The International Spillovers of Synchronous Monetary Tightening

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PRELIMINARY AND INCOMPLETE

Abstract

We use historical data and a calibrated model of the world economy to study how a synchronous tightening of monetary policy can amplify cross-border transmission of monetary policy. The empirical analysis shows that historical episodes of synchronous tightening are associated with tighter financial conditions and larger effects on economic activity than asynchronous ones. In the model, a sufficiently large synchronous tightening can disrupt intermediation of credit by global financial intermediaries causing large output losses and an increase in sacrifice ratio, that is, output lost for a given reduction in inflation. We use this framework to study the gains from coordination that would arise if countries set interest rates cooperatively rather than autonomously adjusting rates to stabilize domestic conditions.

KEYWORDS: Monetary Policy; International Spillovers; Inflation; Panel Data Estimation; Open Economy Macroeconomics.

JEL CLASSIFICATION: C33. E32. E44. F42.

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1 Introduction

Central banks across the world are tightening at an unprecedented pace to tame the ongoing global surge in inflation that started in 2021. The synchronous nature of global monetary tightening has caused concerns that interest rate hikes could be mutually compounding, with large cross-border spillovers, and result in an unintendedly deep downturn in global economic activity. Accordingly, some commentators have called on central banks to coordinate in their fight to tame inflation to avoid driving the world economy into an unnecessarily harsh contraction (Obstfeld, 2022).

There are two main reasons why international monetary policy spillovers can be large and international coordination can become critical in calibrating monetary policy. First, global trade integration implies that for many countries a substantial component of inflation is imported from abroad. When foreign central banks tighten, they affect the price of domestic imports and hence the monetary policy tradeoffs in the home country. While this channel is well understood, its quantitative relevance has grown over time as the international trade landscape has become more interconnected. Second, financial integration implies that tightening of financial conditions in one country can spill over to foreign economies by affecting the balance sheet of intermediaries that operate globally. This financial channel can have important nonlinear features. For small increases in global interest rates, balance sheets can remain relatively healthy and financial amplification of monetary policy shocks can be muted. When global financial conditions tighten enough to impair international financial intermediation, the same monetary shocks could be amplified by endogenous increases in credit spreads for domestic borrowers.

In this paper, we use historical data and a calibrated model of the world economy to study how the synchronous nature of monetary policy tightening can amplify cross-border transmission of monetary policy. In the model presented here, the amplification works through disruptions in the intermediation of credit by global financial intermediaries. Financial spillovers are the most natural channel to explore in studying potential nonlinearities in the response of the economy to global tightening shocks. Accordingly, in our baseline model we focus on this financial channel and muted the role of trade channels by assuming that all exporters set prices in the destination currency (LCP). An extension we are considering is to allow for global dollar pricing of exports, as in the dominant currency pricing paradigm of Gopinath et al. (2020), to study how the central role of the dollar in trade and finance interact to shape global monetary policy tradeoffs.

The empirical analysis offers suggestive evidence that historical episodes of synchronous tightening are associated with tighter financial conditions and larger and more persistent effects on economic activity than asynchronous tightening. The simulations from the model show that if central banks simultaneously adopt a stance that is substantially tighter than what standard policy rules would imply, the global economy can move past a tipping point beyond which monetary spillovers are greatly amplified through financial channels. Additionally, this amplification effect is stronger on output than on inflation thus increasing sacrifice ratios, that is, output losses to achieve a given reduction in inflation. Thus, our analysis highlights that should central banks underestimate spillovers when tightening significantly and synchronously, they risk giving too much weight to inflation and too little weight to economic activity.

We plan to use this framework to study the gains from coordination that would arise if countries set interest rates cooperatively to minimize a global loss function rather than autonomously adjusting rates to stabilize domestic conditions.

The mechanism in our model builds on an extensive literature that studies financial amplification of monetary policy shocks through their effects on borrowers' equity positions, starting from the seminal contribution by Bernanke et al. (1999). While the mechanism was originally applied to non-financial borrowers, Gertler and Karadi (2011) and Gertler et al. (2020) apply it to describe the transmission of various types of monetary and non-monetary shocks through financial intermediaries. Recent work has applied this mechanism to open-economy models, as for instance Ahmed et al. (2021) and Ferrante and Gornemann (2022).

The an empirical analysis contributes to the literature documenting the financial transmission of monetary policy shocks. Gertler and Karadi (2015) and Caldara and Herbst (2019) document that a monetary policy tightening raises spreads on corporate credit. Miranda-Agrippino and Rey (2020) show that US monetary policy shocks induce comovements in the international financial variables that characterize the global financial cycle. Iacoviello and Navarro (2019) find that international spillovers of higher U.S. interest rates are stonger for countries that are more financially vulnerable.

2 Empirical Analysis: Synchronous and Asynchronous Episodes

2.1 Shares of CBs tightening

Over the past half century, central banks have tightened their stance of monetary policy synchronously on several occasions.

[TBA]

2.2 Simultaneous tightening events and event study analysis

Our first goal is to study the aftermath of policy tightening events across synchronous and asynchronous tightening episodes. To this end, we use quarterly data on GDP, unemployment, core inflation, policy interest rates, and (when available) corporate spreads for the 21 advanced economies starting in 1980Q1 and ending in 2019Q4.[1]

The key task is to identify the timing of policy tightening episodes for each country, and then to separate these episodes into synchronous and asynchronous.

First, we define a country's policy tightening event as happening in the quarter t^* when: (a) interest rates are higher by more than 5 basis points than in the previous quarter; (b) interest rates are higher by more than 5 basis points than four quarters before; (c) four quarters after t^* interest rates are lower than in t^*. If this criterion is satisfied in contiguous quarters, we select the first quarter in which the condition is met.

Formally, the set $H(i)$ contains all quarters satisfying criteria (a),(b), and (c) in country i:

$$H(i) = \left\{ s \,\middle|\, \begin{array}{rl} r_s^i > r_{s-1}^i + .05 & (a) \\ r_s^i > r_{s-4}^i + .05 & (b) \\ r_s^i > r_{s+4}^i & (c) \end{array} \right\}$$

where r_s^i is the policy rate in coutnry i in quarter s. The set $T^*(i)$ isolates the first quarter satisfying (a),(b), and (c) among contiguous quarters:

$$T^*(i) = \left\{ \; s \in H(i) \quad | \quad if \; \exists t \in H(i) \;\; s.t. \; |t-s| = 1 \; then \;\; s < t \qquad \right\}$$

Our definition of the set T^* aims to isolate tightening cycles as individual episodes, rather than considering each hike in the cycle as a separate tightening. Also, by virtue of criterion (c), within each tightening cycle we select the quarter at or close to the end of the tightening cycle.

Using this criterion, we find a total of 127 tightening episodes, an average of about 6 per country over the sample. For instance, this criterion identifies six tightening episodes for the United States in the quarters 1984q1, 1989q1, 1995q1, 2000q1 2006q3, and 2018q4.

To split the tightening episodes into synchronous and asynchronous, we compute a global interest rate as the weighted average (using current dollar GDP weights) of each country's interest rate.

[1] The economies in the sample are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States. When policy interest rates are not available, we use 3-month Treasury Bill rates or an equivalent measure. GDP is expressed in each country in percent deviation from a log quadratic trend.

That is

$$r_s^w = \sum_i w_{is} r_s^i$$

where the weights:

$$w_{is} = \frac{gdp_s^i}{\sum_j gdp_s^j}.$$

We define a global tightening event as happening in the quarter t^* when the global interest rate satisfies the same criterion for a country's tightening event described above, i.e. $t^* \in T^*(w)$. Using this criterion, we find 8 episodes of global tightening, occurring in 1980q4, 1984q1, 1989q4, 1994q4, 2000q2, 2007q1, 2011q2, 2018q4.

For each country, we then define synchronous tightening episodes as those happening within a two-year window since a global tightening (78 episodes out of 127), and asynchronous tightening episodes as those not happening within an eight-quarter window since a global tightening (49 episodes out of 127).[2] That is the set of global tightening episode in country i is given by:

$$S^*(i) = T^*(i) \cap W^*(w)$$

where $W^*(w)$ collects all quarters within the 8 quarters window from a global tightening:

$$W^*(w) = \{t \mid 0 \leq t \ - t^* \leq 8 \ \exists t^* \in T^*(w)\}.$$

The set of asynchronous tightening is just the complement in $T^*(i)$:

$$A^*(i) = T^*(i) \ \setminus S^*(i).$$

To assess how macroeconomic variables behave in the aftermath of tightening episodes, we estimate the following event-study regression:

$$y_{it} = \gamma_i + \sum\nolimits_{\tau=-4}^{10} \sigma_\tau DS_{it-\tau} + \sum\nolimits_{\tau=-4}^{10} \alpha_\tau DA_{it-\tau} + \varepsilon_{it}, \quad (1)$$

where DS_{is} is an indicator function equal to 1 in the event of a synchronous tightening event in country i at time s, and DA_{is} is an indicator function equal to 1 in the event of an asynchronous tightening event in country i at time s:

$$DS_{is} = I_{\{s \in S^*(i)\}} \quad ; \quad DA_{is} = I_{\{s \in A^*(i)\}}$$

[2] Using this definition, the US tightening episodes occurring in, say, 1984q1, 1995q1 and 2018q4 are considered synchronous, whereas the tightening episodes occurring in 1989q1 2000q1, and 2006q3 are asynchronous.

We normalize $\sigma_0 = \alpha_0 = 0$ and plot the sequence of regression coefficients σ_τ and α_τ in Figure 1 for interest rates, inflation, GDP, the unemployment rate, corporate credit spreads, and global interest rates. Asynchronous tightening episodes result in limited increases in unemployment and corporate spreads, and smaller declines in GDP relative to their jump-off points. By contrast, synchronous tightening episodes are associated with larger economic costs, with unemployment rising 1.5 percentage points after two years, and GDP declining by nearly 3 percent, in spite of a similar behavior of inflation. In addition, synchronous tightening episodes are associated with a greater deterioration in financial conditions, with corporate spreads rising by about 100 basis points relative to their jump-off point.

If we adopt a definition of synchronicity that relies on a narrower window, there are fewer synchronous episodes, but the results shown in Figure 1 are qualitatively similar.

This empirical analysis provides suggestive evidence that synchronous episodes might have disproportionately larger economic effects compared to asynchronous episodes, and that global monetary policy spillovers could be associated with a sizeable deterioration in financial conditions. These findings are in line with the financial spillover mechanisms in our model, to which we turn next.

2.3 Monetary Shocks

[TBA]

3 A Model of Financial Spillovers

To quantify the nonlinear financial amplification channel of global tightening shocks, we use a dynamic stochastic general equilibrium (DSGE) model that includes a "U.S." block and a "foreign" block. The model incorporates an array of nominal and real rigidities calibrated using historical data to produce empirically plausible dynamics, as in Christiano et al. (2005) and Smets and Wouters (2007). These include habit formation in consumption and adjustment costs on investment, which imply a gradual adjustment of domestic demand to real interest rates; nominal price rigidities implying that the behavior of price inflation satisfies a "Phillips curve" relation. The model also assumes that exporters in both countries practice "local currency pricing," whereby export prices are set and are rigid in the destination currency. This feature implies that the pass-through of exchange rate changes into import prices is very low for all exporters in the U.S. and abroad.

The model's key feature is the presence of global financial intermediaries specialized in holding assets from multiple countries. Our definition of financial intermediaries is broad and includes banks and nonbanks. These institutions issue dollar-denominated liabilities to U.S. and foreign residents and use liabilities, together with their net worth, to fund assets both in the U.S. and abroad. Figure 2 provides a graphical representation of global financial intermediaries in our model.

Following a large body of literature, we assume that global financial intermediaries' ability to intermediate assets depends on the level of their net worth. When net worth is high, global intermediaries absorb losses by raising more debt, guaranteeing a smooth functioning of international credit markets. When net worth is low, for instance due to a decline in asset prices caused by higher interest rates, financial intermediaries are limited in their ability to issue new debt and sell assets to prevent their leverage from increasing sizably. Assets are absorbed by less specialized buyers at a discount and, as a result, credit spreads rise rapidly.[3]

The nonlinear amplification of global tightening shocks arises from the interaction between this "financial accelerator" mechanism and the global exposure of financial intermediaries. Given the geographic diversification of their portfolios, if only foreign central banks hike, global financial intermediaries suffer losses only on a portion of their assets. As a result, equity losses are contained and intermediaries' ability to issue debt is not impaired. In this case, debt issuance makes up for net worth losses and credit intermediation remains efficient. If many central banks hike synchronously, capital losses occur on many assets at the same time and cause intermediaries' equity to decline more. If the synchronous tightening is large enough, the financial accelerator channel is activated, and credit spreads rise rapidly across countries causing large spillovers.

An important element of our model is the presence of financial institutions that specialize in intermediating assets globally. We have in mind a broad definition of financial intermediaries, including "nonbank" financial institutions. These intermediaries hold imperfectly liquid assets financed partly by short-term debt. Intermediaries are highly levered, in a way that magnifies the effects on the health of their balance sheets of a given movement in asset values.

Financial intermediaries hold both U.S. and foreign assets, as shown in Figure 2. These assets are financed by short-term dollar deposits (issued to both U.S. and foreign residents), and by intermediaries' own internal funds, or net worth. Formally,

$$Q_t K_t + Q_t^* K_t^* = N_t + D_t, \tag{2}$$

where K_t are a given intermediary's holdings of U.S. assets and K_t^* are holdings of foreign assets,

[3] Some papers in the literature explore an alternative channel of monetary policy transmission through banks that relies on different repricing of loan and deposit rates in response to changes in interest rates. See for instance Drechsler et al. (2017).

Q_t and Q_t^* are the respective asset prices, N_t is net worth, and D_t are deposits.

The key friction in the model is that intermediaries face a leverage constraint

$$Q_t K_t + Q_t^* K_t^* \leq \overline{\phi}_t N_t, \tag{3}$$

where $\overline{\phi}_t$ is a "leverage cap." In our model, the leverage cap arises endogenously due to an agency friction between the intermediary and its creditors. More broadly, the literature has emphasized several reasons why leverage caps may arise—including, for example, Value-at-Risk constraints. The mechanism through which nonlinearities arise is then as follows. When N_t is high, banks operate below their leverage cap. As a result, there are no limits to arbitrage, and credit spreads are small. When N_t is low, however, intermediaries are pushed toward the leverage cap, at which point they may be forced to delever if they suffer further net worth losses. The assets sold by intermediaries can be acquired by other entities (which we broadly call "non-specialists") but these other agents are less efficient than global financial institutions at intermediating assets, which implies that they will only purchase assets at a discount. Lower asset prices then feed into lower net worth, further tightening intermediaries' constraints. In this way nonlinear "financial accelerator" dynamics arise.

This discussion hints at how nonlinearities may arise from a global monetary tightening but not from individual tightenings. A monetary tightening in a given foreign country triggers a decline in the value of the assets from that country in the bank's portfolio. To the extent that these assets are a small fraction of the total, the resulting hit to net worth N_t is small. By contrast, when the tightening happens synchronously, assets across all geographic areas lose value, causing a much larger drop in N_t—which may lead the constraint in equation (3) to bind.

Figure 3 provides a graphical description of the mechanism, showing the response of financial intermediaries' equity, U.S. corporate credit spreads, and 1-year ahead U.S. GDP growth following U.S. monetary policy shocks of different sizes, ranging between 0 and 200 basis points on the x-axis. The blue lines report the effects for simulations in which the foreign central bank follows what the policy rule would imply. When foreign economies do not hike synchronously, the U.S. policy shock must be larger than 160 basis points to reach the tipping point where constraint 3 is reached, represented by the kink after which equity starts declining faster. For U.S. monetary policy shocks above this threshold, corporate spreads rise by more and output losses become larger. The red lines report the effects for simulations in which the foreign central bank raises the interest rate 100 basis points more than what the policy rule would imply. When foreign economies hike synchronously, the tipping point is reached for smaller values of U.S. monetary policy shocks.

We now turn to a more quantitative description of the dynamic response of the economy to synchronous and asynchronous tightening in our model.

4 Calibration and Simulations Results

A key element of our calibration is exposure of global banks to foreign economies. This element is important because it gauges how movements in asset values in the U.S. and abroad affect the net worth of global banks, and ultimately drives how exposed global banks are to monetary tightening episodes in either jurisdiction. We use data on exposure to foreign economies of U.S.-headquartered banks, which suggests a ratio of foreign exposure to total assets of around one quarter. In addition, we target global banks' leverage ratio in steady state—defined as assets to net worth, $(Q_t K_t + Q_t^* K_t^*)/N_t$ in equation (2)—of international financial intermediaries to around 5. This value should be considered an average of the leverage ratio of several types of financial institutions that operate internationally, for instance broker dealers, hedge funds, and money market funds. Related literature has used a range of values for target leverage, with a value of 5 being relatively conservative. For example, Morelli et al. (2022) and Gertler and Kiyotaki (2010) target a leverage of 4, while Gertler et al. (2020) target a much larger value of 10.

Aside from the balance sheet of global banks, our calibration includes a number of parameters that govern the effects of monetary policy shocks on several variables. We follow the literature in calibrating these parameters, ensuring that they deliver effects of monetary policy tightening that are consistent with the empirical evidence.

The results of the model simulations are depicted in Figure 4. Panel A shows the effects of foreign central banks deviating from the baseline reaction function and increasing policy rates by an additional 100 basis points on average in 2023, with the U.S. central bank following its baseline reaction function. The responses of foreign and U.S. variables show how the foreign tightening can reduce foreign GDP and inflation by significant amounts but has little spillovers on U.S. activity and inflation.

Panel B considers a symmetric experiment and shows the effects of the U.S. central bank deviating from the baseline reaction function and increasing policy rates by an additional 100 basis points on average in 2023, with the foreign central bank following its baseline reaction. A U.S. tightening has larger spillovers on foreign economies because, in our model, it has larger effects on global financial intermediaries. That said, spillovers remain relatively contained compared to the direct effects on the domestic economy.

Panel C shows the effects of combining the U.S. and foreign monetary policy shocks. In the model, the synchronous tightening pushes the system past the tipping point where monetary spillovers are greatly amplified. The effect of a global tightening, shown by the black solid line, is much larger than the sum of the effects of individual tightening, which are reported for comparison in blue bars. Moreover, the nonlinear amplification effect, measured by the red bars, is stronger on output than on inflation, which increases sacrifice ratios, that is, output losses relative to inflation reductions.

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Figure 1: Historical Behavior around Synchronous and Asynchronous Monetary Tightening Episodes

Figures/sgt_fig1.png

Note: Evolution over time of interest rates, inflation, unemployment rate, and corporate spreads around episodes of interest rate tightening episodes in selected advanced foreign economies since 1980. Each period is one quarter. Synchronous (asynchronous) tightening episodes are those that occur (do not occur) within two years of a U.S. tightening. Synchronous lines are red and asynchronous lines are blue. The lines are constructed using event-study regressions. The shaded regions show 80% confidence intervals. In the unemployment graph, an increase indicates higher unemployment.

Figure 2: Model of the World Economy

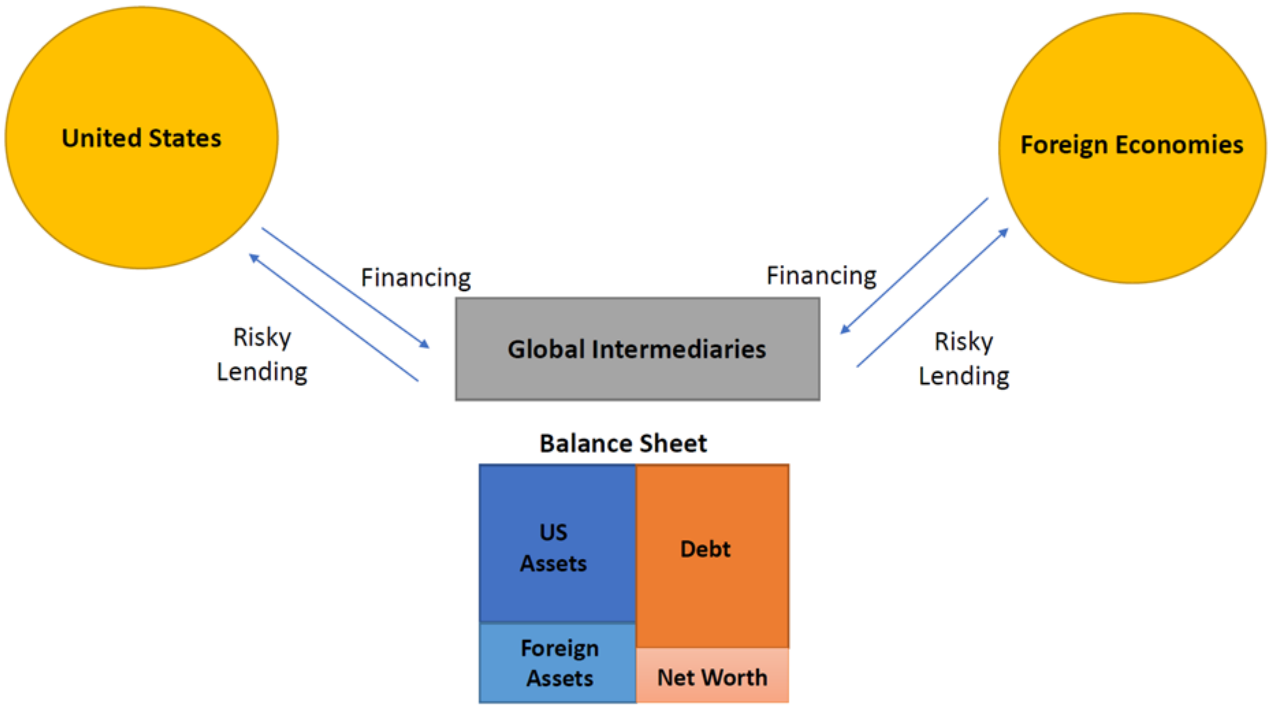
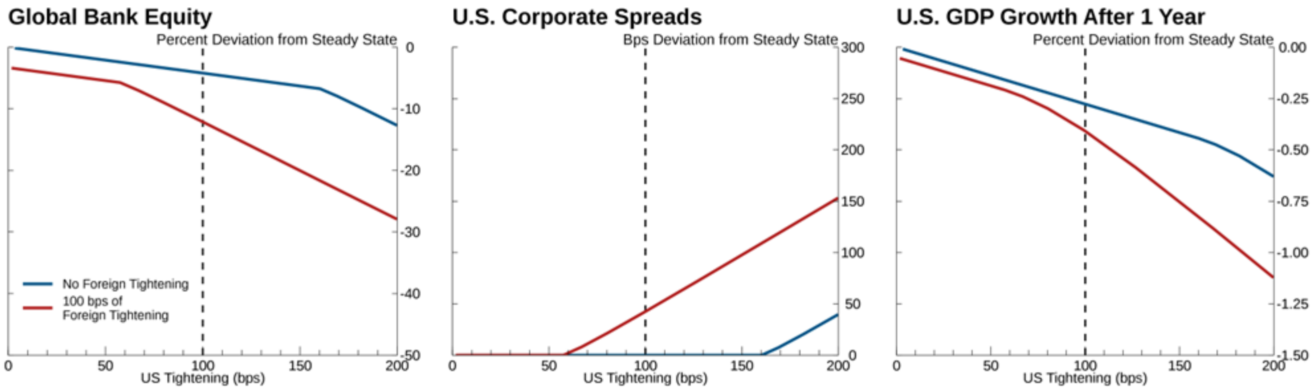
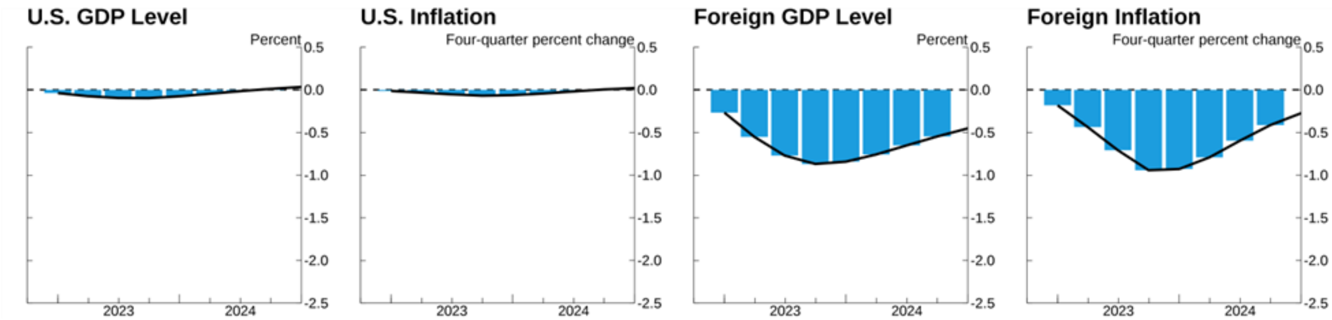


Figure 3: Nonlinear Financial Amplification of Monetary Policy Shocks of Different Sizes

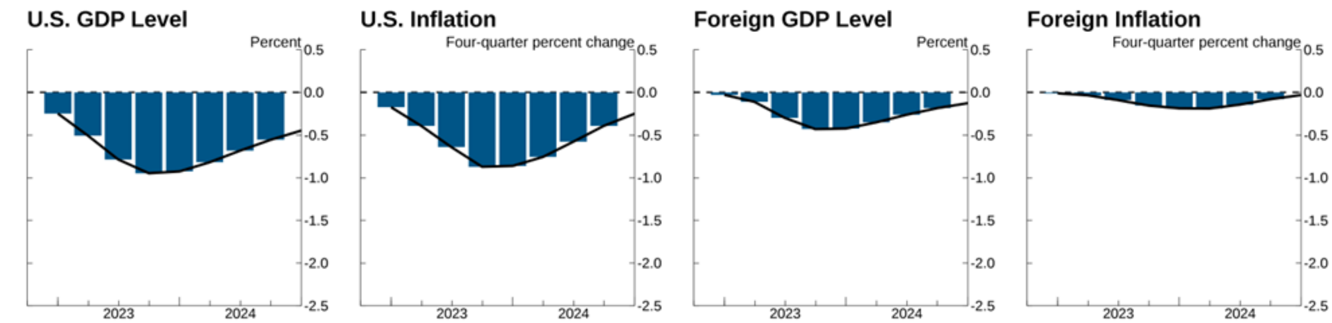


Note: The panels in the figure report the response of financial intermediaries' equity, U.S. corporate credit spreads, and 1-year ahead U.S. GDP growth following U.S. monetary policy shocks of different sizes, ranging between 0 and 200 basis points. The blue lines report the effects for simulations in which the foreign central bank follows what the policy rule would imply. The red lines report the effects for simulations in which the foreign central bank raises the interest rate 100 basis points more than what the policy rule would imply.

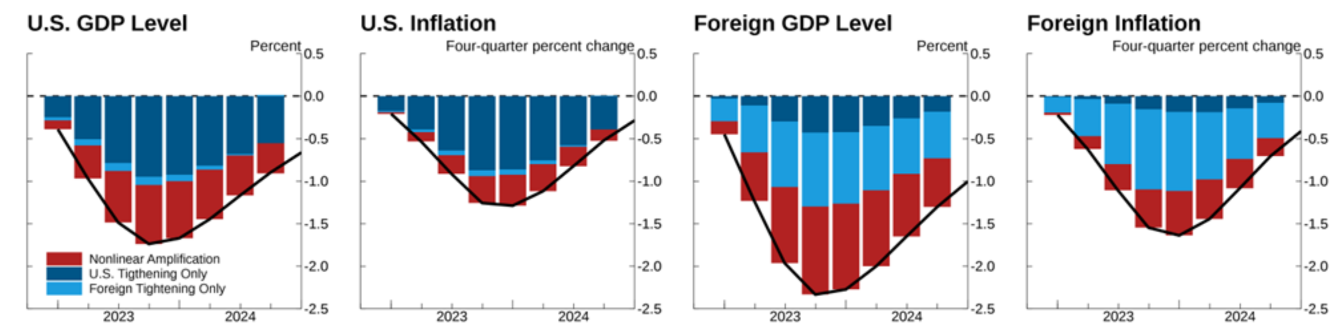
Figure 4: Model Simulations of Synchronous and Asynchronous Monetary Tightening



(A) Foreign policy rates increase 100 bp on average in 2023



(B) U.S. policy rates increase 100 bp on average in 2023



(C) Foreign and U.S. policy rates increase 100 bp on average in 2023

Note: All variables are in deviation from steady state.

Appendix

A Appendix on: Data Sources

- We identify tightening episodes in a sample of advanced and emerging economies using either episodes of prolonged increases in interest rates (version 1 and 2), or episodes of large and prolonged surprises in the residuals of Taylor-rule-style regressions, estimated country by country (version 3).
- Within each country, we break tightening episodes into synchronous and asynchronous episodes depending on whether they happen when global interest rates are rising or not.
- We run event study regressions of policy (or short-term) interest rates, inflation, unemployment, GDP, credit spreads and global banks equity prices (using global banks from the list of Acalin 2022) against dummies defined by the episodes above.
- Sample runs from 1980q1 through 2019q4. Confidence intervals are 70 percent. Due to missing data coverage for some countries, the panel is unbalanced, with initial period varying by country.
- Sample includes 25 advanced economies, and, for the specification with emering economies, 8 additional emerging economies.
- Advanced economies are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom, and the United States
- Emerging economies are: Chile, Hong Kong, Indonesia, Israel, Korea, Mexico, Philippines, South Africa, and Taiwan
- Credit spreads are available for Canada, Germany, Japan, and the United Kingdom (AE), and Chile and Mexico (EE).
- Net worth of global banks is avaialble for Canada, France, Germany, Japan, Spain, Switzerland, United Kingdom and the United States. Net worth is constructed using a weighted stock price index of banks in each country that are global, using the definition of global banks in Acalin (2022). Specifically, the US bank net worth is the weighed stock market index (using market capitalization share as a weight) of JPMorgan, Citi, Wells Fargo, Bank of America, Goldman Sachs, Morgan Stanley; the French index is the weighted index of BNP Paribas and

Societe Generale; the UK index is the weighed index of HSBC, Barclays, NatWest, Lloyd's; the Japan index is the weighted index of Sumitomo Mitsui FG and Mitsubishi UFJ FG. The German index is the Deutsche Bank price index; the Spain index is the weighted index of Banco Santander and BBVA; the Switzerland index is the Credit Suisse price index; and the Canada index is the weighted index of Royal Bank of Canada and Toronto Dominion.

- Inflation is measured using the core CPI index for AEs, and headline CPI for EEs.
- A tightening episode is a period with either rising interest rates over one and four quarters (1=AFE or 2=AFE+EME), or with two consecutive positive monetary policy shocks larger than 25bps (3). A synchronous tightening is a tightening happening when global interest rates are rising over one and four quarters.
- In specification 1 (AFE), there are 57 asynchronous and 86 synchronous tightenings (and N=3,189, NCOUNTRIES=25)
- In specification 2 (AFE+EME), there are 62 asynchronous and 139 synchronous tightenings (and N=3,189, NCOUNTRIES=33)
- In specification 3 (AFE and Taylor rule shock), there are 78 asynchronous and 58 synchronous tightenings (and N=3,189, NCOUNTRIES=25)
- In all charts, variables are plotted relative to period 0 for each type of episode, alongside 70 percent confidence intervals. So, for instance, if a regression of unemployment on global tightening dummy gives coefficients of 2 in period 1, 3 in period 2, and 5 in period 3, the coefficients plotted are 2-2=0, 3-2=1, and 5-2=3

B Historical Episodes of Tightening in the News

Test

Figure A.1: Data coverage for the Cross-Country Panel

`figuresinflation/test.pdf`

Note: The figure plots the coverage of country-specific variables over our sample.