Revelo et al. (2020 (Revelo; Lucotte; Pradines-Jobet, 2020)) demonstrates that advanced and emerging economies often respond differently to monetary and macroprudential changes, By interacting AE_i with $Target_{i,t}$, it is possible to test whether inflation-targeting, in tandem with being an advanced economy, influences credit dynamics differently. Emerging and developing economies usually are more vulnerable to macroeconomic instability and financial cycles than advanced economies, so it is reasonable to consider that a regime that one of the results perceived is less inflation volatility (Stojanovksi e Petrevski, 2019 (Stojanovikj; Petrevski, 2019); Stojanovksi e Petrevski, 2024 (Stojanovikj; Petrevski, 2024)) may impact those countries differently. It is also interesting to highlight that EMDEs, usually, have more credibility and expectation problems regarding their monetary authorities, as well as less rigid institutional frameworks, and in a context like this, an inflation-targeting regime may not only anchor expectations, but also be associated with a significant institutional revamping, in regards to independence and accountability of the Central Banks (Chugunov et al, 2019 (Chugunov; Pasichnyi; Nepytaliuk, 2019)).

Taking that in consideration, separating the effects between these two groups may provide relevant insights for the object of this research.

4.4 Model 3: Three-Way Interaction (Advanced Economies, Inflation Targeting, and Macroprudential Policy Index

Finally, the final model specification differs itself from the previous by adding a three-way interaction, adding $\text{PruC}_{i,t-\ell}$ to the interaction featured in Model 2. The specification follows the structure outlined below:

$$
\begin{aligned}
\text{CreditGrowth}_{i,t} \;=\; & \alpha^{(\ell)} \;+\; \beta^{(\ell)}\,\text{PruC}_{i,t-\ell} \;+\; \gamma^{(\ell)}\,\text{Policy}_{i,t-1} \\
& +\; \delta^{(\ell)}\,\text{GDP}_{i,t-1} \;+\; \kappa_1^{(\ell)}\,2008_t \;+\; \kappa_2^{(\ell)}\,2020_t \\
\textbf{For each } \ell \in \{1,2,3,4\}: \quad & +\; \theta^{(\ell)}\,\text{Target}_{i,t} \\
& +\; \rho^{(\ell)}\Big(\text{AE}_i \;\times\; \text{Target}_{i,t} \;\times\; \text{PruC}_{i,t-\ell}\Big) \\
& +\; +\mu_i^{(\ell)} \;+\; \epsilon_{i,t}^{(\ell)}.
\end{aligned}
$$

Again, the symbols refer to the same variables described before. This model, by including the three-way interaction $\text{AE}_i \;\times\; \text{Target}_{i,t} \;\times\; \text{PruC}_{i,t-\ell}$ enables the analyzes of how a macroprudential policy stance change effects differ between the four distinct groups: inflation-targeting advanced economies, inflation-targeting emerging and developing economies, non-inflation-targeting advanced economies and non-inflation targeting emerging and developing economies.

By doing that, it is possible to see how differently these groups have their credit stock growth affected by macroprudential policy changes in regards to the net-effects of macroprudential policy action, as well as

This model, however, due to the presence of high-order interactions, is keen to show high multicolinearity, which could undermine the conclusions brought by the model. However, the previous models may work as robustness checks for this model, if the coefficients look similar, the standard errors don't explode and overall model stability is maintained.

5 Results

5.1 Baseline Model - No Interaction

5.1.1 Credit to the General Non-Financial Sector

Table 5.1 – Baseline Model - Non-financial Sector

Variable	Lag 1	Lag 2	Lag 3	Lag 4
PruC$_{i,t-\ell}$	0.085 (0.121)	-0.076 (0.121)	-0.233* (0.120)	-0.250* (0.118)
Policy$_{i,t-1}$	0.896*** (0.034)	0.879*** (0.034)	0.858*** (0.034)	0.849*** (0.034)
GDP$_{i,t-1}$	0.050 (0.031)	0.054 (0.031)	0.064* (0.030)	0.063* (0.030)
2008$_t$	1.353*** (0.369)	1.320*** (0.369)	1.317*** (0.366)	1.338*** (0.366)
2020$_t$	1.747*** (0.368)	1.682*** (0.368)	1.576*** (0.366)	1.610*** (0.363)
Target$_{i,t}$	-0.386 (0.723)	-0.942 (0.649)	-1.047 (0.647)	-1.118. (0.652)
Observations	2562	2565	2530	2494
R-squared	0.231	0.223	0.219	0.216
Adj. R-squared	0.218	0.210	0.206	0.202
F-statistic	126.285	120.821	116.279	112.214

Note: Standard errors in parentheses. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

The macroprudential policy index used in this model, $PruC$, is the sum of $+1/0/-1$ across all macroprudential policy instruments featured in the dataset in the respective quarter, that is, it captures the net intent of the macroprudential policy measures adopted in that respective period.

The reasoning behind using the sum of all instruments for an index comes from how macroprudential policy usually relies on multiple tools, so summing would lead to an understanding of the intent behind the policy measures in that specific period, that is, if the responsible authority is aiming for a tightening or loosening stance for that period. The net stance as the index measure also enables a better comparability between countries and across time, as the policy tools vastly shifts across different countries and the countries also change their available tool set at different periods, due to risen necessities and changes in legislation.

Looking into the coeficient that acompanies $PruC$, we see that it is small and not statistically significant at earlier lags, even donning a positive coefficient at the earliest lag structure. Later, at lags 3 and 4, it turns statistically significant and negative, also achieving a larger magnitude overall, when compared to both earlier lags. This suggests that, if a country takes a net tightening action on macroprudential policy instruments, it is able to enact a

negative effect on credit growth, specially on the longer run, with the greater negative effect taking place after four quarters of the action being taken. This result is consistent with other works like Revelo (2020) (Revelo; Lucotte; Pradines-Jobet, 2020), which also found a stronger lagged effect for the macroprudential policy indexes used in the work.

The inflation-targeting regime dummy, which assumes 1 for countries that have an formal, single-country inflation-targeting regime at the respective period, and zero otherwise, is accompanied by a negative coefficient in all four lag periods, albeit not significant in the first two lag structures. This would imply that inflation-targeting countries have a tendency to have lower baseline credit growth, specially in the medium term. A way to interpret this is that an inflation-targeting regime might, over time, impose a more disciplined monetary and fiscal environment, specially for emerging and developing economies, something that is vastly discussed in the literature (Miles, 2007 (Miles, 2007); Abo-Zaid and Tuzeman, 2012 (Abo-Zaid; Tuzemen, 2012); Combes et al, 2014 (Combes *et al.*, 2014); Fry-McKibbin and Wang, 2014 (Fry-McKibbin; Wang, 2014); Ardakani et al, 2018 (Ardakani; Kishor; Song, 2018); Minea et al, 2021 (Minea; Tapsoba; Villieu, 2021)), which could eventually manifest in slower credit expansion. Other possible interpretation that could rise from this results is that inflation-targeting regimes are associated with greater financial stability (Fouejieu, 2017 (Fouejieu, 2017); Gong and Qian, 2022 (Gong; Qian, 2022); Kim and Mehrotra, 2017 (Kim; Mehrotra, 2017)).

All in all, for the general non-financial sector, we see that tightening macroprudential policy action has a statistically significant negative effect on credit growth, albeit delayed. It is also observed that inflation-targeting countries exhibit statistically significant lower baseline credit growth than non-targeting countries, again, at three and four quarters delay structure for $PruC$.

5.1.2 Households and Non-Profit Organizations Servicing Households

Table 5.2 – Baseline Model - Household Sector

Variable	Lag 1	Lag 2	Lag 3	Lag 4
$\mathbf{PruC}_{i,t-\ell}$	-0.584*** (0.135)	-0.622*** (0.132)	-0.570*** (0.130)	-0.534*** (0.125)
$\mathbf{Policy}_{i,t-1}$	0.226*** (0.037)	0.218*** (0.037)	0.195*** (0.036)	0.175*** (0.036)
$\mathbf{GDP}_{i,t-1}$	0.529*** (0.034)	0.511*** (0.033)	0.497*** (0.032)	0.485*** (0.031)
$\mathbf{2008}_t$	2.940*** (0.411)	3.053*** (0.402)	3.195*** (0.396)	3.387*** (0.385)
$\mathbf{2020}_t$	-0.497 (0.404)	-0.458 (0.396)	-0.440 (0.391)	-0.245 (0.378)
$\mathbf{Target}_{i,t}$	-0.051 (0.809)	0.527 (0.708)	1.038 (0.700)	1.655* (0.686)
Observations	2535	2540	2507	2473
R-squared	0.113	0.113	0.114	0.118
Adj. R-squared	0.098	0.098	0.099	0.103
F-statistic	52.798	53.150	52.986	54.336

Note: Standard errors in parentheses. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Now looking at credit directed at households and non-profit organizations serving households, we see that *PruC*'s coefficient is negative from the get-go, being statistically significant starting at the two quarter lag mark. This supports the idea, seen in articles like Kim and Mehrotra (2022) (Kim; Mehrotra, 2022), that credit directed at households is especially responsive to macroprudential policy action. That is logical when you consider that some of the macroprudential policies that are focused on the borrower, like LTV and DTI limits, often target household lending more directly, so it is reasonable to see credit directed at households having a more direct reaction when isolated.

In regards to the inflation-targeting regime dummy, it is positive across all lag structures, however, it does not present statistically significant results up until the four quarter lag structure. One possible reasoning behind this is that in inflation-targeting environments, the general financing backdrop might have more stability, which encourages more mortgages or consumer lending, which is plausible considering these countries may have a more stable inflationary environment.

The bottom line here is that net tightening macroprudential policy stance has a robust and relatively quicker negative impact on credit aimed at households. However, as for the inflation-targeting regime dummy does not show a lower level of household credit growth, unlike the other sectors, if anything, it has slightly positive effects at later lags.

5.1.3 General Government

Table 5.3 – Baseline Model - Government Sector

Variable	Lag 1	Lag 2	Lag 3	Lag 4
$\mathbf{PruC}_{i,t-\ell}$	-0.310 (0.235)	-0.457* (0.236)	-0.738** (0.237)	-0.428 (0.236)
$\mathbf{Policy}_{i,t-1}$	-0.098 (0.131)	-0.044 (0.133)	-0.061 (0.133)	-0.033 (0.135)
$\mathbf{GDP}_{i,t-1}$	-0.780*** (0.062)	-0.797*** (0.062)	-0.791*** (0.062)	-0.804*** (0.062)
$\mathbf{2008}_t$	4.890*** (0.748)	4.804*** (0.758)	4.742*** (0.760)	4.732*** (0.765)
$\mathbf{2020}_t$	2.791*** (0.709)	2.871*** (0.716)	2.630*** (0.722)	2.905*** (0.717)
$\mathbf{Target}_{i,t}$	-1.325 (1.470)	-1.623 (1.353)	-1.785 (1.367)	-2.154 (1.389)
Observations	1888	1889	1862	1835
R-squared	0.146	0.151	0.154	0.152
Adj. R-squared	0.131	0.136	0.139	0.137
F-statistic	52.889	54.886	55.648	53.900

Note: Standard errors in parentheses. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Now for the general government, the results are somewhat mixed but generally negative. We have significant effect at the two quarter and three quarter lag structures, and the effect with the largest magnitude in the three quarter lag, for the matter. This pattern suggests that there is a delayed effect in the medium run for credit extended to the government. The lack of immediate significance may, indeed, show that this type of credit is less sensitive to macroprudential policy changes in the very short-run, however, considering that it is still negative, despite non-significant, it may as well be interpreted as a limitation of the model results. It is important to note, however, the most significant and the stronger effect overall, in terms of magnitude, is located at the three quarter lag, indicating the stronger effect is felt at the medium-run, and somewhat earlier than the general non-financial sector.

When looking at the inflation-targeting regime dummy, we have negative coefficients from the one quarter lag structure up to the four quarter lag structure, albeit not statistically significant at any point. This could indicate that, unlike the results for credit directed at households or the greater non-financial sector, having a formal inflation-targeting regime does not materially alter the baseline credit growth rate for government borrowing, at least not in a statistically robust way.

The main outline is that credit to the government appears somewhat sensitive to the effects of macroprudential policies, being more rapidly affected by changes than the greater non-financial sector, but slower than credit directed at households. Meanwhile, for this sector, there doesn't seen to be a statistically significant effect of having an inflation-targeting regime, results that, however, should be taken carefully, considering the limitations in sample size for this sector data.

5.2 First Interaction - $Target \times AE$

5.2.1 Credit to the General Non-Financial Sector

Table 5.4 – First Interaction Model - Non-Financial Sector

Variable	Lag 1	Lag 2	Lag 3	Lag 4
$\mathbf{PruC}_{i,t-\ell}$	0.089 (0.121)	-0.096 (0.121)	-0.257* (0.120)	-0.241* (0.119)
$\mathbf{Policy}_{i,t-1}$	0.898*** (0.034)	0.879*** (0.034)	0.858*** (0.034)	0.848*** (0.034)
$\mathbf{GDP}_{i,t-1}$	0.050 (0.031)	0.062* (0.031)	0.071* (0.030)	0.070* (0.030)
$\mathbf{2008}_t$	1.388*** (0.368)	1.378*** (0.365)	1.369*** (0.362)	1.395*** (0.362)
$\mathbf{2020}_t$	1.741*** (0.367)	1.652*** (0.363)	1.545*** (0.361)	1.598*** (0.358)
$\mathbf{Target}_{i,t}$	-1.604 (1.345)	-2.324. (1.373)	-3.129* (1.399)	-3.545* (1.450)
$\mathbf{Target}_{i,t}$**:AE**$_i$	2.705 (1.713)	3.527* (1.733)	4.427* (1.750)	4.856** (1.794)
Observations	2524	2489	2454	2418
R-squared	0.235	0.230	0.227	0.224
Adj. R-squared	0.222	0.216	0.213	0.209
F-statistic	108.991	104.396	101.125	97.619

Note: Standard errors in parentheses. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

This secondary model adds an interaction between the inflation-targeting regime dummy variable and an advanced economy dummy, that is equal to 1 if the country is an advanced economy and equal to 0 if it is an emerging or developing economy. The interaction, $Target \times AE$, aims to add a layer to the previous model, differentiating between AEs with a formal, single country, inflation target regime and EMDEs with the same regime. With this, we can differentiate between those two groups and see how the effects fare between them.

The coefficient associated with $PruC$ in this model starts small and not statistically significant at the first two lag structures, being positive at the one quarter lag and starts to be negative at the two quarter lag. This result suggests, similarly to the results found at the previous model for the same credit sector, that a net tightening of macroprudential policy instruments has a effect on reducing credit growth, albeit with a delayed effect.

Looking at the inflation-targeting dummy, we see that the coefficient is increasingly negative across lags, and starts being statistically significant at the two quarter lag mark. This can be interpreted as, for EMDE, a lower baseline credit growth associated with an inflation target regime. The interaction term $Target \times AE$ captures the additional shift in baseline credit, and it is negative throughout all lag structures, being significant starting at the two quarter lag. Looking at the net effect, it shows a positive shift to baseline credit growth for countries that are both inflation-targeting and AE.

This can be consistent with the presence of a more developed financial system in countries that are both inflation-targeting and AE, which might allow households and firms to sustain higher borrowing even within a stable monetary policy framework.

5.2.2 Households and Non-Profit Organizations Servicing Households

Table 5.5 – First Interaction Model - Household Sector

Variable	Lag 1	Lag 2	Lag 3	Lag 4
$\mathbf{PruC}_{i,t-\ell}$	-0.624*** (0.136)	-0.652*** (0.134)	-0.597*** (0.133)	-0.547*** (0.128)
$\mathbf{Policy}_{i,t-1}$	0.222*** (0.038)	0.206*** (0.037)	0.186*** (0.037)	0.167*** (0.036)
$\mathbf{GDP}_{i,t-1}$	0.539*** (0.035)	0.528*** (0.034)	0.509*** (0.033)	0.495*** (0.032)
$\mathbf{2008}_t$	2.942*** (0.412)	3.091*** (0.406)	3.256*** (0.400)	3.481*** (0.389)
$\mathbf{2020}_t$	-0.485 (0.405)	-0.449 (0.399)	-0.440 (0.394)	-0.255 (0.381)
$\mathbf{Target}_{i,t}$	-5.375*** (1.574)	-3.270* (1.594)	-0.691 (1.616)	2.923. (1.626)
$\mathbf{Target}_{i,t}$**:**$\mathbf{AE}_i$	7.288*** (1.965)	5.368** (1.974)	3.056 (1.983)	-0.360 (1.977)
Observations	2497	2464	2431	2397
R-squared	0.121	0.119	0.118	0.121
Adj. R-squared	0.105	0.103	0.101	0.105
F-statistic	48.123	46.507	45.389	46.349

Note: Standard errors in parentheses. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

When looking at the coefficient accompanying $PruC$, it is negative and statistically significant from the one quarter lag through the four quarter lag, again, a similar result to the previous model, indicating that credit directed at households tend to be more sensitive to macroprudential policy tightening.

The inflation-targeting dummy presents a different behavior in this model than the previous one, however. In this model, it starts strongly negative and highly significant at the one quarter lag, staying negative and significant at the two quarter lag and negative but non-significant at the three quarter lag. This shows that, for EMDE, at the short-to-medium run, an inflation-targeting regime is associated with lower baseline credit growth. But at the fourth quarter lag structure, the coefficient turns positive, albeit marginally significant. Meaning that the observed difference in baseline credit growth difference diminishes over time. Now looking at the interaction, it is strongly positive and significant at the first two lag structures, and outweighs the negative effect associated with the Target dummy, indicating that household credit expansions in advanced economies presents a higher baseline line credit growth when compared to EMDE targeting countries in the short-to-medium run. The effects is insignificant and positive at three quarter lag and negative, albeit still not significant, at the four quarter lag structure.

5.2.3 General Government

Table 5.6 – First Interaction Model - Government Sector

Variable	Lag 1	Lag 2	Lag 3	Lag 4
$\mathbf{PruC}_{i,t-\ell}$	-0.335 (0.236)	-0.618** (0.235)	-0.809*** (0.236)	-0.334 (0.235)
$\mathbf{Policy}_{i,t-1}$	-0.139 (0.131)	-0.175 (0.132)	-0.191 (0.132)	-0.159 (0.133)
$\mathbf{GDP}_{i,t-1}$	-0.766*** (0.063)	-0.750*** (0.063)	-0.753*** (0.062)	-0.771*** (0.062)
$\mathbf{2008}_t$	4.953*** (0.744)	5.029*** (0.745)	4.987*** (0.746)	5.010*** (0.752)
$\mathbf{2020}_t$	2.713*** (0.704)	2.594*** (0.703)	2.386*** (0.708)	2.738*** (0.704)
$\mathbf{Target}_{i,t}$	6.433 (5.550)	7.619 (6.716)	7.213 (9.402)	-1.419 (1.797)
$\mathbf{Target}_{i,t}\mathbf{:AE}_i$	-7.756 (5.819)	-8.867 (6.942)	-8.395 (9.568)	–
Observations	1860	1833	1806	1779
R-squared	0.147	0.150	0.153	0.149
Adj. R-squared	0.131	0.134	0.137	0.133
F-statistic	44.786	45.466	45.761	50.781

Note: Standard errors in parentheses. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

As for the general government, the coefficient associated with *PruC* is outright negative, albeit not significant, turning significant at the two and three quarter lag structure, and being not significant again at the four quarter lag.

As for the inflation-targeting dummy and the interaction with AE, both are insignificant throughout all lag structures. Which suggests that neither being an advanced economy nor having an inflation-targeting regime is a key differentiator when it comes to government borrowing growth, again, it is important to consider the limitations regarding this sector specifically.

5.3 Second Interaction - $PruC \times Target \times AE$

5.3.1 Credit to the General Non-Financial Sector

Table 5.7 – Second Interaction Model - Non-Financial Sector

Variable	Lag 1	Lag 2	Lag 3	Lag 4
PruC$_{i,t-\ell}$	2.692*** (0.396)	1.076** (0.401)	-0.926* (0.402)	-1.501*** (0.399)
Policy$_{i,t-1}$	0.848*** (0.034)	0.855*** (0.035)	0.873*** (0.035)	0.873*** (0.035)
GDP$_{i,t-1}$	0.063* (0.031)	0.067* (0.031)	0.069** (0.030)	0.069** (0.030)
2008$_t$	1.515*** (0.365)	1.435*** (0.365)	1.333*** (0.362)	1.356*** (0.361)
2020$_t$	1.611*** (0.364)	1.575*** (0.364)	1.569*** (0.362)	1.660*** (0.359)
Target$_{i,t}$	-0.906 (1.338)	-1.947 (1.378)	-3.364* (1.406)	-3.996** (1.453)
Target$_{i,t}$**:AE**$_i$	2.196 (1.702)	3.265. (1.736)	4.710** (1.755)	5.300** (1.796)
PruC$_{i,t-\ell}$**:AE**$_i$	-2.847*** (0.434)	-1.193** (0.439)	0.821. (0.440)	1.387** (0.437)
PruC$_{i,t-\ell}$**:Target**$_{i,t}$	-2.546*** (0.461)	-1.179* (0.464)	0.758 (0.464)	1.471** (0.463)
PruC$_{i,t-\ell}$**:Target**$_{i,t}$**:AE**$_i$	2.106*** (0.553)	0.747 (0.556)	-1.061. (0.555)	-1.588** (0.555)
Observations	2524	2489	2454	2418
R-squared	0.251	0.234	0.228	0.227
Adj. R-squared	0.237	0.219	0.213	0.212
F-statistic	82.991	74.495	71.222	69.701

Note: Standard errors in parentheses. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

This specification's main feature is the interaction $PruC \times Target \times AE$ for the different lag structures. This interaction is meant to allow an interpretation on how effective macroprudential policy action is for each of the four different groups present in the analysis: inflation targeting advanced economies, inflation targeting emerging and developing economies, non-inflation targeting advanced economies and non-inflation targeting emerging and developing economies. Taking that in consideration, the coefficients that accompanies $PruC$ tells how credit growth, measured in percentage, responds, on average, when the net macroprudential policy stance changes by one unit. In our model, $PruC$ is also featured in interactions, so we need to take that in consideration when analyzing the complete effect of $PruC$ on credit growth, as it varies depending on the two dummies that accompanies it in the three-way interaction $Pruc \times Target \times AE$.

So, while looking at the net-effects of $PruC$ on credit growth, we can again divide the sample in four different groups, it is possible to outline the results as follows:

Group	AE	Target$_{i,t}$	Effect of $PruC$
EMDE, non-targeting	0	0	β (Baseline effect without AE and Target)
EMDE, targeting	0	1	$\beta + \rho_1$ (Target interaction is 'on')
AE, non-targeting	1	0	$\beta + \rho_2$ (AE interaction is 'on')
AE, targeting	1	1	$\beta + \rho_1 + \rho_2 + \rho_3$

Table 5.8 – Effects of $PruC$ for Different Groups

Taking that in consideration, the following table relays the net effect for the macroprudential policy index at the different lag structures for the groups previously devised:

Group (AE, Target)	Lag 1	Lag 2	Lag 3	Lag 4
EMDE, non-targeting: (0, 0)	2.6922	1.0764	-0.9261	-1.5014
EMDE, targeting: (0, 1)	0.1463	-0.1027	-0.1676	-0.0302
AE, non-targeting: (1, 0)	-0.1550	-0.1166	-0.1047	-0.1147
AE, targeting: (1, 1)	-0.5945	-0.5486	-0.4075	-0.2314

Table 5.9 – Net Effects of $PruC$ for Groups Across Lags

There is a clear pattern that can be visualized here. The emerging and developing economies, both targeting and non-targeting, present a "delayed effect", which is show in the results as an initial increase in credit growth associated with a net tightening action across instruments on the macroprudential policy index, a result similar to what was presented by previous works like Revelo (2020) (Revelo; Lucotte; Pradines-Jobet, 2020). However, the pattern that can be seen here paints a different picture. When looking at advanced economies, we see a more immediate negative effect on advanced economies, however, more important than that, we see that inflation targeting economies, both emerging and advanced alike, have a more immediate effect of macroprudential policy action.

That is, being either an advanced economy or having an inflation targeting regime can reduce the lag between the policy implementations and the effects on reducing credit growth. However, when looking only for the longer run, the magnitude of the effects in absolute terms is smaller for the advanced economies and inflation targeting economies, but that can be a result of an effect that is diluted over time versus an effect that only takes place later on.

It is also important to highlight that, for EMDE, having an inflation-targeting regime is associated with a lower overall credit growth than EMDE without targeting in all lag structures, as well as lower baseline credit growth than both targeting AEs and non-targeting AEs, indicating that it is possible that, for an EMDE, having an inflation targeting-regime has a strong effect on credit growth as a whole, and not only macroprudential policy effects.

The literature discusses thoroughly how an inflation targeting regime, specially for

EMDE, can achieve not only a structural break on inflation and keep inflation under control, but is also capable of providing greater financial stability and even economic growth (CITE). Considering that, it is understandable that having and inflation targeting leads to a lower baseline level of credit growth. As for the slightly higher levels of baseline credit growth associated with inflation-targeting AEs, that could be credited to the presence of more developed and capillary financial systems overall.

It is discussed by some studies in the literature that, for EMDE, despite inflation-target being well regarded as being capable of achieving price stability, it is effects on overall financial stability are more nuanced, specially considering that EMDE are more vulnerable to financial cycles than AEs (Bhalla et al, 2023 (Bhalla; Bhasin; Loungani, 2023); Zhang and Wang, 2022 (Zhang; Wang, 2022)). However, there are far more studies pointing in the direction of inflation-targeting being associated with an overall improvement in financial stability, and even economic growth, albeit that being a really disputed claim in the last few years (Hu, 2006 (Hu, 2006); Fouejieu, 2017 (Fouejieu, 2017); Gong and Qian, 2022 (Gong; Qian, 2022); Kim and Mehrotra, 2017 (Kim; Mehrotra, 2017)), which would work as an additional explanation on why an inflation-targeting regime being associated with faster negative effects on credit growth due to macroprudential policy effects for both AE and EMDE.

5.3.2 Households and Non-Profit Organizations Servicing Households

Table 5.10 – Second Interaction Model - Household Sector

Variable	Lag 1	Lag 2	Lag 3	Lag 4
PruC$_{i,t-\ell}$	-1.931*** (0.455)	-2.336*** (0.452)	-2.607*** (0.449)	-2.005*** (0.435)
Policy$_{i,t-1}$	0.245*** (0.038)	0.241*** (0.038)	0.234*** (0.038)	0.199*** (0.037)
GDP$_{i,t-1}$	0.532*** (0.035)	0.520*** (0.034)	0.503*** (0.033)	0.490*** (0.032)
2008$_t$	2.884*** (0.412)	3.023*** (0.406)	3.184*** (0.399)	3.426*** (0.389)
2020$_t$	-0.447 (0.405)	-0.391 (0.399)	-0.331 (0.394)	-0.196 (0.381)
Target$_{i,t}$	-5.561*** (1.574)	-3.543* (1.592)	-1.094 (1.611)	2.601 (1.625)
Target$_{i,t}$**:AE**$_i$	7.479*** (1.964)	5.640** (1.971)	3.414. (1.978)	-0.057 (1.975)
PruC$_{i,t-\ell}$**:AE**$_i$	1.396** (0.499)	1.964*** (0.494)	2.321*** (0.491)	1.719*** (0.476)
PruC$_{i,t-\ell}$**:Target**$_{i,t}$	1.620** (0.525)	1.717*** (0.520)	1.997*** (0.515)	1.429** (0.501)
PruC$_{i,t-\ell}$**:Target**$_{i,t}$**:AE**$_i$	-1.717** (0.633)	-1.931** (0.627)	-2.117*** (0.620)	-1.608** (0.604)
Observations	2497	2464	2431	2397
R-squared	0.124	0.124	0.126	0.126
Adj. R-squared	0.108	0.107	0.109	0.109
F-statistic	34.764	34.315	34.323	33.899

Note: Standard errors in parentheses. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Group (AE, Target)	Lag 1	Lag 2	Lag 3	Lag 4
EMDE, non-targeting: (0, 0)	-1.931	-2.336	-2.607	-2.005
EMDE, targeting: (0, 1)	-0.311	-0.619	-0.610	-0.576
AE, non-targeting: (1, 0)	-0.535	-0.372	-0.286	-0.286
AE, targeting: (1, 1)	-0.632	-0.586	-0.406	-0.465

Table 5.11 – Net Effects of PruC for Groups Across Lags (Households)

While looking at the results for credit aimed at households and non-profit organizations servicing households, we see a more immediate effect across the board, with all four groups having immediate negative effects at the one period lag level.

Kim and Mehrotra (2022) (Kim; Mehrotra, 2022) argued through their results that macroprudential policy changes affect strongly investments, and specially residential investments and household credit. In the context of their work, they discuss that as the transmission mechanism through macroprudential policy shocks can affect real economic variables, like GDP. However, our results align when showing that macroprudential policy action seems to ahve a more immediate affect in credit directed to households than when looking at the whole non-financial sector.

Looking at the different results between groups, we can see a different pattern than the one painted for the general non-financial sector. We see a greater effect across the board for non-targeting EMDE, which also align with findings from Kim and Mehrotra (2022) (Kim; Mehrotra, 2022), who argued that macroprudential policy tends to have a greater effect in magnitude in economies that have a less developed financial landscape. Since inflation-targeting is often associated with a more financial and exchange rate stability, as well as a more developed overall financial framework, it is reasonable to conclude that EMDE with inflation-taargeting regimes may have a better

5.3.3 General Government

Table 5.12 – Second Interaction Model - Government Sector

Variable	Lag 1	Lag 2	Lag 3	Lag 4
PruC$_{i,t-\ell}$	0.478 (1.050)	-0.983 (1.057)	-0.915 (1.059)	-0.559 (1.062)
Policy$_{i,t-1}$	-0.146 (0.132)	-0.179 (0.133)	-0.194 (0.133)	-0.160 (0.134)
GDP$_{i,t-1}$	-0.766*** (0.063)	-0.750*** (0.063)	-0.751*** (0.062)	-0.768*** (0.062)
2008$_t$	4.953*** (0.744)	5.028*** (0.745)	4.992*** (0.747)	5.028*** (0.752)
2020$_t$	2.678*** (0.707)	2.575*** (0.706)	2.389*** (0.711)	2.764*** (0.706)
Target$_{i,t}$	6.073 (5.560)	7.594 (6.729)	7.160 (9.415)	-1.506 (1.802)
Target$_{i,t}$**:AE**$_i$	-7.346 (5.831)	-8.823 (6.957)	-8.395 (9.582)	-
PruC$_{i,t-\ell}$**:AE**$_i$	-0.923 (1.086)	0.422 (1.095)	0.010 (1.098)	0.103 (1.103)
PruC$_{i,t-\ell}$**:Target**$_{i,t}$	-0.031 (1.272)	0.403 (1.286)	0.222 (1.286)	0.179 (1.290)
PruC$_{i,t-\ell}$**:Target**$_{i,t}$**:AE**$_i$	-0.052 (1.372)	-0.527 (1.386)	0.027 (1.388)	0.223 (1.393)
Observations	1860	1833	1806	1779
R-squared	0.148	0.150	0.153	0.149
Adj. R-squared	0.130	0.133	0.136	0.131
F-statistic	31.549	31.795	32.010	33.880

Note: Standard errors in parentheses. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Group (AE, Target)	**Lag 1**	**Lag 2**	**Lag 3**	**Lag 4**
EMDE, non-targeting: (0, 0)	0.478	-0.983	-0.915	-0.559
EMDE, targeting: (0, 1)	0.447	-0.580	-0.693	-0.380
AE, non-targeting: (1, 0)	-0.445	-0.561	-0.905	-0.456
AE, targeting: (1, 1)	-0.528	-0.685	-0.656	-0.054

Table 5.13 – Net Effects of `PruC` for Groups Across Lags (Government)

As for credit directed for the general government, we see that there is an immediate effect for AE, both targeting and non-targeting, while there is a delayed effect for EMDE, again, both targeting and non-targeting. Meaning that, in regards to credit directed at the government, the prevalent difference between the countries is in regards to whether they are EMDE or AE, and lesser so if they have inflation-targeting or not. This time, we see a higher magnitude for both non-targeting groups, in contrast to their targeting counterparts. We can infer that, for the government, inflation-targeting frameworks often accompany more stable funding regimes and possibly a clearer and more structured monetary and fiscal policy rule set, often featuring fiscal rules and restrictions to procuring funding through credit (Ardakani et al, 2018 (Ardakani; Kishor; Song, 2018)), thus borrowing could be less prone to big swings, so the observed magnitude of macroprudential policy impacts is smaller. However, this is an interpretation of the results at face value, disregarding the low significance displayed in the results.

Regarding the differences between EMDE and AE in this context, in EMDEs, gov-

ernments may rely on a wider range of domestic financing sources, such as state-owned banking systems or less-developed bond markets, and may as well face more volatile macroeconomic conditions, which may make the transmission of changes in macroprudential policy stances more uneven or delayed. On the other side, in AEs, more established capital markets and greater investor confidence may lead to a faster, though sometimes smaller in magnitude, reaction. Considering this, it is possible that the difference between the two groups in how timely the response to macroprudential policy happens is associated with an overall institutional landscape difference, as well as different needs in government funding.

However, it is important to note that the results for this sector should be taken with caution, not only because of the weaker significance of the estimates, but also because of the significantly smaller sample, driven by the unavailability of data for most countries regarding credit to the non-private non-financial corporations.

Despite that, a question highlighted by these results that may merit further investigation is the implied fact, by the low statistical significance, that, while an inflation-targeting regime might anchor macroeconomic expectations and is regarded as capable of reducing volatility, it may not have a significant impact in government debt and financing.

6 On the matter of multicolinearity

One major concern that is often raised when progressively adding multiple interaction terms is the potential for increases in multicolinearity between the variables. The following tables report the Variance Inflation Factors (VIF) for the three models, across each of the three credit sector that were analyzed.

Table 6.1 – VIF Results for General Sector (Models 1, 2, and 3)

Variable	Model 1	Model 2	Model 3
PruC	1.067821	1.069013	11.604242
Policy	1.026240	1.534247	1.574782
GDP	1.124469	1.155569	1.161975
2008	1.103473	1.103814	1.105141
2020	1.074337	1.076518	1.080054
Target	1.027770	4.960789	5.224725
AE	–	4.906911	5.045317
Target:AE	–	4.847000	5.113176
PruC:Target	–	–	7.367344
PruC:AE	–	–	9.456828
PruC:Target:AE	–	–	5.052820

Table 6.2 – VIF Results for Household Sector (Models 1, 2, and 3)

Variable	Model 1	Model 2	Model 3
PruC	1.050716	1.051856	11.553293
Policy	1.023507	1.533079	1.580038
GDP	1.119752	1.142997	1.151815
2008	1.103834	1.104088	1.105375
2020	1.064053	1.066518	1.069711
Target	1.028752	5.265524	5.465233
AE	–	5.088767	5.178735
Target:AE	–	5.093849	5.337129
PruC:Target	–	–	7.345367
PruC:AE	–	–	9.326965
PruC:Target:AE	–	–	4.907733

Table 6.3 – VIF Results for Government Sector (Models 1, 2, and 3)

Variable	Model 1	Model 2	Model 3
PruC	1.092436	1.094283	22.147129
Policy	1.171480	1.586558	1.608405
GDP	1.212632	1.217968	1.220998
2008	1.172070	1.177702	1.177743
2020	1.086362	1.094924	1.102763
Target	1.079332	8.590926	9.306567
AE	–	3.792351	4.104917
Target:AE	–	8.388862	9.092055
PruC:Target	–	–	13.380898
PruC:AE	–	–	20.392825
PruC:Target:AE	–	–	11.701815

In all three sectors, the baseline model specfication, without the interaction terms, show really low VIF values, mostly in the range of 1.0 to 1.2, which indicates minimal colinearity among those predictors. As expected, once including the two-way interaction in the second specification, VIF increases significantly, notably for Target, which is expected, considering that the interaction term can be partially redundant with the individual effects. As for the model with the three-way interaction, as expected, some variables exhibit even greater VIF values, above 5 or even 10, which suggests higher correlation among these variables.

The high VIF, while a reasonable concern, primarily reflects the fact that those explanatory variables appears multiple times in the regression. Considering that, it is important to take the results carefully, however, when focusing on joint effects for the specified subgroups, rather than interpreting each individual coefficient in isolation, the model adds an important dimension of analysis that can be taken in consideration.

Another important point to highlight is that, despite some VIF values rising above 10 in the final models, particularly in the government sector, which suffer with other problems. When we look at other diagnostics, we see that the models are still stable despite that, which is a fortunate indicator.

The standard errors are not exploding, the coefficients maintain credible signs and the results are compatible between the three models. Meaning that the first model, without interactions and that features low VIF values, works as a robustness check for the other two models. This suggests that the models are still providing useful insights, specially when using the interactions for the further interpretation of the effects between the different groups.

7 Limitations

The main source of limitation regarding the results presented in this research comes from data availability. A significant point to make is that the group of emerging and developing economies that do not use inflation targeting is sub-represented in the data sample used in this work, having only three countries. So for further analysis and to strengthen the conclusions provided by the results in this ressearch, it would be desired to include more non-advanced, non-inflation targeting countries in the analyzed sample, a matter that would have to deal with data availability for sectorial credit, nominal policy rates and seasonally adjusted, real GDP. The data availability issue is particularly prominent for the government credit sector, as it is considerably lacking in representation for emerging and developing economies, so those results, especially, should be taken with this consideration in mind.

An important dimension that also needs consideration in the context of monetary policy and macropdrudential policy is the concept of shadow rates. Shadow rates as a concept were introduced by Black (1995) (Black, 1995), it extends the traditional interest rate definition to account for situations where the nominal interest rates are at or nearing the zero lower bound (ZLB).The concept become a pillar in the effort to understand the stance of monetary policy when the conventional tools are constrained by the zero lower bound, especially in the aftermath of the 2008 global financial crisis. The shadow rates, then, are able to provide a theoretical framework that allows for negative interest rates in models, reflecting the effects of unconventional monetary policies such as quantitative easing and forward guidance. Authors like Wu and Xia (2016) (Wu; Xia, 2016) developed a shadow rate term structure model to estimate the macroeconomic impact of monetary policy at the ZLB. The authors argue, through their findings, that unconventional monetary policies can indeed be quantified through shadow rates, offering a more accurate representation of monetary conditions and, most importantly, a more accurate depiction of the monetary authority intentions with their stances.

Some works on the subject of macroprudential policy effects, like Revelo (2022) (Revelo; Levieuge, 2022), use shadow rates for the monetary policy stance from the likes of Japan, the United States and the Eurozone as controls in their models on macroprudential policies, which corroborates that incorporating a shadow rates series for some countries in the model might strengthen the validity and robustness of the results. Considering that, another possibility for further ressearch that could lead to more robust results overall is the inclusion of shadow rates in the model for the countries that delve near the zero lower bound for their nominal monetary policy stances.

8 Conclusion

Broadly, the empirical results provided in this analysis shows that changes in macroprudential policy stance, captured by our net stance index $PruC$, can significantly influence credit growth, across multiple borrowing sectors.

A net tightening action is shown to negatively influence credit growth across all three non-financial sector, a result that is in confluence with works like Cerutti et al. (2017) (Cerutti; Claessens; Laeven, 2017), Revelo (2020) (Revelo; Lucotte; Pradines-Jobet, 2020) and Alam et al (2019) (Alam *et al.*, 2019), albeit with differing magnitudes, timing and significances. One relevant highlight is that the effect on credit directed at households and non-profit organizations serving households appears quicker and with greater significance, while it tends to emerge more gradually for the general non-financial sector and for government borrowing. This occurrences are aligned with existing literature, like Kim et al. (2022) (**??**), which findings also points towards the direction of a stronger effect of macroprudential policy on household credit.

Additionally, the results also point in the direction of the relevance of a country's institutional framework for both overall credit stability and macroprudential policy effects. Having a formal, single-country inflation-targeting regime is generally associated with a lower baseline level of credit growth, particularly in EMDE. In fact, in AEs, inflation targeting can even coincide with a slightly higher baseline credit growth in some cases. These differences may reflect more developed financial systems in AEs and the varying ways that monetary policy may interact with financial stability objectives, specially in EMDEs, which are significanttly more vulnerable to financial cycles and shocks.

In regards of the three-way interaction $PruC \times Target \times AE$, there is a more nuanced distinction:

- **Household credit:** An immediate and consistently negative effect for all sub-groups, however, featuring a larger effect in magnitude EMDEs, both targeting and non-targeting.
- **Non-financial sector credit:** A delayed, negative effect that manifests faster in countries with inflation-targeting. The negative effect is even faster, and with a greater magnitude, in advanced economies with inflation-targeting.
- **Government credit:** The estimates generally indicate a negative response to macroprudential tightening, but with lower statistical significance. The strongest difference appears between AE and EMDE in terms of speed of the response. There is also larger magnitude of effect for both non-targeting groups.

These results should, however, be taken with caution, specially considerations about

their magnitude, as introducing multiple interaction terms understandably raises multicollinearity, reflected in elevated VIFs. However, the standard errors remain moderate, and the sign and magnitude of the coefficients are consistent with the simpler baseline models, which points towards the fact that the heightened correlations do not invalidate the core findings in this research.

A fundamental caveat is data availability. Sectoral credit series for many EMDEs and, especially, non-inflation-targeting EMDEs have a significantly lesser availability, limiting sample size and heterogeneity in some sub-groups. This issue is more acute for government credit, where the panel has considerably less countries.

A potential channel of improvement for the reported models lies into using shadow rates, which are particularly important for countries that gravitates close to the zero lower bound. Incorporating a shadow rate measure, like the ones proposed by Wu and Xia (2016) (Wu; Xia, 2016)) could improve the accuracy of monetary policy controls and better capture unconventional policy measures in advanced economies.

Even in face of these constraints, the overall evidence underscores that macroprudential policies can effectively curb excessive credit growth, with particular potency in household lending. Additionally, monetary regimes, especially in EMDEs adopting inflation-targeting frameworks, can shape baseline credit expansion and the transmission of macroprudential policy. Future research with broader data coverage and refined monetary policy indicators can further elucidate how different policy tools and institutional frameworks jointly determine credit expansion and overall behavior, in both advanced and emerging economies.

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