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MACROPRUDENTIAL POLICY, CYCLICAL VOLATILITY AND BANKING SECTOR RESILIENCE

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Abstract

This paper examines the effect of macroprudential policies at an economy-wide level on house prices, credit growth, and bank performance across 36 OECD countries from 1990 to 2023. The findings highlight the significant role of tools such as capital requirements, loan-to-value and debt-service-to-income ratios in curbing excessive credit growth and stabilising house prices. Additionally, the study reveals that liquidity-oriented macroprudential tools can enhance banks' profitability. On the other hand certain tools are found to have effects contrary to stability, such as leading to greater bank risk. To ensure the robustness of findings we perform analysis winsorising our datasets, examining both standalone and combined effects, and investigating the effect of regulation in two subsamples: larger and smaller economies. These results provide valuable insights for policymakers aiming to balance economic and financial stability with sustainable growth.

Keywords: Macroprudential policy, credit growth, house prices, bank profitability, bank risk
JEL codes: C13, G23, O16

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Outline

1. Introduction

In recent years, policymakers have assigned increasing importance to macroprudential policy as a tool to attain and maintain financial stability, complementing "microprudential" regulation of individual banks. The distinction is that macroprudential regulatory actions are aimed at the financial system as a whole or at important segments of it rather than at individual institutions. Empirical studies of macroprudential policy effects have shown the significance of policy instruments like loan-to-value (LTV) and debt-service-to-income (DSTI) ratios, capital requirement and targeted taxation in controlling objectives of significance to financial stability such as house prices, credit growth and banks' resilience.

In this paper, we aim to test the statistical significance of the effect of macroprudential regulation on four key target variables in OECD countries. Two relate to the objective of limiting financial volatility and boom-bust cycles that can lead to banking crises, namely real house price growth and growth in the credit/GDOP ratio. The other two relate to the resilience of the financial sector, namely bank profitability and bank risk at the banking sector level.

Our work advances on the existing literature by utilising more recent data, analysing the impact of LTV using actual average values as well as dummy variables, and providing a comprehensive analysis of bank resilience at a banking-sector rather than individual bank level. In addition, we are using both impulse- and cumulative approaches to investigate the short-term and longer-term effects of regulation.

Moreover, we perform robustness checks, such as winsorisation (which is common in individual bank analyses but less so when using macro-level data), subsample results in large and smaller economies; and testing whether policies remain significant when combined together in estimation rather than being tested one-by-one.

Overall, we contend that our work will provide policymakers an understanding of the appropriateness of effectiveness of macroprudential policies in various situations and with various targets in mind.

The rest of the paper is structured as follows: Section 2 introduces the origins, development and tools of macroprudential policy. Section 3 focuses on the existing empirical literature on the effects of macroprudential regulation. Section 4 discusses our research design and robustness checks. Section 5 introduces the sources of the data used and modifications of data to increase accuracy of tests. In Section 6 we introduce the results of our analysis. Section 7 shows robustness checks. Section 8 concludes our paper with a discussion on key findings, limitations and recommendations.

2.1 Macroprudential Policy Origins and Importance

According to Clement (2010) in the BIS Review, the term "macroprudential" was first introduced in 1979 during a meeting of the Cooke Committee. Over the period up to 2008, central banks were increasingly monitoring macroprudential developments by publishing "Financial Stability Reports". However, their efforts were constrained by a lack of tools and of consensus on the regulation's effectiveness. Regulators were primarily able to issue warnings in such Financial Stability Reports but not to act effectively against credit/asset price booms or declining resilience of banks at a sectoral level.

The global financial crisis of 2008 underscored the critical need for policies at a macroprudential level and the importance of such regulatory frameworks in modern interconnected economies. Indeed, Ben Bernanke, former chairman of Federal Reserve and Nobel Laureate, noted that the 2008 crisis highlighted existing vulnerabilities of regulatory frameworks, as policymakers were too focused on individual institutions and not on systemic risk (Bernanke, 2018).

The crisis accelerated discussions on the development of macroprudential policies and led to implementation of a comprehensive set of tools to enhance system resilience (Davis and Karim, 2010). Nowadays, macroprudential regulation is often described as a key tool in preventing systemic financial crises, although implementation of it sometimes can be challenging and bear extra costs for both sides: policymakers and individual institutions.

Many research papers have been produced on macroprudential policy effectiveness and researchers are reaching agreement on importance of it. They highlight that rightly adjusted macroprudential policy has a crucial role in the following areas:

1. Systemic risk management: Because financial institutions, markets, and the whole economy are interconnected, macroprudential regulation aims to detect, monitor, and limit episodes of systemic risk, that have significant macroeconomic costs (Borio and Drehmann, 2009).

2. 'Bubble' prevention and sustainable economic growth: Excessive lending and speculative activity, which frequently cause financial bubbles and boom-bust cycles, can be curbed by macroprudential regulation with instruments including capital surcharges, loan-to-value ratios, and credit growth limits. (IMF, 2014).

3. Financial system resilience: Macroprudential policies, which include increased capital and liquidity requirements, make financial institutions more resilient to shocks to the economy and financial system. (Bank for International Settlements, 2010).

4. Contagion control: Because of the interconnectedness of the financial system, the failure of one institution can set off a series of events, so called 'domino effect', that result in financial instability. By placing restrictions on interconnection and bolstering Systematically Significant Financial Institutions (SIFIs), macroprudential regulation seeks to prevent such a spread (Bank for International Settlements, 2016).

European Central Bank analyses (Ampudia et al, 2021) on the effectiveness of macroprudential policy suggests that there is both theoretical and empirical evidence that implementation of macroprudential regulation is widely beneficial. It can not only reduce excessive credit growth and strengthen the resilience of banks and borrowers, but may also benefit long-term economic growth by controlling the duration of the expansion stage and depth of the recession stage.

2.2 Tools of Macroprudential Policy

As mentioned, the main objective of macroprudential policy is minimisation of systemic risk and maintaining financial system resilience and reducing the amplitude of credit cycles. For these purposes, policymakers are using a variety of tools.

In "An Overview of Macroprudential Policy Tools", Claessens (2014) outlines various types of macroprudential tools designed to safeguard financial stability. These tools are categorised into borrower-based and financial institution-based measures. Borrower-based tools, such as loan-to-value (LTV) and debt-to-income (DSTI) ratios, directly limit excessive borrowing by imposing limits that prevent households from overleveraging. Financial-institution-based tools include countercyclical capital buffers, reserve requirements, and liquidity requirements, which ensure that banks maintain sufficient capital and liquidity, especially during economic downturns. However, Claessens also highlighted the challenges in implementing these tools, particularly in terms of coordinating them with other economic policies and adapting them to specific national contexts.

In light of the above, we examine the effect of the following macroprudential tools, which were broadly introduced by Alam et al. (2019) and described in detail in Appendix Table A1: the countercyclical capital buffer, the conservation buffer, capital requirements, the leverage ratio, loan loss provisions, limits on credit growth, loan restrictions, limits on foreign currency lending, debt-service-to-income ratio limits, loan-to-value ratio limits, tax on financial institutions, liquidity measures, loan-to-deposit ratio limits, limits on gross or net open foreign exchange, reserve requirement, SIFI surcharges and other macroprudential policies.

As background to our own research, we now go on to summarise and evaluate some of the key papers in the literature on macroprudential policy effectiveness.

3. Literature Review

3.1 Key papers

Commencing with papers on the effects of macroprudential policies on targets such as house prices and credit growth, Cerutti et al. (2017) constructed an index of macroprudential policies applied across 119 countries from 2000 to 2013. They found that these policies, especially those targeting the housing sector, effectively reduced credit growth and house price inflation, though their effectiveness was generally stronger in emerging markets than in advanced economies.

Akinci and Olmstead-Rumsey (2018) created a novel index of macroprudential policies across 57 advanced and emerging economies to assess their impact on credit growth and house price inflation from 2000 to 2013. The researchers concluded that targeted macroprudential policies, particularly those aimed at the housing sector, were effective in curbing credit and house price growth, with stronger effects observed in emerging markets.

Carreras et al. (2018) used a cointegration framework to evaluate the long-term effectiveness of macroprudential tools across 19 OECD countries over time period. They found that loan-to-value (LTV) ratios and debt-to-income (DSTI) limits were effective in curbing house price inflation and household credit growth, with their impact varying significantly across different countries.

Alam et al. (2019) utilised a new database, the latest version of which we also employ in this paper, covering macroprudential policies in 134 countries from 1990 to 2016 to analyse their impact on household credit and consumption. The researchers found that loan-targeted instruments like LTV ratios effectively limited household credit, particularly in advanced economies, although their effectiveness decreased with the increasing strictness of the measures.

Davis et al (2018) evaluated the wider macroeconomic effects of different macroprudential policies, such as LTV ratios and capital adequacy requirements, using the National Institute Global Econometric Model (NiGEM). The findings suggested that capital adequacy requirements were more effective in reducing financial instability and provided broader economic benefits compared to LTV ratios, though the effectiveness varied across countries.

Turning to key papers focused on bank performance and resilience, Claessens et al. (2013) analysed the impact of various macroprudential policies on bank balance sheets across 48 countries from 2000 to 2010. The authors found that borrower-targeted policies, such as LTV and DSTI caps, effectively reduced banks' leverage and asset growth during economic booms, but were less effective in mitigating declines in lending (credit crunches) during downturns.

Altunbas et al (2018) examined the effect of macroprudential regulation on banks' stability using sample of more than 3000 banks across 61 countries from 1990 to 2012. The main finding of this study is that tightening of macroprudential regulations leads to lower default probability and higher Z-Scores. Additionally, researchers found that the size of the bank, level of capital and share of wholesale finding affect the effectiveness of macroprudential tools.

Davis et al. (2022) examined how different macroprudential policies impact bank profitability, using data for 7250 individual banks in 92 countries (35 advanced countries and 57 emerging markets and developing economies). They concluded that while some policies, like capital adequacy requirements, effectively stabilise the financial system, they also tend to reduce banks' profitability, particularly in more financially developed economies.

A common thread among the papers is the finding of the effectiveness of macroprudential policies in controlling houses prices, credit growth and banks' resilience, or, in other words, stabilising key objectives of financial systems. These findings support the notion that well-designed macroprudential policies can play a crucial role in preventing financial excesses that often lead to economic instability.

These papers, among many others, collectively contribute to a deeper understanding of macroprudential policies, their effectiveness and their limitations. While there is broad agreement on the importance of these policies in maintaining financial stability, the studies also reveal significant challenges, for instance, regarding the effectiveness of some policy interventions during downturns, due to the potential for policy avoidance through cross-border borrowing; their negative impact on banks' profitability, that banks may respond to the regulations that reduce their profit by taking on more risk to compensate; and the need for country-specific adaptations, since there is, as Davis et al (2022) highlight, not "one size fits all".

These findings underscore the complexity of macroprudential policy design and implementation, highlighting the need for careful, context-specific approaches that balance financial stability with economic growth and bank profitability. Our work seeks to contribute to the debate.

3.2 Principal findings across papers

A recurring theme across these studies is the effectiveness of macroprudential policies in managing financial stability, particularly in curbing excessive credit growth and stabilising housing markets. Papers by Alam et al. (2019) and Akinci and Olmstead-Rumsey (2018) both highlight the significant impact of loan-targeted instruments, such as loan-to-value (LTV) ratios, in reducing household credit and controlling house price inflation. These policies are shown to be particularly effective in environments with less stringent existing regulations, where they can mitigate financial excesses that could lead to economic instability. Carreras et al. (2018) also support this view, confirming the effectiveness of LTV and debt-service-to-Income (DSTI) ratios in controlling household credit growth. They find that these tools can in some cases produce immediate effects on credit markets, making them valuable for short-term economic stabilisation.

The widespread use of macroprudential measures, particularly in emerging markets, further underscores their importance. Cerutti et al. (2017) and Alam et al (2019) document that macroprudential policies are more frequently employed in emerging economies, where they are crucial for managing financial stability. This aligns with Claessens et al. (2013), who also highlight the effectiveness of borrower-focused policies, such as LTV and DSTI caps, in reducing systemic risks during economic booms by directly targeting the sources of financial instability. These findings collectively validate the role of macroprudential policies in preventing the buildup of systemic risks and financial excesses that often precipitate crises.

However, the studies also reveal significant limitations, particularly regarding the effectiveness of these policies during economic downturns and their impact on bank profitability. Both Cerutti et al. (2017) and Claessens et al. (2013) highlight that while macroprudential policies are effective in curbing credit growth during boom periods, their efficacy diminishes during recession periods. Cerutti et al. (2017) argue that these policies may even exacerbate downturns by encouraging cross-border borrowing, as financial institutions seek to circumvent domestic restrictions. This behaviour can undermine the overall stability that macroprudential policies aim to promote.

Claessens et al. (2013) add that countercyclical buffers, although useful in controlling credit growth during booms, may restrict banks' ability to lend during downturns, potentially worsening economic conditions. These findings suggest that macroprudential policies, while valuable in preventing the buildup of risks, may be insufficient in managing financial stability across the entire economic cycle. Or at least, there is a need for flexibility in reducing buffers at times of crisis as at the start of the COVID pandemic. Furthermore, there is a clear need for complementary policies, such as monetary and fiscal measures, to support financial systems during adverse economic times, as for example during COVID.

The impact of macroprudential policies on bank profitability presents another area of concern and divergence among the studies. Davis et al. (2022) provide evidence that certain macroprudential measures, particularly those affecting capital requirements and lending practices, can significantly reduce banks' profitability. The study highlights that while these policies are essential for ensuring

financial stability, they may hinder banks' ability to build capital through retained earnings, which is crucial for long-term resilience.

The studies also emphasise the importance of tailoring macroprudential policies to specific national contexts. Papers of Carreras et al. (2018) and Davis et al. (2018) both highlight the varying effectiveness of macroprudential tools across different countries and economic environments. Carreras et al. (2018) find that while certain policies, like LTV and DSTI limits, are consistently effective across OECD countries, others, such as general capital requirements, exhibit more pronounced effects over the long run and may require adaptation to local conditions. Davis et al. (2018) similarly demonstrate that the impact of macroprudential measures like capital adequacy requirements varies significantly across countries, with some experiencing more pronounced benefits than others. This variation underscores the necessity for policymakers to consider local economic environments and institutional settings when designing and implementing macroprudential policies.

Cerutti et al. (2017) further add to the discussion of context-specific effectiveness by showing that the impact of macroprudential policies differs between advanced and emerging economies. In emerging markets, foreign exchange-related tools are particularly effective in managing financial stability, whereas advanced economies benefit more from borrower-based measures like LTV and DSTI ratios. This differentiation reflects the diverse financial structures and risks faced by these economies, reinforcing the need for tailored approaches. Akinci and Olmstead-Rumsey (2018) also highlight the importance of targeted interventions, finding that policies specifically aimed at limiting housing credit growth are more effective than broader measures, especially in economies where bank finance is dominant. This specificity in policy design enhances the overall effectiveness of macroprudential measures.

Altunbas et al (2018) contributes to the existing literature by providing a comprehensive analysis of how macroprudential policies influence bank risk. They found empirical evidence of statistical significance of such measures as capital requirements, credit growth limit, debt-service-to-income ratio, loan-to-value ratio, limits on foreign currency and reserve requirements in reducing the Expected Default Frequency and the Z-score – measures of the probability that bank will become insolvent.

Given these varied findings, the research collectively suggests several key policy recommendations. Policymakers should carefully assess the existing level of macroprudential tightness before implementing additional measures, as highlighted by Alam et al. (2019), who note that there may be diminishing returns to tightening policies where the stance is already stringent. Indeed, in markets where regulations are already tight, further tightening may a have limited impact on credit but could significantly dampen consumption, potentially stifling economic activity. Davis et al. (2022) emphasise the importance of balancing financial stability with bank profitability, cautioning that overly restrictive measures may limit banks' ability to generate earnings, which is crucial for their long-term growth and stability. Finally, the studies by Carreras et al. (2018), Davis et al. (2018), and Cerutti et al. (2017) all underscore the need for country-specific adaptations of macroprudential policies, taking into account the unique economic conditions and risks faced by each nation. This approach is essential for maximizing the effectiveness of macroprudential measures while minimising unintended consequences.

3.3 Gaps

The selected papers on macroprudential policies offer a nuanced understanding of their effectiveness, yet they also reveal several limitations and contradictions. While there is broad agreement on the importance of these policies for maintaining financial stability, the studies differ in their scope, methodologies, and focus, leading to varying conclusions about the impact of macroprudential tools across different contexts.

One recurring theme is the limited scope of the macroprudential tools analysed in the studies. For example, Alam et al. (2019) primarily focus on Loan-to-Value (LTV) limits, which, while crucial, do not cover the full range of available macroprudential instruments. Other critical tools, such as countercyclical capital buffers or debt-service-to-income (DSTI) ratios, are less explored, which limits the understanding of how different tools might interact or complement each other. This narrow focus restricts the ability to comprehensively assess the overall impact of macroprudential policies on financial stability.

The policy indicators used in the testing are typically quite crude. The policy indices usually rise by 1 if policy is tightened and fall by 1 if it is loosened, regardless of the severity of the policy change. Accordingly, estimates are always for the effect of an average policy intervention across the countries concerned. This issue is hard to avoid since most policies are not standardised and thus cannot easily be summarised numerically, with the exception being the loan-to-value limit, as used in our current work. Given its quite recent introduction in the paper by Alam et al (2019), many papers are not including such testing of numerical LTV, which may be crucial for understanding precise consequences of macroprudential policy implementation, as in our current work.

Another common issue across the studies is the geographical and temporal limitations. Alam et al. (2019), Altunbas et al (2018) and Cerutti et al. (2017) analyse data from a broad range of countries, yet they do not fully account for regional differences or the evolving economic conditions that could influence the effectiveness of macroprudential policies. For instance, Alam et al. (2019) cover the period from 1990 to 2016, excluding recent developments, such as the impacts of the COVID-19 pandemic on global financial systems. Similarly, Davis et al. (2018), Altunbas et al (2018) and Akinci and Olmstead-Rumsey (2018) rely on data sets that do not include the most recent economic events, which could limit the applicability of their findings to current and future economic conditions. The studies by Davis et al. (2022) and Carreras et al. (2018), while acknowledging differences between advanced and emerging markets, do not delve deeply into how regional economic conditions and institutional frameworks influence the effectiveness of macroprudential policies.

Additionally, studies made on banks' profitability and risk by Davis et al (2022) and Altunbas et al (2018) focus on the effectiveness of macroprudential tools only at individual bank level, not at the level of the banking sector, which can be crucial as regulators aim to enhance stability of a financial sector as a whole.

The papers also exhibit a tendency to focus on short-term effects at the expense of long-term analysis. For example, Davis et al. (2022) primarily assess the immediate impact of macroprudential policies on bank profitability without exploring how these policies might affect bank performance and financial stability over an extended period. Even Carreras et al. (2018), while distinguishing between short-term and long-term impacts, do not fully explore the dynamic effects of macroprudential policies over different time horizons. This focus on short-term outcomes overlooks

the potential long-term consequences, such as how sustained macroprudential policies might influence economic growth, capital accumulation, and overall financial stability.

Behavioural responses to macroprudential policies are another area where the studies fall short. Alam et al. (2019) and Davis et al. (2022), for instance, provide quantitative analyses but lack detailed insights into how financial institutions and consumers react to changes in policy. Understanding these behavioural dynamics is crucial because banks might adjust their business models, risk-taking behaviours, or capital allocation strategies in response to new regulations, which could significantly influence the effectiveness of these policies. Claessens et al. (2013) also highlight the importance of behavioural responses but do not thoroughly investigate how these reactions might lead to unintended consequences, such as regulatory arbitrage or shifts in financial activity to less regulated sectors.

Furthermore, the studies often overlook the potential spillover effects of macroprudential policies in a globally interconnected financial system. Cerutti et al. (2017) briefly touch on the increase in cross-border borrowing as a result of domestic macroprudential measures but do not deeply explore how these policies might affect other countries. Many papers do not sufficiently consider the global financial interconnectedness that could lead to spillover effects, potentially undermining the effectiveness of domestic macroprudential policies.

Finally, the policy recommendations provided by these studies are often generalised, lacking in specific guidance for policymakers. For instance, Alam et al. (2019) suggest that policymakers consider the existing level of macroprudential tightness before implementing additional measures but do not offer detailed advice on navigating the trade-offs between tightening and loosening measures in different economic contexts. Similarly, Carreras et al. (2018) and Cerutti et al. (2017) identify effective macroprudential tools but provide limited guidance on how to balance these tools with other economic policies to achieve optimal outcomes.

4. Methodology

4.1 Research Design

To analyse the effect of the macroprudential policy tools on house prices, credit and banks' performance, we obtained data from 36 OECD countries as a proxy for advanced economies for the period from 1990 to 2023 (where data are available[2]) to capture a lengthy period including several crises. We hope thereby to increase overall robustness of our results.

The countries covered are Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, the UK and the US.

We undertook panel OLS regressions with time and country dummies on four policy targets of macroprudential policy. First, to estimate the effect on variables relevant to cyclical volatility, we tested for effects on the real residential property prices index and aggregate credit to the private non-financial sector as a percentage of GDP. Second, to estimate the effect of the macroprudential

[2] We note that the data on house prices and credit afford a longer dataset than that for bank performance, much of which begins around 2000.

regulation on banks' performance we tested for effects on the banking sector's return on assets (before tax) and the banking sector's Z-Score. All data employed are at national level including data for banks' performance.

It is crucial to add relevant control variables to our econometric analysis to reduce the bias caused by missing variables. When a significant variable that affects both the dependent and independent variables is left out of the model, it might lead to omitted variable bias. Because the influence of the missing variable is mistakenly assigned to the included independent variables, this omission may result in estimates that are skewed and inconsistent. Control variables enhance the overall robustness of the analysis and increasing the likelihood that observed results are not spurious.

It was decided that for our research purposes the best control variables will be GDP Growth as in Claessens et al (2013), Akinci and Olmstead-Rumsey (2018), Alam et al (2019) and Cerutti et al (2017); short-term interest rates as in Alam et al (2019) and Akinci and Olmstead-Rumsey (2018), lagged dependent as in Alam et al (2019) and Akinci and Olmstead-Rumsey (2018) and CPI year-to-year change as in Davis et al (2022).

The GDP[3] level of a country is almost always non-stationary, thus, to avoid bias and make our econometric analysis more accurate, we are using the log-difference showing growth of GDP, which in turn may influence house prices, credit and banks' performance. Inclusion of GDP growth seeks to ensure changes in dependent variables are not caused by economic cycles and to isolate changes in house prices, bank performance, and credit due to economic growth from macroprudential regulation effects.

Short-term interest rates[4], set by the central bank of a nation typically aim to regulate economic developments, keep inflation under control, and keep the currency stable; they are an essential instrument in monetary policy. The inclusion of short rates aims to isolate the effects of macroprudential policy from broader economic factors like borrowing costs that affect bank performance , house prices, and credit volumes. Also, it helps to separate macroprudential policy effects from monetary policy to ensure observed changes are due to macroprudential regulation. As the short rate is bounded we include it as a level in the equations.

The consumer price index (CPI)[5] is used to evaluate changes in the cost of living and indicates inflation or deflation within an economy. CPI is usually a non-stationary indicator, thus, to avoid misinterpretation of our regression results, we are using year-to-year change of log CPI, that reflects the inflation rate. Inflation affects purchasing power and investment returns, including housing. High inflation can drive up housing prices or increase living costs, reducing disposable income and credit demand. Moreover, since monetary policy is highly related to the inflation rate, by including CPI as a control variable, helps further distinguish the effects of macroprudential policies from those of monetary policy.

[3] A crucial economic metric, the gross domestic product (GDP) represents the total value of all products and services generated in a nation during a given timeframe, often a quarter or a year. It is used to compare the economic performance of various countries and indicates the state of a nation's economy.

[4] Interest rates on financial instruments or loans with a one-year maturity or less

[5] A crucial economic indicator that represents how much consumers must pay on average over time for a variety of products and services

Accordingly, we estimate the following baseline equation for house prices, which is comparable to that used in Akinci and Olmstead-Rumsey (2018)[6]:

$$DLRHP_{it} = \alpha + \beta_1 * DLRHP_{it-1} + \beta_2 * CV_{it-1} + \beta_3 * MPT_{it-1} + \varepsilon_{it} \quad (1)$$

This is the model that is used in evaluation of the effect of macroprudential policies on house prices, where i denotes country, t denotes time period and ε_{it} is the error term for country i at time t. "DLRHP" here denotes first differences of the log of real residential property prices as provided by the BIS. "CV" indicated Control Variables, lagged one period, including GDP Growth, Short-term Interest Rates and CPI year-to-year change; "MPT" is Macroprudential Tools, the dataset of tools used was provided in the IMF's iMaPP database (IMF 2023) which was introduced in Alam et al (2019) and is summarised in Appendix Table A1.

This model includes first lag terms, since the effect of the regulations and the macroeconomy are not instantaneous, and house prices (as well as GDP and the CPI) are in differences of logs to avoid stationarity. We also include a lagged dependent variable to evaluate whether there is significant persistence in the dependent variable. Time and country dummies are included in all estimates to allow for unobserved effects over time and between countries.

$$DLCredit_{it} = \alpha + \beta_1 * DLCredit_{it-1} + \beta_2 * CV_{it-1} + \beta_3 * MPT_{it-1} + \varepsilon_{it} \quad (2)$$

We are using the same approach to model credit growth, where DLCredit is the first difference of the log of aggregate credit to the private non-financial sector (households and companies) as a percentage of GDP, as the original data is not stationary.

To capture the effect of the macroprudential policy on banks' performance, we are using two similar models, firstly modelling the return on assets (before tax), ROA, for evaluation of the effects of macroprudential regulation on banks' profitability at a sectoral level:

$$ROA_{it} = \alpha + \beta_1 * ROA_{it-1} + \beta_2 * CV_{it-1} + \beta_3 * MPT_{it-1} + \varepsilon_{it}, \quad (3)$$

Finally, we use Z-Score as a measure of resilience, where the Z score measures the distance to default of the banking sector in terms of the following calculation: return on average assets plus the capital ratio divided by the standard deviation of the return on average assets.

$$LZSCORE_{it} = \alpha + \beta_1 * LZSCORE_{it-1} + \beta_2 * CV_{it-1} + \beta_3 * MPT_{it-1} + \varepsilon_{it}, \quad (4)$$

We are using the log of Z-Scores to normalise data[7].

[6] The estimates in their paper were quarterly and not annual, they included the VIX index of stock market volatility but excluded inflation, the difference and not the level of the short rate and were estimated by GMM.

[7] More detailed description on the data items and sources is provided in Section 5.

In all our estimates, we analyse the effects of macroprudential tools using both cumulative and impulse approaches as in Carreras et al (2018) and Davis et al (2022). We estimate such effects separately. The cumulative approach allows us to examine the long-term effects of these tools by aggregating their impact over time. This method is particularly useful for understanding how macroprudential policies influence economic variables in the aggregate and over extended periods. In contrast, the impulse approach focuses on the immediate or short-term effects following a policy intervention. By comparing these two approaches, we can assess whether the effects of macroprudential tools are consistent across different time horizons. This dual analysis provides a more nuanced understanding of the temporal dynamics of policy impacts, allowing us to capture both the immediate and sustained effects of macroprudential regulation.

4.2 Robustness Checks

To ensure the robustness of our findings, we employ a multi-faceted methodological approach that includes several key strategies. These strategies are designed to test the stability and reliability of our results, providing a comprehensive assessment of the impact of macroprudential tools at an economy-wide level.

First, whereas in our baseline tests we conduct an individual significance test for each macroprudential tool one by one to determine their standalone impact on dependent variables. to test for robustness we also incorporate the tools into a single regression model to examine their combined effect as in Davis et al (2022) This step is crucial for understanding the interaction and cumulative influence of multiple macroprudential tools when applied together. By integrating all significant tools into one model, we can assess whether their effects remain consistent and whether any interaction effects emerge. This comprehensive approach allows us to determine whether the combined application of macroprudential tools produces synergistic effects or if their individual impacts are diluted when applied concurrently.

Second, we expand our methodological framework by employing winsorisation. In macroeconomic data, extreme values often arise from economic shocks or policy shifts and can significantly skew results. Winsorisation involves capping these extreme outcomes at certain percentiles (1^{st} and 99^{th}), ensuring that our analysis reflects more typical data. This process enhances the stability and interpretability of our models, leading to more accurate and reliable policy recommendations since outliers could distort the results. This approach, while it is commonly used in bank-by-bank estimates such as Altunbas et al (2018) and Davis et al (2022) is less common in the literature at a macro level on dependent variables such as credit and house prices, allowing us to evaluate the significance of incorporating it.

Third, to further test the robustness of our results, we divide our sample into distinct groups and examine whether the observed effects hold across different subsamples. By conducting subgroup analyses, we can identify whether certain macroprudential measures are more effective in specific environments or whether the observed effects are consistent across different contexts. It is crucial for understanding the generalisability of our findings and for identifying potential variations in the effectiveness of macroprudential tools. This approach was used in such papers as Davis et al (2022), Claessens et al (2013) and Alam et al (2019). These papers have explored the effect of macroprudential policy in advanced economies and emerging market and developing economies. However, since our analysis focuses on the effect of macroprudential policy within 36 OECD countries

(advanced economies), we rather utilise subsamples of larger[8] and smaller economies[9]. This approach will allow us to test whether the effectiveness of regulation depending on size of the economy.

5. Data

5.1 Dependent variables

We utilise the database provided by Bank for International Settlements (BIS, 2024) to collect the data regarding house prices. In the BIS database, average residential property prices are represented in two types: real and nominal. To take into consideration the effect of inflation, we are using real prices. To avoid large numbers and potential problems caused by them, all prices are normalised by setting them into a level, where average prices for a residential property in 2010 are equal to 100 and others are in proportion to 2010 level. The BIS database provides houses prices in quarterly timeframe and for the further convenience, we are annualising data by getting the average level for four quarters within a year. In our research we take first differences of logs, therefore, ensuring stationarity, which will lead to a more accurate and reliable results.

For credit data we are also using the database of the Bank for International Settlements as in Carreras et al (2018). We are collecting the data for 'credit to private non-financial sector', which comprises loans taken by households and non-financial companies. All credit data are provided as a percentage of GDP of a country within that timeframe. This helps to normalise data and avoid heteroskedasticity issues. The data are in a quarterly timeframe and we are annualising it finding the average percentage within a year for our further convenience. Since we are interested in a credit expansion and to ensure stationarity, we are taking the first differences of logs to find the growth or the decline in credits to GDP in a year.

To capture macroprudential policy's effect on banks' performance, we utilise values at a country level for pretax returns on assets (ROA) as a proxy for profitability and Z-Score as an indicator of banking sectors' resilience. We use ROA before tax as it is internationally comparable and reflects solely banks' performance. Z-Score captures the likelihood that a nation's commercial banking sector will fail, being defined as its ratio of capitalisation plus returns on assets to volatility of returns on assets. Such banking sector performance data are collected from the Global Financial Development Database (GFDD) which is provided by the World Bank (2022) and represents data as a weighted average value for all commercial banks within a country in a certain year.

5.2 Macroprudential Policy

The database for macroprudential policy measures is the IMF's iMaPP (Integrated Macroprudential Policy) database which was originally constructed by Alam and his colleagues in 2019. To create this database, they combined information of five databases and surveys on Macroprudential Policy conducted by IMF.

In this database Alam et al (2019) are providing the history of macroprudential regulations from 1990 for approximately 160 countries around the world. We use the latest version, dated April 2023. It includes information of usage of 17 various macroprudential tools, as set out in Appendix Table A1,

[8] Countries with a GDP over 1 trillion US dollars in 2023

[9] Countries with a GDP below 1 trillion US dollars in 2023

represented in dummy-type variable, where 1 indicates tightening, 0 denotes absence of change in regulation and -1 represents loosening of policy.

For our research purposes, we are annualising the monthly data in two ways: firstly, we are summing up all values for a country, it means that if macroprudential regulation tightened and then loosened within a year, we are capturing it as 'no change' for that particular year. Secondly, we are also using a cumulative method from 1990 onwards to make our econometric analysis results more accurate, it means that if macroprudential tightened and remained still after that, we are keeping it as 'tightened' policy until the next change in regulation. It shows the "stance" of policy as discussed above.

We also employ the numerical data on loan to value limits that are provided in the iMaPP database.

5.3 Control variables

As mentioned, the inclusion of control variables is critical to ensure the accuracy and robustness of the results. After reviewing relevant literature and empirical studies, we determined that the most appropriate control variables for our dataset are GDP growth, short-term interest rates, and the consumer price index (CPI) year-to-year change. These variables were selected based on their relevance and widespread use in similar econometric analyses, such as Akinci and Olmstead-Rumsey (2018) where they have been shown to significantly influence the dependent variables of interest.

The data on GDP growth for our analysis was obtained from the World Bank's World Development Indicators (WDI) database. The GDP growth values are expressed as a percentage change per year, providing a clear measure of how an economy expands or decreases annually. The data on short-term interest rates was sourced from the OECD's 'Key Economic Indicators' database, which provides annual data on these rates across various countries. The rates are measured in percentage terms per annum. For our analysis, the data on CPI year-to-year change was obtained from the Bank of International Settlements (BIS) data portal. The CPI values are expressed as a percentage change per annum, which allows us to measure how inflation fluctuates on a yearly basis.

5.4 Data Analysis

The descriptive statistics presented in Table 1 for the difference of the log of the real house price index (DLRHP), reveal a mean of 0.021, indicating an average increase in real house prices of just over 2%. The median value is slightly higher at 0.022, suggesting that the distribution of changes in house prices is symmetric, with no significant skewness. The standard deviation of 0.083, highlights high variability in house price changes over time, reflecting the dynamic nature of the housing market. The extremes in DLRHP, with a maximum of 1.289 and a minimum of -0.505, highlight periods of significant fluctuations, possibly tied to economic cycles such as housing booms or downturns.

Table 1. Descriptive Statistics.

Variable	DLRHP	ROA	LZSCORE	DLCredit	CPI	GDP Growth	STIR
Mean	0.021	0.830	2.519	0.015	7.476	2.409	4.383
Median	0.022	0.822	2.553	0.013	2.48	2.613	3.079
Maximum	1.289	38.875	4.051	0.335	1020.621	24.475	72.153
Minimum	-0.505	-17.658	-4.055	-0.247	-4.478	-32.119	-0.848
St. Dev.	0.083	1.996	0.729	0.057	46.029	3.805	5.955

DLRHP – First Differences of Logs for Real House Prices Index, ROA – Average Return on Assets of banks within the country, LZSCORE– Log of Average Z-Scores of banks within the country, DLCredit - First Differences of Logs for Aggregate Real Credit to private non-financial sector as percentage of GDP, CPI – Year-to-year change of Consumer Price Index, GDP Growth – Year-to-year change of real Gross Domestic Product, STIR – short-term interest rates

The mean of the difference of the log of nonfinancial sector credit/GDP (DLCredit) is 0.015, with a median of 0.013, indicating a general trend of credit growth relative to GDP. However, the standard deviation of 0.057 suggests that this growth is not uniform, with periods of both significant expansion and contraction. The maximum value of 0.335 and the minimum of -0.247 further emphasise the cyclical nature of credit availability, which is crucial for understanding financial cycles and potential risks of credit booms or recessions.

The banking sectors' pretax return on assets (ROA) has a mean of 0.83, which implies that, on average, the banks in OECD countries generate a return slightly less than 1% on their assets. However, the maximum and minimum values are particularly telling; with a maximum of 38.875 and a minimum of -17.657, there is considerable variation in profitability among banks. Both values belong to Icelandic banks, where in 2015 average ROA for banks within a country was 38.875 and in 2009, during a crisis, was -17.657. The standard deviation of 1.9964, though relatively low, underscores the presence of outliers that significantly impact the overall distribution.

The mean of the log of the Z-Score (LZS) is 2.519, and the median is slightly higher at 2.553, suggesting that most banking sectors in the dataset maintain a reasonable level of stability. However, the standard deviation of 0.729 indicates that there is considerable variability in the stability of banking sectors, with some being significantly more stable than others. The extreme values, ranging from a minimum of -4.055 to a maximum of 4.051, reflect a broad spectrum of financial sustainability across the OECD countries banks.

Amongst the control variables, CPI year to year change has a mean of 7.48 with the median of 2.48, signalling high skewness of inflation rates with high standard deviation. The maximum value of1020.6, which belongs to Lithuania in 1992 indicating an economic shock during transition with an extreme inflation rate. Meanwhile, GDP growth has a mean of 2.41%, while short term-interest rates have a mean of 4.4%, with the maximum value of 72.2 that belongs to Turkey 1992, suggesting high inflation and high risk premium, and a minimum of -0.85 for Switzerland 2016-2019 during the negative interest rate period.

The correlation matrix shown in Table 2 demonstrates notably strong correlation between CPI and short-term interest rates at 0.59. The positive correlation suggests that as inflation increases, short-

term interest rates tend to rise, reflecting monetary tightening to control inflationary pressures. Additionally, the positive correlation between CPI and ROA (0.29) indicates that higher inflation may be associated with improved profitability in the banking sector, possibly due to higher nominal interest rates boosting banks' earnings on loans while deposit rates are sticky (i.e. a wider net interest margin).

Table 2.Correlation Matrix.

	CPI	DLCredit	GDPG	STIR	DLRHP	ROA	MPST	LZSCORE
CPI	1	0.15	0.19	0.59	0.06	0.29	-0.07	-0.07
DLCredit	0.16	1	-0.25	0.29	0.01	0.05	-0.25	-0.10
GDPG	0.19	-0.25	1	0.13	0.39	0.32	0.32	0.07
STIR	0.59	0.29	0.13	1	0.02	0.29	-0.20	-0.12
DLRHP	0.06	0.01	0.39	0.2	1	0.43	0.09	0.25
ROA	0.29	0.05	0.32	0.29	0.43	1	0.10	0.40
MPST	-0.07	-0.25	0.33	-0.20	0.09	0.10	1	0.09
LZSCORE	-0.07	-0.10	0.07	-0.12	0.25	0.40	0.09	1

DLRHP – First Differences of Logs for Real House Prices Index, ROA – Average Return on Assets of banks within the country , LZSCORE– Log of Average Z-Scores of banks within the country, DLCredit - First Differences of Logs for Aggregate Real Credit to private non-financial sector as percentage of GDP, CPI – Year-to-year change of Consumer Price Index, GDP Growth – Year-to-year change of Gross Domestic Product, STIR – short-term interest rates, MPST – sum of macroprudential tools usage (impulse basis), which is SUM_17 in the iMaPP database

The positive correlation between GDPG and DLRHP (0.39) suggests that economic growth is accompanied by increases in real house prices. This relationship may be due to rising incomes and employment during periods of economic growth, which drive demand for housing. Moreover, the positive correlation between GDPG and ROA (0.32) implies that economic expansion supports higher profitability in the banking sector, which is likely to be through increased lending activity and lesser defaults as well as higher fee and trading incomes.

The Z-Score (LZSCORE), a key indicator of bank stability, is positively correlated with ROA (0.40), indicating that more profitable banks tend to be more stable. This relationship is expected, as profitability enhances a bank's capacity to absorb losses, accumulate capital and maintain solvency.

The correlations involving macroprudential regulation reveal some interesting insights. The sum of macroprudential tools usage (MPST) shows a positive correlation with GDP growth (0.33), indicating a potential relationship between economic growth and tighter regulatory measures to curb the financial cycle and promote bank resilience. Its negative correlation with short term interest rates (-0.20) and CPI inflation (-0.07) suggests that stricter regulations might be associated with lower inflation and a lesser need for monetary tightening via interest rates. Moreover, the negative correlation between credit growth and MPST (-0.25) implies that more stringent macroprudential regulations may effectively constrain credit growth, underscoring the role of regulatory tools in maintaining financial stability. However, the low correlations between MPST and both house price growth (0.09) and log Z score (0.09) suggest that while macroprudential tools are effective in managing credit growth, their impact on housing prices and bank risk might be limited or indirect.

To ensure the stationarity of our modified variables, we conduct the Im-Pesaran-Shin test. Under the null hypothesis Im-Pesaran-Shin test, the series follow a unit root process, i.e. are non-stationary. Table 3, shows us that with 99% probability we can reject the null and conclude that our variables are stationary.

Table 3. Im, Pesaran and Shin test.

Variable	DLRHP	ROA	LZSCORE	DLCredit	CPI	GDP Growth	STIR
Im, Pesaran and Shin W-stat	-6.825	-9.342	-3.115	-8.429	-15.750	-22.822	-31.154
Probability	0.000	0.000	0.001	0.000	0.000	0.000	0.000

DLRHP – First Differences of Logs for Real House Prices Index, ROA – Average Return on Assets of banks within the country , LZSCORE– Log of Average Z-Scores of banks within the country, DLCredit - First Differences of Logs for Aggregate Real Credit to private non-financial sector as percentage of GDP, CPI – Year-to-year change of Consumer Price Index, GDP Growth – Year-to-year change of Gross Domestic Product, STIR – short-term interest rates

6. Results of estimation

6.1 Baseline models

Our results commence with the baselines for testing the macroprudential effects which are based on the approach of Akinci and Olmstead-Rumsey (2018). Note that we first conduct the Hausman test to determine which model, random effects model or fixed effects model, is preferred for our analysis. The null hypothesis in Hausman test is that Random Effects model is preferred due to higher efficiency. As we can observe from results in Table 4, with 95% probability we can reject the null for all baseline models and use fixed effects for our estimations.

Table 4. Hausman test.

Equation	DLRHP	DLCredit	ROA	LZS
Chi-Sq. Statistic	51.970	9.839	148.739	206.172
Chi-Sq. d.f.	4	4	4	4
Probability	0.000	0.043	0.000	0.000

Hausman test for baseline models presented in Table 5

Table 5. Regression results for DLRHP, DLCREDIT, ROA and LZSCORE for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects).

Independent variables	Dependent Variables			
	DLRHP	**DLCREDIT**	**ROA**	**LZSCORE**
Constant	0.0258***	0.014***	0.811***	1.493***
	(5.7)	(4.2)	(4.9)	(15.5)
Lagged Dependent	0.197***	0.443***	0.054	0.400***
	(7.3)	(14.2)	(1.5)	(11.6)
GDP Growth(-1)	0.006***	0.0004	0.108***	0.017***
	(6.2)	(0.5)	(3.3)	(2.8)
Short-term interest rates(-1)	-0.005***	-0.003***	0.002	0.006
	(-4.0)	(-3.1)	(0.03)	(0.6)
CPI Year-to-year change(-1)	-0.003**	0.001	-0.113**	-0.003
	(-2.5)	(1.4)	(-2.2)	(-0.3)
R-Squared	0.50	0.46	0.31	0.84
R-Squared (adj.)	0.46	0.42	0.25	0.82
Standard Error	0.05	0.04	1.68	0.30
F-Statistic	11.6	10.6	4.76	54.31
Prob (F-Statistic)	0.000	0.000	0.000	0.000
Periods Included	32	32	21	21
Cross-Sections Included	35	30	36	36
Observations	873	867	676	679

*Notes: The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient. *, **, *** represent significance at 10%, 5% and 1% respectively. DLRHP – First Differences of Logs for Real House Prices Index. ROA – Average Return on Assets of banks within the country. LZSCORE– Log of Average Z-Scores of banks within the country. DLCredit - First Differences of Logs for Aggregate Real Credit to private non-financial sector as percentage of GDP.*

In the regressions presented in Table 5, we explore the empirical results of our baseline models, which estimate the relationships between our dependent variables (house prices, credit volume, banks' profitability and resilience) and lagged country specific macroeconomic indicators (CPI year-to-year change, GDP growth and short-term interest rates) with lagged dependent variables as explanatory variables, country and time dummies. The table combines results for four distinct models.

The F-tests conducted for each model confirm the overall significance of our estimations, indicating that the models are statistically robust and capable of explaining to some extent the variation in the dependent variables. Note that the number of observations is greater for house prices and credit than for the bank level variables, reflecting more recent starting points for the latter in the Global Financial Development Database.

One of the key findings is the positive significance at the 1% level of the lagged dependent variables for bank resilience, house prices, and credit. This suggests that the previous values of these variables are highly significant in predicting their current levels. Specifically, the persistence of these variables indicates that past performance and trends play a critical role in shaping current outcomes. For

instance, previous increases in house prices tend to lead to further increases, highlighting the momentum effect in the housing market as also found in Carreras et al (2018).

The analysis also reveals a significant positive effect of GDP growth on bank resilience, profitability, and house prices. This implies that as the economy grows, banks tend to become more profitable and resilient, and house prices rise. The underlying mechanism for this relationship may be that economic growth leads to higher income levels, increased borrowing capacity, and greater demand for housing, which in turn boosts house prices. Additionally, economic expansion typically results in higher lending activity and better financial performance for banks, thereby enhancing their profitability and stability.

Conversely, the results indicate a significant negative effect of short-term interest rates on changes in house prices and credit volumes. This inverse relationship suggests that as short-term interest rates rise, the cost of borrowing increases, leading to a reduction in demand for credit and housing. The decline in house prices and credit volumes in response to rising interest rates underscores the sensitivity of these markets to changes in the cost of borrowing as monetary policy tightens.

Moreover, the analysis reveals a significant negative effect of CPI changes on bank profitability and house prices. This finding suggests that rising inflation can decrease the profitability of banks, possibly due to the lower demand on loans. Additionally, inflation may reduce the purchasing power of consumers, leading to lower demand for housing and, consequently, a decline in real house prices.

6.2 House Prices and macroprudential policy

We added macroprudential tools one at a time, firstly the cumulative effect and then the impulse, to the equations for real house prices from 1990 to 2023. We found several significant results regarding the impact of various both cumulated and impulse-based macroprudential tools, when added to the baseline model shown in Table 5.

Notably, as shown in Table 6, a cumulative tightening of capital requirements has a significant negative effect at the 1% level, indicating that stricter capital measures lead to a decrease in house prices. This finding is consistent with the work of Carreras et al. (2018), who found that capital requirements effectively curb house price inflation in OECD countries by reducing credit availability.

Moreover, we observe a significant positive effect for Limits on Foreign Currency (LFC), suggesting that tightening these constraints leads to an increase in house prices, perhaps as banks switch lending to domestic currency mortgages. Additionally, we found a positive, significant effect at the 10% level of the average LTV value (numerical), indicating that lower LTV ratios are associated with falling house prices, which supports the conclusions of Alam et al. (2019) and Akinci and Olmstead-Rumsey (2018) regarding the effectiveness of LTV limits in controlling housing market excesses.

In the impulse-based approach, which captures short-term effects, we observed a strong positive significance for reserve requirements (RR). This suggests that tightening reserve requirements leads to a short-term rise in house prices. There is also a cumulative effect, with the impulse effect being stronger. Reserve requirements are of course not directed at house prices but the positive effect of policy tightening is notable. It may be an aspect of policy tightening during a boom period that includes house price growth.

Table 6. Regression on Individual effect of Macroprudential Tools results for DLRHP for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered one at a time.

	Cumulative	Impulse	Numerical
Capital(-1)	-0.005*** (-2.7)	0.003 (0.7)	
CCB(-1)	-0.003 (-0.8)	-0.004 (-0.6)	
Conservation(-1)	0.001 (0.2)	0.004 (0.7)	
DSTI(-1)	0.002 (0.6)	-0.002 (-0.4)	
LCG(-1)	-0.022 (-1.1)	0.0297 (1.0)	
LFC(-1)	0.01** (2.2)	0.016 (1.1)	
LFX(-1)	-0.016 (-1.6)	0.008 (0.5)	
Liquidity(-1)	0.0002 (0.1)	-0.005 (-1.2)	
LLP(-1)	0.005 (1.3)	0.002 (0.3)	
LoanR(-1)	-0.002 (-0.7)	-0.006 (-0.9)	
LTD(-1)	-0.0104 (-0.9)	-0.014 (-1.0)	
LTV(-1)	0.000 (0.05)	-0.003 (-0.6)	
LVR(-1)	0.005 (0.8)	0.0002 (0.03)	
Other(-1)	0.002 (0.8)	-0.0005 (-0.1)	
RR(-1)	0.004* (1.8)	0.027*** (5.2)	
SIFI(-1)	-0.0004 (-0.13)	-0.0014 (-0.2)	
Tax(-1)	-0.003 (-0.8)	-0.008 (-0.8)	
Average LTV(-1)			0.0005* (1.8)
Sum of tools (-1)	-0.000 (-0.05)	0.001 (0.8)	

*The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient *, **, *** represent significance at 10%, 5% and 1% respectively. Each equation includes the baseline model shown in Table* 5 *and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added one at a time. See Table A1 for detailed definitions of the macroprudential instruments*

6.3 Credit growth and macroprudential policy

Our analysis of credit growth, presented in Table 7, reveals that several cumulative macroprudential instruments, including systemically important financial institutions (SIFI) surcharges, reserve requirements (RR), and loan loss provisions (LLP), have a significant positive sign. This suggests that tightening these instruments correlates with an increase in aggregate credit. This finding aligns partially with Cerutti et al. (2017) who found that SIFI can stimulate credit in developing economies, however, they also found that the effect of reserve requirements on credit growth is significantly negative, which contradicts our findings.

The impact of higher (numerical) Loan-to-Value (LTV) ratios on credit growth, significant at the 5% level, that we observed is consistent with the findings of Alam et al. (2019) and Akinci and Olmstead-Rumsey (2018), who also found significant negative effect of LTV on credit growth. It is the only policy tool in our estimation here to be effective in restraining credit growth.

In the impulse-based approach, the significant positive effects of limits on credit growth (LCG) and loan restrictions (LoanR) on credit growth suggest that these tools are counterproductive in the short term. This observation contradicts with the findings of Alam et al. (2019), who discovered significant negative effect of LoanR on credit growth. It may be that tightening of such policies has a delayed effect on credit well beyond a year.

Table 7. Regression on Individual effect of Macroprudential Tools results for DLCredit for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered one at a time.

	Cumulative	Impulse	Numerical
Capital(-1)	-0.0014 (-1.0)	0.005 (1.2)	
CCB(-1)	-0.001 (-0.3)	0.0001 (0.02)	
Conservation(-1)	0.0013 (0.5)	-0.001 (-0.16)	
DSTI(-1)	-0.003 (-1.4)	-0.005 (-0.9)	
LCG(-1)	0.005 (0.4)	0.027* (1.9)	
LFC(-1)	-0.0006 (-0.2)	0.002 (0.2)	
LFX(-1)	-0.002 (-0.2)	-0.002 (-0.1)	
Liquidity(-1)	0.0001 (0.1)	-0.003 (-0.7)	
LLP(-1)	0.006** (2.4)	-0.001 (-0.18)	
LoanR(-1)	0.0001 (0.04)	0.009* (1.7)	
LTD(-1)	-0.0054 (-0.5)	-0.018 (-1.4)	
LTV(-1)	-0.001 (-0.5)	-0.001 (-0.2)	
LVR(-1)	0.007 (1.5)	-0.007 (-1.0)	
Other(-1)	0.003 (1.3)	0.003 (0.7)	
RR(-1)	0.003* (1.7)	0.005 (1.1)	
SIFI(-1)	0.007** (2.2)	0.006 (1.2)	
Tax(-1)	-0.0001 (-0.027)	0.003 (0.34)	
Average LTV(-1)			0.0005** (2.2)
Sum of tools (-1)	0.0003 (0.7)	0.001 (0.9)	

*The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient. *, **, *** represent significance at 10%, 5% and 1% respectively. Each equation includes the baseline model shown in Table 1 and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added one at a time. See Table* A1 *for detailed definitions of the macroprudential instruments*

6.4 Banks' Performance (pre-tax return on assets and z-score) and macroprudential policy

Our analysis of bank profitability shown in Table 8 reveals a positive and significant effect of liquidity-oriented measures in the impulse-based approach, indicating that in the short term, the profitability of banks tends to increase when these measures are tightened. This suggests that tightening liquidity controls may provide benefits to bank profitability.

When considering bank resilience as measured by the log of Z-Score, the analysis shown in Table 9 reveals a significant negative effect of cumulative loan-to-value (LTV) ratios and Reserve Requirements (RR). These results indicate that tightening these instruments could potentially make banks more vulnerable, likely due to the increased constraints on lending and liquidity management, which contradicts with findings of Altunbas et al (2018), who revealed that tightening of such tools as LTV and DSTI ratios, liquidity and currency oriented measures and reserve requirements increases banks resilience (higher Z-Score). These contradictions in findings may arise because of the differences in approach: Altunbas et al (2018) examine the effects of macroprudential regulation at individual banks level, while we investigate the effects at sectoral level.

Table 8. Regression on Individual effect of Macroprudential Tools results for Return on Assets for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered one at a time.

	Cumulative	Impulse	Numerical
Capital(-1)	-0.051 (-0.7)	-0.184 (-1.2)	
CCB(-1)	-0.095 (-0.6)	-0.256 (-1.0)	
Conservation(-1)	-0.046 (-0.4)	-0.173 (-0.9)	
DSTI(-1)	0.056 (0.5)	0.049 (0.2)	
LCG(-1)	-0.236 (-0.3)	-0.232 (-0.2)	
LFC(-1)	0.074 (0.5)	0.146 (0.3)	
LFX(-1)	-0.143 (-0.2)	0.227 (0.3)	
Liquidity(-1)	-0.002 (-0.03)	0.595*** (3.6)	
LLP(-1)	0.164 (1.07)	-0.025 (-0.1)	
LoanR(-1)	0.044 (0.4)	0.066 (0.3)	
LTD(-1)	-0.922 (-1.4)	-0.453 (-0.6)	
LTV(-1)	-0.028 (-0.4)	-0.041 (-0.2)	
LVR(-1)	0.178 (0.8)	0.016 (0.05)	
Other(-1)	0.095 (0.9)	0.014 (0.1)	
RR(-1)	0.051 (0.5)	0.186 (1.0)	
SIFI(-1)	0.015 (0.12)	-0.03 (-0.2)	
Tax(-1)	-0.158 (-1.02)	-0.395 (-0.9)	
Average LTV(-1)			0.003 (0.3)
Sum of tools (-1)	-0.007 (-0.3)	0.025 (0.5)	

*The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient. *, **, *** represent significance at 10%, 5% and 1% respectively. Each equation includes the baseline model shown in Table 1 and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added one at a time. See Table* A1 *for detailed definitions of the macroprudential instruments*

Table 9. Regression on Individual effect of Macroprudential Tools results for Log of Z-Score for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered one at a time.

	Cumulative	Impulse	Numerical
Capital(-1)	0.002 (0.1683)	0.0025 (0.0878)	
CCB(-1)	0.0085 (0.3369)	-0.0143 (-0.3068)	
Conservation(-1)	0.0037 (0.1799)	0.0002 (0.006)	
DSTI(-1)	-0.006 (-0.2819)	-0.0165 (-0.4466)	
LCG(-1)	-0.0459 (-0.3536)	0.0077 (0.0434)	
LFC(-1)	0.0081 (0.2781)	0.0149 (0.1713)	
LFX(-1)	-0.0292 (-0.2683)	0.0582 (0.4566)	
Liquidity(-1)	-0.0006 (-0.0491)	0.01 (0.3194)	
LLP(-1)	-0.0196 (-0.7131)	0.0063 (0.1467)	
LoanR(-1)	-0.0239 (-1.2263)	-0.0057 (-0.1447)	
LTD(-1)	-0.0336 (-0.2922)	-0.019 (-0.1369)	
LTV(-1)	-0.0265** (-1.9712)	-0.0444 (-1.2948)	
LVR(-1)	-0.0022 (-0.054)	0.0145 (0.2538)	
Other(-1)	-0.0116 (-0.6018)	0.0262 (0.9113)	
RR(-1)	-0.0554*** (-2.664)	0.0238 (0.6968)	
SIFI(-1)	0.0052 (0.224)	0.0003 (0.0077)	
Tax(-1)	-0.0215 (-0.851)	-0.0718 (-1.1189)	
Average LTV(-1)			0.0003 (0.1363)
Sum of tools (-1)	-0.0057 (-1.507)	0.0001 (0.0086)	

*The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient. *, **, *** represent significance at 10%, 5% and 1% respectively. Each equation includes the baseline model shown in Table 1 and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added one at a time. See Table* A1 *for detailed definitions of the macroprudential instruments*

7. Robustness checks

As noted, we ran a number of robustness checks to evaluate whether the baseline results are robust to changes in specification or sample. These were, first, to run the regressions in Table 5 with all the individual macroprudential variables entered together and not one by one; second, to run the regressions in Table 5 with the summary variables from Alam et al (2019) entered one at a time. Third, we re-estimated the regressions in Table 5 with winsorised variables and then tested with all the individual macroprudential policies together. And finally, we reran the specifications in Table 5 separately for large and small OECD economies, and tested the individual macroprudential variables all together.

7.1 Baseline with winsorised variables

Appendix Table A2 presents the baseline model estimations for the winsorised datasets. The results indicate that the year-to-year change in CPI for house price growth, as well as the constant and short-term interest rates for credit growth, become insignificant. Conversely, the CPI change for Log of Z-Score and lagged dependent with short-term interest rates for the return on assets, become significant. These findings suggest that applying winsorisation, notably for the bank performance measures, enhances the accuracy of estimations. The outliers shown in Table 1 may have a disproportionate effect.

7.2 House price effects in the variants

Appendix Table A3 confirms the robustness of the results in Table 6 for house prices and macroprudential policies, as they remain consistent even when all instruments are included simultaneously in the model. Meanwhile, capital and reserve requirements remain significant in the winsorised model. Also, we can note that cumulative capital requirements, limits on credit growth and (with a positive sign) reserve requirements as well as impulse reserve requirements are significant in smaller economies, while for large economies only impulse-based reserve requirements are significant, This may suggest possible higher efficiency of macroprudential regulation in smaller economies, perhaps due to better coordination, relative simplicity and concentration of financial systems.

Appendix Table A4 showing summary variables further highlights the cumulative effect of macroprudential measures aimed at capital supply (sum of capital, countercyclical capital buffer, conservation buffer, and leverage ratio), which is significant and negative, suggesting that tightening these measures leads to a decline in house prices. Additionally, the impulse-based effect of general supply policies (including reserve requirements, liquidity, and foreign exchange measures) is significant and positive, suggesting that these policies, when tightened, correspond to an increase in house prices in the short term.

7.3 Credit growth effects in the variants

Comparing results with Table 7, Appendix Table A5 confirms the robustness of the effects of cumulative loan loss provisions and SIFI surcharges, in both all-together and winsorised datasets, indicating that these instruments accompany higher credit growth across different models. However, the robustness of reserve requirements from Table 7 is less clear, as its significance diminishes in most models.

Moreover, Appendix Table A5 reveals a significant negative effect of cumulative capital requirements and debt service to income (DSTI) ratios on credit growth, indicating that tightening these instruments effectively reduces the overall amount of credit. This is the case both for the all-policies together and winsorised models, in both of which all policies are entered together. This finding aligns with the results of Alam et al. (2019), who demonstrated significant negative effect of DSTI tightening on credit growth in advanced economies. Cerutti et al. (2017) also found that stricter capital requirements and borrower-based measures like DSTI are effective in curbing excessive credit growth.

In larger economies we can observe in Table A5 a significance of cumulative tax measures (which restrain credit) and measures not defined in iMaPP database(which accompany higher credit growth). In the impulse based approach, we can note the significance of loan loss provision and loan-to-deposit ratios with a negative sign, suggesting that tightening of these tools is effective in curbing excessive credits growth, although loan measures appear to be counterproductive in the short run.

Analysis for smaller economies reveals significant negative effects for cumulative and impulse debt-service-to-income measures which are absent from the larger economies, while there are positive effects for cumulative limits on foreign exchange positions, provisions and impulse-based reserve requirements.

Table A6 demonstrates the statistical insignificance of summary measures on credit growth, which contradicts with findings of Alam et al (2019), who found a significant effect of groups of policies like supply-all, demand and loan-targeted measures on real credit growth.

7.4 Bank profitability effects in the variants

The robustness of the finding of a positive and significant effect of impulse liquidity-oriented measures in Table 8 is confirmed by Appendix Table A7, which partly supports the consistency and reliability of this result when all policies are entered together, but not when the variables are winsorised. This observation also partially aligns with findings of Davis et al. (2022), who discovered significant positive effect of liquidity-oriented measures on the return on average equity of banks in advanced countries.

Moreover, when data is winsorised, Appendix Table A7 reveals a positive significance of impulse reserve requirements and negative significance of tax measures suggesting that in a short-term, tax measures reduce banks' profitability which is consistent with findings of Davis et al (2022).

For larger economies Appendix Table A7 shows significant negative effect on banking-sector profitability of such measures as cumulative capital requirements, impulse loan restrictions and impulse reserve requirements, and significant positive effect of impulse loan-to-value ratio and cumulative other measures (not defined in iMaPP database).

For smaller economies, we can observe significant negative effects of both cumulative and impulse capital conservation measures and a strong positive effect of impulse liquidity-oriented measures. Although these findings partially align with findings of Davis et al. (2022), their study also reveals significant effect of reserve requirements (positive), capital requirements (negative), loan restriction (positive), loan-to-value ratio (positive) and other measures (positive) on banks' profitability but only

in emerging market and developing economies, while our analysis suggests that some of these tools remain significant in advanced countries. This may suggest difference between individual bank effects and banking sector effects.

Additionally, Appendix Table A8 showing summary measures shows a significant negative effect of the summary tool for impulse measures oriented towards the supply of capital. This finding indicates that tightening capital supply measures may have adverse effects on financial performance, possibly by restricting scope to lend and limiting banks' operational flexibility. Conversely, the summary tool for measures oriented towards general supply shows a significant positive effect, suggesting that these measures can enhance profitability when applied, consistent with the result for liquidity measures.

7.5 Effects on log Z score in the variants

The robustness of the finding of a significant negative effect of loan-to-value (LTV) ratios and reserve requirements (RR) in Table 9 is confirmed by Appendix Table A9. Furthermore, Appendix Table A10 highlights a significant negative effect of loan-targeted macroprudential measures on bank resilience, which is consistent with a result for LTV. This suggests that measures aimed at restricting lending can, in fact, weaken banks' stability, potentially by reducing their income-generating activities and increasing their exposure to risk.

Overall, we suggest that the robustness checks underline the reliability of the baseline results. They also show some major contrasts between policy effectiveness in small and large OECD economies.

8. Conclusions

8.1 Conclusions of the research

This research provides empirical evidence of the impact of macroprudential regulation on house prices, credit growth, and bank performance at an economy-wide level. Using panel data from 36 OECD countries spanning the period from 1990 to 2023, we conducted a Panel OLS analysis to assess the effectiveness of various macroprudential tools in maintaining financial stability in advanced macroeconomic economies. It advances on existing work by including the latest data, using sector level data for bank performance, using winsorisation with macro data and examining the difference of effect in larger and smaller OECD economies.

Our findings indicate that certain macroprudential measures, such as capital requirements and loan-to-value (LTV) ratios, play a crucial role in controlling house prices – they are effective in mitigating excessive price growth and maintaining stability in the housing market. on the other hand, positive effects are seen from limits on foreign currency lending and reserve requirements, as for example the former may redirect lending from abroad to domestic residential property lending.

Additionally, our analysis reveals that macroprudential instruments like higher LTV ratios (tightening), debt-service-to-income and capital requirements are useful in curbing excessive credit growth. These tools help regulate credit availability, thereby contributing to overall financial stability. On the other hand, positive signs are found for tools such as loan loss provisions, loan restrictions, reserve requirements, surcharges on systemically important financial institutions (SIFIs) suggesting they may be counterproductive, or at least ineffective, to efforts to limit credit growth.

Furthermore, we found that liquidity-oriented macroprudential regulations have a positive impact on bank profitability. However, our results also suggest that tightening measures such as reserve requirements and LTV ratios can significantly reduce banks' resilience as measured by the log of the sectoral Z-Score. This highlights the trade-off between enhancing profitability and maintaining the robustness of financial institutions.

Also, our analysis suggests that macroprudential tools are more effective in smaller economies, possibly due to better coordination, relative simplicity and concentration of financial system. More generally, there are major contrasts between large and small economies in terms of the effectiveness of individual policies, underling the point that there is no “one size fits all” solution.

Overall, our study underscores the importance of a targeted approach in applying macroprudential regulations to achieve balanced economic stability.

8.2 Limitations

While this research provides valuable insights into the effectiveness of macroprudential policies, several limitations must be acknowledged. First, the study relies on panel data analysis, which may not fully capture the nuances of individual country contexts or the impact of specific macroeconomic shocks. Additionally, the analysis is limited to OECD countries, which may reduce the generalisability of the findings to emerging markets or economies with different financial structures. The study also focuses generally on the period from 1990 to 2023, rather than focusing specifically on the effects of macroprudential policies implemented in response to the global financial crisis of 2008 or the policy reversals during the COVID pandemix. Finally, the research does not account for potential behavioural responses by financial institutions or borrowers to changes in macroprudential regulation, which could influence the overall effectiveness of these policies. Additionally, in our work we focus on country level data and do not investigate the effects of macroprudential regulation for banks’ profitability and resilience at individual banks level.

8.3 Recommendations

Based on the findings, it is recommended that policymakers adopt a targeted and flexible approach to macroprudential regulation. Capital requirements at a macro level should be emphasised as a primary tool for controlling credit growth and mitigating systemic risks in the banking sector, complementing their role in microprudential policy of helping ensure individual bank solvency. Tightening loan-to-value limits and debt-service-to-income ratios can help to counter house price booms and credit expansion. Additionally, reserve requirements should be utilised strategically to manage short-term liquidity pressures, while bearing in mind that there is little indication of their effectiveness in countering credit/asset booms or helping bank resilience.

Policymakers should also consider the timing and intensity of macroprudential interventions to avoid unintended consequences, such as reduced credit availability or increased financial sector volatility. Furthermore, it is crucial to coordinate macroprudential policies with other economic policies, such as monetary and fiscal measures, to achieve a balanced approach to economic management as in the pandemic. Finally, continuous monitoring and adjustment of these policies are necessary to adapt to changing economic conditions and ensure long-term financial stability.

Further research on this topic would benefit from expanding the dataset, both in terms of the time period covered and the range of countries included. It is essential to capture the effects of

macroprudential regulations in a diverse set of countries with various economic situations, backgrounds, and financial systems. Banking sector level control variables could be included in the equations for profitability and the log Z-Score as in the Davis et al (2020) study of bank capital, competition and risk at a sectoral level. Estimation by Generalised Method of Moments as well as OLS could be used as a further robustness check to reduce the potential endogeneity in the specification.

Additionally, future research could explore the impact of macroprudential policies on different sectors, such as the effect on prices of high-end versus affordable housing, or the differences in impact on properties located in urban centres compared to rural areas.

Lastly, considering the importance of economic sentiment, further research should investigate potential behavioural responses by financial institutions and borrowers to changes in macroprudential regulations. Understanding these responses is crucial, as they could significantly influence the overall effectiveness of these policies.

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Appendix

Table A1. Macroprudential Tools.

Abbreviation	Name	Description
CCB	Countercyclical Capital Buffer	Macroprudential instrument that policymakers use to enhance resilience of banks during periods of excessive credit growth. It requires bank to retain additional capital when credits are growing rapidly to prevent potential financial crisis by lowering systemic risk and can be released to prevent credit crunches in downturns.
Conservation	Conservation Buffer	Instrument that intended to prepare banks for financial shocks by requiring banks to accumulate capital during stable times, which can be used in case of financial stress to withstand losses.
Capital	Capital Requirements	Beside CCB and Conservation, banks are obligated to hold certain level of capital relative to their risk-weighted assets, the systemic risk buffer. This tool is designed to increase banks robustness by ensuring that they have enough capital to cover their losses and remain solvent, which leads to overall financial stability.
LVR	Leverage Ratio	Tool, established to ensure that bank holds certain adequate level of capital relative to its total non-risk-weighted exposure to maintain bank's solvency. Policymakers try to prevent excessive leverage by imposing a minimum leverage ratio requirement.
LLP	Loan Loss Provision	Macroprudential tool used by policymakers to oblige banks to set aside funds as a reserve for possible loan defaults. The stability and resilience of the financial system are improved by this reserve, which serves as a safeguard against potential losses from non-performing loans. The main purpose is to guarantee that banks have enough reserves to meet anticipated losses, particularly in recessionary times.
LCG	Limit on Credit Growth	Macroprudential tool used to prevent excessive lending in the economy, which potentially can lead to instability. Regulators set limitations for credit growth and penalties for a higher rate, forcing banks to reduce the volume of aggregate credit they grant.
LoanR	Loan Restrictions	More specific category for Limits on Credit Growth in the database, it captures various limitations based on characteristics of loan, creditor etc.
LFC	Limits on Foreign Currency	Macroprudential tools designed to decrease risk factors related to a borrowing and lending in foreign currency. These limits and restrictions are imposed in order to avoid excessive reliance on foreign currency, which can expose them and their clients to exchange rate volatility, liquidity issues, currency mismatches etc.
DSTI	Debt-Service-to-Income ratio	Regulatory instrument that limits the proportion of borrower's income that can be used to service debt payments. The aim of this tool is to be confident that borrower will be able to fulfil taken obligations, therefore, reduce the default risk.

LTV	Loan-to-Value ratio	LTV regulates the amount that borrower can borrow relative to the value of asset being purchased. For instance, if LTV is set at 70%, borrower must provide 30% as a down payment. Using this tool, policymakers are aiming to control excessive credit, prevent potential bubbles and, most importantly, reduce the risk of potential defaults. In Alam's iMaPP database LTV is represented in two different types: numerical value – actual LTV ratio at that moment; and dummy-type variable which captures tightening or loosening of regulation.
Tax	Tax on Financial Institutions	Targeted taxation as a macroprudential tool is designed to curb potential risky behaviour of an individual institution and cool down sectors of economy which are overheating. Examples of such taxation policies include taxes on bank profits, capital gains taxes, short-term capital inflows and stamp duties.
Liquidity	Liquidity Measures	This category in the database includes measures undertaken to ensure that financial institutions maintain adequate liquid assets to be able to comply with short-term obligations to prevent liquidity shortages, which can lead to financial instability. It includes the usage of tools such as Liquidity Coverage Ratio, Net Stable Funding Ratio, Liquid Assets Ratio and others.
LTD	Loan-to-Deposit ratio	Macroprudential measure that limits the volume of loans that financial institution can issue relatively to deposits that it has. The purpose of this measures is to ensure that financial institution, e.g. bank, is not providing excessive loans comparatively to deposits it possesses, therefore, will not face liquidity issues.
LFX	Limits on gross or net open foreign exchange	Regulatory measures that restrict the amount of foreign currency exposure that a financial institution can hold. These limits are set to reduce the risk that arises from fluctuations in exchange rates, which can lead to significant losses if institutions have large unhedged foreign exchange positions.
RR	Reserve Requirement	Reserve Requirement for macroprudential purposes.
SIFI	SIFI surcharges	Regulatory measures towards SIFIs (Systematically Important Financial Institutions) includes such measures as capital and liquidity surcharges. Consequences caused by potential failure of SIFIs are incomparably more dangerous for financial stability due to their size, complexity and deep integration into an economy with a risk of contagion to other institutions, therefore, policymakers are implying special limitations for such institutions to increase the overall robustness of a financial system.
Other		Category from iMaPP database that captures changes in measures, which cannot be attributed to categories above. It includes such tools as limitations on profit distribution, stress testing and others.

Source: Alam et al (2019)

Table A2. Regression results for winsorised DLRHP, DLCREDIT, ROA and LZSCORE for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects).

Independent variables	Winsorised Dependent Variables			
	DLRHP	**DLCREDIT**	**ROA**	**LZSCORE**
Constant	0.022***	0.004	0.593***	1.195***
	(5.5)	(1.1)	(7.4)	(14.2)
Winsorised Lagged Dependent	0.426***	0.486***	0.318***	0.54***
	(13)	(15.8)	(9)	(16.8)
Winsorised GDP Growth(-1)	0.003***	0.002**	0.076***	0.009**
	(3.5)	(2.3)	(4.9)	(2)
Winsorised Short-term interest rates(-1)	-0.005***	0	-0.046*	0
	(-4.6)	(0.5)	(-1.9)	(0)
Winsorised CPI Year-to-year change(-1)	-0.001	-0.001	-0.047**	-0.012**
	(-0.9)	(-1.6)	(-2.5)	(-2.2)
R-Squared	0.576	0.488	0.582	0.914
R-Squared (adj.)	0.540	0.447	0.542	0.906
Standard Error	0.043	0.038	0.688	0.207
F-Statistic	15.833	11.921	14.522	111.339
Prob (F-Statistic)	0.000	0.000	0.000	0.000

The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient
, **, * represent significance at 10%, 5% and 1% respectively*
DLRHP – First Differences of Logs for Real House Prices Index
ROA – Average Return on Assets of banks within the country
LZSCORE– Log of Average Z-Scores of banks within the country
DLCredit - First Differences of Logs for Aggregate Real Credit to private non-financial sector as percentage of GDP

Table A3. Regression on combined effect of Macroprudential Tools results for DLRHP for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered all together.

	All tools together		Winsorised		Larger economies		Smaller economies	
	Cumulative	**Impulse**	**Cumulative**	**Impulse**	**Cumulative**	**Impulse**	**Cumulative**	**Impulse**
Capital (-1)	-0.008***	0.003	-0.005***	0	-0.0003	0.004	-0.01***	0.002
	(-3.7)	(0.6)	(-3)	(-0.1)	(-0.06)	(0.5)	(-3.34)	(0.4)
CCB(-1)	0.002	-0.004	0.001	-0.005	0.003	-0.005	0.003	-0.003
	(0.4)	(-0.5)	(0.2)	(-0.9)	(0.3)	(-0.6)	(0.5)	(-0.3)
Conservation(-1)	0.0001	0.005	0.001	0.004	0.001	0.002	-0.002	0.003
	(0.04)	(0.8)	(0.2)	(0.7)	(0.2)	(0.2)	(-0.3)	(0.3)
DSTI(-1)	-0.0013	-0.003	0	0	0.002	0.007	-0.006	-0.015
	(-0.4)	(-0.4)	(0)	(0)	(0.4)	(1.0)	(-1.0)	(-1.5)
LCG(-1)	-0.029	0.031	-0.028	0.024	-0.021	0.028	-0.077*	-0.021
	(-1.4)	(1.05)	(-1.6)	(1)	(-1.0)	(1.1)	(-1.9)	(-0.3)
LFC(-1)	0.011**	0.017	0.007	0.012	0.005	0.017	0.01	0.008
	(2.3)	(1.06)	(1.6)	(0.9)	(0.6)	(0.7)	(1.5)	(0.4)
LFX(-1)	-0.014	0.009	-0.01	0.004	0.005	0.008	-0.061	-0.026
	(-1.24)	(0.6)	(-1)	(0.3)	(0.5)	(0.7)	(-1.5)	(-0.4)
Liquidity(-1)	0.0004	-0.005	0.001	-0.003	0.006	-0.002	0.004	-0.006
	(0.24)	(-1.1)	(0.5)	(-0.9)	(1.6)	(-0.3)	(1.3)	(-0.9)
LLP(-1)	0.005	0.0016	0.003	0.001	-0.006	-0.008	0.013	0.01
	(1.07)	(0.2)	(0.7)	(0.1)	(-1.3)	(-1.0)	(1.36)	(0.83)
LoanR(-1)	-0.0014	-0.005	-0.001	-0.006	-0.002	-0.001	0.0004	-0.008
	(-0.4)	(-0.7)	(-0.4)	(-1.1)	(-0.5)	(-0.1)	(0.1)	(-0.8)
LTD(-1)	-0.012	-0.012	-0.009	-0.007	-0.009	-0.004	-0.033	-0.013
	(-1.0)	(-0.8)	(-0.8)	(-0.5)	(-0.8)	(-0.3)	(-1.2)	(-0.4)
LTV(-1)	-0.002	-0.003	-0.003	-0.007	0.002	-0.005	-0.005	0.003
	(-0.9)	(-0.53)	(-1.2)	(-1.5)	(0.6)	(-0.8)	(-0.92)	(0.35)
LVR(-1)	0.002	0.002	0.002	-0.001	0.006	-0.002	-0.002	0.0104
	(0.3)	(0.3)	(0.3)	(-0.1)	(0.8)	(-0.2)	(-0.2)	(0.7)
Other(-1)	0.003	0.000	0.003	-0.002	0.003	-0.002	0.002	0.002
	(1.03)	(0.01)	(1)	(-0.4)	(0.8)	(-0.4)	(0.3)	(0.2)
RR(-1)	0.007**	0.027***	0.004*	0.011**	0.0023	0.013**	0.008*	0.03***
	(2.5)	(5.2)	(1.8)	(2.5)	(0.9)	(2.3)	(1.75)	(3.7)
SIFI(-1)	-0.0013	-0.002	0	0	0.007	0.012	-0.000	-0.006
	(-0.4)	(-0.3)	(-0.1)	(0)	(1.0)	(1.12)	(-0.9)	(-0.7)
Tax(-1)	-0.003	-0.009	-0.002	-0.013	-0.0006	-0.007	-0.005	-0.02
	(-0.7)	(-0.9)	(-0.8)	(-1.5)	(-0.1)	(-0.7)	(-0.7)	(-0.9)

The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient
, **, * represent significance at 10%, 5% and 1% respectively*
Each equation includes the baseline model shown in Table 5 (Appendix Table A2 for winsorised) and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added simultaneously. See Appendix Table A1 for detailed definitions of the macroprudential instruments
Larger economies – countries with GDP more than 1 trillion US dollars in 2023
Smaller economies – countries with GDP less than 1 trillion US dollars in 2023

Table A4. Regression on effects of Summary Macroprudential Tools results for DLRHP for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered one at a time.

	Cumulative	Impulse
Demand(-1)	0.0004 (0.3)	-0.002 (-0.6)
Loan Targeted(-1)	0.0005 (0.6)	-0.001 (-0.6)
Supply All(-1)	-0.0002 (-0.2)	0.003 (1.6)
Supply Capital(-1)	-0.003* (-1.95)	0.002 (0.6)
Supply General(-1)	0.001 (0.8)	0.008** (2.4)
Supply Loans(-1)	0.001 (0.74)	-0.001 (-0.3)

The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient
, **, * represent significance at 10%, 5% and 1% respectively*
Each equation includes the baseline model shown in Table 5 and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added one at a time.

Demand = LTV + DSTI
Loan Targeted = Demand + Supply Loans
Supply Capital = Capital + CCB + Conservation + LVR
Supply Loans = LLP + LCG + LoanR + LFC + LTD
Supply General = RR + Liquidity + LFX
Supply All = Supply Capital + Supply General + Supply Loans

See Appendix Table A1 for detailed definitions of the macroprudential instruments.

Table A5. Regression on Overall effect of Macroprudential Tools results for DLCredit for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered all together.

	All tools together		Winsorised		Larger economies		Smaller economies	
	Cumulative	**Impulse**	**Cumulative**	**Impulse**	**Cumulative**	**Impulse**	**Cumulative**	**Impulse**
Capital (-1)	-0.003*	0.005	-0.003*	0.004	0	0.006	0.001	0.008
	(-1.9)	(1.3)	(-1.7)	(1.2)	(0.1)	(0.9)	(0.3)	(1.6)
CCB(-1)	-0.0001	0.001	0	0	0.005	-0.004	-0.002	0.005
	(-0.04)	(0.12)	(0.1)	(0)	(0.6)	(-0.5)	(-0.3)	(0.5)
Conserv ation(-1)	-0.0002	-0.003	-0.002	-0.003	0.004	0.009	-0.009	-0.013
	(-0.1)	(-0.5)	(-0.5)	(-0.5)	(1.0)	(1.1)	(-1.5)	(-1.6)
DSTI(-1)	-0.008***	-0.008	-0.007**	-0.008	0.005	0.008	-0.026***	-0.029***
	(-2.7)	(-1.4)	(-2.3)	(-1.5)	(1.0)	(1.3)	(-4.4)	(-2.8)
LCG(-1)	0.002	0.025*	0.006	0.022*	0.024	0.034	0.022	0.021
	(0.2)	(1.8)	(0.5)	(1.7)	(1.3)	(1.5)	(1.2)	(1.1)
LFC(-1)	-0.0008	0.003	0	0.004	0.012	-0.002	0.001	0.002
	(-0.3)	(0.2)	(0)	(0.4)	(1.5)	(-0.1)	(0.2)	(0.2)
LFX(-1)	0.005	-0.003	0.005	-0.003	0.003	0.01	0.094***	-0.043
	(0.4273)	(-0.2)	(0.5)	(-0.3)	(0.3)	(0.9)	(2.8)	(-0.9)
Liquidity (-1)	-0.0013	-0.0013	-0.001	-0.002	-0.00	0.003	-0.003	-0.003
	(-0.9)	(-0.3)	(-0.7)	(-0.5)	(-0.1)	(0.5)	(-1)	(-0.6)
LLP(-1)	0.01***	-0.003	0.01***	-0.003	-0.004	-0.011*	0.018**	0.009
	(3.1)	(-0.5)	(3.5)	(-0.5)	(-1.0)	(-1.7)	(2.5)	(0.9)
LoanR (-1)	-0.0004	0.009*	0.001	0.01*	0.003	0.013**	-0.003	0.008
	(-0.1)	(1.7)	(0.3)	(1.9)	(0.8)	(2.0)	(-0.5)	(0.9)
LTD(-1)	-0.008	-0.018	-0.008	-0.019	-0.013	-0.02*	-	-
	(-0.7)	(-1.4)	(-0.7)	(-1.5)	(-1.2)	(-1.8)		
LTV(-1)	0.000	-0.0012	0	-0.001	-0.004	-0.007	0.005	0.004
	(0.08)	(-0.3)	(0.2)	(-0.3)	(-1.5)	(-1.3)	(1.5)	(0.5)
LVR(-1)	0.008	-0.006	0.005	-0.006	0.004	-0.001	0.013	-0.004
	(1.6)	(-0.8)	(1.1)	(-0.9)	(0.5)	(-0.2)	(1.6)	(-0.4)
Other (-1)	0.001	0.002	0.001	0.004	0.008**	0.005	-0.003	0.003
	(0.5)	(0.5)	(0.4)	(1)	(2.5)	(1.2)	(-0.7)	(0.4)
RR(-1)	0.003	0.005	0.002	0.005	0.003	0.002	-0.001	0.012*
	(1.6)	(1.12)	(1.1)	(1.1)	(1.5)	(0.4)	(-0.4)	(1.7)
SIFI(-1)	0.009***	0.006	0.007**	0.006	-0.003	0.003	0.006	-0.001
	(2.6)	(1.01)	(2.2)	(1)	(-0.6)	(0.3)	(1.1)	(-0.2)
Tax(-1)	0.0005	0.0014	-0.001	0	-0.009*	-0.007	-0.003	0.004
	(0.2)	(0.2)	(-0.2)	(0)	(-1.7)	(-0.8)	(-0.7)	(0.3)

*The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient, *, **, *** represent significance at 10%, 5% and 1% respectively. Each equation includes the baseline model shown in Table* 5 *(Appendix Table* A2 *for* winsorised*) and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added simultaneously. See* Appendix *Table* A1 for *detailed definitions of the macroprudential instruments. Larger economies – countries with GDP more than 1 trillion US dollars in 2023. Smaller economies – countries with GDP less than 1 trillion US dollars in 2023*

Table A6. Regression on effects of Summary Macroprudential Tools results for DLCredit for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered one at a time.

	Cumulative	Impulse
Demand(-1)	-0.001 (-1.0)	-0.002 (-0.7)
Loan Targeted(-1)	-0.000 (-0.1)	0.0004 (0.2)
Supply All-1)	0.0004 (0.8)	0.0012 (0.8)
Supply Capital(-1)	-0.0003 (-0.3)	0.001 (0.4)
Supply General(-1)	0.0012 (1.0)	0.0002 (0.1)
Supply Loans(-1)	0.0013 (1.1)	0.003 (1.0)

The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient
, **, * represent significance at 10%, 5% and 1% respectively*
Each equation includes the baseline model shown in Table 5 and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added one at a time.

Demand = LTV + DSTI
Loan Targeted = Demand + Supply Loans
Supply Capital = Capital + CCB + Conservation + LVR
Supply Loans = LLP + LCG + LoanR + LFC + LTD
Supply General = RR + Liquidity + LFX
Supply All = Supply Capital + Supply General + Supply Loans

See Appendix Table A1 for detailed definitions of the macroprudential instruments.

Table A7. Regression on Overall effect of Macroprudential Tools results for Return on Assets for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered all together.

	All tools together		Winsorised		Larger economies		Smaller economies	
	Cumulative	Impulse	Cumulative	Impulse	Cumulative	Impulse	Cumulative	Impulse
Capital(-1)	-0.076	-0.231	-0.017	0.046	-0.146*	0.022	-0.104	-0.336
	(-1.0)	(-1.4)	(-0.6)	(0.7)	(-1.8)	(0.2)	(-0.9)	(-1.5)
CCB(-1)	-0.079	-0.268	0.021	-0.043	0.167	0.058	-0.37	-0.351
	(-0.5)	(-1.03)	(0.3)	(-0.4)	(1.3)	(0.4)	(-1.6)	(-0.9)
Conservation(-1)	-0.116	-0.35	-0.015	-0.036	-0.065	-0.035	-0.435*	-0.567*
	(-0.9)	(-1.6)	(-0.3)	(-0.4)	(-0.9)	(-0.3)	(-1.9)	(-1.7)
DSTI(-1)	0.119	0.107	0.029	0.03	-0.007	-0.11	0.072	0.229
	(0.7)	(0.5)	(0.4)	(0.3)	(-0.1)	(-1)	(0.3)	(0.7)
LCG(-1)	-0.326	-0.104	0.019	0.054	-0.066	0.127	0.29	0.026
	(-0.3)	(-0.1)	(0)	(0.1)	(-0.1)	(0.4)	(0.2)	(0)
LFC(-1)	0.081	0.105	0.037	0.09	-	0.318	0.061	0.008
	(0.5)	(0.2)	(0.5)	(0.4)		(0.5)	(0.3)	(0)
LFX(-1)	-0.394	-0.052	-0.138	0.204	-0.059	-0.04	-0.756	-0.761
	(-0.5)	(-0.1)	(-0.4)	(0.6)	(-0.2)	(-0.1)	(-0.5)	(-0.3)
Liquidity (-1)	0.08	0.682***	-0.013	0.055	0.024	0.077	0.045	1.081***
	(1.0)	(3.9)	(-0.4)	(0.8)	(0.3)	(0.8)	(0.3)	(4.1)
LLP(-1)	0.201	0.068	0.08	0.076	0.055	0.065	0.352	0.103
	(1.1)	(0.3)	(1.1)	(0.7)	(0.8)	(0.6)	(0.9)	(0.2)
LoanR(-1)	-0.141	0.025	-0.044	-0.122	-0.062	-0.263**	0.101	0.354
	(-1.0)	(0.1)	(-0.8)	(-1.3)	(-0.9)	(-2.2)	(0.4)	(0.9)
LTD(-1)	-0.806	-1.093	-0.278	-0.214	-0.097	0.393	-1.691	-1.786
	(-1.1)	(-1.4)	(-0.9)	(-0.6)	(-0.2)	(0.9)	(-1.6)	(-1.4)
LTV(-1)	-0.072	-0.084	-0.036	-0.012	0.021	0.251**	-0.084	-0.368
	(-0.7)	(-0.4)	(-0.9)	(-0.1)	(0.4)	(2.1)	(-0.5)	(-1.2)
LVR(-1)	0.062	-0.144	0.113	0.075	0.113	0.179	0.19	-0.491
	(0.2)	(-0.4)	(1.1)	(0.6)	(0.9)	(1.3)	(0.4)	(-0.9)
Other(-1)	-0.051	-0.025	0.046	0.034	0.11*	0.065	-0.005	-0.1
	(-0.4)	(-0.2)	(0.9)	(0.5)	(1.9)	(0.9)	(0)	(-0.3)
RR(-1)	0.138	0.211	0.018	0.211***	0.094	-0.35*	0.101	0.226
	(1.1)	(1.1)	(0.3)	(2.7)	(0.6)	(-1.7)	(0.6)	(0.9)
SIFI(-1)	0.085	0.032	0.01	0.004	0.034	-0.064	0.073	-0.151
	(0.6)	(0.14)	(0.2)	(0)	(0.3)	(-0.4)	(0.3)	(-0.5)
Tax(-1)	-0.148	-0.237	-0.09	-0.421**	0.001	-0.058	-0.403	-0.571
	(-0.9)	(-0.5)	(-1.4)	(-2.2)	(0)	(-0.2)	(-1.5)	(-0.9)

*The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient. *, **, *** represent significance at 10%, 5% and 1% respectively. Each equation includes the baseline model shown in Table* 5 *(Appendix Table* A2 *for* winsorised*) and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added simultaneously. See* Appendix *Table* A1 for *detailed definitions of the macroprudential instruments. Larger economies – countries with GDP more than 1 trillion US dollars in 2023 Smaller economies – countries with GDP less than 1 trillion US dollars in 2023.*

Table A8. Regression on effects of Summary Macroprudential Tools results for Return on Assets for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered one at a time.

	Cumulative	Impulse
Demand(-1)	-0.003 (-0.1)	-0.0001 (-0.001)
Loan Targeted(-1)	0.014 (0.4)	0.004 (0.04)
Supply All-1)	-0.013 (-0.5)	0.053 (0.8)
Supply Capital(-1)	-0.074 (-1.5)	-0.188* (-1.7)
Supply General(-1)	0.009 (0.2)	0.404*** (3.3)
Supply Loans(-1)	0.058 (0.8)	0.01 (0.1)

The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient
, **, * represent significance at 10%, 5% and 1% respectively*
Each equation includes the baseline model shown in Table 5 and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added one at a time.

Demand = LTV + DSTI
Loan Targeted = Demand + Supply Loans
Supply Capital = Capital + CCB + Conservation + LVR
Supply Loans = LLP + LCG + LoanR + LFC + LTD
Supply General = RR + Liquidity + LFX
Supply All = Supply Capital + Supply General + Supply Loans

See Appendix Table A1 for detailed definitions of the macroprudential instruments.

Table A9. Regression on Overall effect of Macroprudential Tools results for Log of Z-Score for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered all together.

	All tools together		Winsorised		Larger economies		Smaller economies	
	Cumulative	Impulse	Cumulative	Impulse	Cumulative	Impulse	Cumulative	Impulse
Capital(-1)	0.008	0.004	0.007	0.005	-0.034	0.005	0.008	-0.012
	(0.6)	(0.2)	(0.8)	(0.3)	(-1.0)	(0.1)	(0.4)	(-0.3)
CCB(-1)	0.023	-0.006	0.019	-0.003	0.027	-0.008	0.024	-0.012
	(0.8)	(-0.1)	(1)	(-0.1)	(0.5)	(-0.1)	(0.6)	(-0.2)
Conservation (-1)	0.006	0.007	-0.003	-0.003	-0.034	-0.013	0.009	0.024
	(0.3)	(0.2)	(-0.2)	(-0.1)	(-1.1)	(-0.2)	(0.2)	(0.4)
DSTI(-1)	0.026	-0.001	0.007	-0.001	-0.012	-0.04	0.067	0.016
	(0.9)	(-0.02)	(0.4)	(0)	(-0.3)	(-0.9)	(1.6)	(0.3)
LCG(-1)	0.014	0.003	0.008	0.004	-0.135	-0.015	0.253	-0.003
	(0.1)	(0.1)	(0.1)	(0)	(-1.1)	(-0.1)	(0.8)	(0)
LFC(-1)	0.011	0.027	0.008	0.03	-0.041	0.127	-0.006	0.012
	(0.4)	(0.3)	(0.4)	(0.5)	(-0.1)	(0.6)	(-0.2)	(0.1)
LFX(-1)	-0.054	0.059	-0.042	0.039	-0.031	0.022	-0.127	0.014
	(-0.4)	(0.4)	(-0.5)	(0.4)	(-0.2)	(0.2)	(-0.5)	(0)
Liquidity(-1)	0.001	0.006	-0.002	0.01	0.01	-0.015	0.004	0.037
	(0.1)	(0.2)	(-0.2)	(0.4)	(0.4)	(-0.4)	(0.2)	(0.7)
LLP(-1)	-0.01	0.019	-0.004	0.012	-0.012	-0.025	-0.026	0.059
	(-0.3)	(0.4)	(-0.2)	(0.4)	(-0.4)	(-0.5)	(-0.4)	(0.8)
LoanR(-1)	-0.017	0.004	-0.014	-0.001	-0.015	-0.005	-0.029	0.014
	(-0.7)	(0.1)	(-0.9)	(0)	(-0.5)	(-0.1)	(-0.7)	(0.2)
LTD(-1)	0.016	-0.063	-0.016	-0.059	-0.066	-0.001	0.071	-0.093
	(0.1)	(-0.4)	(-0.2)	(-0.6)	(-0.3)	(0)	(0.4)	(-0.4)
LTV(-1)	-0.033*	-0.05	-0.014	-0.034	-0.006	-0.036	-0.068**	-0.06
	(-2.0)	(-1.3)	(-1.2)	(-1.3)	(-0.3)	(-0.8)	(-2.3)	(-1.1)
LVR(-1)	0.011	0.007	0.027	0.013	-0.003	0.002	0.049	0.018
	(0.2)	(0.1)	(0.9)	(0.3)	(-0.1)	(0)	(0.6)	(0.2)
Other(-1)	-0.002	0.032	-0.004	0.02	0.031	0.033	0.009	0.052
	(-0.1)	(1.0)	(-0.3)	(0.9)	(1.3)	(1.1)	(0.2)	(1.0)
RR(-1)	-0.054**	0.026	-0.035**	0.026	-0.055	-0.09	-0.041	0.029
	(-2.4)	(0.8)	(-2.3)	(1.1)	(-0.8)	(-1)	(-1.5)	(0.7)
SIFI(-1)	0.004	0.0004	0.015	0.006	0.077	0.047	-0.005	-0.002
	(0.2)	(0.01)	(0.9)	(0.2)	(1.6)	(0.7)	(-0.1)	(0)
Tax(-1)	-0.009	-0.075	0.001	-0.046	0.025	-0.053	-0.012	-0.107
	(-0.3)	(-1.1)	(0.1)	(-1)	(0.7)	(-0.8)	(-0.3)	(-0.9)

*The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient. *, **, *** represent significance at 10%, 5% and 1% respectively. Each equation includes the baseline model shown in Table* 5 *(Appendix Table* A2 *for* winsorised*) and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added simultaneously. See* Appendix *Table* A1 for *detailed definitions of the macroprudential instruments. Larger economies – countries with GDP more than 1 trillion US dollars in 2023. Smaller economies – countries with GDP less than 1 trillion US dollars in 2023*

Table A10. Regression on effects of Summary Macroprudential Tools results for Log of Z-Score for 36 OECD countries, for the period 1990–2023 (estimated by panel OLS with country-level and time fixed effects), policy variables entered one at a time.

	Cumulative	**Impulse**
Demand(-1)	-0.014 (-1.5)	-0.024 (-1.1)
Loan Targeted(-1)	-0.011* (-1.7)	-0.011 (-0.7)
Supply All-1)	-0.004 (-0.9)	0.005 (0.4)
Supply Capital(-1)	0.003 (0.3)	0.0004 (0.02)
Supply General(-1)	-0.013 (-1.3)	0.017 (0.8)
Supply Loans(-1)	-0.014 (-1.1)	0.0006 (0.03)

The coefficient values of the independent variables are presented, with the corresponding t-statistics shown in parentheses beneath each estimated coefficient
, **, * represent significance at 10%, 5% and 1% respectively*
Each equation includes the baseline model shown in Table 5 and is estimated by panel OLS with country and time fixed effects, with macroprudential variables added one at a time.

Demand = LTV + DSTI
Loan Targeted = Demand + Supply Loans
Supply Capital = Capital + CCB + Conservation + LVR
Supply Loans = LLP + LCG + LoanR + LFC + LTD
Supply General = RR + Liquidity + LFX
Supply All = Supply Capital + Supply General + Supply Loans

See Appendix Table A1 for detailed definitions of the macroprudential instruments.