Global risk-mitigating effects of national bank supervisors

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Abstract: We examine how national supervisory frameworks affect global risk-taking in lending by exploiting variation in supervisory authority for early intervention in stressed banks—so called prompt corrective action (PCA) authority—across countries and time. PCA reduces banks' global supply of risky U.S. dollar corporate loans by addressing commitment problems in bank supervision. Automatic intervention triggers protect supervisors from political pressure and time inconsistency, while tools targeting bank manager compensation and shareholder distributions directly address moral hazard. A one-point increase in PCA authority (which ranges from 0 to 6) reduces risky loan supply by up to 3 percent and offsets up to 18 percent of an increase in risky loan supply induced by a one-percentage point cut in the federal funds rate. Non-banks partially fill the gap created by banks' reduced risk-taking, highlighting prudential leakages. Our findings demonstrate that national supervisory design has global macroprudential effects.

Keywords: Global risk-taking channel of U.S. monetary policy; bank supervision; micro-prudential powers; banks and non-banks; prudential leakages.

JEL Classifications: G21, G23, G28, G32, E43, E52, and E58.

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1 Introduction

In an easing cycle of monetary policy, policymakers consistently worry about excessive risk-taking by financial institutions. These concerns are well-founded: banks' risk-taking decisions affect both global financial stability and the transmission of monetary policy (Borio and Zhu (2012); Adrian and Shin (2014)). What makes this particularly challenging is that risk-taking reflects both structural factorssuch as the supervisory and regulatory environmentand cyclical factors like interest rates. Despite extensive research on these factors separately, we have surprisingly limited evidence on their interaction.

We address this gap by examining how national bank supervision affects global risk-taking in lending and whether supervisory tools can mitigate the risk-taking effects of monetary policy. Our focus is on supervisory authority for early intervention in stressed banks — prompt corrective action (PCA) authority— a core microprudential power that addresses fundamental commitment problems in banking supervision. PCA frameworks create structured early intervention systems with automatic triggers that limit regulatory forbearance (Kane (1989); Mailath and Mester (1994)) and protect supervisors from political pressure to delay necessary interventions (Boot and Thakor (1993); Rajan (1994)).

Understanding when and why supervisory tools work is crucial for institutional design. Supervisors face well-documented incentive problems: they may engage in forbearance to avoid acknowledging past mistakes (Kane (1989)), respond to political pressure against intervening in troubled banks (Brown and Dinc (2005)), or defer action due to career concerns about moving to the regulated industry (Lucca, Seru, and Trebbi (2014)). These problems can lead to time-inconsistent supervision where optimal ex-ante policies are not enforced ex-post (Rajan (1994); Morrison and White (2013)). PCA authority potentially solves these problems by removing supervisory discretion at predetermined thresholds, but whether it works in practiceand through which specific mechanismsremains an open empirical question.

We study these issues using the global syndicated loan market, which offers unique advantages for identification. Syndicated loans are extended to a single borrower by multiple lenders from different countries, creating variation in supervisory regimes while holding constant the borrower, loan terms, and economic environment. This allows us to implement an identification strategy that is stronger than Khwaja and Mian (2008)s because we hold borrower term constant. Moreover, we incorporate an additional dimension of cross-country supervisory variation. We focus on U.S. dollar-denominated term loans to both domestic and international borrowers over 1995-2014, a period encompassing multiple monetary policy cycles and significant variation in national supervisory frameworks.

Our analysis merges three datasets: Refinitiv's Loan Connector for syndicated loan originations, Moody's Analytics CreditEdge for borrower expected default frequencies (EDFs), and Barth, Caprio, and Levine (2013)'s surveys of national bank regulatory and supervisory practices. The resulting sample includes banks and borrowers from dozens of countries, with U.S. banks and U.S. borrowers each representing significant but non-dominant shares. Crucially, we construct a "non-U.S. borrower" subsample where loans made by non-U.S. lenders to emerging market borrowers

represent over 70 percent of observations, allowing us to test for global spillovers of U.S. monetary policy while maintaining policy exogeneity.

We find four main results. First, stronger national PCA authority reduces banks' supply of risky loans globally. A one-point increase in the PCA index (which ranges from 0 to 6) reduces the size of loans to risky borrowers by 1.5 percent in our global sample and 2.9 percent in our non-U.S. borrower sample, with essentially no effect on loans to safer borrowers. This structural mitigation effect operates independently of monetary policy conditions.

Second, we document a global risk-taking channel of U.S. monetary policy: Banks increase lending to risky borrowers when U.S. policy rates decline. A one percentage point cut in the federal funds rate increases risky loan sizes by approximately 10 percent in the global sample and 18 percent in the non-U.S. borrower sample. This quantitative effect is novel as the literature typically studies the effect of monetary policy on credit risk or pricing of new loans (Dell'Ariccia, Laeven, and Suarez (2017); Jimenez, Ongena, Peydro, and Saurina (2014)) rather than their sizes. Understanding of the volume of new risky loans appears to be more important from supervisory and financial stability perspectives. Moreover, we incorporate nonlinearity in our analysis, so that the effects of monetary policy on sizes of new loans are different for safe and risky ones.

Third, stronger national PCA authority substantially dampens the monetary policy risk-taking channel. With PCA at its median value, the mitigating effect offsets approximately 17 percent of the policy-induced increase in risky lending in the global sample and 16 percent in the non-U.S. sample. These are economically meaningful magnitudes that demonstrate how institutional design choices affect the transmission of monetary policy through the banking system.

Fourth, we find that PCA effects operate primarily through specific components that address supervisor and bank incentive problems. Early intervention authority matters because it removes supervisor discretion and addresses time inconsistency problems. Cease and desist powers enable supervisors to stop questionable activities before they escalate. Most importantly, authority to suspend dividends and management compensation shows the strongest effects, consistent with these tools directly addressing moral hazard problems by aligning bank manager and shareholder incentives with those of creditors and depositors (Acharya, Mehran, and Thakor (2016); Calomiris and Jaremski (2019)).

We extend our analysis in two important directions. First, we investigate prudential leakages by examining whether non-banks increase participation in risky lending when supervised banks face stronger PCA constraints. We find evidence of such leakages: non-banks take larger shares in risky loan syndicates when banks face more powerful supervisors, particularly during monetary policy easing. However, the economic magnitude was limited during our 1995-2014 sample period because non-bank participation remained relatively small. This finding is increasingly relevant given the dramatic growth of non-bank credit provision since 2014.

Second, we verify robustness across multiple dimensions: different time periods (including pre-crisis 1995-2008 to avoid post-crisis regulatory changes), alternative fixed effects structures, and samples excluding U.S. borrowers to strengthen policy exogeneity. Results are remarkably stable across all specifications.

Our paper contributes to several literatures. First, we add to research on bank supervision and

risk-taking. Previous work establishes that effective supervision reduces bank risk using balance sheet metrics (Delis and Staikouras (2011); Barth, Caprio, and Levine (2013)), that supervisory attention matters (Hirtle, Kovner, and Plosser (2020); Agarwal, Lucca, Seru, and Trebbi (2014)), and that supervisor incentives affect enforcement patterns (Agarwal, Lucca, Seru, and Trebbi (2014); Lucca, Seru, and Trebbi (2014)). We extend this literature by examining how specific supervisory powers affect ex-ante risk-taking in loan originations rather than ex-post balance sheet risk, and by identifying which institutional features make supervision effective.

Second, we contribute to literature on the risk-taking channel of monetary policy. Domestic studies show that lower policy rates lead to riskier lending (Dell'Ariccia, Laeven, and Suarez (2017); Jimenez, Ongena, Peydro, and Saurina (2014); Ioannidou, Ongena, and Peydro (2015)), while international studies document spillovers of U.S. monetary policy to global lending (Bruno and Shin (2015); Miranda-Agrippino and Rey (2020); Lee, Liu, and Stebunovs (2022)). We show that national supervisory frameworks significantly moderate these effects, suggesting that the transmission of monetary policy is shaped by institutional factors beyond traditional monetary channels.

Third, we speak to nascent literature on interactions between monetary policy and prudential regulation. Altavilla, Boucinha, Peydro, and Smets (2019) study the introduction of the Single Supervisory Mechanism in Europe and find that centralized supervision dampened risky lending responses to accommodative policy. We provide complementary evidence using time-series and cross-country variation in supervisory frameworks, identifying specific institutional features that make supervision effective rather than studying a single regime change. Our findings suggest that even absent major institutional reforms, strengthening specific supervisory powers can materially affect risk-taking.

Fourth, we contribute to literature on supervisory incentives and institutional design. Theoretical work emphasizes commitment problems (Mailath and Mester (1994)), regulatory capture (Boot and Thakor (1993)), and time inconsistency (Rajan (1994)) in banking supervision. Empirical evidence confirms that supervisors respond to career incentives (Agarwal, Lucca, Seru, and Trebbi (2014)), political pressure (Brown and Dinc (2005)), and reputational concerns (Morrison and White (2013)). We provide evidence on which institutional features help overcome these problems, showing that rules-based frameworks with automatic triggers and tools targeting bank insider incentives are most effective.

Finally, we add to literature on global banking and cross-border regulatory spillovers. Previous work shows that banks transmit shocks across borders (Cetorelli and Goldberg (2012); Schnabl (2012)), that regulatory arbitrage affects bank location decisions (Houston, Lin, and Ma (2012)), and that host-country regulation affects foreign bank lending (Ongena, Popov, and Udell (2013)). We demonstrate that home-country supervisory policies have global effects through banks' cross-border lending, creating international externalities that may warrant supervisory coordination.

The reminder of the paper is organized as follows. Section 2 places the paper in the literature. Section 3 describes key features of loan syndication and the global market for U.S dollar, Libor-indexed syndicated term loans; measures of ex ante credit risk of syndicated loan borrowers; measures of microprudential powers; and the sample specifics. Section 4 cover the baseline regression model and summarizes the estimation results. Section 5 examines microprudential leakages

due to non-bank participation in loan syndication. Section 6 studies the reasons for the effectiveness of microprudential powers. Finally, section 7 concludes.

2 Place in literature

We draw on a few literature strands: The strand on the effectiveness of microprudential tools in mitigating the riskiness of banks; the strand on a (international) risk-taking channel of monetary policy; and the more nascent strand on mitigants of a risk-taking channel of monetary policy.

The first strand studies the effects of supervision and regulation on the risk or fragility of individual banks. Survey-based measures, such as tallies of supervisory powers in Barth, Caprio, and Levine (2013), or enforcement output-based measures, such as on-site audits and sanctions in Delis and Staikouras (2011), quantify the stringency of supervision. The literature measures bank risk with Z-scores or bank balance sheet metrics, and it finds that effective supervision reduces bank fragility. While we borrow the survey-based measures of supervisory powers from this literature, we focus on the size of risky loans being originated rather than aggregate, balance-sheet measures of bank risk. Our approach is more nuanced and it offers more robust identification of the effects because we trace the exposures to the same risky borrowers of multiple banks that face supervisors with different powers.

The second strand examines a risk-taking channel of monetary policy, primarily in a domestic setting. It finds that, in a country, lower interest rates induce banks to make riskier loans as measured by their qualitative ratings, quantitative credit risk indicators, or credit spreads. Some papers study the volume of risky loans being originated, for example Altavilla, Boucinha, Peydro, and Smets (2019). The literature also examines bank characteristics, such as leverage, that may amplify or mitigate risk-taking. Some other papers investigate the effects of U.S. monetary policy on global or international risk-taking, for example Ioannidou, Ongena, and Peydro (2015) and Lee, Liu, and Stebunovs (2022). In turn, we recognize that U.S. monetary policy has global effects on originations of risky loans by both banks and non-banks, so we examine risk–taking of both U.S. and non-U.S. banks, as well as of non-banks in response to U.S. monetary policy.

The third strand is more novel. Altavilla, Boucinha, Peydro, and Smets (2019) analyze the role of banking supervision in banks' risk-taking behavior in response to monetary policy in the euro area. They exploit the one-time centralization of bank supervision for significant banks from a national level to a supranational level (the so-called Single Supervisory Mechanism) over a period of the ECB's unconventional monetary policy. Essentially, it is a study of one specific event—a transition from national to (more stringent) supranational supervision in a period of unprecedented monetary policy in the euro area.[1] They find that for banks operating in stressed countries only, centralized supervision reduces lending to riskier firms and that monetary policy easing increases bank risk-taking in stressed countries, with centralized supervision partly offsetting the effects. In contrast to Altavilla, Boucinha, Peydro, and Smets (2019), we use global syndicated loan data which cover lenders and borrowers from around the world. In addition, we study the effects of

[1] As Haselmann, Singla, and Vig (2019) show that national supervisors are systematically more lenient than the supranational supervisor.

microprudential powers—specifically, the authority for prompt corrective action as documented in Barth, Caprio, and Levine (2013)'s— that vary across many countries over a long time, which included financial crises and the period of unconventional monetary policy in the United States.

3 Loan syndication, credit risk, and bank superivision

Our approach to identify the effects of bank supervision on risk-taking by financial intermediaries relies on combining data from three sources: Refinitiv's Loan Connector service for detailed information about corporate loan contracts; Moody's EDF-X for the expected default frequency (EDF) of public firms; and Barth, Caprio, and Levine (2013)'s data on bank regulatory and supervisory policies in many countries.

3.1 Syndicated corporate term loans

Syndicated loans is a promising venue for studying risk-taking in part because a wide range of financial intermediaries participates in loan origination and because the structure of loan syndicates lends itself to robust identification strategies.

One of the advantages of studying the global syndicated loan market is its wide coverage of lenders of various nationalities that supply credit to borrowers of varying credit quality from around the world.

The global primary market for U.S. dollar syndicated term loans is a suitable venue to study these issues for several reasons. First, this market is comparable in terms of size to the global primary market for U.S. dollar corporate bonds. Second, the vast majority of syndicated term loans are made to speculative-grade and obscure, non-rated corporations, so lenders take on large positions in risky, mostly leveraged loans. Third, a significant portion of non-U.S. borrowers in the market is from emerging markets, which allows us to identify more robustly any cross-border effects of global factors. Fourth, while banks tend to originate the majority of syndicated term loans, they sell shares in these loans within one month from origination to shadow banks. Hence, the riskiness of loans being originated reflects, to a large extent, risk-taking behavior of the broader financial system rather than just banks. Finally, this market has been tracked for a few decades by data vendors that compile vast, detailed loan-level data sets.

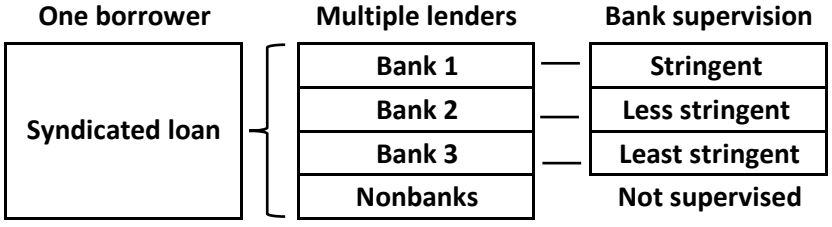


Figure 1: Schematic of a syndicated corporate term loan

Before we describe the details of syndicated loan data, we offer a quick refressher: Syndicated corporate term loans are disbursed at origination. Thus, they appear on bank balance sheets and draw on bank capital immediately. They tend to be larger than bilateral loans, hence, they are more likely attract supervisory attention. Term loans are senior in borrowers' liabilities. They typically have five-to-seven year maturity. In a way, we can establish which characteristics may slow down the supply of leveraged debt to the financial system more because of the nature of the market that we study. Recall that major banks originate syndicated loans to sell to non-banks, such as mutual funds and collateralized loan obligations. Such findings may be of immediate relevance to policy makers contemplating financial risks emanating from corporate debt markets and ways to mitigate such risks. A syndicated term loan is extended to a borrower by multiple lenders, that are not necessarily banks, that form a syndicate for that purpose, and it is administered by an agent, typically a bank. diagram 1.

We draw syndicated loan data from Refinitiv's Loan Connector. This data set contains detailed information on syndicated loans, including names, industries, locations of lenders and borrowers, and, for many loans but not all, lender shares in the syndicates at loan origination. We focus on syndication deals that are either closed or completed, with a distribution method being either syndication or club deal. We focus on loans that are denominated in U.S. dollars and are indexed to the U.S. dollar LIBOR.

We distinguish lenders by their type and syndication role. We rely on 4-digit SIC codes for primary activity given in the Loan Connector data to classify lenders. Banks may play various roles from syndicate to syndicate, ranging from a participant to a agent or an arranger. agents and arrangers play more significant roles in syndicates, have significant shares in those at origination, and typically retain significant shares over the lifetime of those. (The mean and median shares of agents and arrangers are twice as high as those of participants and in the non-U.S. sample three times as high.) In contrast, participants typically have small shares in syndicates and may sell off these shares quickly.

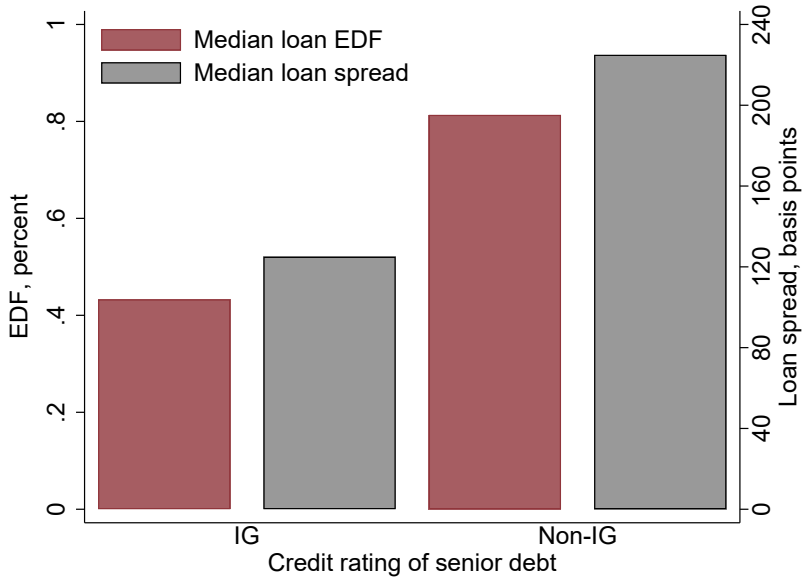


Figure 2: Loan credit risk and spread by borrower debt rating

We focus on agents and arrangers. Because agents and arrangers retain credit risk on their balance sheets over time, they are more likely affected by capital and other regulation.[2] And risk retention is particularly important for us. Banks originate syndicated loans with the intent to distribute to non-banks that either pre-commit to buy shares in the loans being originated or buy those shares shortly after the origination directly from the originators or in the secondary market. Lee, Liu, and Stebunovs (2022) find that the median of bank-owned shares in loans declines from about 90 percent to about 20 percent within a few weeks after loan origination.

We also distinguish borrowers by their location and industry. We assign borrowers to one of 38 Fama-French's industry classifications (see Fama and French (1997)) based on borrower four-digit SIC codes for primary activity given in the Loan Connector data. We use borrower locations to construct a base sample (which includes borrowers from all countries) and a non-U.S. sample (which excludes borrowers from the United States) and to define various fixed effects.

The limited availability of lender shares in the syndicates at loan origination creates potential for biases. This is an issue that the literature has grappled with. For example, Ivashina (2009) does numerous checks to better understand the reporting biases and their evolution over the decades. Following Ivashina (2009), we control 1) for year fixed effects throughout the analysis to assure that the time effect in the reporting of the lead share does not affect the results and 2) for bank fixed effects to account for the stronger incentives of smaller banks to report the detailed information about their syndication activities.

[2]Our approach mimics that of Ivashina (2009) who defines mostly agents and arrangers to be lead banks in syndicates.

3.2 Credit risk of corporate term loans

While Refinitiv's Loan Connector is a rich data set, it does not offer ex ante credit risk measures for loans or borrowers. Thus, we cannot follow the approach of Dell'Ariccia, Laeven, and Suarez (2017) who rely on internal bank ratings of credit quality of new loans or the approach of Aramonte, Lee, and Stebunovs (2022) who use banks' estimates of probabilities of loan default.

Instead, we bring the probabilities of default from another source, as in Lee, Liu, and Stebunovs (2022). We focus on Moody's Analytics CreditEdge EDFs—forward-looking annualized probabilities of default at various horizons—as objective measures of borrower ex ante credit risk. These EDFs are based on the structural debt pricing model of Merton (1974) and historical global corporate default data. We use the vintage of the EDF data that incorporates information from the GFC and post-GFC periods.[3]

As Altunbas, Manganelli, and Marques-Ibanez (2017) note, the EDF methodology has various advantages. First, it is not based on ratings which might be biased indicators of corporate risk due to conflicts of interest. Second, unlike measures of default risks derived exclusively from accounting information—such as Z-scores—EDFs are not a backward-looking indicator of risk. Third, despite their simplifying assumptions, EDF estimations of default risk show strong robustness to model mis-specifications (Jessen and Lando (2015)). Finally, over the recent financial crisis, EDFs have done relatively well as predictors of firms risk on a cross-sectional perspective, compared to other measures of default risk. That is, the relative positions of firms ranked according to their EDF levels in the year before the crisis were good predictors of rank ordering of default risk during the crisis (Munves, Hamilton, and Gokbayrak (2009)). Finally, EDFs are available for a much larger number of firms than credit ratings.

From regulatory and risk management perspectives, EDFs provide an incomplete picture of credit risk. The literature in general suffers from the same issue. It is one of the two components of expected loss, with the other component being loss given default. Given data limitations, any estimates of losses given default will likely be highly inaccurate. But it is likely that losses given default have increased significantly over the sample period because of the proliferation of "covenant lite" loans, which have few if any covenants to protect the lenders, such as restrictions on the borrowers regarding payment terms, income requirements, and asset disposals but which have been in high demand from non-banks. Therefore, the omission of losses given default from analysis does not appear to be essential, because the proliferation of "covenant lite" loans works in our favor.

We merge the EDF data and the Loan Connector data by borrower names and other details using the matching algorithm in Cohen, Friedrichs, Gupta, Hayes, Lee, Marsh, Mislang, Shaton, and Sicilian (2018). For a given loan-borrower EDF match, we retain an EDF for a horizon that approximates the maturity of the loan.

[3]See Nazeran and Dwyer (2015) for a detailed description of the modeling methodology.

3.3 Microprudential power: Prompt corrective action

We draw information about supersory powers from Barth, Caprio, and Levine (2013). They provide a comprehensive survey of bank regulatory and supervisory practices across a large number of countries, which is a valuable resource for understanding how different regulatory and supervisory frameworks can impact banking stability and performance. The authors compile data from over hundred of questions in each of four surveys conducted in 1999, 2003, 2007, and 2011, which cover various aspects of banking regulation, supervision, and monitoring in over 100 countries. They construct summary indexes of these practices to facilitate cross-country comparisons and analyses of changes in banking policies over time.

Barth, Caprio, and Levine (2013) highlight the critical role of prompt corrective action (PCA) in banking regulation and supervision. PCA refers to the authority granted to banking supervisors to take timely and preemptive actions to address potential issues in banks before they escalate into more severe problems. (Specifically, Barth, Caprio, and Levine (2013)'s survey ask whether a law establishes predetermined levels of bank solvency deterioration that force automatic actions, such as intervention.) This regulatory mechanism is designed to enforce early intervention based on predefined triggers, such as capital adequacy ratios, to ensure that banks take corrective measures. By allowing supervisors to act decisively at the first signs of trouble, PCA aims to prevent the deterioration of a bank's financial condition and mitigate systemic risks. For instance, supervisory actions under PCA may include restricting dividend payouts, limiting asset growth, and requiring the injection of additional capital. Their comprehensive survey data from 180 countries reveal substantial variations in the implementation and effectiveness of PCA across different regulatory environments. Their findings suggest that countries with stronger PCA frameworks tend to exhibit greater banking stability and resilience to financial shocks.

The surveys were conducted in select years. We map them to time periods, in spirit of but not exactly as in Karolyi and Taboada (2015).[4] The surveys release years generally differ from the survey reference years. We focus on the references years when applying the surveyed characteristics to time intervals (see table 1). Because some of the characteristics might have been in effect for some time before the year of a given survey, we apply that those characteristics beginning the year before the survey year. We apply the characteristics from the 1999 survey for observations from 1995 through 2000, those from the 2003 survey for observations from 2001 through 2004, those from the 2007 survey for observations from 2005 through 2009, and those from the 2012 survey for observations from 2010 through 2014.

Barth, Caprio, and Levine (2013)'s index of prompt corrective power is based on detailed survey questions and ranges between 0 (no power) and 6 (highest power). The key question is whether the supervisory agency operate an early intervention framework (that is, prompt corrective action) that forces automatic action when certain regulatory triggers/thresholds are breached. If the answer is no, then the index take the value of zero even the agency has some enforcement powers, for example, the authority to issue cease and desist orders.

[4]We also check the robustness of the estimation results to the assignment of Barth, Caprio, and Levine (2013)'s surveys to certain time intervals: We apply that those characteristics for an interval beginning the

Table 1: Barth, Caprio, and Levine (2013)'s surveys of microprudential powers

Survey	Publication year	Reference year	Number of countries	Range of years the survey applied to
I	1999	1999	118	1995-2000
II	2003	2002	151	2001-04
III	2007	2006	142	2005-09
IV	2012	2011	125	2010-14

Note. In spirit of Karolyi and Taboada (2015), we apply the characteristics from a given survey to a certain range of years.

Table 2: Measuring Prompt Corrective Power

Definition		A law establishes predetermined levels of bank solvency deterioration that force automatic actions, such as intervention.	
Questions			Values
	a	Does the supervisory agency operate an early intervention framework (that is, prompt corrective action) that forces automatic action when certain regulatory triggers/thresholds are breached?	0 or 1
		Are the following enforcement powers available to the supervisory agency?	
	b	$*$ Issue cease and desist-type orders for imprudent bank practices	0 or 1
	c	$*$ Require banks to constitute provisions to cover actual or potential losses	0 or 1
	d	$*$ Require banks to reduce or suspend dividends to shareholders	0 or 1
	e	$*$ Require banks to reduce or suspend bonuses and other remuneration to bank directors and managers	0 or 1
	f	Can the supervisory authority force a bank to change its internal organizational structure?	0 or 1
Aggregation		$index = a \times (b + c + d + 2 \times e + f)$	0...6

Note. Adopted from Barth, Caprio, and Levine (2013). The responses to the questions are either No (0) or Yes (1). The formula aggregates the responses into an index, which takes values between 0 and 6.

3.4 Global and non-U.S. samples

We construct two samples: A global sample that includes borrowers from all countries and a non-U.S. sample that excludes borrowers from the United States. The global sample is larger, but the non-U.S. sample re-enforces exogeneity of credit risk and U.S. monetary policy and still preserves significant variation in microprudential powers across bank headquarters countries. (Conversely, we do not explore a sample that excludes U.S. banks because it does not support exogeneity and it reduces the variation.) The breakdown of the samples by bank country and borrower country is in table 3 and the descriptive statistics of our sample 4. Both samples are on a smaller side because of the demands of a identification scheme discussed later.

The analysis of the non-U.S. borrower sample complements and strengthens that of the global sample one for a couple of reasons. First, dropping loans made to U.S. borrowers reduces tremendously the weight in the sample of U.S. banks, which had operated in a strict and relatively stable supervisory and regulatory environment, and increases the weight of non-U.S. banks, which had experience numerous changes in their supervisory and regulatory environments. Therefore, we may identify more robust effects of supervisory and regulatory characteristics in the non-U.S. sample. Second, the findings for this non-U.S. borrower sample are of high interest in their own right: They may tell us about global risk-taking spillovers of U.S. monetary policy and inform us about their potential mitigants.

We cut the sample at 2014 because fast-changing supervisory and regulatory characteristics, in particular for European banks, which account for about 22 percent of sample observations, are not captured by the 2011 survey in Barth, Caprio, and Levine (2013). For instance, in response, to the GFC and the European sovereign and banking crises, the European Union adopted a number of initiatives in 2012 to create a safer banking system. These initiatives included the creation of the Single Supervisory Mechanism (SSM) and the Single Resolution Mechanism (SRM). The SSM, a supranational bank regulator and a part of the ECB, took over in late 2014 supervision of roughly 130 most significant banks in the euro area, a number of which shows up in our sample.[5] Less significant banks continue to be supervised by their national supervisors, but in close cooperation with the ECB.

In part, as a robustness check, we cut the sample at 2008 to show that the findings are not solely attributable to significant changes in supervisory characteristics in response to the GFC and the European sovereign and banking crises and to the federal funds rate being stuck at the zero lower bound since December 2008 with the Federal Reserves engaged in unconventional monetary policy.

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reference year up to the year of the next survey, effectively as in Karolyi and Taboada (2015).

[5]The ECB has the authority to conduct supervisory reviews and on-site inspections and investigations; grant or withdraw banking licenses; assess banks' acquisition and disposal of qualifying holdings ensure compliance with EU prudential rules; set higher capital requirements to counter any financial risks.

Table 3: Lists of sample bank and borrower countries

Bank countries	Percentage of obs.	Borrower countries	Percentage of obs.
Panel A. Global sample			
United States	37.7	United States	44.0
Taiwan	9.3	India	15.7
France	8.5	S. Korea	5.7
Japan	8.2	Hong Kong	4.6
Germany	7.7	China	4.1
United Kingdom	6.6	Turkey	2.5
Canada	4.2	United Kingdom	2.3
S. Korea	2.1	Taiwan	2.3
India	2.0	Phillipines	2.1
Italy	1.9	Malaysia	1.6
Panel B. Non-U.S. sample			
Taiwan	17.1	India	27.2
Japan	12.0	S. Korea	10.3
France	11.7	Hong Kong	8.4
Germany	10.3	China	7.3
United States	10.2	Turkey	4.3
United Kingdom	8.8	United Kingdom	4.2
India	3.7	Taiwan	4.2
S. Korea	3.7	Phillipines	3.8
Italy	3.2	Malaysia	2.9
Singapore	3.0	South Africa	2.0

Note. Top 10 of bank or borrower countries shown in each panel.

4 Global risk-taking channel: Banks

4.1 Regression model

We posit that banks take U.S. interest rates and other factors as given and makes their risk-taking decisions in response to these factors. We associate the U.S. policy rate with returns on safe, liquid assets. We posit that lenders conduct risk management at the highest level of consolidation. Therefore, we assign loans made by immediate lenders to their parent organizations, that is, ultimate lenders. For example, in the U.S. context, we assign a loan made by a bank to that bank's holding company.

We design our identification approach to deal with potential endogeneity of the riskiness of loans and U.S. monetary policy in multiple ways. First, we study ex ante risk-taking by banks that reflects their risk attitude and tolerance at the time of loan originations. This focus on a margin that is under the control of banks (in contrast to the riskiness of their overall portfolios which reflect cyclical changes in loan quality), reduces greatly concerns about endogeneity of risk and monetary policy (see Dell'Ariccia, Laeven, and Suarez (2017), Aramonte, Lee, and Stebunovs (2022), and Lee, Liu, and Stebunovs (2022)). Second, we saturate regression models with various time fixed effects to control for bank and borrower unobserved conditions. Third, we also estimate regression models on a sample that excludes U.S. borrowers where loans made by non-U.S. lenders to borrowers from emerging market economies represent a significant share of observations. This approach mimics the strategy of Jimenez, Ongena, Peydro, and Saurina (2014), who study Spanish banks' risk-taking in response to euro-area policy rates. They consider the ECB's monetary policy to be exogenous to the credit risk that the country's banks face. Ioannidou, Ongena, and Peydro

(2015) study the risk-taking channel of monetary policy in Bolivia, a dollarized country where monetary changes are transmitted exogenously from the USA. They find that a lower policy rate spurs the granting of riskier loans, to borrowers with worse credit histories, lower ex-ante internal ratings, and weaker ex-post performance.

We exploit differences in characteristics of banks lending to the same borrowers, similar to Khwaja and Mian (2008)'s approach. We identify the effects of interest through interaction terms (as in Kashyap and Stein (2000)). In contrast to the typical approach in the literature on a risk-taking channel of monetary policy to put a loan rating or a probability of loan/borrower default on the left in regression models, we use loan amounts as in Altavilla, Boucinha, Peydro, and Smets (2019), and we interact a loan risk characteristic with policy rates on the right. We include various time fixed effects to control for unobserved factors. Recall that each syndicated lender holds a share in a given syndicate. We will refer to those shares as loans.

We write down a regression model with multiple interaction terms and then group the terms based on their economic meaning:

$$\begin{aligned} log(Loan_{j,b,l,t}) = {} & \gamma log(EDF_{j,b,t}) + \beta_P PCA_{l,t} \\ & + \theta_{PR} PCA_{l,t} \times R_t \\ & + \underbrace{\theta_{EP} log(EDF_{j,b,t}) \times PCA_{l,t}}_{structural\ mitigation\ of\ risk-taking} \\ & + \underbrace{\underbrace{\theta_{ER} log(EDF_{j,b,t}) \times R_t}_{gross\ risk-taking\ channel\ of\ MP} + \underbrace{\theta_{ERP} log(EDF_{j,b,t}) \times R_t \times PCA_{l,t}}_{mitigation\ of\ risk-taking\ channel\ of\ MP}}_{net\ risk-taking\ channel\ of\ MP} \\ & + \alpha_b + \alpha_l + \phi_{b,t} + \phi_{l,t} + \varepsilon_{j,b,l,t} \end{aligned} \tag{1}$$

where $Loan_{j,b,l,t}$ is bank l's loan j (a stake in a syndicate) made to borrower b at time t. $EDF_{j,b,t}$ is an EDF for borrower b over a horizon that matches the maturity of loan j. Note that we estimate a semi-log model with a log of EDF because of the pronounced skewness of the distributions of $Loan_{j,b,l,t}$s and $EDF_{j,b,t}$s. $PCA_{l,t}$ is a PCA index at time t of a country where bank l is headquartered. R_t is a U.S. policy rate, which is the federal funds rate before the zero lower bound and the Wu and Xia (2016) shadow federal funds rate during it. α_l and α_b are bank and borrower fixed effects, respectively. $\phi_{b,t}$ and $\phi_{l,t}$ are time fixed effects for borrower b and lender l, respectively, and they vary across specifications. These fixed effects for various combinations of local and global factors and bank and borrower characteristics.[6] $\varepsilon_{j,b,l,t}$s are error terms. We double-cluster errors by time and bank to control for the dependence of observations within time and within banks.[7]

We focus on the regression coeffiecients for the terms that include $log(EDF)$ because they capture directly credit risk management by banks in response to structural and cyclical factors. That said, the terms that include PCA but exclude EDF could be meaningful too. For example,

[6]For example, global push factors include risk appetite, economic uncertainty, and the U.S. dollar exchange rate and local pull factors include economic growth and interest rates in borrower countries.

[7]We rely on Correia (2016)'s estimator for linear models with multi-way fixed effects and error clustering.

bank supervisors may want banks to reduce their exposures to individual borrowers regardless their credit risk or curb their participation in loan syndication more generally. While this approach may be seen as a risk management practice too, it is less direct.

The hypotheses about structural mitigation of risk-taking follow from the strand on the effectiveness of microprudential tools and other mechanisms in reducing build-ups in ex ante credit risk. For example, Delis and Staikouras (2011) find that effective supervision and market discipline requirements are important and complementary mechanisms in reducing bank fragility. Beltratti and Stulz (2012) evaluate the importance of factors that have been put forth as having contributed to the poor (stock returns) performance of banks during the GFC. Among other things, they find that differences in banking regulations across countries are generally uncorrelated with the performance of banks during the crisis, except that large banks from countries with more restrictions on bank activities performed better and decreased lending less. As for the recent euro-area experience, Haselmann, Singla, and Vig (2019) show that banks under the single supervisory mechanism report higher risk weights, higher probability of default, and lower collateral to loan ratios for exposures to the same firms than banks under lenient national supervision. This differential regulatory treatment results in higher capital charges for banks under the Single Supervisory Mechanism, ultimately curtailing their holdings of risky assets.

The second coefficient—that on the interaction of $log(EDF)$ and a U.S. policy rate—captures a risk-taking channel of U.S. monetary policy. Based on the finding in the literature, we hypothesize a negative coefficient: Lenders lend more to more risky borrowers in response to a policy easing. To set a baseline for this coefficient, we estimate a version of model 1 which omits supervision terms.

The third coefficient—that on the interaction of $log(EDF)$ and a supervision characteristic—informs about general mitigation of risk through stricter supervision. We generally hypothesize a negative coefficient as well: Lenders that face more scrutiny or stricter regulation lend in general less to more risky borrowers.

Finally, the third coefficient— that on the triple interaction of $log(EDF)$, a supervision characteristic, and a U.S. policy rate—captures mitigation of a risk-taking channel of U.S. monetary policy through supervision. We hypothesize a positive coefficient: Lenders that face more scrutiny or stricter regulation lend less to riskier borrowers in response to a policy easing. The literature on the effectiveness of PCA characteristics in mitigating a (global) risk-taking channel of monetary policy appears to be more limited and but does offer a few clues. Altavilla, Boucinha, Peydro, and Smets (2019) finds that stricter official supervision, vaguely defined, may help under certain economic conditions. Lee, Liu, and Stebunovs (2022) find that risk-taking of U.S. banks to changes in U.S. interest rates is less sensitive than that of non-U.S. banks and that of non-banks. They speculate that one of the reasons is that U.S. banks are subject to stricter supervision and regulation than banks in other countries or non-banks in general.

Admittedly, our approach may be subject to attenuation bias. While we explicitly control for supervisory power, we do not control for its usage. After all, supervisors may not exercise their power in full and hence we may mitigate risk-taking by banks to a lesser extent. Alas, we cannot control for the usage.[8] So, our estimates may underestimate the true effectiveness of supervisory

[8]In this vein, Cihak and Tieman (2008) compare data on regulation and supervision "on the books" with

powers in mitigating risk-taking.

Table 4: Descriptive statistics for the entire sample

	Global sample					Non-U.S. sample				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	mean	sd	p50	p75	p95	mean	sd	p50	p75	p95
Panel A. Entire sample, 1995-2014										
log(loan)	2.94	1.07	2.97	3.69	4.68	2.76	1.01	2.71	3.40	4.51
log(EDF)	-0.12	1.29	-0.09	0.85	1.81	0.11	1.21	0.18	1.03	1.78
PCA	3.65	2.52	5.00	6.00	6.00	3.20	2.66	4.00	6.00	6.00
R	2.05	3.01	2.01	5.19	5.92	2.19	2.94	2.49	5.22	5.76
Observations	8877					4829				
Panel B. Pre-tightening sample, 1995-2008										
log(loan)	2.80	1.04	2.71	3.40	4.50	2.70	0.94	2.66	3.25	4.29
log(EDF)	-0.10	1.31	-0.10	0.86	1.91	-0.04	1.22	-0.06	0.86	1.74
PCA	2.86	2.47	4.00	5.00	6.00	2.43	2.57	2.00	5.00	6.00
R	4.00	1.70	4.74	5.26	6.40	3.95	1.65	4.54	5.25	6.27
Observations	5721					3254				

Note. The non-U.S. sample excludes U.S. borrowers. SD stands for standard deviation; p50, p75, and p95 for the 50th, 75th, and 95th percentile, respectively.

Table 4 shows the descriptive statistics for both the global and non-U.S. samples. Because of the pronounced skewness of the distributions of some of the variables, we focus on comparing the medians instead of the means. In the global sample, the loans are larger and safer and supervisors have more powers. The variation in all variables is is about the same between the samples.

4.2 Results for the entire period

The estimation results for the key coefficients in table 5 show that microprudential powers reduce the global supply of risky U.S. dollar corporate loans and that banks increase the global supply of risky loans in response to a U.S. monetary policy easing, with microprudential powers substantially mitigating this increase. In the table, the first four columns show the results for the global sample and the remaining four columns for the non-U.S. sample. Each column in each set shows the results for a regression model with a particular combination of bank- and borrower-side (time-varying) fixed effects. In columns 1 and 5, we include bank-country and borrower-country time fixed effects. In columns 2 and 6, we include individual bank time fixed effects and borrower-country time fixed effects. In columns 3 and 7, we retain individual bank time fixed effects but replace borrower-country time fixed effects with borrower-industry time fixed effects. We sort borrowers into 17 Fama-French's industry groups based on borrower four-digit SIC codes. Finally, in our most stringent specification in columns 4 and 8, we retain individual bank time fixed effects but replace borrower-industry time fixed effects with individual borrower time fixed effects. Going from the base specification to the most stringent one halves the number of observations.

data on supervisory implementation from IMF-World Bank assessments of compliance with international standards and codes. They find that datasets focusing only on regulations on the books have low correlation with standard and codes assessments from IMF-World Bank assessments.

We find evidence of a global quantitative risk-taking channel of U.S. monetary policy for riskier borrowers (with ex ante probability of default of over 1 percent, which corresponds to non-IG borrowers) across all the specifications of the controls. Conversely, we find that the size of loans to safer borrowers (with ex ante probability of default of over 1 percent, which corresponds to IG borrowers) shrinks when the policy rate decreases. (Looking at the distribution of $EDFs$ in table 4, only median and below median EDF borrowers in the global sample fall into the IG borrower category.)

We gauge the marginal effects of microprudential powers and U.S. monetary policy for the estimation results in columns (4) and (8) because they correspond to the specifications with the most robust controls. We present the estimates of the effects in table 6. Beginning with the structural mitigation, we evaluate the marginal effect of an increase in PCA as follows: $\Delta\%Loan = 100 \times \widehat{\theta_{EP}} log(EDF) \times \Delta PCA$, where $log(EDF)$ is fixed at a certain percentile of its distribution. While the estimated marginal effects are around zero percent for safe loans (when $log(EDF)$ is set at the medians in either the global or non-U.S. sample), they range from -1.5 percent to -2.9 percent for risky loans (when $log(EDF)$ is set to the 75th percentile of the distribution in the global and non-U.S. sample, respectively). The marginal effect for the non-U.S. sample is higher in absolute terms mostly because non-U.S. borrower loans are riskier and, to some extent, because the regression coefficient for the non-U.S. sample is larger in absolute terms.

Table 5: Regressions for a PCA-mitigated risk-taking channel of U.S. monetary policy

	Global sample				Non-U.S. sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log(EDF) × PCA	-0.013**	-0.020***	-0.017**	-0.017**	-0.022***	-0.031***	-0.030***	-0.028***
	(-2.344)	(-2.708)	(-2.347)	(-2.567)	(-2.850)	(-3.116)	(-3.004)	(-3.110)
log(EDF) × R	-0.056***	-0.081***	-0.092***	-0.115***	-0.142***	-0.168***	-0.165***	-0.174***
	(-3.027)	(-3.252)	(-2.875)	(-3.078)	(-3.133)	(-3.152)	(-3.043)	(-2.919)
log(EDF) × R × PCA	0.003**	0.005***	0.004**	0.005***	0.005***	0.007***	0.007***	0.007***
	(2.092)	(2.693)	(2.567)	(2.738)	(2.791)	(2.689)	(2.721)	(2.747)
Num. of observ.	8877	6178	6130	6015	4829	2893	2875	2847
R-sq. adj.	0.77	0.72	0.70	0.75	0.77	0.70	0.70	0.75
RMSE	0.51	0.59	0.61	0.55	0.48	0.58	0.58	0.54
Bank-country TFE	Y	N	N	N	Y	N	N	N
Borrower-country TFE	Y	Y	N	N	Y	Y	N	N
Borrower-industry TFE	N	N	Y	N	N	N	Y	N
Bank TFE	N	Y	Y	Y	N	Y	Y	Y
Borrower TFE	N	N	N	Y	N	N	N	Y

t statistics in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$
Note. The left hand side variableis log(loans). Select regression coefficients are shown. TFE stands for time fixed effects. Regressions that exclude bank TFE or borrower TFE include individual bank and borrower fixed effects. Errors are clustered by bank and month.

On surface, there is an upper limit on the structural mitigating effects. On the one hand, the median PCA indexes in the global sample is just one notch and in the non-U.S. sample 2 nothces below the maximum on Barth, Caprio, and Levine (2013)'s scale of microprudential powers. Thus, new gains from further empowering bank supervisors would be limited. On the other hand, bank supervisors could increase the intensity of applying their existing powers, which could boost the effectiveness of mitigation. (As we discussed earlier, our estimation results capture a combined effect of the powers and the typical intensity of their use. Because of data limitations, we cannot estimate the separate effects of the two.)

Moving to the cyclical factors (a typical risk-taking channel and its mitigation through bank supervision), the marginal effect of a policy rate cut on the size of loans depends on credit risk of loans. To gauge the effect, we use this formula: $\Delta\%Loan = 100 \times \widehat{\theta_{EP}} log(EDF) \times \Delta R$, where $log(EDF)$ is fixed at a certain percentile of its distribution. The marginal effect of a 1 percentage point cut in the policy rate on the size of risky loans ranges between 9.8 percent and 17.9 percent, for the global and non-U.S. samples, respectively. These effects for safer loans are significantly smaller (-1 percent and 3 percent, respectively).

Table 6: Marginal effects

	Global sample		Non-U.S. sample	
	p50	p75	p50	p75
Structural mitigation	0.15	-1.45	-0.50	-2.88
Gross risk-taking channel	-1.04	9.78	3.13	17.92
Mitigation of the channel	0.18	-1.70	-0.50	-2.88
Net risk-taking channel	-0.86	8.08	2.63	15.04

Note. percentage change in loan size in response to percentage change in something else. Edfs are from desc stats tables. Reg coefs are for specs with bank TFE and borrower TFE. level PCA is 4; delta PCA is 1; and delta R is 1.

The mitigating effects of bank supervision on the risk-taking channel are economically meaningful. Setting the PCA index at 4 and assuming a 1 percentage point cut in the policy rate, microprudential powers reduce the size of risky loans by 1.7 percent in the global sample and by 2.9 percent in the non-U.S. sample (with the difference in effectiveness reflecting the difference in credit risk and, to a lesser extent, the difference in the regression coefficients). Microprudential powers offset an increase in the size of risky loans in response to a 1 percentage point cut in the policy rate by 17 percent in the global sample and by 16 percent the non-U.S. sample.[9] Hence, conditional on bank supervision, the overall marginal effects of U.S. policy rates on the size of risky loans ranges from 8 percent to 15 percent.

As we discussed earlier, agents and arrangers retain larger shares in syndicated loans post origination. Therefore, their participation in risky lending may be more evident to bank supervisors. Second, agents and arrangers tend to be larger banks, which likely implies that supervisors pay more attention to them.[10] In the analysis, we do not differentiate the reasons, in part, because we have data neither on the sample loans post origination (for risk retention analysis) nor on the extent of supervisory attention (such as prompt corrective action notices, on-sight inspections, and so on).

[9]We note that the median PCA in the global sample is 5, so, effectively, the mitigating effect of bank supervisors in the global sample is nearly 22 percent.

[10]Hirtle, Kovner, and Plosser (2020) use U.S. data on supervisors' time use to show that the top-ranked banks by size within a supervisory district receive more attention from supervisors, even after controlling for size, complexity, risk, and other characteristics. Using a matched sample approach, we find that these top-ranked banks that receive more supervisory attention hold less risky loan portfolios, are less volatile, and are less sensitive to industry downturns, but do not have lower growth or profitability.

4.3 Results for the period before supervisory tightening

We have three reasons to repeat the analysis for the period before supervisory and regulatory tightening that followed the GFC. First, we want to establish whether the authority for prompt corrective action was effective prior to the tightening, when PCAs were lower. Second, PCA might been used more intensively post the GFC, which could have driven the results in the entire sample results. Three, we want to establish that the results for the entire sample are not driven by unconventional monetary policies, which we capture with the shadow policy rate.

Panel B in table 4 shows descriptive statistics for the sample spanning the 1995-2008 period. Comparing the medians in this table across the periods: In the global sample, loans are materially smaller, similarly risky; supervisors have a lot less power. In the entire sample, loans are roughly of the same size, significantly safer, and supervisors have again a lot less power. To reiterate, the comparison illustrates the outcome of a global supervisory tightening: The median PCA is up 1 (reaching 5 out of the maximum of 6) and 2 (jumping to 4), respectively, in the global and non-U.S. sample. (Variation in powers is about the same.)

Table 7: Regressions for a PCA-mitigated risk-taking channel of U.S. monetary policy

	Global sample				Non-U.S. sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log(EDF) × PCA	-0.005	-0.016***	-0.012**	-0.010*	-0.022**	-0.031***	-0.031***	-0.031***
	(-0.653)	(-2.925)	(-2.025)	(-1.742)	(-2.466)	(-5.882)	(-5.912)	(-6.002)
log(EDF) × R	-0.073	-0.121**	-0.163***	-0.180***	-0.182**	-0.229***	-0.254***	-0.261***
	(-1.586)	(-2.287)	(-2.747)	(-2.908)	(-2.477)	(-2.948)	(-3.091)	(-3.072)
log(EDF) × R × PCA	0.001	0.004***	0.003**	0.003**	0.005**	0.007***	0.007***	0.007***
	(0.585)	(2.681)	(2.190)	(2.097)	(2.325)	(3.704)	(3.664)	(3.900)
Num. of observ.	5721	3999	3972	3914	3254	2053	2044	2029
R-sq. adj.	0.75	0.71	0.69	0.74	0.75	0.71	0.71	0.75
RMSE	0.52	0.59	0.60	0.55	0.46	0.54	0.54	0.50
Bank-country TFE	Y	N	N	N	Y	N	N	N
Borrower-country TFE	Y	Y	N	N	Y	Y	N	N
Borrower-industry TFE	N	N	Y	N	N	N	Y	N
Bank TFE	N	Y	Y	Y	N	Y	Y	Y
Borrower TFE	N	N	N	Y	N	N	N	Y

t statistics in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$
Note. The left hand side variable is log(loan). Select regression coefficients are shown. TFE stands for time fixed effects. Regressions that exclude bank TFE or borrower TFE include individual bank and borrower fixed effects. Errors are clustered by bank and month.

We show the estimation results for the pre-regulatory tightening period in table 7. They are quantitatively similar to those for the 1995-2014 sample: Microprudential powers reduce the global supply of risky U.S. dollar corporate loans and banks increase the global supply of risky loans in response to a U.S. monetary policy easing, with microprudential powers substantially mitigating this increase. The statistical significance of the regression coefficients and the measures of statistical fit are similar, too.

To ease the quantitative comparison of the results for the entire and pre-regulatory tightening periods, we pull regression coefficients results from 5 and 7 in one table, see table 8. The structural mitigating effects of PCA are very similar in magnitude within the global samples and the non-U.S. samples (η_{EP}s are about the same). The risk-taking channel is significantly weaker in the entire sample (η_{ER} is significantly lower.) It is possibly that factors not captured by the analysis, such as

regulatory developments that followed the Global Financial crisis, weakened the gross risk-taking channel. The results for the mitigating effect of local supervision on the risk-taking channel vary across the global and non-U.S. samples, but are roughly similar within the global samples and the non-U.S. samples.

Table 8: Comparison of regression coefficients

	Global sample		Non-U.S. sample	
	'95-'14	'95-'08	'95-'14	'95-'08
Structural mitigation ($\widehat{\eta_{EP}}$)	-0.017	-0.010	-0.028	-0.031
Gross risk-taking channel ($\widehat{\eta_{ER}}$)	-0.115	-0.180	-0.174	-0.261
Mitigation of the channel ($\widehat{\eta_{ERP}}$)	0.005	0.003	0.007	0.007

Note. Based on columns (4) and (8) for the global and non-U.S. sample of tables 5 and 7.

5 Global risk-taking channel: Non-banks

The literature suggest that supervisory and regulatory pressures on banks may open the proverbial door for non-banks to take over originations of riskier loans from banks, leaving overall originations of these loans unaffected. For example, Kim, Plosser, and Santos (2018) find that the 2013-14 U.S. interagency guidance on leveraged lending (a novel macroprudential tool) caused a migration of leveraged lending from closely supervised banks to non-banks. However, the economic significance of such leakages in the sample is modest because the share of loan originations by non-banks still remained low. Nonetheless, their finding cast doubts about the overall effectiveness of macroprudential regulations in reducing risks to financial stability that leveraged loans pose. In turn, we examine the role of local bank supervision in shaping risk-taking by non-banks—both in general and in response to U.S. monetary policy.

5.1 Regression specifications

We devise a new regression model to test whether more powerful bank supervision boosts the supply of loans by non-banks—both in general and in response to a monetary policy easing. Because non-banks appear in the data only sporadically, we cannot adopt equation 1 with its elaborate fixed effects for individual lenders. Consequently, we analyze non-bank participation at a higher level of aggregation, without differentiating individual non-banks. We define the left-hand side variable as a percentage share of lending by non-banks in a syndicate (recall a syndicate structure from diagram 1). And, on the right-hand side, we place the terms that include a weighted average of PCAs faced by lead banks in that syndicate. While we do not include borrower fixed effects, in part to boost the degrees of freedom, we do control for demand more broadly thorough other fixed effects.

$$
\begin{aligned}
NBS_{j,b,t} = ... + \overline{PCA}_{j,t} \\
+ \quad & \underbrace{\eta_{EP} log(EDF_{j,b,t}) \times \overline{PCA}_{j,t}}_{structural\ amplification\ of\ risk-taking} \\
+ \quad & \underbrace{\underbrace{\eta_{ER} log(EDF_{j,b,t}) \times R_t}_{gross\ risk-taking\ channel\ of\ MP} + \underbrace{\eta_{ERP} log(EDF_{j,b,t}) \times R_t \times \overline{PCA}_{j,t}}_{amplification\ of\ risk-taking\ channel\ of\ MP}}_{net\ risk-taking\ channel\ of\ MP} + ...
\end{aligned}
\tag{2}
$$

We estimate the following linear regression model:

$$
\begin{aligned}
NBS_{j,b,t} = & \gamma log(EDF_{j,b,t}) + \beta_P \overline{PCA}_{j,t} + \eta_{RP} R_t \times \overline{PCA}_{j,t} \\
+ \quad & \underbrace{\eta_{EP} log(EDF_{j,b,t}) \times \overline{PCA}_{j,t}}_{structural\ amplification\ of\ risk-taking} \\
+ \quad & \underbrace{\underbrace{\eta_{ER} log(EDF_{j,b,t}) \times R_t}_{gross\ risk-taking\ channel\ of\ MP} + \underbrace{\eta_{ERP} log(EDF_{j,b,t}) \times R_t \times \overline{PCA}_{j,t}}_{amplification\ of\ risk-taking\ channel\ of\ MP}}_{net\ risk-taking\ channel\ of\ MP} \\
& + \alpha_b + \phi_{b,t} + \varepsilon_{j,b,t}
\end{aligned}
\tag{3}
$$

where $NBS_{j,b,t}$ is a percentage share of non-banks (based on loan volume) in syndicate j made to borrower b at time t. $\overline{PCA}_{j,t}$ is weighted average of PCAs at time t of the countries where lead banks of syndicate j are head-quartered. As earlier, $EDF_{j,b,t}$ is an EDF at a horizon that matches the maturity of syndicate j; R_t is the U.S. monetary policy rate, which is the federal funds rate before the zero lower bound or the Wu-Xia shadow rate during it. α_b is either a borrower country or borrower industry fixed effect. $\phi_{b,t}$ is a (borrower-related) time fixed effect, which varies across specifications (simple time fixed effect, borrower-country time fixed effect, or borrower-industry time fixed effect). $\varepsilon_{j,b,t}$s are white noise errors. We cluster errors by time. As a robustness check, we estimate the model with the left hand side variable transformed into an odd ratio ($log(NBS)/(1-NBS)$) to bound the left-hand side variable and predicted values to be between 0 and 1. The estimation results produce the same signs and similar levels of statistical significance (not shown).

We identify the effects of interest through interaction terms that include $log(EDF_{j,b,t})$.[11] We label the first such interaction term $\eta_{EP} log(EDF_{j,b,t}) \times \overline{PCA}_{j,t}$ as "general amplification of risk-taking". We label the two remaining terms $\eta_{ER} log(EDF_{j,b,t}) \times R_t$ and $\eta_{ERP} log(EDF_{j,b,t}) \times R_t \times \overline{PCA}_{j,t}$ as a non-bank risk-taking channel of U.S. monetary policy and its PCA-induced amplifcation, respectively.

We hypothesize: A positive coefficient η_{EP} (more powerful supervision limits risk-taking by banks, with non-banks taking advantage); a negative coefficient η_{ER} (non-banks take up larger shares in risky syndicates in response to a U.S. monetary policy easing); and a negative coefficient

[11] The terms that include PCA but not EDF could also have an economically meaningful interpretation. For example, supervisors might exercise their powers to pressure banks to reduce exposures to syndicated loan borrowers for other reasons than concerns about credit risk, opening the door for non-bank participation.

η_{ERP} (non-banks take up even a larger share in a risky syndicate in response to a policy easing when lead banks face more powerful supervisors).

Table 9: Descriptive statistics for non-bank regressions

	mean	sd	p50	p75	p95
% share of non-banks in a syndicate, pct	7.51	13.23	0.00	10.00	37.50
log(EDF)	0.20	1.29	0.24	1.11	2.12
$\overline{PCA}$	3.34	1.60	3.50	4.64	5.96
R	2.17	3.02	2.01	5.25	6.00
Number of observations	2296				

Note. For each syndicate, prompt corrective power is a weighted average of this characteristic in countries where agent and arranger banks of that syndicate are headquartered.

We show the descriptive statitistics for the sample, which spans the 1995-2014 period, in table 9. We rely on Refinitiv Loan Connector's classification of lenders to identify non-banks in loan syndicates. The distribution of non-bank share is right-skewed, with the median of 0 percent amd the mean of 7.5 percent. Non-banks' participation in loan originations is a new phenomenon, so most of loans with non-zero nonbank shares were in the later sample years. (The figures for non-bank participation in new leveraged loans are also low in Kim, Plosser, and Santos (2018).) The syndicates in the non-bank sample—with the median EDF of 1.27 percent—tend to riskier than those in the global bank sample (see table 4). The index of supervision power is only 2, significantly lower than that in the global sample.

5.2 Results

The estimation results in table 10 show evidence of "microprudential leakages". First, as hypothesized, non-banks take up a larger share in a risky syndicate where the banks face more powerful supervisors ($\widehat{\eta_{EP}} > 0$) is positive and statistically significant). Second, in contrast to the hypothesis, non-banks take up a smaller share in a risky syndicate in response to a U.S. monetary policy tightening ($\widehat{\eta_{ER}} > 0$). Third, as hypothesized, in response to a U.S. monetary policy tightening, non-banks take a larger share in a risky syndicate where the banks face more powerful supervisors ($\widehat{\eta_{ERP}} < 0$). Evaluating the net effect of the two risk-taking channel terms suggests that non-banks do take up a larger share in a risky syndicate in response to an U.S. monetary policy easing when the banks face supervisors with powers slightly higher than the sample median ($(\widehat{\eta_{ER}} + \widehat{\eta_{ERP}} \times \overline{PCA}) < 0 \, if \, \overline{PCA} > 4$). Put differently, the results imply that a non-bank risk taking channel of U.S. monetary policy is a consequence of powerful local bank supervisors. While the economic significance of these findings is limited (because as in Kim, Plosser, and Santos (2018), non-banks play only a minor role in loan originations in our sample), the findings still provide important insights about unintended side effects of bank supervision that are relevant for the present time, as non-bank participation in loan syndication and in unintermediated lending, such as private credit, has been on a rise.

Table 10: Regressions for a global risk-taking channel for non-banks

	(1)	(2)	(3)
log(EDF) × $\overline{PCA}$	0.687***	0.644***	0.736**
	(3.751)	(2.686)	(2.527)
log(EDF) × R	0.800***	1.213***	1.026***
	(2.848)	(3.075)	(2.786)
log(EDF) × R × $\overline{PCA}$	-0.187**	-0.225**	-0.303***
	(-2.328)	(-2.251)	(-2.870)
Num. of observ.	2296	1752	1514
R-sq. adj.	0.17	0.19	0.26
RMSE	12.04	12.28	11.71
Borr. country FE	Y	N	Y
Borr. industry FE	Y	Y	N
Time FE (TFE)	Y	N	N
Borr. country TFE	N	Y	N
Borr. industry TFE	N	N	Y

t statistics in parentheses
* $p < .1$, ** $p < .05$, *** $p < .01$
Note. Based on the global sample. Select coefficients are shown. The left hand side variable is the percentage share of non-banks in a syndicate, percent. Select regression coefficients are shown. $\overline{PCA}$ is the average power that a syndicate's banks face in their headquarters countries. Borrower industries broken into Fama-French 17 industry groups. Errors are clustered by time.

6 Why does PCA have a mitigating effect?

The authority of PCA is multifaceted, with Barth, Caprio, and Levine (2013) placing the power of early intervention at its core in the construction of PCA index (see table 2). While all the PCA powers could have a mitigating effect on risk-taking by banks, some could have stronger effects than others. Because of the richness of the data, we can examine the effect of each of the PCA powers.

6.1 Regression model

We estimate re-estimate equation 1 with the index for PCA replaced with one of its components at a time. As a reminder, each PCA component is dummy indicating whether a given sup has a certain power or not.

6.2 Estimation results

We show the detailed results for components in tables 11 to 13. For each PCA comp, we show the results only for two regression model specification: the least stringent (with the largest sample) and the most stringent (with the smallest sample). As earlier, we estimate the equation for the entire sample and for the sample that excludes U.S. borrowers, and hence, has a significantly weaker presence of U.S. banks.

Out of the six components, only four have statistically significant mitigating effects, and these four have either allow for supervisors to put quickly a stop to questionable acitivity or to penalize

Table 11: Regressions for early intervention and cease & desist powers

	Early intervention				Cease & desist			
	Global sample		Non-U.S. sample		Global		Non-US	
log(EDF) × authority	-0.051*	-0.081**	-0.095***	-0.137***	-0.054	-0.087**	-0.062	-0.100**
	(-1.832)	(-2.389)	(-2.697)	(-3.493)	(-1.640)	(-2.392)	(-1.545)	(-2.052)
log(EDF) × R	-0.048***	-0.096**	-0.117***	-0.144**	-0.049***	-0.099**	-0.116***	-0.148**
	(-2.798)	(-2.463)	(-2.824)	(-2.346)	(-2.667)	(-2.577)	(-2.727)	(-2.308)
log(EDF) × authority × R	0.011	0.021***	0.023***	0.030***	0.012**	0.023***	0.015	0.029**
	(1.608)	(2.681)	(2.753)	(3.081)	(1.976)	(2.676)	(1.526)	(2.254)
Num. of observ.	9672	6589	5447	3264	9310	6258	5252	3078
R-sq. adj.	0.77	0.75	0.77	0.75	0.77	0.75	0.77	0.75
RMSE	0.51	0.55	0.49	0.54	0.51	0.56	0.49	0.54
Bank-country TFE	Y	N	Y	N	Y	N	Y	N
Borrower-country TFE	Y	N	Y	N	Y	N	Y	N
Borrower-industry TFE	N	N	N	N	N	N	N	N
Bank TFE	N	Y	N	Y	N	Y	N	Y
Borrower TFE	N	Y	N	Y	N	Y	N	Y

t statistics in parentheses
Note. TFE stands for time fixed effects. Regressions that exclude bank TFE or borrower TFE include individual bank and borrower fixed effects. Errors are clustered by bank and month.
* $p < .1$, ** $p < .05$, *** $p < .01$

share holders or bank managers. Specifically, they are early automatic intervention authority, cease and desist order, suspension of dividends, suspension of management bonuses and fees. [12]

Our findings about the timing of formal enforcement actions echoes those of the banking supervision literature. For example, Delis, Staikouras, and Tsoumas (2017) find, albeit with some limitations, that the longer the actions are deferred relative to the deterioration of a bank's financial condition, the more limited their effect on the risk-based capital ratio. That is, Delis, Staikouras, and Tsoumas (2017)'s results are consistent with the idea that an action deferral enables a bank to take more risks which ultimately reduce its financial soundness.

Table 12: Regressions for force loss provisions and dividend suspension powers

	Force provision				Dividend suspension			
	Global sample		Non-U.S. sample		Global		Non-US	
log(EDF) × authority	0.044	0.056	-0.114	-0.047	-0.120**	-0.150**	-0.238***	-0.302***
	(0.857)	(1.036)	(-1.476)	(-0.826)	(-2.273)	(-2.346)	(-3.214)	(-3.324)
log(EDF) × R	-0.027	-0.073*	-0.127***	-0.137*	-0.072***	-0.116***	-0.156***	-0.189***
	(-1.255)	(-1.748)	(-2.694)	(-1.954)	(-3.492)	(-2.935)	(-3.774)	(-2.997)
log(EDF) × authority × R	-0.013	-0.010	0.023	0.011	0.034**	0.035**	0.056***	0.063***
	(-1.126)	(-0.712)	(1.239)	(0.500)	(2.539)	(2.234)	(3.117)	(2.916)
Num. of observ.	9345	6278	5287	3098	9257	6211	5208	3037
R-sq. adj.	0.77	0.75	0.77	0.74	0.77	0.75	0.77	0.75
RMSE	0.51	0.56	0.49	0.54	0.51	0.56	0.49	0.54
Bank-country TFE	Y	N	Y	N	Y	N	Y	N
Borrower-country TFE	Y	N	Y	N	Y	N	Y	N
Borrower-industry TFE	N	N	N	N	N	N	N	N
Bank TFE	N	Y	N	Y	N	Y	N	Y
Borrower TFE	N	Y	N	Y	N	Y	N	Y

t statistics in parentheses
Note. TFE stands for time fixed effects. Regressions that exclude bank TFE or borrower TFE include individual bank and borrower fixed effects. Errors are clustered by bank and month.
* $p < .1$, ** $p < .05$, *** $p < .01$

As for our findings about the effectiveness of payout suspensions, the literature—for example,

[12]The results for fee/bonus suspension are statistically significant only in the sample that excludes U.S. borrowers. This finding does not necessarily indicate that such authority is ineffective in the United States, because it may be an econometric issue due to limited variation issue in the variable.

Pugachev (2019)—finds that, in the United States, enforcement actions that restrict payouts, but not other enforcement actions, elicit negative abnormal returns in their aftermath. Moreover, Pugachev (2019)'s results on the cross-section of abnormal returns suggest that risk-shifting from equity holders, in particular, inside owners, towards other claimants, rather than agency cost-reduction, drives payouts and supports the value of bank equity.

Table 13: Regressions for bonus suspension and force reorganization powers

	Bonus suspension				Force reorganization			
	Global sample		Non-U.S. sample		Global		Non-US	
log(EDF) × authority	-0.048	-0.022	-0.163***	-0.185***	-0.028	0.017	-0.034	-0.032
	(-0.927)	(-0.350)	(-2.625)	(-3.022)	(-1.437)	(0.566)	(-0.889)	(-0.515)
log(EDF) × R	-0.068	-0.166**	-0.169**	-0.265***	-0.036*	-0.070*	-0.104**	-0.110
	(-1.578)	(-2.501)	(-2.574)	(-2.841)	(-1.959)	(-1.755)	(-2.187)	(-1.487)
log(EDF) × authority × R	0.009	0.009	0.038***	0.046***	-0.002	-0.015	0.001	-0.019
	(0.689)	(0.618)	(2.642)	(3.034)	(-0.251)	(-1.213)	(0.066)	(-0.588)
Num. of observ.	5908	3983	3378	2074	9597	6557	5373	3234
R-sq. adj.	0.75	0.74	0.75	0.75	0.77	0.75	0.77	0.75
RMSE	0.52	0.55	0.47	0.50	0.51	0.54	0.48	0.53
Bank-country TFE	Y	N	Y	N	Y	N	Y	N
Borrower-country TFE	Y	N	Y	N	Y	N	Y	N
Borrower-industry TFE	N	N	N	N	N	N	N	N
Bank TFE	N	Y	N	Y	N	Y	N	Y
Borrower TFE	N	Y	N	Y	N	Y	N	Y

t statistics in parentheses
Note. TFE stands for time fixed effects. Regressions that exclude bank TFE or borrower TFE include individual bank and borrower fixed effects. Errors are clustered by bank and month.
* $p < .1$, ** $p < .05$, *** $p < .01$

All in all, credit decisions cannot be explained without understanding the incentives of banks—their managers and shareholders. Our findings shed some light on the these incentives. Suspending bonuses affects managers directly, suspending dividends does so indirectly by rattling the shareholders and causing them to pressure the managers into curbing risk-taking.

7 Conclusions

We examine how national supervisory frameworks affect global risk-taking in lending by financial intermediaries. Using the global syndicated loan market and exploiting variation in prompt corrective action (PCA) authority across countries and time, we provide three main findings. First, PCA authority materially reduces banks' supply of risky loans globally and significantly dampens the risk-taking channel of monetary policy. Second, PCA works primarily through components that address commitment problems in supervision and moral hazard problems in banking. Early intervention authority matters because automatic triggers remove supervisor discretion and protect against political pressure. Authority to suspend dividends and management compensation shows the strongest effects, consistent with these tools aligning bank insider incentives with creditor interests. This provides evidence that effective supervision requires tools that credibly constrain bank behavior. Third, non-banks partially fill the gap created by constrained banks, though the economic magnitude of these leakages was limited during our sample period. This finding has important policy implications for institutional design and system-wide regulation.

Our findings contribute to several policy debates. On **monetary-supervisory complementarity**, traditional policy frameworks emphasize "decoupling"—monetary policy focuses on price stability while supervisory tools handle financial stability. Our evidence suggests these tools are more complementary than this framework assumes. Supervisory strength materially affects how monetary policy transmits through the banking system, and policy-induced risk-taking is most pronounced when supervision is weak. This suggests coordination between monetary and supervisory authorities may be valuable. On **institutional design of supervision**, not all supervisory powers are equally effective. Our component analysis shows that tools addressing fundamental incentive problems—particularly those affecting bank insiders—are most powerful. Effective frameworks require both automatic intervention mechanisms that limit supervisory discretion and tools that directly constrain bank risk-taking incentives. This provides guidance for countries designing or reforming supervisory architectures. On **international spillovers and coordination**, national supervisory policies have global effects through banks' cross-border lending. This creates positive externalities (strong supervision in one country reduces global risk) but also potential free-rider problems (countries may under-invest in supervision given that benefits partly accrue abroad). Our findings suggest potential gains from international coordination of supervisory frameworks, complementing existing coordination on capital standards. On **non-bank financial intermediation**, we document prudential leakages to non-banks that partially offset reduced bank lending. While economically modest during our sample period, these leakages have likely grown substantially given the dramatic expansion of non-bank credit provision since 2014. Our findings support ongoing efforts to extend macroprudential frameworks beyond the banking sector.

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