U.S. Monetary Policy Surprise and Financial Institutions' Behavior: Data Lessons from Banks and Insurance Companies in 72 countries

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Abstract

I document the impact of US monetary policy surprise on the leverage dynamics of banks and insurance companies in 72 countries through event study analysis on the change in their leverage ratio surrounding 156 scheduled FOMC announcements from 2000 to 2019. There are two facts that I present in this study: (1) Less than 20% of the magnitude of the jump in leverage ratio of banks and insurance companies within one day of FOMC announcement are attributed to FOMC announcement effect on interest rates and spot exchange rates movement that are anticipated based on past history and expectations. That is, the impact of US monetary policy to banks and insurers' balance sheet is largely attributed to the surprise jump in leverage ratio following the unexpected outcome of US monetary policy, (2) this surprise jump in leverage ratio due to the unexpected outcome of US monetary policy indicates banks' and insurers' behavioral reactions due to deviation from their own optimal leverage target that may differ to regulatory requirement, and are unique to each bank and insurance companies. Further study is needed to show that this accumulated burden from adjusting to FOMC announcement imperfectly affects the optimal leverage of banks and insurance companies, and increases in interest rate differentials with the USA.

JEL Code: E3, F3

1. Introduction

What is the optimal leverage of banks and insurance companies? Especially those catering to the demands of foreign and domestic customers? For one, a global bank operates within a range of exposure wider than those of regional banks, yet faces the same regulatory requirement and within their means do have the objective to maximize profit and their shareholders' wealth. Practical reasons for investigating the behaviour of such banks are well-founded, for there are unresolved debate on whether leverage regulation does bind for these banks. For an entity that utilize their balance sheet leverage to generate profit, it is worth making a distinction between own leverage constraint versus regulatory leverage constraint. Theoretically, this distinction enables us to examine these banks' behaviour through a fundamental lens.

In this paper, I attempt to document the response of banks and insurers to US monetary policy shocks that enlarges the impact of the foreign exposure in their balance sheet on their operation. I summarize and explain a monetary policy transmission channel that impacts banks' and insurance companies' balance sheets through idiosyncratic exchange rate shock: This idiosyncratic exchange rate shock affects balance sheet through the currency denomination of balance sheet assets and liabilities of each bank and insurance companies. This is a first step in understanding how their leverage target changes before and after a shock of this nature is akin to identifying a transmission channel of these shocks through their balance sheet.

Taking a case for banks, Figure 1 and 2 show two key features of bank leverage. First, they have the natural tendency to have **high leverage**, and much heterogeneity with respect to this feature is seen in the case of emerging market banks. For example, the range of book-value leverage of French Banks is very narrow, around 0.9-0.1, compared to banks in Brazil, Argentina, Thailand and Indonesia. Second, there seems to be a **leverage target** for these banks since book-value revert back to the same level after the peak of the Global Financial Crisis. This second feature is especially obvious for banks in advanced economies.

Figure 1: Book-Leverage of Banks in Advanced Economies

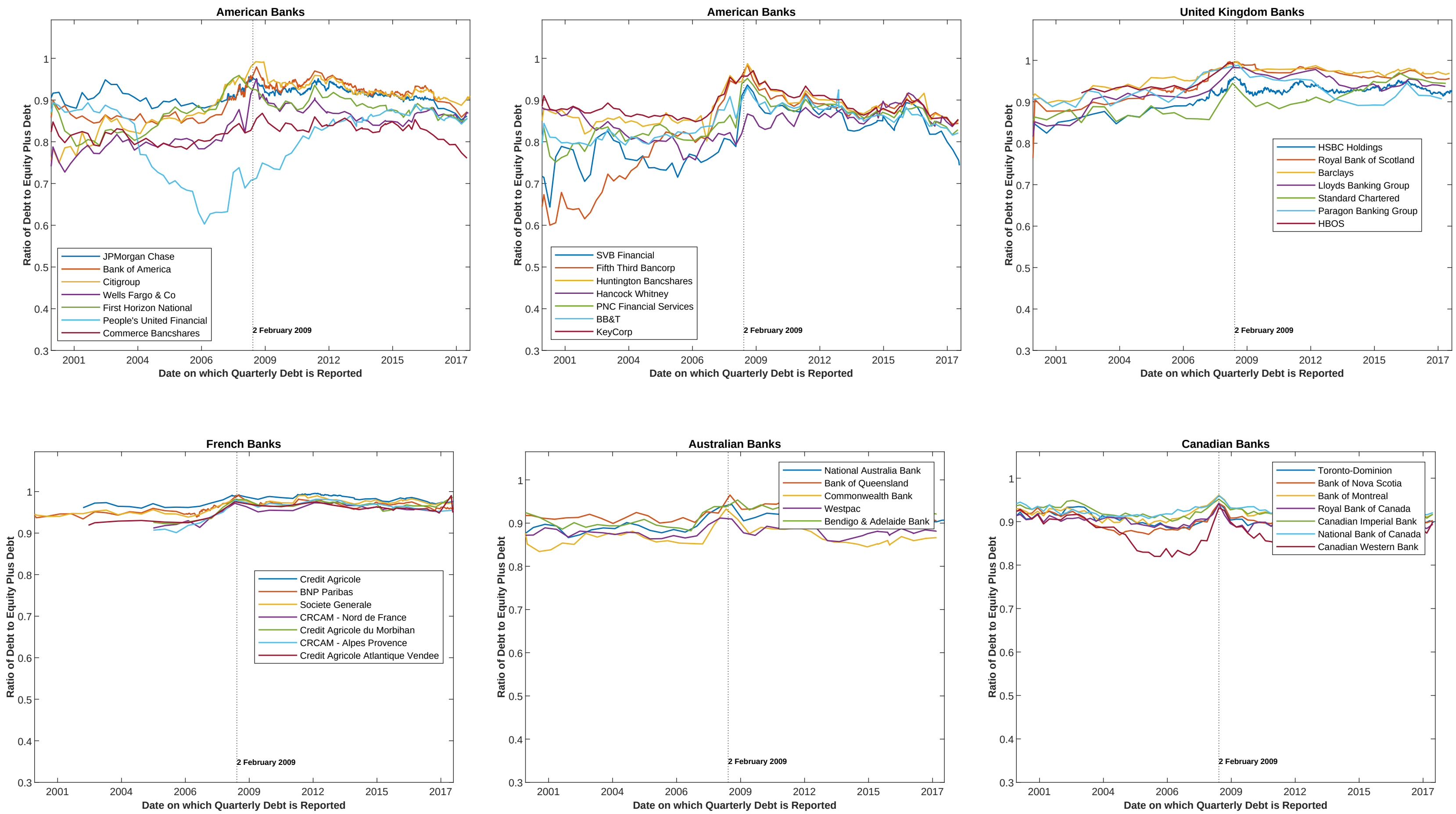
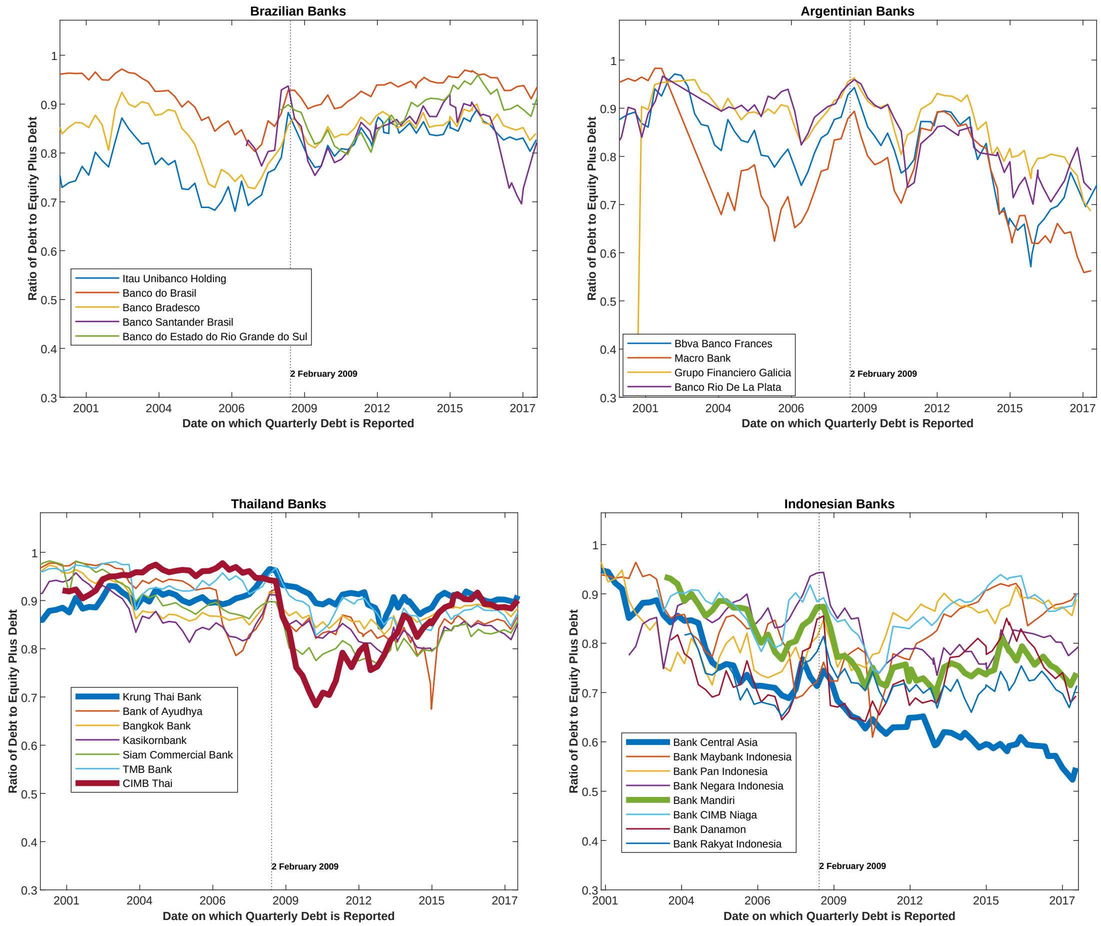


Figure 2: Book-Leverage of Banks in Emerging Economies



Theoretically, it has been argued that high leverage is optimal for banks given the nature of their balance sheet (DeAngelo and Stulz (2015)). Banks do generate value to their shareholders from loan spread and liquidity spread. Optimal risk management strategy allows banks to collateralize the asset side of their balance sheet that will allow them to make money from the liability side of their balance sheet, which is not possible for non-financial firms. For insurance, no staunch evidence of particular level of leverage has been found so far.

These figures give motivation of the existence of leverage target for banks and perhaps insurance companies. In light of this, there is one key of contribution of this paper: I showed the existence of a shadow leverage target as banks and insurers are reverting back to their initial leverage ratio at different paces following FOMC announcements during 2000-2019 (Fact 1). Banks in a region where the local currency has large interest rate differential with the USD are thrown off further in the longer horizon (Fact 2). As banks are highly leveraged with large portion of debt in their leverage ratio, the local currency appreciation has more impact on emerging economies' banks due to higher foreign net exposure in theory balance sheets. This, coupled with the fact that banks are leverage-driven business and heavily regulated unlike insurance companies leads to the different magnitudes of the impact of unexpected US monetary policy in the longer horizon. This points to the existence of a monetary policy transmission channel that impacts banks' balance sheets through idiosyncratic exchange rate shock, orthogonal from other channels that have been identified so far as it works through the accumulation of burden for not perfectly adjusting to each FOMC announcement.

To show these two facts, I conduct an event study surrounding 156 FOMC announcements during 2000-2019 to isolate monetary transmission channel unique to each bank and insurance company's balance sheet and estimate the response of banks and insurers via local projections surrounding these FOMC announcements. For the remaining of the paper, Section 2 details the empirical methodology, Section 3 details the construction of US monetary policy shock used in the local projection surrounding FOMC announcements from June 2000 to December 2019, Section 4 details the two empirical facts on banks' and insurers' behavior in facing US monetary policy shocks and Section 5 concludes.

2. Empirical Methodology

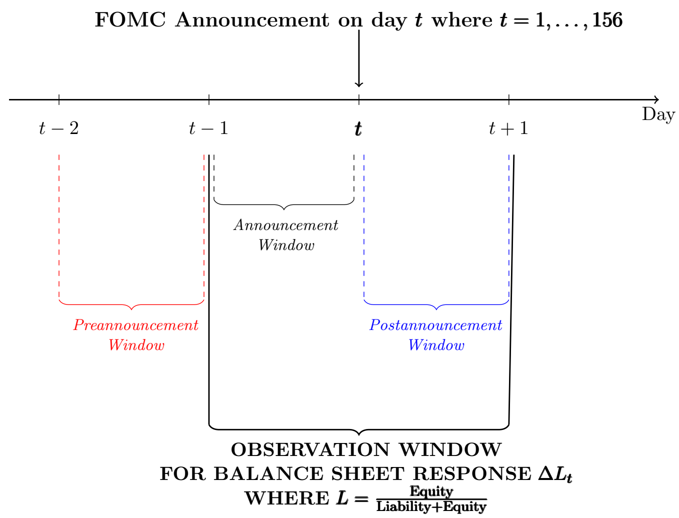
Data. I use the daily leverage ratio data of 500 banks and 192 insurance companies in 72 countries constructed by the New York University Global Volatility Lab to construct a panel dataset containing pairs of the change in banks and insurance companies' leverage ratio surrounding US FOMC announcements from June 2000 to December 2019 with the corresponding US monetary policy shock extracted from the US Treasury yield curve and a newly created exchange rate index.

The daily leverage ratio data is a ratio of equity to equity plus debt: market capitalization is used as a proxy for equity and the debt is the short and long-term book-value debt. My US monetary policy shock is the FOMC announcement effects: the financial market reactions to the unexpected FOMC decisions that are identified on the US Treasury yield curve and the spot exchange rates. The FOMC announcement effect on the US Treasury yield curve is what often termed as either US monetary policy shock or US monetary policy surprise in the recent literature. I added an exchange rate dimension to this standard monetary policy shock to capture the impact of US monetary policy conditional on the foreign currency exposure of banks' and insurers' balance sheet. To do so, I append a newly created exchange rate index that captures the FOMC announcement effect on the spot exchange rates of 22 currencies to the yield curve shock. The construction and the identification of my US monetary policy shocks are detailed in the next section.

Event Study. There are 156 event windows surrounding all FOMC announcements on US monetary policy that I observed from June 2000 to December 2019. Figure 3 depicts the individual event window where L is the leverage ratio for a particular bank or insurer on FOMC announcement day t.

In here I would like to distinguish between FOMC announcements and FOMC statements: FOMC announcements take place when the FOMC release their statements to inform the public about monetary policy stance in the USA after their meetings. Meanwhile, FOMC statements contain any information conveyed by the Fed Chairman's speeches including those outside the FOMC announcement of their monetary policy decision, for example during the Jackson Hole Symposium. There will be uncertainty coming into each FOMC meetings that would be resolved after the monetary policy decision is announced, whereas uncertainty on US monetary policy action

Figure 3: Event Window Surrounding FOMC Meeting Day



often remains after Fed Chairman's speech at the Jackson Hole Symposium. I focus on FOMC announcements in this paper.

To isolate the endogenous reactions of banks and insurance companies to these US monetary policy announcements, I conduct local projection of banks and insurance companies' leverage ratio surrounding FOMC announcement days following Jordà (2005), as in several recent papers documenting FOMC effect (Miranda-Agrippino and Nenova (2022); Kroencke, et al. (2021). I use the following local projection:

$$
\begin{aligned}
\underbrace{\Delta L_{i,t}}_{\textbf{Response to announcement on day } t} &= \underbrace{\sum_{j=\{S,C,L\}} \beta^j \sigma_t^j}_{\textbf{Announcement Window from } t-1 \textbf{ to } t} \\
&+ \underbrace{\sum_{k=1}^{5} \beta^{\text{Major}} X_{k,\text{Ann.}}^{\text{Major}} + \sum_{l=1}^{6} \beta^{\text{Rem.}} X_{l,\text{Ann.}}^{\text{Rem.}}}_{\textbf{Announcement Window from } t-1 \textbf{ to } t} \\
&+ \underbrace{\sum_{k=1}^{5} \hat{\beta}^{\text{Major}} X_{k,\text{Postann.}}^{\text{Major}} + \sum_{l=1}^{6} \hat{\beta}^{\text{Rem.}} X_{l,\text{Postann.}}^{\text{Rem.}}}_{\textbf{Postannouncement Window from } t \textbf{ to } t+1} \\
&+ \underbrace{\alpha_i}_{\textbf{Fixed effect}} + \underbrace{\gamma_t}_{\textbf{Time effect}} + \underbrace{e_{i,t}}_{\textbf{Error term}}
\end{aligned}
\tag{2.1}
$$

In (2.1), the 1-day response to US monetary policy shock is the change in leverage ratio $\Delta L_{i,t}$ from the day before the announcement to the day after the announcement that includes the postannouncement window. The local projection (2.1) predicts the cumulative change in leverage ratio at the end of the day following FOMC announcement, $L_{i,t}$. The US monetary policy shock in (2.1) is identified on the innovation of the latent factors on the US Treasury yield curve; σ_t^S, σ_t^C and σ_t^L, and the change in the spot exchange rates during announcement window from the day before to the end of FOMC announcement day: $X_{k,\text{Ann.}}^{\text{Major}}$, $X_{k,\text{Ann.}}^{\text{Rem.}}$, $X_{k,\text{Postann.}}^{\text{Major}}$ and $X_{k,\text{Postann.}}^{\text{Rem.}}$. Table 1 summarizes the variables used in the local projection (2.1).

The response of banks and insurance companies in the longer horizon is obtained by extending the local projection (2.1) to longer than a day after FOMC announcement. The results of the local projection surrounding FOMC announcement form two empirical facts of banks and insurance companies' behavior in response to US monetary policy shock.

Table 1: Summary of Variables

Constructed Variable (*Unit*)	**Interpretation**	**Data** (*Source*)	**Estimation Methods**
σ_t^S, σ_t^C, σ_t^L (% point change)	Announcement effect on US interest rate w.r.t shock day t	% point change in UST yield surrounding shock day t, 1-30 years of maturity, (*Daily, SVENY Fed*)	Latent factors estimation from Diebold, etc (2006),
$X^{\text{Major}}_{k,\{\text{Ann., Postann.}\}}$ $X^{\text{Rem.}}_{l,\{\text{Ann., Postann.}\}}$ (Δ log change)	Announcement effect on exchange rate w.r.t shock day t	Log change in spot exchange rates surrounding shock day t, foreign per USD (*Daily, Fed H.10*)	Principal components estimation
$\Delta L^j_{i,t}$ (% point change)	Balance sheet response w.r.t shock day t	Leverage ratio (*Daily, NYU Global Volatility Lab*)	Difference surrounding shock day t

3. Unexpected US Monetary Policy Decisions

The US monetary policy shocks studied in this paper represent the unexpected component of the Federal Open Market Committee (FOMC) decisions from June 2000 to December 2019. The schedules of the FOMC meetings are publicized[1] and therefore financial market participants continue to form their expectations about US monetary policy until the FOMC statements are released following the conclusion of the meeting, after which any uncertainties regarding FOMC decision have resolved. Given this timing, I identify the US monetary policy shock on the innovations of the latent factors of the US Treasury yield curve and the movements in the spot exchange rates during a 1-day period starting from the day before an FOMC meeting until the end of the meeting day after the FOMC statements have been released.

The market reactions during this narrow event window were prompted by the FOMC announcement of the US monetary policy, in absence of other events occurring in the same event window. This high-frequency identification of monetary policy shock around a tight window surrounding monetary policy announcements follows the spirit of Kuttner (2001) and Gurkaynak, Sack and Swanson (2005). Kuttner (2001) decomposes the change in the fed funds target into the

[1] https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm

"surprise" and the "expected" components by computing the surprise from the 1-day change of the spot-month fed funds future rates, and further shows that interest rates' response to the "surprise" component of US monetary policy is significantly stronger than the response to the changes in fed funds target that are expected by markets. Using tick-by-tick data of federal futures rates, Gurkaynak, Sack and Swanson (2005) finds similarly to Kuttner (2001)[2] that the "surprise" component of US monetary policy dominates the impact on asset prices, rather than the "expected" component. Bernanke and Kuttner (2005) also show that the stock market's response to FOMC announcements is dictated by the "surprise" component of fed funds target change. The identified "surprise" component of FOMC monetary policy decisions in these papers is analogous to the US monetary policy shock that I identify from the US Treasury yield curve during 2000-2019 in this paper.

Analogous to Kuttner (2001), I decompose market reactions to FOMC announcement that are reflected in the US Treasury yield curve during 2000-2019 into two orthogonal components: the "surprise" and the "expected" components. To do so, I estimate the state-space representation of the US Treasury yield curve in Diebold, Rudebusch and Aruoba (2006) using daily zero-coupon US Treasury bond yield data of 1-30 years maturities during 2000-2019 period and obtain the 1-day innovations of the three latent factors: the slope, curvature and level factors. The one-step Kalman filter procedure allows for the decomposition of the 1-day change in the UST yield curve into the two orthogonal components: the 1-day change due to information prior to and after the release of FOMC statements on US monetary policy after their meeting (the innovations of the latent factors). The latter is the "surprise" component reflecting the unexpected component of FOMC decision.

Diebold, Rudebusch and Aruoba (2006) summarize the dynamic of the slope, level and curvature factors in the transition equation

$$f_t - \mu = A\left(f_{t-1} - \mu\right) + \sigma_t \tag{3.1}$$

where $f_t = (L_t, S_t, C_t)$ and L_t, S_t and C_t are the level, slope and curvature factors respectively. I

[2] Gurkaynak, Sack and Swanson (2005) identifies the two factors associated with significant changes in FOMC statements from the intraday data of federal funds futures and eurodollar futures: the "current federal funds rate target" ("surprise") factor and the "future path of policy" ("path") factor. The former is analogous to the "surprise" component in Kuttner (2001) while the latter corresponds to 1-year changes in futures fed funds rates that are independent of changes in the current fed funds rate target.

interpret the innovations of the latent factors $\sigma_t = (\sigma_t^L,\, \sigma_t^S,\, \sigma_t^C)$ as the US monetary policy shock captured on the long-end, middle and short-end of the US Treasury yield curve respectively. The dynamic interpretation of the Nelson–Siegel representation of the yield at time t for i-year maturity, $y_t(\tau_i)$

$$y_t(\tau_i) = L_t + S_t\left(\frac{1 - e^{-\lambda\tau_i}}{\lambda\tau_i}\right) + C_t\left(\frac{1 - e^{-\lambda\tau_i}}{\lambda\tau_i} - e^{-\lambda\tau_i}\right) \text{for } i = 1,\, \ldots,\, 30\,\text{year} \tag{3.2}$$

is then used in the measurement equation

$$y_t(\tau_i) = \Omega f_t + \epsilon_t \tag{3.3}$$

where Ω is the matrix of factor loadings containing the terms that multiply the factors L_t, S_t and C_t in (3.2) and ϵ_t is the measurement disturbances. I use both the transition equation (3.1) and the measurement equation (3.3) to form the state-space system that represents the US Treasury yield curve from 2000 to 2019 in my paper.

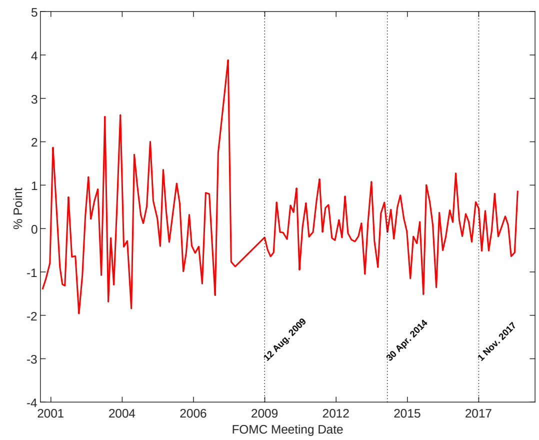
These innovations could be used as the proxy for US monetary policy shocks that are identified on the whole spectrum of maturities of the US Treasury yield curve. The innovations of the latent factors σ_t^S, σ_t^C and σ_t^L are sensitive to the change in the US monetary policy regime. The innovation σ_t^S captures the movement in the short end of the yield curve (1 to 5-year maturities) and captures the surprise during the conventional monetary policy period in the US as shown in Figure 4. Figure 4 also show that the innovations σ_t^C and σ_t^L that capture the unexpected component of FOMC decisions in the middle (6 to 9-year maturities) and long end (10 to 30-year maturities) of the US Treasury yield curve plays a dominant role during unconventional monetary policy period in the US and in the subsequent periods.

The decomposition of US monetary policy shock into three shocks that addresses market reactions at different parts of the yield curve has its advantage, eg. during LSAP period the σ_t^S is not significant but instead σ_t^C and σ_t^L are significant, and hence these shocks should work in the local projection (2.1) for banks and insurers in emerging economies. In contrast, US monetary policy shocks identified in the short end of the yield curve or on the US/EU stock market as in Jarociński and Karadi (2020) will fail to do their jobs in the local projection (2.1) for banks and insurers in emerging economies.

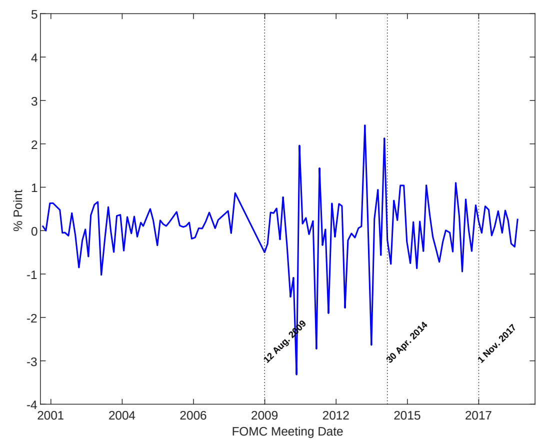
These results also speak to recent papers that identify US monetary policy shocks with more involved assumptions. Table 4 in Appendix B shows that these innovations are comparable to standard monetary policy shocks identified using intraday data in recent papers (Nakamura and Steinsson (2018); Jarociński and Karadi (2020); Jarociński (2021)). The innovations σ_t^S also corresponds to the "surprise" component in the fed funds target (standard monetary policy shocks) in Kuttner (2001).

Figure 4: σ_t^S, σ_t^C and σ_t^L from 2000 to 2019

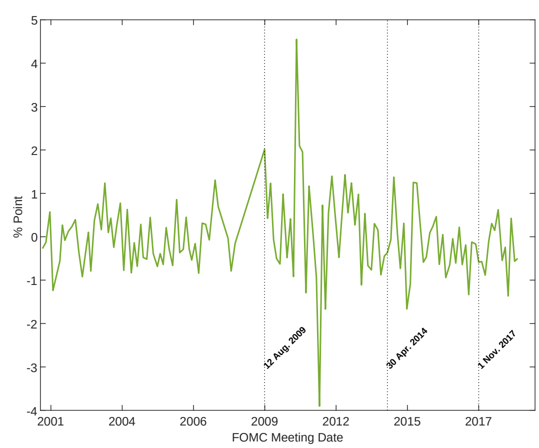
(a) σ_t^S



(b) σ_t^C



(c) σ_t^L



To summarize:

(1) One-step Kalman filter procedure in Diebold, Rudebusch and Aruoba (2006) gives the innovations of the slope, curvature and level factors describing the US Treasury yield curve in the space of event windows that contain FOMC announcements, σ_t^S, σ_t^C and σ_t^L respectively.

(2) This set of innovations addresses the movement in the shortest-end of the yield curve (σ_t^S, 1-3.5 years of maturity), the longest end of the yield curve (σ_t^L, 10-30 years of maturity) and in between (σ_t^C).

(3) Why it works: decomposition of the change in the UST yield curve due to "old" information (ie. expected) vs "new" information (ie. innovations, surprise).

To create the vector of US monetary policy shocks, I also append a newly created exchange rate indexes $X^{\text{Major}}_{k,\text{Ann.}}$, $X^{\text{Rem.}}_{k,\text{Ann.}}$, $X^{\text{Major}}_{k,\text{Postann.}}$ and $X^{\text{Rem.}}_{k,\text{Postann.}}$ to the yield curve shocks. The idea behind the construction of these exchange rate indexes is that the surprise movements in spot exchange rates due to FOMC announcement occur during the announcement window, with the subsequent adjustment takes place until the end of postannouncement window. Both surprise and the adjustment to this surprise matter as it will impact balance cheet response conditional on the foreign net exposure of each banks' and insurers' balance sheet.

These exchange rate indexes capture the FOMC announcement effect on the spot exchange rates (foreign per USD) of 22 currencies. Essentially, they are vectors of principal component scores of the change in spot exchange rates of two groups of currencies in both announcement and postannouncement windows: 10 major currencies and the 12 remaining currencies in Fed H.10. Summarizing spot exchange rates movements of 22 currencies via 11 principal components purged out noises in the spot exchange rate movements during the narrow event windows.

4. Banks' and Insurers' Response to US Monetary Policy Shock

I argue that the discrepancy between the expected US monetary policy stance and the actual monetary policy decision reached by the FOMC affects the capital structure decision of banks and insurance companies in and outside the US. In proposing this view, I am presenting two empirical facts on the behavior of banks and insurance companies surrounding 156 FOMC announcements from June 2000 to December 2019: first, the impact of US monetary policy on the balance sheets of banks and insurers are largely attributed to the surprise jumps in leverage ratio following unexpected US monetary policy decisions and second, these surprise jumps indicates reactions unique to each banks and insurers due to the deviation from their optimal leverage target.

These two empirical facts indicate a monetary policy transmission channel that impacts banks' and insurance companies' balance sheets through idiosyncratic exchange rate shock. This monetary transmission channel is orthogonal from other channels that have been identified so far, as it works through the accumulation of burden from not perfectly adjusting to each FOMC announcement throughout the years.

Two Empirical Facts on Banks and Insurers' Behavior

Tables 2 and 3 document the short-run balance sheet response: the change in leverage ratio to a 1 standard deviation of US monetary policy shocks by the end of the two sub-windows surrounding FOMC announcement. This response is calculated from the local projection (2.1), where the magnitudes and signs of the standard deviations of the shocks are calculated for the period of 2000 to 2019.

Fact 1. The impact of US monetary policy on banks and insurers' balance sheet is largely attributed to the surprise jump in leverage ratio following the unexpected outcome of US monetary policy. Table 2 below shows that 1 standard deviation of US monetary policy shocks causes leverage ratios of banks in the 72 countries to move further from their level before the announcement: by the end of day $t+1$ the impact of US announcement has not subsided yet as $\sum_{\text{Ann.,Postann.}} \Delta L \neq 0$.

The case for insurance companies is the same, and in both cases emerging economies recorded the larger change in leverage ratio at the end of announcement day t. Meanwhile, leverage ratio of banks in emerging countries revert to the previous level in postannouncement window after US

Table 2: Banks' 1-Day Response to US Monetary Policy (in bps)

(a) Easing

	$L_t - L_{t-1}$ (End of Announcement Day t)	$L_{t+1} - L_t$ (A Day After)
USA	34.24	22.10
Emerging	15.95	-5.05
Advanced	4.52	5.69
Other	7.44	8.34
AU, NZ and CA	8.49	13.50
Remaining	10.27	-3.53

(b) Tightening

	$L_t - L_{t-1}$ (End of Announcement Day t)	$L_{t+1} - L_t$ (A Day After)
USA	-3.79	-7.95
Emerging	-9.36	-15.89
Advanced	-1.49	-2.88
Other	-0.82	-4.35
AU, NZ and CA	-9.93	-9.84
Remaining	-1.48	-6.68

monetary policy easing, albeit imperfectly. The impact of US monetary policy shock is asymmetric with heterogeneity in response captured during easing, especially for banks.

In both tables for banks and insurance companies, the leverage ratios of banks and insurance spiked up after US monetary policy easing announcement, and went down after US monetary policy tightening as predicted by theory. However, in the postannouncement window, the process of reverting to the level of leverage ratio a day before the announcement are different for banks and insurance companies in different regions, with much heterogeneity during US monetary policy easing as opposed to US monetary policy tightening.

Table 3: Insurers' 1-Day Response to US Monetary Policy (in bps)

(a) Easing

	$\Delta L = L_t - L_{t-1}$ (End of Announcement Day t)	$\Delta L = L_{t+1} - L_t$ (A Day After)
USA	40.70	13.21
Emerging	30.09	10.82
Advanced	9.05	3.78
Other	50.46	9.51
AU, NZ and CA	16.37	-5.91
Remaining	41.55	10.22

(b) Tightening

	$\Delta L = L_t - L_{t-1}$ (End of Announcement Day t)	$\Delta L = L_{t+1} - L_t$ (A Day After)
USA	-12.78	-8.71
Emerging	-26.13	-8.52
Advanced	-12.79	-2.74
Other	-2.91	-10.35
AU, NZ and CA	-9.9	-7.63
Remaining	-42.17	9.71

The key takeaway here is that unexpected US monetary policy causes leverage ratios of banks and insurance companies to move further from their level before the announcement: the impact of US announcement has not subsided by the end of postannouncement window as the change in leverage ratio is far from zero in magnitude. FOMC announcement effect on announcement and postannouncement windows explain $\leq 20\%$ of the variation in the leverage ratio jump surrounding FOMC.

Conducting the same 1-day local projections (2.1) using well-known monetary policy shocks from Kuttner (2001), Jarociński and Karadi (2020) and Jarociński (2020) in place of my shocks shows that the innovations in the yield curve latent factors work well as part of monetary policy shock in this paper, especially in the case of emerging economies. Additionally, including the FOMC announcement effect $X_{EX,t}$ on spot exchange rate movements to a certain extent controls for the information effect discussed in Gurkaynak, Sack and Swanson (2005).

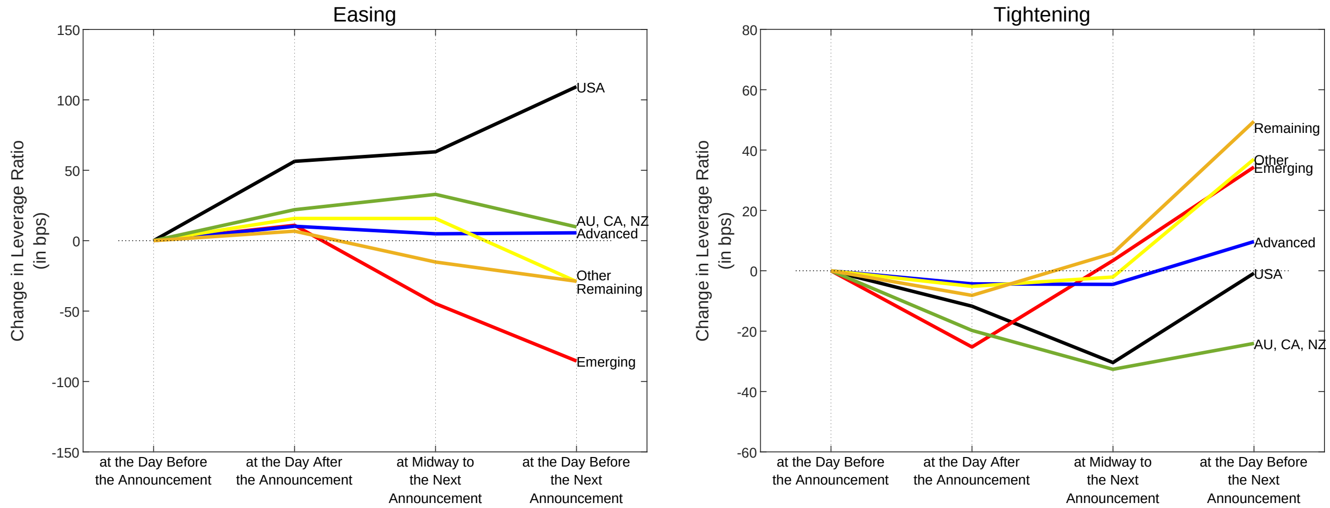
Fact 2. The surprise jump in leverage ratio due to unexpected US monetary policy outcome indicates behavioral reactions due to deviation from optimal leverage target that are not necessarily the same as regulatory leverage ratio requirement, and are unique to each entity. By extending the short-run local projection (2.1) to longer horizon, I find that the short-run result extends to a day before the next announcement while the US monetary policy shock coefficients are still very much significant. Figure 5 exhibits the cumulative change in leverage ratios (or average response) at three points of times: a day after each announcement, midway through to next announcement and a day before each announcement, obtained by extending the local projection to longer than a day after FOMC announcement.

Figure 5 shows that banks and insurers are reverting back to their initial leverage ratio at different pace, and only in few cases these banks and insurance companies can get to where they were before the announcement (ie. When the change in leverage ratio is close to zero): banks and insurers in Advanced economies, Australia, New Zealand and Canada, and in one particular case banks in the US after its monetary policy tightening.

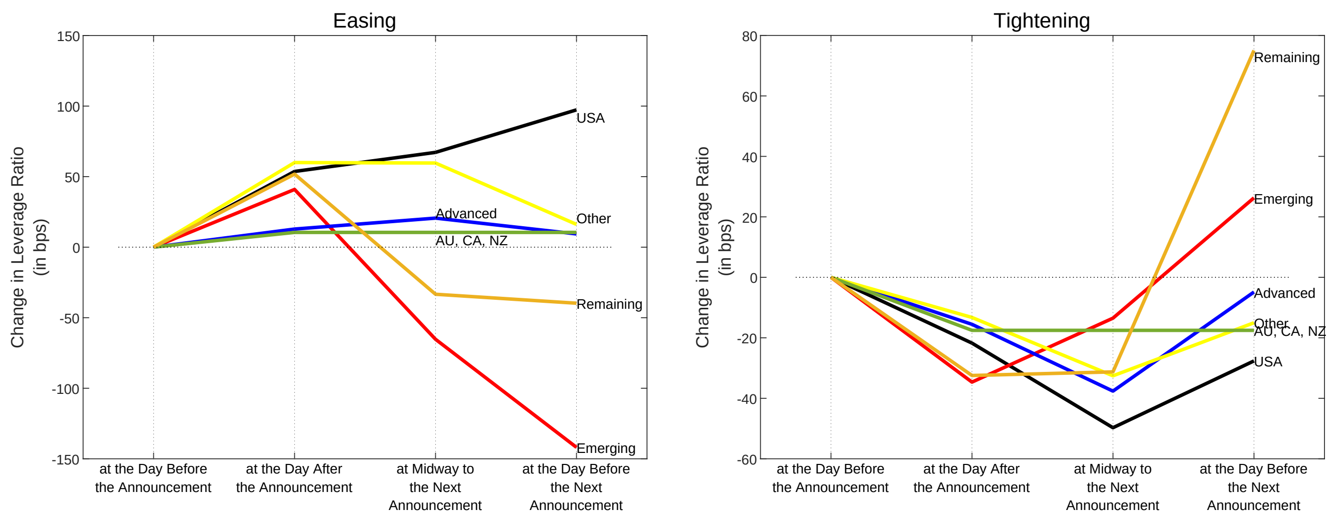
The existence of the "shadow" leverage target is documented in Figure 5 as banks and insurers revert back to their initial leverage ratio right before the next FOMC announcement, albeit with little success. Local currencies in emerging economies have large interest rate differential with the USD, and therefore even when the leverage ratios of banks in these economies start to revert back quicker than in other regions, they are thrown off further in the longer horizon. As banks are highly leveraged the local currency appreciation have more impact on emerging economies banks as the foreign net exposure is higher in this region. The fact that banks are leverage-driven business and heavily regulated unlike insurance companies also leads to the different magnitude of the impact of unexpected US monetary policy in the longer horizon.

Figure 5: Response to US Monetary Policy Shock in Longer Horizon (in bps)

(a) Banks' Response



(b) Insurance Companies' Response



5. Conclusion

The impact of US announcement has not subsided by the end of postannouncement window as the change in leverage ratio is far from zero in magnitude, and unexpected US monetary policy causes leverage ratios of banks and insurance companies to move further from their level before the announcement. FOMC announcement effects during announcement and postannouncement windows explain $\leq 20\%$ of the variation in the leverage ratio jump surrounding FOMC announcements, and US monetary policy shock coefficients are still very much significant in the longer horizon. Banks and insurance companies are trying to return their leverage ratios to the level before the announcement, which means they are trying to revert back to a certain target unique to each of them, which I call the **shadow leverage target**. These empirical facts indicates a monetary policy transmission channel that impacts banks' and insurance companies' balance sheets through idiosyncratic exchange rate shock, and is **orthogonal** to other channels that have been identified so far as it works through the accumulation of **"burden"** for not perfectly adjusting to each FOMC announcement.

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Appendix B. Tables

Table 4: Correlation between $\sigma_t = (\sigma_t^S, \sigma_t^C, \sigma_t^L)$ and Other US Monetary Policy Shocks

	σ_t^S	σ_t^C	σ_t^L
Kuttner (2001)			
surprise	0.388	0.040	-0.035
expected	-0.032	-0.001	-0.127
Nakamura and Steinsson (2018)			
standard monetary policy shock	0.677	0.215	-0.042
Jarociński and Karadi (2020)			
standard monetary policy shock	0.643	0.186	-0.094
information shock	0.180	0.095	0.058
Jarociński (2021)			
standard monetary policy shock	0.330	0.026	-0.072
forward guidance shock	0.456	0.314	0.096
LSAP shock	-0.310	0.032	0.473
information shock	0.187	0.206	0.087

Table 5: Signs and Magnitudes of US Monetary Policy Shocks

	Shock sign (Easing)	Shock sign (Tightening)	1 Standard Deviation (Easing)	1 Standard Deviation (Tightening)
σ_t^S	-1	1	0.98	0.79
σ_t^C	1	1	1.28	0.35
σ_t^L	1	-1	1.11	0.51
$X_{1,\text{Ann.}}^{\text{Major}}$	-1	1	1.20	0.63
$X_{2,\text{Ann.}}^{\text{Major}}$	-1	1	1.15	0.63
$X_{3,\text{Ann.}}^{\text{Major}}$	-1	1	1.13	0.72
$X_{4,\text{Ann.}}^{\text{Major}}$	1	-1	1.10	0.79
$X_{5,\text{Ann.}}^{\text{Major}}$	-1	1	1.04	0.87
$X_{1,\text{Postann.}}^{\text{Major}}$	1	-1	1.07	0.88
$X_{2,\text{Postann.}}^{\text{Major}}$	1	-1	1.08	0.71
$X_{3,\text{Postann.}}^{\text{Major}}$	1	-1	1.07	0.83
$X_{4,\text{Postann.}}^{\text{Major}}$	1	-1	1.06	0.87
$X_{5,\text{Postann.}}^{\text{Major}}$	-1	1	1.12	0.81
$X_{1,\text{Ann.}}^{\text{Rem.}}$	1	-1	1.18	0.68
$X_{2,\text{Ann.}}^{\text{Rem.}}$	-1	-1	1.12	0.84
$X_{3,\text{Ann.}}^{\text{Rem.}}$	-1	-1	1.04	0.95
$X_{4,\text{Ann.}}^{\text{Rem.}}$	1	-1	1.02	0.99
$X_{5,\text{Ann.}}^{\text{Rem.}}$	-1	1	1.14	0.68
$X_{6,\text{Ann.}}^{\text{Rem.}}$	-1	1	1.14	0.84
$X_{1,\text{Postann.}}^{\text{Rem.}}$	-1	-1	1.13	0.87
$X_{2,\text{Postann.}}^{\text{Rem.}}$	-1	-1	1.15	0.77
$X_{3,\text{Postann.}}^{\text{Rem.}}$	-1	1	1.08	0.95
$X_{4,\text{Postann.}}^{\text{Rem.}}$	-1	1	0.97	0.92
$X_{5,\text{Postann.}}^{\text{Rem.}}$	1	1	1.15	0.79
$X_{6,\text{Postann.}}^{\text{Rem.}}$	1	1	1.07	0.92