U.S. Monetary Policy Spillover to Emerging Economy Corporate Bond Market

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Abstract

Motivated by the considerable increase in the foreign debt by the corporate sector of the emerging economies (EME), we investigate the spillover of the U.S. monetary policy shocks to the EME corporate bond spreads. In addition, we study the channels through which the U.S. monetary shocks affect the borrowing costs by the EME firms in the international financial markets. The U.S. monetary policy is identified using a daily frequency data of the Federal Funds rate and its futures price. We then take an event study approach to quantify the causal effect of the U.S. monetary policy on the EME corporate bond spreads. A 100 basis points unanticipated increase in the Federal Funds rates at the day of the FOMC meeting results in a 80-110bp increase in corporate bond spreads. Merging the spread data with the corporate balance sheet data, we also show that the financial accelerator channel is present in the transmission of the U.S. monetary policy shocks.

Keywords: Corporate bonds; emerging economy; U.S. monetary policy; FOMC meeting

JEL codes: E44, E52, F36, F42, G12

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1 Introduction

The global macroeconomic factors are becoming more important to emerging economy (EME) business cycles due to trade and financial integration. For example, Rey (2016) highlights the effect of global financial factors on business cycles by documenting the growing magnitude of the cross-boarder capital flows, resulting in limited central banks' ability to respond to smooth the business cycles.

One of the most important global macroeconomic factors is the U.S. macroeconomic conditions, considering its size of the economy. Being a center of the global financial market, the U.S. financial market conditions possess non-trivial effects on emerging economy business cycles through the international financial linkage. Noting that the U.S. monetary policy is conventionally conducted by targeting the short-term interest rates and associated open market operations in the U.S. financial market, a natural consequence is the growing importance of the U.S. monetary policy on international financial markets, as highlighted by Miranda-Agrippino and Rey (2020).

As documented in Caballero et al. (2019), another significant macroeconomic development of the global economy is a substantial increase in foreign corporate debt by firms incorporated in emerging economies. In particular, they highlight that the outstanding stock of the private debt quadrupled from the early 2000s to mid-2010s, mainly driven by the USD denominated corporate bond issuance.

The research question that we address in this article arises naturally from the aforementioned observations: the importance of the U.S. monetary policy and the rapidly growing corporate bond issuance by emerging economy firms in the international financial market. Motivated by these, we aim to understand the effect of the U.S. monetary policy on the borrowing costs that the EME firms face in the international financial markets. There have been extensive efforts to investigate the effect of the U.S. monetary policy on the price of both domestic and foreign assets, for example, the U.S. yield curves, emerging economy sovereign spreads, and global stock market indices. However, to our knowledge, the effort to understand the relationship between the

U.S. monetary policy and the price of the *corporate* bonds issued by the EME firms in the international financial markets remains limited at most. Our primary goal is to fill this gap, and thus, we exclusively focus on the bond instruments, instead of the bank loan and equity financing, following the observation that the bond issuance mainly drives the increase in the private debt of EME.

We extend this agenda even further by investigating the channel through which the U.S. monetary policy spills over to the corporate borrowing costs of the EME firms, mostly focusing on the financial accelerator channel.

We use a daily frequency data of the Federal Funds rate, Federal Funds futures, and the spreads of corporate bonds issued by EME firms where the data is sourced from the Bloomberg. The primary advantage of the high-frequency data arises from the improved identification of the U.S. monetary shocks. This allows estimating the effect of the U.S. monetary policy shocks on corporate bond spreads more cleanly. We take the event study approach to identify the U.S. monetary policy shocks around the Federal Open Market Committee (FOMC) meeting, closely following Gurkaynak and Wright (2011) and Bernanke and Kuttner (2005). The U.S. monetary policy shock is measured by the discrepancy between the target Federal Funds rate after the FOMC announcement and the Federal Fund futures rate. Taking a simple regression approach, we show that the contractionary (expansionary) U.S. monetary policy shock causes a substantial increase (decrease) in corporate bond spreads in the international financial market.

Two key findings arise. First, a 100 basis points unanticipated increase in the Federal Funds rate after the FOMC meeting results in approximately 80 to 110 basis points increase in the corporate bond spreads. We also show that the unconventional monetary policy (three rounds of quantitative easing) generally had expansionary effects reducing the corporate spread by 2 to 20 basis points. Second, corporate spreads of the bonds issued by the high leverage firms respond more sensitively to the U.S. monetary policy shock. This finding confirms that the financial accelerator channel is in action when the U.S. monetary policy shocks transmit to the EMEs through the international financial market.

We extend the existing literature of the high frequency event studies in four important dimensions. First, this article is closely related to the literature on how the U.S. monetary policy affects interest rate of various class of debt instruments. Most importantly Hanson and Stein (2015) empirically study the effect of the U.S. monetary policy affects the U.S. treasury yield curve. The effort is not limited only to the U.S. Treasuries. For example, Gurkaynak and Wright (2011) and Andersen et al. (2007) investigate the U.S. monetary policy spillover to the treasury yields of the advanced economies, while Albagli et al. (2019) and Hausman and Wongswan (2011) extends the agenda to the sovereign yield in emerging economies. However, the study on the spillover of the U.S. monetary policy to the corporate bond yield remains substantially limited. The notable exception is Anderson and Cesa-Bianchi (2020), who investigate the effect of the U.S. monetary policy to the U.S. corporate bonds in a high-frequency setting. We add to the literature by expanding the focus to a (1) corporate bond (2) in an emerging economy setting.

The extension to the emerging economy corporate sector relates our research to the second set of literature on emerging economy debt. The primary variable of interest, corporate bonds issued by firms in the international financial market, is not randomly chosen. Instead, our research is motivated by the previous studies documenting a rapid growth of corporate bond issuance by EME firms in the international markets (Powell, 2014; Shin, 2014; Turner, 2014; Caballero et al., 2019). We add to the literature by documenting the interest rate movements of the international markets' rapidly growing financial instruments.

Third, this paper is closely related to the literature on the U.S. monetary spillover to emerging economies, mainly through the financial market friction channel. There has been an extensive effort to examine how the global macroeconomic conditions, including the U.S. business cycles, affect the emerging economies both theoretically and empirically. On a theoretical front, Neumeyer and Perri (2005) and Uribe and Yue (2006) develop a small open economy general equilibrium model highlighting the potential importance of the interest rate channel of the transmission of global shocks. Subsequent studies (Gertler et al., 2007; García-Cicco et al., 2010; Chang and Fernández, 2013) commonly reconfirm the role of financial market frictions in the transmission of global shocks. Narrowing to the U.S. monetary policy spillover, there has been a massive empirical effort to evaluate the U.S. monetary policy shocks' effect on a broad set of financial assets and capital flows in the large set of countries, most importantly Albagli et al. (2019) and Hausman and Wongswan (2011) among others (Wongswan, 2009; Fratzscher et al., 2018). The empirical importance of interest rates and the financial market developments/frictions in the transmission of the U.S. monetary policy has been highlighted by Kim (2001), Bruno and Shin (2014), Georgiadis (2016), Avdjiev and Hale (2019), Kalemli-Ozcan (2019), and Brauning and Ivashina (2020) with an exception of Ammer et al. (2010) which highlights demand channel, and Dedola et al. (2017) who documents no systematic role of country characteristics including financial market developments in the transmission of the U.S. monetary policy shocks. To our limited knowledge, this research is the first to explore the U.S. monetary policy spillover to the emerging economy corporate bond market. We add to the literature by expanding the focus to the EME corporate bonds and provide empirical evidence of the financial market friction channel in the transmission of the global shocks. These findings corroborate recent theoretical studies (Fernández and Gulan, 2015; Chang et al., 2017) highlighting the role of financial market frictions embedded in the corporate sector in the transmission of the global shocks.

Last, our research is closely related to the literature on how the firm-level characteristics are associated with corresponding asset prices. This strand of literature mostly focuses on stock returns (Savor and Wilson, 2014). For example, Ozdagli (2018) and Armstrong et al. (2019) document that the stock returns are less responsive to the U.S. monetary policy shock if firms are associated with more substantial information frictions and poor accounting quality. In contrast, Chava et al. (2020) document a stronger response of the stock returns to the U.S. monetary policy if firms suffer from the financial market frictions. Laeven and Tong (2012) reach a similar conclusion using emerging economy samples. While previous studies mostly focus stock returns, Anderson and Cesa-Bianchi (2020) is a notable exception focusing on the corporate bonds. They find that the spreads of bonds issued by financially constrained U.S. firms respond more sensitively to the U.S. monetary policy shocks. We extend the literature by reaching a similiar conclusion in an EME setting; highly levered firms suffer higher credit costs in response to contractionary U.S. monetary policy shocks.

The rest of this article consists of four sections. Section 2 describes the data. Section 3 discusses the regression approach. Section 4 studies the transmission channels. Section 5 concludes.

2 Data and Explanatory Analysis

The two core variables of interest are the U.S. monetary policy and corporate corporate spreads of bonds issued by EME firms in the international financial market. We first dicuss the identification of the U.S. monetary policy shocks. The monetary policy reaction is apparently consists of both endogenous and exogenous components. While the response of economic variables to the both components is an interesting question, economists are often interested in the exogenous innovation on the policy rate changes assuming the rational economic agents. There is extensive literature on the U.S. monetary policy shock identification. We take a high-frequency event study approach by Bernanke and Kuttner (2005) to decompose the policy rate changes into exogenous (hereafter "surprise") and endogenous (hereafter "expected") components. We use daily frequency Federal Funds rate and Federal Funds futures contract's price to identify the U.S. monetary policy surprise around the FOMC meetings. The surprise component of the U.S. monetary policy is measured by the changes in futures price on the FOMC date relative to the dates prior to the monetary policy event. Since the futures contract price is based on the monthly average, we adjust the changes with an appropriate scale factor. The formal expression of the U.S. monetary policy surprise at the FOMC date t is

$$\Delta i_t^u = \frac{D}{D-d}\left(f_{m,d} - f_{m,d-1}\right)$$

where $f_{m,d}$ is the current-month futures rate, D is the number of days in the month, and d denotes the day of the month. The expected component of the policy rate change Δi^e is natually defined as

$$\Delta i^e = \Delta i - \Delta i^u$$

where Δi denotes the policy rate change on the day of the FOMC meeting.

Table 1 presents the summary statistics of the U.S. monetary policy shock Δi^u for the sample period from June 1999 to July 2019. The sample period is chosen to maximize the sample observations of the corporate bond spreads, which will be discussed later when introducing the bond spread data. The sample period consists of 143 scheduled FOMC meetings. Approximately 60 percent of the announcements were made after the onset of the Global Fiancial Crisis (hereafter GFC) initiated by the collapse of the Lehman Brothers. Among 143 meeting, 35 meetings are associated with contractionary shocks, while 31 meetings are associated with negative expansionary shocks implying that roughly 55 percent of the meetings did not deliver any monetary shock to market participants. The size of the surprise increase in the policy rate is 3.1 basis points, and the surprise rate cut is 3.7 basis points on average. The magnitude of the contractionary and expansionary shocks are larger for the pre-GFC samples as the large fraction of the post-GFC samples are subject to the zero lower bound (ZLB).

We now turn to the corporate spreads of bonds issued by firms in emerging economies. The sample emerging economies are chosen following the filters introduced in Caballero et al. (2019) to ensure that countries experiencing rapid growth in corporate bond issuance in the international markets are well represented by the sample. The inclusion of the Chinese samples is controversial due to the pervasive high capital controls. Chinese samples are included considering its growing importance in the world economy. The main results are robust when China is excluded from the sample. Following is the list of 18 sample emerging economies.

- Latin America: Brazil, Chile, Colombia, Ecuador, Mexico, and Peru
- East Asian and Pacific: China, Indonesia, Korea, Malaysia, Philippines, and Thailand
- Eastern Europe and Central Asia: Czech Republic, Hungary, Russia, and Turkey
- Other Regions: South Africa and Israel

We use option-adjusted-spread (OAS) data taken from Bloomerg to measure the borrowing costs of the firms in the international financial market. The option-adjusted-spread has an advantage over the yield-to-maturity as OAS explicitly accounts for the default risk and options embedded. See O'Kane and Saurav (2005), Gabaix et al. (2007), and Caballero et al. (2019) for a detailed discussion on OAS. We limit the scope of the analysis to bonds issued by firms incorporated in sample countries. Hence, all sovereign bonds are excluded. Also, only U.S. Dollar-denominated bonds are included in the sample, considering that this research's primary goal is to understand the U.S. monetary policy spillover through the international financial market. This implicitly assumes the dominating currency is USD when EME firms tab the international financial market. Indeed Caballero et al. (2019) document that the large fraction of international debt securities is issued in USD. Monetary policy in one country entails exchange rate fluctuations. By focusing on USD bonds, we are also able to control for the currency risks as well. Lastly, OAS is defined as spreads over the U.S. Treasuries of comparable maturity. Assuming that the term premium is fully incorporated into Treasury rates, this additionally allows us to control for the term premium, and as a result, to focus on international spillover through credit spreads and associated financial friction channels. Overall, we analyze 8,616 bonds issued by 1,191 firms incorporated in 18 emerging countries for the sample period starting in June 1999. The beginning of the sample period reflects that international bond issuance by the corporate sector of EMEs took off in only after the early 2000s.

We measure the response of the corporate spreads of a bond b issued by firm f incorporated in country c to the U.S. monetary policy at the FOMC date t as follows:

$$\Delta OAS^{b,f,c}_{t,h,s} = OAS^{b,f,c}_{t+h} - OAS^{b,f,c}_{t-s}$$

where $OAS^{b,f,c}_{\tau}$ is an observed OAS at time τ. It is essentially change in the OAS from s days before the meeting to h days after the meeting. We set $s = 3$ and $h = 1$ to 10 as a benchmark considering that corporate bond markets are less liquid than sovereign bond markets or stock markets. Note that less liquidy implies a longer period for the price adjustment. Indeed it seems that there is no consensus on the adequate length of the window in previous studies taking high-frequency event study approaches. We discuss the robustness of the result for the different values of s in the later sections. Observations whose OAS is either negative or above 10,000bps are excluded from the sample since the latter condition technically implies default. We winsorize the observations below and above the bottom and the top 1 percentile by country and year in order to safeguard the results driven by the extreme values. Lastly, privately placed bonds are excluded from the sample.

Figure 1 graphically summarizes the U.S. monetary policy spillover to the corporate spreads. The figure shows the sample average of $\Delta OAS^{b,f,c}_{t,h,s}$ conditioning on the sign of the monetary policy shocks for different values of h ranging from 1 to 10. In other words, we calculate the sample average of the changes in OAS for the contractionary, expansionary, and neutral FOMC meetings separately. We demean $\Delta OAS^{b,f,c}_{t,h,s}$ by year and country to account for potentially heterogeneous reaction to the policy shocks for different countries and years. Three findings arise from the Figure. First, contractionary shocks are associated with increased corporate borrowing costs in the international market, and the opposite pattern is observed in case of expansionary shocks. The result is consistent with the monetary economics literature that the contractionary monetary shocks results in economic downturn by inducing increased borrowing costs. Second, the response of corporate spreads is hump-shaped. In other words, it takes several days for the effect of the monetary policy shocks to reach a peak. The reaction's magnitude increases monotonically and reachs the peak in 9 days in response to contractionary shocks. In contrast, no monotonic relationship is found in case of expansionary shocks while the effect seems to be maximized around 5 to 9 days after the FOMC meetings. Third, the response to the monetary shocks is asymmetric. Corporate bond spreads react more sensitively to contractionary shocks than to expansionary shocks. Note that the Federal Funds rate decreases (increase) by 3.7bps (3.1bps) on average in case of expansionary (contractionary) shocks (See Table 1). Spread reactions to contractionary shocks are larger, while the magnitude of contractionary shocks is smaller on average compared to expansionary shocks. Such finding hints to the potential asymmetry. One odd observations is a slightly negative response to the neutral monetary policy stance.

3 EME Corporate Bond Spread and U.S. Monetary Policy

3.1 Econometric Specification

We establish a causal relationship between the U.S. monetary policy and EME corporate bond spreads and quantify the U.S. monetary spillover effect more formally by taking a regression approach. As discussed previously, the U.S. monetary policy is a combination of the Federal Reserve's endogenous reaction to the macroeconomic conditions and unexpected shock components. Therefore, it is crutial to cleanly decompose two components for the consistent estimation. This is particularly important in a financial market contexts as asset prices such as interest rates and stock prices are forward-looking. The vector-autoregression approach, for example, Christiano et al. (1999), is widely employed in monetary economics literature to identify monetary policy shocks. Starting Bernanke and Kuttner (2005), the effort to identify monetary policy shocks has been further extended to a high-frequency event study approach, especially if particular research interest is fast-moving asset prices. Hence we directly follow the econometric specification employed in Bernanke and Kuttner (2005) and Albagli et al. (2019).

The benchmark regression model is

$$OAS^{b,f,c}_{t,h,s} = \beta_0 + \beta_1 \Delta i^u_t + \beta_2 \Delta i^e_t + \lambda_{semi-yr-country} + \epsilon_{b,f,c,t}$$

where $\lambda_{semi-yr-country}$ denotes semi year-country fixed effect (interaction term of semi-year dummies and country dummies). The fixed effect specification is substantially stronger compared to previous studies employing year fixed effects and country fixed effects, for example, Albagli et al. (2019). The year fixed effects control for global business cycles that could simultaneously affect the U.S. monetary policy decision and international bond market conditions. The country fixed effect controls for time invariant factors unique to individual countries. However, these fixed effects cannot control time-variant country specific factors. However, country-specific macroeconomic factors clearly vary over time, and at the same time, interact with corporate borrowing costs. In this regard, semi-year-country fixed seems more effect in addressing potentially omitted variable bias. We further discuss various fixed effect specifications in the following section. Following the literature standard, we estimate the model using a simple ordinary least squares method pooling the entire observations over bonds, firms, countries, and the FOMC meetings. Observations are clustered at the dimension specified by the fixed effects.

3.2 Benchmark Estimation

Table 2 summarizes the estimation results for different values of h. The estimation result confirms the substantial U.S. monetary policy spillover to the EME corporate spreads. We first dicuss the estimation of β_1. β_1 coefficients are statistically significant at one percent level for $h = 1$ to $h = 7$. Estimation results have a strong economic significance too. 100bps unantipated increase in the U.S. monetary policy results in approximately 82 to 114 basis points increases in the EME spreads. This implies that the EME firms face additional 50-75 basis points of borrowing costs due to the contractionary stance of the U.S. monetary policy. Note that the interest rates of comparable safe asset (U.S. Treasury in a current setting) reacts to the U.S. monetary policy as documented in Hanson and Stein (2015) as well. Hence the results in Table 2 are the conservative estimate of the additional burden that EME firms should bear if they tab the international financial market. The second important observation is that the effect of the U.S. monetary policy peaks several days after the FOMC meeting. The effect seems to be maximized 5 to 7 days after the meeting. The results are consistent with Chava and Hsu (2019) documenting the lagged effect of the policy shocks if the financial instrument is relatively less liquid. Last, the β_2 estimates are statistically significant for some h's implying that even anticipated components of the U.S. monetary policy have not been priced prior to the FOMC meeting. This result may imply that the market participants are not perfectly forward-looking. However, the economic significance is limited at most. A 100bps anticipated increase in the U.S. monetary policy rate results in only a 15bps increase in EME corporate spreads. We interpret this result that market participants are generally forward-looking, but expected factors are occasionally not priced due to the relatively less-liquid corporate bond market and limited trading opportunites.

3.3 Robustness

The benchmark regression specification takes the simplest form. Considering high-frequency approach, even a simple regression equation satisfies the *ceteris-paribus* assumption relatively well. Nonetheless, we estimate different specifications of the model to ensure the robustness of the result. The first exercise examines the size of the event window. In the benchmark, s is set to 3, meaning that changes in corporate spreads compared to the OAS 3 days prior to the meeting. To our knowledge, previous studies use various values of s, and there seems to be no consensus on the adequate window size. In the first exercise, we replace the dependent variable $\Delta OAS_{t,h,s}^{i,j,k}$

with an average of $\Delta OAS^{i,j,k}_{t,h,s}$ for $s = 1, 2, 3, 4, 5$.[1] Table 3 summarizes the estimation result. The results are largely similar with the benchmark result. The U.S. monetary surprise has both statistical and economic significance on the EME corporate spreads, and the effect is maximized 5-7 days after the meeting is held. The expected components also have a statistically significant effect on the EME spreads, yet the economic significance remains limited. One notable difference with the benchmark is smaller β_1 estimiates. They are approximately half of the benchmark, while we still consider the estimates possess sufficient economic significance. Figure 2 presents the point estimate of β_1 for each s. Solid line segments represent statistically significant β_1s while dotted line segments imply statistical insignificance at 10% level. Overall, contractionary monetary policy induces higher corporate borrowing costs in the international bond market regardless of the setting of the window length s. However, the quantitative result varies for different values of s. In general, a larger window (larger s) is associated with stronger effects. Statistical significance is robust to the window size s. All β_1s are statistically significant at least at 10% level for all $h = 1$ to $h = 5$ when $s = 2$ to $s = 5$.[2] However it turns out that β_1 is significant only when $h = 2$ in case of tighter window setting ($s = 1$). This is possibly due to the less liquid corporate bond market.

The second exercise discusses an alternative estimation technique and addresses potential inconsistency arising from the omitted variable biases. Figure 3 shows β_1 for different values of h for alternative regression specifications. The line is solid if the coefficient is statistically significant at 10 percent level, while the dotted region denotes statistical insignificance. We first consider if the results are robust if the sample is clustered by year. The year-clustered error accounts for the possibility that international financial market conditions vary over time depending on global economic conditions. The estimation result ("alt 1") suggests that the EME corporate spreads are substan-

[1]The average is defined as $\Delta \widetilde{OAS}^{i,j,k}_{t,h,s} = average\left(\Delta OAS^{i,j,k}_{t,h,1}, \Delta OAS^{i,j,k}_{t,h,2}, \Delta OAS^{i,j,k}_{t,h,3}, \Delta OAS^{i,j,k}_{t,h,4}, \Delta OAS^{i,j,k}_{t,h,5}\right)$ for each h

[2]Only exception is when $s = 2$ when $h = 2$

tially affected by the U.S. monetary policy shocks. However, the statistical significance disappears when h is greater than 5. Second, we add firm fixed effects in addition to year and country fixed effects ("alt 2"). This prevents an inconsistent esitmation due to the time invariant firm characteristics, for example, the brand value. The point estimates are almost identical to those of the benchmark, which reconfirms the U.S. monetary policy spillover. However, the statistical significance disappears when h is greater than 5. Third, we replace year and country fixed effects with country-year fixed effects. The benchmark regression does not control for country specific macroeconomic factors. The omission of the country-specific macroeconomic conditions could generate a substantial bias. For example, the cost of borrowing is jointly determined by the supply and the demand for credit. Country-specific macroeconomic factors affect firms' demand for credit substantially. During the boom, firms are more likely to tab international financial markets as investment demand increases. Hence, without proper control of country-specific factors, the estimation is subject to inconsistency. A common approach to address this issue is to include relevant macroeconomics variables such as GDP growth directly into the regression. We take an alternative approach ("alt 3") of including the fixed effects, which is also a common approach to control country-specific credit demand factors. The point estimates are virtually identical to the benchmark, which reconfirms the U.S. monetary policy spillover independent from the country-specific macroeconomic conditions. However, the statistical significance disappears when h is greater than 5. Fourth, we replace country-year fixed effect with country-year-quarter fixed effects. It controls for the country-specific macroeconomic conditions varying at a quarterly frequency. The estimation result reconfirms the U.S. monetary policy spillover to the EME corporate spreads. However, the point estimates converges to zero gradually, and loses statistical significance when h is greater than 5. Lastly, we include firm fixed effects in addition to country-year-quarter fixed effects ("alt-5"). This specification is, by far, the strongest control that we could imagine while avoiding high multicollinearity arising from overly many fixed effects. The result is almost identical to the "alt-4".

As a third exercise, we examine the role of the GFC sample. To do so, we estimate the benchmark model splitting the sample into two sub-periods: pre-GFC and post-GFC samples. We consider the FOMC meeting at October 29, 2008 as a cutoff. The post-GFC sample contains substantially larger observations than the pre-GFC sample. This is consistent with the fact that the increasing trend of EME corporate bond issuance in the international markets accelerated after the GFC.[3] The Panel A and B in Table 5 summarize the estimation results for two subsample periods. The estimation confirms that the main results hold regardless of the sample periods. For both periods, the contractionary U.S. monetary surprise results in increasing EME corporate spreads, and the magnitude of the effect is not smaller than the benchmark result. Hence we conclude that the U.S. monetary policy spillover is universal as it is not limited to a specific subsample.

However, there are two notable differences between the pre- and the post-GFC sample. First, the peak of the effect arrives earlier in the post-GFC sample. As reported in Panel B, the U.S. monetary policy spillover is maximized two days after the FOMC meeting, and gradually diminishes thereafter. In contrast, the effect of the U.S. monetary policy gradually increases for the entire s of our consideration. As previously mentioned, the corporate bond issuance and the outstanding stocks in the international financial markets started to grow at an even faster pace after the GFC. As a consequence of the low-interest-rate environment, global investors' portfolio has shifted towards the EME assets as a part of the "search for yield" after the GFC. This allows us to infer that the EME corporate bond market became more liquid, and such changes in the market environment enable more immediate price adjustments to the policy shocks are the crisis.

Another noticeable difference is the response to expected policy changes, β_2. EME corporate spreads respond to the expected rate changes with both economic and statistical significance before the GFC. In contrast, β_2 is statistically significant, but its economic significance is virtually negliable after the GFC. We relate this result to the

[3]See Powell (2014), Shin (2014), Turner (2014), and Caballero et al. (2019).

market liquidity argument once more. Before the GFC, the EME corporate bond market is not liquid enough, and investors may occasionally fail to capture the trading opportunity before the FOMC meeting, although investors do anticipate the policy rate changes.

The financial market disruption was exceptionally severe, and the major central banks engaged in the financial market in an unprecedented manner in 2008. Concerning the results driven by the 2008 sample, we re-estimate the model, excluding the entire 2008 sample from the pre- and post-GFC subperiods. The estimation results are reported in the Panel C and Panel D of Table 5. The results are similar to Panel A and Panel B, allowing us to conclude that the 2008 sample is not driving the entire result.

4 Transmission Channel

The previous section provides empirical evidence of the causal relationship between the U.S. monetary policy and the EME firms' corporate borrowing costs in the international financial market. This section discusses the U.S. monetary policy transmission channel focusing on financial market frictions and the demand spillover from the U.S. economy.

There is extensive literature on the U.S. monetary policy spillover to the emerging country asset prices. Many studies highlight how country-level characteristics such as financial market developments and institutional qualities function as a transmission channel (Hausman and Wongswan, 2011). However, these channels has rarely been tested using firm-level data at a high-frequency setting.

In this section, we merge the bond issuers' balance sheet data to bond spread data and empirically test the financial market and demand spillover channel of the U.S. monetary policy. We retrieve bond issuers' balance sheet data from the annual Compustat Global, and limit the scope of the analysis to non-financial firms following the literature standard.[4] This procedure yields 20,681 observations of 741 bonds issued

[4]We require firms to report positive revenue and total assets and non-negative total liabilities. In addi-

by 319 firms in 15 countries. The sample size is approximately one-fifith compared to the benchmark sample, and Ecuador, Hungary, and South Africa are dropped as no observations are matched.

4.1 Financial Market Friction Channel

We first investigate the financial friction channel. The notion of the financial market friction mostly follows costly state verification (CSV) introduced in Townsend (1979). Under the CSV assumption the higher the leverage is, the higher the default risk and credit spread is. Hence, the corporate spread is a function of net worth and the size of borrowing. Bernanke et al. (1999) and Fernández and Gulan (2015) introduce financial market frictions employing CSV assumption to general equilibrium models and show that macroeconomic shocks, including interest rate shocks, are amplified through the frictions. Guided by theoretical developments, we test for the financial market friction channel of the U.S. monetary policy spillover by interacting the U.S. money surprise and firm leverage. To be concrete, we interact dummy variable indicating high and low leverage firm f at year yr, $D^f_{yr,\,high\,lev}$ and $D^f_{yr,\,low\,lev}$, with expected and surprise component of the U.S. policy rates, Δi^u and Δi^e. The leverage is measured as a ratio of total debt to total assets. We calculate the top and bottom 33 percentile from the entire Compustat universe. We calculate the tercile by country to account for potentially heterogenous financing patterns for each country depending on financial market developments. If the observed leverage belongs to top (bottom) 33 percentile, we label the observation "high leverage" ("low leverage"), and medium leverage otherwise.

The top panel of Table 8 summarizes the estimation result when interaction terms are included. The coefficient estimates associated with Δi^u is statistically significant at least at a 5 percent level. 100bps unexpected increase in the U.S. monetary policy causes approximately 28 to 59bps increase in spreads depending on h. We conclude

tion, observations associated with negative cash assets and plants, properties, and equipment are excluded from the sample. Lastly, observations with total liabilities greater than the total assets are also excluded, as these firms are virtually facing bankruptcy. Lastly, observations with missing EBIT and EBITDA are also dropped. We label financial firms if the SIC is 6000-6999.

that the economic significance is still present while it is smaller than the benchmark regression. The coefficient estimates associated with $\Delta i^u \times D_{high\,lev}$ is positive for all h implying that spreads of bonds issued by high leverage firms are more sensitive to the U.S. monetary policy shocks. In other words, high-leverage firms suffer more from the contractionary U.S. monetary policy shocks whenever they finance through the international bond markets. However, the estimates are statistically significant only for the limited subsets of h. None of the low-leverage interaction terms are statistically significant. Altogether, the evidence of the financial market friction channel working through the total leverage is limited at most.

We refine the leverage measure to the short-term debt to total assets ratio to further investigate the financial market friction channel. This exercise is motivated by the fact that the financial distress is higher to the firms scheduled to service the principal payment shortly following the contraction of U.S. monetary shocks. The bottom Panel of Table 8 summarizes the regression result. The coefficient estimates of Δi^u is statistically significance for all h with a substantial economic significance. Most importantly, the regression coefficient for the interaction term with a low leverage dummy $\Delta i^u \times D_{low\,lev}$ is negative and statistically significant. This implies that the medium and high leverage firms face substantially higher corporate bond spreads following the U.S. monetary policy contraction compared to the low leverage firms. The estimation result strongly supports that the financial market friction channel works mostly through short-term debt burden than long-term debt.

We further extend the above exercise to ensure the importance of the short-term debt burden and the financial market frictions. Firms' financial distress is binding only if firms do not have enough liquid assets to service their debt. In other words, if a firm has sufficiently large liquidity assets on its balance sheets, a high-leverage ratio does not necessarily imply higher financial distress. Following the argument, we could infer that the size of debt burden *relative to* cash assets should matter the most if the financial market friction channel is present. To test this hypothesis, we refine the leverage measure as $\frac{debt-cash}{total\,assets}$ and re-estimate the model. The larger the variable is, the more a firm is financially distressed. Table **??** summarize the estimation result. The top panel uses total debt while the bottom panel uses short-term. The top panel reconfirms that the evidence of the financial market friction working through total debt is limited. The interaction term with a high-leverage firm dummy is statistically significant only for the selected hs. However, the bottom panel reconfirms that the financial market friction channel is strong when we focus the interest to short-term debt. The interaction term with the high-leverage dummy is statistically significant, and has substantial economic significance. While statistical significance is limited, the interaction term with the low-leverage dummy is all negative suggesting that firms with large short-term debt relative to their cash assets are most critically and adversely affected by the contractionary U.S. monetary policy.

4.2 Demand Spillover Channel

The U.S. monetary policy affects not only the financial markets but also real sectors of the economy. Indeed, one of the critical transmission channels of the monetary policy is demand channel. A contractionary monetary policy results in decreased aggregate demand and thus an economic downturn in the short-run. Considering the size of the economy, a decreased U.S. aggregate demand spills over to emerging countries. EME firms will face a lower demand from the U.S. as a result of the contractionary shocks. Hence, firms' profitability will decrease, and bond investors will take this factor into account when pricing corporate bonds. A testable hypothesis arises. Spreads of bonds issued by firms closely correlated to the U.S. business cycle will face higher borrowing costs in response to contractionary monetary policy shocks.

Potentially, the best way to measure a firm's exposure to the U.S. cycle would be a fraction of the U.S. export to revenue ratio. Unfortunatey, this information is not available. We take an alternative approach to measure the exposure to the U.S. economy. We simply calculate the serial correlation of the year-on-year sales growth and the U.S. GDP growth rate.[5]

[5]We require firms to report at least ten years of sales growth data, and this filter excludes approximately

We include an interaction term of the U.S. monetary policy and the measured correlation into the benchmark regression. The estimation result is reported in Table 9. The interaction term is positive and statistically significant for $h = 3$ to $h = 7$. The result allows us to infer that firms exposed more to the U.S. business cycle are more sensitive to the U.S. monetary policy shocks. The more firms are exposed to the U.S. cycles, the higher corporate spreads they face when hit by contractionary U.S. monetary policy shocks. This estimation result is consistent with the demand spillover channel of the U.S. monetary policy.

5 Concluding Remarks

The Federal Reserve is one of the most important players in the financial markets. Therefore, the U.S. monetary policy spills over to the emerging economies through various channels. Motivated by the recent rapid growth of the corporate bond issuance in the international financial markets by firms incorporated in emerging economies, we study the effect of the U.S. monetary policy on EME corporate bond spreads. Taking a simple event study approach employing a high-frequency data, we document a substantial spillover of the U.S. monetary policy to the corporate bond spreads.

In addition, we test for the financial market friction and demand spillover channel of the U.S. monetary policy transmission. The main conclusion is that the financial market friction channel is present mosty working through the short-term debt burden. We also confirm that the spreads of bonds issued by firms exposed more to the U.S. business cycles respond more sensitively to the U.S. monetary policy shocks.

3 percent of the observation.

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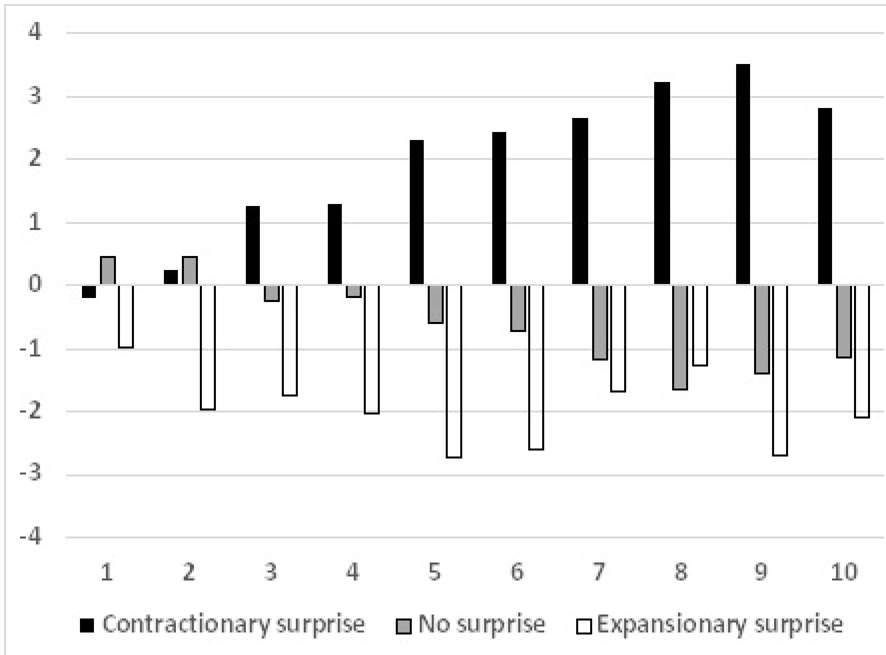
Figures and Tables

Table 1: Summary of Statistics of the U.S. Monetary Policy

		All	pre GFC	post GFC
All sample	num. of FOMC meeting	143	58	85
	mean	0.0	0.2	-0.2
	SD	4.0	6.0	1.8
	min	-19.4	-19.4	-11.9
	max	23.8	23.8	4.1
Contractionary shock	num. of FOMC meeting	35	16	19
	mean	3.1	5.6	1.1
	SD	5.1	6.8	1.0
	min	0.3	0.5	0.3
	max	23.8	23.8	4.1
Expansionary shock	num. of FOMC meeting	31	14	17
	mean	-3.7	-5.4	-2.3
	SD	4.6	5.8	2.9
	min	-19.4	-19.4	-11.9
	max	-0.4	-0.5	-0.4

Notes: Sample period: June 1999 - July 2019, Unit: Basis points, FOMC meetings prior to October 27 2008 are considered pre-GFC meetings.
Source: Bloomberg

Figure 1: Average response of the corporate bond spread



Notes: The Figure shows average response of the OAS to monetary shocks for the sample period June 1999 - July 2019. Each bar represents the average of $\Delta OAS^{b,f,c}_{t,h,s}$ conditioning on the sign of the U.S. monetary policy shocks for different values of h ranging from 1 to 10 (s is set to 3). $\Delta OAS^{b,f,c}_{t,h,s}$ is demeaned by country and year prior to calculating the average.
Source: Bloomberg

Table 2: Estimation Result - Benchmark

	h=1	h=2	h=3	h=4	h=5	h=6	h=7	h=8	h=9	h=10
Δi^u	0.82***	1.08***	0.77***	0.89***	1.13**	1.14**	1.06*	0.86	1.10	0.99
	(3.16)	(3.78)	(2.70)	(2.84)	(2.33)	(2.11)	(1.80)	(1.34)	(1.52)	(1.35)
Δi^e	0.15***	0.15**	0.11	0.15*	0.17	0.24*	0.25*	0.19	0.22	0.24
	(2.62)	(2.32)	(1.52)	(1.76)	(1.58)	(1.95)	(1.91)	(1.07)	(1.04)	(1.09)
Observations	92302	92302	92302	92302	92302	92302	92302	92302	92302	92302

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table summarizes the benchmark estimation result for the sample period June 1999 - July 2019. Pooled OLS esitmation is employed. Year and country fixed effects are not reported.
Source: Authors' calculation

Table 3: Estimation Result - Different window size

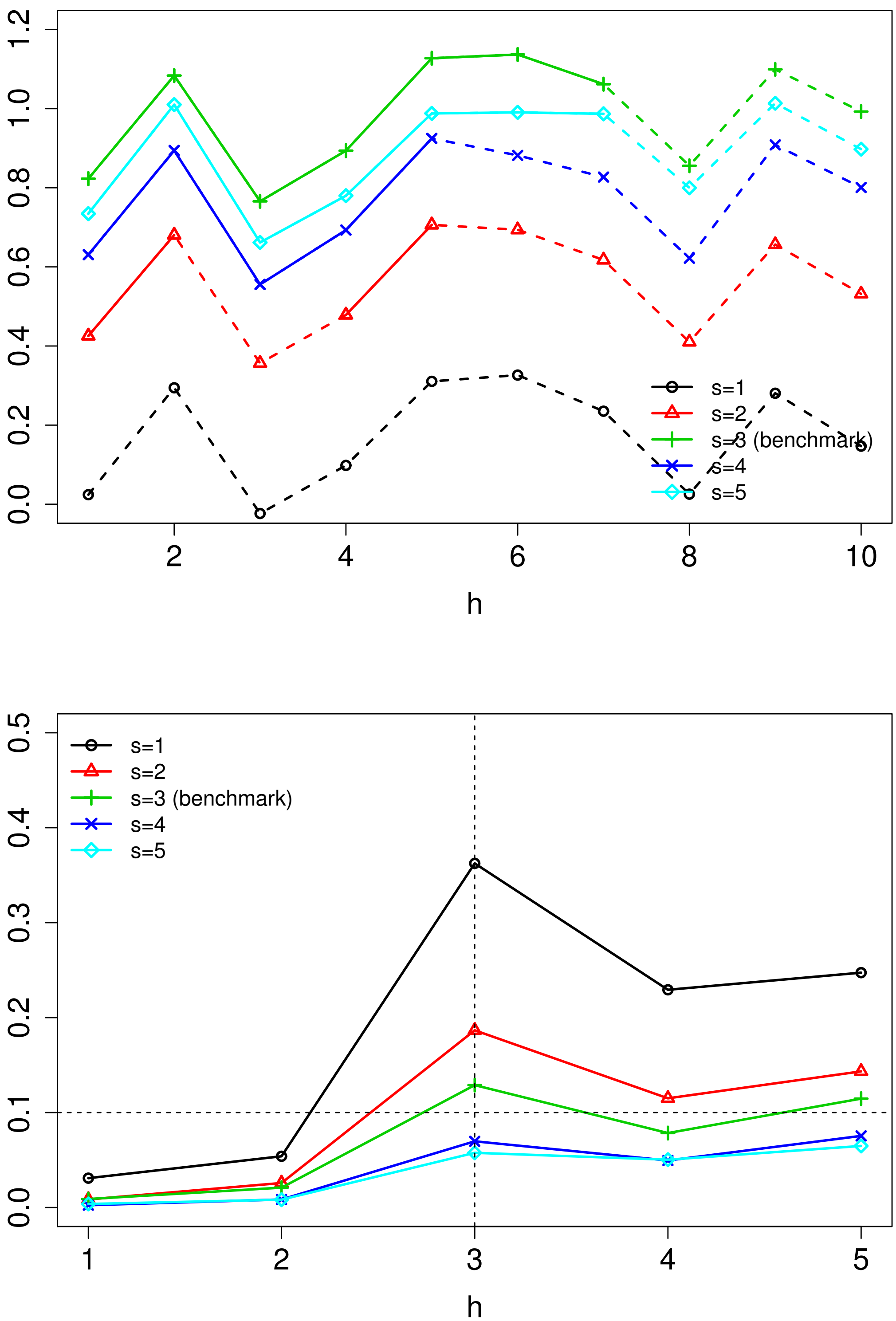
	h=1	h=2	h=3	h=4	h=5	h=6	h=7	h=8	h=9	h=10
Δi^u	0.53**	0.79***	0.46*	0.59**	0.81*	0.81	0.75	0.54	0.79	0.67
	(2.40)	(3.24)	(1.93)	(2.14)	(1.86)	(1.63)	(1.37)	(0.90)	(1.16)	(0.98)
Δi^e	0.14***	0.14**	0.11	0.14*	0.15	0.22**	0.24*	0.18	0.21	0.22
	(2.82)	(2.46)	(1.56)	(1.75)	(1.60)	(1.99)	(1.96)	(1.03)	(1.01)	(1.06)
Observations	92302	92302	92302	92302	92302	92302	92302	92302	92302	92302

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

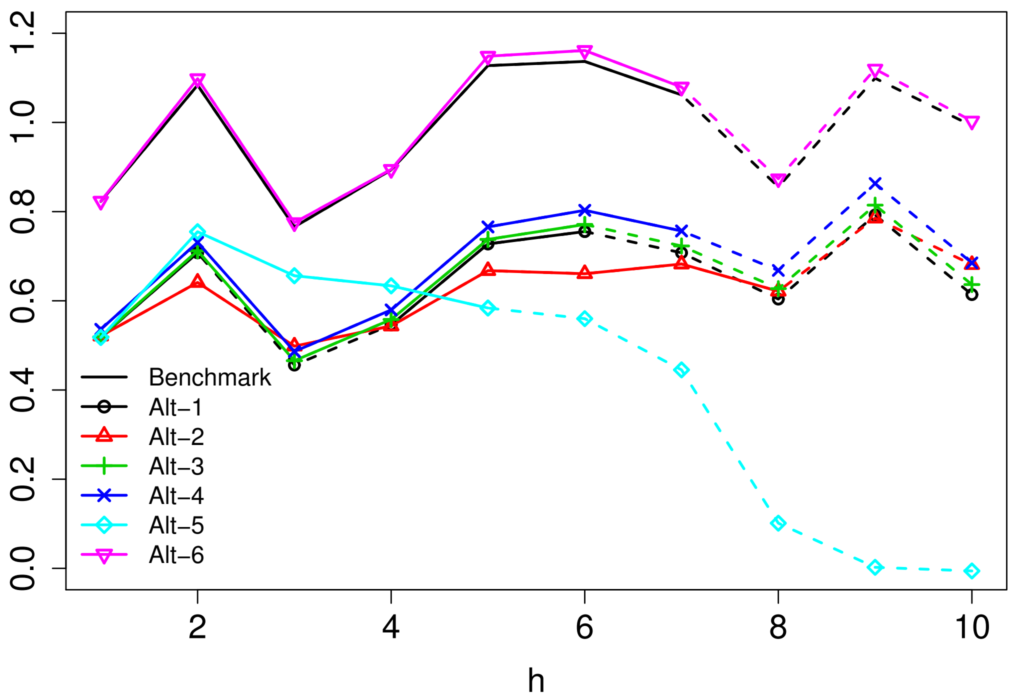
Notes: This table reproduces Table 2 for the sample period June 1999 - July 2019 after replacing the dependent variable to $\Delta \widetilde{OAS}^{i,j,k}_{t,h,s} = average\left(\Delta OAS^{i,j,k}_{t,h,1}, \Delta OAS^{i,j,k}_{t,h,2}, \Delta OAS^{i,j,k}_{t,h,3}, \Delta OAS^{i,j,k}_{t,h,4}, \Delta OAS^{i,j,k}_{t,h,5}\right)$. Pooled OLS esitmation is employed. Year and country fixed effects are not reported.
Source: Authors' calculation

Figure 2: Estimation Result - different window



Notes: The Figure shows the point estimate of β_1 under alternative specifications summarized in the box. The solid line represents 10 percent statiscal significance. The dotted line means statiscal insignificance.
Source: Authors' calculation

Figure 3: Estimation Result - Alternative Specification



	Benchmark	Alt-1	Alt-2	Alt-3	Alt-4	Alt-5	Alt-6
year		o		o			
country			o	o			
year-country					o		
year-semi-country	o						o
year-quarter-country						o	
firm							o
cluster	one-way	one-way	one-way	two-way	one-way	one-way	two-way

Notes: The Figure shows the point estimate of β_1 under alternative specifications summarized in the box. The solid line represents 10 percent statiscal significance. The dotted line means statiscal insignificance.
Source: Authors' calculation

Table 4: Estimation Result - ZLB

	h=1	h=2	h=3	h=4	h=5	h=6	h=7	h=8	h=9	h=10
Δi^u	0.55**	0.87***	0.44	0.59*	0.89*	0.87	0.84	0.64	0.90	0.59
	(2.42)	(2.90)	(1.52)	(1.78)	(1.67)	(1.56)	(1.38)	(0.98)	(1.22)	(0.89)
Δi^e	0.089*	0.097	0.046	0.066	0.089	0.16	0.16	0.11	0.16	0.13
	(1.83)	(1.50)	(0.65)	(0.83)	(0.85)	(1.38)	(1.29)	(0.57)	(0.71)	(0.63)
Observations	59299	59299	59299	59299	59299	59299	59299	59299	59299	59299

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reproduces Table 2 for the sample period June 1999 - July 2019 after replacing the dependent variable to $\Delta\widetilde{OAS}_{t,h,s}^{i,j,k} = average\left(\Delta OAS_{t,h,1}^{i,j,k}, \Delta OAS_{t,h,2}^{i,j,k}, \Delta OAS_{t,h,3}^{i,j,k}, \Delta OAS_{t,h,4}^{i,j,k}, \Delta OAS_{t,h,5}^{i,j,k}\right)$. Pooled OLS esitmation is employed. Year and country fixed effects are not reported.
Source: Authors' calculation

Table 5: Estimation Result - Global Financial Crisis

Panel A: Before Oct 29, 2008

	h=1	h=2	h=3	h=4	h=5	h=6	h=7	h=8	h=9	h=10
Δi^u	0.51	0.83*	0.74	0.83*	1.31	1.45*	1.62*	1.49*	1.64*	1.57*
	(1.38)	(1.79)	(1.64)	(1.76)	(1.54)	(1.73)	(1.86)	(1.80)	(1.80)	(1.91)
Δi^e	0.17*	0.27**	0.39***	0.44***	0.60**	0.74***	0.86***	0.83***	0.95***	1.00***
	(1.68)	(2.15)	(3.01)	(3.19)	(2.52)	(3.11)	(3.45)	(3.47)	(3.71)	(4.19)
Observations	10162	10162	10162	10162	10162	10162	10162	10162	10162	10162

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B: After Oct 29, 2008 (including)

	h=1	h=2	h=3	h=4	h=5	h=6	h=7	h=8	h=9	h=10
Δi^u	0.88***	1.16***	1.06***	1.14***	0.93*	0.58	0.12	-0.50	-0.56	-0.57
	(3.03)	(3.43)	(2.85)	(2.92)	(1.86)	(0.93)	(0.15)	(-0.50)	(-0.74)	(-0.87)
Δi^e	0.060	0.022	-0.024	-0.011	-0.059	-0.039	-0.057	-0.16	-0.25	-0.23
	(1.21)	(0.36)	(-0.32)	(-0.13)	(-0.63)	(-0.40)	(-0.49)	(-0.82)	(-1.23)	(-1.14)
Observations	82140	82140	82140	82140	82140	82140	82140	82140	82140	82140

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel C: -2007

	h=1	h=2	h=3	h=4	h=5	h=6	h=7	h=8	h=9	h=10
Δi^u	0.44	0.75*	0.71	0.91*	1.36	1.43*	1.57*	1.43*	1.62*	1.56*
	(1.25)	(1.69)	(1.60)	(1.91)	(1.64)	(1.75)	(1.85)	(1.79)	(1.80)	(1.93)
Δi^e	0.16	0.34	0.35	0.35	0.54	0.70*	0.91**	0.95**	1.02**	1.05***
	(0.87)	(1.43)	(1.50)	(1.38)	(1.29)	(1.77)	(2.19)	(2.36)	(2.44)	(2.67)
Observations	8956	8956	8956	8956	8956	8956	8956	8956	8956	8956

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel D: 2009-

	h=1	h=2	h=3	h=4	h=5	h=6	h=7	h=8	h=9	h=10
Δi^u	0.63***	1.03***	0.80**	0.92**	0.70	0.35	-0.15	-0.63	-0.47	-0.85
	(2.68)	(3.60)	(2.45)	(2.54)	(1.38)	(0.53)	(-0.17)	(-0.59)	(-0.61)	(-1.25)
Δi^e	0.049	0.016	-0.036	-0.021	-0.069	-0.049	-0.068	-0.17	-0.24	-0.24
	(1.02)	(0.27)	(-0.49)	(-0.25)	(-0.74)	(-0.51)	(-0.58)	(-0.84)	(-1.21)	(-1.20)
Observations	81745	81745	81745	81745	81745	81745	81745	81745	81745	81745

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reproduces Table 2 for the pre- and post-GFC subperiods.
Source: Authors' calculation

Table 6: Estimation Result - Unconventional Monetary Policy

	h=1	h=2	h=3	h=4	h=5	h=6	h=7	h=8	h=9	h=10
Δi^u	0.72***	1.01***	0.74***	0.85***	1.09**	1.07**	0.98*	0.80	1.02	0.79
	(3.29)	(3.74)	(2.69)	(2.78)	(2.24)	(2.06)	(1.74)	(1.31)	(1.48)	(1.23)
Δi^e	0.078*	0.10*	0.084	0.10	0.12	0.19*	0.20*	0.16	0.16	0.18
	(1.71)	(1.85)	(1.13)	(1.19)	(1.34)	(1.84)	(1.76)	(1.00)	(0.86)	(1.01)
QE=1	-19.4*	-9.62	-3.48	-5.85	-6.43	-3.82	-18.2	-11.6	-9.70	-28.4
	(-1.72)	(-0.98)	(-0.27)	(-0.34)	(-0.41)	(-0.22)	(-1.02)	(-0.64)	(-0.70)	(-1.14)
QE=2	-2.40***	-2.04**	-6.55***	-9.24***	-7.91**	-6.05	-17.1	-16.4	-14.1	-13.8
	(-4.57)	(-2.50)	(-8.66)	(-5.30)	(-2.10)	(-1.63)	(-1.64)	(-1.61)	(-0.99)	(-1.03)
QE=3	10.8*	9.99	12.7*	14.4*	18.1**	18.3*	17.8*	26.0**	27.8*	22.9
	(1.89)	(1.58)	(1.90)	(1.92)	(2.22)	(1.94)	(1.91)	(1.97)	(1.84)	(1.65)
QE=4	-3.21	-3.34*	-4.65**	-2.37	-2.81	-1.30	1.95	0.46	0.42	-2.10
	(-1.63)	(-1.91)	(-2.33)	(-1.02)	(-1.37)	(-0.51)	(0.83)	(0.21)	(0.17)	(-0.97)
QE=5	-0.031	-0.78	0.55	0.68	0.88	1.10	0.27	0.13	0.36	-1.93
	(-0.03)	(-0.66)	(0.35)	(0.41)	(0.50)	(0.58)	(0.14)	(0.06)	(0.16)	(-0.88)
Observations	94068	94068	94068	94068	94068	94068	94068	94068	94068	94068

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reproduces Table 2 for the pre- and post-GFC subperiods.
Source: Authors' calculation

Table 7: Unconventional Timeline

Date	Program	Event	Description	source
08.11.25	QE1	FOMC Statement	LSAP annoucned, $100b GSE + $500b MBS	Fratzsher, Lo Duca, Straub (2016)
08.12.16		FOMC Statement	First suggestion extending QE to Treasury	Fratzsher, Lo Duca, Straub (2016)
09.01.28		FOMC Statement	Fed ready purchase Treasury	Fratzsher, Lo Duca, Straub (2016)
09.03.18		FOMC Statement	LSAP extended $300b Tr + $750b MBS + $100b GSE	Fratzsher, Lo Duca, Straub (2016)
10.08.27	QE2	Bernanke Speech	Further QE necessary	Fratzsher, Lo Duca, Straub (2016)
10.10.15		Bernanke Speech	Fed ready for additional QE	Fratzsher, Lo Duca, Straub (2016)
10.11.03		FOMC Statement	QE2 announced $600b Tr	Fratzsher, Lo Duca, Straub (2016)
11.09.21	MEP	FOMC Statement	MEP announced +$400b (+6yr) - $400b (-3yr)	Fratzsher, Lo Duca, Straub (2016)
12.06.20		FOMC Statement	MEP extended	Fratzsher, Lo Duca, Straub (2016)
12.08.22	QE3	FOMC Statement	FOMC members anticipates additional round of QE	Fratzsher, Lo Duca, Straub (2016)
12.09.13		FOMC Statement	QE3 announced $40b/month (labor market)	Fratzsher, Lo Duca, Straub (2016)
12.12.12		FOMC Statement	QE3 announced $40b/month continues w.o sterilization	Fratzsher, Lo Duca, Straub (2016)
17.06.14	QT	FOMC Statement	"FOMC expects BS normalization program this year"	author
17.09.20		FOMC Statement	BS normalization begins following month	author

Notes: This table reproduces Table 2 for the pre- and post-GFC subperiods.
Source: Authors' calculation

Table 8: Estimation Result - Leverage

	(1) h=1	(2) h=2	(3) h=3	(4) h=4	(5) h=5	(6) h=6	(7) h=7	(8) h=8	(9) h=9	(10) h=10
Δi^u	0.42	0.70**	0.59*	0.51	0.77**	0.78*	0.80*	0.63	0.87	0.92
	(1.34)	(2.46)	(1.88)	(1.63)	(2.00)	(1.88)	(1.68)	(1.24)	(1.42)	(1.40)
$\Delta i^u \times D_{high\,lev\,(total)}$	0.33	0.37	0.45	0.72	0.42	0.71	0.52	0.68	0.59	0.36
	(0.98)	(0.85)	(0.85)	(1.06)	(0.65)	(0.97)	(0.70)	(1.00)	(0.71)	(0.47)
$\Delta i^u \times D_{low\,lev\,(total)}$	0.014	0.24	0.13	0.21	0.28	0.24	0.15	0.27	0.60	0.21
	(0.04)	(0.63)	(0.35)	(0.50)	(0.58)	(0.49)	(0.29)	(0.48)	(0.92)	(0.31)
Δi^e	0.23**	0.28***	0.30***	0.35**	0.46***	0.53***	0.59***	0.58***	0.70***	0.80***
	(2.30)	(2.59)	(2.59)	(2.52)	(2.75)	(2.86)	(2.83)	(2.64)	(2.76)	(2.89)
$\Delta i^e \times D_{high\,lev\,(total)}$	-0.054	-0.10	-0.080	-0.078	-0.20*	-0.16	-0.24*	-0.26***	-0.28**	-0.35**
	(-1.02)	(-1.47)	(-1.15)	(-0.55)	(-1.90)	(-1.29)	(-1.92)	(-2.76)	(-2.02)	(-2.20)
$\Delta i^e \times D_{low\,lev\,(total)}$	-0.044	-0.16**	-0.14*	-0.12	-0.24**	-0.18	-0.23*	-0.27**	-0.35**	-0.37**
	(-0.65)	(-2.06)	(-1.88)	(-1.15)	(-2.18)	(-1.53)	(-1.77)	(-2.04)	(-2.21)	(-2.11)
Adjusted R^2	0.302	0.253	0.240	0.246	0.238	0.224	0.209	0.141	0.130	0.141
Observations	20681	20681	20681	20681	20681	20681	20681	20681	20681	20681

t statistics in parentheses
$^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

	(1) h=1	(2) h=2	(3) h=3	(4) h=4	(5) h=5	(6) h=6	(7) h=7	(8) h=8	(9) h=9	(10) h=10
Δi^u	0.86**	1.14***	1.09**	1.04**	1.16**	1.42**	1.13*	1.02	1.22*	1.12
	(2.42)	(2.94)	(2.58)	(2.20)	(2.19)	(2.35)	(1.87)	(1.60)	(1.72)	(1.63)
$\Delta i^u \times D_{high\,lev\,(short)}$	-0.17	-0.087	0.048	0.38	0.15	0.10	0.37	0.70	0.52	0.52
	(-0.33)	(-0.15)	(0.06)	(0.41)	(0.17)	(0.11)	(0.42)	(0.93)	(0.55)	(0.55)
$\Delta i^u \times D_{low\,lev\,(short)}$	-0.73**	-0.69**	-0.81**	-0.64	-0.60	-0.81	-0.38	-0.48	-0.39	-0.37
	(-2.42)	(-2.06)	(-2.22)	(-1.51)	(-1.33)	(-1.60)	(-0.77)	(-0.96)	(-0.68)	(-0.68)
Δi^e	0.27**	0.28**	0.30**	0.32**	0.38**	0.44***	0.46**	0.42**	0.53**	0.60**
	(2.31)	(2.51)	(2.48)	(2.54)	(2.48)	(2.70)	(2.54)	(2.12)	(2.38)	(2.53)
$\Delta i^e \times D_{high\,lev\,(short)}$	-0.11	-0.11	-0.073	-0.0052	-0.054	0.11	0.024	0.066	0.046	0.053
	(-0.87)	(-1.01)	(-0.49)	(-0.03)	(-0.49)	(0.76)	(0.29)	(0.71)	(0.49)	(0.53)
$\Delta i^e \times D_{low\,lev\,(short)}$	-0.17*	-0.13*	-0.13*	-0.084	-0.12	-0.12	-0.082	-0.069	-0.058	-0.11
	(-1.90)	(-1.65)	(-1.75)	(-1.04)	(-1.49)	(-1.51)	(-1.04)	(-0.85)	(-0.57)	(-0.95)
Adjusted R^2	0.303	0.254	0.241	0.246	0.238	0.224	0.208	0.140	0.130	0.141
Observations	20681	20681	20681	20681	20681	20681	20681	20681	20681	20681

t statistics in parentheses
$^{*}\ p < 0.1$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Notes: This table reproduces Table 2 for the sample period June 1999 - July 2019 including interaction terms. The top panel defines leverage as total debt to total assets ratio. The bottom panel measures leverage with short-term debt.
Source: Authors' calculation

Table 9: Estimation Result - all together

	(1) h=1	(2) h=2	(3) h=3	(4) h=4	(5) h=5	(6) h=6	(7) h=7	(8) h=8	(9) h=9	(10) h=10
Δi^u	0.29	0.56***	0.24	0.18	0.50*	0.33	0.49	0.60	0.60	0.69
	(1.32)	(2.88)	(0.97)	(0.86)	(1.91)	(0.92)	(1.32)	(1.05)	(1.11)	(1.16)
Δi^e	0.20**	0.26***	0.25***	0.30***	0.42***	0.50***	0.57***	0.61***	0.68***	0.79***
	(2.46)	(2.81)	(2.74)	(2.81)	(3.04)	(2.99)	(3.01)	(2.67)	(2.86)	(3.03)
$\Delta i^u \times D_{high\,lev\,(total)}$	0.32	0.38	0.55	0.79	0.52	0.90	0.67	0.60	0.55	0.38
	(1.20)	(1.00)	(1.19)	(1.31)	(0.81)	(1.22)	(0.86)	(0.87)	(0.75)	(0.53)
$\Delta i^u \times D_{low\,lev\,(total)}$	0.041	0.28	0.20	0.25	0.33	0.32	0.20	0.29	0.67	0.29
	(0.11)	(0.72)	(0.54)	(0.63)	(0.69)	(0.67)	(0.39)	(0.50)	(1.02)	(0.41)
$\Delta i^e \times D_{high\,lev\,(total)}$	-0.042	-0.091	-0.059	-0.053	-0.18**	-0.15	-0.23**	-0.28***	-0.28**	-0.35**
	(-0.97)	(-1.51)	(-1.01)	(-0.40)	(-2.01)	(-1.25)	(-1.98)	(-2.78)	(-2.15)	(-2.38)
$\Delta i^e \times D_{low\,lev\,(total)}$	-0.034	-0.15**	-0.13*	-0.099	-0.23**	-0.17	-0.22*	-0.29**	-0.35**	-0.36**
	(-0.52)	(-1.97)	(-1.77)	(-0.98)	(-2.26)	(-1.47)	(-1.74)	(-2.03)	(-2.21)	(-2.12)
$\Delta i^u \times corr(sales, US)$	0.70	0.79	2.12	1.93	1.56	2.75*	1.93	0.19	1.62*	1.35
	(0.94)	(0.88)	(1.57)	(1.41)	(1.33)	(1.88)	(1.57)	(0.22)	(1.68)	(1.46)
$\Delta i^e \times corr(sales, US)$	0.20	0.22	0.31	0.38	0.31	0.24	0.21	-0.082	0.15	0.19
	(1.18)	(1.25)	(1.37)	(1.37)	(1.30)	(1.35)	(1.02)	(-0.74)	(0.85)	(0.83)
Adjusted R^2	0.310	0.261	0.246	0.251	0.247	0.232	0.218	0.146	0.132	0.144
Observations	20050	20050	20050	20050	20050	20050	20050	20050	20050	20050

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

	(1) h=1	(2) h=2	(3) h=3	(4) h=4	(5) h=5	(6) h=6	(7) h=7	(8) h=8	(9) h=9	(10) h=10
Δi^u	0.69***	0.95***	0.72***	0.67**	0.87**	1.00**	0.83*	0.85	0.80	0.82
	(2.69)	(3.54)	(2.70)	(2.35)	(2.48)	(2.34)	(1.79)	(1.48)	(1.54)	(1.48)
Δi^e	0.25**	0.26***	0.26***	0.28***	0.33***	0.40***	0.43***	0.42**	0.49**	0.56**
	(2.43)	(2.70)	(2.65)	(2.80)	(2.67)	(2.81)	(2.65)	(2.14)	(2.40)	(2.58)
$\Delta i^u \times D_{high\,lev\,(short)}$	-0.031	0.11	0.32	0.66	0.43	0.48	0.72	0.97	0.83	0.76
	(-0.06)	(0.18)	(0.37)	(0.68)	(0.43)	(0.46)	(0.68)	(1.03)	(0.77)	(0.72)
$\Delta i^u \times D_{low\,lev\,(short)}$	-0.64**	-0.61**	-0.73**	-0.52	-0.51	-0.75	-0.34	-0.36	-0.20	-0.26
	(-2.29)	(-1.99)	(-2.22)	(-1.41)	(-1.28)	(-1.60)	(-0.70)	(-0.80)	(-0.42)	(-0.53)
$\Delta i^e \times D_{high\,lev\,(short)}$	-0.092	-0.078	-0.028	0.052	0.0075	0.19	0.088	0.098	0.099	0.12
	(-0.80)	(-0.81)	(-0.21)	(0.30)	(0.07)	(1.13)	(0.93)	(0.91)	(0.96)	(1.26)
$\Delta i^e \times D_{low\,lev\,(short)}$	-0.17*	-0.13*	-0.12*	-0.081	-0.11	-0.11	-0.073	-0.066	-0.048	-0.10
	(-1.94)	(-1.70)	(-1.76)	(-1.03)	(-1.50)	(-1.43)	(-0.97)	(-0.80)	(-0.48)	(-0.90)
$\Delta i^u \times corr(sales, US)$	0.63	0.74	2.06	1.83	1.53	2.58*	1.88	0.24	1.65	1.41
	(0.81)	(0.82)	(1.53)	(1.30)	(1.24)	(1.71)	(1.46)	(0.31)	(1.53)	(1.36)
$\Delta i^e \times corr(sales, US)$	0.20	0.22	0.31	0.40	0.36	0.33	0.29	0.011	0.25	0.32
	(1.27)	(1.31)	(1.44)	(1.38)	(1.39)	(1.48)	(1.19)	(0.10)	(1.11)	(1.15)
Adjusted R^2	0.311	0.262	0.246	0.251	0.247	0.232	0.218	0.145	0.131	0.143
Observations	20050	20050	20050	20050	20050	20050	20050	20050	20050	20050

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reproduces Table 2 for the sample period June 1999 - July 2019 including interaction terms with the U.S. business cycle correlation.
Source: Authors' Calculation