Firm-Level Investment Responses in an Open Economy: Does Domestic Monetary Policy Matter?

Jun Hee Kwak*[1], Yoonsoo Lee†[2], and Chul Won Park‡[3]

[1] *Sogang University*

August 2025

Abstract

In a small open economy, external and domestic monetary policy shocks affect firms in distinct ways. Analyzing a unique firm-bond matched dataset for Korea covering both public and private firms, we find a stark divergence: U.S. monetary tightening curtails firm investment without widening credit spreads, while domestic tightening widens spreads but leaves investment unaffected. This suggests external shocks bypass domestic funding costs through non-interest-rate channels, whereas domestic shocks raise funding costs but face investment inertia. Both effects are amplified by high exchange-rate volatility, with the most pronounced impact on vulnerable firms. The effectiveness of monetary policy, therefore, depends critically on the shock's origin and its interaction with market conditions and corporate balance sheets.

Keywords: Monetary Policy Transmission, Firm Investment, Credit Spread, Open Economy

JEL classification: E22, E52, G32

*Seoul, Republic of Korea, School of Economics, Sogang University. E-mail: jhkwak@sogang.ac.kr

†Seoul, Republic of Korea, School of Economics, Sogang University. E-mail: ylee@sogang.ac.kr

‡Seoul, Republic of Korea, School of Economics, Sogang University. E-mail: inuuniw@u.sogang.ac.kr

1 Introduction

Corporate investment is not only a key driver of business cycles but also a primary channel for the transmission of monetary policy, making it a crucial focus for central banks (Bernanke et al., 1999). While recent studies highlight that monetary policy effects are heterogeneous across firms (Ottonello and Winberry, 2020; Jungherr et al., 2022) and that shocks from major economies like the United States create significant international spillovers (Saxegaard et al., 2022), a critical gap in the literature remains. Specifically, the international transmission of monetary policy through corporate bond markets—and its ultimate effect on firm investment—is not well understood, largely due to a lack of sufficiently granular data.

This paper fills this gap by empirically examining how U.S. and domestic monetary policy shocks influence corporate investment and its funding costs in a small open economy. To guide our analysis, we ask three core questions:

1. How do corporate investment and financing costs respond differently to external versus domestic monetary policy shocks?

2. How do firm-specific financial characteristics–such as liquidity, debt structure, and foreign currency exposure–shape these responses?

3. How does the prevailing financial environment, particularly exchange rate volatility, alter the transmission of these shocks, and which firms are most vulnerable?

Our key contribution is the construction and analysis of a novel, firm-bond matched dataset for Korea that links comprehensive firm-level balance sheet information with bond-level data on corporate bond issuance. This granular dataset, covering a representative sample of both public and private firms, provides a direct view into the yields and quantities of bond financing for individual firms. This unique level of detail enables us to explicitly connect firm-level funding costs to real investment decisions, offering a clearer picture of the international monetary transmission mechanism.

We analyze the dynamic responses of Korean firms' investment and credit spreads to U.S. and Korean monetary policy shocks, identifying heterogeneous effects according to firm-level financial conditions. We show that indicators such as the Interest Coverage Ratio (ICR) and foreign-currency debt maturity structure are key in differentiating firms' responses. The results reveal that U.S. monetary policy shocks have a significant and immediate impact on Korean firms' investment, while leaving their credit spreads largely unchanged in stable market conditions—suggesting transmission through uncertainty, sentiment, and global-demand channels rather than the domestic interest-rate channel. In contrast, Korean monetary policy shocks significantly widen credit spreads, especially for low-ICR firms, but do not have a statistically significant effect on investment. Both domestic and external policy effects, however, are amplified during periods of high exchange rate volatility, with the largest impacts concentrated among financially vulnerable firms. Furthermore, we find that short-term foreign-currency debt exposure amplifies investment sensitivity to U.S. shocks far more than long-term exposure, underscoring the role of maturity management in mitigating external risks. Our analysis of global financial shocks, proxied by the VIX index, shows that global financial tightening systematically depresses investment, particularly for highly levered firms or those with a large share of current liabilities. This provides firm-level evidence for the global financial cycle (Rey, 2016; Miranda-Agrippino and Rey, 2020) and complements our monetary policy findings by demonstrating how firm balance-sheet characteristics condition vulnerability to global shocks.

These patterns point to distinct underlying mechanisms for external and domestic monetary policy transmission in Korea. U.S. monetary policy tightening, while leaving Korean firms' credit spreads largely unchanged in tranquil periods, triggers a short-run contraction in investment. This suggests that the primary transmission operates not through domestic funding costs, but through channels such as heightened uncertainty, weaker corporate sentiment, and deteriorating global demand expectations. In other words, external shocks appear to affect the investment decision-making process directly—by altering firms' outlook on future profitability—rather than indirectly through measurable changes in the domestic cost of capital.

By contrast, Korean monetary policy tightening produces a prompt and statistically significant widening of corporate credit spreads, especially for firms with low interest coverage ratios, yet does not lead to an immediate decline in investment. This decoupling between financial market responses and real investment may reflect the fact that many corporate investment plans are based on longer-term considerations and are less sensitive to short-term fluctuations in borrowing costs, particularly when the magnitude of domestic policy changes is relatively modest. It may also indicate that, in the absence of a major shift in macroeconomic outlook, domestic rate changes alone are insufficient to alter firms' capital expenditure paths in the short run.

Together, these results imply that the transmission of monetary policy to the real economy in a small open economy like Korea depends critically on the nature of the shock. External shocks from major economies can bypass domestic financial markets and directly affect investment through global uncertainty and demand channels, whereas domestic shocks tend to operate primarily through funding cost channels, with limited near-term effects on real activity. This distinction underscores the importance of recognizing that the absence of movement in market interest rates or credit spreads does not necessarily imply weak transmission—external shocks can still meaningfully alter firms' investment behavior through non-interest-rate channels. Conversely, substantial financial market reactions to domestic policy do not automatically translate into immediate real effects, highlighting the role of adjustment costs and expectations on the market demand.

Related Literature

This study is closely related with the large body of the monetary policy transmission literature. Recent research on the effects of monetary policy, particularly when considering firms' financing conditions, has increasingly relied on micro-level data, such as firm-level or bond-level datasets, to estimate the heterogeneous effects of monetary policy. A prominent example is the work by Ottonello and Winberry (2020), which uses firm-level financial data from U.S. companies (Compustat) to estimate how monetary policy shocks differentially affect investment based on firms' financial health.

Another recent study by Jungherr et al. (2022) combines U.S. corporate data with bond market information to demonstrate that firms with a higher share of maturing debt are more sensitive to monetary policy shocks. Their findings highlight how debt maturity profiles can amplify the sensitivity of firms' investment decisions to interest rate changes, particularly for firms facing imminent refinancing needs. Similarly, Deng and Fang (2022) find that firms with a higher proportion of long-term debt exhibit slower responses to monetary policy changes. This suggests that firms with longer debt maturities are less exposed to short-term fluctuations in interest rates, leading to more muted investment adjustments in response to policy shifts. In addition to these studies, other notable contributions include Cloyne et al. (2019), who document that younger firms without dividend payouts are more sensitive to monetary tightening due to their greater reliance on external financing.

Kalemli-Özcan and Kwak (2020) study provides a review of the literature on capital flows and leverage, expanding understanding of monetary policy transmission mechanisms. The research emphasizes the importance of firm heterogeneity, particularly leverage, revealing that highly leveraged firms are more sensitive to changes in monetary policy and capital flow conditions. It highlights the role of financial frictions and balance sheet effects in transmitting monetary policy shocks in the context of international capital flows, and discusses how exchange rate fluctuations affect firms differently based on their leverage and foreign currency debt exposure. This aligns with the findings of Saxegaard et al. (2022), offering crucial insights into monetary policy spillover effects in an international context. They work provides a broader perspective on how firm-level financial characteristics interact with domestic monetary policy and international capital flows, reinforcing the growing consensus that monetary policy effects are heterogeneous across firms and significantly influenced by firm-specific financial factors, such as greater exposure to trade linkages. Together, these studies highlight a growing consensus: the effects of monetary policy are not uniform across firms but are significantly shaped by firm-specific factors such as leverage, debt maturity, and exposure to external financing constraints.

These studies build on the traditional framework of Bernanke et al. (1999) financial accelerator model, which emphasizes the role of financial frictions in amplifying the effects of monetary policy. By incorporating firm heterogeneity—such as leverage ratios, debt maturity structures, and default risks—these recent works provide both empirical and theoretical insights into how monetary policy affects firms differently depending on their financial characteristics.

Prior empirical research has examined the heterogeneous effects of monetary policy on corporate behavior in the South Korean context. Through an empirical analysis of annual financial statements of Korean listed firms, Park and Ok (2018) demonstrated that the transmission of monetary policy exhibits significant heterogeneity across firm characteristics, particularly with respect to firm size and leverage ratios. Additionally, Witheridge (2024) examines how monetary policy tightening leads to an increase in inflation in emerging markets, contrasting with the typical deflationary response found in advanced economies. Using high-frequency exchange rate changes around monetary policy announcements to identify monetary policy shocks, the study shows this inflation response can be explained by a fiscal-led regime where weak fiscal policy reaction to government debt leads to monetary policy accommodation. This reinforces the importance of considering fiscal policy interactions when studying monetary policy effectiveness in emerging markets. Kim (2007) employed data from Korean listed companies to investigate the differential impacts of policy rate adjustments on firms' user cost of capital and investment behavior under varying inflationary environments. The findings suggest that the magnitude and effectiveness of monetary policy transmission through the cost of capital channel is contingent upon prevailing inflation levels.

Our findings contribute to the literature on monetary policy transmission in open economies by providing new evidence on three fronts. First, we document a clear asymmetry in how U.S. and Korean monetary policy shocks propagate to Korean firms: U.S. shocks primarily affect real investment through non-interest-rate channels, while Korean shocks mainly influence credit spreads without triggering an immediate investment response. This highlights that domestic and external shocks operate through distinct mechanisms, which has received limited attention in prior work.

Second, we show that these effects are highly state-dependent, with both U.S. and Korean shocks exerting stronger influence during periods of heightened exchange-rate volatility. The amplification is concentrated among financially vulnerable firms, suggesting that macro-financial conditions can magnify firm-level heterogeneity in policy transmission.

Third, by linking firm-level responses to measures of global financial stress such as the VIX index, we demonstrate that the global financial cycle acts as a pervasive background force shaping the transmission of both domestic and external shocks. This underscores the importance of integrating global conditions and firm balance-sheet strength into assessments of monetary policy effectiveness in small open economies.

Together, these results reveal that monetary policy in small open economies operates within a complex environment shaped by the origin of the shock, the state of global financial markets, and firm-level vulnerabilities, offering a richer framework for understanding policy transmission than models focusing solely on domestic interest-rate channels.

Layout The remainder of this paper is organized as follows: Section II presents the data used in the study, including MPS (Monetary Policy Shock), firms' financial data, and other variables. Section III discusses the methodology employed, focusing on the Local projection and presents the empirical results, encompassing dynamic response findings. Finally, Section IV concludes the paper, summarizing the key findings and their implications for understanding the dynamics of monetary policy transmission.

2 Data

2.1 Monetary Policy Shocks

This paper employs the Monetary Policy Shocks (MPS) identified by the High-Frequency Identification (HFI) methodology from Choi et al. (2024). The study includes monetary policy shock estimates for 170 countries, providing crucial data for analyzing monetary policy transmission channels across various nations using HFI method, following Gertler and Karadi (2015). In this paper, we specifically focuses on U.S. and Korean monetary policy shocks.

The HFI methodology identifies monetary policy shocks by capturing asset price movements immediately following policy announcements. This approach is particularly powerful in extracting the unanticipated component of policy changes, as it measures the immediate market response to policy announcements. Following Ottonello and Winberry (2020), the monetary policy shock for the U.S. is identified using the following specification:

$$\varepsilon_t^m = \tau(t) \times (\mathrm{ffr}_{t+\Delta+} - \mathrm{ffr}_{t-\Delta-}), \tag{2.1}$$

$$\tau(t) \equiv \frac{\tau_m^n(t)}{\tau_m^n(t) - \tau_m^d(t)} \tag{2.2}$$

where t represents the time of the monetary announcement, ffr_t is the implied Fed Funds Rate from a current-month Federal Funds future contract at time t, $\Delta+$ and Δ_- control the size of the time window around the announcement (45 minutes after and 15 minutes before, respectively), $\tau(t)$ adjusts for the timing of the announcement within the month, $\tau_m^d(t)$ denotes the day of the meeting in the month, and $\tau_m^n(t)$ represents the number of days in the month.

For Korean monetary policy shocks, the identification methodology varies by period. For 2009-2020, the study employs the high-frequency shock identification method from Ahn et al. (2021). For 2000-2008, this paper identifies monetary policy shocks using Taylor rule residuals following Romer and Romer (2004).[1]

The high-frequency shocks are time-aggregated to quarterly frequency to merge them with firm-level data, following Ottonello and Winberry (2020). Specifically, this study constructs a moving average of the raw shocks weighted by the number of days in the quarter after the shock occurs. For easier interpretation, the signs are normalized such that a positive shock indicates an unexpectedly expansionary monetary policy. The summary statistics (Table 1) for the period from January 2000 to January 2020 show that both U.S. and Korean monetary policy shocks have positive means and exhibit similar patterns, although the U.S. shocks display greater standard deviation.

Table 1: Summary Statistics of Monetary Policy Shocks

	U.S.	KOR
Mean	0.0040	0.0034
S.D.	0.0548	0.0264
Min	-0.2488	-0.1038
Max	0.2231	0.0972
Observations	201	181

[a] Summary statistics of monetary policy shocks for the period from 1/1/2000 to 1/1/2020. High-frequency shocks are identified using the event study strategy. Sources are from the Bank of England and CME Group for futures data.

[1] The use of Taylor rule residuals for the pre-2009 period is necessitated by data limitations, as high-frequency data around monetary policy announcements are not available for this period.

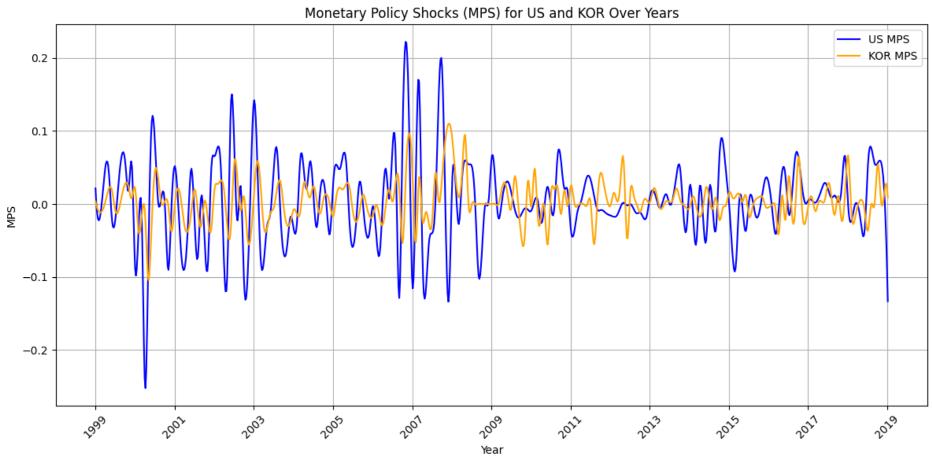


Figure 1: Time series plot of Monetary policy shock

Notes: This figure shows the monthly time series of monetary policy shocks for the United States (blue line) and Korea (orange line) from 2000 to 2020. The shocks are normalized such that positive values indicate expansionary monetary policy. The data frequency is monthly, and the series are standardized to have comparable scales.

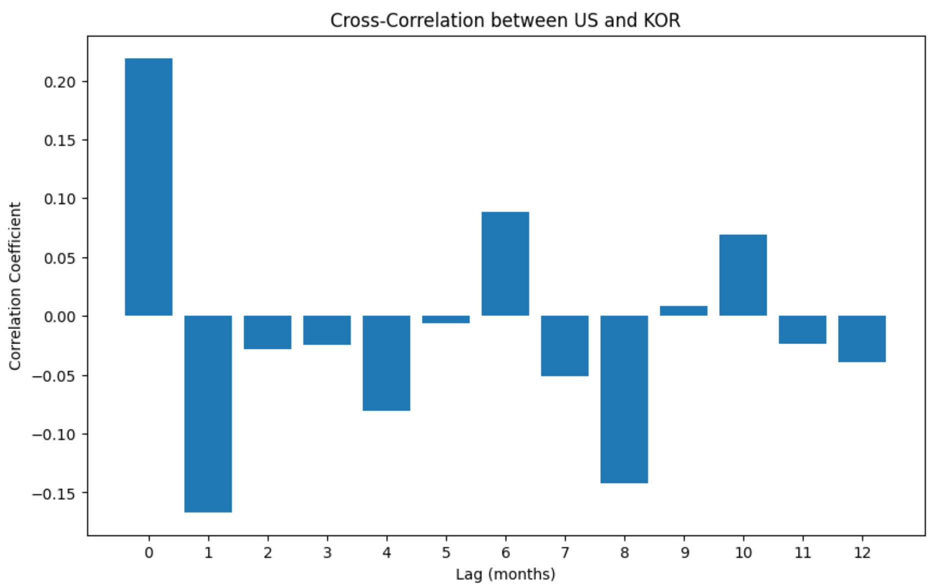


Figure 2: Cross-Correlation between US and KOR Monetary policy shock

Notes: This figure displays the cross-correlation coefficients between U.S. and Korean monetary policy shocks for lags 0 to 12 months. The blue bars represent the correlation coefficients at each lag, with the y-axis showing the magnitude of correlation. The correlation is computed using the standardized monetary policy shock series from 2000 to 2020. Lag k shows the correlation between U.S. monetary policy shock at time t and Korean monetary policy shock at time t+k. The horizontal axis denotes the lag length in months.

2.2 Firm-Level Variables

This study employs firm-level data from Valuesearch (formerly KIS-value), a corporate database service provided by NICE Information Service. To ensure data quality and consistency, following Ottonello and Winberry (2020), the sample is restricted to firms with observation exceeding 40-quaters of tangible assets and foreign debt ratio, resulting in 8,621 companies for 77 industry-sectors that include KOSPI and KOSDAQ listed firms, externally audited firms, and delisted companies.

The primary measure of investment, capital stock, is constructed following the methodologies of Ottonello and Winberry (2020) and Jungherr et al. (2022). For each firm, the capital stock series is initialized using its first equipment observation and recursively constructed by incorporating period-to-period changes in equipment, applying linear interpolation only for single-quarter missing values using adjacent quarters' data. The analysis incorporates foreign debt ratios, which are calculated in multiple ways following Kim et al. (2015). Additional key variables include firm size (measured as the logarithm of deflated total assets), sales growth, liquidity and various financial health indicators such as the interest coverage ratio (ICR), leverage, current liability ratio (CLR) and current ratios. Notably, in this study, for the purpose of facilitating coefficient analysis and graph interpretation, the Local projection analysis used the inverse of ICR (Interest Coverage Ratio) and CR (Current Ratio). Therefore, the ICR and CR variables used in the analysis can be interpreted similarly to other variables (CLR, LEV) - higher values indicate weaker short-term solvency and financial soundness of firms. To facilitate interpretation and address the typically skewed distribution of financial ratios, all financial variables are standardized to have zero mean and unit standard deviation, following Ottonello and Winberry (2020). The correlation between firm-level variables is documented in Table 6, 7 and 8 in Appendix A.

Additionally, to validate the representativeness of our dataset, we examine the coverage of our firm sample relative to the aggregate economy. Specifically, we calculate the ratio of total sales from manufacturing firms in our sample to the nominal gross output of the manufacturing sector from Korea Productivity Center's Statistical Database Portal, which is based on the Bank of Korea's National Accounts (2008 SNA). As shown in Table 3, our sample represents a substantial portion of the manufacturing sector's economic activity, with coverage ratios increasing from 39.2% in 2000 to 62.2% in 2021, and averaging 51.2% over the entire sample period. This high and stable coverage ratio suggests that our firm-level dataset captures a significant portion of the Korean corporate sector, particularly for larger firms that are more likely to be affected by international financial conditions. The detailed information of firm-level data is provided in Appendix A.

Table 2: Summary Statistics

Variables	N	Mean	S.D.	Min	Max
ln(sales)	303,231	17.77	1.85	0.34	26.07
size	555,851	24.52	1.85	6.87	33.79
liq	583,745	0.09	0.12	0.00	0.64
clr	513,866	0.72	0.26	0.01	1.00
st fdr	546,922	0.14	1.02	0	1.17
lt fdr	577,528	0.02	0.11	0	0.88
1/icr	471,871	0.17	1.16	-6.29	6.79
1/cr	513,274	0.77	0.91	0	6.61
lev	553,901	0.47	0.29	0	1.58
ln(cap)	551,463	22.24	2.34	6.79	32.46
ln(cf)	422,399	-1.27	2.00	-13.77	3.41

Note: This table presents summary statistics for the main variables used in the analysis, for 8621 firms. All variables are winsorized at the 1st and 99th percentiles to mitigate the impact of outliers. Log transformations are applied to variables with large absolute values for better interpretation. Variables include: sales(ln(sales), liquidity (liq), current liabilities ratio (clr), foreign debt ratio (fdr), short-term and long-term foreign debt ratio (st fdr, lt fdr), interest coverage ratio (icr), current ratio (cr), leverage (lev), capital stock (cap), and cash flow (cf).

Table 3: Coverage of the Manufacturing Sector Based on Gross Output

Year	Ratio	Year	Ratio
2000	0.392	2011	0.500
2001	0.427	2012	0.507
2002	0.451	2013	0.485
2003	0.466	2014	0.505
2004	0.479	2015	0.513
2005	0.465	2016	0.514
2006	0.467	2017	0.536
2007	0.475	2018	0.549
2008	0.503	2019	0.548
2009	0.512	2020	0.594
2010	0.535	2021	0.622
Average: 0.512			

Notes: Each year represents the sum of manufacturing firms' total sales as a share of nominal gross output for manufacturing sector. The nominal gross output data is from the Korea Productivity Center's Statistical Database Portal, based on the Bank of Korea's National Accounts which follows the 2008 SNA (System of National Accounts). We calculated the ratio using annual data, based on the fourth quarter values of each year.

2.3 Bond data

To analyze heterogeneous firm-level responses to monetary policy shocks, we constructed a comprehensive credit spread dataset by merging corporate bond data with firm financial information. We obtained the corporate bond data from Yonhap Infomax, a leading financial information provider in South Korea. The merge was executed in a hierarchical manner, primarily using business registration numbers, followed by company names, and finally firm identification codes when necessary.

The construction of our credit spread measure follows the methodology proposed by Gilchrist and Zakrajšek (2012), who developed a duration-matched approach to calculate credit spreads. This approach involves creating a synthetic risk-free bond that matches the duration of the corporate bond, which provides a more accurate measure of credit risk than simple yield differentials.

Our procedure for calculating credit spreads can be summarized as follows:

First, we merged issuance panel data with yield panel data using bond codes:

$$\text{CreditSpread}_{i,t} = r_{i,t} - \text{Rf}_{i,t} \tag{2.3}$$

where $r_{i,t}$ represents the corporate bond yield for bond i at time t, and $\text{Rf}_{i,t}$ is the duration-matched risk-free rate.

For each bond, we calculated the duration-matched risk-free rate by matching each bond with the appropriate government treasury yield based on its remaining maturity. We identified the applicable treasury yield through a detailed maturity-matching process that assigns the closest available treasury yield to each corporate bond based on its remaining time to maturity. This approach ensures that we compare bonds with similar maturity characteristics.

We then calculated the theoretical price of a risk-free bond with the same cash flow structure as the corporate bond using the formula:

$$P = \sum_{i=1}^{n} \frac{C}{(1+r_f)^{(i \cdot 3/12)}} + \frac{1}{(1+r_f)^{(n \cdot 3/12)}} \tag{2.4}$$

where C is the coupon rate, r_f is the matched government rate, and n is the number of coupon payments. In the Korean corporate bond market, it is standard for bonds to pay coupons on a quarterly basis. Accordingly, we assume quarterly coupon payments when computing the theoretical price of the synthetic risk-free bond, and adjust the discounting intervals in the pricing formula to reflect this frequency.

$$\mathrm{Rf}_{i,t} = \frac{1}{P} - 1 \tag{2.5}$$

We then computed the duration-matched risk-free yield as $(1/P - 1)$, which represents the yield of a synthetic risk-free bond that has the same duration as the corporate bond. Finally, the credit spread was calculated as the difference between the corporate bond yield and the duration-matched risk-free yield.

To ensure data quality, we applied winsorization by capping credit spreads at the 1st and 99th percentiles. This filtering process helps to minimize the impact of extreme values that might distort our analysis.

The constructed dataset was then transformed into a monthly panel by keeping the last observation for each bond in each month. This monthly dataset was subsequently merged with firm-level financial information to create a comprehensive panel that allows us to examine how firms with different financial characteristics respond to monetary policy shocks.

The advantage of this approach, as highlighted by Gilchrist and Zakrajšek (2012), is that it provides a more accurate measure of credit risk by controlling for differences in duration between corporate and government bonds. Traditional yield spread calculations that simply subtract a government yield of similar maturity fail to account for differences in cash flow structures, which can lead to biased estimates of credit risk. Additionally, this method allows us to examine firm-level heterogeneity in credit spread responses to monetary policy shocks, which is essential for understanding the transmission of monetary policy through the credit channel.

Furthermore, as Gilchrist and Zakrajšek (2012) emphasized, these duration-matched credit spreads are particularly useful for capturing the financial distress component of corporate bond spreads, which is crucial for analyzing how monetary policy affects firms with different financial conditions. This approach enables us to isolate the credit risk component from other factors that influence bond yields, such as liquidity and tax effects.

Table 4: Summary Statistics: Credit Spread

Statistic	Value
N (Obs)	8,344,808
Mean	5.06
S.D.	3.04
Min	0
Median (50th)	4.25
Max	22.29
Skewness	1.80
Kurtosis	7.38

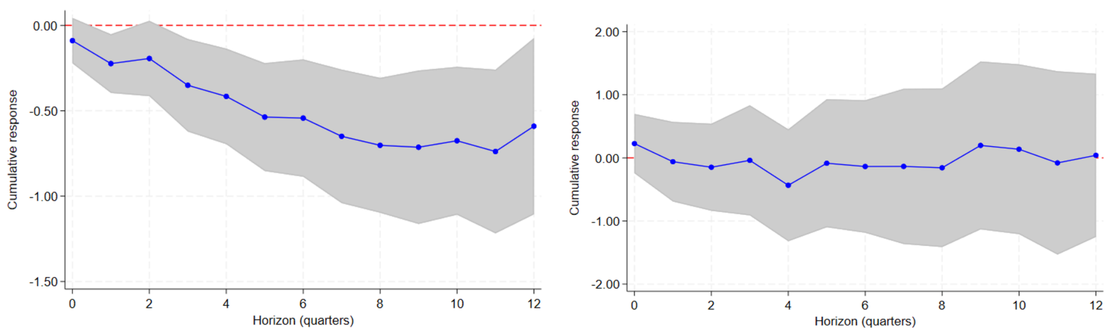
3 Firms' Heterogeneous Response to Monetary Policy

3.1 Baseline Empirical study

To establish a baseline understanding of how monetary policy shocks affect firm-level investment in our sample, we begin by estimating a simple, unconditional local projection specification, employing the Local Projection method by Jordà (2005). Specifically, we estimate the following regression for each forecast horizon h :

$$\log k_{jt+h} - \log k_{jt} = \alpha_{jh} + \beta_h \varepsilon_t^m + \Gamma_h' Z_{jt-1} + e_{jth} \tag{3.1}$$

where the dependent variable is the cumulative change in the logarithm of the capital stock of firm j from quarter t to $t+h$. The term ε_t^m denotes the identified monetary policy shock at time t, either from the United States or from Korea. The coefficient β_h measures the average cumulative investment response at horizon h to an unanticipated policy change. Firm fixed effects α_j^h capture time-invariant heterogeneity across firms, while industry-by-quarter fixed effects control for shocks common to all firms within a sector at a given point in time. The control vector $Z_{j,t-1}$ includes one-quarter-lagged firm-level covariates—sales growth, size (log of total assets), cash flow, and liquidity—following Ottonello and Winberry (2020). Standard errors are two-way clustered at the firm and quarter level.



(a) By U.S. Monetary Policy Shock

(b) By Korean Monetary Policy Shock

Figure 3: Impulse Response of Cumulative Investment to Monetary Policy Shocks

Notes: This figure shows the impulse responses of cumulative firm-level investment to monetary policy shocks. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors are two-way clustered at the firm and quarter level.

Figure 3 presents the estimated unconditional impulse responses for horizons up to twelve quarters. Panel (a) shows the results for U.S. monetary policy shocks, while Panel (b) reports the responses to Korean monetary policy shocks. The solid blue lines denote point estimates, and the shaded regions represent 95% confidence intervals.

Two salient patterns emerge. First, U.S. monetary policy shocks exert a sizable and persistent influence on Korean firms' investment. A contractionary U.S. shock leads to a statistically significant decline in investment that becomes visible after roughly three to four quarters and intensifies over time, peaking around eight to ten quarters after the shock. The persistence and magnitude of this effect are economically meaningful and can operate through multiple transmission channels. Higher U.S. interest rates may influence Korean corporate investment via exchange rate movements, which increase the domestic currency value of foreign currency liabilities; through global financial conditions, which tighten the availability and raise the cost of external finance; and via demand-side effects, as slower global growth reduces export prospects. In combination, these channels raise firms' financing constraints and weaken investment incentives, particularly for those with significant foreign currency exposure or reliance on external capital markets.

Second, the estimated responses to Korean monetary policy shocks are notably weaker in the unconditional average. While there are occasional negative and statistically significant effects at certain horizons, the overall pattern lacks the persistence and magnitude observed for U.S. shocks. This muted impact may reflect structural constraints on Korea's monetary autonomy arising from policy synchronization with the United States and the high degree of capital mobility, which together limit the independent influence of domestic interest rate policy on firms' investment decisions.

To examine the heterogeneous dynamic effects of monetary policy shocks on firm investment over different horizons, this study employs the Local Projection method by Jordà (2005) following Ottonello and Winberry (2020) and estimates the following specification:

$$\log k_{jt+h} - \log k_{jt} = \alpha_{jh} + \alpha_{sth} + \beta_h (X_{jt} - \overline{X_j}) \varepsilon_t^m + \Gamma'_h Z_{jt-1} + e_{jth} \tag{3.2}$$

where the dependent variable now represents the cumulative change in log capital from period t to $t+h$, with h denoting the horizon in quarters. The coefficient β_h measures the cumulative response of investment to monetary policy shocks at horizon h, conditional on firms' financial positions. Similar to the baseline specification, α_{jh} captures firm-specific fixed effects and α_{sth} represents sector-by-quarter-by-horizon fixed effects. The remaining variables and control vector Z_{jt-1} for a number of factors such as sales growth, size(log of total assets), cash flow, liquidity as following Ottonello and Winberry (2020). Prior to the analysis, all variables are standardized (with mean zero and standard deviation of one) to facilitate interpretation of the coefficients. The coefficients represent the semi-elasticity of investment responses. For instance, in Panel (b) of Figure 4, when a firm's Short-term foreign debt ratio is one standard deviation above the mean, its investment growth rate in response to monetary policy shocks is approximately 29 percentage points lower. To illustrate, if an accommodative monetary policy shock induces a 100% investment increase in firms with average short-term foreign currency debt ratios, firms with ST-FDR one standard deviation above the mean would experience only a 71% increase in investment. All results for the full set of financial indicators - including Interest Coverage Ratio, Short-term Net Foreign Debt Ratio, Current Liabilities Ratio, Long-term Net Foreign Debt Ratio, Current Ratio, and Leverage - are provided in B.1 Heterogeneous Investment Responses of the Appendix B. Figures in that appendix present the impulse responses for each variable and monetary policy shock specification, complementing the main results reported here.

The dynamic analysis using local projections provides insights into the temporal evolution of monetary policy transmission. Figure 4 contrast the cumulative investment responses to U.S. and Korean monetary policy shocks conditional on firms' ICR and CR levels. The response to U.S. monetary policy exhibits clear heterogeneity that becomes more pronounced over time, with both low-ICR and low-CR firms showing significantly stronger negative responses peaking around 8-10 quarters after the shock. This persistent heterogeneity suggests that firms' short-term liquidity conditions play a crucial role in their ability to respond to changes in external monetary conditions, consistent with the credit channel emphasized in He (2024). The dynamic effects of short-term foreign currency debt exposure (Figure 10) are particularly revealing for understanding the international transmission of monetary policy. Firms with high short-term foreign currency debt show increasingly negative investment responses to U.S. monetary policy shocks over time, suggesting that foreign currency debt exposure creates persistent constraints on investment behavior. This finding appears to support Rey (2016) and Miranda-Agrippino and Rey (2020)[2]'s argument about the global finan-

[2] Rey (2016) challenges the traditional monetary policy trilemma, arguing that the global financial cycle transforms the "trilemma" into a "dilemma." Miranda-Agrippino and Rey (2020) show that US monetary

cial cycle's persistent influence through international credit markets and provides firm-level evidence for the prolonged effects of external monetary conditions on small open economies.

The comparison between short-term and long-term foreign currency debt exposures reveals interesting differences in their transmission patterns. While firms with high short-term foreign currency debt exhibit pronounced negative responses to U.S. monetary policy shocks, the responses of firms with high long-term foreign currency debt are relatively muted (Figure 10). This differential response suggests that the maturity structure of foreign currency debt matters significantly for monetary policy transmission. The stronger sensitivity of short-term foreign currency debt might reflect the immediate refinancing needs and heightened rollover risks faced by firms with shorter debt maturities, consistent with the findings of Jungherr et al. (2022) on debt maturity effects.

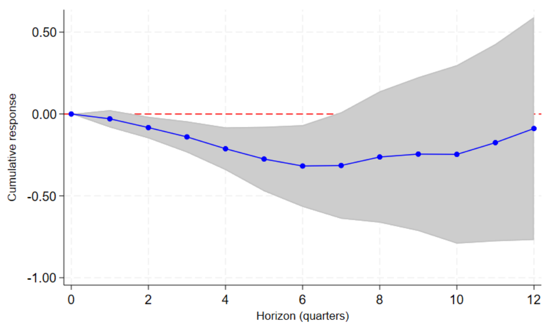
The muted dynamic responses to Korean monetary policy shocks (Figure 4, panel (c) and (d)) could provide temporal evidence of potential constraints on domestic monetary policy effectiveness. The limited impact persists across different time horizons and firm characteristics, including ICR dimension, suggesting that these constraints might be structural rather than temporary. This persistence aligns with Han and Kim (2023)'s findings about the significant role of external factors in domestic financial conditions.

Several important channels explain the heterogeneous investment responses of firms. First, U.S. monetary tightening typically leads to exchange rate fluctuations, affecting firms through refinancing risk in short-term foreign currency debt and their short-term payment capabilities. Even when firms borrow in domestic currency, their lenders (banks) may have foreign currency exposures, making firms indirectly vulnerable to exchange rate movements during U.S. monetary tightening. In contrast, Korean monetary tightening tends to appreciate the domestic currency, potentially mitigating impacts on firms' short-term payment capabilities.

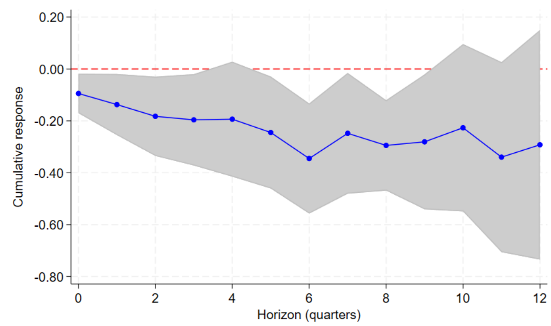
policy significantly influences global financial conditions through its effect on risk premiums and capital flows.

A second transmission channel operates through policy synchronization. Given that Korean monetary policy often follows U.S. policy with some lag rather than leading it, domestic firms' investment decisions may be less responsive to Korean monetary policy actions. Furthermore, the monetary policy trilemma suggests that exchange rate management necessitated by interest rate differentials may constrain the magnitude of domestic monetary shocks. These transmission mechanisms may operate differently during crisis periods. Particularly, when the market anticipates monetary tightening in Korea but encounters unexpected monetary shocks-especially around the zero lower bound or during policy rate holds, which our high-frequency identification of monetary policy surprises can capture-firms with limited short-term funding capacity may reduce investment more substantially than their counterparts. This differential response during crisis periods will be examined in detail in Section 3.2.

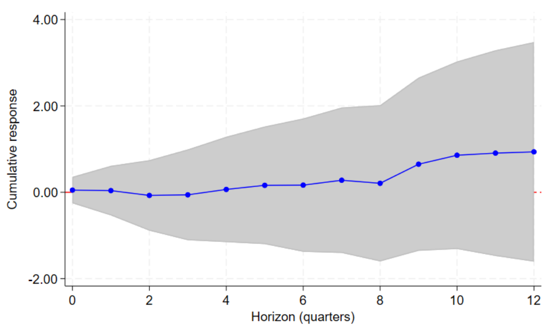
An important nuance is that U.S. monetary policy affects Korean corporate investment primarily through non-interest-rate channels, as we will see in Section 3.3. While U.S. policy shocks have strong and persistent effects on investment, domestic credit spreads show subtle reaction, suggesting that the funding-cost channel is not the main driver. Instead, uncertainty and sentiment channels such as changes in global demand expectations, investor confidence, and overall economic outlook are likely at play. These are factors the Bank of Korea cannot easily shield against, even if it adjusts domestic interest rates.



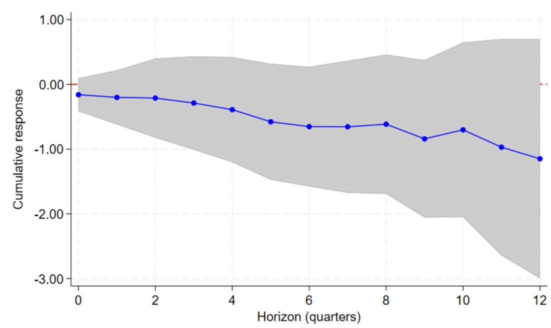
(a) By Interest Coverage Ratio : U.S.



(b) By Short-term Net Foreign Debt Ratio : U.S.



(c) By Interest Coverage Ratio : Korean



(d) By Short-term Net Foreign Debt Ratio : Korean

Figure 4: Heterogenous Impulse Response of Cumulative Investment to Monetary Policy Shocks

Notes: This figure shows the impulse responses of cumulative firm-level investment to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors are two-way clustered at the firm and quarter level. Financial ratios are standardized to have zero mean and unit standard deviation. Interest Coverage Ratio is inverted in analysis.

3.2 State-Dependent Effects During Periods of Exchange Rate Volatility

Given these transmission channels, we further examine how their effectiveness varies during periods of heightened market stress. Particularly, we focus on periods of high exchange rate volatility, when both refinancing risks and policy synchronization effects might be amplified. During periods of high exchange rate volatility, both channels - refinancing risk and policy synchronization - might operate differently. Foreign currency borrowers face heightened refinancing pressures, while domestic monetary policy might need to respond more actively to external conditions. To formally analyze these state-dependent effects, we employ a dummy variable local projection approach following Ramey and Zubairy (2018)[3]:

$$\log k_{jt+h} - \log k_{jt} = \alpha_{jh} + \alpha_{sth} + \sum_{s} \beta_h^s[(X_{jt} - \overline{X_{jt}}) \cdot \varepsilon_t^m \times I_t^s] + \Gamma'_h Z_{jt-1} + e_{jth} \tag{3.3}$$

where I_t^s is a dummy variable that equals one during periods of high FX volatility (when $s = high$) or low FX volatility (when $s = low$), with $\sum_{s\in\{high,low\}} I_t^s = 1$ for all t.

This study employs two different thresholds to identify periods of high FX volatility. The first classification (2 standard deviations) identifies two major episodes of extreme exchange rate volatility: the Global Financial Crisis (2008:Q4-2009:Q1), and the initial COVID-19 shock (2020:Q1). These periods experienced exchange rate volatility exceeding two standard deviations above the mean and represent episodes when global financial shocks severely constrained domestic monetary policy autonomy.

The second classification (1.5 standard deviations) captures additional periods of heightened, though less extreme, exchange rate volatility. This broader definition includes ex-

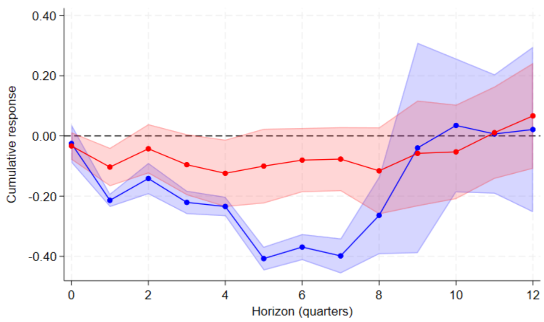
[3] They employ state-dependent analysis to test whether US government spending multipliers are higher during periods of economic slack (high unemployment) or when interest rates are near the zero lower bound, challenging the common belief that fiscal stimulus is more effective during economic downturns.

tended periods around the major crises: the Global Financial Crisis (2008:Q3-2009:Q2), and the COVID-19 period (2020:Q1-2020:Q2). It also includes the period of China's economic slowdown and subsequent market turbulence (2015:Q3-2015:Q4). During these episodes, exchange rate volatility exceeded 1.5 standard deviations above the mean, reflecting periods when global financial conditions significantly influenced domestic financial markets. For robustness, this study report results using this alternative classification in Appendix B. The consistency of our findings across both volatility thresholds suggests that our main conclusions about the relationship between global financial cycles and domestic policy transmission are not sensitive to the specific definition of high-volatility periods. All other periods are classified as low FX volatility regimes. Detailed results for all financial variables under both volatility classifications are provided in Appendix B.1.

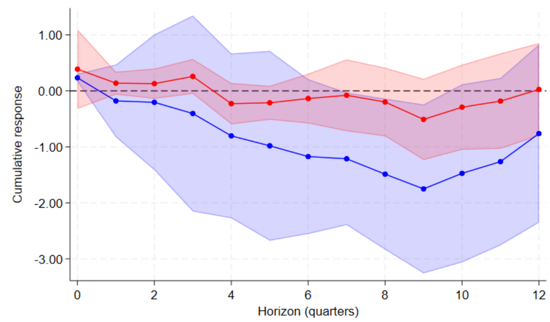
The analysis of state dependent responses during periods of high exchange rate volatility in figure 5 provides compelling evidence on how monetary policy transmission mechanisms operate differently under market stress. We find particularly striking patterns in both U.S. and Korean monetary policy effects during these periods of heightened exchange rate volatility.

The crisis state results in Figure 5 reveal a notable contrast between the role of foreign currency debt and liquidity conditions during periods of high exchange rate volatility. For both U.S. and Korean monetary policy shocks, short term foreign currency debt does not appear to be a significant differentiator of investment responses the estimated differences between firms with high and low exposure are small in magnitude and statistically insignificant. This suggests that, contrary to the conventional view emphasizing currency mismatch vulnerabilities, the direct balance sheet effects of short-term foreign liabilities are not the primary amplification mechanism in these episodes.

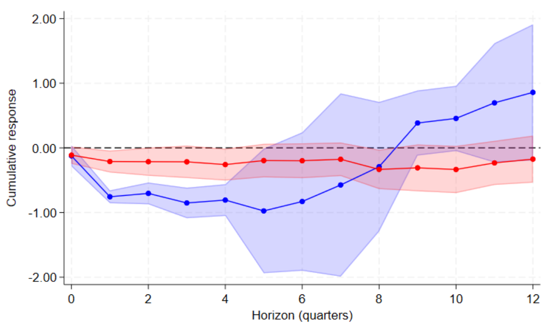
Instead, a firm's ability to service debt from current earnings, as measured by the interest coverage ratio (ICR), emerges as a much more important determinant of sensitivity to monetary policy shocks under volatile exchange rate conditions. Firms with weaker



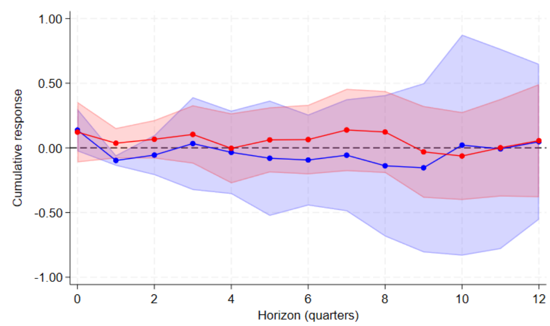
(a) By Interest Coverage Ratio, U.S. shock



(b) By Short term Debt Ratio, U.S. shock



(c) By Interest Coverage Ratio, Korean shock



(d) By Short term Debt Ratio, Korean shock

Figure 5: Impulse Response of Cumulative Investment, using dummy variables which indicate volatility level

Notes: The blue (red) line and shaded area represent the point estimates and 95% confidence intervals during high (low) FX volatility periods. High volatility periods are defined as quarters when FX volatility exceeds 2 standard deviations above the mean, specifically during the Global Financial Crisis (2008:Q4-2009:Q1), and COVID-19 shock (2020:Q1). All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls. Interest Coverage Ratio variables are inverted in analysis.

ICRs—indicating tighter cash flow positions relative to their interest obligations—display substantially larger investment contractions during high volatility periods. This pattern is consistent across both U.S. and Korean shocks, highlighting a liquidity or debt-service-capacity channel as the key driver of crisis time amplification. Notably, for Korean monetary policy shocks, the baseline results in Section 3.1 showed limited average effects on investment. However, the state dependent analysis here reveals that such effects become pronounced for financially weaker firms—particularly those with low ICR—when exchange rate volatility is elevated.

One plausible interpretation is that during episodes of elevated market uncertainty, such as the Global Financial Crisis (2008–2009) and the COVID-19 crisis (2020), financial markets and creditors place greater emphasis on firms' immediate repayment capacity rather than the currency composition of their liabilities. Under such circumstances, firms with strained liquidity may face disproportionately tighter financing conditions, regardless of whether their debt is denominated in foreign or domestic currency. As a result, the crisis-period amplification of monetary policy effects appears to be shaped more by internal liquidity constraints than by external currency-mismatch exposure.

The mechanism may appears to work through two interacting channels. First, higher exchange rate volatility directly increases the importance of firms' financial positions in determining their policy sensitivity. Firms with weaker balance sheets become especially vulnerable during volatile periods, making them more responsive to policy changes. Second, during periods of high exchange rate volatility, firms' access to foreign funding becomes more limited, increasing their dependence on domestic financial markets. This suggests that monetary policy surprises we measure through our high frequency identification method (that is, unexpected changes in monetary policy stance that markets did not anticipate) can have larger effects on firms' investment decisions. The combination of heightened financial frictions and increased reliance on domestic funding leads to stronger overall policy transmission during volatile periods.

3.3 Credit Spread

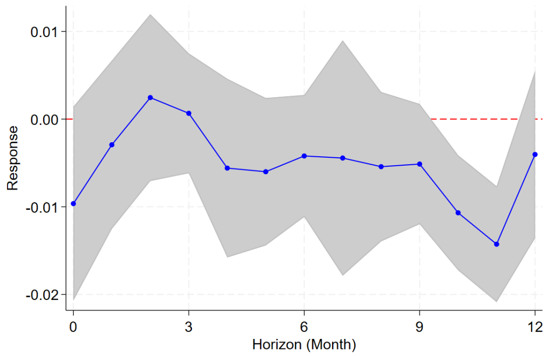
We next turn to corporate credit spreads as an outcome variable to shed light on the transmission channels of monetary policy shocks. While the investment responses documented in Section 3.1 capture the real-side effects on firms' capital expenditures, credit spreads provide a direct measure of firms' borrowing costs and perceived credit risk in financial markets. If monetary policy primarily operates through the funding cost channel, we would expect contractionary shocks to widen corporate credit spreads, thereby increasing the cost of external finance. Conversely, if investment responses occur without significant movements in credit spreads, this would suggest that other mechanisms such as exchange rate adjustments, global demand conditions, or uncertainty and sentiment effects are at play.

To test this, we estimate the effects of monetary policy shocks on firm-level credit spreads using the same local projection framework as in Section 3.1. For each forecast horizon h, we estimate:

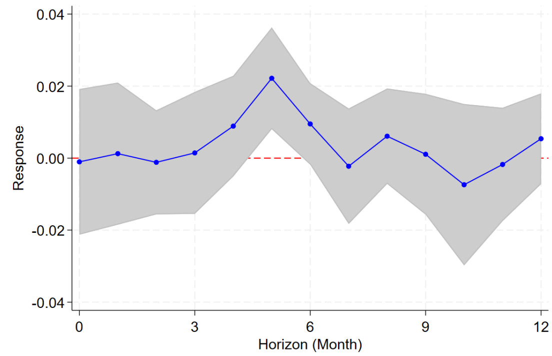
$$\mathrm{CS}_{i,j,t+h} - \mathrm{CS}_{i,j,t} = \alpha_i + \gamma_{s,t} + \beta_h \varepsilon_t^m + \theta_h' Z_{i,j,t-1} + u_{i,j,t+h} \tag{3.4}$$

where the dependent variable represents the credit spread of bond j issued by firm i at horizon h months ahead. The credit spread is defined as the difference between the yield on a firm's corporate bond and the yield on a maturity-matched Korean Treasury bond, measured in basis points. As before, ε_t^m denotes the identified monetary policy shock either from the U.S. or from Korea and β_h captures the cumulative change in the credit spread at horizon h. Firm fixed effects α_j^h account for unobserved, time-invariant firm heterogeneity, and industry-by-quarter fixed effects absorb common sectoral shocks. The control vector $Z_{j,t-1}$ includes lagged firm-level variables such as leverage, size, liquidity, and profitability to isolate the effect of monetary policy from other concurrent factors. Standard errors are two-way clustered at the firm and time level.

Figure 6 reports the estimated impulse responses of credit spreads to U.S. (Panel (a)) and



(a) By U.S. Monetary Policy Shock



(b) By Korean Monetary Policy Shock

Figure 6: Impulse Response of Credit Spread to Korean Monetary Policy Shocks

Notes: This figure shows the impulse responses of firm-level Credit Spreads to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls: one-month-lagged sales growth, size (log of total assets), cash flow, liquidity, bond maturity (in years), and credit rating group dummies. Standard errors are two-way clustered at the firm and month level. Financial ratios are standardized to have zero mean and unit standard deviation.

Korean (Panel (b)) monetary policy shocks over a 12-months horizon. Shaded areas denote 95% confidence intervals.

The results indicate a sharp contrast with the investment responses documented in Section 3.1. For U.S. monetary policy shocks, the point estimates are close to zero across all horizons, and confidence intervals are wide, suggesting no statistically significant effect on domestic corporate credit spreads. This finding implies that the strong investment responses to U.S. monetary policy shocks are unlikely to operate through the conventional interest rate or funding-cost channel.

In contrast, Korean monetary policy shocks have a more discernible impact on domestic credit spreads. A contractionary Korean shock is associated with a statistically significant widening of credit spreads, peaking within two to four quarters after the shock before gradually returning toward zero. The magnitude of this response, while modest in absolute terms, is economically meaningful: a one-standard-deviation tightening in Korean monetary policy increases average corporate credit spreads by roughly 2 basis points at the peak.

These baseline results point to an important asymmetry. Whereas Korean monetary policy appears to transmit partly through domestic funding costs, U.S. monetary policy affects Korean firms' investment without materially altering their borrowing spreads. This asymmetry reinforces the interpretation that U.S. shocks primarily influence investment through alternative channels, such as exchange rate movements, global financial conditions, and sentiment, rather than directly through domestic credit markets.

To further investigate whether the impact of monetary policy on corporate credit spreads varies systematically with firms' financial health, we estimate a state-contingent specification that interacts monetary policy shocks with firm-level balance sheet indicators. This approach allows us to assess whether financially weaker firms—those with lower debt-service capacity or higher currency-mismatch exposure—exhibit systematically different responses in their borrowing costs compared to stronger firms. Specifically, we estimate:

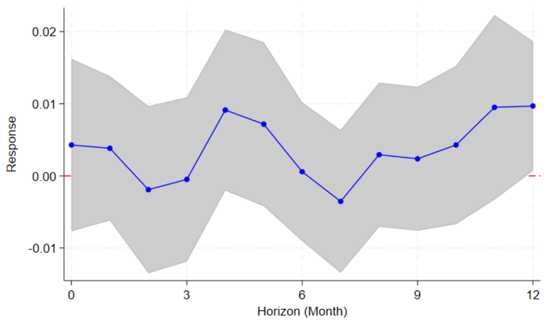
$$\mathrm{CS}_{i,j,t+h} - \mathrm{CS}_{i,j,t} = \alpha_i + \gamma_{s,t} + \beta_h[(X_{jt} - \overline{X_{jt}}) \times \varepsilon_t^m] + \theta_h' Z_{i,j,t-1} + u_{i,j,t+h} \tag{3.5}$$

Figure 7 presents the heterogeneous responses of firm-level credit spreads to monetary policy shocks, estimated using the specification in Equation (3.5). The dependent variable is the credit spread (in basis points) of bond j issued by firm i, measured h months after the shock. The coefficient β_h captures the differential response of credit spreads to monetary policy shocks, conditional on a given firm-level financial indicator. We examine multiple standardized measures of firms' financial health, including the interest coverage ratio (ICR) and the short term net foreign debt ratio, each lagged by two months. Detailed results for all financial variables under both volatility classifications are provided in Appendix B.2.

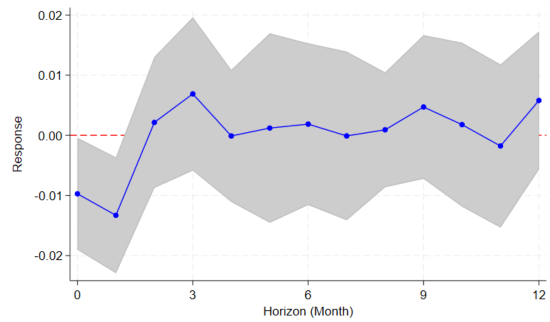
The monetary policy shocks ε_t^m are obtained from high-frequency identification, separately for U.S. and Korean monetary policy. All regressions include firm fixed effects (α_i), industry-by-month fixed effects ($\gamma_{s,t}$), and the full set of firm-level controls: one-month-lagged sales growth, size (log of total assets), cash flow, liquidity, bond maturity (in years), and credit rating group dummies. Standard errors are two-way clustered at the firm and month level. All financial indicators are standardized to have mean zero and standard deviation one, so the estimated coefficients measure the differential effect of monetary policy shocks for a one-standard-deviation change in the indicator. For interpretability, ICR variables are inverted so that higher values correspond to weaker interest-service capacity.

The results indicate a clear asymmetry between U.S. and Korean monetary policy shocks. For U.S. shocks, neither the interest coverage ratio (ICR) nor the short-term net foreign debt ratio generates large or statistically significant heterogeneity in credit spread responses over the 12-month horizon : the point estimates are small, and the 95% confidence intervals generally include zero. In contrast, for Korean monetary policy shocks, firms with weaker debt-servicing capacity (lower ICR) exhibit a noticeably stronger widening of credit spreads, peaking at around 0.02 (2 basis points) within the first few months after the shock. This suggests that domestic monetary tightening amplifies financing costs more for firms with tighter liquidity positions. The short-term net foreign debt ratio, however, remains an insignificant differentiator in both cases.

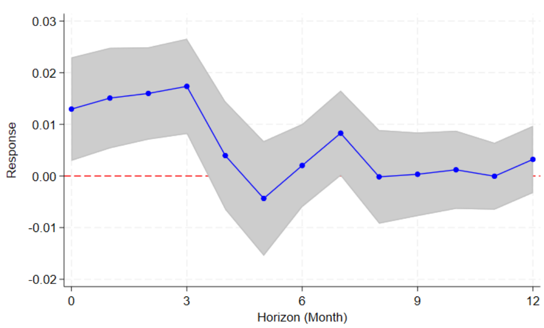
This pattern stands in contrast to the investment results, where certain financial indicators—particularly ICR—played a more important role under high exchange rate volatility (Section 3.2). Taken together, the findings reinforce the conclusion from the baseline analysis that the main transmission of U.S. monetary policy to Korean firms is unlikely to operate through domestic credit spreads, while the effects of Korean policy on spreads are present and more pronounced for financially weaker firms, especially those with low ICR.



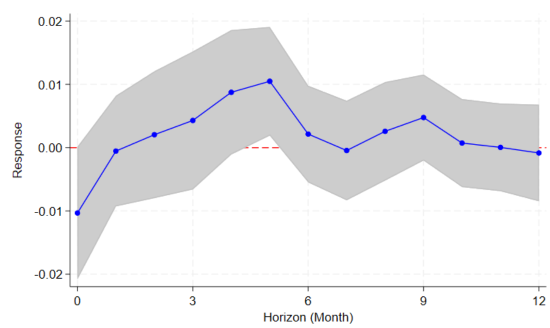
(a) By Interest Coverage Ratio : U.S.



(b) By Short-term Net Foreign Debt Ratio : U.S.



(c) By Interest Coverage Ratio : KOR



(d) By Short-term Net Foreign Debt Ratio : KOR

Figure 7: Impulse Response of Credit Spread to Monetary Policy Shocks

Notes: This figure shows the impulse responses of firm-level Credit Spreads to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls: one-month-lagged sales growth, size (log of total assets), cash flow, liquidity, bond maturity (in years), and credit rating group dummies. Standard errors are two-way clustered at the firm and month level. Financial ratios are standardized to have zero mean and unit standard deviation. Interest Coverage Ratio variables are inverted in analysis.

3.4 State-Dependent Effects During Periods of Exchange Rate Volatility : Credit Spread

To further investigate the transmission mechanism of monetary policy under different market conditions, we extend the state-dependent analysis in Section 3.2 to corporate credit spreads. The rationale is twofold. First, credit spreads directly measure firms' borrowing costs and perceived default risk in financial markets, thus providing a more immediate gauge of the funding-cost channel than investment responses. Second, by conditioning on periods of high exchange rate (FX) volatility, we can identify whether the sensitivity of borrowing costs to monetary policy shocks is amplified during episodes of heightened market stress.

Formally, we estimate the following specification:

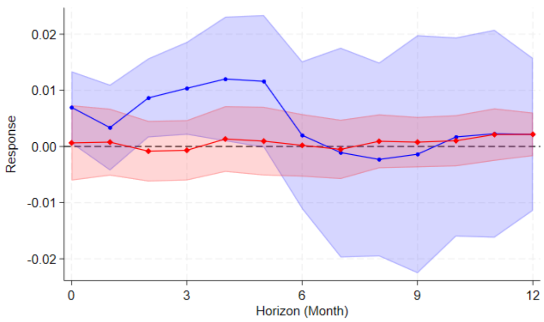
$$CS_{i,j,t+h} - CS_{i,j,t} = \alpha_i + \gamma_{s,t} + \sum_{v \in \{\text{high},\text{low}\}} \beta_h^v \left[(X_{j,t} - \bar{X}_j) \cdot \varepsilon_t^m \cdot I_t^v \right] + \theta_h' Z_{j,t-1} + u_{i,j,t+h}, \quad (3.6)$$

where $CS_{i,j,t+h}$ denotes the credit spread (in basis points) of bond j issued by firm i at horizon h months after the monetary policy shock ε_t^m. High-volatility periods are identified as quarters in which FX volatility exceeds two standard deviations above its historical mean, corresponding to the Global Financial Crisis (2008:Q4–2009:Q1) and the COVID-19 shock (2020:Q1). $X_{j,t}$ is the standardized firm-level financial indicator of interest—here, the inverted Interest Coverage Ratio (ICR) and the short-term debt ratio. All regressions include firm fixed effects α_i, industry-by-month fixed effects $\gamma_{s,t}$, and a standard set of lagged firm-level controls.

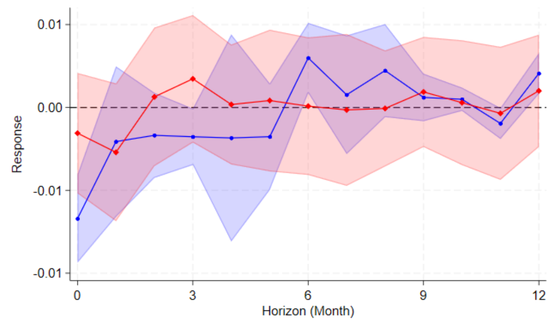
Figure 8 presents the results for two key firm characteristics: the Interest Coverage Ratio (ICR) and the short-term debt ratio (ST-FDR). Several findings emerge. First, in both the U.S. and Korean shock cases, short-term debt exposure does not generate meaningful differences in credit spread responses during high volatility periods, the estimated effects remain close to zero and statistically insignificant. This suggests that, in contrast to conventional currency mismatch concerns, short-term debt structure is not the main amplification mechanism for credit spreads during crises.

Second, debt-servicing capacity (ICR) plays a dominant role. For both U.S. and Korean monetary policy shocks, firms with weaker ICRs experience substantially larger increases in credit spreads during high FX volatility. These effects peak around three to four months after the shock, reaching approximately 0.01–0.02 (1–2 basis points). The amplification is economically relevant given the short horizon and reflects heightened sensitivity of lenders to cash-flow risk in stressed environments.

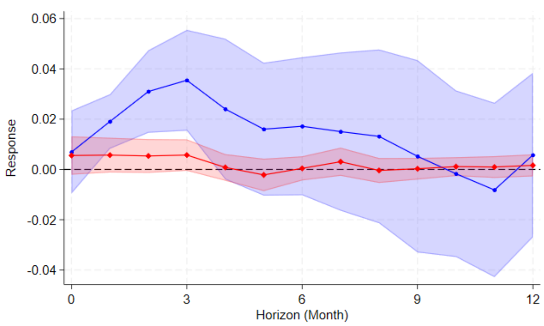
An interesting asymmetry arises: in normal periods, U.S. monetary policy shocks have negligible effects on Korean firms' credit spreads, but under high FX volatility the response of low-ICR firms becomes clearly positive and statistically significant. This is consistent with our earlier investment results, where U.S. shocks—while generally not transmitted via domestic funding costs—can impact credit conditions when global market stress increases the salience of firm liquidity risk. For Korean monetary policy shocks, the high-volatility regime similarly amplifies credit spread widening for low-ICR firms, revealing that domestic policy can influence financing costs more strongly when exchange rate movements are large. Overall, these results indicate that the credit spread channel of monetary policy in a small open economy is state-dependent: in tranquil periods, external shocks rarely move domestic credit spreads, but during high FX volatility, lenders re-price risk sharply for firms with weak debt-servicing capacity, regardless of the shock's origin.



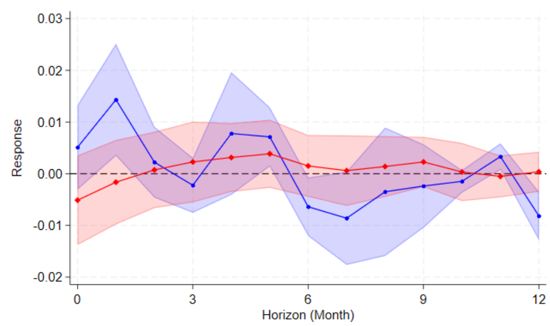
(a) By Interest Coverage Ratio, U.S. shock



(b) By Short term Debt Ratio, U.S. shock



(c) By Interest Coverage Ratio, Korean shock



(d) By Short term Debt Ratio, Korean shock

Figure 8: Impulse Response of Credit Spread, using dummy variables which indicate volatility level

Notes: The blue (red) line and shaded area represent the point estimates and 95% confidence intervals during high (low) FX volatility periods. High volatility periods are defined as quarters when FX volatility exceeds 2 standard deviations above the mean, specifically during the Global Financial Crisis (2008:Q4-2009:Q1), and COVID-19 shock (2020:Q1). All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls. Interest Coverage Ratio variables are inverted in analysis.

3.5 The Role of Global Financial Cycles

The preceding sections have shown that two facts. First, U.S. monetary policy shocks have sizeable effects on firm investment even when domestic credit spreads barely move in tranquil times. Second, Korean monetary policy has modest average effects, yet both policies become more powerful during episodes of high exchange rate volatility, with the amplification concentrated among firms with weak debt-servicing capacity (low ICR). These patterns suggest that, beyond policy-specific shocks, shifts in global risk appetite may act as a common background force shaping corporate decisions. In other words, part of the state-dependent transmission documented above may reflect the *global financial cycle* rather than the idiosyncratic features of each policy shock.

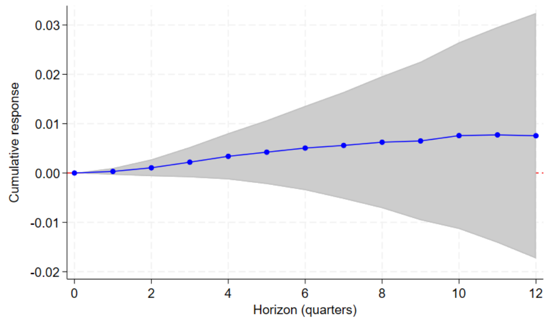
We therefore re-estimate our heterogeneity-based local projections by replacing the monetary policy shock with the VIX index—a standard proxy for global financial conditions. Our goal is not to claim new causal identification, but to assess whether a tightening of global financial conditions (an increase in $\log VIX_t$) generates systematic co-movement in investment and whether balance-sheet fragilities (e.g., leverage, current-liability share, and the inverse ICR) govern the magnitude of this response in the same way as in Sections **??**–**??**. A negative coefficient should be interpreted as global tightening reducing investment. Formally, we estimate:

$$\log k_{jt+h} - \log k_{jt} = \alpha_{jh} + \alpha_{sth} + \beta_h (X_{jt} - \overline{X_{jt}}) \log VIX_t + \Gamma'_h Z_{jt-1} + e_{jth} \tag{3.7}$$

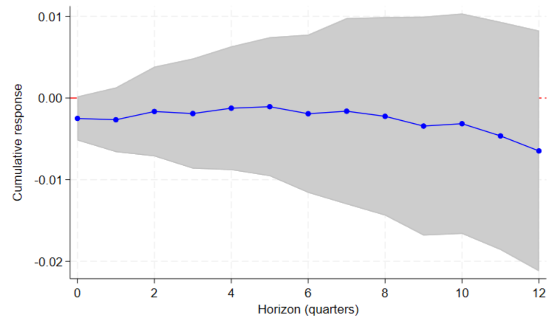
where $\log VIX_t$ represents the logarithm of the VIX index at time t, which serves as a proxy for global financial conditions following Rey (2016) and Miranda-Agrippino and Rey (2020). The coefficient β_h now measures the cumulative response of investment to changes in global financial conditions at horizon h, conditional on firms' financial positions. The interpretation of other variables and fixed effects remains the same as in equation (3.2), and maintain the same set of control variables and standardization approach described earlier. This modification allows us to directly examine how the global financial cycle, as captured by the VIX index, influences firm-level investment decisions through various financial characteristics, providing a complementary perspective to our monetary policy analysis.

Current liability ratio shows a notable negative trend, with the effect becoming increasingly pronounced over time. This indicates that firms with higher proportions of short-term debt in their total debt structure are particularly vulnerable to changes in global financial conditions, consistent with the rollover risk channel emphasized in the literature. The leverage effect is particularly substantial. This pronounced negative response for highly leveraged firms provides firm-level evidence for the global financial cycle hypothesis of Rey (2016), demonstrating how financial structure can amplify the transmission of global shocks in small open economies. The analysis of foreign currency debt exposure in relation to VIX changes reveals some nuanced patterns. Both short-term and long-term foreign currency debt ratios show relatively modest and statistically insignificant responses to changes in global financial conditions as measured by the VIX index. This muted response is maintained across different time horizons, with confidence intervals consistently including zero. The lack of strong differential responses between short-term and long-term foreign currency debt suggests that the maturity structure of foreign currency borrowing may not be a primary channel through which global financial uncertainty affects firm investment decisions in our sample. Instead, the more pronounced responses appear in other financial characteristics, particularly in firms' leverage ratios and current Liabilities ratios. As shown in panels (e) and (f) of Figure 9, firms with higher leverage and current liabilities ratios show significantly stronger negative responses to VIX increases, suggesting that overall balance sheet strength, rather than the specific composition of foreign currency debt or the short-term liquidity position, may be more crucial in determining firms' resilience to global financial shocks.

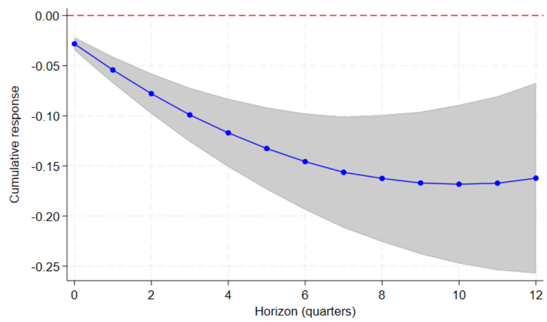
These findings collectively suggest that firms' financial positions, particularly their lever-



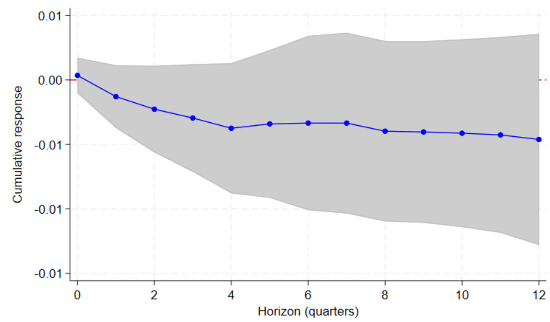
(a) By Interest Coverage Ratio



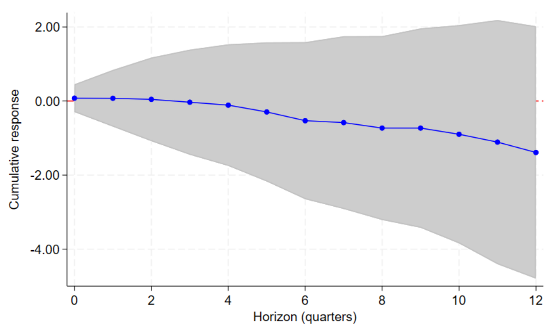
(b) By Short-term Net Foreign Debt Ratio



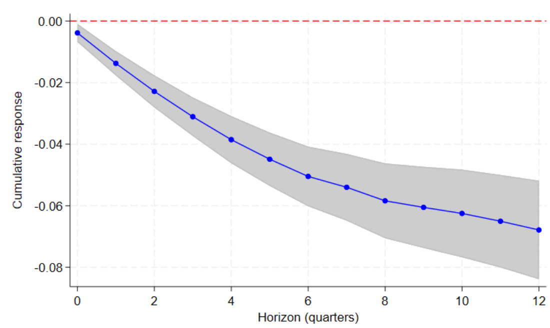
(c) By Current Liability Ratio



(d) By Long-term Net Foreign Debt Ratio



(e) By Current Ratio



(f) By Leverage

Figure 9: Impulse Response of Cumulative Investment to VIX

Notes: This figure shows the impulse responses of cumulative firm-level investment to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors are two-way clustered at the firm and quarter level. Financial ratios are standardized to have zero mean and unit standard deviation. ICR and CR vaiables are inverted in analysis.

age and liquidity management, play crucial roles in determining their sensitivity to global financial conditions. The results complement our earlier findings about monetary policy transmission and suggest that firm-level financial characteristics serve as important channels through which global financial cycles affect real economic outcomes in small open economies. These patterns also have important implications for macroprudential policy, suggesting that monitoring and managing firm-level financial vulnerabilities might be crucial for maintaining financial stability in an environment of powerful global financial cycles.

4 Conclusion

This paper has examined how U.S. and Korean monetary policy shocks affect firm investment and credit spreads in a small open economy, using a local projection framework with firm-level heterogeneity. The analysis yields several empirical regularities.

First, U.S. monetary policy tightening leaves Korean firms' credit spreads largely unchanged in normal times but induces a pronounced short-run contraction in investment. This finding suggests that the transmission of U.S. shocks operates less through the Korean interest-rate channel and more through indirect mechanisms such as heightened uncertainty, weaker investment sentiment, and deteriorating global growth expectations. As a result, adjustments in the Bank of Korea's policy rate alone are unlikely to fully insulate Korean firms' investment from such shocks.

Korean monetary policy shocks, by contrast, significantly widen Korean firms' credit spreads, with the effect peaking within three to four months and concentrated among firms with low interest coverage ratios. This pattern indicates that Korean monetary tightening amplifies the market's re-pricing of risk, especially for financially vulnerable firms. However, these spread increases do not translate into a statistically significant contraction in Korean firms' investment, implying that the pass-through from funding costs to real investment is either delayed or mitigated by offsetting factors.

Foreign-currency maturity structure emerges as an important source of heterogeneity in real responses. Firms with high short-term foreign-currency debt exposure experience much larger declines in investment following U.S. monetary tightening than firms with predominantly long-term exposures, highlighting the role of maturity management in buffering external shocks.

Periods of high exchange-rate volatility further condition the transmission of both U.S. and Korean shocks. In such states, lenders' sensitivity to cash-flow risk rises sharply, and credit spread widening is disproportionately concentrated among low-ICR firms. This state dependence underscores the importance of balance-sheet strength in determining the incidence of monetary tightening.

Finally, replacing policy shocks with the VIX index reveals that global financial tightening systematically depresses investment, with the strongest effects observed for firms with high leverage or a large share of current liabilities. These results point to the global financial cycle as a pervasive background force that can generate co-movement and amplify the effects of both U.S. and Korean monetary policy shocks.

Taken together, our findings highlight that the transmission of monetary policy to Korean firms depends not only on the origin of the shock but also on the interaction between global financial conditions, exchange-rate volatility, and firm-level vulnerabilities. U.S. shocks primarily affect Korean firms' investment through uncertainty, sentiment, and global-demand channels, limiting the scope for Korean monetary policy to fully offset their impact. In high-volatility regimes, targeted macroprudential measures aimed at liquidity and debt-service capacity can help contain risk re-pricing, while managing the short-term foreign-currency maturity profile is essential for enhancing resilience to external shocks. Policy evaluation should explicitly account for these state-dependent mechanisms when designing stabilization strategies.

Appendix A: Data Construction and Variable Definitions

This appendix provides detailed information about the construction of variables used in the analysis. This study uses firm-level data from Valuesearch (formerly KIS-value), a comprehensive corporate database service provided by NICE Information Service. Valuesearch contains financial statements, stock prices, and other information for over 1.5 million Korean companies, including listed companies, externally audited firms, and unlisted companies. Our sample is restricted to firms with observation exceeding 40-quaters of tangible assets and foreign debt ratio, resulting in 8,621 companies for 77 industry-sectors All variables are winsorized at the 1st and 99th percentiles to mitigate the impact of outliers and deflated using the GDP deflator. Especially, to enhance analytical clarity in coefficient interpretation and graphical visualization, this study employs inverted values of ICR (Interest Coverage Ratio) and CR (Current Ratio) in the Local projection analysis. Consequently, these transformed ICR and CR variables align with other financial indicators (CLR, LEV) in their interpretation - where higher values signify greater financial vulnerability and weaker short-term payment capacity of firms. Our sample data include in 29.1% of KOSPI+KOSDAQ listed firms.

A.1 Capital Stock Construction

The capital stock series is constructed following Ottonello and Winberry (2020) and Jungherr et al. (2022). For each firm i at time t, the series is initialized using the first equipment observation and then recursively constructed as follows:

$$K_{i,1} = \text{Assets}_{i,1} \qquad \text{(Initial value)} \tag{4.1}$$

$$K_{i,t} = \frac{K_{i,t-1} + K_{i,t+1}}{2} \qquad \text{if } K_{i,t} \text{ is missing for 1 quarter} \tag{4.2}$$

$$\text{Cumulative Growth}_{i,t,h} = \ln(Ki, t+h) - \ln(K_{i,t-1}) \quad \text{for } h = 0, \ldots, 12 \tag{4.3}$$

where $\text{Assets}_{i,t}$ represents the book value of equipment (tangible fixed assets) for firm i at time t. The sample is restricted to firms with at least 40 quarters of non-zero and non-missing equipment observations. Linear interpolation is applied only in cases where a single quarter of data is missing, using values from immediately adjacent quarters.

A.2 Financial Ratios and Indicators

The Interest Coverage Ratio measures a firm's debt service capacity and is computed as:

$$\text{ICR}_{i,t} = \frac{\text{EBIT}_{i,t}}{\text{Interest Cost}_{i,t}} \tag{4.4}$$

where $\text{EBIT}_{i,t}$ represents earnings before interest and taxes, and $\text{Interest Cost}_{i,t}$ represents the total interest expenses.

Following Kim et al. (2015), foreign debt ratios are calculated for both short-term and long-term components :

$$\text{ST-FDR}_{i,t} = \frac{\text{CFLD}_{i,t} + \text{FSD}_{i,t} + \text{FTP}_{i,t} - \text{FAS}_{i,t}}{\text{TA}_{i,t} - \text{TD}_{i,t}} \tag{4.5}$$

$$\text{LT-FDR}_{i,t} = \frac{\text{FLD}_{i,t}}{\text{TA}_{i,t} - \text{TD}_{i,t}} \tag{4.6}$$

where ST-FDR is Short-term Foreign Debt Ratio, LT-FDR is Long-term Foreign Debt Ratio, CFLD is Current Foreign Long-term Debt, FSD is Foreign Short-term Debt, FTP is Foreign Trade Payables, FAS is Foreign Assets, TA is Total Assets, and TD is Total Debt.

The Current Liabilities Ratio measures the proportion of short-term debt in total debt:

$$\text{CLR}_{i,t} = \frac{\text{Current Liabilities}_{i,t}}{\text{Total Debt}_{i,t}} \tag{4.7}$$

The Current Ratio is a fundamental liquidity metric that evaluates a company's ability to meet its short-term obligations using its short-term assets. It provides a snapshot of a firm's short-term financial health. Current assets include cash, cash equivalents, accounts receivable, inventory, and other assets expected to be converted to cash within one year. Current liabilities encompass accounts payable, short-term debt, and other obligations due within one year :

$$\text{CR}_{i,t} = \frac{\text{Current Assets}_{i,t}}{\text{Current Liabilities}_{i,t}} \tag{4.8}$$

A.3 Additional Financial Variables

The analysis also includes several other financial variables:

- **Size**: Measured as $\ln(\text{Total Assets}_{i,t})$

- **Cash Flow**: Defined as $\frac{\text{EBIT}_{i,t}}{\text{Capital Stock}_{i,t}}$
- **Leverage**: Calculated as $\frac{\text{Total Debt}_{i,t}}{\text{Total Assets}_{i,t}}$
- **Liquidity**: Measured as $\frac{\text{Cash and Cash Equivalents}_{i,t}}{\text{total assets}_{i,t}}$

All financial ratios are standardized to have zero mean and unit standard deviation to facilitate interpretation of the coefficients and to address the typical right-skewed distribution of financial ratios. Summary statistics for these variables are presented in Table 2, and their correlations are shown in Tables 6, 7, and 8.

Table 5: Summary Statistics : KOSPI + KOSDAQ

Variables	N	Mean	S.D.	Min	Max
ln(sales)	150,349	18.41	1.78	0.35	26.07
size	158,153	25.73	1.70	13.51	33.54
liq	157,135	0.09	0.10	0.00	0.64
clr	152,967	0.73	0.21	0.01	1.00
st fdr	169,513	0.11	0.81	0.00	9.32
lt fdr	160,426	0.01	0.06	0.00	0.88
1/icr	141,132	0.18	1.14	-6.30	6.79
1/cr	152,772	0.79	0.78	0.00	6.60
lev	158,153	0.39	0.23	0.39	1.58
ln(capital)	189,581	23.47	2.33	7.01	32.46
ln(cf)	189,583	0.64	3.69	-5.32	30.17

Note: This table presents summary statistics for the main variables used in the analysis, for 3449 firms. All variables are winsorized at the 1st and 99th percentiles to mitigate the impact of outliers. Log transformations are applied to variables with large absolute values for better interpretation. Variables include: sales(ln(sales)), size, liquidity (liq), current liabilities ratio (clr), foreign debt ratio (fdr), short-term and long-term foreign debt ratio (st fdr, lt fdr), interest coverage ratio (icr), current ratio (cr), leverage (lev), capital stock (ln(capital)), and cash flow.

Table 6: Overall Correlation Matrix

Variable	LEV	CLR	ICR	ST FDR	LT FDR	CR
LEV	1.0000					
CLR	-0.0939	1.0000				
ICR	-0.1892	0.0607	1.0000			
ST FDR	0.0797	0.0442	-0.0221	1.0000		
LT FDR	0.1806	-0.1239	-0.0386	0.0975	1.0000	
CR	-0.5293	-0.1788	0.1774	-0.0342	-0.0728	1.0000

Note: LEV is leverage (total debt to total assets). CLR is current liabilities ratio. ICR is the interest coverage ratio. ST FDR and LT FDR are net short-term and long-term foreign currency debt ratios, respectively. CR is the current ratio (current assets to current liabilities). All variables are winsorized at the 1st and 99th percentiles.

Table 7: Between-firm Correlation Matrix

Variable	LEV	CLR	ICR	ST FDR	LT FDR	CR
LEV	1.0000					
CLR	-0.2333	1.0000				
ICR	-0.1884	0.1692	1.0000			
ST FDR	0.0968	0.0794	-0.0526	1.0000		
LT FDR	0.2910	-0.2029	-0.0866	0.1145	1.0000	
CR	-0.3889	-0.1911	0.0920	-0.0371	-0.1090	1.0000

Note: LEV is leverage (total debt to total assets). CLR is current liabilities ratio. ICR is the interest coverage ratio. ST FDR and LT FDR are net short-term and long-term foreign currency debt ratios, respectively. CR is the current ratio (current assets to current liabilities). Between-firm correlations are calculated using firm-level means. All variables are winsorized at the 1st and 99th percentiles.

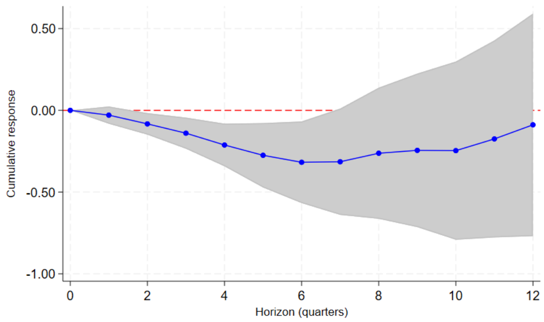
Table 8: Within-firm Correlation Matrix

Variable	LEV	CLR	ICR	ST FDR	LT FDR	CR
LEV	1.0000					
CLR	-0.0618	1.0000				
ICR	-0.0910	0.0319	1.0000			
ST FDR	0.0961	0.0126	-0.0060	1.0000		
LT FDR	0.1350	-0.1057	-0.0167	0.0898	1.0000	
CR	-0.4057	-0.2894	0.0895	-0.0236	-0.0181	1.0000

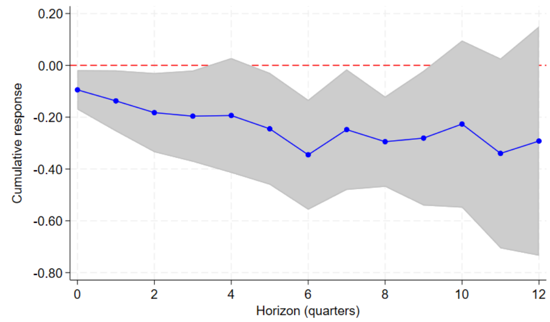
Note: LEV is leverage (total debt to total assets). CLR is current liabilities ratio. ICR is the interest coverage ratio. ST FDR and LT FDR are net short-term and long-term foreign currency debt ratios, respectively. CR is the current ratio (current assets to current liabilities). Within-firm correlations are calculated using deviations from firm-specific means. All variables are winsorized at the 1st and 99th percentiles.

Appendix B : Additional results

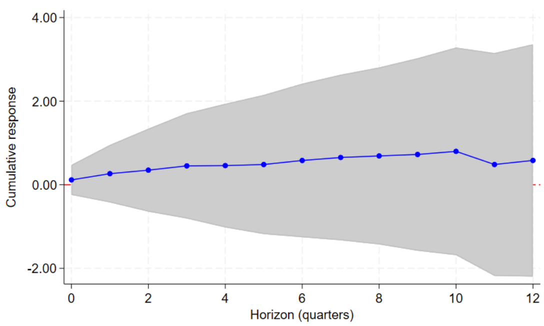
B.1 Heterogeneous Investment Responses



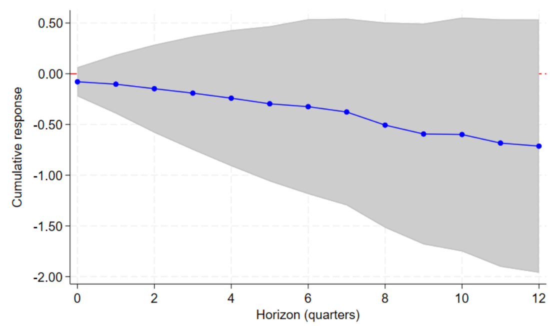
(a) By Interest Coverage Ratio



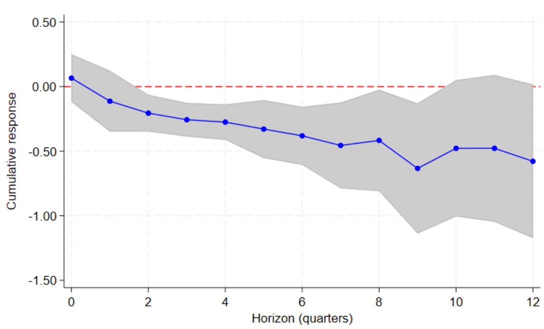
(b) By Short-term Net Foreign Debt Ratio



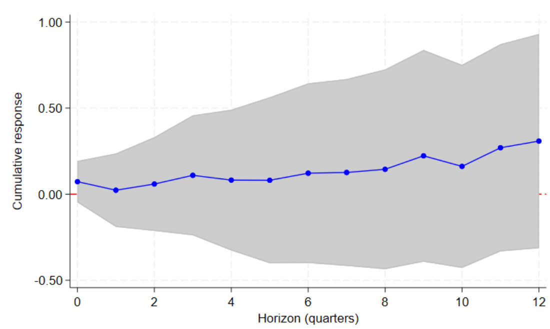
(c) By Current Liabilities Debt Ratio



(d) By Long-term Net Foreign Debt Ratio



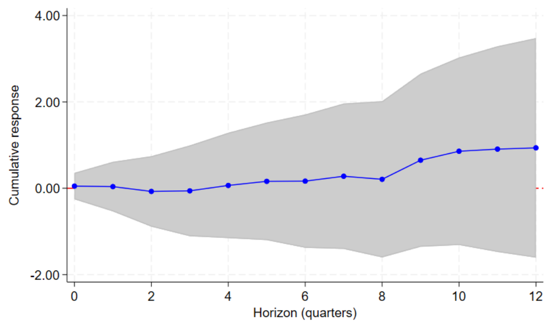
(e) By Current Ratio



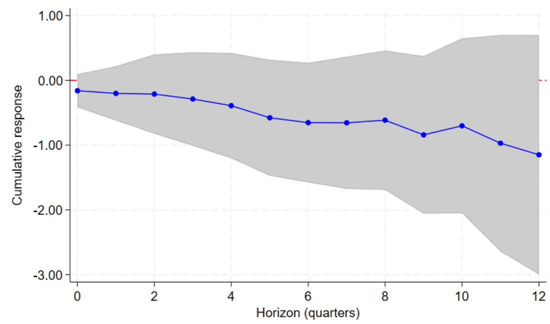
(f) By Leverage

Figure 10: Impulse Response of Cumulative Investment to U.S. Monetary Policy Shocks

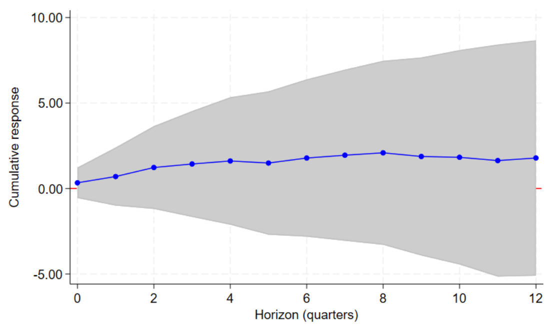
Notes: This figure shows the impulse responses of cumulative firm-level investment to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors are two-way clustered at the firm and quarter level. Financial ratios are standardized to have zero mean and unit standard deviation. ICR and CR vaiables are inverted in analysis.



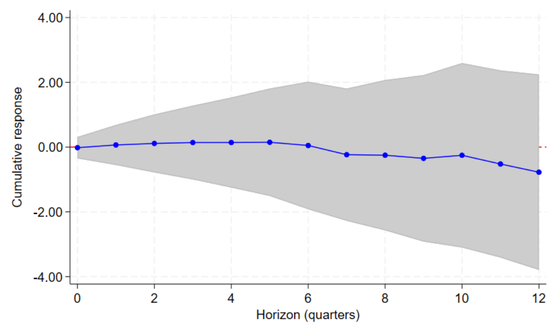
(a) By Interest Coverage Ratio



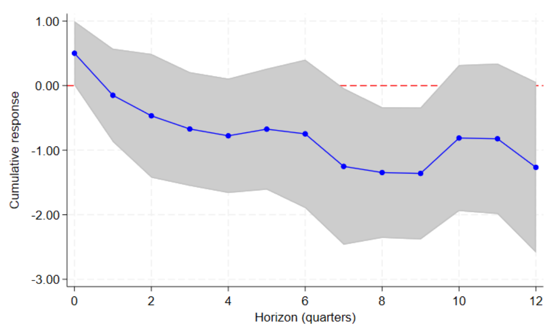
(b) By Short-term Net Foreign Debt Ratio



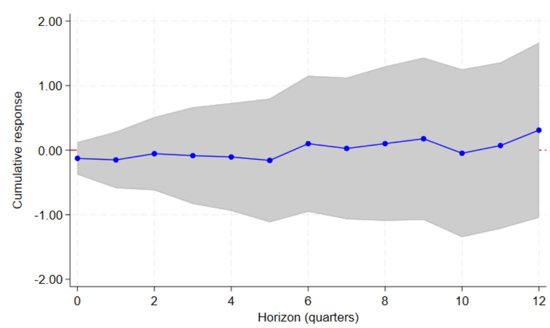
(c) By Current Liabilities Debt Ratio



(d) By Long-term Net Foreign Debt Ratio



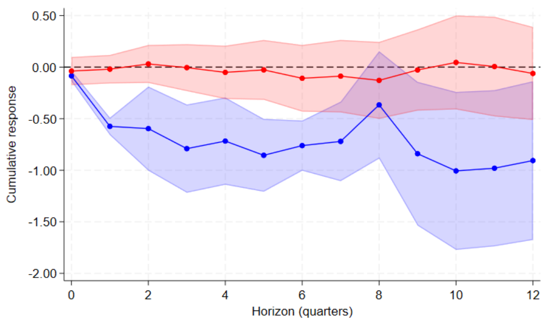
(e) By Current Ratio



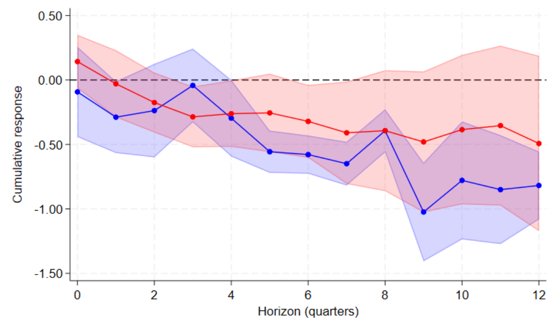
(f) By Leverage

Figure 11: Impulse Response of Cumulative Investment to Korean Monetary Policy Shocks

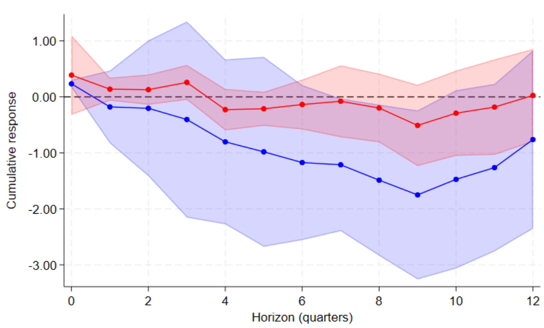
Notes: This figure shows the impulse responses of cumulative firm-level investment to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors are two-way clustered at the firm and quarter level. Financial ratios are standardized to have zero mean and unit standard deviation. ICR and CR vaiables are inverted in analysis.



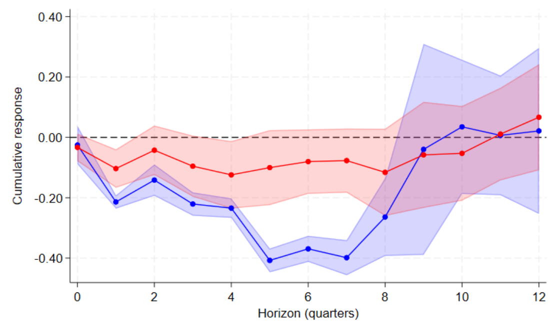
(a) By Current Liabilities Ratio, U.S. shock



(b) By Current Ratio, U.S. shock



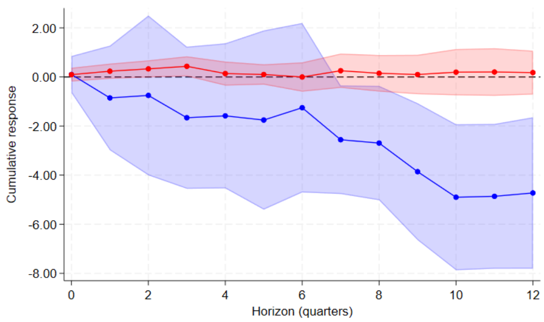
(c) By Short term Debt Ratio, U.S. shock



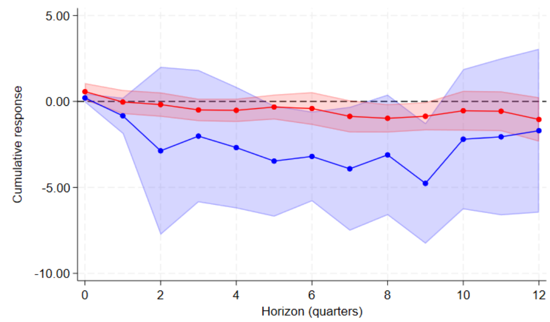
(d) By Interest Coverage Ratio, U.S. shock

Figure 12: Impulse Response of Cumulative Investment, using dummy variables which indicate volatility level

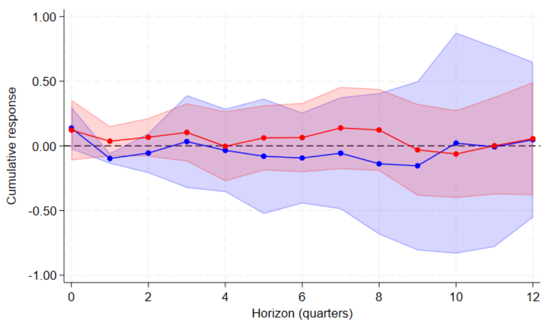
Notes: The blue (red) line and shaded area represent the point estimates and 95% confidence intervals during high (low) FX volatility periods. High volatility periods are defined as quarters when FX volatility exceeds 2 standard deviations above the mean, specifically during the Global Financial Crisis (2008:Q4-2009:Q1), and COVID-19 shock (2020:Q1). All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls. CR vaiables are inverted in analysis.



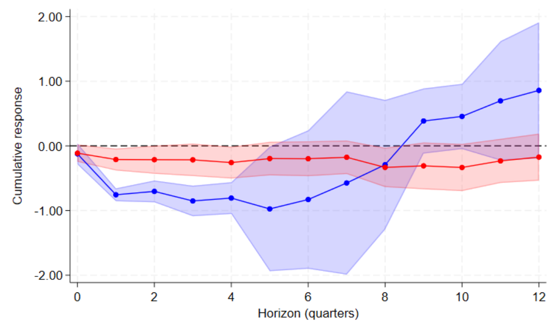
(a) By Current Liabilities Ratio, Korean shock



(b) By Current Ratio, Korean shock



(c) By Short term Debt Ratio, Korean shock



(d) By Interest Coverage Ratio, Korean shock

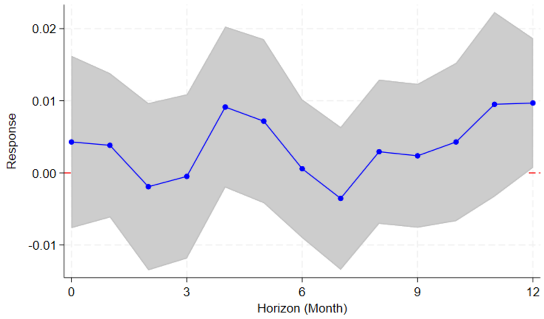
Figure 13: Impulse Response of Cumulative Investment, using dummy variables which indicate volatility level

Notes: The blue (red) line and shaded area represent the point estimates and 95% confidence intervals during high (low) FX volatility periods. High volatility periods are defined as quarters when FX volatility exceeds 2 standard deviations above the mean, specifically during the Global Financial Crisis (2008:Q4-2009:Q1), and COVID-19 shock (2020:Q1). All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls. CR vaiables are inverted in analysis.

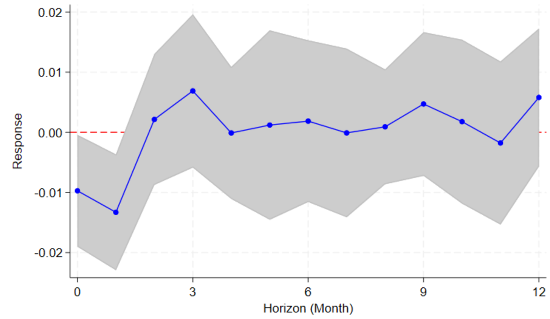
B.2 Heterogeneous Credit Spread Responses

B.3 Alternative FX Volatility Classification

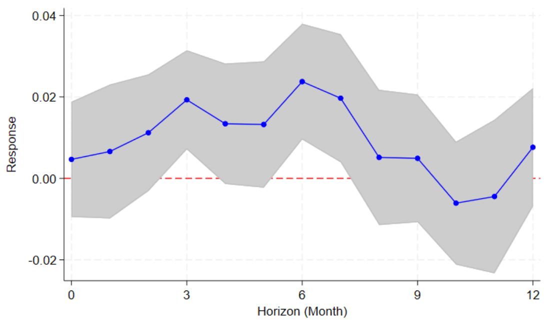
This appendix presents robustness checks using an alternative classification of FX volatility periods. While our baseline analysis identifies high-volatility periods using a threshold of two standard deviations above the mean exchange rate volatility, here we employ a more inclusive threshold of 1.5 standard deviations. This broader classification captures additional periods of moderate market stress, allowing us to test whether our main findings about the interaction between global financial conditions and domestic monetary policy transmission are robust to different definitions of market volatility. The results using this alternative classification remain qualitatively similar to our baseline findings, though the estimated effects are somewhat smaller in magnitude. This is consistent with our expectation that including periods of more moderate FX volatility would yield less pronounced differences in monetary policy transmission. The robustness of our main conclusions to this alternative specification suggests that the identified relationship between global financial conditions and domestic policy effectiveness is not driven by our specific choice of volatility threshold.



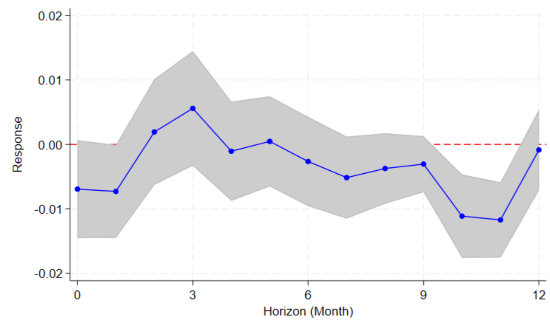
(a) By Interest Coverage Ratio



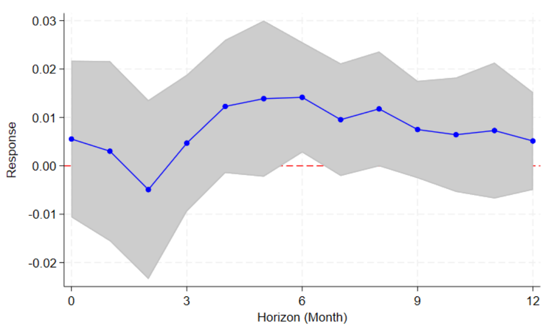
(b) By Short-term Net Foreign Debt Ratio



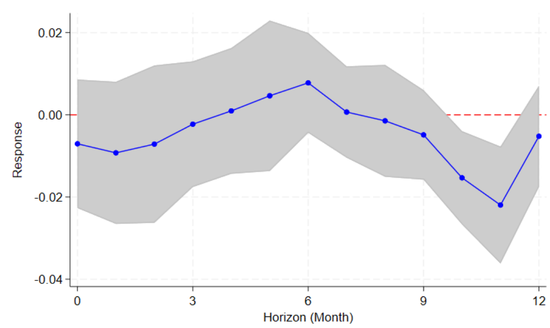
(c) By Current Liabilities Debt Ratio



(d) By Long-term Net Foreign Debt Ratio



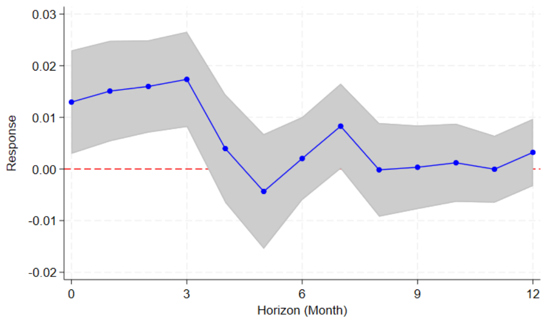
(e) By Current Ratio



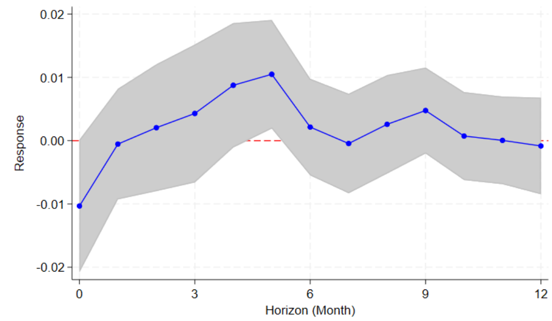
(f) By Leverage

Figure 14: Impulse Response of Credit Spread to U.S. Monetary Policy Shocks

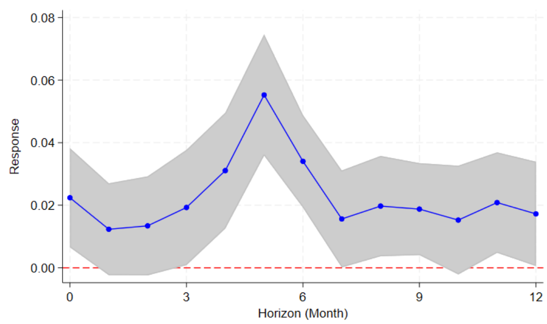
Notes: This figure shows the impulse responses of firm-level Credit Spread to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors are two-way clustered at the firm and quarter level. Financial ratios are standardized to have zero mean and unit standard deviation. ICR and CR vaiables are inverted in analysis.



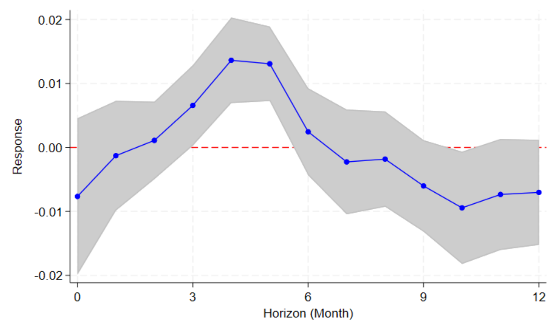
(a) By Interest Coverage Ratio



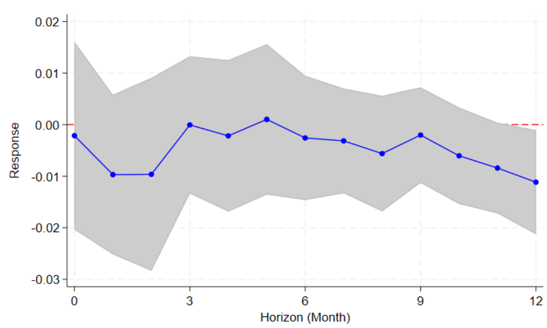
(b) By Short-term Net Foreign Debt Ratio



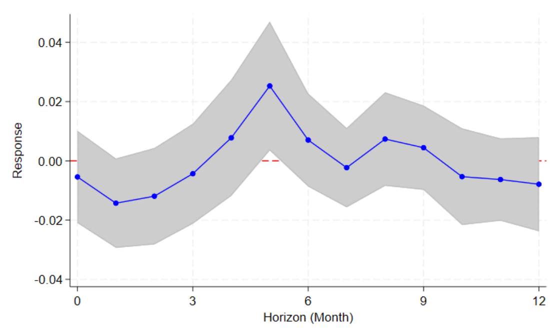
(c) By Current Liabilities Debt Ratio



(d) By Long-term Net Foreign Debt Ratio



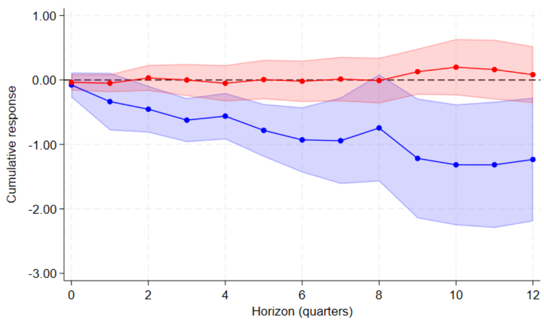
(e) By Current Ratio



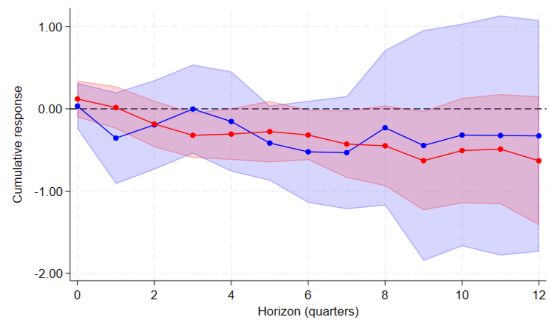
(f) By Leverage

Figure 15: Impulse Response of Credit Spread to Korean Monetary Policy Shocks

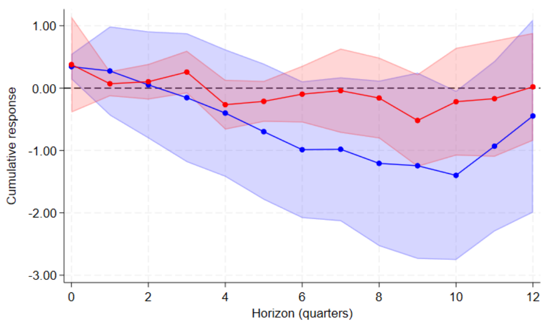
Notes: This figure shows the impulse responses of firm-level Credit Spread to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors are two-way clustered at the firm and quarter level. Financial ratios are standardized to have zero mean and unit standard deviation. ICR and CR vaiables are inverted in analysis.



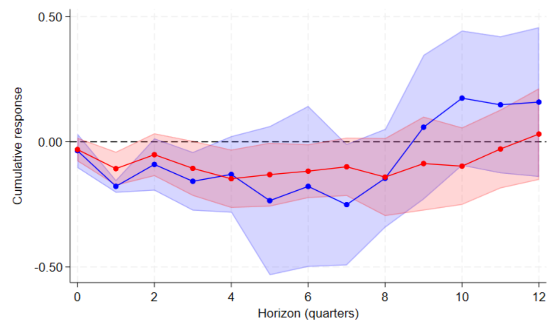
(a) By Current Liabilities Ratio, U.S. shock



(b) By Current Ratio, U.S. shock



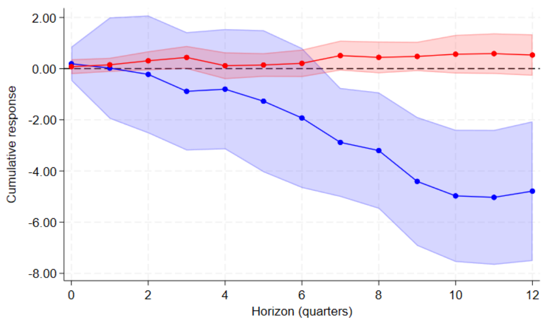
(c) By Short term Debt Ratio, U.S. shock



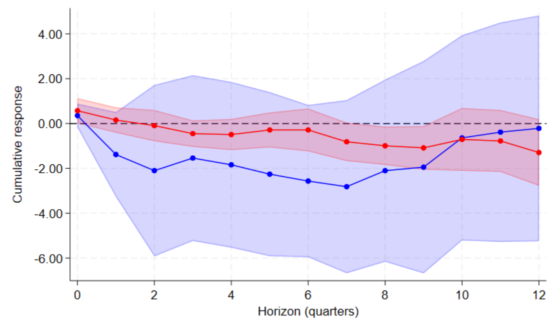
(d) By Interest Coverage Ratio, U.S. shock

Figure 16: Impulse Response of Cumulative Investment, using dummy variables which indicate volatility level

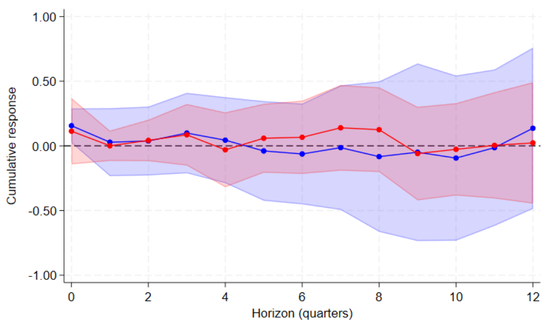
Notes: The blue (red) line and shaded area represent the point estimates and 95% confidence intervals during high (low) FX volatility periods. High volatility periods are defined as quarters when FX volatility exceeds 2 standard deviations above the mean, specifically during the Asian Financial Crisis (1997:Q4-1998:Q1), Global Financial Crisis (2008:Q4-2009:Q1), and COVID-19 shock (2020:Q1). All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls.



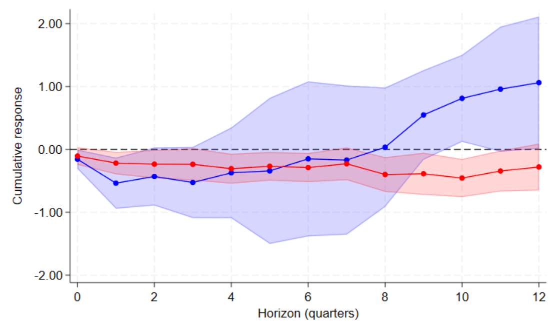
(a) By Current Liabilities Ratio, Korean shock



(b) By Current Ratio, Korean shock



(c) By Short term Debt Ratio, Korean shock



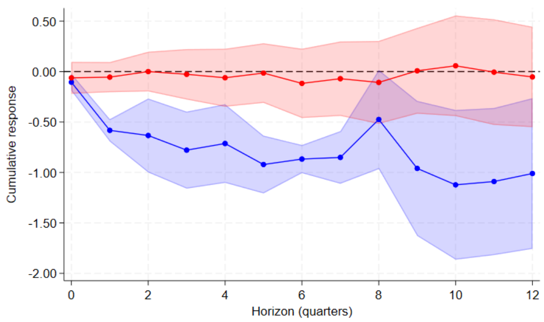
(d) By Interest Coverage Ratio, Korean shock

Figure 17: Impulse Response of Cumulative Investment, using dummy variables which indicate volatility level

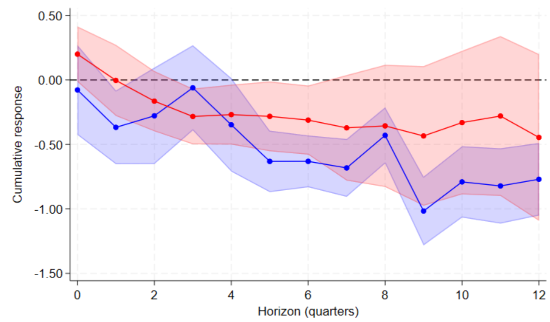
Notes: The blue (red) line and shaded area represent the point estimates and 95% confidence intervals during high (low) FX volatility periods. High volatility periods are defined as quarters when FX volatility exceeds 2 standard deviations above the mean, specifically during the Asian Financial Crisis (1997:Q4-1998:Q1), Global Financial Crisis (2008:Q4-2009:Q1), and COVID-19 shock (2020:Q1). All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls.

B.4 Evidence from KOSPI and KOSDAQ Listed Firms

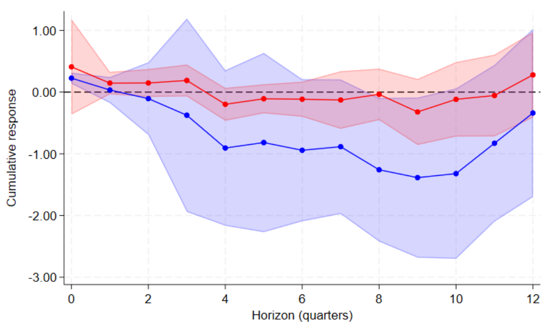
The results using KOSPI and KOSDAQ data largely confirm our main findings from the full sample analysis. When we restrict our sample to listed firms, the key empirical patterns remain remarkably consistent. Firms' heterogeneous responses to U.S. monetary policy shocks based on their financial characteristics persist, with firms having lower ICRs, higher short-term foreign currency debt ratios, and lower current ratios showing stronger investment sensitivity. Similarly, the state-dependent effects during high FX volatility periods are preserved, where both U.S. and Korean monetary policy effects show significant amplification. While the point estimates from the listed firm sample exhibit slightly smaller magnitudes in some specifications, the statistical significance and overall patterns of the results remain unchanged. This robustness is particularly meaningful as listed firms typically have higher quality financial data and are subject to stricter disclosure requirements, providing additional confidence in our baseline findings. The consistency of results across different samples suggests that the identified transmission mechanisms reflect fundamental features of how monetary policy affects corporate investment in small open economies, rather than being artifacts of sample selection.



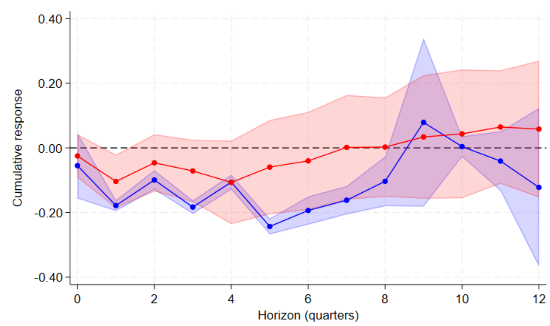
(a) By Current Liabilities Ratio, U.S. shock



(b) By Current Ratio, U.S. shock



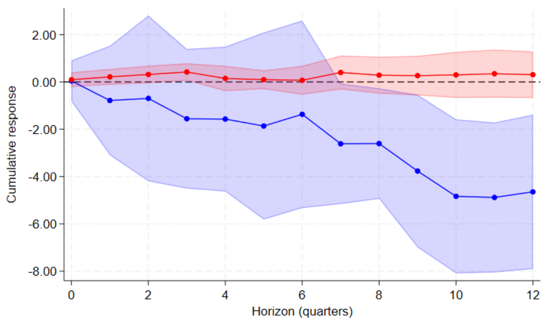
(c) By Short term Debt Ratio, U.S. shock



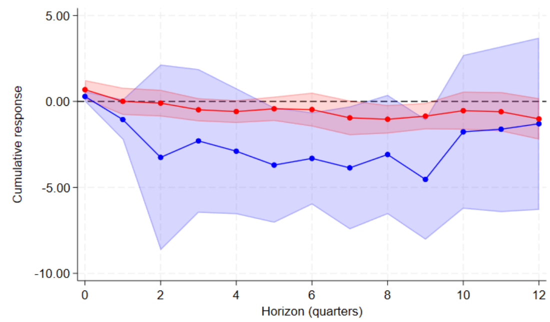
(d) By Interest Coverage Ratio, U.S. shock

Figure 18: Impulse Response of Cumulative Investment, using dummy variables which indicate volatility level

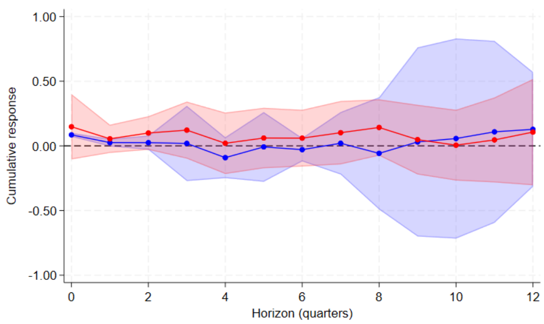
Notes: The blue (red) line and shaded area represent the point estimates and 95% confidence intervals during high (low) FX volatility periods. High volatility periods are defined as quarters when FX volatility exceeds 2 standard deviations above the mean, specifically during the Asian Financial Crisis (1997:Q4-1998:Q1), Global Financial Crisis (2008:Q4-2009:Q1), and COVID-19 shock (2020:Q1). All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls.



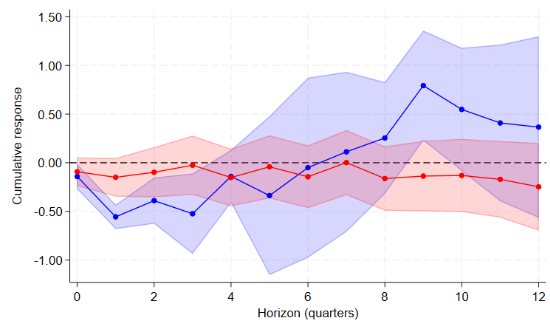
(a) By Current Liabilities Ratio, Korean shock



(b) By Current Ratio, Korean shock



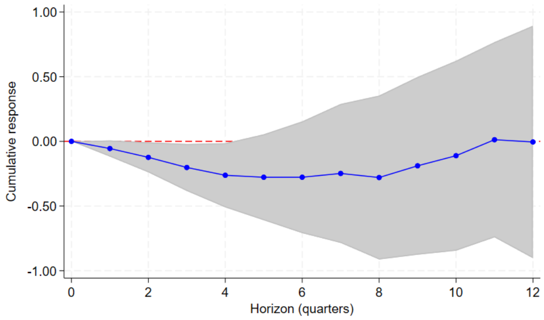
(c) By Short term Debt Ratio, Korean shock



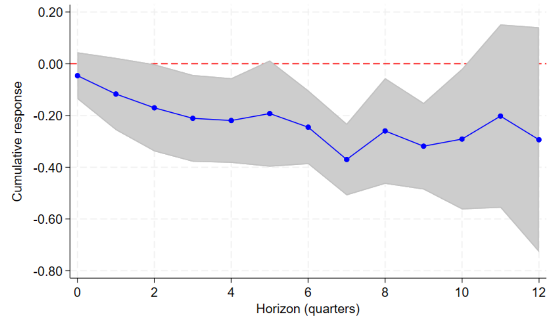
(d) By Interest Coverage Ratio, Korean shock

Figure 19: Impulse Response of Cumulative Investment, using dummy variables which indicate volatility level

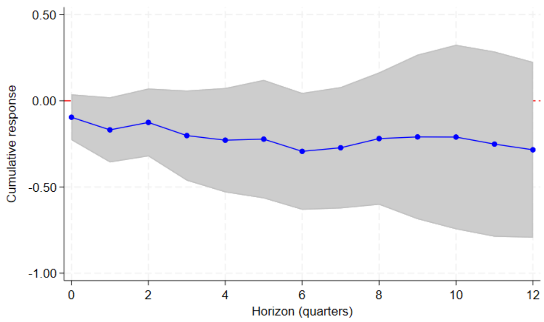
Notes: The blue (red) line and shaded area represent the point estimates and 95% confidence intervals during high (low) FX volatility periods. High volatility periods are defined as quarters when FX volatility exceeds 2 standard deviations above the mean, specifically during the Asian Financial Crisis (1997:Q4-1998:Q1), Global Financial Crisis (2008:Q4-2009:Q1), and COVID-19 shock (2020:Q1). All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls.



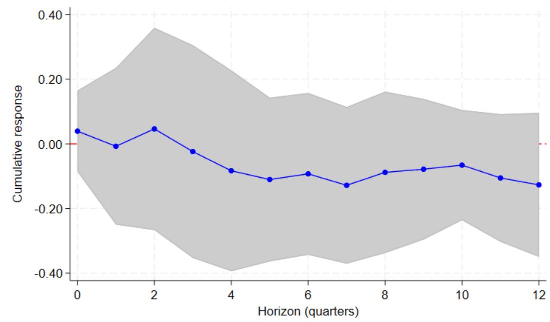
(a) By Interest Coverage Ratio



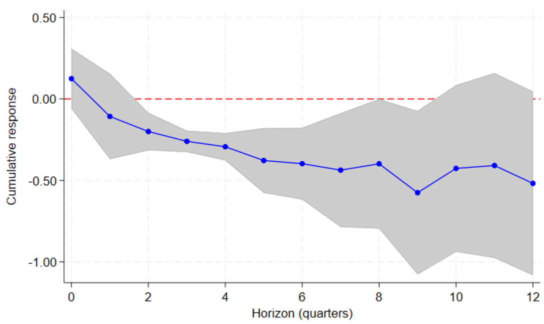
(b) By Short-term Net Foreign Debt Ratio



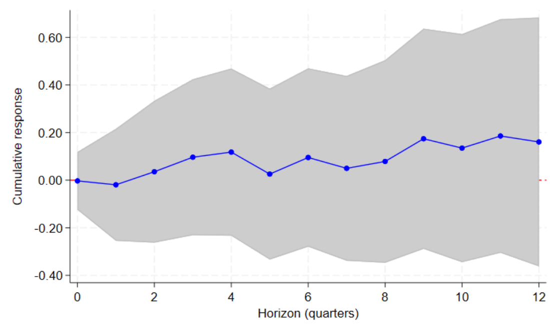
(c) By Current Liabilities Debt Ratio



(d) By Long-term Net Foreign Debt Ratio



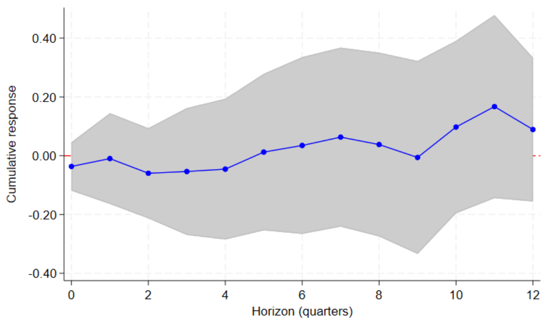
(e) By Current Ratio



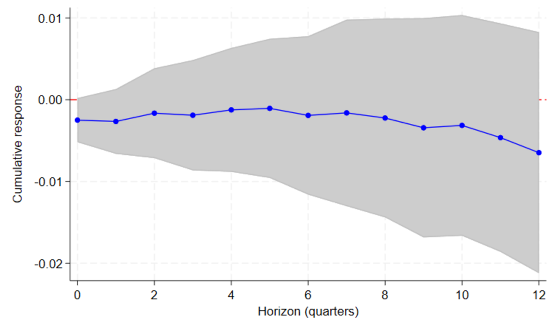
(f) By Leverage

Figure 20: Impulse Response of Cumulative Investment to U.S. Monetary Policy Shocks : KOSPI and KOSDAQ

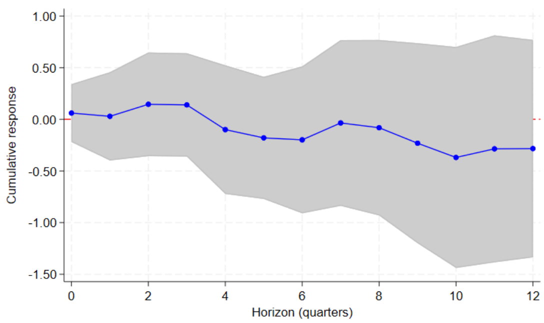
Notes: This figure shows the impulse responses of cumulative firm-level investment to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors are two-way clustered at the firm and quarter level. Financial ratios are standardized to have zero mean and unit standard deviation. ICR and CR vaiables are inverted in analysis.



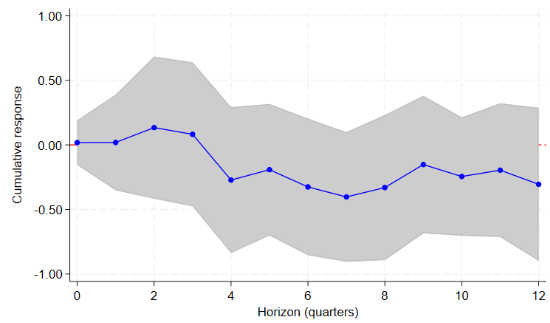
(a) By Interest Coverage Ratio



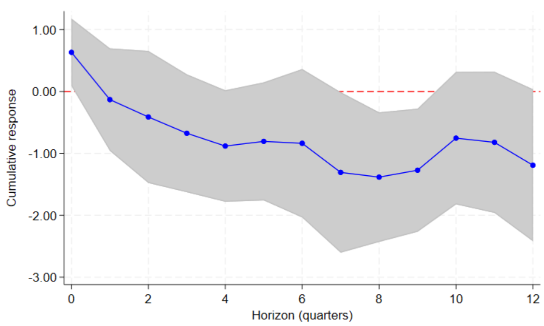
(b) By Short-term Net Foreign Debt Ratio



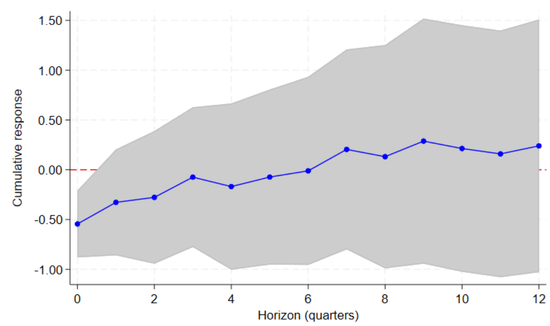
(c) By Current Liabilities Debt Ratio



(d) By Long-term Net Foreign Debt Ratio



(e) By Current Ratio



(f) By Leverage

Figure 21: Impulse Response of Cumulative Investment to Korean Monetary Policy Shocks : KOSPI and KOSDAQ

Notes: This figure shows the impulse responses of cumulative firm-level investment to monetary policy shocks interacted with various financial ratios. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. All regressions include firm fixed effects, industry-time fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors are two-way clustered at the firm and quarter level. Financial ratios are standardized to have zero mean and unit standard deviation. ICR and CR vaiables are inverted in analysis.

B.5 Specific coefficient in local projection analysis

Table 9: Full list of coefficients in local projection for selected forecast horizons h : U.S. Monetary Policy Shock

	$\Delta^{h+1} \log k_{it+h}$			
	$h = 0$	$h = 4$	$h = 8$	$h = 12$
1/ICR × MP shock	-0.000*	-0.262**	-0.280	-0.005
	(0.000)	(0.127)	(0.323)	(0.458)
N	120,319	118,692	116,869	115,065
CLR × MP shock	0.116	0.458	0.689	0.582
	(0.184)	(0.755)	(1.081)	(1.418)
N	113,765	113,708	113,667	113,612
ST FDR × MP shock	-0.094**	-0.193**	-0.295***	-0.292
	(0.038)	(0.083)	(0.089)	(0.226)
N	161,344	159,764	157,485	155,286
LT FDR × MP shock	-0.079	-0.241	-0.506	-0.713
	(0.073)	(0.342)	(0.516)	(0.637)
N	141,801	140,089	138,025	135,986
1/CR × MP shock	-0.006	-0.368***	-0.475**	-0.549**
	(0.071)	(0.116)	(0.190)	(0.215)
N	113,765	113,708	113,667	113,612
LEV × MP shock	0.065	0.060	0.096	0.255
	(0.044)	(0.065)	(0.086)	(0.120)
N	139,148	137,313	135,262	133,230
Firm FE	Yes	Yes	Yes	Yes
Industry-quarter FE	Yes	Yes	Yes	Yes

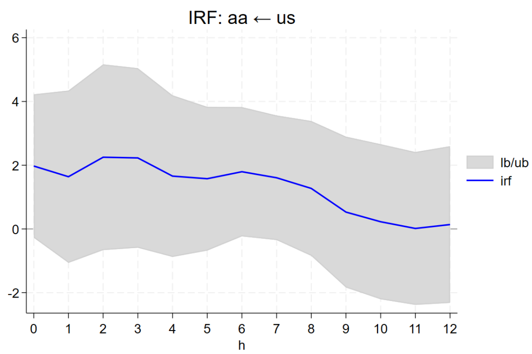
Notes: All specifications include firm-level controls lagged by one quarter: sales growth, firm size (log of total assets), cash flow, and liquidity. ICR is the interest coverage ratio. CLR is current liabilities ratio. CR is current ratio. LEV is leverage. ST-FDR and LT-FDR are net short-term and long-term foreign currency debt ratios, respectively. All financial ratios are standardized. Model include both firm fixed effects and quarter × sector fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors (in parentheses) are two-way clustered the firm and quarter level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. ICR and CR vaiables are inverted in analysis.

Table 10: Full list of coefficients in local projection for selected forecast horizons h : korean Monetary Policy Shock

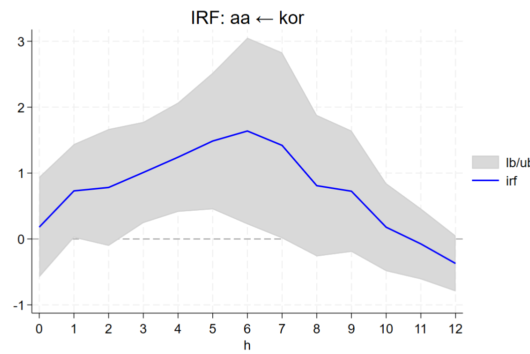
	$\Delta^{h+1}\log k_{it+h}$			
	$h=0$	$h=4$	$h=8$	$h=12$
1/ICR × MP shock	-0.000	-0.230	-0.122	0.348
	(0.000)	(0.228)	(0.647)	(1.061)
N	118,729	117,154	115,401	113,637
CLR × MP shock	0.335	1.611	2.088	1.785
	(0.255)	(1.902)	(2.746)	(3.513)
N	112,403	112,347	112,306	112,252
ST FDR × MP shock	-0.160	-0.391	-0.616	-1.150
	(0.131)	(0.414)	(0.549)	(0.943)
N	159,552	158,026	155,820	153,664
LT FDR × MP shock	-0.018	0.141	-0.251	-0.776
	(0.169)	(0.710)	(1.185)	(1.541)
N	140,009	138,351	136,360	134,364
1/CR × MP shock	0.390*	-0.879**	-1.433**	-1.217**
	(0.210)	(0.373)	(0.583)	(0.531)
N	112,403	112,347	112,306	112,252
LEV × MP shock	-0.110	-0.088	0.167	0.339
	(0.129)	(0.191)	(0.256)	(0.299)
N	137,356	135,575	133,597	131,608
Firm FE	Yes	Yes	Yes	Yes
Industry-quarter FE	Yes	Yes	Yes	Yes
N				

Notes: All specifications include firm-level controls lagged by one quarter: sales growth, firm size (log of total assets), cash flow, and liquidity. ICR is the interest coverage ratio. CLR is current liabilities ratio. CR is current ratio. LEV is leverage. ST-FDR and LT-FDR are net short-term and long-term foreign currency debt ratios, respectively. All financial ratios are standardized. Model include both firm fixed effects and quarter × sector fixed effects, and firm-level controls (one-quarter lagged sales growth, size, cash flow, and liquidity). Standard errors (in parentheses) are two-way clustered the firm and quarter level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. ICR and CR vaiables are inverted in analysis.

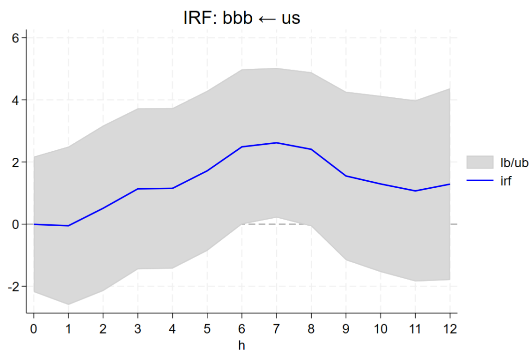
B.6 Impulse Response of Interest Rate : Bank Loan and Corporate Bond



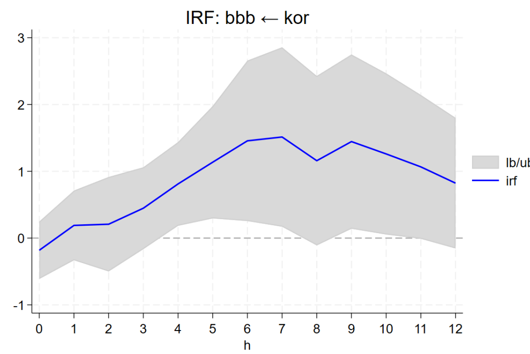
(a) AA level, U.S. Monetary Policy Shock



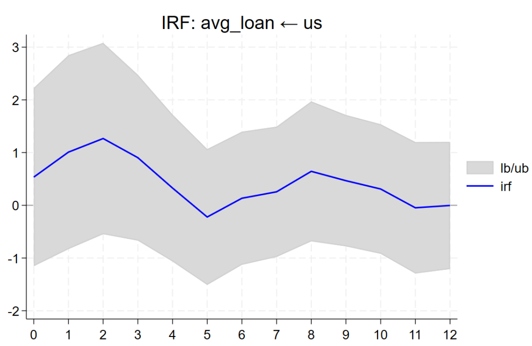
(b) AA level, Korean Monetary Policy Shock



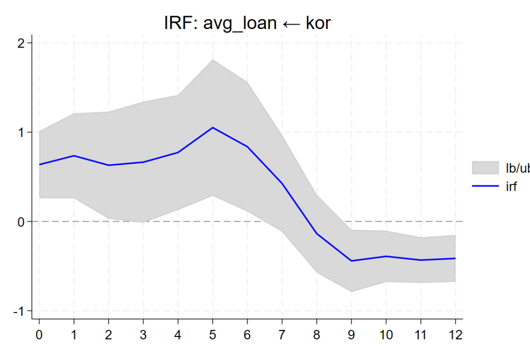
(c) BBB level, U.S. Monetary Policy Shock



(d) BBB level, Korean Monetary Policy Shock



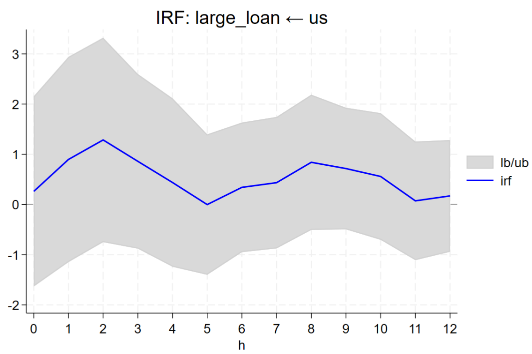
(e) Average, U.S. Monetary Policy Shock



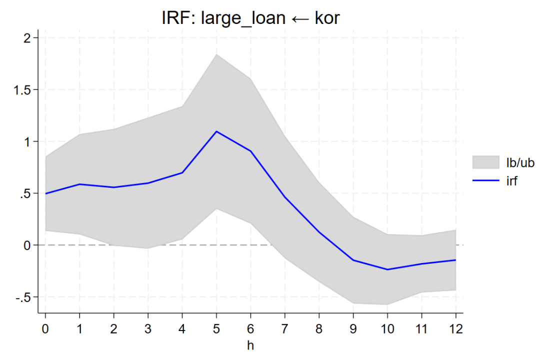
(f) Average, Korean Monetary Policy Shock

Figure 22: Impulse Responses of interest rate by Monetary Policy Shocks : Corporate Bond

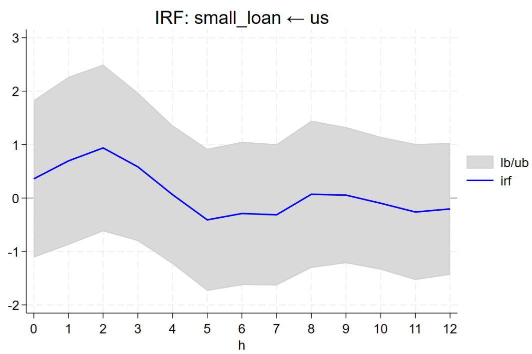
Notes: This figure shows the impulse responses of interest rate to monetary policy shocks. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. Standard errors are clustered at the quarter level.



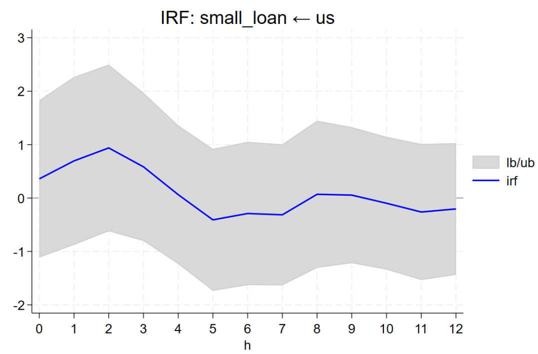
(a) Large Firms, U.S. Monetary Policy Shock



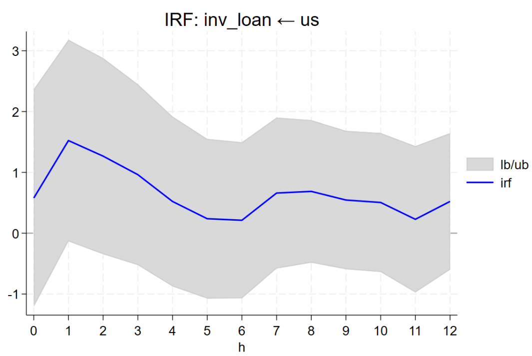
(b) Large Firms, Korean Monetary Policy Shock



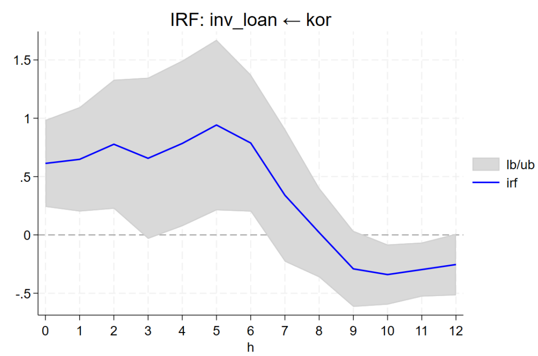
(c) Small Firms, U.S. Monetary Policy Shock



(d) Small Firms, Korean Monetary Policy Shock



(e) Average, U.S. Monetary Policy Shock



(f) Average, Korean Monetary Policy Shock

Figure 23: Impulse Responses of interest rate by Monetary Policy Shocks : Bank Loan

Notes: This figure shows the impulse responses of interest rate to monetary policy shocks. The solid blue line represents point estimates and the shaded area represents 95% confidence intervals. Standard errors are clustered at the quarter level.

References

Ahn, Jung Sup, Ju Wan Kim, and Byoung Ho Lee. 2021. "Identification of Monetary Policy Shocks in Korea Using High-Frequency Data: Focusing on Central Bank Information Effects in Monetary Policy." *Korean Journal of Economic Studies* 69:45–116.

Bernanke, Ben S, Mark Gertler, and Simon Gilchrist. 1999. "The Financial Accelerator in a Quantitative Business Cycle Framework." In *Handbook of Macroeconomics*, edited by John B Taylor and Michael Woodford, volume 1, chapter 21, pp. 1341–1393. Elsevier.

Choi, Sangyup, Tim Willems, and Seung Yong Yoo. 2024. "Revisiting the monetary transmission mechanism through an industry-level differential approach." *Journal of Monetary Economics* 141:103556.

Cloyne, James, Clodomiro Ferreira, Maren Froemel, and Paolo Surico. 2019. "Monetary Policy, Corporate Finance, and Investment." Technical Report 1911, Banco de España Working Paper Series.

Deng, Minjie and Min Fang. 2022. "Debt maturity heterogeneity and investment responses to monetary policy." *European Economic Review* 144:104095.

Gertler, Mark and Peter Karadi. 2015. "Monetary policy surprises, credit costs, and economic activity." *American Economic Journal: Macroeconomics* 7:44–76.

Gilchrist, Simon and Egon Zakrajšek. 2012. "Credit spreads and business cycle fluctuations." *American economic review* 102:1692–1720.

Han, Yongseung and Myeong Hwan Kim. 2023. "Monetary shocks on the Korean stock index: structural VAR analysis." *Eurasian Economic Review* 13:85–102.

He, Yugang. 2024. "External financial and monetary policy shocks: Do they matter for Korean macroeconomy?" *Heliyon* 10:e20741.

Jordà, Òscar. 2005. "Estimation and inference of impulse responses by local projections." *American economic review* 95:161–182.

Jungherr, Joachim, Matthias Meier, Timo Reinelt, and Immo Schott. 2022. "Corporate debt maturity matters for monetary policy." *Review of Economic Studies* 89:3153–3194.

Kalemli-Özcan, Şebnem and Jun Hee Kwak. 2020. "Capital flows and leverage." *Annual Review of Economics* 12:833–846.

Kim, Hyun-Eui. 2007. "Integration Policy and Corporate Investment in Globalization." *Economic Analysis* 13:1–55.

Kim, Yun Jung, Linda L Tesar, and Jing Zhang. 2015. "The impact of foreign liabilities on small firms: Firm-level evidence from the Korean crisis." *Journal of International Economics* 97:209–230.

Miranda-Agrippino, Silvia and Hélène Rey. 2020. "US monetary policy and the global financial cycle." *The Review of Economic Studies* 87:2754–2776.

Ottonello, Pablo and Thomas Winberry. 2020. "Financial heterogeneity and the investment channel of monetary policy." *Econometrica* 88:2473–2502.

Park, Sang-Jun and Seung-Hwan Ok. 2018. "Integration Policy and Corporate Investment Behavior: Analysis of Asset Self-Selection Effect and Alternative Rate of Return." *Economic Analysis* 24:1–36.

Ramey, Valerie A and Sarah Zubairy. 2018. "Government spending multipliers in good times and in bad: evidence from US historical data." *Journal of Political Economy* 126:850–901.

Rey, Hélène. 2016. "International Channels of Transmission of Monetary Policy and the Mundellian Trilemma." *IMF Economic Review* 64:6–35.

Romer, Christina D and David H Romer. 2004. "A new measure of monetary shocks: Derivation and implications." *American Economic Review* 94:1055–1084.

Saxegaard, Elif C. Arbatli, Melih Firat, Davide Furceri, and Jeanne Verrier. 2022. *US monetary policy shock spillovers: Evidence from firm-level data*. Number 2022-191. International Monetary Fund.

Witheridge, William. 2024. "Monetary Policy and Fiscal-led Inflation in Emerging Markets." Job Market Paper.