Essays on macroprudential policies and corporate finance

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Abstract

This thesis investigates the determinants and the implications of macroprudential policies– a novel policy that specifically designed to enhance financial stability after the global financial crisis. There are three chapters that complete this thesis. The following describes a brief abstract of all of them. The first chapter investigates bank and non-bank credit activities of SMEs and examines the causal effect of macroprudential policies (MaPs) on the credit constraints faced by SMEs. With respect to bank financing, MaPs can lead to a higher interest rate, a shorter maturity, and a reduced available size of loans. The effect of MaPs is primarily driven by bank lines of credit, whereas bank loans are mostly insensitive to the effect. Moreover, micro and small firms are more adversely affected than medium-sized firms, consistent with a flight-to-quality effect in bank lending. We also document inward spillovers: tighter foreign macroprudential policies ease domestic SME constraints. The study offers policy-relevant firm-level evidence on the trade-off between financial stability and SME financing conditions today. The second chapter presents new evidence on the impact of macroprudential policies on corporate investment using matched firm-bank data from the European Investment Bank Investment Survey (EIBIS), covering 29 countries over the period 2015-2022. We show that macroprudential tightening leads to a significant reduction in corporate investment, primarily driven by a contraction in bank credit supply. Firms respond by scaling back external financing, with the effects particularly pronounced among financially constrained firms and those borrowing from less-capitalized banks. Notably, the decline in investment is concentrated in tangible capital formation, while intangible investment remains largely unaffected. By disentangling the transmission channels and investment-specific responses to macroprudential policies, our findings underscore structural heterogeneity in credit constraints and asset pledgeability, thereby highlighting key trade-offs between financial stability and investment dy-

namics. The third chapter estimates the impact of geopolitical risk on macroprudential policy actions across a panel of 42 countries. Rising geopolitical risk leads to a statistically significant deactivation of macroprudential tightening, resulting in a less restrictive overall policy stance. A one-standard-deviation increase in GPR is associated with a reduction in tightening actions of 0.067, equivalent to approximately a 12.4% decrease relative to its standard deviation. The deactivation of macroprudential tightening is even more pronounced when geopolitical stress is preceded by a more restrictive monetary policy stance: a 50-basis-point increase in the policy rate more than doubles the baseline effect. We attribute this finding to an intertemporal policy trade-off: policy authorities prioritize short-term economic stability over medium-term systemic risk containment in response to geopolitical shocks.

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Declaration

"I declare that, except where explicit reference is made to the contribution of others, that this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution."

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Chapter 1

Introduction

This dissertation studies how financial regulation, financial intermediation, and external uncertainty shape firm behaviour and policy responses. Although the three chapters are self-contained and address distinct research questions, they are united by a common concern: how shocks and policy interventions are transmitted through financial systems to affect credit allocation, corporate decision-making, and macro-financial stability. In particular, the thesis focuses on the role of macroprudential policy and related sources of financial frictions in shaping outcomes at the firm and policy level. Across the three chapters, I examine how macroprudential tools affect small and medium-sized enterprises' access to finance, how macroprudential tightening changes the composition of corporate investment, and how geopolitical risk influences the activation of macroprudential policy itself.

The overarching motivation for this dissertation is that the relationship between financial stability and real economic activity is inherently two-sided. On the one hand, macroprudential regulation is intended to mitigate systemic risk, smooth credit cycles, and strengthen the resilience of financial institutions. On the other hand, such regulation may affect the quantity and price of credit, thereby shaping firms' financing conditions, investment choices, and growth opportunities. These real effects are unlikely to be uniform. They depend on firm heterogeneity, on the structure of bank-firm relationships, on the

availability of alternative financing channels, and on broader institutional and geopolitical conditions. Understanding these transmission mechanisms is essential for designing policy frameworks that safeguard financial stability without generating unnecessarily large costs for firms and the real economy.

This issue has become increasingly important in the post-Global Financial Crisis era. Since 2008, macroprudential policy has become a central pillar of the policy toolkit in both advanced and emerging economies. At the same time, firms have operated in an environment characterized by repeated episodes of financial stress, sovereign debt tensions, the COVID-19 pandemic, rapid changes in monetary conditions, and, more recently, rising geopolitical fragmentation. These developments have raised new questions about the interaction between prudential regulation and firm behaviour. Does tighter regulation constrain credit access for smaller and more opaque firms? Does it alter not only the level of investment but also the type of capital firms accumulate? Do policymakers continue to tighten macroprudential policy when geopolitical uncertainty and systemic risk rise, or do they step back from activation? The three chapters of this thesis address these questions from complementary angles.

A broader objective of the dissertation is to move beyond aggregate evidence and provide micro-founded evidence on macro-financial transmission. A large literature studies macroprudential policy using country-level aggregates such as credit growth, house prices, or banking-sector indicators. While this literature has generated important insights, aggregate outcomes cannot reveal which firms bear the costs of tighter regulation, through which financing margins these effects operate, or how heterogeneity in asset structure and bank characteristics shapes pass-through. Similarly, when studying policy responses to geopolitical risk, aggregate analysis often says little about whether policymakers alter the intensity or composition of macroprudential actions. By combining firm-level surveys, bank-level data, country-level policy measures, and cross-country macro-financial information, this thesis aims to provide evidence that is both economically meaningful and policy relevant.

The dissertation contributes to three broad debates. First, it contributes to the literature on the real effects of macroprudential regulation by showing that these policies influence not only aggregate credit outcomes but also firm-level financing constraints and investment behaviour. Second, it contributes to the literature on investment and intangible capital by showing that financial shocks and regulatory tightening affect the composition of corporate investment in ways that depend on asset pledgeability. Third, it contributes to the emerging literature on geopolitical risk and financial stability by showing that rising geopolitical stress not only raises systemic risk, but may also weaken the willingness of authorities to implement macroprudential tightening. In this sense, the thesis studies both the transmission of macroprudential policy to firms and the determinants of macroprudential policy itself.

The remainder of this introductory chapter proceeds as follows. Section 1.1 outlines the broader motivation and common themes of the dissertation. Section 1.2 summarizes the first chapter on macroprudential policy and SME access to finance. Section 1.3 summarizes the second chapter on macroprudential policy and the composition of corporate investment. Section 1.4 summarizes the third chapter on geopolitical risk and macroprudential policy. Section 1.5 discusses the cross-cutting contributions of the dissertation. Section 1.6 concludes with the structure of the thesis.

1.1 Motivation and Common Theme

A central theme of this thesis is that financial regulation and financial shocks affect real outcomes through heterogeneous transmission channels. In frictionless markets, firms would be able to substitute seamlessly between internal and external finance, and prudential regulation would have limited consequences for real activity beyond its impact on aggregate stability. In practice, however, firms differ substantially in their informational opacity, collateral availability, bank dependence, and access to alternative financing. Be-

cause of these differences, a given regulatory shock may tighten conditions disproportionately for some firms while leaving others relatively unaffected. These asymmetries are especially relevant for small and medium-sized enterprises and for firms whose balance sheets are dominated by intangible capital.

The dissertation is also motivated by the view that macroprudential policy cannot be fully understood in isolation from the surrounding economic and institutional environment. The effectiveness and consequences of prudential measures depend not only on the tools themselves, but also on the structure of financial intermediation, the role of cross-border financial linkages, the condition of bank balance sheets, and the broader uncertainty environment faced by policymakers. For example, a tightening of domestic prudential regulation may constrain some borrowers while also generating inward spillovers from foreign financial systems. Similarly, rising geopolitical uncertainty may increase systemic financial risk while simultaneously discouraging authorities from tightening regulation further. These interactions suggest that the study of macroprudential policy requires both a micro-level perspective on transmission and a macro-level perspective on policy reaction functions.

Another common feature of the three chapters is their focus on identification. A recurring challenge in empirical work on financial policy is endogeneity. Macroprudential policies are typically adjusted in response to credit conditions, financial vulnerabilities, and economic developments. Similarly, firm outcomes such as investment and credit constraints are jointly determined by supply and demand forces. In each chapter, I therefore place substantial emphasis on identifying plausibly exogenous variation. The first and third chapters adopt instrumental-variable strategies to isolate exogenous changes in policy or geopolitical risk. The second chapter constructs purged macroprudential shocks from country-specific policy reaction equations to separate unexpected policy variation from underlying macro-financial conditions. These strategies are central to the contribution of the thesis because they allow the analysis to move beyond conditional correlations and toward causal interpretation.

Finally, the dissertation is motivated by policy relevance. Financial regulation necessarily involves trade-offs. Policymakers seek to reduce systemic risk and improve resilience, but tighter regulation may also affect credit supply, firm financing conditions, and investment. At the same time, in periods of heightened geopolitical uncertainty, policymakers may face competing objectives across monetary, prudential, and macroeconomic stabilization policies. By documenting where and how these trade-offs arise, the thesis aims to inform both academic debates and policy design.

1.2 Chapter 1: Macroprudential Policies and SMEs' Access to Finance

The first chapter examines how macroprudential policies affect the financing conditions of small and medium-sized enterprises. SMEs are central to employment, value added, and entrepreneurial dynamism in Europe, yet they are also among the most financially constrained firms in the economy. Their dependence on bank-intermediated finance, combined with their relatively high informational opacity and limited collateral, makes them especially sensitive to changes in credit supply. Despite a large literature on the aggregate effects of macroprudential policy, there is still limited evidence on how these policies affect SMEs at the micro level, through which financing channels the effects operate, and whether non-bank finance or cross-border lending can offset domestic tightening.

This chapter addresses those gaps using firm-level survey data from the ECB/EC SAFE database, country-level macroprudential data from the IMF's iMaPP database, and cross-border financial linkage information from the European Commission's FinFlows database. The empirical analysis focuses on SME credit constraints measured using survey-based indicators that jointly capture financing needs and changes in availability. This measure-

ment strategy is important because observed borrowing outcomes alone do not distinguish clearly between demand-side and supply-side factors. By constructing financing-gap type indicators across different financing instruments, the chapter offers a more precise picture of when firms experience binding funding constraints.

The chapter makes four main contributions. First, it refines the measurement of SME credit constraints by using SAFE survey questions in a way that aligns closely with the survey's own financing-gap logic. Rather than relying only on whether a loan was rejected or approved, the analysis identifies situations in which firms simultaneously report increased demand for finance and worsening availability. This approach captures a strict notion of binding financing constraints.

Second, the chapter distinguishes between different bank financing instruments, especially term loans and credit lines. This distinction is crucial because credit lines are central to SME liquidity management and may be more sensitive to regulatory tightening than term loans. The chapter shows that tighter macroprudential policy raises SMEs' probability of being credit constrained, with particularly strong effects on bank credit lines. It further shows that macroprudential tightening worsens financing conditions through higher borrowing costs, reduced available amounts, and shorter maturities, while collateral requirements respond less systematically.

Third, the chapter studies whether domestic macroprudential tightening induces substitution toward non-bank financing channels. This issue matters because, if bank regulation simply pushes firms toward alternative funding sources, the real effects of regulation may be smaller than suggested by bank-finance outcomes alone. The results show, however, that the main non-bank margin affected is trade credit, suggesting that tighter bank regulation may propagate along supply chains rather than generate broad substitution toward unconstrained non-bank finance.

Fourth, the chapter examines inward spillovers from foreign macroprudential policies. Using foreign macroprudential conditions weighted by bilateral financial linkages, the analysis shows that tighter regulation abroad can ease domestic SME credit constraints. This finding suggests that internationally active banks reallocate liquidity across borders in response to regulatory differentials. The chapter therefore highlights an important asymmetry: domestic tightening worsens financing conditions for SMEs, but foreign tightening can partially offset these effects by relaxing domestic constraints through inward spillovers.

Methodologically, the chapter also contributes by confronting endogeneity directly. Because macroprudential policies are often implemented in response to changing financial conditions, OLS estimates may understate their true causal effects. To address this issue, the chapter instruments domestic macroprudential policy with institutional-quality measures, especially Rule of Law, and shows that the IV estimates are substantially larger than the baseline OLS estimates. The evidence suggests that macroprudential tightening has a sizeable causal effect on SME financing conditions.

Overall, the first chapter demonstrates that macroprudential policy affects the real economy through firm-level credit constraints and that these effects are highly heterogeneous across financing instruments and firm types. The chapter's broader implication is that prudential regulation, while improving financial stability, may also generate non-negligible costs for smaller firms. It therefore highlights the need for policymakers to consider both the distributional consequences of prudential tightening and the possibility of international spillovers.

1.3 Chapter 2: Macroprudential Policies and the Composition of Corporate Investment

The second chapter turns from financing constraints to real investment decisions. Its central question is not simply whether macroprudential policy affects corporate investment, but how it changes the composition of investment across different forms of capital. This distinction is important because modern firms invest not only in physical assets such as machinery and buildings, but increasingly in intangible assets such as research and development, software, data, organizational capabilities, and training. These different forms of investment vary sharply in their pledgeability, financing needs, and sensitivity to changes in credit supply.

The chapter is motivated by a gap in the literature. Existing work shows that tighter bank regulation and prudential policy can reduce investment, but most studies proxy investment using fixed assets or balance-sheet aggregates and therefore cannot distinguish between tangible and intangible investment. Yet this distinction matters greatly. Tangible assets can often be pledged as collateral and are therefore more compatible with bank-based finance. By contrast, intangible assets are harder to value, less collateralizable, and more dependent on internal finance. For that reason, prudential tightening may affect different firms and different types of investment in different ways.

To study this issue, the chapter combines firm-level data from the European Investment Bank Investment Survey with country-level macroprudential policy data from the IMF's iMaPP database and bank-level information from BankFocus. The EIBIS data are especially valuable because they provide direct information on firms' investment by

category and on their financing experiences, including discouragement, rejection, dissatisfaction with contract terms, and cash holdings. This makes it possible to examine not only whether investment falls after macroprudential tightening, but also which forms of capital adjustment occur and through which financing channels.

The chapter's first main finding is that macroprudential tightening reduces corporate investment overall. A tightening shock lowers the total investment rate and generates meaningful declines in investment relative to firm assets. This finding is important because it confirms that prudential regulation has real effects beyond the financial system.

The second main finding is that the investment response is strongly heterogeneous by asset structure. Tangible-intensive firms reduce tangible investment, especially machinery and equipment, while intangible-intensive firms reduce knowledge investment, especially R&D. This result is central to the chapter's contribution because it shows that prudential tightening does not affect all forms of investment symmetrically. Instead, the adjustment depends on the type of capital firms produce and on the financing frictions they face. Organizational investment is comparatively stable, suggesting that some forms of intangible investment may be less adjustable in the short run.

The third main finding concerns the financing channel behind these differences. The chapter shows that macroprudential tightening leads to different forms of credit rationing for different firms. Intangible-intensive firms are more likely to face outright rejection and discouragement, consistent with the weak pledgeability of their assets. Tangible-intensive firms, by contrast, remain more likely to obtain credit but face quantity rationing, receiving less than requested. This distinction between extensive-margin and intensive-margin rationing is one of the most important insights of the chapter because it links the type of firm asset structure directly to the form of financial tightening.

The fourth main finding is that these credit-friction differences are reflected in firms' balance-sheet behaviour. Intangible firms respond to tighter macroprudential conditions by increasing precautionary cash holdings, suggesting that they divert internal funds away from knowledge-based investment toward liquidity buffers. Tangible firms do not exhibit the same cash-hoarding response. This pattern supports a financing-channel interpretation in which prudential shocks tighten external finance and induce different forms of internal adjustment depending on pledgeability.

The chapter then extends the analysis to the banking sector and matched bank-firm relationships. It shows that macroprudential tightening reduces banks' loan volumes while strengthening capitalization, indicating that the policy is effective in generating more resilient bank balance sheets. At the same time, the negative effect on investment remains even after controlling for bank-firm relationships, suggesting that the transmission works through within-bank changes in lending stance rather than merely through sorting across lenders. Moreover, bank heterogeneity matters: better-capitalized banks mitigate the negative pass-through of macroprudential tightening to borrowers, especially for knowledge investment among intangible firms and tangible investment among tangible firms. This result highlights that bank balance-sheet strength conditions the real effects of prudential policy.

Taken together, the second chapter shows that macroprudential regulation reshapes not only how much firms invest, but also what they invest in. It therefore contributes to both the macroprudential-policy literature and the literature on intangible capital formation. More broadly, it implies that the costs of prudential tightening may extend beyond short-run output and credit to the longer-run composition of productive capital, especially in economies where intangible investment is increasingly important.

1.4 Chapter 3: Geopolitical Risk and Macroprudential Policies

While the first two chapters study the effects of macroprudential policy on firms, the third chapter examines the determinants of macroprudential policy itself. Specifically, it asks whether rising geopolitical risk affects the activation of macroprudential regulation. This question has become increasingly important in light of recent surges in geopolitical tensions, including interstate conflict, wars, sanctions, and threats of trade fragmentation. These developments have heightened uncertainty and increased macro-financial vulnerability, but it remains unclear whether they lead policymakers to respond by tightening macroprudential regulation or by stepping back from such action.

The chapter begins from the observation that geopolitical risk is positively associated with systemic financial risk. Using the Caldara-Iacoviello geopolitical risk index and NYU Stern's SRISK indicator, the chapter documents a positive correlation between geopolitical stress and systemic financial vulnerability across 42 economies. It further uses local projections to show that geopolitical shocks lead to a persistent build-up of systemic risk over time. This evidence motivates the core question of the chapter: if geopolitical risk raises systemic risk, do macroprudential authorities react by tightening policy?

Using monthly data for 42 economies from 2008 to 2021, the chapter studies the relationship between geopolitical risk and macroprudential policy actions. The macroprudential data come from the IMF's iMaPP database, while the geopolitical risk index comes from Caldara and Iacoviello. The empirical challenge is endogeneity: geopolitical risk may be correlated with other macro-financial shocks that also affect policy responses. To isolate causal variation, the chapter develops an instrumental-variable strategy based on foreign

geopolitical shocks originating in major geopolitical powers, especially the permanent members of the United Nations Security Council, weighted by geographic proximity. This shift-share style design provides plausibly exogenous variation in domestic geopolitical risk.

The chapter reports three principal findings. First, rising geopolitical risk reduces macroprudential tightening actions rather than triggering loosening actions. In other words, the main response is a deactivation of tightening. This result is important because it suggests that geopolitical shocks may weaken countercyclical macroprudential policy precisely when systemic risk is rising.

Second, the response is nonlinear. The decline in macroprudential tightening is significantly stronger during episodes of extreme geopolitical stress, especially when the geopolitical risk index exceeds the upper tail of its country-specific historical distribution. This threshold behaviour implies that policymakers are especially reluctant to tighten prudential regulation during severe geopolitical shocks.

Third, the chapter shows that the prevailing stance of monetary policy shapes the macroprudential response. When geopolitical risk is high and monetary policy is also restrictive, the deactivation of macroprudential tightening becomes substantially stronger. This interaction suggests that policymakers perceive simultaneous monetary and macroprudential tightening under geopolitical stress as excessively contractionary. The chapter therefore uncovers a policy trade-off: authorities appear to prioritize short-run macroeconomic stabilization over medium-term systemic-risk containment when geopolitical uncertainty rises.

The chapter also documents important heterogeneity across macroprudential instruments. The decline in tightening is concentrated in entity-based and capital- or loan-targeted tools, while general-targeted tools respond less strongly. It further shows that geopolitical risk is associated with higher loan-to-value ratios, indicating weaker borrower-based restraint when specific quantitative tools are examined. These results imply that geopolitical shocks affect not only whether macroprudential policy is activated, but also which instruments are deployed and how stringently they are calibrated.

The contribution of the third chapter is therefore twofold. First, it adds to the literature on the macro-financial consequences of geopolitical risk by showing that geopolitical shocks affect not only market outcomes and systemic risk, but also regulatory behaviour. Second, it contributes to the literature on macroprudential implementation by identifying a new source of policy inaction. The broader implication is that macroprudential frameworks may be most vulnerable to political or economic hesitation precisely in periods when external stress raises the need for vigilance.

1.5 Cross-Chapter Contributions of the Dissertation

Although the three chapters are independent, together they provide a coherent account of how macroprudential policy interacts with firm behaviour, financial intermediation, and external uncertainty.

First, the dissertation advances the literature on the real effects of macroprudential policy by showing that prudential regulation matters at the micro level. Chapter 1 demonstrates that tighter macroprudential policy increases SME financing constraints across several margins, especially for bank credit lines and smaller firms. Chapter 2 shows that mac-

roprudential tightening affects not only the level of firm investment but also its composition, with distinct effects on tangible and intangible-intensive firms. Together, these results show that macroprudential policy has distributional and allocative consequences that cannot be inferred from aggregate credit indicators alone.

Second, the dissertation highlights the importance of heterogeneity. SMEs are not affected uniformly by prudential regulation. The same is true for firms with different asset structures and for borrowers attached to different banks. The thesis repeatedly shows that firm opacity, asset pledgeability, financing dependence, and bank capitalization shape the transmission of regulation. These heterogeneous mechanisms are central because they imply that prudential policy can reallocate credit and investment in ways that may have long-run consequences for innovation, productivity, and firm dynamics.

Third, the dissertation contributes to understanding cross-border dimensions of financial regulation. Chapter 1 documents inward spillovers from foreign macroprudential policies to domestic SME financing conditions. Chapter 3 shows that geopolitical shocks transmitted from powerful foreign countries can shape domestic macroprudential policy responses. In both cases, domestic outcomes cannot be fully understood without considering international interconnectedness. This reinforces the view that macroprudential policy is not purely domestic in financially integrated systems.

Fourth, the dissertation emphasizes the importance of policy trade-offs. In the first two chapters, tighter macroprudential policy improves resilience but worsens financing conditions and reduces investment. In the third chapter, geopolitical risk raises systemic vulnerability but is associated with less, not more, tightening. These findings point to a recurring tension between short-run stabilization, financial resilience, and long-run pro-

ductive capacity. This tension does not imply that macroprudential policy is undesirable. Rather, it suggests that prudential frameworks may need to be complemented by other policies, including targeted credit guarantees, innovation-supportive financing arrangements, or stronger international coordination.

Finally, the dissertation contributes methodologically by using micro-macro matched data and identification strategies that address endogeneity more directly than much of the existing literature. By combining survey-based measures of credit constraints and investment with bank-level and country-level data, the thesis provides a richer empirical account of macro-financial transmission than would be possible using balance-sheet aggregates alone.

1.6 Structure of the Thesis

The remainder of the thesis is organized as follows. Chapter 2 studies the effect of macroprudential policies on SMEs' access to finance. Using firm-level survey data, it examines whether tighter macroprudential regulation increases credit constraints across bank and non-bank financing channels, how those effects vary across firm size and financing instruments, and whether foreign macroprudential tightening generates inward spillovers that ease domestic constraints.

Chapter 3 examines the effect of macroprudential policy tightening on the composition of corporate investment. Using firm-level investment and financing data matched to bank-level information, it analyzes how prudential shocks affect total investment, tangible investment, and intangible investment, and how these effects vary with firms' asset structure and with the financial condition of their main banks.

Chapter 4 studies the effect of geopolitical risk on macroprudential policy actions. Using cross-country monthly data and an instrumental-variable strategy based on foreign geopolitical shocks, it examines whether rising geopolitical uncertainty leads authorities to tighten macroprudential policy or instead to step back from activation, and whether that response depends on the monetary-policy stance and the type of prudential instrument considered.

Chapter 5 concludes the thesis by summarizing the main findings, drawing out their broader implications for financial regulation, firm behaviour, and macro-financial stability, and outlining avenues for future research.

In summary, this dissertation argues that macroprudential policy is a powerful but imperfect tool. It shapes credit allocation, firm financing conditions, and investment behaviour, yet it is also itself shaped by institutional and geopolitical forces. Understanding these two directions of influence is essential for evaluating the role of financial regulation in modern economies. The three chapters that follow provide firm-level, bank-level, and cross-country evidence on these issues and together offer a broader perspective on the interaction between financial stability policy and real economic outcomes.

Chapter 2

Macroprudential Policies & SME's Access to Finance

Abstract

This paper examines how macroprudential policies affect credit constraints for small and medium-sized enterprises across bank and non-bank financing channels using firm-level survey data. We find that tighter policies raise borrowing costs, shorten maturities, and reduce credit volumes, especially through bank credit lines rather than loans. Moreover, micro and small firms are more adversely affected than medium-sized firms, consistent with a flight-to-quality effect in bank lending. We also document inward spillovers: tighter foreign macroprudential policies ease domestic SME constraints. The study offers policy-relevant firm-level evidence on the trade-off between financial stability and SME financing conditions today.

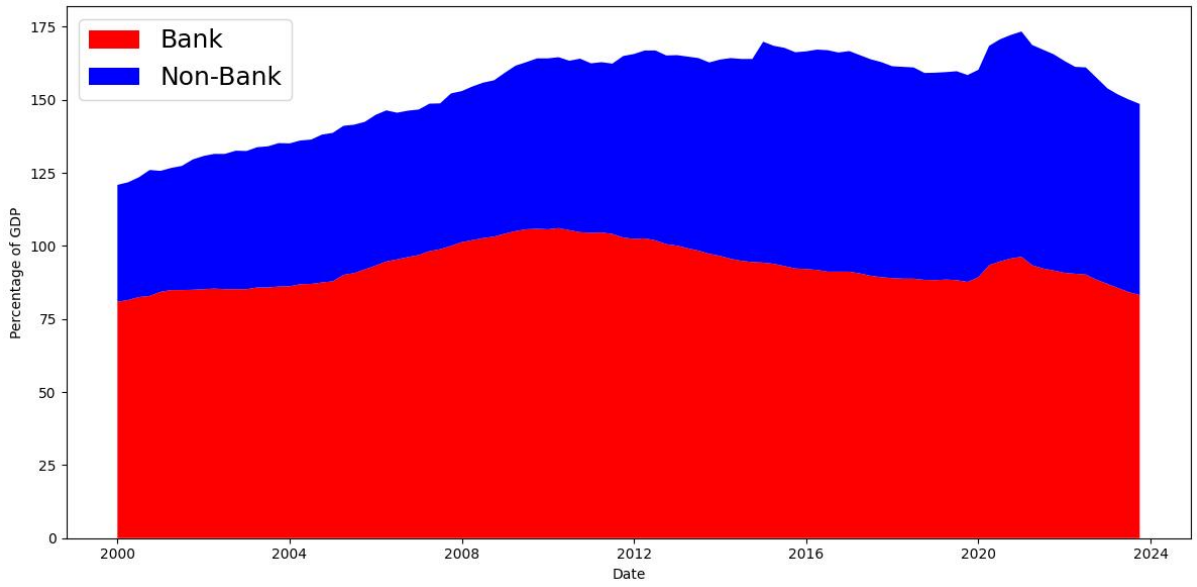
Key words: Macroprudential policy, credit constraints, financial stability

2.1 Introduction

Small and medium-sized enterprises (SMEs) play a central role in the European non-financial business sector. They account for 99.8% of non-financial enterprises, generate 51.8% of gross value added, and provide 64.4% of employment (Kraemer et al. 2022). Given their economic importance, SMEs' financing conditions are tightly linked to aggregate economic performance and financial stability. This link became particularly salient during the COVID-19 pandemic, when many SMEs experienced acute liquidity shortages and relied heavily on external financing, including bank credit, public guarantee schemes, and subsidised lending.

SMEs depend predominantly on bank-intermediated finance to cover working capital needs–often through bank credit lines–and to fund longer-term investment through bank loans. At the same time, the structure of corporate credit provision has changed markedly over the past two decades. The expansion of the shadow banking sector has increased the importance of non-bank credit, including trade credit, leasing, debt securities, and equity financing. Figure 2.1 shows that non-bank credit accounts for nearly 45% of total credit to the non-financial sector in 2023. This compositional shift is economically important because restrictions in bank lending can induce substitution toward non-bank financing. Consistent with this mechanism, Casey and O'Toole (2014) show that SMEs facing bank credit constraints are more likely to rely on trade credit, highlighting the interconnectedness of bank and non-bank funding sources.

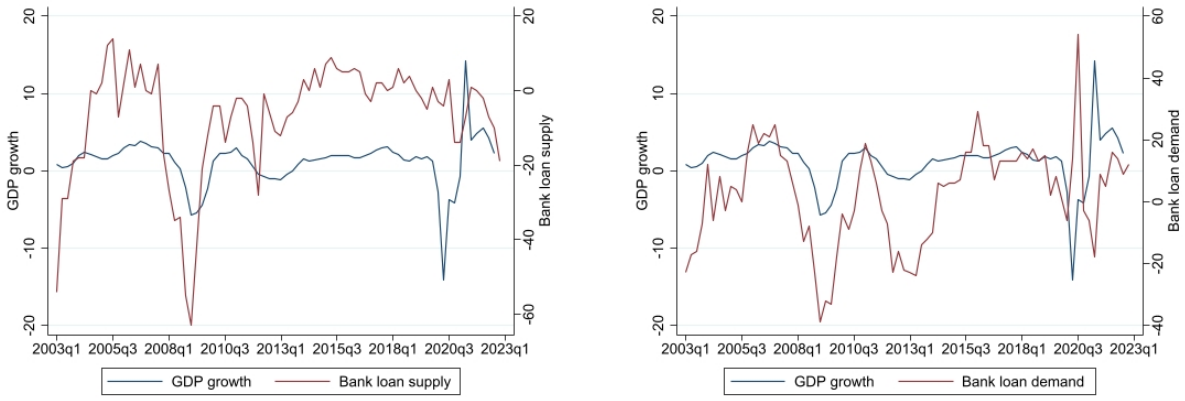
Figure 2.1: Bank vs. Non-Bank Credit to the Non-Financial Sector in the EU27



Notes: This figure plots bank and non-bank credit to the non-financial sector, as a percentage of GDP, in the EU27 from 2000Q1 to 2023Q4. *Source:* BIS.

A mismatch between firms' demand for external finance and lenders' willingness to supply credit can generate credit constraints, which in turn adversely affect firm growth, investment, and employment (Ayyagari et al. 2008; Beck et al. 2005). Measuring credit constraints, however, is challenging because observed credit outcomes reflect both demand-side financing needs and supply-side lending conditions. To address this issue, the euro area Bank Lending Survey (BLS) conducted by the European Central Bank provides useful aggregate indicators of loan supply and demand. Following Ferrando et al. (2013), Figure 2.2 plots euro area GDP growth alongside BLS-based loan supply and demand indicators over 2003–2023. Both indicators co-move strongly with GDP growth, underscoring the cyclical nature of credit conditions. Motivated by these insights, this paper constructs firm-level measures of credit constraints that combine information on both financing needs and perceived availability, rather than relying on either dimension in isolation.

Figure 2.2: GDP Growth and SMEs' Bank Loan Supply and Demand: Motivating Evidence



(a) GDP growth and loan supply

(b) GDP growth and loan demand

Notes: The left panel plots GDP growth and the net percentage of banks reporting an easing in credit standards for SMEs in the euro area over time ($r = 0.3540$, $p = 0.0014$). The right panel plots GDP growth and the net percentage of banks reporting an increase in bank loan applications in the euro area over time ($r = 0.2962$, $p = 0.0080$). *Source:* ECB Bank Lending Survey.

The global financial crisis of 2008 highlighted the need for a regulatory framework that goes beyond microprudential supervision. Macroprudential policies (MaPs)–designed to limit systemic risk and dampen excessive credit cycles–have since become a central pillar of financial regulation. A large literature evaluates the effectiveness of MaPs using aggregate outcomes such as credit growth, house prices, and systemic risk indicators, and generally finds that tighter MaPs curb credit expansion (Cerutti et al. 2017; Claessens et al. 2013). However, aggregate evidence cannot reveal how these policies affect individual firms. This limitation is particularly important for SMEs, which face stronger informational frictions, rely disproportionately on external finance, and have fewer financing alternatives than large firms.

Understanding whether MaPs tighten SMEs' financing conditions is therefore critical for assessing potential trade-offs between financial stability and real economic activity. If MaPs materially increase SMEs' credit constraints, regulatory tightening may have unintended distributional and real effects, even if aggregate credit growth appears contained. Identifying such effects requires micro-level evidence and a credible empirical strategy, since MaPs are typically implemented in response to evolving credit conditions and financial vulnerabilities.

This paper contributes to the growing empirical literature on the real effects of macroprudential policies by clarifying measurement, transmission channels, and cross-border externalities at the firm level. Our contributions are fourfold.

First, we refine the measurement of SMEs' tight financing conditions using SAFE's qualitative questions in a way that is closely aligned with the survey's own "financing gap" logic. Specifically, our baseline indicator identifies episodes in which an enterprise reports an increase in financing needs while simultaneously reporting a deterioration in the availability of that financing instrument. This definition captures a strict notion of a binding financing gap and is therefore not a mechanical averaging of demand and supply.

Second, we distinguish between bank term loans and bank credit lines. This distinction is essential in bank-based economies because credit lines are a key liquidity management tool for SMEs and may be more sensitive to regulatory tightening than term lending. We further exploit SAFE's contract-term information to study which margins adjust (interest rates, maturities, and amounts versus collateral requirements).

Third, we extend the analysis to non-bank finance (especially trade credit) to assess whether tighter bank regulation is offset by substitution or instead propagates along supply chains via suppliers' own funding constraints.

Fourth, we provide novel firm-level evidence on cross-border spillovers of macroprudential policies. Exploiting variation in foreign MaPs weighted by bilateral financial linkages, we show that tighter regulation abroad alleviates domestic SMEs' credit constraints, particularly by lowering interest rates and improving access to credit lines. These inward spillover effects suggest that internationally active banks reallocate liquidity across borders in response to regulatory differentials, partially offsetting the impact of domestic MaPs.

Our findings have important policy implications. While MaPs are effective tools for enhancing financial stability, they can impose non-negligible costs on SMEs by tightening access to liquidity, especially through credit lines. Policymakers should therefore consider the distributional consequences of regulatory tightening and the role of complementary policies–such as targeted public guarantees or SME-focused liquidity facilities–to mitigate adverse real effects. Moreover, the presence of significant cross-border spillovers underscores the importance of international coordination of macroprudential policies. In financially integrated economies, uncoordinated regulatory actions may shift credit across borders rather than reduce systemic risk, leading to uneven financing conditions for firms.

The remainder of the chapter is organized as follows. The next section reviews the related literature. We then describe the data, present the methodology and baseline results, discuss endogeneity and the identification strategy, report robustness checks, analyse the channels, examine spillover effects, and conclude.

2.2 Literature Review

This paper relates to several strands of literature on macroprudential policies, firm-level credit constraints, and cross-border spillovers. While this literature has made substantial progress, important gaps remain, particularly regarding the micro-level transmission of MaPs to SMEs across different financing channels.

A first strand of the literature studies the effectiveness of MaPs in curbing aggregate credit cycles and systemic risk. Using cross-country or country-level data, a large body of work documents that countercyclical MaPs can dampen credit growth and enhance financial stability (see, among others, Cerutti et al. 2017; Claessens et al. 2013). However, aggregate evidence does not reveal how MaPs affect the financing conditions of individual firms. This limitation is particularly relevant for SMEs, which are more informationally opaque and more dependent on external finance. As a result, existing macro-level studies cannot speak directly to whether MaPs exacerbate credit constraints at the firm level, nor to which firms are most affected.

A related gap concerns identification. Because MaPs are typically adjusted in response to evolving credit conditions, endogeneity is widely recognised as a central challenge (Kuttner and Shim 2016; Forbes 2021). Early empirical studies often rely on lagged MaP indices and dynamic panel estimators such as GMM (e.g., Cerutti et al. 2017; Claessens et al. 2013; Cizel et al. 2019). While these approaches mitigate simultaneity concerns, they do not fully isolate exogenous variation in MaPs. More recent work exploits micro-level heterogeneity in banks or firms to strengthen causal inference (Claessens et al. 2013; Yang and Suh 2023; Ayyagari et al. 2018; Ćehajić and Košak 2022). Nevertheless, there remains limited evidence that convincingly establishes a *causal* link between MaPs and SMEs' credit constraints over a long time horizon and across multiple financing channels.

A second strand of the literature examines how banking-sector shocks affect SMEs' access to finance, often using survey data such as the Survey on the Access to Finance of Enterprises (SAFE). Studies show that adverse financial conditions raise borrowing costs and rejection rates for SMEs, especially during crisis periods (Ferrando et al. 2017; Bremus and Neugebauer 2018). However, most of this literature focuses on macroeconomic or banking shocks rather than regulatory shocks, and typically concentrates on bank loans. As a result, we know relatively little about whether MaPs–despite being prudential in nature–translate into tighter credit conditions for SMEs, and whether these effects operate through contract terms such as interest rates, maturities, and credit availability rather than outright loan denial.

A third gap concerns the role of non-bank finance. The literature on MaPs documents potential leakage effects, whereby tighter regulation of banks induces substitution toward non-bank credit (Cizel et al. 2019; Bengui and Bianchi 2022). Yet, most evidence is based on aggregate data, leaving open the question of how such leakage operates at the firm level. In particular, it remains unclear whether SMEs can effectively substitute bank credit with non-bank financing, such as trade credit, or whether MaPs propagate credit constraints along supply chains when non-bank providers themselves depend on bank funding.

Finally, while a growing literature studies international spillovers of prudential policies through cross-border bank lending (Buch and Goldberg 2017; Bruno et al. 2017; Claessens et al. 2023), there is scant micro-level evidence on how foreign MaPs affect domestic firms' financing conditions. Existing studies typically focus on bank balance sheets or aggregate lending flows, rather than on firm-level credit constraints and contract terms. Consequently, we lack direct evidence on whether foreign MaPs can alleviate or exacerbate domestic SMEs' credit constraints, and through which channels such spillovers operate.

Taken together, these gaps motivate our empirical analysis. At the domestic level, tighter MaPs may constrain banks' balance-sheet capacity and limit risk-taking, thereby reducing the supply of bank-intermediated credit (Cerutti et al. 2017; Claessens et al. 2013). Supply-based instruments–such as capital requirements, liquidity requirements, and countercyclical capital buffers–raise the cost of lending and tighten regulatory constraints on banks' asset composition, inducing banks to deleverage or rebalance their portfolios away from riskier borrowers.

SMEs are disproportionately affected by such tightening because they face higher informational frictions, weaker collateral positions, and stronger dependence on bank finance relative to large firms (Ayyagari et al. 2008; Beck et al. 2005). In the presence of asymmetric information, banks respond to regulatory tightening by adopting a flight-to-quality strategy, reallocating credit toward safer and more transparent borrowers (Bernanke et al. 1996). As a result, even absent a decline in aggregate credit demand, SMEs are more likely to experience a deterioration in effective credit access when MaPs are tightened.

Importantly, tighter credit conditions need not materialise solely through outright loan rejection. A growing literature shows that banks often adjust credit supply along intensive margins, including higher interest rates, shorter maturities, and smaller credit limits, especially for opaque firms (Ferrando et al. 2017; Bremus and Neugebauer 2018). These adjustments increase the probability that SMEs perceive themselves as credit constrained, even when formal access to credit is not completely cut off. Consistent with micro-level evidence using SAFE data, prudential tightening can therefore translate into higher measured credit constraints for SMEs through worsening price and quantity terms rather than through denial of credit per se (Ćehajić and Košak 2022; Ayyagari et al. 2018).

At the international level, macroprudential policies can generate cross-border spillovers through internationally active banks and global capital flows. A growing literature shows that when MaPs tighten in one jurisdiction, multinational banks respond by reallocating capital, liquidity, and lending activity toward countries with relatively looser regulatory stances (Buch and Goldberg 2017; Bruno et al. 2017). Such regulatory arbitrage or portfolio rebalancing can lead to an expansion of credit supply in recipient countries, even if domestic macroeconomic conditions remain unchanged.

For domestic SMEs, these inward spillovers may translate into improved financing conditions. International banks that face tighter constraints abroad may increase lending to domestic affiliates or borrowers, easing local credit conditions through lower borrowing costs, larger credit limits, or improved access to liquidity-providing instruments such as credit lines (Baskaya et al. 2017; Claessens et al. 2023). Because SMEs are particularly sensitive to changes in bank liquidity and pricing conditions, they are likely to benefit disproportionately from such inward reallocations.

Crucially, foreign MaPs are plausibly exogenous to the credit conditions of individual domestic firms, strengthening the causal interpretation of inward spillover effects (Buch and Goldberg 2017). We therefore examine whether tighter macroprudential regulation abroad alleviates domestic SMEs' credit constraints, especially along margins related to interest rates and access to bank credit lines, which are most responsive to banks' liquidity management and cross-border capital allocation.

2.3 Data

We use a linked micro-macro dataset for 11 European countries over 2010–2020. Country-level macroprudential policy data come from the IMF's integrated Macroprudential Policy (iMaPP) database. Firm-level financing information comes from the ECB's Survey on the Access to Finance of Enterprises (SAFE). In the spillover analysis, we complement these data with bilateral financial-asset exposures from the European Commission's FinFlows database.

2.3.1 Firm-level data

Traditional quantitative proxies of credit constraints, such as investment-cash flow sensitivities or the KZ and WW indices, can be difficult to interpret and may be biased (Farre-Mensa and Ljungqvist 2015; Hadlock and Pierce 2010). We therefore rely on survey-based information from the Survey on the Access to Finance of Enterprises (SAFE), a joint ECB-European Commission survey that directly asks firms about financing needs, availability, and outcomes. SAFE is particularly suitable for this chapter because it records both the demand side and the perceived supply side of external finance, rather than inferring credit constraints indirectly from balance-sheet behavior.

SAFE was launched in 2009 and is conducted every six months in survey "waves." It covers non-financial enterprises only and collects information on firms' financing conditions, age, turnover, employment, and sector. Firms are sampled from the Dun & Bradstreet business register, and some firms appear in more than one wave, though not necessarily in consecutive waves. SAFE should therefore be viewed as a repeated cross-section with short-panel features rather than as a balanced panel.

SAFE does not provide consistent coverage for all countries in every wave, so we restrict the analysis to the 11 countries that are observed consistently over the study period: Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, the Netherlands, and Portugal. This restriction is driven by data comparability rather than by any ex ante selection on financing outcomes. We exclude large firms (250 employees or more) because the anonymous SAFE files do not report sector information for them, which would make the firm-level controls inconsistent across specifications. We also drop waves 1 and 2 because the wording and coding of the core financing questions differ from later waves.[1] The final sample therefore covers waves 3 to 24, corresponding to 2010Q2–2021Q1. To align the country-level policy and macroeconomic variables with SAFE's reference periods, we aggregate them semi-annually and use one-wave lags in the regressions. After applying these filters, the working sample contains 131,518 firm-wave observations. Table A.2 in the appendix reports the country-by-wave composition of the SAFE sample, which makes clear both why these 11 countries are retained and how coverage evolves over time.

To measure SME credit constraints, we combine firms' answers to Question 5 and Question 9 for each financing instrument. Question 5 asks whether the firm's need for a given type of external finance increased, remained unchanged, or decreased over the previous six months. Question 9 asks whether the availability of that same financing instrument improved, remained unchanged, or deteriorated over the same period. The relevant wording is reproduced below because these survey items are central to the construction of the dependent variables, and Table A.3 in the appendix reproduces the core SAFE questions used in both the baseline and alternative measures.

- Question 5: For each of the following types of external financing, please indicate if your needs increased, remained unchanged or decreased over the past six months? (Types of financing: credit line, bank loans, trade credit, equity capital, debt securities, and other loans)

1. In addition, some terms in the questionnaire for firms in Germany are adjusted from wave 3 onward.

- Question 9: For each of the following types of financing, would you say that their availability has improved, remained unchanged or deteriorated for your enterprise over the past six months? (Types of financing: credit line, bank loans, trade credit, equity capital, debt securities, and other loans)

For each financing instrument, we define a binary financing-gap indicator equal to one when the firm's financing need increased in Question 5 and availability deteriorated in Question 9. This coding identifies situations in which demand for finance rises while the perceived supply of that same instrument worsens, which is a strict notion of a binding financing gap. We construct separate indicators for credit lines, bank loans, trade credit, equity capital, debt securities, and other loans. Following García-Posada Gómez (2019) and Ferrando et al. (2017), we also define an overall bank-financing constraint indicator equal to one if either the credit-line constraint or the bank-loan constraint equals one. The distinction between credit lines and bank loans is important in our setting because the two instruments are not perfect substitutes and, as shown below, credit lines are substantially more sensitive to macroprudential tightening.

2.3.2 Country-level data

In Europe, macroprudential policy has become more prominent in the regulatory reform agenda since the Global Financial Crisis. We use the IMF's iMaPP database (Alam et al. 2024), which records monthly policy actions for 17 macroprudential tools across 134 countries from 1990 to 2020. Each tool is coded as 1 for tightening, 0 for no change, and -1 for loosening.[2] As Forbes (2021) notes, these data do not capture policy intensity. They do, however, provide a transparent way to measure the direction and frequency of

2. The 17 instruments are countercyclical capital buffers (CCB), capital conservation buffers (Conservation), capital requirements (Capital), leverage ratios (LVR), loan loss provision requirements (LLP), limits on credit growth (LCG), loan restrictions (LoanR), limits on foreign-currency lending (LFC), limits to loan-to-value ratios (LTV), limits to debt-to-income ratios (DSTI), taxes and levies (Tax), liquidity requirements (Liquidity), limits to loan-to-deposit ratios (LTD), limits on foreign exchange positions (LFX), reserve requirements (RR), surcharges for systemically important financial institutions (SIFI), and other measures (Other). Table A.4 in the appendix presents the detailed definition of each tool.

policy action across countries and over time. Following Claessens et al. (2023) and Yang and Suh (2023), we construct a net macroprudential index as the difference between the number of tightening actions and the number of loosening actions. Thus, if a country records two tightenings and one loosening in a given period, the net index equals +1. Following Ayyagari et al. (2018), we work with three indices: the overall net MaP index, a supply-based index, and a demand-based index. The supply-based MaPs include countercyclical capital buffers (CCB), capital conservation buffers (Conservation), capital requirements targeted on firms (Capital), leverage ratios (LVR), loan loss provision requirements (LLP), limits on credit growth targeted on firms (LCG), loan restrictions targeted on firms (LoanR), limits on foreign currency lending (LFC), taxes and levies (Tax), liquidity requirements (Liquidity), limits to loan-to-deposit ratio (LTD), limits on foreign exchange positions (LFX), reserve requirements (RR), surcharges for systemically important financial institutions (SIFI), and other measures (Other). The demand-based MaPs include limits to loan-to-value ratios (LTV) and limits to debt-to-income ratios (DSTI). Panel B of Table 2.1 shows meaningful variation in the use of these policy indices across the 11 countries and over 2010–2020. The supply-based index ranges from -4 to 4, while the demand-based index ranges from -1 to 2. We also include country-level macroeconomic controls: the policy interest rate, consumer prices, real GDP growth, and the Composite Indicator of Systemic Stress (CISS). Table A.1 in the appendix reports the definition and source of each variable. Because SAFE is fielded semi-annually, we align the MaP indices and macroeconomic controls to the relevant SAFE reference periods and use one-wave lags in the regressions. This timing choice reduces simultaneity concerns and ensures that policy variables are measured prior to the reported financing outcomes.

2.3.3 Summary statistics

Table 2.1 reports summary statistics for the main variables used in the analysis. Panel A describes the financing-gap indicators. On average, 9% of firm-wave observations are classified as constrained in overall bank finance (Constraint_{Bank}). By construction, this measure is stricter than simple rejection-based indicators because it requires both increased financing need and deteriorated availability. Among the contract-term outcomes, higher interest rates and tighter collateral requirements are the most frequently reported adverse changes, which is consistent with the view that banks often adjust credit conditions on intensive margins before outright denial. Non-bank constraints are less common overall, though trade credit stands out as the dominant non-bank margin. The observation counts differ across outcomes because not every firm reports on every financing instrument or contract term in a given wave; by contrast, the macroprudential and macroeconomic variables vary at the country-wave level and are repeated across firms within each country-wave cell.

Panel B reports the macroprudential indicators. The aggregate MaP index has a mean of 0.506, and the supply-based component has a mean of 0.472, indicating that tightening actions modestly outnumber loosening actions in the sample. The foreign-exposure index is available for the spillover subsample and exhibits more limited variation, which is expected because it is a weighted average of foreign policy stances.

Panel C summarizes the firm-level controls. The sample is dominated by young and small firms, which is consistent with SAFE's SME focus. Around 38% of observations are micro firms, and more than half of the sample falls into the lowest turnover category. The sector composition is reasonably balanced, though services account for the largest share.

Panel D describes the macroeconomic environment. GDP growth and the policy rate display substantial time-series and cross-country variation, while the CISS index captures episodes of elevated financial stress. The rule-of-law indicator also varies meaningfully across countries, which is important for the instrumental-variable analysis below.

Table 2.1: Descriptive Statistics

Variable	**N**	**Mean**	**SD**	**Min**	**Max**
Panel A: Dependent variables					
Constraint_{Bank}	131,518	0.090	0.287	0	1
$\text{Constraint}_{Bank\text{-}Q7A\text{-}Q7B}$	150,023	0.060	0.237	0	1
Constraint_{Loan}	131,518	0.058	0.233	0	1
Constraint_{Line}	131,518	0.060	0.237	0	1
$\text{Constraint}_{Interest}$	54,109	0.319	0.466	0	1
$\text{Constraint}_{Amount}$	54,109	0.126	0.333	0	1
$\text{Constraint}_{Maturity}$	54,109	0.068	0.251	0	1
$\text{Constraint}_{Collateral}$	54,109	0.263	0.440	0	1
$\text{Constraint}_{Non\text{-}bank}$	117,642	0.055	0.228	0	1
$\text{Constraint}_{Trade\ credit}$	117,642	0.038	0.192	0	1
$\text{Constraint}_{Equity}$	117,642	0.004	0.063	0	1
Constraint_{Debt}	117,642	0.003	0.051	0	1
$\text{Constraint}_{Leasing}$	117,642	0.006	0.080	0	1
$\text{Constraint}_{Other}$	117,642	0.005	0.068	0	1
Panel B: Macroprudential tools					
MaPs	131,518	0.506	1.551	-6	5
MaPs_{supply}	131,518	0.472	1.345	-4	4
$\text{MaPs}_{foreign}$	86,962	0.476	0.255	0.029	1
Panel C: Firm-level control variables					
Age_1	131,518	0.829	0.376	0	1
Age_2	131,518	0.106	0.308	0	1
Age_3	131,518	0.043	0.202	0	1
Age_4	131,518	0.011	0.105	0	1
Size_1	131,518	0.377	0.484	0	1
Size_2	131,518	0.343	0.475	0	1
Size_3	131,518	0.281	0.450	0	1
Sector_1	131,518	0.247	0.431	0	1
Sector_2	131,518	0.114	0.318	0	1
Sector_3	131,518	0.262	0.440	0	1
Sector_4	131,518	0.377	0.485	0	1
Turnover_1	131,518	0.505	0.500	0	1
Turnover_2	131,518	0.266	0.442	0	1
Turnover_3	131,518	0.176	0.381	0	1
Turnover_4	131,518	0.035	0.184	0	1
Panel D: Macroeconomic variables					
GDP	131,518	0.633	3.828	-13.305	23.155
CPI	131,518	4.609	0.034	4.498	4.689
CISS	131,518	0.201	0.232	0.021	0.972
Rule of law	131,518	1.238	0.556	0.070	2.120
Interest rate	131,518	2.531	1.130	1.080	6.800

Notes: Table 2.1 reports summary statistics for the main variables used in the analysis. The dependent variables include credit constraint indicators related to bank financing, bank loans, and credit lines. The independent variables comprise macroprudential policy indices (MaPs and $\text{MaPs}_{\text{supply}}$). Control variables include firm characteristics and macroeconomic indicators, both at firm-wave level.

2.4 Methodology and baseline results

2.4.1 Methodology

We estimate a linear probability model using micro-macro data to analyze the probability that a firm is credit constrained:

$$Y_{ict} = \alpha_c + \lambda_t + \beta MaP_{ct-1} + \gamma Z_{ct-1} + X_{ict} + \varepsilon_{ict}. \tag{2.1}$$

Y_{ict} is a binary variable that equals one if firm i in country c is credit constrained at time t, and zero otherwise. α_c denotes country fixed effects, and λ_t denotes wave fixed effects, which control for time-invariant country characteristics and common time trends. MaP_{ct-1} is the main variable of interest capturing the net tightening of macroprudential policies (MaPs). Z_{ct-1} is a vector of macroeconomic control variables, and X_{ict} is a vector of firm-level covariates that controls for observable heterogeneity, including sector, size, age, and turnover. I include lagged values of MaPs and macroeconomic controls to mitigate simultaneity concerns.

2.4.2 Baseline results

In our baseline analysis, we use the full index covering all 17 macroprudential tools as the main explanatory variable. This choice allows us to capture the aggregate effect of MaPs on SME financing conditions. While some studies exclude borrower-based instruments such as LTV and DSTI, on the grounds that they primarily target household credit (see Yang and Suh 2023),we retain them, since these tools may still affect SME financing through their application to commercial mortgages or broader market-wide lending standards.

Table 2.2 reports the OLS estimates of the marginal effects of MaPs on SMEs' probability of being constrained in accessing bank finance. Column (1) includes only country and time fixed effects. Column (2) adds macroeconomic controls, and Column (3) includes a full set of firm-level controls. Across all specifications, the estimated coefficient on MaPs is positive and statistically significant, indicating that tighter MaPs increase the likelihood that SMEs experience bank-related credit constraints. In the fully controlled specification (Column 3), a one-unit tightening in the net MaP index is associated with a 0.48 percentage point increase in the probability of being constrained. While this magnitude may appear modest, it is economically meaningful given the relatively low unconditional mean of the dependent variable (Constraint_{Bank}), which equals 0.09 (see Table 2.1). The result suggests that even moderate policy tightening can have material effects on marginal credit access for SMEs.

These findings are consistent with the domestic credit-supply channel discussed above and complement previous evidence. For instance, Ćehajić and Košak (2022) also find a positive association between MaPs and SME credit constraints using SAFE data. However, their analysis focuses only on firms that apply for bank credit, whereas our outcome variable

incorporates both demand and supply conditions, reducing potential selection bias. Our results also extend the literature by using a longer panel that covers the COVID-19 period and by explicitly controlling for firm heterogeneity, including sector, size, age, and turnover.

Moreover, the baseline estimates are consistent with the descriptive patterns presented in Table 2.1, where we observe that 9% of firms report being credit constrained for bank finance. The relatively low incidence rate underscores the importance of detecting marginal effects, particularly among firms on the margin of access. The positive effect of MaPs holds even after accounting for key macroeconomic controls such as GDP growth, inflation, and interest rates, suggesting that the observed impact is not merely a reflection of cyclical conditions.

Taken together, the baseline results provide initial evidence that macroprudential tightening transmits to SME financing conditions and contributes to higher credit constraints in the bank lending market. In the next section, we examine whether this relationship holds under alternative identification strategies designed to address endogeneity.

Table 2.2: Baseline Results: MaPs and Bank Credit Constraint

VARIABLES	(1) Constraint$_{Bank}$	(2) Constraint$_{Bank}$	(3) Constraint$_{Bank}$
MaPs	0.0021*	0.0040**	0.0048***
	(0.0011)	(0.0016)	(0.0018)
GDP		0.0003	-0.0002
		(0.0010)	(0.0014)
CPI		0.0105***	0.0123***
		(0.0036)	(0.0024)
Interest		0.0089	0.0070
		(0.0185)	(0.0176)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Firm controls	No	No	Yes
Macro controls	No	Yes	Yes
Observations	131,518	131,518	131,518

Notes: Table 2.2 presents OLS estimates of the effects of MaPs. The dependent variable is Constraint$_{\text{bank}}$, a binary indicator equal to one if a firm is credit constrained for bank financing and zero otherwise. Column (1) includes only country and time fixed effects. Column (2) adds macroeconomic controls, including the interest rate, GDP growth, and the consumer price index. Column (3) further adds firm-level controls. Standard errors clustered at the country-wave level are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

2.5 Endogeneity

A central empirical challenge in identifying the causal effect of macroprudential policies (MaPs) on SME credit constraints lies in addressing endogeneity. As noted by Kuttner and Shim (2016), MaPs are typically implemented in response to changes in systemic risk or credit conditions, which implies that reverse causality may bias estimates and attenuate the true effect. Specifically, if policymakers respond to deteriorating credit conditions by loosening MaPs–such as reducing capital requirements–this reaction introduces a negative correlation between the MaPs index and credit constraints, which could offset the underlying causal effect of policy tightening. Similarly, unobservable factors such as institutional quality, financial development, or regulatory preferences may influence both the use of MaPs and firm-level credit conditions, further biasing the interpretation of the regression results.

To illustrate, consider a tightening of capital requirements, represented by a positive value in our net MaP index. In theory, this action reduces banks' lending capacity and increases the probability that SMEs become credit constrained. However, if authorities systematically loosen MaPs when firms already face financing difficulties, observed estimates will understate the true impact of MaPs. Additionally, countries with stronger institutions may be more proactive in implementing MaPs while simultaneously offering a more supportive environment for SME finance. In this case, the positive correlation between institutional quality and MaPs, combined with a negative correlation between institutional quality and credit constraints, would again bias OLS estimates downward.

To address these concerns, we adopt an instrumental variable (IV) strategy. We exploit institutional quality–specifically, the "Rule of Law" indicator from the World Bank's Worldwide Governance Indicators (WGI) database–as an instrument for the use of MaPs. This indicator measures the degree to which agents have confidence in and abide by the rules of society, including the quality of contract enforcement, property rights, and the functioning of institutions (Kaufmann et al. 2010). We argue that the rule of law affects the willingness and ability of macroprudential authorities to act, but it is unlikely to be directly correlated with firm-level credit constraints conditional on macroeconomic and firm-level controls. As Table 2.3 shows, the Rule of Law scores in our sample range from 0.07 to 2.12, with substantial variation across countries and over time.

Table 2.3: Annual Distribution of Rule of Law by Country

Country	**Obs**	**Mean**	**Min**	**Median**	**Max**
Austria	1844	79044	83090	1.830	1.940
Belgium	11	1.424	1.350	1.420	1.550
Germany	11	1.55	1.35050	1.20	1.85170
Spain	11	1.022	0.889	1.1.020	1.170
Finland	11	2.026	1.944	2.050	2.1220
France	11	1.415	1.320	1.430	1.500
Greece	11	0.3313	00700	0.200	0.580
Ireland	11	1.607	1.380	1.710	1.776
Italy	11	0.369	0.2240	03900	0.480
Netherlands	11	1.835	1.750	1.810	1.970
Portugal	11	1.092	1.000	1.120	1.180
Overall	**121**	**1.430**	**0.070**	**1.430**	**2.122**

Notes: This table reports the his table of the Rule of Law indicator for the 11 countries over 2010–2020: Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, the Netherlands, and Portugal.

The IV results are presented in Table 2.4. Column (1) reports the reduced-form relationship between the instrument (Rule of Law) and the dependent variable (Constraint_{Bank}). The coefficient is positive and statistically significant at the 5% level, confirming that institutional quality is associated with tighter credit conditions, potentially through more active macroprudential policymaking. Column (2) shows the first-stage regression of MaPs on the instrument. The Rule of Law strongly predicts the adoption of tighter MaPs, with a coefficient of 1.6117 and an F-statistic of 27.79, well above the conventional threshold of 10 for weak instrument concerns.

Table 2.4: IV Results: MaPs and Bank Credit Constraint

VARIABLES	Reduced Form (1) $Constraint_{Bank}$	First Stage (2) MaPs	Second Stage (3) $Constraint_{Bank}$
MaPs			0.0560**
			(0.0271)
Rule of Law	0.0903**	1.6117***	
	(0.0420)	(0.4299)	
First-stage F-statistic		27.79***	
Kleibergen-Paap LM-statistic		14.05***	
Anderson-Rubin Wald test		7.15**	
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes
Observations	131,518	131,518	131,518

Notes: Table 2.4 presents IV estimates of the marginal effects of MaPs. The dependent variable is $\text{Constraint}_{\text{bank}}$, a binary indicator equal to one if a firm is credit constrained for bank financing and zero otherwise. Column (1) reports the reduced-form specification. Column (2) presents the first-stage regression of MaPs on the instrument. Column (3) reports the second-stage IV estimate. All specifications include firm-level and macroeconomic controls. Standard errors clustered at the country-wave level are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Column (3) reports the second-stage IV estimates. The coefficient on MaPs is 0.0560 and statistically significant at the 5% level, implying that a one-unit tightening in the MaP index increases the probability of being credit constrained by 5.6 percentage points. This effect is more than ten times the OLS estimate (0.0048 in Table 2.2, Column 3), highlighting the extent of downward bias due to endogeneity in the baseline regressions.

To further validate our instrument, we report the Anderson-Rubin Wald test, which rejects the null hypothesis that the coefficient on MaPs is zero at the 5% significance level (p-value = 0.02). The Kleibergen-Paap LM statistic also supports the relevance of the instrument.

We assess the economic magnitude of the IV estimate in two complementary ways. First, following Cecchetti et al. (2023) and Huang et al. (2017), we scale the coefficient by the standard deviation of the MaP index (1.511 in Table 2.1), which implies that a one-standard-deviation tightening increases the probability of credit constraint by approxim-

ately 8.46 percentage points. Second, we follow Li et al. (2016) and Chen and Lan (2020) in comparing this estimate to the unconditional mean of the outcome variable (0.0905). We find that one net tightening action increases the probability of constraint by 61.88% relative to the mean, underscoring the sizable economic effect of macroprudential policy tightening on SME financing conditions.

Taken together, these results provide strong evidence that the positive relationship documented in our baseline analysis reflects a causal effect. Moreover, the IV estimates reveal a substantially larger impact than the OLS estimates, consistent with theoretical expectations about endogeneity bias. In the following sections, we explore the underlying mechanisms by examining how MaPs affect specific credit terms and whether the effects vary by firm characteristics and financing channels.

2.6 Robustness

2.6.1 Alternative measurement of MaPs: supply-based MaPs

To verify that our baseline results are not driven by the inclusion of borrower-based instruments, we construct an alternative macroprudential policy index based solely on supply-based tools. These tools include capital requirements, liquidity requirements, and reserve requirements, among others, and primarily target the banking sector's ability to extend credit. This approach follows Ayyagari et al. (2018), Yang and Suh (2023), and Claessens et al. (2023), who argue that supply-based MaPs more directly influence firm-level financing conditions through the bank lending channel.

Table 2.5 reports the results of our instrumental variable (IV) estimation using the supply-based MaP index as the explanatory variable. Column (1) shows the reduced-form regression, where *Rule of Law* is significantly and positively associated with the probability of a firm being credit constrained. Column (2) confirms the strength of the instrument, with a first-stage F-statistic of 31.36, well above the conventional threshold. Column (3) presents the second-stage IV estimate: a one-unit increase in the supply-based MaP index increases the probability of being credit constrained by 9.86 percentage points. This result is statistically significant at the 5% level and substantially larger than our baseline OLS estimates, reinforcing the view that supply-based MaPs have a strong causal impact on SME bank financing.

The magnitude of the coefficient implies that tightening MaPs focused on the supply side materially deteriorates access to bank credit for SMEs. This is consistent with the interpretation that bank-intermediated credit channels are sensitive to regulatory measures that restrict capital or liquidity availability. The robustness of this finding supports our baseline conclusion that MaPs increase the probability that SMEs are credit constrained.

Table 2.5: Robustness: Supply-Based MaPs and Bank Credit Constraint

VARIABLES	Reduced Form (1) Constraint_{Bank}	First Stage (2) MaPs_{supply}	Second Stage (3) Constraint_{Bank}
MaPs_{supply}			0.0986**
			(0.0429)
Rule of Law	0.0903*	0.9159***	
	(0.0420)	(0.1847)	
First-stage F-statistic		31.36***	
Kleibergen-Paap LM-statistic		17.32***	
Anderson-Rubin Wald test		8.19**	
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes
Observations	131,518	131,518	131,518

Notes: Table 2.5 presents IV estimates of the effects of supply-based MaPs. The dependent variable is $\text{Constraint}_{\text{bank}}$, a binary indicator equal to one if a firm is credit constrained for bank financing and zero otherwise. Column (1) reports the reduced-form specification. Column (2) presents the first-stage regression of supply-based MaPs on Rule of Law. Column (3) reports the second-stage IV estimate. All specifications include firm-level and macroeconomic controls. Standard errors clustered at the country-wave level are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

2.6.2 Alternative measurement of credit constraints

As a robustness check, we construct an alternative bank-credit-constraint indicator using SAFE Questions 7A and 7B. Unlike the baseline financing-gap measure based on Questions 5 and 9, this alternative measure focuses on actual borrowing outcomes and discouragement. Specifically, a firm is coded as constrained if it (i) did not apply for a bank loan because it expected rejection, or (ii) applied but was rejected, received less than requested, or refused the offer because the cost was too high. This definition follows Ferrando et al. (2017) and provides a useful benchmark based on realized or anticipated borrowing outcomes.

Using this alternative dependent variable, the IV estimates continue to indicate a meaningful effect of macroprudential tightening on SME financing conditions. The first-stage results again show a strong relationship between *Rule of Law* and the MaP index, with an F-statistic of 22.60. The second-stage IV estimate shows that tighter MaPs significantly increase the likelihood of a firm being credit constrained, with a coefficient of 0.0417 (significant at the 10% level). The reduced-form estimate also confirms a positive effect of institutional quality on constraint probability, consistent with the view that stronger institutions are more likely to activate MaPs.

Although the estimated effect size is somewhat smaller than in our baseline results, it remains economically meaningful and statistically significant. This result confirms that our findings are robust to alternative definitions of credit constraints, including those based on firms' perceived access to finance and actual borrowing outcomes. Taken together, these robustness checks validate the main conclusion that MaPs–particularly those targeting the supply side–exacerbate SMEs' access problems in bank financing markets.

2.7 Channel analysis

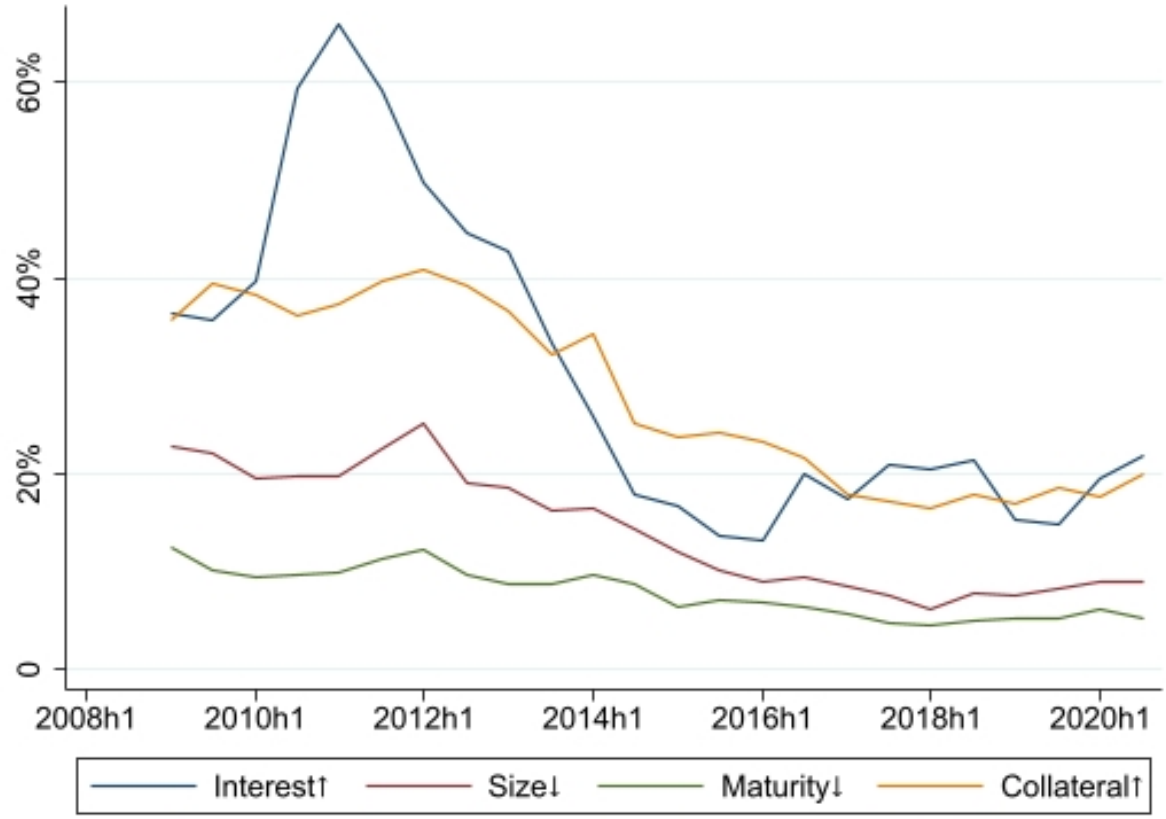
2.7.1 MaPs and bank loan conditions

To shed light on the transmission mechanism underlying the baseline and IV results, we next examine how macroprudential policies affect specific bank loan terms. While the previous sections document that tighter MaPs increase the probability that SMEs are credit constrained, they do not reveal *how* banks adjust lending conditions in response to regulatory tightening. Understanding these contractual adjustments is crucial for distinguishing between price, quantity, and non-price channels of credit supply.

We exploit firms' responses to Question 10 of the SAFE survey, which reports changes in the terms and conditions of bank financing over the past six months. Some SAFE questions are asked only to relevant sub-samples by survey design. In particular, questions on changes in specific bank contract terms (e.g., interest rates, maturities, and collateral requirements) are routed to firms that engaged with bank financing in the reference period. Therefore, the number of observations for contract-term outcomes is smaller than that for the baseline financing-gap indicators based on Q5 and Q9. This difference reflects questionnaire filtering rather than arbitrary missingness. Based on these responses, we construct four binary outcome variables indicating whether a firm experienced (i) a higher interest rate, (ii) a smaller available loan or credit line amount, (iii) a shorter loan maturity, or (iv) a stricter collateral requirement. These variables capture distinct margins along which banks can adjust credit supply without necessarily rejecting loan applications outright.

Figure 2.3 provides a descriptive overview of these contract terms over time. All four indicators peak during the sovereign debt crisis, suggesting that banks actively tightened loan conditions in periods of heightened financial stress. Among them, reported increases in interest rates exhibit the largest volatility, highlighting the importance of price adjustments in bank lending to SMEs.

Figure 2.3: Bank Loan Conditions



Notes: This figure plots the percentage of SMEs reporting a higher interest rate, smaller available size, shorter maturity, and more stringent collateral requirements for bank financing.

The IV estimates for these four loan conditions show a clear pattern. The first-stage regression confirms that the instrument, *Rule of Law*, strongly predicts the MaP index, with a first-stage F-statistic of 48.42. The Kleibergen–Paap LM statistic and the Anderson–Rubin test further support the relevance and validity of the instrument.

The second-stage estimates reveal a clear and economically meaningful pattern. Tighter MaPs significantly increase the probability that firms face higher borrowing costs: a one-unit increase in the MaP index raises the likelihood of an interest rate increase by 23.2 percentage points. Similarly, MaPs are associated with a higher probability of quantity

and maturity constraining. Firms are more likely to experience a reduction in the available loan amount and a shortening of loan maturity. In contrast, the coefficient on collateral requirements is positive but statistically insignificant, indicating that collateral terms are relatively insensitive to macroprudential tightening.

These findings suggest that banks primarily transmit macroprudential shocks through price and quantity margins rather than through collateral requirements. This pattern is consistent with theories of bank risk management and the information-based view of credit markets. SMEs are typically more informationally opaque and face higher agency costs than large firms. As shown by Bernanke et al. (1996), in adverse conditions lenders adopt a flight-to-quality strategy, tightening credit terms for riskier borrowers by raising interest rates and shortening maturities. Our results indicate that MaPs operate through similar channels, even though they are regulatory rather than macroeconomic shocks.

The prominent role of maturity and loan size adjustments is also consistent with the liquidity channel of macroprudential policy. Supply-based MaPs, such as liquidity and reserve requirements, constrain banks' balance sheets and incentivise them to manage liquidity risk more actively. As documented by Acharya et al. (2020) and Acharya et al. (2021), banks facing higher liquidity risk tend to renegotiate or tighten credit lines and shorten maturities to better control future cash outflows. Shorter maturities allow banks to reprice risk more frequently and reduce exposure to long-term uncertainty. In addition, heightened regulatory uncertainty following MaP tightening may increase term premia, making short-term lending relatively more attractive (Gürkaynak and Wright 2012).

By contrast, the absence of a significant effect on collateral requirements can be rationalised by the distinction between asset-based and earnings-based lending. Collateral constraints link borrowing capacity to the value of tangible assets, whereas earnings-based constraints depend on firms' cash flows and profitability. SMEs–especially those in services and knowledge-intensive sectors–often lack substantial tangible assets and rely more

heavily on earnings-based lending. As shown by Lian and Ma (2020) and Ivashina et al. (2022), asset-based loans are less responsive to policy shocks due to the relatively stable pledgeability of hard assets. In this context, tightening collateral requirements may be less effective or less informative than adjusting prices and quantities. Our results therefore suggest that MaPs predominantly affect SMEs through earnings-based borrowing constraints rather than asset-based ones.

Overall, this analysis provides micro-level evidence on the bank-lending channel of macroprudential policy. Tighter MaPs do not merely increase the probability that SMEs are credit constrained; they also worsen credit conditions along multiple contractual dimensions. The combination of higher interest rates, reduced loan size, and shorter maturity indicates a broad tightening of effective credit supply, even in the absence of outright loan rejection. These findings help explain why relatively small average effects on the probability of credit constraint can nevertheless have substantial real consequences for SME financing and investment decisions.

2.7.2 MaPs, firm size, and bank finance type

The previous subsection shows that MaPs tighten bank credit conditions primarily through price and quantity terms. A natural implication is that these effects may be heterogeneous across borrowers and across bank finance instruments. Banks can respond to tighter regulation by reallocating credit toward safer borrowers (flight to quality) (Bernanke et al. 1996). Within the SME segment, firm size is a standard proxy for opacity and default risk: smaller firms tend to be more informationally opaque, have weaker balance sheets, and face higher agency costs. At the same time, banks supply credit through both term loans and credit lines, which differ in contractual structure and risk exposure. Credit lines are contingent commitments and can create liquidity risk for banks when drawdowns spike, making them particularly sensitive to regulatory tightening (Acharya et al. 2020; Acharya et al. 2021).

To evaluate these margins, we examine IV estimates of the effect of MaPs on (i) the overall bank constraint indicator, Constraint_{Bank}, (ii) bank loan constraints, Constraint_{Loan}, and (iii) credit line constraints, Constraint_{Line}, both in the full sample and separately for micro, small, and medium firms.[3] All specifications include the same set of macro and firm controls as in the baseline IV model and absorb country and wave fixed effects.

3. Micro firms have 1–9 employees, small firms 10–49 employees, and medium firms 50–249 employees.

Table 2.6: IV Estimates of the Heterogeneous Effect of MaPs Across Firm Size

	Full Sample				Micro			
VARIABLES	First Stage (1) MaPs	Second Stage (2) $Constraint_{Bank}$	Second Stage (3) $Constraint_{Loan}$	Second Stage (4) $Constraint_{Line}$	First Stage (5) MaPs	Second Stage (6) $Constraint_{Bank}$	Second Stage (7) $Constraint_{Loan}$	Second Stage (8) $Constraint_{Line}$
MaPs		0.0560**	0.0269	0.0537**		0.0792**	0.0464**	0.0718**
		(0.0271)	(0.0175)	(0.0269)		(0.0361)	(0.0214)	(0.0359)
Rule of Law	1.6117***				1.6572***			
	(0.4299)				(0.4529)			
First-stage F-statistic	27.79***				22.58***			
Kleibergen-Paap LM-statistic	14.05***				11.92***			
Anderson-Rubin Wald test	7.15**				9.26**			
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	131,518	131,518	131,518	131,518	49,496	49,496	49,496	49,496
	Small				Medium			
VARIABLES	First Stage (9) MaPs	Second Stage (10) $Constraint_{Bank}$	Second Stage (11) $Constraint_{Loan}$	Second Stage (12) $Constraint_{Line}$	First Stage (13) MaPs	Second Stage (14) $Constraint_{Bank}$	Second Stage (15) $Constraint_{Loan}$	Second Stage (16) $Constraint_{Line}$
MaPs		0.0537*	0.0192	0.0581*		0.0346	0.0127	0.0285*
		(0.0308)	(0.0205)	(0.0302)		(0.0205)	(0.0180)	(0.0151)
Rule of Law	1.5470***				1.7281***			
	(0.4632)				(0.4514)			
First-stage F-statistic	32.34***				27.48***			
Kleibergen-Paap LM-statistic	12.50***				9.87***			
Anderson-Rubin Wald test	8.02**				6.26**			
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	45,047	45,047	45,047	45,047	36,975	36,975	36,975	36,975

Notes: Table 2.6 presents IV estimates of the heterogeneous effects of MaPs on credit constraints for overall bank financing ($Constraint_{Bank}$), bank loan ($Constraint_{Loan}$), and credit line ($Constraint_{Line}$) across firm size. The dependent variable is a binary indicator equal to one if a firm is credit constrained and zero otherwise. All specifications include firm-level controls (Age, Sector, Turnover), macroeconomic controls (Interest Rate, GDP Growth, CPI), and country and time fixed effects. Standard errors clustered at the country-wave level are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 2.6 reports the results. These estimates provide two main insights. First, consistent with the flight-to-quality mechanism, the effect of MaPs on overall bank constraints is concentrated among smaller firms. For micro firms, a one-unit increase in MaPs raises the probability of being constrained in accessing bank finance by 7.92 percentage points, and the effect remains statistically significant. For small firms, the corresponding effect is 5.37 percentage points, significant at the 10% level. In contrast, for medium-sized firms the point estimate is smaller (3.46 percentage points) and statistically insignificant.

Second, the heterogeneity is sharper once we distinguish between bank loans and credit lines. Across size groups, MaPs have weak and statistically insignificant effects on bank loan constraints (Constraint_{Loan}), whereas the effects on credit line constraints (Constraint_{Line}) are consistently positive and statistically significant. In the full sample, MaPs increase credit line constraints by 5.37 percentage points (Column 4), while the effect on loan constraints is economically smaller and not precisely estimated (Column 3). This pattern becomes more pronounced for micro firms: MaPs increase credit line constraints by 7.18 percentage points (Column 8) and also increase overall loan constraints by 4.64 percentage points (Column 7), while the overall bank constraint effect remains large (Column 6). For small firms, the credit line margin again dominates (5.81 percentage points; Column 12), with little evidence of tightening through bank loans (Column 11). Even for medium firms, where overall bank constraints do not respond significantly, the credit line constraint still increases (2.85 percentage points; Column 16), suggesting that banks treat committed liquidity provision as the more sensitive exposure under macroprudential tightening.

These results complement the earlier contract-term evidence. The finding that MaPs shorten maturity and reduce available amounts is consistent with banks tightening revolving and contingent credit, where limits and renewal terms can be adjusted relatively quickly. In addition, because credit lines create off-balance-sheet exposures that can become on-balance-sheet precisely when liquidity conditions deteriorate, tighter capital and

liquidity regulation can raise the effective cost of providing lines even absent an immediate drawdown (Acharya et al. 2020). In contrast, term loans are typically disbursed in a lump sum with predetermined amortization schedules, making them less directly tied to bank liquidity insurance and less flexible to adjust on short notice.

Overall, the heterogeneous effects indicate that MaPs tighten SME bank financing primarily by constraining liquidity provision to smaller firms, rather than by uniformly restricting term lending. This within-SME flight-to-quality pattern and the stronger sensitivity of credit lines provide a micro foundation for the average effects documented in Tables 2.2–2.4. They also motivate the subsequent analysis of substitution away from bank finance: if MaPs disproportionately restrict flexible bank liquidity (credit lines), affected SMEs may have stronger incentives to seek alternative short-term funding sources, such as trade credit.

2.7.3 Leakage effects: MaPs and non-bank credit activities

The preceding analysis shows that tighter MaPs constrain bank finance for SMEs, particularly through credit lines and for smaller firms. An important policy concern is whether these constraints induce *leakage*–that is, a reallocation of credit demand from regulated banks toward non-bank sources. Such substitution may partially offset the tightening of bank credit, but it may also transmit regulatory shocks beyond the banking sector if non-bank lenders are indirectly exposed to bank funding conditions.

Table 2.7 reports IV estimates of the effects of MaPs on non-bank credit constraints. Column (1) confirms a strong first stage, with the *Rule of Law* instrument significantly predicting MaPs (F-statistic = 34.58). Columns (2)–(7) report second-stage estimates for overall non-bank financing and its main components.

Table 2.7: IV Estimates: MaPs and Non-Bank Credit Activities

VARIABLES	First Stage (1) MaPs	Second Stage (2) Constraint$_{Non\text{-}bank}$	Second Stage (3) Constraint$_{Trade\ credit}$	Second Stage (4) Constraint$_{Equity}$	Second Stage (5) Constraint$_{Debt}$	Second Stage (6) Constraint$_{Leasing}$	Second Stage (7) Constraint$_{Other}$
MaPs		0.0409***	0.0415***	0.0029	0.0045*	-0.0008	-0.0016
		(0.0107)	(0.0132)	(0.0043)	(0.0021)	(0.0025)	(0.0020)
Rule of Law	1.9778***						
	(0.6514)						
First-stage F-statistic	34.58***						
Kleibergen-Paap LM-statistic	19.26***						
Stock-Yogo weak ID test	21.03***						
Anderson-Rubin Wald test	8.06**						
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	117,642	117,642	117,642	117,642	117,642	117,642	117,642

Notes: Table 2.7 presents IV estimates of the effects of MaPs on non-bank credit activities. The dependent variables are indicators for overall non-bank financing constraints, trade credit, equity capital, debt securities, leasing, and other financing constraints. All specifications include firm-level and macroeconomic controls, as well as country and time fixed effects. Standard errors clustered at the country-wave level are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Two results stand out. First, tighter MaPs significantly increase the probability that SMEs are constrained in accessing non-bank finance overall. A one-unit increase in MaPs raises $\text{Constraint}_{\textit{Non-bank}}$ by 4.09 percentage points (Column 2). Given the low unconditional mean of non-bank constraints reported in Table 2.1, this effect is economically meaningful and indicates that macroprudential tightening spills over beyond the regulated banking sector.

Second, this effect is driven majorly by trade credit. Column (3) shows that MaPs increase the probability of being constrained in trade credit by 4.15 percentage points, statistically significant at the 1% level. By contrast, the effects on other non-bank sources–equity capital, debt securities, leasing, and other financing–are small and mostly statistically insignificant, with only a weak effect on debt securities (Column 5). This asymmetric pattern suggests that MaPs primarily transmit to non-bank credit through channels that remain closely linked to bank-intermediated funding.

The prominence of trade credit is consistent with its role as the most important alternative short-term financing source for SMEs. Prior work shows that firms facing tighter bank credit are more likely to rely on trade credit (Casey and O'Toole 2014), and that suppliers with better access to bank loans extend more trade credit to their customers (Petersen and Rajan 2015). When MaPs tighten banks' balance-sheet constraints, suppliers themselves may face reduced bank credit availability, limiting their ability to provide trade credit. In this sense, trade credit does not act as a pure substitute for bank finance; instead, it propagates macroprudential shocks along supply chains.

The absence of significant effects for equity, leasing, and other non-bank instruments further supports this interpretation. These financing sources are either less dependent on bank funding or accessible only to a narrow subset of SMEs. As documented by Demirgüç-Kunt et al. (2020), firms with access to capital markets can rely on equity as a "spare tire" during periods of bank credit tightening. Most SMEs in the SAFE sample, however, lack such access, making trade credit the primary non-bank margin of adjustment.

Taken together, these findings provide micro-level evidence of domestic leakage effects of macroprudential policy. Rather than inducing a broad substitution toward non-bank finance, MaPs primarily tighten trade credit conditions, amplifying financing frictions for SMEs that rely on supplier credit. This mechanism complements the bank-lending channel documented earlier and underscores that regulatory tightening can propagate through interconnected funding networks.

2.8 Further analysis: spillover effect

Given the globalization of financial systems, do MaPs implemented abroad generate cross-border externalities, such as improved access to credit for firms in countries that receive the resulting capital flows? Giovanni et al. (2021) study how the global financial cycle (GFC) spills over to corporate lending in Turkey and find that an easing of the GFC improves credit conditions in an emerging market. Building on Buch and Goldberg (2017) and Baskaya et al. (2017), this paper further provides evidence on the inward transmission of foreign MaPs implemented in 67 economies (home countries) to 11 domestic economies (host countries).

Our 11 European host countries help identify the causal relationship between regulatory changes in one economy and credit conditions in another through international spillovers, because they have relatively liberal capital accounts and open banking sectors. Moreover, the firm-level survey data support a causal interpretation because foreign MaPs are unlikely to respond to the credit conditions of any particular firm. Consistent with Buch and Goldberg (2017), we treat foreign MaPs as exogenous to an individual firm's credit activity. We allow firms to have heterogeneous exposure to foreign MaPs and to respond differently to changes in these policies.

We test whether MaPs implemented in foreign countries, denoted by $\text{MaP}_{\text{foreign}}$, affect domestic credit conditions for SMEs. Following Baskaya et al. (2017) and Claessens et al. (2023), we measure the overall exposure of country i to MaPs adopted in country j by weighting foreign policies by the share of financial assets that j holds in i relative to total financial assets in i during that period. This share captures the strength of the financial linkage between countries i and j. The financial-asset data come from the European Commission FinFlows database. We include 67 partner countries/territories that together account for over 90% of all financial assets held in our 11 reporting countries over 2010–2018. Formally,

$$MaPforeign_{it} = \sum_{j} w_{ij} MaP_{jt}. \tag{2.2}$$

Here, w_{ij} is the share of financial claims of country j on country i in a given period. We define inward transmission as the effect of foreign MaPs on domestic firms in the host country. To illustrate this channel, consider a French multinational bank that owns an affiliate bank in Germany. The bank can reallocate capital across its French operations and German affiliate as part of its internal liquidity management, subject to regulatory supervision in both France and Germany. If Germany adopts MaPs and these policies affect the French bank's lending in France, we interpret this as an inward-transmission channel. We estimate the inward-transmission effect using:

$$Y_{ict} = \alpha_c + \lambda_t + \beta_1 MaPforeign_{ct-1} + \beta_2 MaPforeign_{ct-2} + \beta_3 MaPforeign_{ct-3} + \gamma Z_{ct-1} + X_{ict} + \varepsilon_{ict}. \tag{2.3}$$

Here, α_c and λ_t denote country and time fixed effects that control for time-invariant country characteristics and common time trends, respectively. $MaPforeign_{ct-1}$, $MaPforeign_{ct-2}$, and $MaPforeign_{ct-3}$ are the weighted sums of MaPs implemented in foreign countries at $t-1$, $t-2$, and $t-3$.

2.8.1 Bilateral financial linkage and foreign MaPs

We next examine whether macroprudential tightening abroad affects domestic SME credit conditions through cross-border financial linkages. This analysis speaks directly to the inward-spillover channel discussed above and complements the domestic bank-lending and leakage channels documented above. If tighter MaPs in foreign countries constrain lending by internationally active banks, capital may be reallocated toward jurisdictions with looser regulation, potentially easing domestic credit conditions in financially open host countries.

To capture this inward transmission mechanism, we construct a weighted foreign MaP index, $MaPforeign$, following Baskaya et al. (2017) and Claessens et al. (2023). The index aggregates MaPs implemented in partner countries, weighted by bilateral financial asset exposures derived from the European Commission's FinFlows database. This approach allows us to exploit variation in both foreign regulatory stances and the intensity of bilateral financial linkages. As foreign MaPs are unlikely to respond to credit conditions of individual domestic firms, they provide a plausibly exogenous source of variation in domestic financing conditions (Buch and Goldberg 2017).

Table 2.8: Spillover Effect: Inward Transmission

	Panel A: Bank finance type			Panel B: Bank contract terms			
	(1) Constraint_{Bank}	(2) Constraint_{Line}	(3) Constraint_{Loan}	(4) $\text{Constraint}_{Amount}$	(5) $\text{Constraint}_{Maturity}$	(6) $\text{Constraint}_{Collateral}$	(7) $\text{Constraint}_{Interest}$
MaPforeign_{t-1}	-0.1272**	-0.1159***	-0.0472	-0.1205*	-0.0580	-0.1700	-0.4082
	(0.0455)	(0.0370)	(0.0471)	(0.0583)	(0.0481)	(0.1636)	(0.2338)
MaPforeign_{t-2}	-0.0601	-0.0895**	0.0046	-0.0195	-0.0674	-0.2370*	-0.5104***
	(0.0400)	(0.0381)	(0.0486)	(0.0346)	(0.0568)	(0.1347)	(0.1541)
MaPforeign_{t-3}	0.0101	-0.0072	-0.0074	0.1113**	0.0864**	0.2665**	0.2781
	(0.0502)	(0.0448)	(0.0277)	(0.0379)	(0.0347)	(0.0862)	(0.1665)
MaPforeign_{sum}	-0.1773**	-0.2126***	-0.0500	-0.0287	-0.0390	-0.1404	-0.6406*
	(0.0760)	(0.0467)	(0.0881)	(0.0727)	(0.0374)	(0.2327)	(0.3185)
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	86,962	86,962	86,962	35,649	35,649	35,649	35,649

Notes: Table 2.8 presents the spillover effects of foreign MaPs on domestic bank financing. The dependent variables are indicators for bank financing constraints, credit line constraints, loan constraints, and intensive-margin loan terms. We test whether the weighted sum of MaPs implemented in foreign countries at times $t-1$, $t-2$, and $t-3$ is significantly different from zero. All specifications include firm-level and macroeconomic controls, as well as country and time fixed effects. Standard errors clustered at the country-wave level are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 2.8 reports the results on inward transmission of foreign MaPs. We use seven binary dependent variables and estimate the average effect of foreign MaPs on the probability that a firm is credit constrained: (i) overall bank financing, (ii) credit lines, (iii) bank loans, and constraints reflected in (iv) smaller size of the loans, (v) shorter maturity, (vi) stricter collateral requirements, and (vii) higher interest rates. We test whether the overall effect of foreign MaPs, computed as $\beta_1 + \beta_2 + \beta_3$, differs from zero. The estimates indicate that foreign MaPs improve credit conditions for overall bank financing. Credit lines respond more strongly to regulatory changes than bank loans. Moreover, foreign MaPs reduce the probability that domestic firms face higher interest rates.

Panel A focuses on bank finance outcomes, while Panel B examines bank contract terms. For each dependent variable, we estimate the dynamic effects of foreign MaPs at horizons $t-1$, $t-2$, and $t-3$, and test whether their sum, denoted $MaPforeign_{sum}$, is statistically different from zero.

Two main findings emerge. First, foreign MaPs significantly *alleviate* domestic bank credit constraints. Column (1) shows that the cumulative effect of foreign MaPs reduces the probability that an SME is constrained in accessing bank finance by 17.7 percentage points. The result is consistent with an inward spillover channel whereby tighter regulation abroad induces capital reallocation toward the host country, easing local credit conditions.

Second, the spillover effects are concentrated in credit lines rather than term loans. Column (2) shows that foreign MaPs significantly reduce the probability of being constrained in accessing credit lines, with a cumulative effect of -21.3 percentage points, statistically significant at the 1% level. In contrast, Column (3) shows no significant effect on bank loan constraints. This asymmetry mirrors our earlier finding that credit lines are the most MaP-sensitive instrument on the domestic side and suggests that international banks adjust their provision of contingent liquidity more actively across borders in response to regulatory tightening.

Panel B further clarifies the transmission mechanism through contract terms. The strongest and most robust effect appears for interest rates. Column (7) shows that foreign MaPs significantly reduce the probability that SMEs face higher interest rates, with a cumulative effect of -64.1 percentage points. This finding is consistent with the view that inward capital flows lower domestic funding costs and competitive lending margins. Evidence for other contract terms–loan size, maturity, and collateral–is weaker.

Taken together, these results provide clear micro-level evidence of inward spillovers from foreign macroprudential policies. While domestic MaPs tighten SME financing conditions through bank balance-sheet and contract-term channels, foreign MaPs operate in the opposite direction, relaxing domestic credit constraints via international financial linkages. The fact that spillovers are strongest for credit lines and interest rates reinforces the interpretation that globally active banks reallocate liquidity and price credit in response to regulatory differentials across jurisdictions.

These findings underscore the importance of considering cross-border interactions when evaluating the real effects of macroprudential policy. In financially integrated economies, domestic regulatory tightening may be partially offset–or amplified–by policy actions abroad. More broadly, the results suggest that coordination of macroprudential policies across countries can be crucial for managing unintended spillovers and ensuring that financial regulation achieves its intended stabilisation goals without creating uneven credit conditions across borders.

2.8.2 Inward Transmission of Foreign vs. Domestic MaPs

Finally, we examine how domestic credit conditions vary with foreign and domestic MaPs by including both policy measures in the same specification:

$$\begin{aligned} Y_{ict} = {} & \alpha_c + \lambda_t + \beta_1 MaPforeign_{c,t-1} + \beta_2 MaPforeign_{c,t-2} \\ & + \beta_3 MaPforeign_{c,t-3} + \beta_4 MaPhome_{c,t-1} + \beta_5 MaPhome_{c,t-2} \\ & + \beta_6 MaPhome_{c,t-3} + \gamma Z_{c,t-1} + X_{ict} + \varepsilon_{ict}. \end{aligned} \tag{2.4}$$

Here, α_c and λ_t denote country and time fixed effects that control for time-invariant country characteristics and common time trends, respectively. $MaPforeign_{c,t-1}$, $MaPforeign_{c,t-2}$, and $MaPforeign_{c,t-3}$ are weighted sums of MaPs implemented abroad at horizons $t-1$, $t-2$, and $t-3$. $MaPhome_{c,t-1}$, $MaPhome_{c,t-2}$, and $MaPhome_{c,t-3}$ are purged indices of domestic MaPs at the same horizons. For *MaPhome*, following Altavilla et al. (2020), we regress the domestic MaPs index on GDP and CISS and use the residual (purged) component as the measure of domestic MaPs.

Next, we provide empirical evidence to directly contrast the effects of foreign and domestic macroprudential policies on SME credit conditions by jointly including both policy measures in the same specification. Doing so allows us to assess whether inward spillovers from foreign MaPs remain economically and statistically relevant once domestic regulatory tightening is explicitly controlled for, and whether the two policy stances operate through symmetric or asymmetric channels.

Table 2.9: Spillover Effect: Inward Transmission of Foreign vs. Domestic MaPs

Panel A: Foreign vs. Domestic MaPs				
	(1)	(2)	(3)	
VARIABLES	Constraint_{Bank}	Constraint_{Bank}	Constraint_{Bank}	
$\text{MaP}_{foreign}$	-0.1773**		-0.1618*	
	(0.0760)		(0.0813)	
MaP_{home}		0.0776**	0.0866**	
		(0.0263)	(0.0282)	
Macro controls	Yes	Yes	Yes	
Firm controls	Yes	Yes	Yes	
Country FE	Yes	Yes	Yes	
Time FE	Yes	Yes	Yes	
Observations	86,962	86,962	86,962	
Panel B: Bank finance type				
	(4)	(5)		
VARIABLES	Constraint_{Line}	Constraint_{Loan}		
$\text{MaP}_{foreign}$	-0.2147***	-0.0230		
	(0.0490)	(0.0968)		
MaP_{home}	0.0716**	0.0316		
	(0.0238)	(0.0249)		
Macro controls	Yes	Yes		
Firm controls	Yes	Yes		
Country FE	Yes	Yes		
Time FE	Yes	Yes		
Observations	86,962	86,962		
Panel C: Bank Contract Terms				
	(6)	(7)	(8)	(9)
VARIABLES	$\text{Constraint}_{Amount}$	$\text{Constraint}_{Maturity}$	$\text{Constraint}_{Collateral}$	$\text{Constraint}_{Interest}$
$\text{MaP}_{foreign}$	0.0683	0.0029	-0.1846	-0.5942**
	(0.1054)	(0.0516)	(0.2269)	(0.2631)
MaP_{home}	0.0658**	0.0245	0.1744***	0.2788***
	(0.0274)	(0.0239)	(0.0309)	(0.0617)
Macro controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	35,649	35,649	35,649	35,649

Notes: Table 2.9 reports the inward transmission effects of foreign and domestic macroprudential policies on domestic bank financing. Columns (1) to (3) focus on overall bank credit constraints, columns (4) and (5) on credit lines and bank loans, and columns (6) to (9) on intensive-margin loan terms. All specifications include firm-level and macroeconomic controls, as well as country and time fixed effects. Standard errors clustered at the country-wave level are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 2.9 reports the results. Panel A focuses on overall bank credit constraints. Column (1) shows that foreign MaPs are associated with a statistically significant reduction in the probability that SMEs are credit constrained in accessing bank finance. The estimated result implies that the tightening in foreign MaPs lowers the likelihood of bank constraints. Importantly, Column (3) demonstrates that this effect remains robust after jointly controlling for domestic MaPs.

By contrast, domestic MaPs exhibit the opposite qualitative effect. Consistent with the baseline and IV results reported earlier, tighter domestic MaPs increase the probability that SMEs are credit constrained. The comparison across Columns (1)–(3) highlights a clear asymmetry: while domestic MaPs tighten credit conditions, foreign MaPs relax them. This contrast provides particularly strong support for the inward-spillover interpretation and underscores the relevance of international regulatory interactions in financially integrated economies.

Panel B decomposes these effects by bank finance type. The results show that the inward transmission of foreign MaPs is concentrated majorly in credit lines. Column (4) reports a large and statistically significant negative coefficient for Constraint_{Line}, indicating that foreign MaPs substantially reduce the probability that firms are constrained in accessing credit lines. In contrast, Column (5) shows no statistically significant effect on bank loan constraints. This asymmetry mirrors our earlier findings for domestic MaPs and reinforces the interpretation that credit lines–rather than term loans–are the primary margin through which banks reallocate liquidity in response to regulatory changes across borders.

Panel C turns to intensive-margin contract terms. Among the four loan conditions considered, the most robust inward spillover effect again appears for interest rates. Column (9) shows that foreign MaPs significantly reduce the probability that SMEs face higher borrowing costs. In contrast, the coefficients for loan size, maturity, and collateral requirements are statistically insignificant, although their signs generally point toward easing rather than tightening. These results suggest that inward capital reallocation primarily operates through pricing rather than non-price terms.

Taken together, the evidence in Table 2.9 reveals a striking asymmetry between domestic and foreign macroprudential policies. Domestic MaPs tighten SME financing conditions by restricting bank liquidity and worsening contract terms, particularly for credit lines. Foreign MaPs, in contrast, alleviate domestic credit constraints by lowering borrowing costs and expanding access to contingent liquidity. This pattern is consistent with a reallocation mechanism whereby internationally active banks shift lending capacity toward jurisdictions with relatively looser regulatory stances.

These findings have important policy implications. They suggest that the real effects of macroprudential policy cannot be fully understood in isolation: in open and financially integrated economies, domestic regulatory tightening may be partially offset by inward spillovers from abroad. At the same time, uncoordinated macroprudential actions across countries can generate uneven credit conditions and redistribution effects across firms. From a policy perspective, the results therefore strengthen the case for international coordination of macroprudential frameworks, especially when the objective is to safeguard financial stability without unduly constraining SME access to finance.

Chapter 3

Macroprudential Policies & the Composition of Corporate Investment

Abstract

We show that macroprudential policy (MaPP) tightening reduces corporate investment via the financing channel. Following MaPP tightening, intangible-intensive firms face higher loan rejection rates and increase precautionary cash holdings, diverting internal funds from knowledge-based investment. By contrast, tangible-intensive firms face quantity rationing and cut tangible investment. Bank capitalization shapes the pass-through: better-capitalized banks mitigate the effect on their borrowers. Together, firm asset tangibility and bank capitalization jointly determine the MaPP transmission to investment, underscoring a trade-off between financial stability and investment dynamics.

Key words: Macroprudential policies, bank lending, corporate investment, tangible investment, intangible investment

3.1 Introduction

Firms' investment decisions are pivotal for long-run economic growth and corporate value creation. These decisions depend critically on access to external finance, particularly in bank-based financial systems such as those in Europe, where the banking sector remains the dominant source of funding for non-financial corporations. Within this market structure, regulatory interventions that affect credit supply can potentially have significant effects on firms' ability to invest, with concomitant implications for productivity, employment, and innovation. One important form of such intervention is the use of macroprudential policy (MaPP), which is increasingly implemented in the post-GFC period to smooth credit cycles, mitigate systemic risk, and bolster financial stability (Claessens 2015; Freixas et al. 2015; Forbes 2021; Biljanovska et al. 2023).

A large literature studies the macroeconomic effects of MaPP on aggregate credit, capital flows, and house prices (Agenor et al. 2013; Kuttner and Shim 2016; Bruno et al. 2017; Boar et al. 2017; Cerutti et al. 2017; Akinci and Olmstead-Rumsey 2018; Kim and Mehrotra 2018; Richter et al. 2019; Baskaya et al. 2025). Much less is known about how MaPP affects the composition of corporate investment at the firm level. This gap matters because modern economies increasingly rely on intangible capital—such as R&D, software, data, and organizational capabilities—as a key driver of productivity growth (Corrado et al. 2009; Corrado and Hulten 2010; Chen 2014; Crouzet et al. 2022).

Corporate finance theory suggests that investment composition may respond heterogeneously to changes in credit conditions. Intangible assets typically face stronger financing frictions because their low pledgeability makes them weak collateral for bank lending (Cingano et al. 2016; Balduzzi et al. 2018; Popov and Rocholl 2018; Farinha et al. 2019). Thus, the effect of MaPP on investment composition is a priori ambiguous. If intangible projects rely less on bank credit, MaPP tightening should disproportionately restrain collateral-backed tangible investment. Alternatively, by tightening banks' balance-sheet

constraints, MaPP may reallocate lending toward safer, well-collateralized projects and away from intangible-intensive firms, amplifying financing frictions for innovation-oriented investment. How MaPP ultimately reshapes the mix of tangible and intangible investment across firms with different asset structures is thus an open empirical question.

This paper asks whether MaPP tightening reduces corporate investment and, if so, through which margins. It further studies which investment categories adjust to MaPP tightening, for which firms, and through which financing mechanisms. We provide new evidence on how firms' asset tangibility shapes the transmission of MaPP to real activity.

Our empirical approach is guided by the idea that MaPP transmits primarily through bank credit supply. Prudential tools targeting financial institutions—such as capital requirements (Gropp et al. 2019; Fraisse et al. 2020; Juelsrud and Wold 2020), dynamic provisioning (Lis and Herrero 2010; Jiménez et al. 2017), reserve requirements (Alper et al. 2018; Camors et al. 2019), and surcharges for systemically important institutions (Violon et al. 2020; Favara et al. 2021; Degryse et al. 2023)—affect banks' lending capacity and tighten credit conditions, thereby shaping firms' financing choices and investment. Importantly, the strength and form of this transmission should depend on pledgeability: when collateral is weak, credit tightening may operate through access (screening and rejection), whereas when collateral is strong, it may operate more through quantities and terms (Ioannidou et al. 2022; Cole et al. 2024).

In this paper, we combine firm-level data from the European Investment Bank Investment Survey (EIBIS) with national macroprudential actions from the IMF's Integrated Macroprudential Policy (iMaPP) database (Alam et al. 2024). To focus on policy actions most relevant for the corporate credit channel, we construct a targeted MaPP index. Specifically, we restrict attention to supply-side instruments plausibly affecting banks' lending capacity and exclude borrower-based measures such as LTV and DSTI limits,

which typically target household credit. A further advantage of EIBIS is that it records firms' primary bank, allowing us to link borrowers to bank balance-sheet characteristics and examine heterogeneity in pass-through by bank strength (e.g., size, Tier-1 capital, and profitability).

Identifying the causal effect of MaPP requires separating policy variation from concurrent macro-financial conditions. For identification, we adopt the approach of Auerbach and Gorodnichenko (2012), as adapted to macroprudential settings by Altavilla et al. (2020). Specifically, we construct macroprudential shocks as the residuals from regressions of national MaPP stance index on lagged macro-financial variables. These shocks are orthogonal to contemporaneous macro-financial developments and can be interpreted as exogenous drivers of firm-level outcomes.

We document three main findings. First, MaPP tightening reduces corporate investment by an economically meaningful amount. Second, MaPP tightening changes investment composition in a way that depends on firms' asset structure. Following Döttling and Ratnovski (2023), we classify firms as tangible- or intangible-intensive. To account for cross-country differences in industrial structure, we classify firms within each country-year: firms above the median intangible-to-total asset ratio are 'intangible' and those below are 'tangible'. We find that tangible firms primarily curtail investment in physical capital (e.g., machinery and equipment), whereas intangible firms reduce spending on knowledge-based capital (e.g., R&D and software). We trace this asymmetry to differences in how MaPP-induced credit rationing operates: tangible firms face quantity rationing at the intensive margin, while intangible firms face outright loan rejections at the extensive margin. In response, intangible firms raise precautionary cash holdings—a margin that is largely absent for tangible firms. These heterogeneous outcomes highlight asset pledgeability as the key structural determinant of how MaPP transmits to the real economy. Third, we investigate the role of banks in MaPP transmission and find that the investment effects of MaPP persist even within bank-firm relationships. Moreover, firms borrowing from better-capitalized banks are more resilient to MaPP tightening.

Taken together, our evidence points to a financing channel of transmission in which MaPP tightening compresses investment through different margins depending on asset collateralizability. While MaPP tools curb bank lending and dampen tangible investment cycles, they can also tighten financing constraints for intangible-intensive firms and induce liquidity hoarding, with potential implications for investment in knowledge-based capital.

The remainder of the chapter is structured as follows. The next section reviews the related literature. We then describe the data, present the empirical analysis, examine the financing channel, and conclude.

3.2 Literature Review

This chapter contributes to two strands of literature. First, we add firm-level evidence to the literature on the short-term real costs of prudential policy. One source of these costs stems from the inherently countercyclical nature of macroprudential regulation: by design, policy tightening restrains credit expansion during booms, but may also dampen real activity in the short run (Borio and Shim 2007; Brunnermeier et al. 2009). For example, Richter et al. (2019) show that MaPP tightening reduces credit growth, slows house price appreciation, and leads to a temporary decline in output. Similarly, Mendicino et al. (2020) find that tighter capital requirements enhance bank resilience and generate long-run benefits, but are also associated with substantial transitional costs through a short-run contraction in credit supply and aggregate demand. A more recent literature points to an additional short-run cost of tighter prudential regulation: it may alter banks' risk-taking incentives and thereby distort credit allocation. In this spirit, Anguren et al. (2024) show that banks more exposed to the tightening of Basel III capital requirements reallocate credit toward ex-ante riskier firms, consistent with an attempt to limit firm exits.[1]

1. See Caballero et al. (2008), Acharya et al. (2019), Acharya et al. (2022b), Becker and Ivashina (2022), Schivardi et al. (2020), Bonfim et al. (2023), Albuquerque and Iyer (2024) and De Jonghe et al. (2024) for related evidence on bank risk-taking behavior consistent with loan evergreening or zombie lending.

Relatedly, prior work finds that tighter capital requirements reduce corporate investment (Fraisse et al. 2020; De Marco et al. 2021). However, these studies typically proxy investment using changes in fixed assets, which obscures heterogeneity across investment types. Our dataset allows us to move beyond this limitation by decomposing corporate investment into tangible, knowledge, and organizational capital, thereby enabling a more granular analysis of the transmission of macroprudential policy. A second advantage of our approach is that we directly observe firms' credit-market experiences using survey-based information on loan applications and outcomes, including discouragement, rejection, and dissatisfaction with key contract terms (amount, cost, maturity, and collateral). These measures capture both formal and informal credit constraints that are typically unobserved in credit registries and balance-sheet data (Kaplan and Zingales 1997; Lamont et al. 2001), and they allow us to distinguish whether MaPP tightening operates primarily through the extensive margin of credit access (screening and denial) or through the intensive margin (quantities and terms). This feature helps us map investment responses to specific mechanisms of credit rationing and strengthens the interpretation of a credit-supply channel.

Second, we contribute to the literature on intangible capital formation. A well-documented trend is the rising share of intangible capital in corporate portfolios (Corrado and Hulten 2010; Peters and Taylor 2017; Haskel and Westlake 2018; Alexander and Eberly 2018; Corrado et al. 2022; Crouzet et al. 2022; Ewens et al. 2025). However, due to its limited pledgeability, intangible capital is typically financed through internal rather than external funds (Aghion et al. 2004; Falato et al. 2022; Acharya et al. 2007; Li 2025). Consistent with this friction, Dell'Ariccia et al. (2021) argue that banks have a comparative advantage in funding standardized, collateral-backed projects and are less effective at supporting innovation-intensive activities such as R&D. Echoing this channel, Beck et al. (2023) document that bank-generated liquidity disproportionately supports tangible investment, with limited effects on intangible capital formation; moreover, in economies where industries rely more on intangible assets, this liquidity does not translate into higher growth.

Related evidence links supervisory and monetary shocks to investment composition. Ampudia et al. (2021) show that the Single Supervisory Mechanism reduced credit at supervised banks and induced borrowers to shift from intangibles toward cash and collateralizable assets. Döttling and Ratnovski (2023) find that intangible investment is less responsive to monetary policy shocks than tangible investment. Caggese and Pérez-Orive (2022) show that low real rates stimulate intangible investment less because of low collateral value and heavier reliance on internal finance, especially for constrained firms and lumpy projects.

3.3 Data

We use a linked micro-macro panel dataset covering 29 countries (the EU27, the UK, and the US) from 2015 to 2022.[2] Firm-level information on investment and financing is drawn from the European Investment Bank Investment Survey (EIBIS). Bank-level balance sheet and income statement data are sourced from the Bureau van Dijk's BankFocus database. Country-level MaPP data are obtained from International Monetary Fund's integrated Macroprudential Policy (iMaPP) database.

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2. European Union member states (AT: Austria, BE: Belgium, BG: Bulgaria, CY: Cyprus, CZ: Czech Republic, DE: Germany, DK: Denmark, EE: Estonia, ES: Spain, FI: Finland, FR: France, GR: Greece, HR: Croatia, HU: Hungary, IE: Ireland, IT: Italy, LT: Lithuania, LU: Luxembourg, LV: Latvia, MT: Malta, NL: Netherlands, PL: Poland, PT: Portugal, RO: Romania, SE: Sweden, SI: Slovenia, SK: Slovakia)

3.3.1 EIBIS: firm-level survey-based information

The EIBIS provides annual firm-level data on investment and financing behavior for a representative sample of approximately 12,000 firms across 29 countries over the period 2015-2022.[3] The survey is administered through computer-assisted telephone interviews (CATI) conducted in the local language.[4] The sample comprises firms operating in NACE sectors C to J.[5] The chosen sampling frame for all countries is based on the BvD ORBIS database, which effectively captures the target business population with no systematic sampling bias (Brutscher et al. 2020).

The dataset offers several advantages over traditional balance sheet-based sources. First, rather than inferring investment from changes in fixed assets, the EIBIS provides direct information on corporate investment, which extends beyond the boundaries of accounting-based definitions. In particular, it captures detailed data on firms' investment in various types of tangible and intangible assets. Following Corrado et al. (2005) and Ewens et al. (2025), we decompose investment into three components: tangible investment (land, buildings and infrastructure; machinery and equipment), knowledge capital investment (research and development; software, data, and IT networks), and organizational capital investment (organizational capital; employee training).

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3. Our sample's coverage, as well as its distribution by firm size and sector, is consistent with Kalemli-Özcan et al. (2024), ensuring the representativeness of the dataset. Aggregate survey data, the questionnaire, and detailed documentation of the survey methodology are available at www.eib.org/eibis.

4. Consistent with the survey design employed in Campello et al. (2010), the respondent is the most senior individual at the firm responsible for investment and financing decisions. This person is typically the owner, Finance Manager, Finance Director or Head of Accounts, Chief Financial Officer, or Chief Executive Officer.

5. The sector classification follows the NACE Rev. 2 system, with the relevant sectors defined as follows: C: manufacturing; D: electricity, gas, steam and air conditioning supply; E: water supply; sewerage, waste management and remediation activities; F: construction; G: wholesale and retail trade; repair of motor vehicles and motorcycles; H: transportation and storage; I: accommodation and food service activities; J: information and communication.

Second, the survey captures credit frictions—including informal constraints—that are typically invisible in credit registries. Prior work shows that discouraged borrowers and informal rejections vary systematically across countries and can bias registry-based analyses (Brown et al. 2014; Popov 2016). The EIBIS classifies a firm as credit constrained if it (1) receives less than requested (quantity rationing), (2) applies and is rejected, (3) does not apply because borrowing costs are expected to be too high (price constraint), or (4) does not apply because it expects to be rejected (discouragement). Among firms that obtained external finance, the survey records satisfaction with (i) amount, (ii) cost, (iii) maturity, and (iv) collateral, each on a five-point Likert scale. We code separate binaries equal to one if the firm reports being fairly or very dissatisfied on each dimension.

3.3.2 Matching firm- and bank-level data

Corporate borrowing in Europe often concentrates in a single institution, a pattern widely interpreted as evidence of close bank-firm ties (Ongena et al. 2012). We use the reported primary bank to capture these ties and incorporate the resulting firm-bank links directly into the empirical analysis.

The survey asks each firm to identify its main bank. When a firm reports multiple banking relationships, the questionnaire explicitly requests the primary one. Following the literature on firm-bank lending relationships (Ongena and Smith 2000, 2001; Giannetti and Ongena 2012; Ferrando et al. 2019; Ampudia et al. 2021; Poelhekke et al. 2021; Ferrando et al. 2022; Kalemli-Özcan et al. 2022; Betz and De Santis 2022), we define *bank* as its primary banking partner.

We match each firm's *bank* to bank-level balance sheet and income statement information from Bureau van Dijk's BankFocus database. This merge links firm-level financing and investment outcomes to bank characteristics in a unified panel.

The matched dataset traces the chain from bank characteristics to firms' financing choices and, ultimately, to investment outcomes. This structure enables us to identify the impact of macroprudential policies on financing decisions and to quantify their real effects on corporate investment dynamics.

3.3.3 iMaPP: macroprudential regulations

The iMaPP database (Alam et al. 2024) provides monthly country-level indicators for 17 macroprudential policy (MaPP) tools. Each indicator takes the value 1 for a tightening action, 0 for no change, and -1 for a loosening action.[6] Although comparing the intensity of macroprudential policy across instruments and countries is inherently difficult (Forbes 2021), these discrete indicators offer a transparent and tractable way to measure policy changes over time.

Following Albuquerque et al. (2025) and Altavilla et al. (2020), we focus on supply-side MaPP tools that are most likely to affect banks' lending capacity. This group includes measures directly constraining credit supply—such as limits on credit growth, loan loss provisioning requirements, and loan restrictions—as well as broader prudential instruments, including capital requirements, liquidity requirements, reserve requirements, and the countercyclical capital buffer.

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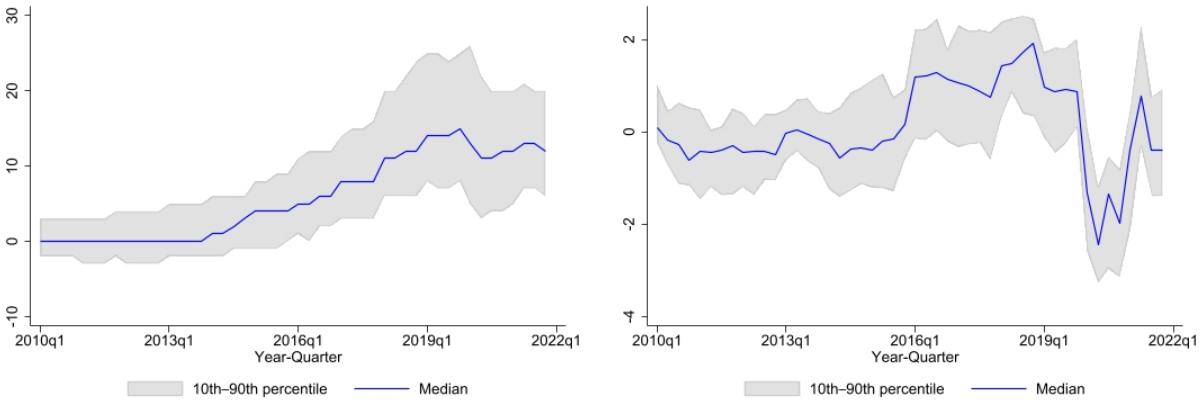
6. Table A.4 reports detailed definitions of all MaPP tools.

We first aggregate the monthly indicators to the quarterly frequency. We then construct a cumulative quarterly MaPP stance index by summing policy changes across the selected tools within each country from 1990 onward, following Akinci and Olmstead-Rumsey (2018), Altavilla et al. (2020), Ahnert et al. (2021), Chari et al. (2022), Bergant et al. (2024), Cecchetti et al. (2023) and Albuquerque et al. (2025). This approach assumes that each country starts from a neutral macroprudential stance at the beginning of the sample, so the index tracks the cumulative tightening or loosening of policy over time.



(a) MaPP Stances (b) MaPP Shocks

Figure 3.1: MaPP Stances Versus MaPP Shocks over Time. This figure compares the MaPP stance index and standardized MaPP shocks. The left-hand panel plots cumulative MaPP stances and the right-hand panel plots MaPP shocks for 29 sample countries over time. The MaPP stance index adds (subtracts) one when a new macroprudential tool tightens (loosens). The MaPP shocks index is obtained as the residual from a regression of the MaPP stance index on a set of controls. The blue line represents the median across countries, while the grey shaded area shows the range between the 10th and 90th percentiles. Source: Alam et al. (2024) and authors' calculations.

Figure 3.1(a) plots the evolution of the MaPP stance index for the sample countries over 2010–2022. The index ranges from -5 to 24 across the 29 countries in our sample, with higher values indicating a tighter macroprudential stance. The median country-level stance is 2, and the mean is 3.73. Denmark exhibits the tightest stance in the sample, followed by Poland, Austria, and Hungary. Consistent with the existing literature, macroprudential policy appears broadly countercyclical, with authorities tightening measures

during periods of strong domestic credit expansion. Since the Global Financial Crisis, both advanced and emerging economies have used MaPP more actively, and tightening actions have substantially outnumbered loosening measures (Akinci and Olmstead-Rumsey 2018; Forbes 2021).

A central empirical challenge is that macroprudential policy is not randomly assigned. Authorities typically adjust MaPP in response to developments in the credit cycle and broader macro-financial conditions, which may also affect firms' investment decisions. Our firm-level setting helps mitigate reverse causality, since MaPP is not set in response to the behavior of individual firms (Galati and Moessner 2018). Nevertheless, endogeneity concerns remain because aggregate shocks—such as changes in credit conditions, output growth, or inflation—may jointly influence both policy decisions and firm outcomes.

To address this issue, we follow the two-stage "purged shocks" approach used in recent work on macro-financial policy transmission (Auerbach and Gorodnichenko 2012; Iacoviello and Navarro 2019; Altavilla et al. 2020; Ahnert et al. 2021; Chari et al. 2022; Caldara et al. 2024). In the first stage, we estimate country-specific regressions of the quarterly MaPP stance index on lagged macroeconomic and financial variables. The residuals from these regressions capture the component of macroprudential policy that is not explained by observable domestic macro-financial conditions and are interpreted as exogenous MaPP shocks. In the second stage, we use these residuals to estimate the effect of MaPP shocks on firm-level investment.

Formally, for each country c, we estimate

$$MaPP_{c,t} = \alpha_c + \beta_c' Z_{c,t-1} + u_{c,t}, \tag{3.1}$$

where $MaPP_{c,t}$ denotes the quarterly MaPP stance index in country c at time t, and $Z_{c,t-1}$ is a vector of lagged macro-financial controls. Specifically, $Z_{c,t-1}$ includes lags of credit growth, GDP growth, and inflation. We allow the coefficients to differ freely across countries by estimating the regression separately for each country. The number of lags is chosen using the Akaike and Schwarz information criteria, with a maximum of four lags for each variable.[7] The residual $u_{c,t}$ is our quarterly MaPP shock measure. Figure 3.1(b) presents the resulting country-level MaPP shock series. To align the shock series with the annual frequency of the firm-level survey data, we convert the quarterly residuals into annual shocks by averaging the four quarterly shocks preceding each survey year.

3.3.4 Descriptive statistics

Tables 3.1 and 3.2 present the variable definitions and summary statistics used in the regression analysis, respectively. Panels A and B of Table 3.2 report statistics for the full sample, while Panel C focuses on the merged bank-firm sample. The full sample comprises an unbalanced panel of 31,216 firm-year observations across 11,888 firms.

Our primary dependent variables are total investment, tangible investment, knowledge capital investment, and organizational capital investment. Each is measured as a ratio of total assets. The mean values of these investment measures are 9.0%, 7.1%, 1.2%, and 0.6%, respectively. Among firm characteristics, the average (log) total assets equals 15.191. Approximately 50% of firms reported engaging in export or import activities in the previous year, and nearly 90% are classified as mature firms, having been established for over 10 years. Regarding firm size by number of employees, 15.1% have 1-9 employees, 31.4% have 10-49 employees, 35.1% have 50-249 employees, and 18.4% employ over 250 individuals. 29.3%, 29.5%, 25.7%, and 15.5% of firms are categorized as micro (annual turnover

7. The results reported in the remainder of the paper are robust to using alternative lag lengths when constructing the macroprudential policy shocks.

less than €2 million), small (between €2 million and €10 million), medium (between €10 million and €50 million), and large (over €50 million), respectively. In line with Ampudia et al. (2021), we define a firm's intangible asset share as the ratio of intangible capital to total capital. This share averages 7.8% in our sample.

Table 3.1: Variables Description

Variable	Definition	Sources
Panel A: Firm Characteristics		
Investment	Total investment / total assets	EIBIS
Tangible investment	Buildings and equipments investment / total assets	EIBIS
Knowledge investment	R&D, data, and software investment / total assets	EIBIS
Organizational investment	Organizational capital and training / total assets	EIBIS
Intangible assets share	Intangible assets / (tangible assets + intangible assets)	EIBIS
Firm total assets	Natural logarithm of total assets	EIBIS
Turnover	Natural logarithm of turnover	EIBIS
Age	Natural logarithm of age	EIBIS
Headcount	Natural logarithm of number of employees	EIBIS
Export/import	Export dummy equal to 1 if the firm reports exports/imports	EIBIS
Liquidity ratio	(Current assets − stocks) / current liabilities	EIBIS
Leverage ratio	Total debt / total assets	EIBIS
Panel B: Macro Variables		
$MaPP_{shock}$	Purged index of macroprudential policy	Authors' calculation
GDP growth	Real GDP growth	ECB
CPI growth	Change in consumer prices	ECB
Financial institution development	Index of financial institution development	IMF FD
Financial market development	Index of financial market development	IMF FD
Export growth	Annual change in total exports	World Bank WDI
Import growth	Annual change in total imports	World Bank WDI
Credit growth	Annual change in total credit	World Bank WDI
FDI net inflows (% of GDP)	FDI net inflows as a percentage of GDP	World Bank WDI
FDI net outflows (% of GDP)	FDI net outflows as a percentage of GDP	World Bank WDI
Government effectiveness	Index of government effectiveness	World Bank WGI
Political stability	Index of political stability	World Bank WGI
Rule of law	Index of agents' confidence in the rules of society	World Bank WGI
Regulatory quality	Index of regulatory quality	World Bank WGI
Panel C: Bank Characteristics		
Bank total assets	Natural logarithm of total assets	BankFocus
Bank ROA	Return on assets	BankFocus
Bank ROE	Return on equity	BankFocus
Bank Tier 1 ratio	Tier 1 ratio	BankFocus
Bank capital ratio	Bank equity / total assets	BankFocus
Bank liquidity ratio	Liquid assets / deposits and short-term funding	BankFocus
Bank loan volume to assets	Bank loan volume / total assets	BankFocus

Notes: EIBIS = European Investment Bank Investment Survey; IMF iMaPP = IMF Integrated Macroprudential Policy dataset; IMF FD = IMF Financial Development Index; WDI = World Development Indicators; WGI = Worldwide Governance Indicators.

Table 3.2: Descriptive Statistics

Variable	N	Mean	SD	Min	Med	Max
Panel A: Firm Characteristics (Firm Level)						
Total investment (scaled by total assets)	31,216	0.090	0.140	0	0.039	0.677
Tangible investment (scaled by total assets)	31,216	0.071	0.126	0	0.024	0.559
Knowledge investment (scaled by total assets)	31,216	0.012	0.032	0	0.002	0.179
Organizational investment (scaled by total assets)	31,216	0.006	0.015	0	0.001	0.086
Intangible assets share	31,216	0.078	0.197	0	0.001	1
Firm total assets (log)	31,216	15.191	2.155	10.443	15.135	20.783
Turnover (log)	31,216	15.505	2.007	11.002	15.502	20.561
Age (log)	31,216	3.084	0.663	1.386	3.178	4.644
Headcount (log)	31,216	3.858	1.510	1.386	3.892	7.859
Export/import	31,216	0.522	0.500	0	1	1
Liquidity ratio (%)	31,216	1.698	1.687	0.069	1.161	7.938
Leverage ratio (%)	31,216	0.575	0.316	0.044	0.562	2.037
Panel B: Macroeconomic Variables						
$MaPP_{shock}$	31,216	0.016	1.014	-2.678	0.330	1.634
GDP growth (%)	31,216	1.922	5.551	-21.950	2.600	21.720
CPI growth (%)	31,216	1.048	1.248	-2.100	1.000	4.233
Financial institution development	31,216	0.653	0.129	0.358	0.671	0.879
Financial market development	31,216	0.467	0.276	0.022	0.529	0.949
Export growth (%)	31,216	4.726	5.352	-10.650	4.650	16.339
Import growth (%)	31,216	5.263	5.480	-9.229	5.012	32.354
Credit growth (%)	31,216	2.752	6.819	-14.470	3.190	18.600
FDI net inflows (% of GDP)	31,216	0.048	1.800	-0.401	0.027	0.813
FDI net outflows (% of GDP)	31,216	0.032	1.950	-0.568	0.0125	0.650
Government effectiveness	31,216	1.055	0.560	-0.177	1.066	2.014
Political stability	31,216	0.665	0.329	-0.140	0.729	1.426
Rule of law	31,216	1.072	0.627	-0.140	1.051	2.053
Regulatory quality	31,216	1.133	0.502	0.135	1.075	2.040
Panel C: Bank Characteristics (Bank-Firm Level)						
Total assets (log)	12,238	10.713	2.169	4.473	10.808	14.666
ROA (%)	12,238	0.661	0.803	-2.807	0.572	2.453
Tier 1 ratio (%)	12,238	17.319	5.156	9.800	16.200	27.890
NPL ratio	12,238	5.893	6.311	0.385	4.216	44.593
Liquidity ratio (%)	12,238	40.952	26.044	5.617	35.376	85.376
Loan volume / assets (%)	12,238	57.450	13.481	17.038	59.035	83.148

Notes: Table 3.2 reports descriptive statistics for the variables used in the analysis. Panel A lists firm-level variables, Panel B macroeconomic variables, and Panel C bank characteristics. See Table 3.1 for variable definitions.

3.4 Empirical analysis

3.4.1 The effect of MaPP on investment

We estimate the responses of corporate investment to the MaPP shocks using the following specification:

$$Y_{f,s,c,t} = \alpha_f + \theta_{s,t} + \delta MaPP_{c,t-1} + \gamma' Z_{c,t-1} + \zeta' X_{f,s,c,t-1} + \varepsilon_{f,s,c,t} \tag{3.2}$$

where $Y_{f,s,c,t}$ is the corporate investment as a ratio to its total assets of firm f from sector s in country c at time t. We include firm (α_f) fixed effects to control for firm-specific time-invariant factors that explain variation in investment. We also include sector-year fixed effects ($\theta_{s,t}$) that account for unobserved time-varying sector heterogeneity. $MaPP_{c,t-1}$ is the variable of interest, indicating the purged MaPP shocks at time $t-1$. $Z_{c,t-1}$ is a set of macroeconomic control variables, and $X_{f,s,c,t-1}$ is a set of firm covariates to control for observable firm-level heterogeneity such as size, age, turnover, etc. $\varepsilon_{f,s,c,t}$ is the error term. We cluster robust standard errors by country in all specifications, bootstrapping the standard errors over the two stages with 10,000 replications.

Table 3.3 shows that MaPP tightening has a negative impact on corporate investment. Quantitatively, a one-standard-deviation MaPP shock is associated with a 2.4 percentage point reduction in the total investment rate.

To examine how this decline varies across investment types, we follow Corrado et al. (2005) and Ewens et al. (2025) and decompose total investment into tangible investment (land, buildings and infrastructure; machinery and equipment), knowledge capital investment (research and development; software, data, and IT networks), and organizational capital investment (organizational capital; employee training). Tangible capital has a clear, measurable value and is often used as collateral in financial transactions, whereas knowledge and organizational capital are non-physical and harder to value.[8]

Table 3.3: Effects of MaPP Shocks on Total and Component Investment

	Dependent variable: investment ratio			
	Total	Tangible	Knowledge	Organizational
	(1)	(2)	(3)	(4)
$MaPP_{shock}$	-0.0240***	-0.0207***	-0.0023*	-0.0009
	(0.0088)	(0.0079)	(0.0013)	(0.0008)
Firm controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes
Observations	31,216	31,216	31,216	31,216

Notes: Table 3.3 reports the effects of MaPP shocks on corporate investment. Column (1) reports the baseline effect on total investment. Columns (2) to (4) report the effects on tangible, knowledge, and organizational investment, respectively. All dependent variables are measured as ratios to total assets. All specifications include firm and macroeconomic controls, firm fixed effects, and sector-year fixed effects. Firm controls include staff headcount, turnover, age, total assets, financial conditions, and an export dummy. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

8. We distinguish knowledge investment from organizational investment for three reasons. First, they differ in economic nature and adjustment frictions. Knowledge capital often involves codified innovation and scalable digital assets with substantial fixed costs and option value, while organizational capital is embedded in firm-specific processes, managerial practices, and workforce capabilities that accumulate gradually with higher adjustment costs. Second, their financing and accounting treatment differs: R&D and software/data are more likely to be capitalized and may benefit from targeted funding and policy support, whereas training and organizational improvements are frequently expensed and managed through operating budgets. Third, measurement of aggregate intangibles differs across categories and countries. As noted by Nonnis et al. (2024), separating knowledge and organizational-capital investment is crucial for understanding past growth and future prospects. Our firm-level survey explicitly differentiates between the two, mitigating national-accounts measurement issues.

Columns 2-4 in Table 3.3 document the effects for tangible, knowledge, and organizational investment. Quantitatively, a one-standard-deviation increase in MaPP tightening reduces the tangible investment rate by 2.1 percentage points, a significant effect equivalent to 16.4% of its standard deviation. The contraction in knowledge capital investment is statistically significant but economically less pronounced, amounting to a 0.23 percentage point decline in its investment-to-asset ratio, or 7.2% of its standard deviation. We find no statistically significant effect on organizational capital investment.

Table 3.4 unpacks these aggregates. Within tangible investment, the decline is concentrated in machinery and equipment, while land and buildings are insignificant—consistent with longer planning horizons, lumpiness, and financing structures (e.g., mortgages/long-term leases) that are less sensitive to marginal credit tightening. Within knowledge capital, the decrease is driven by R&D, which is consistent with the financing patterns of innovation. Because knowledge capital is harder to collateralize, it is typically more reliant on internal finance. The MaPP-induced tightening of external credit may therefore trigger a precautionary response, prompting firms to divert internal funds towards liquidity buffers and away from new projects.[9] Consequently, while firms protect core innovation projects with high sunk costs, they curtail more discretionary R&D spending at the margin. By contrast, software, IT, and data show no statistically significant change, likely reflecting its modular, often subscription-based nature, which does not require major capital reallocation.

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9. This precautionary motive is particularly acute for intangible-intensive firms. The limited pledgeability of their assets exposes them to more severe external financing frictions, thereby intensifying their reliance on internal liquidity to fund growth opportunities (Opler et al. 1999; Almeida et al. 2004).

Table 3.4: Effects of MaPP Shocks on Corporate Investment Components

	Tangible	Land	Machine	Knowledge	R&D	IT	Organizational	Training	OC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$MaPP_{shock}$	-0.0207***	-0.0083	-0.0124**	-0.0023*	-0.0015*	-0.0008	-0.0009	0.00001	-0.0009
	(0.0079)	(0.0054)	(0.0058)	(0.0013)	(0.0009)	(0.0008)	(0.0008)	(0.0002)	(0.0008)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31,216	31,216	31,216	31,216	31,216	31,216	31,216	31,216	31,216

Notes: Table 3.4 reports baseline estimates of the effect of MaPP shocks on disaggregated investment ratios. Tangible, knowledge, and organizational investment are aggregate measures constructed as the sums of their two subcomponents: respectively, (i) land and machinery, (ii) R&D and IT/software/data, and (iii) training and organizational capital, all scaled by total assets. All specifications include firm and macroeconomic controls, firm fixed effects, and sector-year fixed effects. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

We subject our estimates to two robustness checks, reported in the Appendix, to verify that the baseline result in Table 3.3 does not hinge on specific empirical set-ups. First, following Albuquerque et al. (2025), we narrow the MaPP measure to instruments that directly target loan supply by excluding stress-testing tools and prudential requirement instruments. This addresses concerns that the broader MaPP index may mix supervisory actions or bank-health information with credit-supply shifts. Table 3.5 reports that the results are consistent with the baseline. Second, government support during the COVID-19 pandemic may directly relax financing constraints, affect investment independently of MaPP shocks, and be targeted toward more distressed firms, creating selection concerns. We therefore exclude firms that received public assistance during COVID-19, which removes approximately 6,900 firm-year observations. Table 3.6 reports the re-estimated effects, which remain consistent with the baseline.

Table 3.5: Robustness: Effects of MaPP Shocks on Investment Using a Narrow Definition of Credit-Related MaPP

	Dependent variable: investment ratio			
	Total	Tangible	Knowledge	Organizational
	(1)	(2)	(3)	(4)
$MaPP_{shock}$	-0.0219**	-0.0190**	-0.0021*	-0.0008
	(0.0081)	(0.0074)	(0.0011)	(0.0008)
Firm controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes
Observations	31,216	31,216	31,216	31,216

Notes: Table 3.5 reports the effects of credit-related MaPP shocks on corporate investment. Column (1) reports the baseline effect on total investment. Columns (2) to (4) report the effects on tangible, knowledge, and organizational investment, respectively. All dependent variables are measured as ratios to total assets. All specifications include firm and macroeconomic controls, firm fixed effects, and sector-year fixed effects. Firm controls include staff headcount, turnover, age, total assets, financial conditions, and an export dummy. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 3.6: Robustness: Effects of MaPP Shocks on Investment Excluding Firms That Received Public Assistance During COVID-19

	Dependent variable: investment ratio			
	Total	Tangible	Knowledge	Organizational
	(1)	(2)	(3)	(4)
$MaPP_{shock}$	-0.0293***	-0.0253**	-0.0030*	-0.0010
	(0.0110)	(0.0102)	(0.0017)	(0.0012)
Firm controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes
Observations	24,336	24,336	24,336	24,336

Notes: Table 3.6 reports the effects of MaPP shocks on corporate investment after excluding firms that received public assistance during COVID-19. Column (1) reports the baseline effect on total investment. Columns (2) to (4) report the effects on tangible, knowledge, and organizational investment, respectively. All dependent variables are measured as ratios to total assets. All specifications include firm and macroeconomic controls, firm fixed effects, and sector-year fixed effects. Firm controls include staff headcount, turnover, age, total assets, financial conditions, and an export dummy. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

3.4.2 Comparing intangible firms vs. tangible firms

We next examine whether firms' asset composition shapes the investment response to MaPP tightening. Following Döttling and Ratnovski (2023), we split the sample within each country-year based on firms' intangible-to-total asset ratios: firms above the country-year median are classified as intangible firms, and those below as tangible firms.[10]

Table 3.7 reports summary statistics for the two groups. Intangible firms exhibit a higher knowledge-investment rate and a lower tangible-investment rate, with no significant difference in organizational investment across the two groups. The groups are otherwise comparable in liquidity ratio, leverage ratio, size, age, and turnover.

10. Classifying within country-year is essential because MaPP vary at the country level and asset composition differs systematically across countries. A cross-sectional split would conflate firm traits with country-level fixed effects; our approach compares relatively intangible and tangible firms under the same institutional and policy environment.

Table 3.7: Summary Statistics by Firm Type

	All Firms			Intangible Firms			Tangible Firms		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Intangible Ratio	0.078	0.001	0.197	0.173	0.039	0.267	0.001	0.000	0.005
Liquidity Ratio	1.698	1.160	1.687	1.576	1.110	1.566	1.801	1.214	1.777
Leverage Ratio	0.575	0.562	0.316	0.580	0.572	0.308	0.570	0.554	0.323
Log Size	15.191	15.135	2.155	15.491	15.528	2.129	14.985	14.819	1.990
Log Age	3.084	3.178	0.663	3.129	3.219	0.672	3.045	3.135	0.653
Log Turnover	15.505	15.502	2.007	15.671	15.723	1.976	15.438	15.271	1.856
Total Investment	0.090	0.039	0.140	0.081	0.038	0.129	0.097	0.041	0.148
Tangible Investment	0.071	0.024	0.126	0.060	0.021	0.114	0.080	0.026	0.136
Knowledge Investment	0.012	0.002	0.032	0.015	0.003	0.035	0.010	0.001	0.028
Organizational Investment	0.006	0.001	0.015	0.006	0.001	0.014	0.007	0.001	0.016
Observations		31,216			14,798			15,701	

Notes: Table 3.7 reports summary statistics for key variables for all firms, and for intangible and tangible firms separately. Intangible firms are defined as firms with an above-median intangible ratio, measured as intangible assets divided by total assets, within a given country-year. Tangible firms are defined as firms below the median.

Table 3.8 shows that the overall decline in investment following MaPP tightening masks substantial heterogeneity across firm types and investment categories. The aggregate contraction is driven predominantly by reductions in tangible investment among tangible firms, consistent with the view that macroprudential tightening operates chiefly through the bank credit channel and disproportionately affects collateral-backed, externally financed expenditures. Knowledge investment plays a smaller role in the aggregate, but the decline is concentrated among intangible firms, indicating that prudential tightening can also spill over into innovation-related spending even when such investment is typically financed with internal funds. By contrast, organizational investment remains stable in both groups, suggesting that firms view these expenditures as less adjustable in the short run—consistent with their gradual accumulation and deep embedding in operations.

Table 3.8: Effects of MaPP Shocks on Corporate Investment Components: Intangible vs. Tangible Firms

Panel A: Intangible Firms									
	Tangible	Land	Machine	Knowledge	R&D	IT	Organizational	Training	OC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$MaPP_{shock}$	-0.0091	-0.0021	-0.0070	-0.0044**	-0.0033**	-0.0011	-0.0009	0.0005	-0.0014
	(0.0086)	(0.0025)	(0.0080)	(0.0019)	(0.0016)	(0.0010)	(0.0018)	(0.0005)	(0.0018)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,798	14,798	14,798	14,798	14,798	14,798	14,798	14,798	14,798
Panel B: Tangible Firms									
	Tangible	Land	Machine	Knowledge	R&D	IT	Organizational	Training	OC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$MaPP_{shock}$	-0.0386**	-0.0169	-0.0217**	-0.0008	-0.0001	-0.0006	-0.0008	-0.0001	-0.0007
	(0.0147)	(0.0122)	(0.0095)	(0.0010)	(0.0008)	(0.0007)	(0.0007)	(0.0002)	(0.0006)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,701	15,701	15,701	15,701	15,701	15,701	15,701	15,701	15,701

Notes: Table 3.8 reports the estimated effects of MaPP shocks on disaggregated investment ratios. Panel A reports the results for intangible firms and Panel B for tangible firms. Intangible (tangible) firms are defined as firms with an intangible-capital share above (below) the annual median within each country. Each column reports the coefficient on $MaPP_{shock}$ from separate regressions where the dependent variable is the investment category divided by total assets. Tangible, knowledge, and organizational investment are aggregate measures constructed as the sums of their two subcomponents: respectively, (i) land and machinery, (ii) R&D and IT/software/data, and (iii) training and organizational capital, all scaled by total assets. All specifications include firm and macroeconomic controls, firm fixed effects, and sector-year fixed effects. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Taken together, these patterns suggest that MaPP tightening primarily restrains pledgeable, externally financed outlays at firms with more tangible asset bases, while inducing a mild retrenchment in innovation-related spending at intangible firms and leaving organizational budgets largely insulated.

3.5 The financing channel

Having documented a heterogeneous investment response—and the pivotal role of intangible capital in MaPP transmission—we next examine the financing channel through which MaPP shocks affect corporate investment, and how this channel differs by investment type and by firm tangibility.

Our framework follows the classic insight that, in frictionless markets, financing does not affect real decisions—since internal and external funds are perfect substitutes and capital structure is irrelevant (Modigliani and Miller 1958). With financial frictions, however, information asymmetries, issuance and transaction costs, illiquidity, agency problems, and distress costs drive a wedge between internal and external finance, creating an external finance premium (Bernanke and Gertler 1995). This wedge is especially salient when assets are hard to pledge, making access to debt more uncertain for intangible-intensive firms.

We examine two complementary mechanisms through which a MaPP-induced credit supply shock may transmit to investment. Using one of the unique aspects of the EIBIS data, i.e., direct information from loan application outcomes, we first test whether collateral-related frictions affect credit markets. In particular, a MaPP shock, by design, prompts banks to tighten lending standards. The literature on credit rationing suggests that this can occur on either the extensive margin (affecting a firm's access to credit) or the intensive margin (affecting the terms and quantity of credit conditional on access). Our first set of tests examines adjustments in these margins.

The second mechanism relates to internal capital reallocation. Tighter external finance elevates perceived future funding risk and triggers a precautionary savings motive (Almeida et al. 2004). To self-insure against this risk, firms may divert internal funds away from investment and towards building liquidity buffers. Crucially, the intensity of both

the external and internal financing frictions likely depends on a firm's asset structure. The low pledgeability of intangible assets suggests that intangible-intensive firms may be particularly exposed to these channels. The subsequent analysis therefore examines heterogeneous effects on firms' cash holdings.

3.5.1 Evidence from firm-level data

3.5.1.1 Credit rationing: extensive vs. intensive margins

To examine the financing channel of MaPP transmission, we analyze firms' loan-application outcomes from the borrower's perspective. Following standard approaches to isolate credit-supply effects (Popov 2016; Ferrando et al. 2017), we restrict the sample to firms with potential credit demand.[11] We then construct four binary outcomes that capture distinct forms of credit frictions: (i) *discouraged* (the firm did not apply because it expected to be rejected), (ii) *rejected* (the firm applied but was denied), (iii) *price-rationed* (the firm did not apply due to high expected borrowing costs), and (iv) *quantity-rationed* (the firm received less than requested). We estimate each outcome separately. These frictions differ systematically by firms' asset structure. Among intangible-intensive firms, rejection is the most prevalent outcome (9.18%), followed by quantity rationing (1.85%), discouragement (1.33%), and price rationing (0.61%). Among tangible-intensive firms, the corresponding rates are 7.73%, 2.04%, 0.71%, and 1.20%, respectively.

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11. We exclude observations in which firms report (i) no planned large investments (hence no need for external finance) or (ii) no application because internal funds, existing external finance, or committed credit lines were sufficient. The remaining firms either applied for external finance or did not apply due to supply-side concerns.

Table 3.9: Effects of MaPP Shocks on Firms' Access to Bank Finance

	Quantity-constrained	Price-constrained	Discouraged	Rejected
	(1)	(2)	(3)	(4)
Panel A: Intangible Firms				
$MaPP_{shock}$	0.0009	-0.0001	0.0015*	0.0107***
	(0.0015)	(0.0007)	(0.0009)	(0.0036)
Observations	8177	8177	8177	8177
Panel B: Tangible Firms				
$MaPP_{shock}$	0.0029**	0.0002	-0.0003	-0.0016
	(0.0013)	(0.0011)	(0.0011)	(0.0033)
Observations	8585	8585	8585	8585
Macro controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

Notes: Table 3.9 reports the effects of MaPP shocks on firms' access to bank finance. Panel A reports the results for intangible firms and Panel B for tangible firms. The dependent variables are binary indicators for a firm's credit application being quantity rationed, price rationed, discouraged, and rejected, each equal to one if the firm experienced the respective type of credit constraint and zero otherwise. All specifications include firm and macroeconomic controls, firm fixed effects, and sector-year fixed effects. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 3.9 reveals that MaPP tightening triggers two distinct forms of credit rationing, operating on different margins for intangible and tangible firms. For intangible firms (Panel A), a one standard deviation increase in MaPP tightening raises the probability of rejection by 1.07 percentage points. This represents a 12% increase relative to the sample average rejection rate of 9.18%, indicating an economically significant tightening of credit access for these firms. It also increases the probability of discouragement by 0.15 percentage points (11% relative to the sample mean). Lacking the physical collateral that banks demand, their applications are either denied at the first hurdle or are not even attempted due to the high perceived probability of failure.

In contrast, for tangible firms (Panel B), a one standard deviation increase in MaPP tightening increases the likelihood of quantity rationing by 0.29 percentage points (equivalent to 14% relative to the sample mean), while discouragement, rejection, and price rationing remain statistically unchanged. Compared with intangible-intensive firms, tangible-intensive firms appear less exposed to outright denial, consistent with stronger collateral positions. However, they are still affected by credit tightening: banks facing balance-sheet constraints respond by rationing the loan amounts they are willing to extend.

Taken together, these findings support the view that MaPP tightening causes extensive-margin rationing (outright denials and discouragement due to expected denial) for intangible firms, but intensive-margin rationing (reduced loan amounts) for tangible firms. This pattern is consistent with collateral-based lending: weaker pledgeability of intangible assets leads banks to screen out borrowers rather than adjust terms, whereas tangible collateral supports loan approval but at tighter quantities.

To probe the mechanism further, we next restrict attention to firms that obtained external finance and examine their ex-post assessments of the associated contract terms. This conditional analysis clarifies how MaPP tightening affects loan terms for borrowers that pass the initial screening stage. We use firms' reported satisfaction along four dimensions—(a) the amount obtained (loan size), (b) the cost of external finance, (c) the repayment horizon (maturity), and (d) collateral requirements—and construct an indicator equal to one if the firm reports being fairly dissatisfied or very dissatisfied on a given dimension.[12]

12. EIBIS question wording: "Thinking about all of the external finance you obtained for your investment activities, how satisfied or dissatisfied are you with it in terms of …?" Respondents are asked to provide a single response for each item: (A) the amount obtained, (B) the cost of the external finance obtained, (C) the length of time over which it has to be repaid, and (D) the collateral required. Response options are: (1) very satisfied, (2) fairly satisfied, (3) neither satisfied nor dissatisfied, (4) fairly dissatisfied, and (5) very dissatisfied. Our dissatisfaction indicator equals one for responses (4) and (5) (and zero otherwise).

Table 3.10: Effects of MaPP Shocks on Loan Contract Dissatisfaction

	Dependent variables: Dissatisfied with			
	Amount	Interest	Maturity	Collateral
	(1)	(2)	(3)	(4)
Panel A: Intangible Firms				
$MaPP_{shock}$	-0.0271	-0.0166	0.0135	0.0382***
	(0.0189)	(0.0170)	(0.0222)	(0.0144)
Observations	6897	6897	6897	6897
Panel B: Tangible Firms				
$MaPP_{shock}$	0.0153**	0.0086	0.0096	0.0075
	(0.0063)	(0.0120)	(0.0109)	(0.0092)
Observations	7290	7290	7290	7290
Macro controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

Notes: Table 3.10 reports the effects of MaPP shocks on firms' dissatisfaction with loan contract terms among firms that obtained a bank loan. Panel A reports the results for intangible firms and Panel B for tangible firms. The dissatisfaction indicators equal one if the firm was very or fairly dissatisfied with: (a) the amount offered, (b) the cost of finance, (c) loan maturity, or (d) collateral requirements. All specifications include firm and macroeconomic controls, firm fixed effects, and sector-year fixed effects. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The results in Table 3.10 align closely with the collateral-based mechanism described above. For intangible firms, tighter MaPP conditions increase dissatisfaction with collateral requirements (Panel A, Column 4), but not with size, cost, or maturity. This is consistent with weaker pledgeability: conditional on approval, banks extract more collateral rather than adjust other terms. By contrast, for tangible firms, MaPP tightening raises dissatisfaction with the loan amount received (Panel B, Column 1), while collateral, cost, and maturity are statistically unchanged—matching the quantity-rationing pattern we found in applications.

In summary, the application-stage evidence (more rejection and slight discouragement for intangibles; quantity rationing for tangibles) and the contract-term evidence (collateral pressure for intangibles; amount cuts for tangibles) present a coherent narrative: MaPP tightening shifts the adjustment margin according to pledgeability—screening for low-tangibility borrowers and quantity rationing for high-tangibility borrowers.

3.5.1.2 Balance sheet responses: cash holdings

We next examine how MaPP tightening reshapes firms' liquidity, focusing on cash holdings. As outcomes of interest, we use two standard measures—cash scaled by total assets and by net assets.

Table 3.11 shows a clear asymmetry by asset tangibility. For intangible firms, MaPP tightening increases cash holdings, consistent with a precautionary liquidity response. The mechanism dovetails with the evidence we showed earlier: tighter macroprudential conditions raise rejection and discouragement and, conditional on approval, intensify collateral requirements. Faced with greater screening and limited pledgeability, intangible firms hoard liquidity—building buffer stocks to insure against funding risk. This suggests that when credit access is cut off, firms do not simply reallocate funds to other investments; instead, they prioritize building liquidity buffers (a 'buffer-stock' precautionary motive). This pattern accords with the broader macro-finance view that limited pledgeability in intangible firms fosters corporate liquidity hoarding (Li 2025). By contrast, tangible firms do not exhibit systematic shifts in cash ratios. This muted liquidity response is coherent with a distinct transmission margin: their access to credit is preserved enough that they can meet investment needs through ongoing cash flow, as evidenced by unchanged cash holdings (i.e., they do not need to dip into cash reserves).

Table 3.11: Effects of MaPP Shocks on Firms' Cash Holdings

	Cash / Assets	Cash / Net Assets
	(1)	(2)
Panel A: Intangible Firms		
$MaPP_{shock}$	0.0322**	0.0368**
	(0.0153)	(0.0182)
Observations	14,798	14,798
Panel B: Tangible Firms		
$MaPP_{shock}$	0.0079	0.0085
	(0.0122)	(0.0138)
Observations	15,701	15,701
Macro controls	Yes	Yes
Firm controls	Yes	Yes
Sector-Year FE	Yes	Yes
Firm FE	Yes	Yes

Notes: Table 3.11 reports the effects of MaPP shocks on firms' cash holdings. Panel A reports the results for intangible firms and Panel B for tangible firms. Column (1) uses the cash-to-assets ratio, defined as cash and cash equivalents divided by total assets. Column (2) uses the cash-to-net-assets ratio, where net assets are defined as total assets minus cash and cash equivalents. All regressions include firm and macroeconomic controls, firm fixed effects, and sector-year fixed effects. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Taken together, MaPP tightening reconfigures liquidity positions according to pledgeability. Intangible firms respond on the liquidity margin—hoarding cash in the face of tighter screening and collateral demands—while tangible firms keep cash buffers steady.

3.5.2 Complementary evidence from bank-level data

In this section, we extend the analysis to the banking sector to shed light on the lender-side mechanisms underlying MaPP transmission. Leveraging the firm-level identification of each respondent's primary bank, we construct matched firm-bank relationships and examine whether bank financial characteristics mediate the impact of MaPP tightening on corporate investment. We first quantify the effect of MaPP shocks on banks' credit supply and balance-sheet indicators, including capitalization and profitability. We then investigate heterogeneity in firm-level investment responses as a function of the financial strength of the banks with which firms maintain credit relationships.

3.5.2.1 Bank-level responses to MaPP

Firms are asked to provide their main bank's name. In cases where respondents mention multiple banks, they are asked to designate only their main bank.[13] As a preliminary step, we investigate the effect of MaPP on the credit activities, financial health, and performance of the 513 distinct banks from the BankFocus database that maintain credit relationships with firms in our EIBIS sample.

In order to understand how banks respond to MaPP shocks by changing their total lending, we first estimate

$$Bank_{b,c,t} = \alpha_b + \lambda_t + \beta\, MaPP_{c,t-1} + \gamma' Z_{c,t-1} + \zeta' X_{b,c,t-1} + \varepsilon_{b,c,t} \tag{3.3}$$

where $Bank_{b,c,t}$ is the credit stock, financial health, and other financial characteristics of interest for the bank b in country c at time t, depending on the specification. We include bank fixed effects (α_b) to account for time-invariant bank characteristics operating in a specific country. We also include year fixed effects (λ_t). $MaPP_{c,t-1}$ is the variable of interest, indicating MaPP shocks at time $t-1$. $Z_{c,t-1}$ is the lagged terms of a set of macroeconomic control variables, and $X_{b,c,t-1}$ is the lagged terms of a set of bank covariates to control for observable bank-level heterogeneity.

A priori, macroprudential policies are expected to operate primarily through changes in banks' lending behavior. To examine this channel, we analyze whether MaPP shocks affect bank loan volumes, measured as the ratio of loans to total assets.

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13. To ensure the accuracy of the bank-firm relationship, the survey instructs staff not to prompt respondents with answers from previous waves. If a respondent mentions a different bank name, the response is verified for consistency.

Table 3.12: Effects of MaPP Shocks on Banks' Credit Activities and Financial Health

	Total Loan / Asset	Tier 1 Ratio	Return on Assets
	(1)	(2)	(3)
$MaPP_{shock}$	-0.1157*	0.0726**	0.0052
	(0.0678)	(0.0328)	(0.0090)
Macro controls	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Number of banks	513	513	513
Observations	3168	3168	3168

Notes: Table 3.12 reports the effects of MaPP shocks on banks' credit activities, financial health, and performance. Columns (1) to (3) report the effects on total loan volume scaled by total assets, the Tier 1 ratio, and return on assets, respectively. All regressions include macroeconomic and bank-level controls, as well as bank and year fixed effects. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 3.12 reports regression estimates. The column 1 result implies that MaPP shocks do reduce bank loan volumes, in line with aggregate-level evidence from prior studies. To assess the impact of MaPP on bank capitalization, we use the Tier 1 capital ratio, a standard proxy for a bank's net worth and financial strength widely employed in empirical research (Jiménez et al. 2012, 2014; Carlson et al. 2013; Popov 2016). The result in column 2 indicates that banks' Tier 1 capital ratios increase in response to MaPP tightening. The increase in capital ratios is consistent with macroprudential tools that raise effective capital buffers (or induce banks to manage risk-weighted assets downward). Taken together, these patterns are exactly the kind of risk-sensitive balance-sheet adjustment MaPP are designed to elicit: less credit volume and stronger capitalization. Column 3 shows no significant effect on bank performance, as measured by ROA. One interpretation is that lower volumes and higher buffers reduce profitability, while repricing, fee income, and improved asset quality offset these effects. Lower volumes and higher capital requirements weigh on profitability, but these effects may be balanced by re-pricing, fee income, lower credit losses, and shifts toward low-risk assets. In short, MaPP tightening improves resilience without an immediate, systematic hit to accounting returns. Taken together, these findings suggest that MaPP tightening curtails credit supply by reducing lending volumes while strengthening banks' capital positions.

The bank-level adjustment helps rationalize the asymmetric firm responses documented above. As banks tighten screening and bolster capital, low-pledgeability (intangible) borrowers are more likely to be screened out or to face stricter collateral requirements—outcomes reflected in those firms' higher cash buffers. For high-pledgeability (tangible) borrowers, credit access is preserved but loan amounts are cut. This aligns with banks' efforts to contain risk-weighted exposure while maintaining relationship lending, and it manifests as quantity rationing in loan approvals and a greater reliance on internal funds, without large changes in cash holdings.

Overall, Table 3.12 depicts a coherent bank-side transmission of MaPP: credit intensity falls, balance-sheet strength rises, portfolio risk eases, and profitability remains broadly stable. These adjustments closely align with firm-level patterns in access, terms, and balance-sheet choices, providing a unified financing-channel interpretation of the macroprudential transmission we document.

3.5.2.2 The role of banking relationships in MaPP transmission

After conducting bank-level analyses, we re-estimate our baseline regression, incorporating the effect of bank-firm relationships. In Table 3.13, we show results based on the following specification for the effect of MaPP on corporate investment:

$$Y_{f,s,b,c,t} = \alpha_{f,b} + \lambda_{s,t} + \beta\, MaPP_{c,t-1} + \gamma' Z_{c,t-1} + \zeta' X_{f,s,c,t-1} + \varepsilon_{f,s,b,c,t} \tag{3.4}$$

where $Y_{f,s,b,c,t}$ is the corporate investment as a ratio to its total assets for the firm f from sector s in country c borrowing from bank b at time t. We include firm-bank fixed effects (denoted by $\alpha_{f,b}$) to net out any match-specific, time-invariant factors (e.g., geographic proximity, legacy ties, client specialization), and sector-year fixed effects ($\lambda_{s,t}$).

Table 3.13: Effects of MaPP Shocks on Investment: Incorporating Banking Relationships

	Tangible Investment		Knowledge Investment		Organizational Investment	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Intangible Firms						
$MaPP_{shock}$	-0.0175	-0.0144	-0.0069*	-0.0125**	-0.0016	-0.0041
	(0.0201)	(0.0217)	(0.0040)	(0.0055)	(0.0032)	(0.0056)
Observations	5307	3158	5307	3158	5307	3158
Panel B: Tangible Firms						
$MaPP_{shock}$	-0.0712*	-0.1276**	0.0001	0.0004	0.0005	0.0002
	(0.0378)	(0.0547)	(0.0008)	(0.0012)	(0.0005)	(0.0008)
Observations	6439	4240	6439	4240	6439	4240
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Firm FE	No	Yes	No	Yes	No	Yes

Notes: Table 3.13 reports the effects of MaPP shocks on corporate investment for firms with banking relationships. Panel A reports the results for intangible firms and Panel B for tangible firms. The dependent variables are firms' tangible, knowledge, and organizational investment, each scaled by total assets. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 3.13 shows that the investment response to MaPP tightening remains significant even after controlling for bank-related factors. Replicating the baseline on firms that report a main bank, we find that tighter MaPP are associated with lower investment. Replacing firm fixed effects with firm-bank pair fixed effects delivers the same qualitative conclusion: within a given bank-firm match—holding constant geography, relationship history, and other match-specific traits—investment declines when MaPP tighten. The identifying variation is thus the country-time variation in MaPP and the ensuing within-bank adjustment in lending stance to the same client.

Together with our bank-level evidence—lower loan issuance alongside stronger capitalization and safer portfolios—these results point to banks' time-varying re-optimization as the proximate driver: MaPP tightening induces lenders to tighten screening and curb granted amounts; that shift passes through to incumbent borrowers as reduced investment, even absent any change in the relationship match.

The within-relationship nature of the effect also helps reconcile the heterogeneous firm responses documented earlier. For intangible firms, weaker pledgeability makes the within-bank tightening most visible on the extensive margins (more screening, tougher collateral), prompting precautionary liquidity accumulation. For tangible firms, access is largely preserved but amounts are cut, so the same within-bank tightening manifests as quantity rationing and substitution toward internal funds, with limited changes in cash. In short, Table 3.13 demonstrates that the MaPP-investment link is not a by-product of sorting across banks or matches; it is a supply-side contraction working through banks' own balance-sheet and risk-management responses, transmitted directly to the firms with whom they maintain relationships.

3.5.2.3 Role of bank-level heterogeneity in MaPP transmission

Having established that the MaPP-investment link operates within bank-firm relationships—that is, it is bank-driven rather than the result of firms sorting across lenders—we next ask which banks transmit MaPP tightening more strongly. This step moves from identifying the bank-lending channel to characterizing its heterogeneity across lenders' balance-sheet conditions and business models. Prior work shows that banks' responses to prudential regulation depend on their balance-sheet strength, with tighter policies inducing de-risking—tougher screening and stronger capitalization—especially at smaller or weakly capitalized institutions (Altunbas et al. 2018; Baskaya et al. 2024). Guided by this view, we examine whether the pass-through of MaPP shocks to firm investment varies with bank character-

istics (capitalization, asset quality, size, profitability), holding the bank-firm match fixed. We interact MaPP shocks with lagged bank traits and retain firm-bank and sector-year fixed effects, so identification comes from within-relationship changes in a given bank's stance across MaPP regimes.

We estimate:

$$\begin{aligned} Y_{f,s,b,c,t} = \alpha_{f,b} + \lambda_{s,t} + \beta_1 MaPP_{c,t-1} + \beta_2 MaPP_{c,t-1} \times Bank_{b,c,t-1} \\ + \gamma' Z_{c,t-1} + \zeta' X_{f,s,c,t-1} + \eta' C_{b,c,t-1} + \varepsilon_{f,s,b,c,t} \end{aligned} \tag{3.5}$$

where $Y_{f,s,b,c,t}$ is the corporate investment of firm f from sector s in country c at time t as a ratio to its total assets. We include firm-bank fixed effects ($\alpha_{f,b}$) and sector-year fixed effects ($\lambda_{s,t}$). $MaPP_{c,t-1}$ indicates MaPP shocks at time $t-1$. $Z_{c,t-1}$ is the lagged terms of a set of macroeconomic control variables, and $X_{f,s,c,t-1}$ is the lagged terms of a set of firm covariates to control for observable firm-level heterogeneity. $C_{b,c,t-1}$ is the lagged terms of a set of bank covariates.

Table 3.14 reports whether the MaPP-investment link varies with banks' lagged balance-sheet strength, holding the bank-firm match fixed. For intangible firms (Panel A), MaPP tightening is associated with a significant contraction in knowledge investment, consistent with our baseline results. This adverse effect is attenuated at better-capitalized, larger, and more profitable lenders. When pledgeability is low, well-capitalized banks can rely less on collateral demands and instead sustain more funding for intangible projects that would otherwise be vulnerable to MaPP-induced credit tightening. The interaction pattern is concentrated on knowledge investment (not on tangible or organizational spending), which fits the earlier evidence that for intangible firms, MaPP tightening bites the most on projects with low collateral value and longer payback horizons. In short, for intangible firms, bank capitalization is a buffer that tempers the MaPP pass-through.

Table 3.14: Effects of MaPP Shocks on Investment: Bank Heterogeneity

	Tangible Investment	Knowledge Investment	Organizational Investment
	(1)	(2)	(3)
Panel A: Intangible Firms			
$MaPP_{shock}$	-0.0171	-0.0163**	0.0013
	(0.0169)	(0.0072)	(0.0019)
$MaPP_{shock}\times$ Bank Size	0.0119*	0.0034*	-0.0020
	(0.0062)	(0.0019)	(0.0017)
$MaPP_{shock}\times$ Bank ROA	0.0419	0.0082*	0.0007
	(0.0278)	(0.0048)	(0.0020)
$MaPP_{shock}\times$ Tier 1 Ratio	-0.0043	0.0036**	0.0024
	(0.0069)	(0.0016)	(0.0021)
$MaPP_{shock}\times$ NPL Ratio	0.0005	-0.0016	-0.0009
	(0.0029)	(0.0011)	(0.0006)
Observations	2,556	2,556	2,556
Panel B: Tangible Firms			
$MaPP_{shock}$	-0.0892*	0.0006	0.0012
	(0.0496)	(0.0017)	(0.0009)
$MaPP_{shock}\times$ Bank Size	-0.0126	0.0008	0.0004
	(0.0151)	(0.0009)	(0.0005)
$MaPP_{shock}\times$ Bank ROA	0.0161	0.0011	0.0014
	(0.0280)	(0.0009)	(0.0012)
$MaPP_{shock}\times$ Tier 1 Ratio	0.0158*	-0.0002	-0.0006
	(0.0089)	(0.0005)	(0.0006)
$MaPP_{shock}\times$ NPL Ratio	-0.0129*	0.0005	-0.0005
	(0.0068)	(0.0005)	(0.0005)
Observations	3,422	3,422	3,422
Firm controls	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes
Bank-Firm FE	Yes	Yes	Yes
Sector-Year FE	Yes	Yes	Yes

Notes: Table 3.14 reports the effects of MaPP shocks on corporate investment conditional on bank-level financial characteristics. Panel A reports the results for intangible firms and Panel B for tangible firms. The dependent variables are firms' tangible, knowledge, and organizational investment, each scaled by total assets. All specifications include firm, bank, and macroeconomic controls, as well as bank-firm and sector-year fixed effects. Bootstrapped standard errors clustered by country are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

For tangible firms (Panel B), MaPP tightening reduces tangible investment. Here, heterogeneity runs squarely through bank capitalization and asset quality: higher Tier 1 ratios soften the investment decline, whereas weaker asset quality (higher NPLs) amplifies it. By contrast, bank size and profitability play a limited role. This is consistent with a quantity-rationing channel operating within relationships: when MaPP tightening raises the shadow cost of risk-weighted assets, banks with thicker capital cushions and cleaner portfolios can cut granted amounts less aggressively, while more constrained banks retrench more.

3.6 Conclusion

We show that MaPP tightening reduces corporate investment through a financing channel, with effects that depend on the pledgeability of firms' assets. At the aggregate level, MaPP tightening is associated with a clear overall contraction in investment. In terms of composition, however, the response is not uniform: tangible firms cut back on tangible capital, whereas intangible firms scale down knowledge investment. Thus, MaPP shocks compress both types of investment, but along different firm-asset margins.

The transmission operates through distinct rationing margins for different borrowers. Intangible firms face tighter screening—higher rejection and discouragement rates—consistent with limited collateral and low pledgeability. Tangible firms retain access to credit but are quantity-rationed. These application-stage patterns map into contract terms (greater collateral pressure for intangible firms, larger amount cuts for tangible-intensive firms) and then into balance sheets: intangible-intensive firms respond by hoarding liquidity, whereas tangible-intensive firms keep cash broadly unchanged. Taken together, these results are consistent with a financing channel in which MaPP shifts the adjustment margin according to asset pledgeability.

On the lender side, MaPP tightening reduces loan issuance while strengthening bank capitalization, with limited impact on profitability. This pattern is in line with the risk-sensitive rebalancing that MaPP are designed to induce, and it mirrors the borrower-side evidence of constrained external finance. Crucially, when we hold the bank–firm match fixed, investment still falls in response to MaPP tightening, indicating that the key driver is a within-bank, time-varying lending stance rather than sorting across lenders.

We also document bank-level heterogeneity in the transmission. Better-capitalized lenders cushion the decline in tangible investment among tangible firms and the decline in knowledge investment among intangible firms, while weaker asset quality amplifies the contraction in tangible investment. This pattern is consistent with a capital-constraint/de-risking mechanism: when the shadow cost of risk-weighted assets rises, banks with stronger buffers can preserve credit to incumbents, whereas more constrained balance sheets retrench more sharply.

These findings have implications beyond the financial system. First, macroprudential policies achieve their core resilience objective by strengthening bank balance sheets, but they also induce cuts in both tangible and knowledge investment. Because intangible firms are often key contributors to innovation and long-run productivity growth, the sensitivity of their knowledge investment to MaPP tightening could raise concerns about long-run costs for knowledge-based economies, an issue policymakers may need to monitor. Second, the strength of bank balance sheets shapes how much real activity is compressed for a given firm. Policy designs that recognize this heterogeneity—for example, by combining MaPP with instruments that specifically ease collateral frictions for innovation-related investment, or that foster deeper equity-like financing for intangible-intensive firms—can help attenuate unintended effects on knowledge formation.

Finally, our results suggest that structural changes in the nature of capital may alter the MaPP-investment nexus. As the share of intangible capital in overall investment continues to rise, a financial system that remains heavily reliant on collateralised bank lending may transmit MaPP to real activity in increasingly uneven ways: aggregate investment may become less sensitive to bank-based tools, even as knowledge investment remains exposed through financing frictions at intangible firms. Understanding how macroprudential frameworks and financial structures can evolve to support both financial stability and the accumulation of intangible capital is an important task for future research.

Chapter 4

Geopolitical Risk & Macroprudential Policies

Abstract

We estimate the impact of geopolitical risk on macroprudential policy actions across a panel of 42 countries. Rising geopolitical risk leads to a statistically significant deactivation of macroprudential tightening, resulting in a less restrictive overall policy stance. A one-standard-deviation increase in GPR is associated with a reduction in tightening actions of 0.067, equivalent to approximately a 12.4% decrease relative to its standard deviation. The deactivation of macroprudential tightening is even more pronounced when geopolitical stress is preceded by a more restrictive monetary policy stance: a 50-basis-point increase in the policy rate more than doubles the baseline effect. We attribute this finding to an intertemporal policy trade-off: policy authorities prioritize short-term economic stability over medium-term systemic risk containment in response to geopolitical shocks.

Key words: geopolitical risk, macroprudential policies, financial stability

4.1 Introduction

Rising geopolitical tensions are increasingly viewed as a threat to global macro-financial stability (IMF 2023; Bank for International Settlements 2024; European Central Bank 2024). Such tensions can act as a trigger to financial instability through various channels: cross-border capital retrenchment, increased uncertainty and risk aversion, trade and financial fragmentation and broader liquidity and solvency stress for firms, households and financial institutions (International Monetary Fund (2023)). Geopolitical tensions have surged sharply in recent years, exemplified by regional conflicts and threats of war in the Middle East, the ongoing Russian invasion of Ukraine, and threats of a global trade war among the world's major economic blocs (the U.S., China, and the EU). These developments motivate an important research question: do macroprudential authorities respond to geopolitical risk shocks, and if so, how? The goal of this paper is to empirically identify this link.

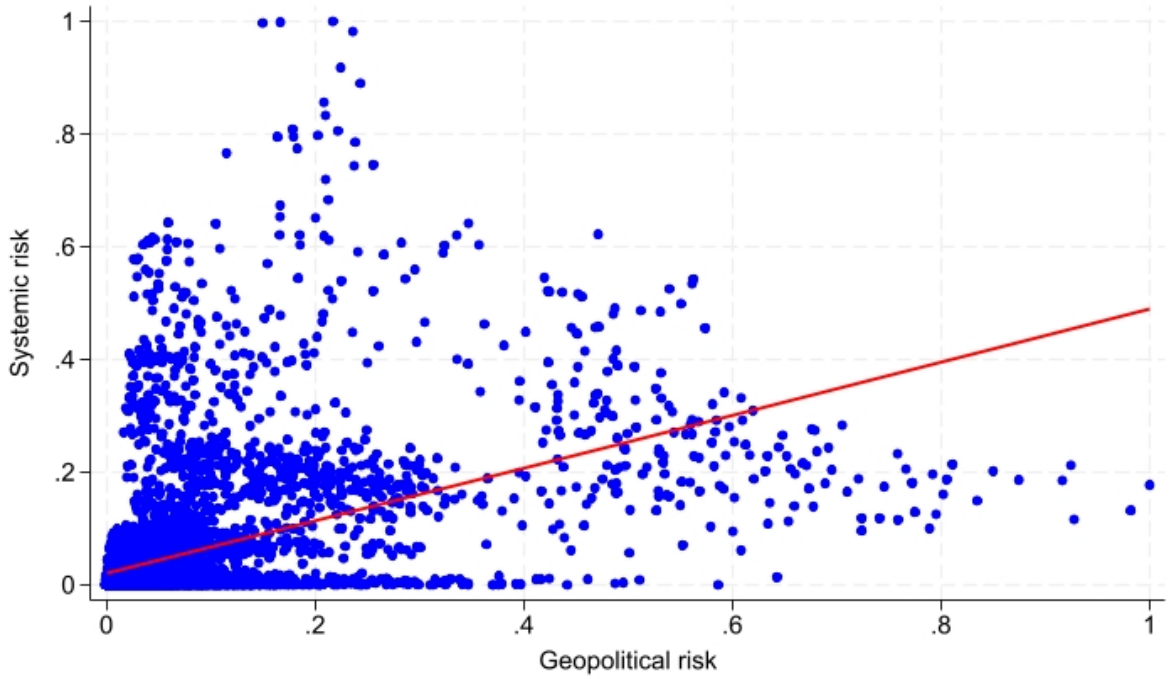

Figure 4.1: Geopolitical Risk vs. Systemic Risk. Figure 4.1 displays a scatter plot between geopolitical risk and the systemic risk index from 2008 to 2021 in 42 economies. The red line represents the best fit ($r = 0.4843$, $p = 0.0000$). Both indices are normalized to $[0, 1]$. Source: Caldara & Iacoviello (2022); NYU Stern (SRISK) Volatility Laboratory (V-Lab) (2025).

Before we dive deeper, we address a preliminary question: are geopolitical risk shocks associated with higher systemic risk in the financial system? To measure systemic risk, we employ the NYU Stern's SRISK indicator of systemic financial risk (Volatility Laboratory (V-Lab) 2025), available for a sample of 42 countries between 2008 and 2021.[1] Figure 4.1 shows a scatterplot of the monthly SRISK indicator against the widely cited monthly Caldara–Iacoviello geopolitical risk indicator (Caldara and Iacoviello 2022), demonstrating a significant positive correlation. Motivated by this *prima facie* evidence, Figure 4.2 displays the average cumulative dynamic response of the SRISK indicator to a one-standard-deviation increase in geopolitical risk estimated using a flexible local projection framework following Jordà (2005) and Jordà et al. (2013). The figure documents that an increase in geopolitical risk leads to a persistent and statistically significant build-up in systemic risk over a 30-month horizon.

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1. The SRISK indicator measures various risk dimensions for major global financial firms. It calculates the expected capital shortfall for each firm when the financial system as a whole is undercapitalised. The capital shortfall represents the contribution of each institution to systemic risk. The methodology behind the index has been developed by (Acharya et al. 2017).

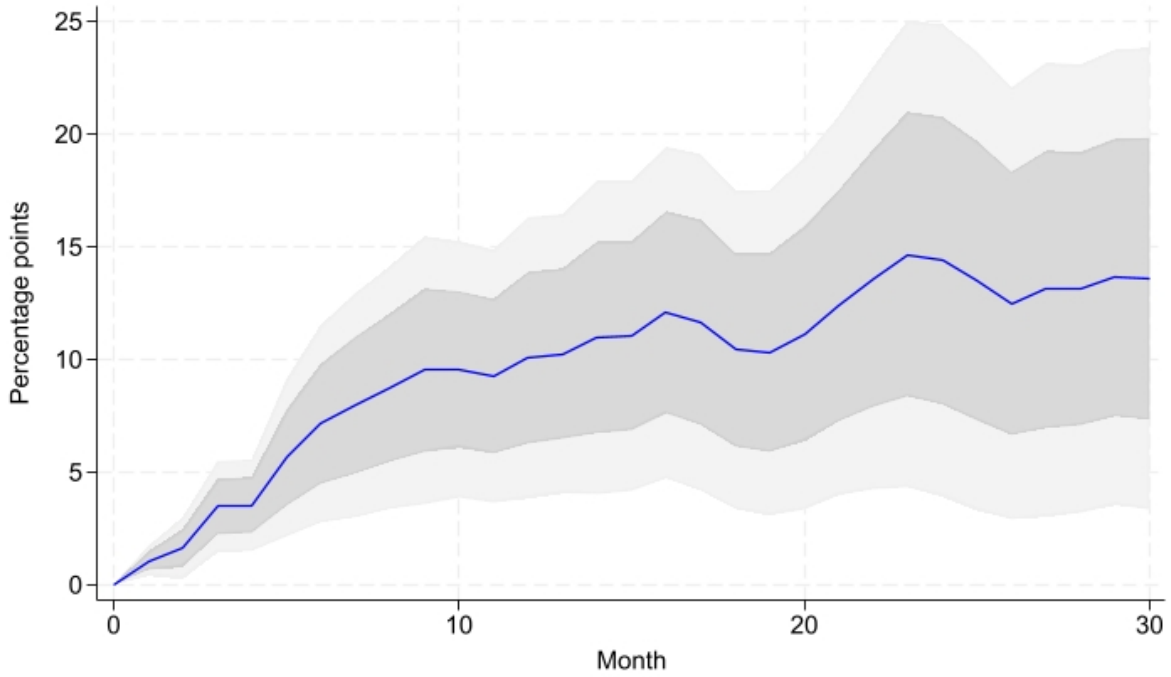

Figure 4.2: Local Projection: Responses of Systemic Risk to Geopolitical Risk. This figure plots the cumulative dynamic response of systemic risk over 30 months to a one-standard-deviation change in geopolitical risk from 2008 to the end of 2021 across 42 economies in our sample. Standard errors are clustered at the country level. The blue line shows the average response, while the dark and light gray shaded areas denote the 68% and 90% confidence bands, respectively. The regression is described in Appendix C and includes country and year-month fixed effects, four lags of systemic risk, and a set of country-level control variables. The GPR index is from Caldara & Iacoviello (2022), and the systemic risk index is from NYU Stern Volatility Laboratory (V-Lab) (2025).

Our core empirical analysis employs a sample from 2008 to 2021 of 42 advanced, emerging and developing countries for which we can collect monthly data on geopolitical risk and combine them with a rich description of macro-prudential policy measures from the database developed by Alam et al. (2024).[2] An important empirical issue that we need to address is the potential endogeneity between geopolitical risk and systemic financial risk.

2. The selection of 2008 as the start of the sample is guided by the systematic use of the macroprudential policy measures we examine; they have become part of the standard macro-financial policy toolkit around the globe in the aftermath of the Global Financial crisis (Nier et al. 2011; IMF-FSB-BIS 2016; BIS 2018; Lepers 2024).

Even if geopolitical risk is measured orthogonally to economic events, unobserved confounders may shift both geopolitical risk and systemic financial risk, and thus trigger a macroprudential policy reaction. Therefore, in order to estimate the causal impact of geopolitical risk on macroprudential policy measures, we carefully design an instrumental variable based on foreign, as opposed to domestic, geopolitical shocks that originate in the five countries that comprise the United Nations Security Council. Our instrument is based on the idea that geopolitical risk in a given country is partially shaped by international developments, specifically those that stem from geopolitically influential countries. We build upon the spillover structure proposed by Bonfiglioli et al. (2022) and construct our instrument using a shift-share style design, where lagged foreign geopolitical risk shocks ("shifts") are weighted by a time-invariant measure of bilateral geographic proximity ("shares") to capture exogenous spillovers into domestic geopolitical risk. Our baseline empirical specification employs this instrument to measure the exogenous variation of geopolitical risk in a two-stage least squares framework.

We report three main findings. First, an increase in geopolitical risk triggers a macroprudential policy tightening *de-activation* but does not trigger actions that imply macroprudential loosening. Quantitatively, a one standard deviation increase in GPR leads to a reduction of 12.4% in macroprudential tightening actions in the following month relative to its standard deviation.

Second, we assess whether the macroprudential policy response we identify exhibits threshold-dependent behaviour, rather than a constant linear response. We show that the de-activation of macroprudential tightening becomes significantly stronger in episodes of extreme geopolitical risk, defined when the risk indicator exceeds the 75th percentile of our sample historical distribution. The strongest tightening de-activation responses are estimated when the risk indicator surpasses the 90th percentile. Thus, periods of severe geopolitical uncertainty lead policymakers to pull back macroprudential tightening actions.

Third, we explore whether the prevailing stance of monetary policy shapes the macroprudential policy response during episodes of severe geopolitical risk. We show that a shift of monetary policy towards a more restrictive stance leads to a stronger de-activation of macroprudential tightening measures. Quantitatively, during sharp rises in geopolitical risk that fall in the 90th percentile of the sample distribution, a monetary tightening equivalent to 50 basis points causes a reduction in macroprudential tightening equivalent to 73% relative to its standard deviation.

This finding suggests a significant asymmetry and strategic interaction between monetary and macroprudential policies, highlighting a key policy trade-off: tightening both monetary and macroprudential policy in tandem during episodes of rising geopolitical stress may be viewed as overly restrictive, with the potential to amplify downside risks to economic growth and financial stability. It confirms a view from the IMF (2023): "Addressing financial stability risks while pursuing the price stability mandate could introduce a challenging trade-off for central banks. As central banks tighten monetary policy to tackle high inflation, strains in financial markets can pose a challenge for policymakers given the tension between price stability and financial stability objectives." Sharp increases in geopolitical risk raise uncertainty about the range of future macroeconomic outcomes. When monetary policy conditions are restrictive, and policy lags are long, a macroprudential tightening may precipitate an unnecessary reduction in credit provision and risk a deeper slowdown or recession at a time when financial institutions are already –due to uncertainty and risk aversion– becoming more prudent in their lending activities.

We further uncover meaningful heterogeneity in policy responses across different categories of macroprudential instruments. The decline in tightening actions is more pronounced in entity-based tools that directly affect the balance sheets of financial institutions. Furthermore, tools targeting capital adequacy and lending standards exhibit greater sensitivity to geopolitical risk than general-targeted measures, consistent with regulatory reluctance to constrain institutional balance sheets during episodes of external stress. We also examine the macroprudential response exploiting a specific numerical instrument available:

loan-to-value ratio limits applicable to household and corporate sector borrowing. The results show that geopolitical risk is associated with an increase in these limits, suggesting a relaxed implementation of borrower-based tools. Overall our findings suggest that geopolitical risk weakens both the activation and calibration of macroprudential instruments.

Our findings point to an emerging vulnerability in macroprudential policy frameworks: geopolitical shocks may increase systemic financial risk but can also reduce the likelihood of regulatory tightening. This underlines the strategic importance of developing macroprudential frameworks that remain operationally credible and responsive under conditions of rising geopolitical uncertainty, especially as geopolitical tensions continue to shape the modern economic landscape globally.

The remainder of the chapter is organised as follows. The next section reviews the related literature. We then describe the dataset and macroprudential classification schemes, outline the empirical specification and identification strategy, present the main results, report robustness checks, and conclude.

4.2 Literature Review

This chapter relates to several strands of the literature. First, we extend the growing body of research on the macro-financial consequences of geopolitical risk. Recent studies highlight that geopolitical risk is a key driver of various macroeconomic and financial outcomes, affecting growth, inflation, investment, bank profitability, cost of funding and capitalization and credit allocation (Wang et al. 2024; Caldara et al. 2022; Di Giovanni et al. 2024; Mohr and Trebesch 2024; International Monetary Fund 2023; European Central Bank 2024). From a financial stability perspective, recent work emphasises the import-

ance of incorporating geopolitical shocks into macroprudential surveillance frameworks, given their impact on bank lending and institutional solvency (**behn**; International Monetary Fund 2023; Niepmann and Shen 2024). Second, we contribute to the literature on macroprudential policy implementation. A long-standing concern is to what extent regulators are willing to tighten macroprudential policy or use their full set of macroprudential tools in a timely and countercyclical manner, under political pressure (Brunnermeier et al. 2009; Freixas et al. 2015; Sever and Yücel 2022; Muller 2023). Empirical studies show that macroprudential policy responses often weaken around election periods and that institutional independence plays a key role in policy activation (Lim et al. 2013; Lepers 2024). Our findings highlight a new dimension of macroprudential policy inaction by showing that geopolitical shocks—an external, often politically sensitive source of uncertainty—are associated with a reduction in macroprudential tightening.

4.3 Data

We compile a monthly dataset covering 42 countries from 2008 to 2021. The key variables are the geopolitical risk (GPR) index from Caldara and Iacoviello (2022), macroprudential policy actions (MaPs) from Alam et al. (2024), and a rich set of institutional, political, and macroeconomic controls. The final estimating sample contains 6,199 country-month observations.

We use various indicators to capture institutional characteristics including: Central Bank Independence (CBI) index from Romelli (2022), manually collected national election dates following Muller (2023), Governance indicators from the World Bank's Worldwide Governance Indicators (voice and accountability, rule of law, regulatory quality, and government effectiveness). Macroeconomic controls include the unemployment rate, population growth, GDP per capita and GDP growth, inflation, government consumption, trade openness, financial development index (IMF) and the Gini index (SWIID). We further

control for religious tension and bureaucracy quality from the International Country Risk Guide (ICRG), global connectedness (Altman and Bastian 2024), and United Nations Security Council (UNSC) membership (Dreher et al. 2009).[3] The full set of variables and data sources are described in Table C.1 in the Appendix.

4.3.1 Geopolitical risk

The GPR is a text-based indicator (see Appendix Figure C.2 for the world-level GPR across time) that measures the threat, realization, and escalation of adverse events associated with wars, terrorism, and tensions among states and political entities. It effectively captures major geopolitical shocks such as the 9/11 attacks (2001), the Iraq War (2003), the Russian annexation of Crimea (2014), the Paris Attacks (2015), and the Russo-Ukrainian War (2022), among others. It is constructed by counting the frequency of related terms in articles published in 10 major international newspapers. The index is normalised and available at a monthly frequency for 44 countries dating back to 1900.[4] The index is calculated as the share of articles that reference geopolitical risk events in any given month, including threats of conflict and political instability, over the total number of articles published in the same month.[5] Caldara and Iacoviello (2022) provide

3. The population growth is included as a driver of housing credit demand. Macroprudential authorities typically respond to housing cycles. Because geopolitical shocks often alter migration and demographic trends, failing to net out population growth risks conflating the credit-cycle channel with the direct effect of geopolitical risk (Lee and Jung 2023).

4. These are Argentina, Australia, Belgium, Brazil, Canada, Chile, China, Colombia, Denmark, Egypt, Finland, France, Germany, Hong Kong, Hungary, India, Indonesia, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, Norway, Peru, Philippines, Poland, Portugal, Russia, Saudi Arabia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, Tunisia, Turkey, Ukraine, United Kingdom, United States, Venezuela, and Vietnam. Among these 44 countries, Egypt and Venezuela have never implemented MaPs, yielding a final sample of 42 countries.

5. The data is gathered using a dictionary-based method via automated text searches across 10 major international news outlets: Chicago Tribune, the Daily Telegraph, Financial Times, The Globe and Mail, The Guardian, the Los Angeles Times, The New York Times, USA Today, The Wall Street Journal, and The Washington Post.

evidence to suggest that the GPR indicator contains information orthogonal to various widely used macro-uncertainty indicators. The events that move GPR appear unrelated to economic events while at the same time can lead to heightened financial volatility and policy uncertainty.

4.3.2 Macroprudential policies

We measure macroprudential policy actions using monthly data from the iMaPP database introduced in (Alam et al. 2024). The database includes comprehensive information on 17 macroprudential policy tools across 140 countries since 1990.[6] It integrates information from five major existing databases and information from the IMF's Annual Macroprudential Policy Survey. The database provides dummy-type policy action indicators: each policy action is recorded as 1 (*tightening*), 0 (*no change*), or -1 (*loosening*). The information therefore captures the direction of policy change but not the intensity of the change (i.e. large changes are treated equally as small changes). The tools include countercyclical capital buffers, capital conservation buffers, general capital requirements, leverage ratios, liquidity ratios, reserve requirements, taxes and levies, foreign exchange and currency exposure limits, and borrower-side tools such as loan-to-value ratio (LTV) and debt-service-to-income ratio (DSTI) caps. Table A.4 in the Appendix provides the descriptions for the 17 macroprudential policy tools.

The database provides country-month information for the number of MaP tightening actions, denoted MaP^T, and the number of loosening actions, denoted MaP^L. The number of tightening actions ranges from 0 to 7 with a mean of 0.17, while the number of loosening actions ranges from 0 to 3 with a mean of 0.04. In other words, macroprudential policy changes are observed at an irregular monthly frequency, but the empirical dependent

6. The iMaPP adopts the IMF definition of macroprudential policy: *the use of primarily prudential tools to limit systemic risk*.

variables are monthly counts that are equal to zero in months with no policy action and positive in months with one or more actions. Tightening actions are substantially more common than loosening actions, reflecting the growing prominence of financial-stability tightening in the post-GFC period.

To explore potential policy heterogeneity and allow for more granular analysis, we classify MaP instruments along two dimensions. First, we follow Alam et al. (2024) to distinguish macroprudential instruments based on their policy objective, which we term Objective-Based Categories. These include (a) *loan-targeted tools* such as loan loss provisioning that aim at influencing lending practices, (b) *capital-targeted tools* such as CCBs that aim at accumulating capital during credit booms, and (c) *general-targeted tools* such as liquidity requirements and reserve ratios broadly aiming at enhancing system-wide resilience. Second, we adopt the Activity- vs. Entity-Based regulatory framework. This includes (a) *activity-based (quantity-focused)* tools aimed at restricting financial behaviours such as lending volumes or leverage ratios and (b) *entity-based (price-focused)* tools aimed at altering operating conditions for institutions via capital and liquidity requirements.[7]

Such classifications are increasingly common and relevant in the literature. Cizel et al. (2019) show that quantity-focused tools often lead to regulatory arbitrage, as credit shifts to non-bank sectors. Baskaya et al. (2025) find that quantity-focused measures significantly reduce total credit in emerging markets, while Borio et al. (2022) offer criteria for distinguishing activity- and entity-based regulation and stress their relevance for regulating non-bank financial institutions. This classification allows us to assess whether geopolitical risk triggers differential macroprudential policy interventions across various policy tools.

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7. While the demand- vs. supply-based tools classification is also used in the macroprudential policy literature in different contexts, we abstract from this classification in our analysis. This is primarily due to the limited within-sample variation in demand-based instruments (only LTV and DSTI are included) across countries and time over the study period, which renders the classification empirically uninformative for our purposes.

4.4 Empirical strategy and identification

We begin by estimating a simple Ordinary Least Squares (OLS) specification:

$$MaP_{i,t} = \alpha_i + \lambda_t + \beta GPR_{i,t-1} + \gamma' Z_{i,t-1} + \varepsilon_{i,t} \tag{4.1}$$

where $MaP_{i,t}$ denotes the number of macroprudential policy actions (tightening or loosening) implemented by country i in month t. The terms α_i and λ_t represent country and time fixed effects respectively, capturing unobserved time-invariant heterogeneity and global or regional shocks affecting all countries. The key independent variable, $GPR_{i,t-1}$, is the lagged geopolitical risk index for country i. The vector $Z_{i,t-1}$ includes all macroeconomic and institutional control variables (lagged by one month) as described in Table A1. Using the lagged values for both GPR and the control variables ensures that regressors are predetermined relative to policy actions.

The OLS estimate of β captures the conditional correlation between geopolitical risk and macroprudential policy actions. However, several sources of endogeneity limit our ability to interpret this as a causal relationship. First, if macroprudential policy effectively mitigates financial risk (Akinci and Queralto 2022; Boissay et al. 2023; Fernandez-Gallardo 2023), it may reduce the impact of geopolitical shocks on the financial system. Second, geopolitical tensions may coincide with changes in macrofinancial conditions that can independently trigger macroprudential policies. Although including an extensive set of control variables and fixed effects is intended to tackle such concerns, the presence of unobserved confounders remains a potential threat to identification.

An additional identification concern arises from the interaction between macroprudential policy measures and the composition of banks' asset portfolios. Specifically, macroprudential tightening may incentivize banks to reallocate their balance sheets towards sovereign debt, especially in regulatory regimes where domestic government bonds are treated as risk-free assets for capital adequacy purposes. Empirical evidence suggests that banking regulation can lead to such risk-substitution behaviour, especially in systems where sovereign exposures are not subject to appropriate risk-weighting (Reis 2020; D'Erasmo et al. 2024). If geopolitical shocks coincide with increases in sovereign credit risk, such portfolio shifts can confound the true policy response to the geopolitical shock, as the observed response may reflect a reaction to shifts in the perceived state of sovereign asset holdings in the banking system. Such dynamics emphasize the importance of employing an identification strategy that isolates the exogenous variations in geopolitical risk in order to estimate the causal effect of GPR on macroprudential policies.

4.4.1 Instrumental variable (IV) strategy

To address potential endogeneity in the relationship between geopolitical risk and macroprudential policy actions, we implement an instrumental variable (IV) strategy that exploits the exogenous component of geopolitical risk arising from foreign geopolitical shocks. A valid instrument must satisfy two key conditions: (a) relevance, namely, it must be strongly correlated with domestic geopolitical risk; (b) exogeneity, namely, it must be orthogonal to unobserved country-specific factors that may simultaneously influence domestic macroprudential policy decisions; and (c) the exclusion restriction: the instrument must affect domestic macroprudential policy actions exclusively through its effect on domestic geopolitical risk.

Our instrument is based on the idea that geopolitical risk in a given country is, at least, partially shaped by foreign adverse events, specifically those originating in geopolitically influential states with close geographical proximity to the domestic economy. We build upon the spillover structure proposed by Bonfiglioli et al. (2022) and construct our instrument using a shift-share style design, where lagged foreign GPR shocks ("shifts") are weighted by a time-invariant measure of bilateral geographic proximity ("shares") to capture exogenous spillovers into domestic geopolitical risk.[8] The identifying assumption is that, conditional on controls, exposure to foreign geopolitical shocks—interacted with a predetermined and time-invariant connectivity measure—induces variation in domestic GPR that is exogenous to domestic macroeconomic, financial and policy dynamics. Formally we define our instrument as follows:

$$\text{GPR\_shock}_{i,t-1} = \sum_{j \in \Omega_{-i}} \left(\frac{GPR_{j,t-1}}{N_{-i}} \right) \cdot \ln \left(connect_{i,j} \right) \tag{4.2}$$

where $GPR_{j,t-1}$ is the lagged value of the geopolitical risk index for country $j \neq i$, and N_{-i} is the number of foreign countries included in the set of foreign countries Ω_{-i}. The term $connect_{i,j}$ represents the bilateral connectedness between country i and country j, proxied by the inverse of the (log-transformed) geographical distance between them. The log-inverse distance metric captures the intensity of potential geopolitical spillovers, under the assumption that countries closer to major geopolitical actors are more exposed to their external shocks. The use of the time-invariant geographic distance as a weighting scheme further strengthens the exogeneity of the instrument ensuring that the assigned (distance) weights are not influenced by contemporaneous political or economic developments. In our baseline specification, the set of foreign countries Ω_{-i} includes the five permanent members of the United Nations Security Council (UNSC).[9] It is plausible that these countries

8. Bilateral distances, defined as the number of kilometers between the capital cities of each country pair, are taken from CEPII's GeoDist database.

9. The permanent members of the UNSC are China, France, Russia, United Kingdom, and United States. For the five permanent members of the UN Security Council, we construct the instrumental variable using the same method, with the exception that each country is excluded from its own instrument construction.

wield disproportionate influence over the international security environment and can be the originators of geopolitical events with global ramifications. As a robustness check, we construct an alternative instrument using the G7 countries as the set of foreign countries Ω_{-i}.

Together, we estimate the causal impact of geopolitical risk on macroprudential policy actions using the following two-stage least squares (2SLS) specification:

$$MaP_{i,t} = \alpha_i + \lambda_t + \hat{\beta}\,\widehat{GPR}_{i,t-1} + \gamma' Z_{i,t-1} + \varepsilon_{i,t} \tag{4.3}$$

Equation (4.3) models the number of macroprudential policy actions ($MaP_{i,t}$) as a function of exogenous geopolitical risk ($\widehat{GPR}_{i,t-1}$), which is instrumented using foreign GPR shocks.

4.5 Empirical results

We first examine conditional correlations between GPR and the use of macroprudential tightening and loosening actions (MaPs). We then investigate the timing of macroprudential responses to GPR shocks, estimating a series of regressions with leads and lags of the GPR index as the main explanatory variable. Next, we report results from the instrumental variable estimation strategy, which tackles endogeneity concerns and allows us to provide a causal interpretation of the impact of GPR on MaPs. We then explore heterogeneity in the response across macroprudential tools classifications, distinguishing between entity-based and activity-based instruments, as well as capital-, loan-, and

general-targeted measures to capture variation across transmission channels and regulatory dimensions. Finally, we examine whether the stance of monetary policy moderates the effect of high geopolitical risk on macroprudential tightening, uncovering novel evidence on inter-policy interactions during periods of rising geopolitical stress.

Table 4.1: Conditional Correlation (OLS) Estimates

	MaP^T		MaP^L	
	(1)	(2)	(3)	(4)
GPR	-0.0632**	-0.0761***	-0.0019	-0.0006
	(0.0311)	(0.0273)	(0.0177)	(0.0172)
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Macro controls	No	Yes	No	Yes
Observations	7014	6199	7014	6199

Notes: Table 4.1 reports OLS estimates of the impact of geopolitical risk on tightening and loosening macroprudential policy actions. The dependent variables are tightening actions of macroprudential policy, denoted by MaP^T, and loosening actions of macroprudential policy, denoted by MaP^L. Columns (1) and (3) report specifications without macroeconomic controls, while columns (2) and (4) include them. The macroeconomic controls, not reported individually, include the unemployment rate, population growth, GDP per capita, GDP growth, inflation, government consumption, trade openness, the financial development index, the Gini index, voice and accountability, rule of law, regulatory quality, government effectiveness, regional tension, bureaucracy quality, global connectedness, UNSC membership, election, and central bank independence. Standard errors are clustered at the country level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Conditional correlation estimates. Table 4.1 reports OLS estimates from equation (4.1). Columns (1) and (2) report the conditional correlation estimates between GPR and macroprudential tightening (MaP^T), while columns (3) and (4) report the conditional correlation estimates between GPR and loosening actions (MaP^L). An increase in GPR is associated with a reduction in tightening actions (MaP^T). In the specification with macroeconomic controls (column 2), the coefficient estimate (-0.0761) represents a reduction in tightening actions equivalent to 14.1% relative to its sample standard deviation (0.54). A one standard deviation increase in GPR causes a reduction in tightening actions of 0.029, approximately a 5.37% decline relative to its standard deviation (0.54). This estimate is based on a GPR standard deviation of 0.38 (Table C.1) and a coefficient of -0.076 from column 2 of Table 4.1, yielding $0.38 \times 0.076 = 0.029$. The implied percentage change is

0.029 / 0.54 × 100 = 5.4%. By contrast, as reported in columns (3) and (4), a GPR innovation does not trigger a statistically significant change of loosening actions. This pattern is consistent with a "pause rather than reverse" interpretation: when geopolitical stress rises, authorities appear more likely to stop adding further tightening measures than to actively unwind the existing macroprudential stance.

Dynamic conditional correlations. To further examine the timing of the relationship between GPR and MaPs, Figure 4.3 plots point estimates and 90% confidence intervals for β, obtained by separately estimating Equation 4.1 using different lags and leads of GPR with tightening actions as the dependent variable. The results indicate that the reduction in tightening actions is negatively and significantly correlated with past GPR, particularly within a three-month window. The negative correlation is strongest for shorter lags, peaking at the first lag of GPR. Furthermore, the results show no significant correlation between tightening actions and future GPR, suggesting that current macroprudential policy actions do not influence geopolitical risk, which is consistent with the absence of reverse causality. Motivated by these findings, we use the first lag of GPR as the independent variable in our main specifications below. The one-month lag should be interpreted as an empirical timing convention for monthly panel estimation rather than as a claim that policymakers mechanically re-optimise the full macroprudential stance within a single month after every geopolitical shock.

Instrumental variable estimation. To address potential endogeneity, we employ the IV strategy described in Section 4.4.1, using weighted foreign GPR shocks as an instrument for domestic GPR. Table 4.2 reports the IV estimation, and for comparison, in column (1), the OLS coefficient estimate. Column (2) regresses the outcome variable on the proposed instrument.

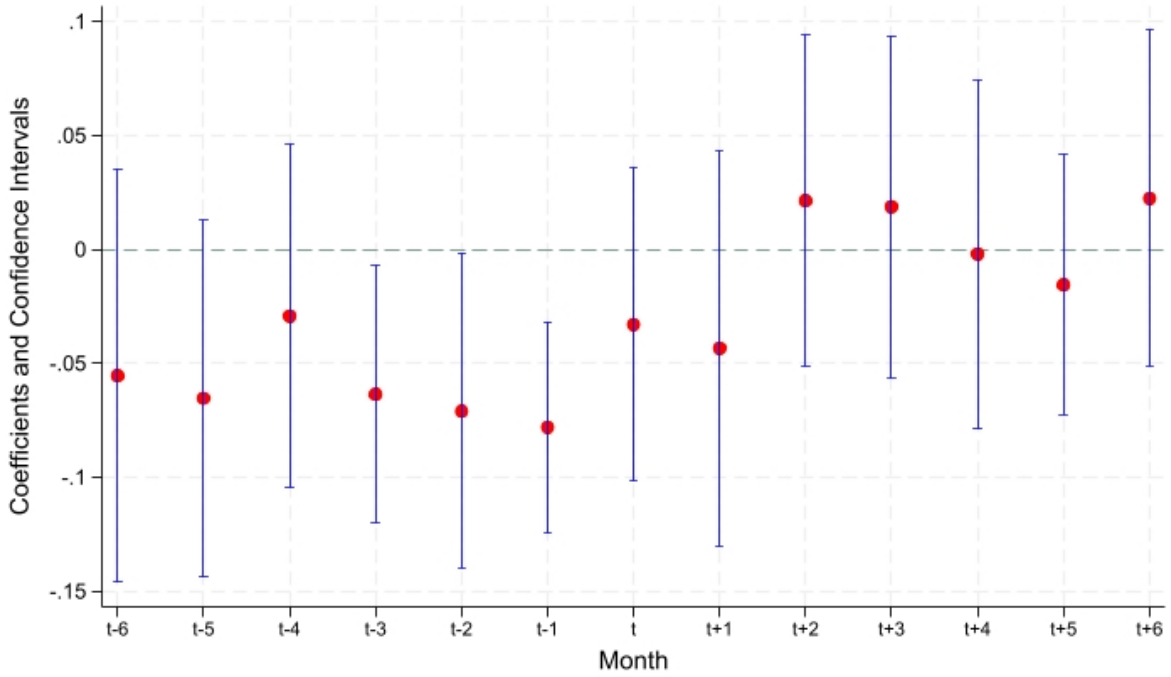

Figure 4.3: The Timing of the Impact of Geopolitical Risk on Tightening Actions of Macroprudential Policy. This figure presents the relationship between lags and leads of geopolitical risk and tightening macroprudential policy actions. Each coefficient is obtained by separately estimating the specification in column (2) of Table 4.1 using a different lag or lead of the geopolitical risk index, as indicated on the horizontal axis. All regressions are estimated using OLS. The confidence intervals are based on standard errors clustered at the country level and correspond to the 90% confidence level.

The estimated coefficient suggests that foreign geopolitical shocks exert a negative impact on the use of MaPs, which verifies that foreign GPR shocks can serve as a useful input in our instrumental framework. Columns (3) and (4) report the results of the two stages of least squares (2SLS). In the first stage (column 3), we confirm that the instrumental variable used to predict GPR is strongly correlated with the endogenous variable (i.e. domestic GPR), with a first-stage F-statistic of 16.17. This value is well above the conventional threshold of 10, indicating that weak identification is not an issue in our model and that the instrument is valid. The 2SLS coefficient estimate (column 4) suggests that GPR has a more pronounced effect on reducing MaPs tightening actions than estimated by OLS. Specifically, the IV estimated coefficient is approximately 2.3 times larger than the OLS estimated coefficient, indicating that the latter might be biased downwards due to unobserved factors that are correlated with both GPR and MaPs. Quantitatively, a one standard deviation increase in GPR causes a reduction in tightening actions of 0.067, approximately a 12.4% decline relative to its standard deviation (0.54). This estimate is based on a GPR standard deviation of 0.38 and a coefficient of -0.1755 from column 4 of Table 4.2, yielding $0.38 \times 0.1755 = 0.067$. The implied percentage change is 0.067 / 0.54 $\times$ 100 = 12.4%.

Table 4.2: OLS and IV Estimates: Effect of GPR on MaP Tightening

	OLS	Reduced Form	First Stage	2SLS
	(1)	(2)	(3)	(4)
GPR	-0.0761***			-0.1755**
	(0.0273)			(0.0896)
Foreign GPR shocks		-0.0160*	0.0914***	
		(0.0088)	(0.0227)	
F-statistic			16.17***	
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Observations	6199	6199	6199	6199

Notes: Table 4.2 reports OLS, reduced-form, first-stage, and two-stage least squares (2SLS) estimates of the effect of geopolitical risk on tightening macroprudential policy actions. The dependent variable is the use of tightening actions of macroprudential policy. The instrument is foreign geopolitical risk shocks. Standard errors are clustered at the country level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Threshold effects. Our baseline results show a systematic decline in macroprudential tightening in response to geopolitical risk shocks. Given the nature of geopolitical risk, rising sharply and unexpectedly though infrequently over time, we assess whether the effect of GPR on macroprudential policy actions exhibits threshold-dependent behaviour, rather than a constant linear response.

Formally, for each country i, we construct a series of binary indicators that capture episodes of extreme geopolitical risk. Specifically, we define:

$$\text{HighGPR}_{i,t} = \mathbf{1}\left(\text{GPR}_{i,t} > q_i^{(p)}\right) \tag{4.4}$$

where $q_i^{(p)}$ is the pth percentile of the within-sample GPR distribution for country i, with $p \in \{75, 80, 85, 90, 95\}$. Each indicator variable thus identifies whether a given country-month observation falls within a regime of high geopolitical risk, relative to that country's own historical experience.

We then estimate the following specification for each threshold level p:

$$\text{MaP}_{i,t} = \alpha_i + \lambda_t + \beta_p \,\text{HighGPR}_{i,t-1} + \gamma' Z_{i,t-1} + \varepsilon_{i,t} \tag{4.5}$$

where the high-GPR indicator is instrumented using lagged foreign GPR shocks, as in the baseline model. This approach allows us to isolate exogenous variation in high GPR regimes and test whether the impact on macroprudential policy is concentrated in the upper tail of the GPR distribution.

Table 4.3 presents the results. Across all thresholds, we find negative and statistically significant effects of high-GPR regimes on macroprudential tightening. The magnitude of the effect increases as the threshold rises, with the largest coefficients observed at the 90th and 95th percentile cutoffs. These findings suggest that the dampening effect of geopolitical risk on macroprudential policy tightening is primarily driven by extreme geopolitical events, rather than by moderate fluctuations in the level of geopolitical uncertainty.

This threshold behaviour is consistent with a state-contingent policy response. During episodes of severe geopolitical stress, policymakers may be particularly reluctant to activate regulatory tools that impose balance sheet constraints on financial institutions. The perceived risk of exacerbating macroeconomic volatility or undermining financial market confidence may outweigh the benefits of preemptive action. As a result, high-impact interventions—especially tightening measures—may be postponed or diluted.

Our findings suggest that external geopolitical shocks not only elevate systemic financial risk but also weaken the willingness or capacity of authorities to act pre-emptively through macroprudential channels. Recognising this asymmetric response is essential for strengthening the credibility and effectiveness of macroprudential frameworks in an increasingly uncertain geopolitical landscape.

Table 4.3: IV Estimates: Effect of High GPR Indicators on MaP Tightening

	75th Percentile		80th Percentile		85th Percentile		90th Percentile		95th Percentile	
	First Stage	2SLS	First Stage	2SLS	First Stage	2SLS	First Stage	2SLS	First Stage	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
75+(%) GPR		-0.2494**								
		(0.1238)								
80+(%) GPR				-0.2678**						
				(0.1288)						
85+(%) GPR						-0.2782**				
						(0.1366)				
90+(%) GPR								-0.3507**		
								(0.1687)		
95+(%) GPR										-0.6733**
										(0.3288)
Foreign GPR shocks	0.0643***		0.0599***		0.0576***		0.0457***		0.0238***	
	(0.0110)		(0.0107)		(0.0091)		(0.0092)		(0.0074)	
F-statistic	34.23***		30.36***		39.90***		24.69***		10.36***	
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6199	6199	6199	6199	6199	6199	6199	6199	6199	6199

Notes: Table 4.3 reports first-stage and two-stage least squares (2SLS) estimates of the effect of high geopolitical risk regimes on tightening macroprudential policy actions. The dependent variable is the number of macroprudential tightening actions in a given country-month. The key explanatory variables are binary indicators equal to one when the geopolitical risk index exceeds the 75th, 80th, 85th, 90th, or 95th percentile of the within-sample distribution for each country. For each threshold, the high-GPR indicator is instrumented using foreign geopolitical risk shocks constructed as in the baseline specification. Standard errors are clustered at the country level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Monetary policy as a moderator of macroprudential responses under high geopolitical risk. A growing body of research explores the interaction between monetary and macroprudential policies, particularly whether these tools operate as substitutes or complements in promoting financial stability (Borio and Shim 2007; Nier and Kang 2016; Kim and Mehrotra 2018; Martinez-Miera and Repullo 2019; Altavilla et al. 2020; Laeven et al. 2022). **bruno2017comparative** find that macroprudential policies are more effective when they complement monetary policy—particularly when they reinforce monetary tightening—than when they operate in opposing directions. Behn et al. (2025) examine how macroprudential policy tightening affects credit conditions during periods of monetary policy tightening. Their findings suggest that the interaction between the two policy domains can alter the overall impact on credit supply, highlighting the importance of accounting for policy coordination and potential spillovers in tightening cycles.

Building on this literature, we investigate whether the stance of monetary policy moderates the macroprudential response during episodes of high geopolitical risk. Specifically, we design a specification that introduces an interaction between a high-GPR indicator—defined as a binary variable equal to one when the GPR index exceeds the 90th percentile of its within-country distribution—and the quarterly change in the domestic policy rate.[10] This specification aims to capture whether macroprudential tightening varies systematically - i.e. is attenuated or amplified - with the prevailing monetary stance during periods of acute geopolitical stress.

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10. While the policy rate is a widely used indicator of monetary stance, it may not fully capture the stance of monetary policy—particularly in environments where unconventional tools play a significant role. As suggested by Cerutti et al. (2017), monetary stimulus in advanced economies has increasingly relied on non-standard measures, complicating cross-country comparisons of policy stance. Nevertheless, the policy rate remains the most consistently available and comparable proxy across our country sample and time period. We collect the monthly BIS central bank policy rates (Bank for International Settlements 2025) and supplement these with policy rate data reported directly by central banks via Bloomberg.

$$\begin{aligned}\mathrm{MaP}_{i,t} = \alpha_i + \lambda_t + \beta\,\mathrm{HighGPR}_{i,t-1} + \theta\,\Delta\mathrm{PolicyRate}_{i,t-1} \\ + \mu\,\mathrm{HighGPR}_{i,t-1} \times \Delta\mathrm{PolicyRate}_{i,t-1} + \gamma' Z_{i,t-1} + \varepsilon_{i,t}\end{aligned} \tag{4.6}$$

where $\mathbf{HighGPR}_{i,t-1}$ is a binary indicator equal to one if the geopolitical risk (GPR) index in country i at time $t-1$ exceeds the 90th percentile of its within-country distribution.[11] $\mathbf{\Delta PolicyRate}_{i,t-1}$ denotes the quarterly percentage change in the domestic policy rate indicating the change in the monetary policy stance.[12] The specification includes an interaction term between $\mathbf{HighGPR}_{i,t-1}$ and $\mathbf{\Delta PolicyRate}_{i,t-1}$. This interaction term captures how the macroprudential response conditional on high geopolitical stress varies with the change in the policy rate.

Consistent with our baseline IV strategy, we instrument $\mathbf{HighGPR}_{i,t-1}$ using lagged foreign GPR shocks. In the interaction specification, the term $\mathbf{HighGPR}_{i,t-1} \times \mathbf{\Delta PolicyRate}_{i,t-1}$ is also treated as endogenous, as it contains the endogenous variable $\mathbf{HighGPR}_{i,t-1}$. To satisfy the exclusion restriction and ensure identification, we follow standard IV practice (Wooldridge 2010; Sanderson and Windmeijer 2016)[13] and construct a second excluded instrument by interacting the baseline instrument – foreign GPR shocks – with the domestic policy rate change. This results in two excluded instruments—foreign GPR shocks and their interaction with the domestic policy rate change—for two endogenous regressors: $\mathbf{HighGPR}_{i,t-1}$ and $\mathbf{HighGPR}_{i,t-1} \times \mathbf{\Delta PolicyRate}_{i,t-1}$.

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11. Specifically, we define:

$$\mathrm{HighGPR}_{i,t} = \mathbf{1}\left(\mathrm{GPR}_{i,t} > q_i^{(90)}\right) \tag{4.7}$$

where $q_i^{(90)}$ is the 90th percentile of the within-sample GPR distribution for country i.

12. That is, for each month, we compute the percent change in the official policy rate relative to three months earlier. Given policy inertia and the fact that central banks do not follow a precise monthly policy cycle, the quarterly change better captures changes in the monetary policy stance.

13. When including an interaction of an endogenous regressor with an exogenous variable, the corresponding instrument must likewise interact the original instrument with this exogenous variable.

We assess the strength of the instrument set and report weak-instrument diagnostics for the first-stage regression. The Kleibergen-Paap rk Wald F-statistic for joint significance of instruments is 17.79 (Kleibergen and Paap 2006), exceeding the conventional Stock-Yogo threshold of 7.03 (Stock and Yogo 2005), indicating that, taken together, the instruments possess ample explanatory power. Conditional tests corroborate this conclusion: the Sanderson-Windmeijer conditional F-statistics are 36.06 for $\text{HighGPR}_{i,t-1}$ and 63.16 for the interaction term $\text{HighGPR}_{i,t-1} \times \Delta\text{PolicyRate}_{i,t-1}$ (Sanderson and Windmeijer 2016). Both exceed the 19.93 benchmark, ruling out concerns about weak instruments and validating the strength of our IV specification.

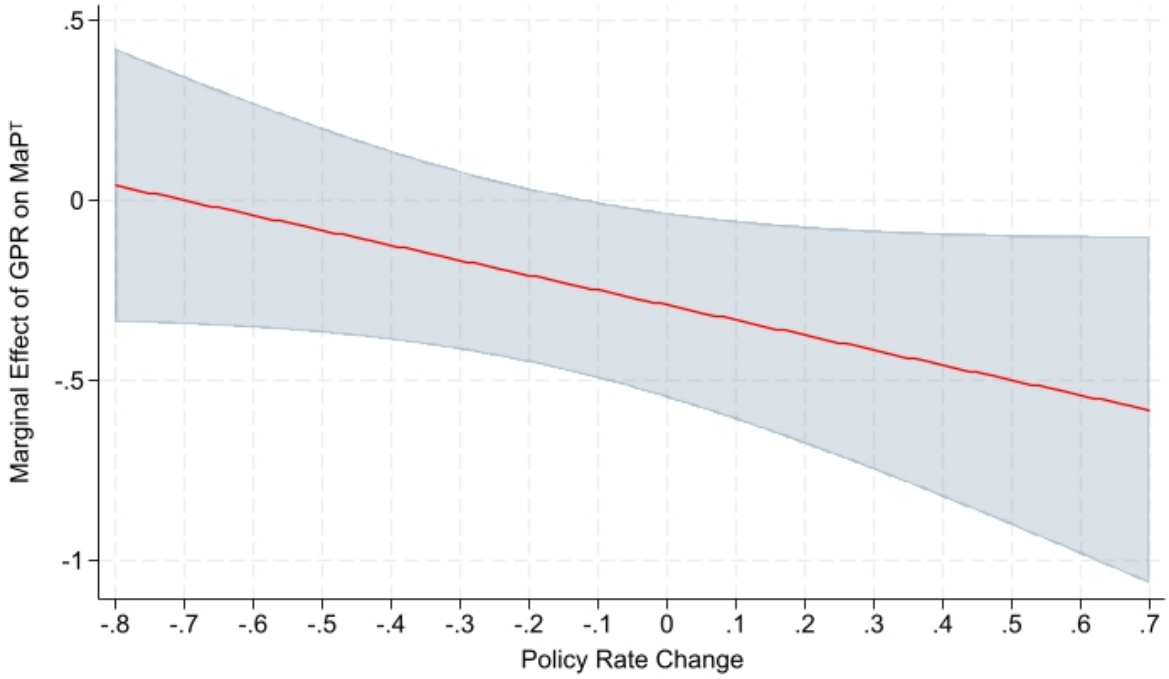


Figure 4.4: Macroprudential Tightening Responses During High Geopolitical Periods Conditional on the Quarterly Policy Rate Change. This figure displays the estimated marginal effect of high geopolitical risk (GPR) on macroprudential tightening actions, conditional on the quarterly percentage change in the domestic policy rate. The dependent variable is the monthly count of macroprudential tightening actions in country i. The key explanatory variable is a binary indicator equal to one when the GPR index exceeds the 90th percentile of its within-country distribution. This indicator is interacted with the quarterly percentage change in the policy rate, plotted along the horizontal axis over the 1st to 99th percentile of the sample distribution. The high-GPR indicator is instrumented using lagged foreign GPR shocks, as in the baseline IV specification. The shaded bands denote 90% confidence intervals based on standard errors clustered at the country level.

Figure 4.4 displays the marginal effect of GPR on macroprudential policy tightening actions for different values of monetary policy rate changes. Formally, the marginal effect is given by $\beta + \mu \times \Delta\text{PolicyRate}_{i,t-1}$. The marginal effect of high GPR on macroprudential tightening becomes statistically significant at the ten percent significance level for policy rate changes greater than -0.1. The marginal reduction in macroprudential tightening is successively stronger in absolute value as the monetary policy stance becomes more restrictive. To get a better sense of magnitudes of de-activation of macroprudential policy conditional on different levels of monetary tightening we evaluate the marginal estimated effect at the sample median of the policy rate equal to 2%. An increase in the policy rate of 25 basis points causes a macroprudential reduction of tightening measures equivalent to 64% relative to its standard deviation. A stronger monetary tightening by 50 basis points causes a macroprudential reduction of tightening measures equivalent to 73% relative to its standard deviation. High GPR events (in the 90th percentile of country distributions of GPR) in our sample include the Paris attack on 13 November 2015, which led to a sharp rise in GPR for France and spillovers to neighboring Germany, Netherlands and Belgium. The 2014 Crimean crisis and the ensuing conflict between Russia and Ukraine is recorded as a high GPR event during both March and April 2014. The NATO's military intervention in Libya, led to a sharp rise of GPR for the U.K., U.S.A, and Canada in March 2011.

We conclude that under monetary policy tightening, macroprudential authorities are more likely to refrain from additional tightening measures in response to large geopolitical risk shocks. An interpretation of this finding is that the perceived risk of compounding contractionary effects from tightening both monetary and macroprudential policy in tandem during episodes of rising geopolitical stress may be viewed as overly restrictive, with the potential to amplify downside risks to economic growth and financial stability. Our findings therefore support a view from the IMF regarding the interaction between monetary and macroprudential policy: 'Addressing financial stability risks while pursuing the price stability mandate could introduce a challenging trade-off for central banks. As central banks tighten monetary policy to tackle high inflation, strains in financial markets can

pose a challenge for policymakers given the tension between price stability and financial stability objectives." These results also align with Behn et al. (2025), who document that simultaneous monetary and macroprudential tightening—'double tightening"—magnifies economic downturns; therefore, policymakers must coordinate their actions carefully to avoid an excessively restrictive stance.

By contrast, the estimated marginal effects of GPR on macroprudential tightening are statistically insignificant for negative policy rate changes, i.e. when monetary policy is easing. This suggests that accommodative monetary conditions do not systematically shape the macroprudential policy response in the face of high GPR. Overall, our findings establish a significant asymmetry and strategic interaction between monetary and macroprudential policies, highlighting a key policy trade-off: in the face of rising geopolitical risk, policymakers prioritise short-term economic and political stability over medium-term systemic risk containment.

Analysis of entity-based and activity-based macroprudential tools. We classify the 17 MaP measures into two categories: entity-based and activity-based tools. According to Borio et al. (2022), entity-based MaPs – such as capital requirements, liquidity buffers, and leverage ratios – enhance the resilience of financial institutions and are therefore central to the regulatory framework. Table 4.4 reports the IV estimates across entity-based and activity-based tools. The results suggest that GPR shocks lead to a significant decline in the use of entity-based MaPs. By contrast, the impact of GPR shocks on activity-based MaP actions is not statistically significant. A possible interpretation is that the macroprudential authority might pull back tightening of entity-based MaPs in response to GPR shocks in an attempt to support the supply of credit due to political considerations. Empirically, political concerns have been shown to play an important

role in delayed macroprudential interventions in banks ((Imai 2009; Gropp et al. 2024). Martynova et al. (2022) develop a model of "capital forbearance", demonstrating why supervisors sometimes let under-capitalised banks operate ("forbear') after shocks: doing so buys time and reduces disorderly failure when resolution capacity is limited.

Table 4.4: Impact of GPR on MaPs: IV Estimation (Entity-Based vs. Activity-Based)

	Dependent variable: Different categories of MaPs			
	1st Stage	MaP^T	MaP^T_{entity}	$MaP^T_{activity}$
	(1)	(2)	(3)	(4)
GPR		-0.1755**	-0.1576***	-0.0179
		(0.0896)	(0.0537)	(0.0581)
Foreign GPR shocks	0.0914***			
	(0.0227)			
First-stage F-statistic	16.17***			
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Observations	6199	6199	6199	6199

Notes: Table 4.4 reports IV estimates of the effects of geopolitical risk on different categories of macroprudential policy tightening. Column (1) presents the first-stage regression. Columns (2) to (4) report the estimated effects of geopolitical risk on total macroprudential tightening (MaP^T), entity-based tightening (MaP^T_{entity}), and activity-based tightening ($MaP^T_{activity}$). The classification of macroprudential policy tools is reported in Table C.3. Standard errors are clustered at the country level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Analysis of objective-based categories: capital-targeted, loan-targeted and general-targeted macroprudential tools. To examine heterogeneity in macroprudential responses by policy objective, we disaggregate MaP instruments into three categories: capital-targeted, loan-targeted, and general-targeted tools, following the classification proposed in Alam et al. (2024). Table 4.5 reports the IV estimates for each category. The results show that geopolitical risk shocks are associated with a statistically significant decline in the use of both capital-targeted and loan-targeted MaPs. The effect on general-targeted tools is not statistically significant. Our findings suggest that policymakers exhibit greater reluctance to deploy instruments that impose direct constraints on either bank capital or credit supply in the face of elevated geopolitical risk. It is likely that, during periods of geopolitical uncertainty, macroprudential authorities prioritise preserving credit flows

and liquidity over preemptively tightening financial conditions. In particular, tightening capital requirements or curbing loan growth may be perceived as overly contractionary or even politically costly, even in a systemically risky environment. This documented pattern underscores a potential policy trade-off between maintaining short-term macro-financial stability and enforcing countercyclical prudential discipline, while also highlighting the asymmetry in regulatory responsiveness across different categories of macroprudential tools.

Table 4.5: Impact of GPR on MaPs: IV Estimation (Capital-Targeted, Loan-Targeted, and General-Targeted)

	Dependent variable: Different targeted MaPs			
	1st Stage	$\text{MaP}^{T}_{\text{capital}}$	$\text{MaP}^{T}_{\text{loan}}$	$\text{MaP}^{T}_{\text{general}}$
	(1)	(2)	(3)	(4)
GPR		-0.0770*	-0.1364*	0.0379
		(0.0450)	(0.0815)	(0.0792)
Foreign GPR shocks	0.0914***			
	(0.0227)			
First-stage F-statistic	16.17***			
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Observations	6199	6199	6199	6199

Notes: Table 4.5 reports IV estimates of the effects of geopolitical risk on different categories of macroprudential tightening. Column (1) presents the first-stage regression. Columns (2) to (4) report the estimated effects of geopolitical risk on capital-targeted macroprudential tools ($\text{MaP}^{T}_{\text{capital}}$), loan-targeted macroprudential tools ($\text{MaP}^{T}_{\text{loan}}$), and general-targeted macroprudential tools ($\text{MaP}^{T}_{\text{general}}$). The classification of macroprudential policy tools is reported in Table C.3. Standard errors are clustered at the country level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

4.6 Robustness checks

In this section, we assess the robustness of our findings along three key dimensions. First, we test the sensitivity of our results to an alternative instrumental variable constructed by using the G7 countries as the source of geopolitical risk. Given the significant global influence of G7 nations, this approach ensures that the instrument captures geopolitical shocks emanating from economically and politically dominant countries. Second, we estimate a dynamic fixed-effects model to account for potential persistence in the use of macroprudential policies. Finally, we exploit a quantitative measure of the regulatory limit on loan-to-value (LTV) ratios of real estate loans by banks and nonbank financial institutions available in the iMaPP dataset–one of the most common macroprudential instruments and estimate the impact of GPR shocks on LTV ratios.

Alternative instrument. To validate the robustness of our identification strategy, we re-estimate the IV specification shown in Equation (4.3) using an alternative instrument for domestic GPR based on spillovers from G7 countries, rather than the five permanent members of the United Nations Security Council[14]. The G7 nations exert substantial influence on global geopolitical dynamics and are therefore plausible sources of exogenous geopolitical shocks. Table 4.6 reports the IV estimates using this alternative instrument. The first-stage regression confirms the instrument's relevance, with a strong and statistically significant correlation between foreign and domestic GPR and an F-statistic (12.36) above the conventional threshold. The second-stage estimates remain negative and statistically significant, consistent with our baseline findings reported in Table 4.2. This suggests that our main results are insensitive to the specific composition of the countries used to instrument domestic GPR.

14. These are Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States.

Table 4.6: Results of an Alternative IV

	OLS	Reduced Form	First Stage	2SLS
	(1)	(2)	(3)	(4)
GPR	-0.0761***			-0.1680*
	(0.0273)			(0.0956)
Foreign GPR shocks		-0.0139*	0.0826***	
		(0.0082)	(0.0235)	
F-statistic			12.36***	
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Observations	6199	6199	6199	6199

Notes: Table 4.6 reports OLS, reduced-form, first-stage, and two-stage least squares (2SLS) estimates of the effect of geopolitical risk on tightening macroprudential policy actions. In this specification, the instrument is the weighted geopolitical spillover from G7 countries. Column (1) reports the baseline OLS estimate, column (2) the reduced-form regression, column (3) the first-stage regression, and column (4) the second-stage 2SLS estimate. Standard errors are clustered at the country level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Dynamic fixed effects model. Next, we estimate a dynamic fixed effects model to account for the potential persistence of macroprudential policy actions over time. The specification is as follows:

$$MaP^{T}_{i,t} = \alpha_i + \lambda_t + \phi MaP^{T}_{i,t-1} + \hat{\beta}\,\widehat{GPR}_{i,t-1} + \gamma' Z_{i,t-1} + \varepsilon_{ict} \tag{4.8}$$

where $MaP^{T}_{i,t}$ represents the total frequency of macroprudential policy tightening actions in country i during month t. The specification above (which is otherwise identical to Equation (4.3)) introduces $MaP^{T}_{i,t-1}$ to control for persistence in the use of MaPs, recognizing that past policy actions may influence current policy decisions while also capturing the autoregressive nature of macroprudential policy implementation.

Table 4.7 presents the estimation results for the dynamic fixed-effects model both from OLS and IV specifications. The coefficient estimates for ϕ, representing the lagged effect of macroprudential tightening actions ($MaP^{T}_{i,t-1}$) on current policy actions, are found to be statistically insignificant across all specifications. This suggests that past macroprudential policy actions do not significantly influence the current frequency of MaP implementation. Furthermore, the estimated effect of geopolitical risk (GPR) on MaPs remains consistent with our baseline results. The negative impact of GPR on the use of tightening macroprudential policies persists, indicating that an increase in geopolitical risk leads to a relaxation of MaPs, even when accounting for dynamics in policy behaviour. Overall, these findings reinforce the robustness of our baseline results and suggest that the effect of geopolitical risk on macroprudential policies is robust to including potential effects of past policy actions.

Table 4.7: Dynamic Fixed Effects Model: OLS and IV Estimates of the Effect of GPR on MaPs

	OLS	Reduced Form	First Stage	2SLS
	(1)	(2)	(3)	(4)
GPR	-0.0761***			-0.1757**
	(0.0273)			(0.0891)
$MaPs_{t-1}$	-0.0008	-0.0008	-0.0022	-0.0012
	(0.0179)	(0.0178)	(0.0039)	(0.0179)
Foreign GPR shocks		-0.0161*	0.0914***	
		(0.0088)	(0.0226)	
F-statistic			16.33***	
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
Observations	7014	6199	6199	6199

Notes: Table 4.7 reports OLS, reduced-form, first-stage, and two-stage least squares (2SLS) estimates of the effect of geopolitical risk on tightening macroprudential policy actions in a dynamic fixed effects specification. Lagged macroprudential policy actions, MaP_{t-1}, are included to capture persistence. The instrument is foreign geopolitical risk shocks. Standard errors are clustered at the country level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Evidence from a numerical measure: the LTV ratio. While our main analysis focuses on the direction of macroprudential policy actions, it is also important to assess whether geopolitical risk affects the intensity of macroprudential policy when instruments can be measured on a quantitative scale. To examine this, we shift attention on a particular instrument, namely, the LTV ratio, commonly applied to the household mortgage market.[15] The LTV ratio is measured as the maximum allowable ratio of a mortgage loan to the appraised value of the property at origination. In our sample, the LTV ratio varies from 0.44 to 1.10, with a mean of 0.89 and a standard deviation of 0.15. This range reflects significant cross-country and temporal variation in the stringency of credit standards applied to household borrowers.

Table 4.8: IV Estimates: Effect of GPR on the Loan-to-Value (LTV) Ratio

	First Stage	2SLS
	(1)	(2)
GPR		0.0200*
		(0.0110)
Foreign GPR shocks	0.0915***	
	(0.0228)	
F-statistic	16.08***	
Country FE	Yes	Yes
Time FE	Yes	Yes
Macro controls	Yes	Yes
Observations	6080	6080

Notes: Table 4.8 reports first-stage and two-stage least squares (2SLS) estimates of the effect of geopolitical risk on a representative numerical macroprudential policy instrument, the loan-to-value (LTV) ratio. The dependent variable is the LTV ratio, where higher values indicate a more lenient application of borrower-based credit constraints. Domestic geopolitical risk is instrumented using foreign geopolitical risk shocks. Standard errors are clustered at the country level and reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

15. In the literature, the LTV ratio is also commonly used as a proxy of macroprudential stance, see Richter et al. (2019), Acharya et al. (2022a), Teixeira and Venter (2023), Biljanovska and Chen (2025) and Lee and Jung (2023).

Table 4.8 reports IV estimates using foreign GPR shocks as an instrument for domestic GPR. The dependent variable is the LTV ratio, where higher values indicate less stringent credit conditions, namely a relaxation of borrower-based constraints. The estimated coefficient is positive and statistically significant, suggesting that higher levels of geopolitical risk are associated with increases in the LTV ratio. This implies that, in the face of elevated geopolitical stress, macroprudential authorities may opt to ease existing borrower-based constraints. The findings complement our baseline results, demonstrating that geopolitical shocks not only lead to deactivation of tightening actions but also weaken the intensity of regulatory enforcement when specific instruments are being used.

4.7 Conclusion

This paper examines empirically how geopolitical risk impacts macroprudential policy in a sample of 42 countries from 2008 to 2021. Increases in geopolitical risk are systematically associated with a significant de-activation of macroprudential tightening, but do not cause macroprudential loosening, leading to an overall less restrictive policy stance. Quantitatively our estimates suggest a 12.4% reduction in tightening actions in the month immediately after a one-standard-deviation increase in geopolitical risk. The deactivation of tightening during periods of extreme geopolitical stress is stronger when preceded by a more restrictive monetary policy stance. A fifty basis point monetary tightening more than doubles the deactivation of macroprudential tightening relative to the baseline effect.

The observed decline in macroprudential policy tightening during periods of rising geopolitical stress raises significant macro-financial implications. First, it suggests that global geopolitical uncertainty may weaken the (countercyclical) deployment of macroprudential tools when financial stability may be threatened. Our analysis shows that the decline in macroprudential tightening is particularly pronounced during episodes of extreme geopolitical stress, when geopolitical risk exceeds the upper tail of its historical distribution. This

suggests that regulatory inaction is not only systematic but also intensifies as geopolitical uncertainty escalates, highlighting a nonlinear response of policy implementation during high-risk periods. One possible explanation supported by our results is that policy authorities - macroprudential and monetary policy - face short-term trade-offs: implementing tighter financial measures coupled with a more restrictive monetary policy stance during periods of high geopolitical stress may be seen as overly contractionary, potentially amplifying financial fragility or economic slowdowns. In such cases, authorities may defer action, prioritising immediate economic or political stability over medium-term risk containment.

These findings point to a structural vulnerability in macroprudential policy frameworks: geopolitical shocks may increase systemic financial risk but can also reduce the likelihood of regulatory tightening. This finding further highlights the importance of developing macroprudential frameworks that remain operationally credible and responsive under conditions of rising geopolitical uncertainty. As geopolitical tensions continue to shape the global macro-financial landscape, policymakers must ensure that the institutional design and operational scope of macroprudential policy allow for timely and effective intervention.

Chapter 5

Conclusion

This thesis studies how macroprudential policy affects firm financing, corporate investment, and the policy response to external uncertainty. Across three empirical chapters, it shows that macroprudential policy has economically meaningful real effects at the firm level and that those effects are shaped by heterogeneity in financing instruments, asset structure, bank balance sheets, and the broader geopolitical environment. The overarching message is that macroprudential policy is a powerful but imperfect tool: it can strengthen financial resilience, but it can also tighten financing conditions for firms and is itself vulnerable to inaction when external risks intensify.

The first chapter examines how macroprudential policy affects SME financing conditions. Using SAFE survey data for 11 European countries, it shows that tighter macroprudential policy increases the probability that SMEs become credit constrained. The effect is concentrated in bank credit lines rather than term loans, is stronger for micro and small firms, and is transmitted through higher borrowing costs, smaller available amounts, and shorter maturities. The chapter also shows that tighter domestic macroprudential policy worsens trade-credit constraints, suggesting that financing frictions propagate along supply chains rather than being broadly offset by non-bank substitution. At the same time, tighter foreign macroprudential policy can ease domestic SME credit conditions through inward spillovers, especially via interest rates and credit-line availability.

The second chapter turns to real investment and studies how macroprudential tightening affects the composition of corporate capital formation. Using firm-level data from the European Investment Bank Investment Survey, together with bank-level information from BankFocus and policy data from the IMF's iMaPP database, it shows that macroprudential tightening reduces investment through the bank credit channel. The effects differ systematically by asset structure. Tangible firms primarily reduce physical investment and experience quantity rationing, whereas intangible firms face stronger rejection and discouragement effects, cut knowledge investment, and respond by building precautionary cash buffers. The chapter further shows that better-capitalized banks mitigate the pass-through of macroprudential tightening to borrowers, highlighting the role of bank balance-sheet strength in shaping the real effects of prudential regulation.

The third chapter examines the determinants of macroprudential policy itself. Using monthly data for 42 countries, it shows that rising geopolitical risk reduces macroprudential tightening rather than triggering loosening. This deactivation effect is stronger during episodes of extreme geopolitical stress and when monetary policy is already restrictive. The chapter therefore identifies a policy trade-off: when geopolitical tensions rise and short-run macroeconomic risks intensify, policymakers appear less willing to tighten prudential regulation even though systemic financial risk may be building. The evidence also shows that the pullback is concentrated in specific categories of macroprudential instruments, especially those that directly constrain financial institutions' balance sheets or credit provision.

Taken together, the three chapters make four broader contributions. First, they provide micro-founded evidence on the real effects of macroprudential policy, showing that prudential tools affect not only aggregate credit conditions but also firm-level financing gaps, credit-market experiences, and investment decisions. Second, they show that heterogeneity matters. SMEs, tangible firms, intangible firms, and borrowers linked to stronger or weaker banks do not respond in the same way to regulatory tightening. Third, they highlight the importance of international transmission. Domestic outcomes are influenced not

only by home-country regulation but also by foreign macroprudential actions and geopolitical shocks originating abroad. Fourth, they show that policy trade-offs are central to the operation of macroprudential frameworks: the same tools that enhance resilience can tighten financing conditions, and the same external risks that raise systemic vulnerability can reduce policymakers' willingness to tighten.

These results have several policy implications. A first implication is that the effectiveness of macroprudential policy should not be evaluated solely using aggregate credit growth or banking-sector indicators. Policymakers should also consider how tightening affects the distribution of credit across firms, financing instruments, and investment categories. A second implication is that complementary policies may be needed when prudential tightening is desirable from a stability perspective but costly for firms. Examples include targeted public guarantees, SME liquidity facilities, or institutional arrangements that support lending to firms with weak collateral but strong long-term growth potential. A third implication is that international coordination matters. In financially integrated systems, macroprudential actions in one jurisdiction can spill over into another, while geopolitical shocks may alter the timing and intensity of policy responses.

The thesis also has limitations. The first and second chapters rely heavily on survey data, which provide information on perceived financing conditions and investment behavior but do not observe every contractual margin or all realized credit quantities. The measurement of macroprudential policy inevitably abstracts from differences in instrument intensity, because available international databases record the direction of policy changes more cleanly than their calibration. In addition, while the identification strategies are designed to strengthen causal interpretation, no empirical approach can eliminate all concerns about omitted macro-financial or institutional factors. These limitations should be borne in mind when interpreting magnitudes and when generalizing the results beyond the countries and periods studied here.

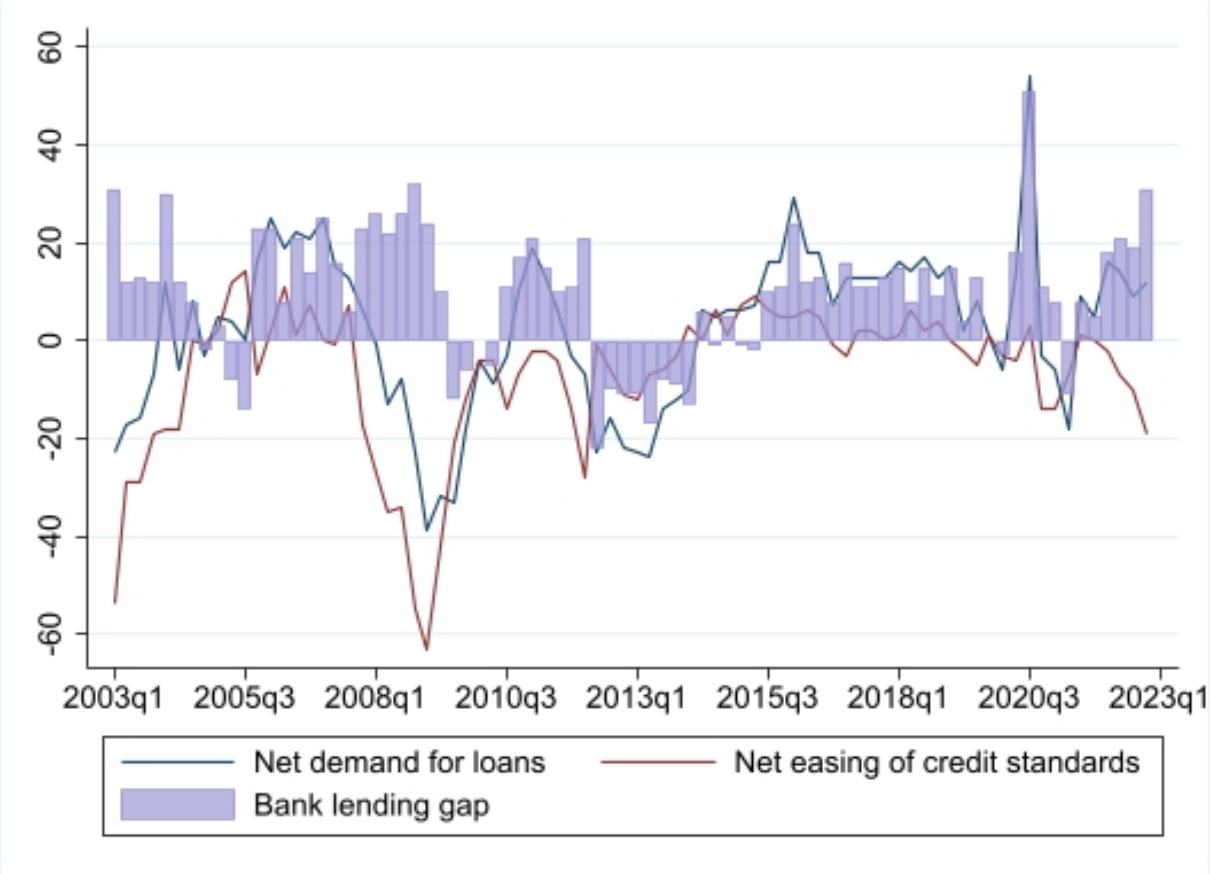
Several avenues for future research follow naturally from this work. One is to study whether the firm-level financing and investment effects documented here persist in the longer run and influence innovation, productivity, firm survival, or market structure. A second is to examine more explicitly how macroprudential tightening interacts with industrial composition and the rising importance of intangible capital in modern economies. A third is to investigate whether different institutional designs for macroprudential governance make policy frameworks more resilient to geopolitical stress and other sources of external uncertainty. Finally, richer administrative credit data linked to survey measures could help distinguish more sharply between formal rejection, discouraged borrowing, and non-price rationing across different lending environments.

In sum, the thesis argues that macroprudential policy shapes the real economy in both direct and indirect ways. It affects SMEs' access to finance, firms' investment choices, and the policy reaction itself under external stress. Understanding these channels is essential if macroprudential frameworks are to achieve their financial-stability goals without imposing unnecessarily large costs on credit allocation, productive investment, and long-run growth.

Appendices

A Chapter 1 Supporting Materials

Figure A.1: Bank Lending Gap for European SMEs



Notes: This figure plots the weighted net percentage of banks reporting an increase in loan demand, the percentage of banks reporting an easing in credit standards, and the difference between the two. The data are from the ECB Bank Lending Survey. Here, q denotes quarters.

Table A.1: Variables Definition

Variable	Definition	Sources
Constraint_{Bank}	Dummy variable equal to 1 if the firm reported an increase in demand and a decrease in availability for bank loans or credit lines during the past 6 months.	ECB/EC SAFE
Constraint_{Loan}	Dummy variable equal to 1 if the firm reported an increase in demand and a decrease in availability for bank loans during the past 6 months.	ECB/EC SAFE
Constraint_{Line}	Dummy variable equal to 1 if the firm reported an increase in demand and a decrease in availability for bank credit lines during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Bank\text{-}Q7A\text{-}Q7B}$	Dummy variable equal to 1 if the firm reported a failure in applications for bank loans during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Interest}$	Dummy variable equal to 1 if the firm reported that the interest rate was increased by the bank during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Amount}$	Dummy variable equal to 1 if the firm reported that the available loan size was reduced by the bank during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Maturity}$	Dummy variable equal to 1 if the firm reported that loan maturity was reduced by the bank during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Collateral}$	Dummy variable equal to 1 if the firm reported that collateral requirements were increased by the bank during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Non-bank}$	Dummy variable equal to 1 if the firm reported an increase in demand and a decrease in availability for non-bank credit during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Tradecredit}$	Dummy variable equal to 1 if the firm reported an increase in demand and a decrease in availability for trade credit during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Equity}$	Dummy variable equal to 1 if the firm reported an increase in demand and a decrease in availability for equity finance during the past 6 months.	ECB/EC SAFE
Constraint_{Debt}	Dummy variable equal to 1 if the firm reported an increase in demand and a decrease in availability for corporate debt during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Leasing}$	Dummy variable equal to 1 if the firm reported an increase in demand and a decrease in availability for leasing during the past 6 months.	ECB/EC SAFE
$\text{Constraint}_{Other}$	Dummy variable equal to 1 if the firm reported an increase in demand and a decrease in availability for other non-bank credit during the past 6 months.	ECB/EC SAFE
Age_1	Dummy variable equal to 1 if the firm is less than 2 years old.	ECB/EC SAFE
Age_2	Dummy variable equal to 1 if the firm is between 2 and 5 years old.	ECB/EC SAFE
Age_3	Dummy variable equal to 1 if the firm is between 5 and 10 years old.	ECB/EC SAFE
Age_4	Dummy variable equal to 1 if the firm is more than 10 years old.	ECB/EC SAFE
Size_1	Dummy variable equal to 1 if the firm has 1 to 9 employees.	ECB/EC SAFE
Size_2	Dummy variable equal to 1 if the firm has 10 to 49 employees.	ECB/EC SAFE
Size_3	Dummy variable equal to 1 if the firm has 50 to 249 employees.	ECB/EC SAFE
Sector_1	Dummy variable equal to 1 if the firm operates in industry.	ECB/EC SAFE
Sector_2	Dummy variable equal to 1 if the firm operates in construction.	ECB/EC SAFE
Sector_3	Dummy variable equal to 1 if the firm operates in wholesale or retail trade.	ECB/EC SAFE
Sector_4	Dummy variable equal to 1 if the firm operates in other services.	ECB/EC SAFE
Turnover_1	Dummy variable equal to 1 if annual turnover is below €2 million.	ECB/EC SAFE
Turnover_2	Dummy variable equal to 1 if annual turnover is between €2 million and €10 million.	ECB/EC SAFE
Turnover_3	Dummy variable equal to 1 if annual turnover is between €10 million and €50 million.	ECB/EC SAFE
Turnover_4	Dummy variable equal to 1 if annual turnover exceeds €50 million.	ECB/EC SAFE
MaPs	Index of net macroprudential actions	IMF iMaPP
MaPs_{supply}	Index of net supply-based MaPs	IMF iMaPP
$\text{MaPs}_{foreign}$	Foreign macroprudential index	IMF iMaPP and authors' calculations
GDP	Real GDP growth	ECB
CPI	Consumer price index	ECB
Interest rate	Total cost of borrowing to non-financial corporations	ECB
CISS	Composite Indicator of Systemic Stress	ECB
Rule of law	Index of agents' confidence in and adherence to the rules of society	World Bank WGI

Table A.2: SAFE Country Composition

Year and wave (2009H1–2014H2)												
Country	**2009H1**	**2009H2**	**2010H1**	**2010H2**	**2011H1**	**2011H2**	**2012H1**	**2012H2**	**2013H1**	**2013H2**	**2014H1**	**2014H2**
Austria	50	127	152	354	356	368	347	370	355	336	351	590
Belgium	49	95	126	419	393	386	373	378	401	374	361	585
Germany	232	630	727	663	672	658	680	693	679	644	910	1,063
Spain	373	788	821	718	762	787	786	791	807	776	1,008	1,177
Finland	12	78	68	357	400	397	352	384	382	394	379	411
France	279	680	803	798	817	831	828	793	833	839	1,110	1,109
Greece	86	166	124	392	334	397	350	355	392	399	418	668
Ireland	34	85	84	445	444	442	460	458	445	454	420	416
Italy	382	767	817	839	788	821	830	839	843	874	1,197	1,238
Netherlands	55	155	147	385	360	372	361	358	381	348	571	713
Portugal	72	136	189	331	299	281	317	373	357	346	380	621
Total	**1,624**	**3,707**	**4,058**	**5,701**	**5,625**	**5,740**	**5,684**	**5,792**	**5,875**	**5,784**	**7,105**	**8,591**
Year and wave (2015H1–2020H2)												
Country	**2015H1**	**2015H2**	**2016H1**	**2016H2**	**2017H1**	**2017H2**	**2018H1**	**2018H2**	**2019H1**	**2019H2**	**2020H1**	**2020H2**
Austria	374	608	387	611	375	606	379	578	365	606	378	422
Belgium	365	601	367	581	359	593	371	566	362	585	365	521
Germany	1,062	1,115	1,081	1,101	1,101	1,078	1,062	1,028	1,030	1,046	917	894
Spain	1,009	1,164	963	1,128	968	1,116	972	1,103	944	864	969	1,110
Finland	406	410	416	406	401	406	398	397	395	396	411	403
France	1,104	1,121	1,114	1,094	1,089	1,122	1,052	1,074	1,039	1,016	1,086	1,054
Greece	420	644	421	633	395	609	361	643	391	632	404	603
Ireland	412	424	426	422	419	414	411	398	399	416	414	417
Italy	1,231	1,194	1,195	1,166	1,162	1,187	1,151	1,153	1,124	1,166	1,174	1,151
Netherlands	590	724	591	705	584	707	565	683	573	677	546	513
Portugal	406	629	376	617	380	608	375	543	362	625	361	563
Total	**7,379**	**8,634**	**7,337**	**8,464**	**7,233**	**8,446**	**7,097**	**8,166**	**6,984**	**8,029**	**7,025**	**7,651**

Notes: This table reports the number of SMEs surveyed in each country and wave over time. "H" denotes the half-yearly survey rounds.

Table A.3: Core SAFE Questions Used in Chapter 1

Item	Survey wording used in the chapter
Q5	For each of the following types of external financing, please indicate if your needs increased, remained unchanged or decreased over the past six months. Types of financing: credit line, bank loans, trade credit, equity capital, debt securities, and other loans.
Q7a	Have you applied for the following types of financing in the past six months. Response options: applied; did not apply because of possible rejection; did not apply because of sufficient internal funds; did not apply for other reasons.
Q7b	If you applied and tried to negotiate for this type of financing over the past six months, what was the outcome. Response options: received everything; received 75% and above; received below 75%; refused because the cost was too high; was rejected.
Q9	For each of the following types of financing, would you say that their availability has improved, remained unchanged or deteriorated for your enterprise over the past six months. Types of financing: credit line, bank loans, trade credit, equity capital, debt securities, and other loans.

Notes: This table reproduces the SAFE question wording used to construct the baseline financing-gap measures and the alternative application-outcome measure discussed in Chapter 1.

Table A.4: 17 Macroprudential Tools (Excerpt from the IMF iMaPP Database)

Instrument	**Description**
CCB	A requirement for banks to maintain a countercyclical capital buffer. Implementations at 0% are not considered a tightening in dummy-type indicators.
Conservation	Requirements for banks to maintain a capital conservation buffer, including the one established under Basel III.
Capital	Capital requirements for banks, including risk weights, systemic risk buffers, and minimum capital requirements.
LVR	A limit on leverage of banks, calculated by dividing a measure of capital by the bank's non-risk-weighted exposures.
LLP	Loan loss provision requirements for macroprudential purposes, including dynamic provisioning and sectoral provisions (e.g. housing loans).
LCG	Limits on the growth or volume of aggregate credit, household-sector credit, or corporate-sector credit, and penalties for high credit growth.
LoanR	Loan restrictions that may depend on loan characteristics, lender characteristics, and other factors.
LFC	Limits on foreign-currency lending, and rules or recommendations on foreign-currency loans.
LTV	Limits on loan-to-value ratios, applied to residential and commercial mortgages as well as other secured loans.
DSTI	Limits on the debt-service-to-income ratio and the loan-to-income ratio.
Tax	Taxes and levies applied to specified transactions, assets, or liabilities, including stamp duties and capital gains taxes.
Liquidity	Measures to mitigate systemic liquidity and funding risks, including liquidity coverage ratios, liquid asset ratios, and net stable funding ratios.
LTD	Limits on the loan-to-deposit ratio and penalties for high loan-to-deposit ratios.
LFX	Limits on net or gross open foreign exchange positions, FX exposures and FX funding, and currency mismatch regulations.
RR	Reserve requirements for macroprudential purposes.
SIFI	Measures to mitigate risks from global and domestic systemically important financial institutions, including capital and liquidity surcharges.
Other	Macroprudential measures not captured above, such as stress testing, restrictions on profit distribution, and structural measures.

Table A.5: 67 Partner Countries/Territories List

ISO	Country/Territory	ISO	Country/Territory	ISO	Country/Territory
ARE	United Arab Emirates	ARG	Argentina	AUT	Austria
AUS	Australia	BEL	Belgium	BGR	Bulgaria
BHR	Bahrain	BRA	Brazil	BHS	Bahamas
CAN	Canada	CHE	Switzerland	CHL	Chile
CHN	China	COL	Colombia	CRI	Costa Rica
CYP	Cyprus	CZE	Czech Republic	DEU	Germany
DNK	Denmark	EST	Estonia	ESP	Spain
FIN	Finland	FRA	France	GRC	Greece
HKG	Hong Kong	HRV	Croatia	HUN	Hungary
IDN	Indonesia	IRL	Ireland	ISR	Israel
IND	India	ISL	Iceland	ITA	Italy
JPN	Japan	KOR	South Korea	KWT	Kuwait
LBN	Lebanon	LTU	Lithuania	LUX	Luxembourg
LVA	Latvia	MAR	Morocco	MLT	Malta
MUS	Mauritius	MEX	Mexico	MYS	Malaysia
NLD	Netherlands	NOR	Norway	NZL	New Zealand
OMN	Oman	PHL	Philippines	POL	Poland
PRT	Portugal	ROU	Romania	SRB	Serbia
RUS	Russia	SAU	Saudi Arabia	SWE	Sweden
SGP	Singapore	SVN	Slovenia	SVK	Slovakia
THA	Thailand	TUR	Turkey	TWN	Taiwan
UKR	Ukraine	GBR	United Kingdom	USA	United States
ZAF	South Africa				

B Chapter 2 Supporting Materials

Table B.1: EIBIS Country Coverage

European countries	**Non-EU countries**
Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden	United Kingdom; United States

Notes: The chapter uses the annual EIBIS waves from 2015 to 2022. The European component of the sample consists of the EU27; the two additional countries are the United Kingdom and the United States.

Table B.2: Key EIBIS Financing Questions Used in Chapter 2

Construct used in the chapter	**Survey information used**
Quantity rationing	Whether the firm received less external finance than requested.
Rejection	Whether the firm applied for external finance and the application was rejected.
Price constraint	Whether the firm did not apply because borrowing costs were expected to be too high.
Discouragement	Whether the firm did not apply because it expected to be rejected.
Contract-term dissatisfaction	Whether the firm reported being fairly or very dissatisfied with the amount, cost, maturity, or collateral terms offered on external finance.
Main bank identifier	The firm's reported primary bank, which is used to merge EIBIS with BankFocus bank-level characteristics.

Notes: This table summarizes the core EIBIS items used to construct the financing outcomes in Chapter 2. The survey wording is condensed for readability but follows the EIBIS questionnaire categories used in the empirical coding.

C Chapter 3 Supporting Materials

Table C.1: Description of Variables

Variable	Definition	Sources
GPR	Geopolitical Risk Index	Caldara and Iacoviello (2022)
$MaPs^{T}$	Tightening macroprudential policy index	IMF iMaPP
$MaPs^{L}$	Loosening macroprudential policy index	IMF iMaPP
$MaPs^{T}_{activity}$	Activity-based tightening MaPs	IMF iMaPP
$MaPs^{T}_{entity}$	Entity-based tightening MaPs	IMF iMaPP
$MaPs^{T}_{capital}$	Capital-targeted tightening MaPs	IMF iMaPP
$MaPs^{T}_{loan}$	Loan-targeted tightening MaPs	IMF iMaPP
$MaPs^{T}_{general}$	General-targeted tightening MaPs	IMF iMaPP
LTV	Loan-to-value ratio	IMF iMaPP
Unemployment	Unemployment rate	World Bank
Population	Population growth rate	World Bank
GDP	Natural logarithm of GDP	World Bank
GDP Growth	GDP growth rate	World Bank
CPI	Consumer price index	World Bank
Consumption	Government final consumption	World Bank
Trade	Trade (exports + imports as % of GDP)	World Bank
Government	Government effectiveness	World Bank WGI
Regulation	Regulatory quality	World Bank WGI
Rule	Rule of law	World Bank WGI
Voice	Voice and accountability	World Bank WGI
FD	Financial development index	IMF
Bureaucracy	Bureaucracy quality	International Country Risk Guide (ICRG)
Religious	Religious tension	International Country Risk Guide (ICRG)
GINI	Gini index	SWIID
CBIE	Central bank independence (overall)	Romelli (2022)
$CBIE_{Board}$	Independence in deciding board composition	Romelli (2022)
$CBIE_{Policy}$	Independence in deciding policy	Romelli (2022)
$CBIE_{Obj}$	Independence in policy objective	Romelli (2022)
Connect	Global connectedness index	Altman and Bastian (2024)
Breadth	Global connectedness breadth index	Altman and Bastian (2024)
Depth	Global connectedness depth index	Altman and Bastian (2024)

Table C.2: Descriptive Statistics

Variable	N	Mean	SD	Min	p50	Max
GPR	7056	0.200	0.380	0.000	0.060	3.620
$MaPs^{T}$	7056	0.170	0.540	0.000	0.000	7.000
$MaPs^{L}$	7056	0.040	0.220	0.000	0.000	3.000
$MaPs^{T}_{activity}$	7056	0.030	0.180	0.000	0.000	2.000
$MaPs^{T}_{entity}$	7056	0.120	0.440	0.000	0.000	6.000
$MaPs^{T}_{capital}$	7056	0.051	0.270	0.000	0.000	3.000
$MaPs^{T}_{loan}$	7056	0.054	0.269	0.000	0.000	5.000
$MaPs^{T}_{general}$	7056	0.065	0.263	0.000	0.000	2.000
LTV	6888	0.890	0.148	0.444	1.000	1.100

Table C.3: Classification of MaPs

Abbreviation	Name	Activity/Entity-Based	Target
CCB	Countercyclical capital buffer	Entity	Capital
Conservation	Capital conservation buffer	Entity	Capital
Capital	Capital requirements	Entity	Capital
LVR	Leverage ratio	Entity	General
LLP	Loan loss provisioning requirements	Entity	Loan
LCG	Limits on credit growth	Activity	Loan
LoanR	Loan restrictions	Activity	Loan
LFC	Limits on foreign currency lending	Activity	General
LTV	Loan-to-value ratio limits	Activity	Loan
DSTI	Debt-to-income and debt-service-to-income ratio limits	Activity	Loan
Tax	Taxes and levies	Entity	General
Liquidity	Liquidity requirements (e.g., LCR, NSFR)	Entity	General
LTD	Loan-to-deposit ratio limits	Activity	Loan
LFX	FX exposure and position limits	Activity	General
RR	Reserve requirements	Entity	General
SIFI	Surcharges for systemically important financial institutions (SIFIs)	Entity	Capital

Notes: This table classifies macroprudential tools by their regulatory scope (activity-based or entity-based) and policy target (capital, loan, or general).

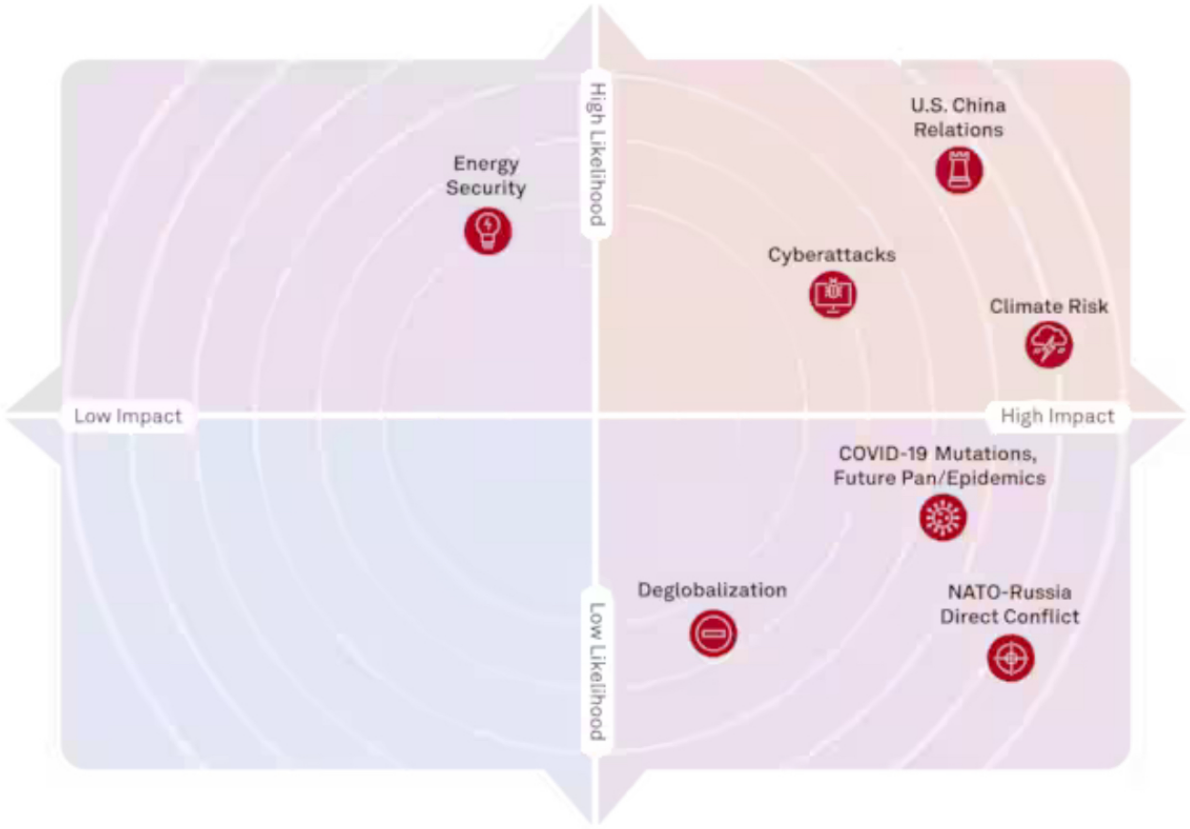


Figure C.1: Likelihood and Impact of Top 2024 Geopolitical Risks. This figure presents the likelihood and impact of the top geopolitical risks in 2024, as assessed by S&P Global (2024). Source: S&P Global.

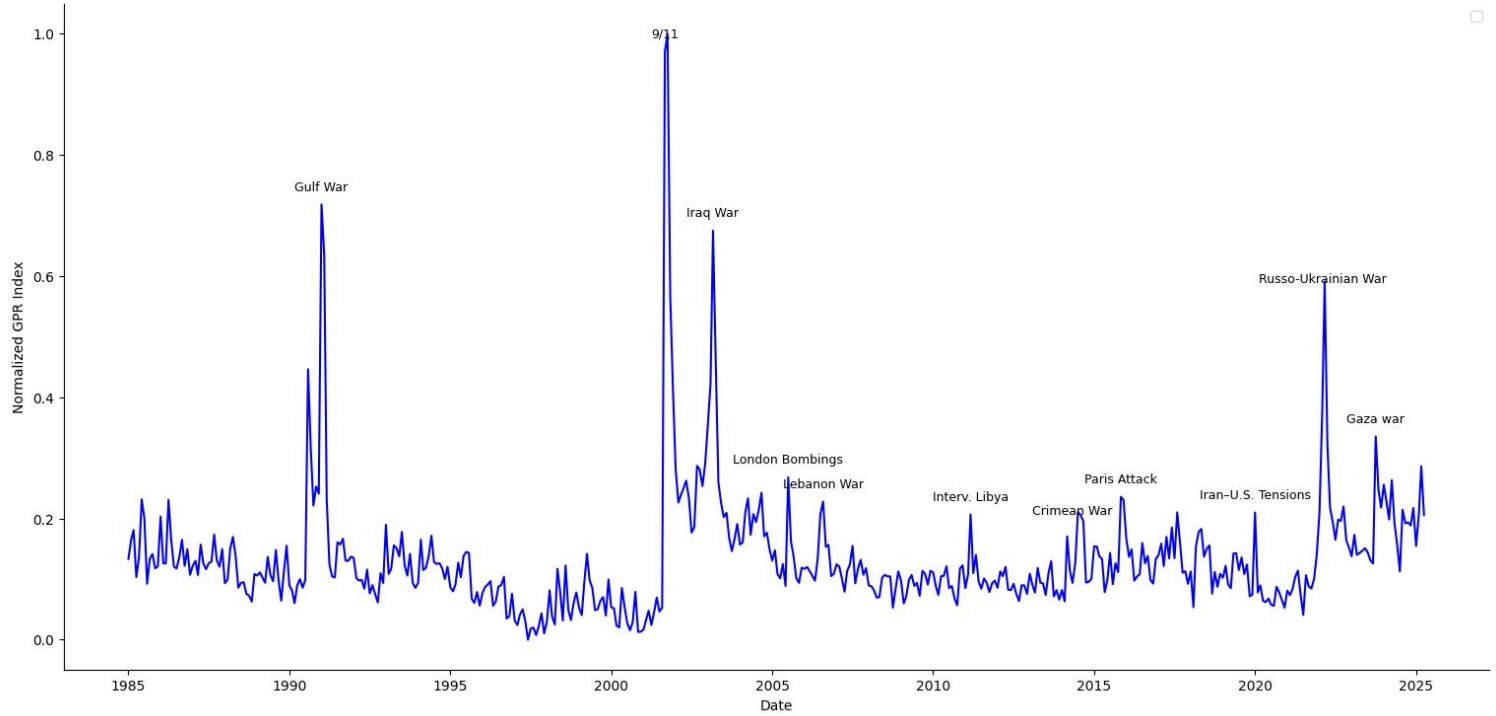


Figure C.2: Geopolitical Risk (GPR) Index (World Average). This figure shows the world-average Geopolitical Risk (GPR) Index from 1985 to 2024. The index is normalized to $[0, 1]$. It tracks geopolitical risk in real time, reflecting perceptions from the press, the public, global investors, and policymakers. Source: Caldara and Iacoviello (2022).

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