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Monetary News, U.S. Interest Rate and Business Cycles
in Emerging Economies

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Monetary News, U.S. Interest Rate and Business Cycles in Emerging Economies

Alejandro Vicondoa[‡]

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Abstract

This paper identifies anticipated (news) and unanticipated (surprise) shocks to the U.S. Fed Funds rate using CBOT Fed Funds Future Market and assesses their propagation to emerging economies. Anticipated movements account for 80% of quarterly Fed Funds fluctuations and explain a significant fraction of the narrative monetary policy shocks. An expected 1% increase in the reference interest rate induces a fall of 2% in GDP of emerging economies two quarters before the shock materializes. Unanticipated contractionary shocks also cause a recession. Both shocks have a larger impact in emerging relative to developed economies and the financial channel is the most relevant for their transmission. Anticipation is also relevant to understand the transmission of U.S. real interest rate shocks.

JEL Classification: E32, E52, F41, F44.

Keywords: International business cycle, interest rate, news shocks, small open economy.

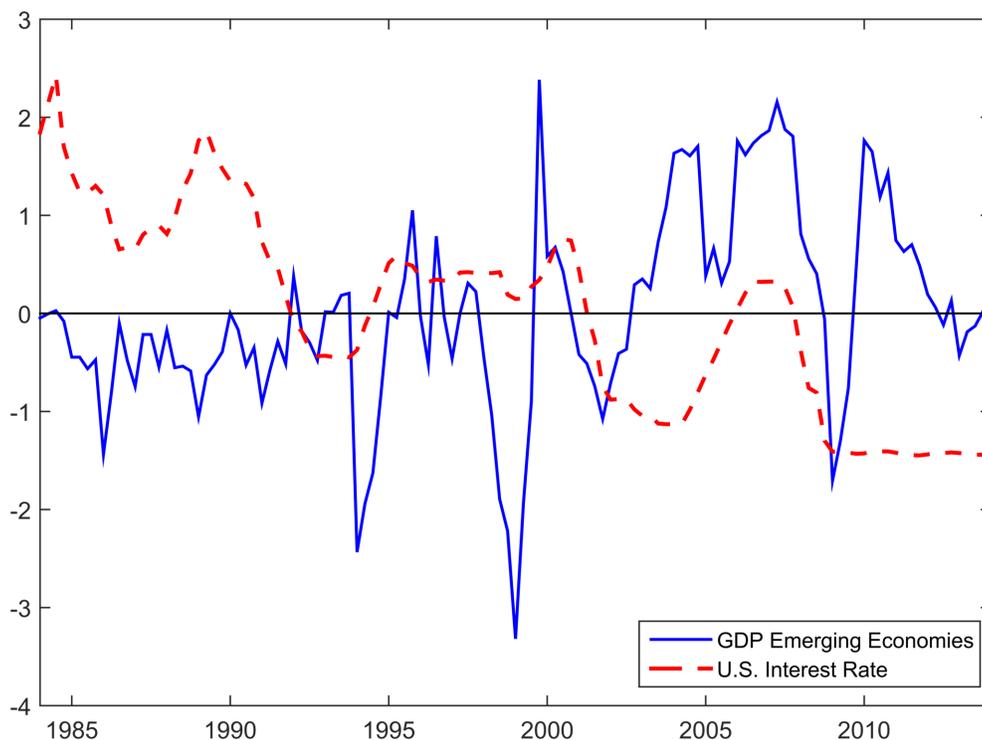
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1 Introduction

Movements in the international interest rate are a relevant driver of business cycle fluctuations in emerging economies (Neumeayer and Perri, 2005; Uribe and Yue, 2006). Figure 1 displays the evolution of the effective Federal Funds rate and GDP growth in Emerging Economies.¹ Periods of high (low) U.S. interest rate are associated with lower (higher) GDP growth. In fact, the contemporaneous correlation between these two variables is -0.23 and statistically significant, confirming the negative relationship between them. While standard theoretical models suggest that a contractionary monetary policy in the U.S. induces a recession in a small open economy, empirical VAR evidence has not reached a consensus on the effects of these shocks (see Canova, 2005; Uribe and Yue, 2006; Mackowiak, 2007; Ilzetzi and Jin, 2013). Understanding this issue is relevant for explaining business cycle fluctuations in these countries.

Figure 1: *Effective Federal Funds Rate and GDP annual growth rate of Emerging Economies*



Source: FRED and International Financial Statistics (IMF) data.

A common feature of previous empirical works is that they abstract from potential anticipation effects. However, many movements in the U.S. interest rate are anticipated by the market before

¹Both variables are standardized with respect to their means and expressed in annual terms.

they occur. A potential source of monetary anticipation is the practice of “forward guidance” through which the Central Bank informs the future course of monetary policy. Moreover, since 1988, the CBOT Fed Funds Future market provides a Market based unbiased expectations indicator of the evolution of interest rates (Owens and Webb, 2001; Hamilton, 2009). Financial markets and exchange rates may react to these expected movements before the change in the interest rate realizes. Hansen and Sargent (1991) demonstrate that, in case of anticipation, a Vector Autoregressive Model (VAR) that does not contain enough information fails to capture the dynamics of the variables. This fact may explain the lack of consensus from previous works about the effects of U.S. monetary policy shocks on emerging economies. Hence, this paper identifies anticipated and unanticipated U.S. interest rate shocks and assesses their propagation to these countries. While anticipated shocks are “news” which have a delayed effect on the interest rate but affect, on impact, agents’ expectations, unanticipated shocks change the interest rate contemporaneously.

To identify anticipated and unanticipated shocks, I use data from the CBOT Fed Funds Future market. First, I compute the anticipated change of the Fed Funds rate and show that it contains useful information to explain realized changes in this rate. Then, following a similar procedure to Romer and Romer (2004), I purge the anticipated and surprise policy movements of systematic policy changes, which relate to current and expected business cycle conditions. The identified series of anticipated shocks contain useful information to predict the narrative monetary policy shocks of Romer and Romer (2004), updated by Tenreyro and Thwaites (2015). Finally, I estimate the effects of anticipated and unanticipated shocks on macroeconomic aggregates of emerging economies.

Results show that emerging economies react once they receive the news about the future evolution of the Fed Funds, even before the change materializes. While news about a 1% contractionary interest rate shock induces an immediate fall of 2% in GDP of emerging economies, the reaction of developed economies is mild and significant only when the change materializes. The financial channel, through the domestic interest rate and the cross-border bank flows, is the most relevant one to explain the difference in response between these two groups. Unanticipated contractionary interest rate shocks also induce a recession in emerging economies. Similar results hold if I use real interest rate shocks instead of nominal ones.

Previous attempts in the international macroeconomic literature assess the propagation of U.S. monetary policy to emerging economies without reaching a conclusive evidence. On the one hand, Canova (2005) finds that a contractionary shock induces an increase in the domestic interest rate, a depreciation of the exchange rate, improvements in the trade balance and a delayed positive effect on output in Latin American economies. Ilzetzki and Jin (2013) show that, after 1990, a contractionary monetary policy shock has expansionary effects on emerging economies, coupled with a depreciation of domestic currencies against the U.S. Dollar. This expansion, which contradicts the predictions of most standard open macroeconomic theoretical models, has been identified as a puzzle by the authors. On the other hand, Uribe and Yue (2006) estimate the effects of changes in the U.S. real

interest rate and claim that it induces a recession in an emerging economy. [Mackowiak \(2007\)](#) and [Dedola, Rivolta, and Stracca \(2015\)](#) find that a contractionary monetary policy shock in the U.S. generates, on average, a contraction of real GDP in these economies. In this paper, I show that anticipation helps to explain this lack of consensus and that an increase in the interest rate has a contractionary effect on emerging economies. Moreover, the financial channel is the most relevant for the transmission of these shocks and explains the different response compared to developed economies.

There has been a renewed interest in the effects of news shocks, understood as shocks that are observed before they materialize. [Schmitt-Grohe and Uribe \(2012\)](#) show that anticipated shocks account for half of the predicted aggregate macroeconomic fluctuations. Following this line, many papers have tried to disentangle the effects of news shocks on different macroeconomic variables. For example, [Ramey \(2011\)](#) and [Mertens and Ravn \(2012\)](#) show that timing is important for measuring accurately the effects of fiscal policy shocks. Regarding monetary policy, previous studies have analyzed the effects of unanticipated shocks to the interest rate rule in a closed-economy DSGE framework. [Milani and Treadwell \(2012\)](#) and [Gomes, Iskrev, and Mendicino \(2013\)](#) show that anticipated (news) shocks in monetary policy are more relevant than unanticipated (surprise) ones to explain U.S. output fluctuations. Results confirm that anticipated interest rate shocks have significant effects on business cycles of emerging economies.

The remaining of this paper is organized as follows. [Section 2](#) describes the identification and properties of news and surprise U.S. interest rate shocks and compares it with the narrative series of monetary policy shocks. [Section 3](#) characterizes the empirical strategy used to identify the macroeconomic effects of both types of shocks on emerging economies and displays the benchmark empirical results. [Section 4](#) presents results for alternative empirical specifications. [Section 5](#) shows the responses to real interest rate shocks. Finally, [Section 6](#) concludes.

2 Identification of News and Surprise U.S. Interest Rate Shocks

In this section, I describe the strategy used to identify news and surprise U.S. interest rate shocks. First, I compute anticipated and unanticipated movements in the U.S. interest rate using information from Fed Funds future markets. However, expectations about movements in this interest rate capture expected reaction of the Federal Reserve Bank to all the expected changes in U.S. business cycle. Then, I use market's expectations regarding U.S. main macroeconomic variables to purge pure U.S. interest rate shocks from the systematic changes. Finally, I assess the properties of this series by comparing it to the narrative series of monetary policy shocks.

2.1 Anticipated and Unanticipated Movements in U.S. Interest Rate

To capture private sector’s expectations about the evolution of U.S. interest rate, I use data from the Chicago Board of Trade (CBOT) Fed Funds Future Market for different maturities. [Hamilton \(2009\)](#) shows that these contracts are an excellent predictor of the Fed Funds rate. Unlike using a time series model (like VARs) to compute expectations about interest rates, market-based forecasts have the advantage of adapting to changes in the FED’s reaction to the state of the economy (i.e. potential time varying parameters in the Taylor rule, see [Cochrane and Piazzesi \(2002\)](#)).

The price of the Fed Funds future contracts is based on the average monthly Federal Funds interest rate. At the beginning of a month, these prices are based primarily upon future expectations about the Fed Funds effective rate in that month.² Considering that I want to compute market’s expectation for each quarter, I use the price of Fed Funds futures at the beginning of each period for all the available horizons and I compute an average of all the contracts that belong to that quarter.³ The anticipated change of this variable over time is defined as:

$$\Delta i_{t,j}^a = \mathbb{E}_{t-1} (i_{t+j} - i_{t+j-1}) \quad \text{for } j = \{0, 1, 2, 3\} \quad (1)$$

where $\Delta i_{t,j}^a$ denotes the anticipated movement in the fed funds rate j quarters ahead with respect to the previous one and $\mathbb{E}_{t-1}(i_{t+j})$ represents the expected value of the Fed Funds rate for the period $t+j$ conditional on the information available from the previous period.⁴ On the other hand, I define an unanticipated (surprise) movement as:

$$\Delta i_t^u = i_t - \mathbb{E}_{t-1} i_t \quad (2)$$

where Δi_t^u denotes the unanticipated movement in the Fed Funds rate, which is defined as the difference between the realized rate and the ones agents were expecting at the beginning of the quarter.⁵ [Figure 2](#) displays the dynamics of the anticipated movement of the interest rate at the beginning of the quarter and the realized one.

Markets tend to anticipate quite accurately the evolution of the Fed Funds rate in the incoming quarter. The contemporaneous correlation between the anticipated movement and the realized one

²See [Owens and Webb \(2001\)](#) and “Reference Guide: CBOT Fed Fund Futures” for a detailed description on how this market works.

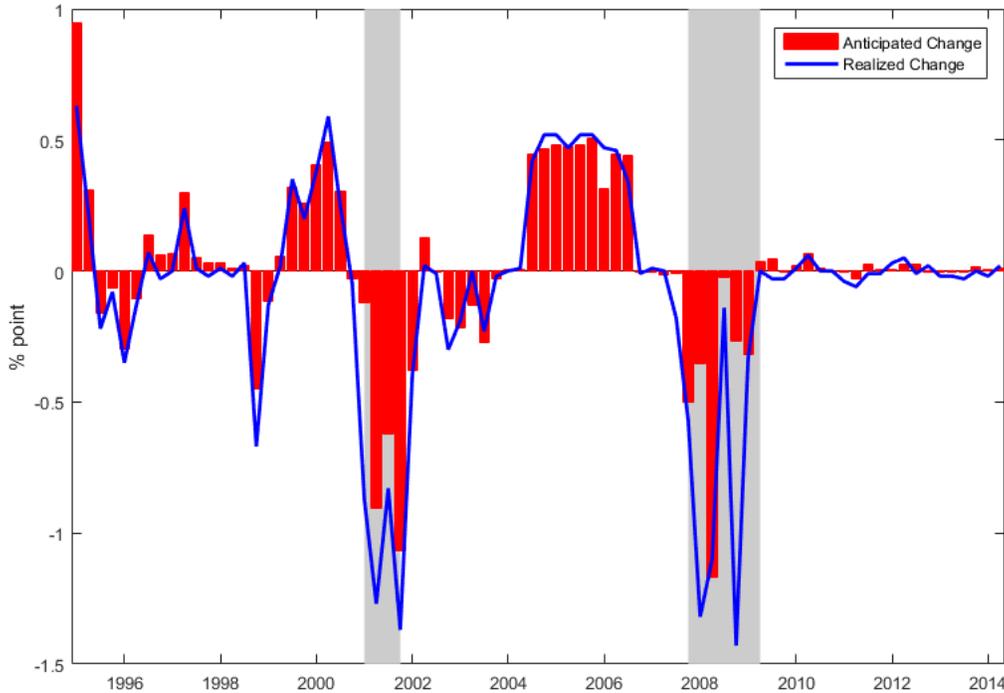
³For example, for the first quarter of 1995, I take the end of the day prices of January 3, which was the first active day of the quarter. I use the front, 2nd, and 3rd continuous contracts to compute expectations about the current quarter interest rate. The 4th, 5th, and 6th and 7th, 8th, and 9th contracts are used, respectively, to compute expectations regarding the next 2 following quarters. Contracts longer than nine months ahead are significantly less liquid.

⁴In particular, I consider market expectations about the interest rates at the beginning of the quarter with all the information available from the previous periods.

⁵Note that $\Delta i_t = i_t - i_{t-1} = \Delta i_{t,0}^a + \Delta i_t^u$

is 0.89.⁶ Moreover, anticipated movements explain 80% of realized Fed Funds fluctuations.⁷ This fact reinforces the relevance of considering anticipation to assess the effects of interest rate shocks. As expected, unanticipated movements, which correspond to the difference between the line and the bars in Figure 2, occur mostly during recessions, when it is more difficult to predict the evolution of monetary policy.

Figure 2: Anticipated and realized changes in the Fed Funds Rate



Note: Anticipated Change is computed as difference between market expectations regarding the value of the Fed Funds rate in the current quarter and the realized value of the previous quarter. The realized change denotes the change in the average Fed Funds rate with respect to the previous quarter. Shaded areas denote the recessions in the U.S defined by NBER.

A crucial issue is to determine which is the horizon of anticipation of fluctuations in the Fed Funds rate. For this reason, I estimate the current changes in this rate on the expected change made at the beginning of the current quarter and on the previous three quarters. Table 1 displays the results.⁸

⁶ A similar result holds if I plot the one quarter ahead anticipated change instead of the same quarter one. In this case, the contemporaneous correlation between expectations and the corresponding realized change is 0.55.

⁷ The R-squared of the OLS regression of current changes in the Fed Funds on the expected ones at the beginning of the quarter is 0.798.

⁸ In this table I report only the Adj. R^2 and the F-Statistic because I focus on the power of the forecasts to explain the realized evolution of the interest rate. The Online appendix displays the estimated coefficients for each equation.

Table 1: *Horizon of forecastability of changes in the Fed Funds*

	Δi_t			
	$\Delta i_{t,0}^a$	$\Delta i_{t-1,1}^a$	$\Delta i_{t-1,1}^a$	$\Delta i_{t-3,3}^a$
Adj. R^2	0.80	0.31	0.11	0.01
F-Stat	308.1	33.8	9.4	0.1

Note: OLS estimates of the projection of Δi_t on the expected change in the interest rate ($\Delta i_{i,j}$). Δi_t denotes the contemporaneous change in the Fed Funds rate. $\Delta i_{i,j}^a$ denotes the expected change in the interest rate for j quarters ahead with respect to the previous one, conditional on the information available at the beginning of time t . R^2 and F – Stat correspond to the adjusted R-squared and the value of the F statistic, respectively.

The predictive power of forecasts about the change in the Fed Funds rate decline significantly with the horizon. While the contemporaneous and two periods ahead forecasts explain a significant fraction of the realized change, the one made three quarters ahead provides noisy information. This fact may be associated to the decline in the liquidity properties of the Fed Futures after nine months ahead. Then, in the empirical analysis, I consider two quarters ahead anticipation for changes in the U.S. interest rate.

2.2 Identifying Interest Rate Shocks

Some fluctuations of the U.S. interest rate are due to changes in business cycle conditions in the U.S. economy (i.e. they reflect the systematic response to other shocks that affect U.S. economy). One way of identifying interest rate shocks in this framework is to follow a similar procedure to [Romer and Romer \(2004\)](#), assuming a Taylor rule, but considering market's expectations instead of Greenbook forecasts. In particular, for this case, I estimate the following equations:

$$\Delta i_t^u = \alpha_0 + \alpha_1 i_{t-1} + \alpha_2 (\hat{y}_t - \mathbb{E}_{t-1} \hat{y}_t) + \alpha_3 (\hat{u}_t - \mathbb{E}_{t-1} \hat{u}_t) + \alpha_4 (\hat{\pi}_t - \mathbb{E}_{t-1} \hat{\pi}_t) + (\epsilon_t - \mathbb{E}_{t-1} \epsilon_t) \quad (3)$$

$$\begin{aligned} \Delta i_{t,i}^a = & \gamma_{0,i} + \gamma_{1,i} \mathbb{E}_{t-1} (i_{t+i-1}) + \gamma_{2,i} \mathbb{E}_{t-1} (y_{t+i} - y_{t+i-1}) + \gamma_{3,i} \mathbb{E}_{t-1} (u_{t+i} - u_{t+i-1}) + \\ & \gamma_{4,i} \mathbb{E}_{t-1} (\hat{\pi}_{t+i} - \hat{\pi}_{t+i-1}) + \mathbb{E}_{t-1} (\epsilon_{t+i} - \epsilon_{t+i-1}) \quad \forall i = 0, 1, 2 \end{aligned} \quad (4)$$

Equation (3) decomposes the unanticipated change between unexpected movements in GDP growth (\hat{y}_t), unemployment (\hat{u}_t), inflation ($\hat{\pi}_t$), and the unanticipated interest rate shock ($\epsilon_t - \mathbb{E}_{t-1} \epsilon_t$). Equation (4) expresses an anticipated change as a function of expected changes in the same macroeconomic variables for the different horizons ($i = 0, 1, 2$) plus the anticipated interest

rate shock.⁹ To estimate these equations, I consider market’s expectations regarding the evolution of GDP, unemployment, and inflation by quarter published by Survey of Professional Forecasters (SPF), a quarterly survey of macroeconomic forecasts reported by the Federal Reserve Bank of Philadelphia. This data set, which has been widely used in previous studies, contains forecasts by quarter up to one year ahead of the main macroeconomic variables in the U.S. conditional on the information available from the previous quarter.¹⁰ All equations are estimated by OLS and I identify the residuals of each of them, the last terms, as the unanticipated and anticipated U.S. interest rate shocks.¹¹

This way of identifying anticipated and unanticipated shocks differs from the identified monetary policy surprises defined by [Gürkaynak, Sack, and Swanson \(2005\)](#). They identify two components of monetary policy: a “current Fed Funds rate target” and a “future path of policy”, by extracting two factors that explain the variability of a set of Fed Funds futures for different maturities. However, their approach is not directly comparable to mine since they do not distinguish the exact timing of the policy path (i.e. in which particular month markets expect an increase in the interest rate). Considering the aim of this paper and that U.S. interest rate is exogenous for small emerging economies, I employ a different complementary strategy. First, I do not focus on particular events and my strategy is more comparable to the VAR literature on monetary policy shocks (see [Kuttner \(2001\)](#)). Second, instead of computing the difference in price for the same contract, I calculate the one across different maturities at the beginning of the quarter. Thus, anticipated movements capture market’s expectations about the evolution of the Fed Funds rate incorporating all the available information at that particular date. Third, markets may have already incorporated all the relevant information by the time of the FOMC meeting and, in this case, the surprise defined by [Gürkaynak, Sack, and Swanson \(2005\)](#) would be zero. However, this fact does not mean that there is no expected change in the monetary policy stance for emerging economies.

2.3 Comparison with Series of Monetary Policy Shocks and Surprises

Previous studies have used different empirical strategies to identify U.S. monetary policy shocks. The narrative series of [Romer and Romer \(2004\)](#), updated by [Tenreyro and Thwaites \(2015\)](#)(TT(2015)), is one of the most popular ones. This series is defined as changes in the reference interest rate at

⁹Appendix B contains a detailed derivation of both expressions, assuming a simple Taylor rule.

¹⁰This data set asks to professional forecasters their expectations about the evolution of macroeconomic variables for the following quarters during the first month of the ongoing quarter. In order to use expectations that are aligned with the computation of expected interest rate, I employ the forecasts after the first release of macro data from the previous quarter. The main advantage of this data set is that it contains expectations for each variables and quarter up to one year ahead. For this exercise, I use expectations about GDP growth, Unemployment rate and GDP deflator inflation rate. See <https://www.philadelphiafed.org/research-and-data/real-time-center/survey-of-professional-forecasters/> for more detailed information about this survey.

¹¹I have also estimated these equations by GMM to control for the potential reverse causality between macroeconomic variables and interest rate shocks. The recovered shocks are highly correlated with the ones obtained with OLS.

FOMC meetings that are not endogenous reactions to fluctuations in the economy. In particular, [Romer and Romer \(2004\)](#) remove the discretionary policy changes that were responding to the fluctuations in macroeconomic variables within policy makers' information set. [Table 2](#) displays the contemporaneous correlation between this series and the interest rate shocks I identified in the previous subsection.¹²

Table 2: *Correlation across different shocks*

Series	TT(2015)	Δi_t^u	$\Delta i_{t,0}^a$	$\Delta i_{t-1,1}^a$	$\Delta i_{t-2,2}^a$
Δi_t^u	0.51***				
$\Delta i_{t,0}^a$	0.69***	0.08			
$\Delta i_{t-1,1}^a$	0.50***	0.16	0.59***		
$\Delta i_{t-2,2}^a$	0.21	0.12	0.29***	0.55***	
TT(2015)					

Note: Contemporaneous correlation between the different shocks and their significance levels. ***, **, and * denote 1%, 5% and 10% confidence level. TT(2015) denotes the monetary policy shocks series of [Tenreyro and Thwaites \(2015\)](#), who update the series of [Romer and Romer \(2004\)](#).

The first fact that emerges is that the anticipated series about the current quarter is highly and significantly (0.69) correlated with TT(2015) series. Moreover, the correlation of TT(2015) is still positive and significant with respect to the anticipated series made one period in advance. Second, the unanticipated series is also positive correlated with TT(2015) series, which means that a fraction of TT(2015) can be considered a surprise. Finally, a relevant finding is that surprise and anticipated shocks are orthogonal. This will be useful both to identify relationship with respect to TT(2015) series and to assess their effects on emerging economies.

The anticipated series are made at the beginning of each quarter, before the realization of TT(2015) series for the same quarter, and are orthogonal to unanticipated shocks.¹³ These facts may help to disentangle the relationship between these series and TT(2015). In particular, I test whether the series identified in this paper contain useful information to predict the narrative ones. To test this hypothesis formally, I estimate the following equation:

$$TT_t = \alpha + \beta \text{AntShock}_t + \epsilon_t$$

where AntShock_t denotes $\{\Delta i_{t,0}^a, \Delta i_{t-1,1}^a, \Delta i_{t-2,2}^a\}$, the predictions about the evolution of the

¹²Appendix C displays the anticipated and unanticipated shocks together with the narrative series of monetary policy shocks. Similar results hold if I use the anticipated and unanticipated changes in the U.S. interest, without the orthogonalization proposed in Section 2.2.

¹³The narrative series of monetary policy shocks of TT(2015) are computed for each FOMC meeting, which takes place after the first day of each quarter.

interest rate made at the beginning of this quarter and at the previous ones, and TT_t denotes the contemporaneous series of $TT(2015)$.¹⁴ The shocks proposed in this paper contain useful information to predict the other series if the β is statistically significant. Table 3 displays the results of these regressions:

Table 3: *Predictive power of anticipated shocks*

	TT(2015)	TT(2015)	TT(2015)	TT(2015)
$\Delta i_{t,0}^a$	0.73*** (0.11)			0.55*** (0.15)
$\Delta i_{t-1,1}^a$		0.53*** (0.13)		0.32* (0.18)
$\Delta i_{t-2,2}^a$			0.40 (0.27)	-0.13 (0.25)
Adj. R^2	0.47	0.24	0.02	0.42
F-Stat	45.74***	16.54***	2.23	12.96***
Obs	52	51	50	50

Note: OLS regressions between the different shocks. ***, **, and * denote significance at the 1%, 5%, and 10%, respectively. $TT(2015)$ denotes the monetary policy shocks series of *Tenreiro and Thwaites (2015)*, who update the series of *Romer and Romer (2004)*. Adj. R^2 and F-Stat correspond to the adjusted R-squared and the value of the F statistic.

The current quarter and the one quarter ahead anticipated interest rate shocks contain useful information to predict $TT(2015)$ series.¹⁵ In particular, anticipated shocks explain 47% of the observed fluctuations in $TT(2015)$ shocks. As expected, the closer to the quarter, the more informative is the forecast. Given these results, including only the current value of any of these shocks may not be enough to describe the dynamic response of macroeconomic variables. Since markets forecast quite accurately the changes in the U.S. interest rate, emerging economies could start reacting to these shocks even before the change materializes. This fact should be reflected immediately in high frequency variables and may also affect contemporaneous macroeconomic variables.

3 Empirical Analysis

This section presents the estimated macroeconomic effects of news (anticipated) and surprise (unanticipated) U.S. interest rate shocks, identified in the previous section, on emerging economies.

¹⁴Results are robust if I add lags of TT series to the regression.

¹⁵The regressions have less observations because the $TT(2015)$ series finishes in December 2007.

First, I specify the empirical model used to assess the effects of both types of shocks on emerging economies. Then, I describe the estimation method and the data set. Finally, I present the Impulse Response Functions (IRFs) of the main macroeconomic variables of emerging economies to both types of shocks and compare them with the reaction of developed economies.

3.1 Empirical Model

The empirical model is a VAR system that includes both surprise and anticipated interest rate shocks identified in Section 2.2 in an exogenous block:

$$X_t = B + C(L)X_{t-1} + D(L)\Delta i_t^u + E(L)\Delta i_{t,0}^a + F\Delta i_{t,1}^a + G\Delta i_{t,2}^a + \epsilon_t \quad (5)$$

where X_t is a vector of endogenous variables, $C(L)$, $D(L)$, $E(L)$ denote P-order lag polynomials, and Δi_t^u and $\Delta i_{t,j}^a$ are the surprise and anticipated interest rate shocks, respectively.¹⁶ Finally, ϵ_t is a white noise vector of disturbances. This system is similar to the one proposed by [Mertens and Ravn \(2012\)](#) to study the effects of anticipated tax shocks in the U.S. In order to allow for persistence in the changes in U.S. interest rate, the system includes lags of both shocks (i.e. Δi_t^a and Δi_t^u).¹⁷

This specification is in line with small open economy models and with previous empirical studies that consider changes in U.S. interest rate as exogenous. One of its main advantages is that the effects of these shocks do not rely on the ordering of the variables. In particular, there is no need to impose zero restrictions on the contemporaneous reaction of domestic variables to changes in U.S. interest rate, nor to identify the other shocks in the system.

In the baseline specification, X_t is defined as:

$$X_t = [\text{Credit}_t, \text{TOT}_t, \text{GDP}_t, I_t, \frac{TB_t}{GDP_t}, \text{NEER}_t, \text{CPI}_t, R_t]$$

where Credit_t denotes the cross-border bank flows to the whole economy, TOT_t is the terms of trade of the country, I_t represents investment, $\frac{TB_t}{GDP_t}$ is the ratio of trade balance to GDP, NEER_t denotes nominal exchange rate, CPI_t represents Consumer Price Index, and R_t denotes the country nominal interest rate.¹⁸ This set of variables is necessary to capture both the macroeconomic effects (both on economic activity and inflation) and the transmission channels (financial and trade channels).

¹⁶Following the results of Table 1, I consider only two quarters as the anticipation horizon for U.S. interest rate shocks.

¹⁷In the baseline specification, I include one lag of each shock. However, results are robust to not including any lags or allowing for more lags.

¹⁸A reduction (increase) in the FX indicates a depreciation (appreciation) of the domestic currency. Results are robust if I use the Capital Flight computed from the Balance of Payments instead of Cross-Border Bank Flows. The country interest rate is defined as the ten year U.S. government bond yield plus the country spread, proxy by the JP Morgan EMBI Global Index. Appendix A contains a detailed description of the sources of each series.

3.2 Estimation Method

I estimate the VAR presented in (5) by pooling quarterly data from Argentina, Brazil, Chile, Mexico, Philippines, South Africa, and Turkey. The sample begins in the first quarter of 1995, when the FED explicitly started to announce its target level for the Fed Funds rate, and ends in the second quarter of 2014.¹⁹ The choice of countries is guided by macroeconomic and financial data availability to construct a representative sample of emerging economies, similar to the ones used by Uribe and Yue (2006) and Akinci (2013). I estimate the system with quarterly data in order to capture more precisely the transmission channels and the macroeconomic effects.²⁰ Precise definitions of the variables and data sources are included in the Data Appendix.

The system is estimated using the Least Square Dummy Variable (LSDV) estimator or fixed effects estimator, which has been widely used to estimate Panel VARs with a large time series dimension. As this dimension is significantly larger than the cross-sectional one, the LSDV is preferred to GMM as it has better finite sample properties. Nickell (1981) shows that a potential concern with the Panel VAR is the inconsistency of the least squares parameter estimates due to the combination of fixed effects and lagged independent variables. However, because the time series dimension of the dataset is large (78 observations), the inconsistency problem is likely not to be a major concern.

The estimation procedure imposes that $C(L)$, $D(L)$, $E(L)$, F and G are the same across countries. This assumption seems appropriate since estimations using different country groups yield similar results for news and surprise shocks.²¹ Considering the information criteria, I estimate a VAR with 2 lags.²²

3.3 Impulse Responses

In this subsection, I present the macroeconomic responses of emerging economies to the anticipated and surprise shocks identified in Section 2.2. Figure 3 displays the reaction of macroeconomic variables to a two quarters ahead anticipated 1% contractionary U.S. interest rate shock.²³

¹⁹The sample for each country depends on data availability. Prior to 1995 there is no availability of continuous series of future contracts for nine months ahead.

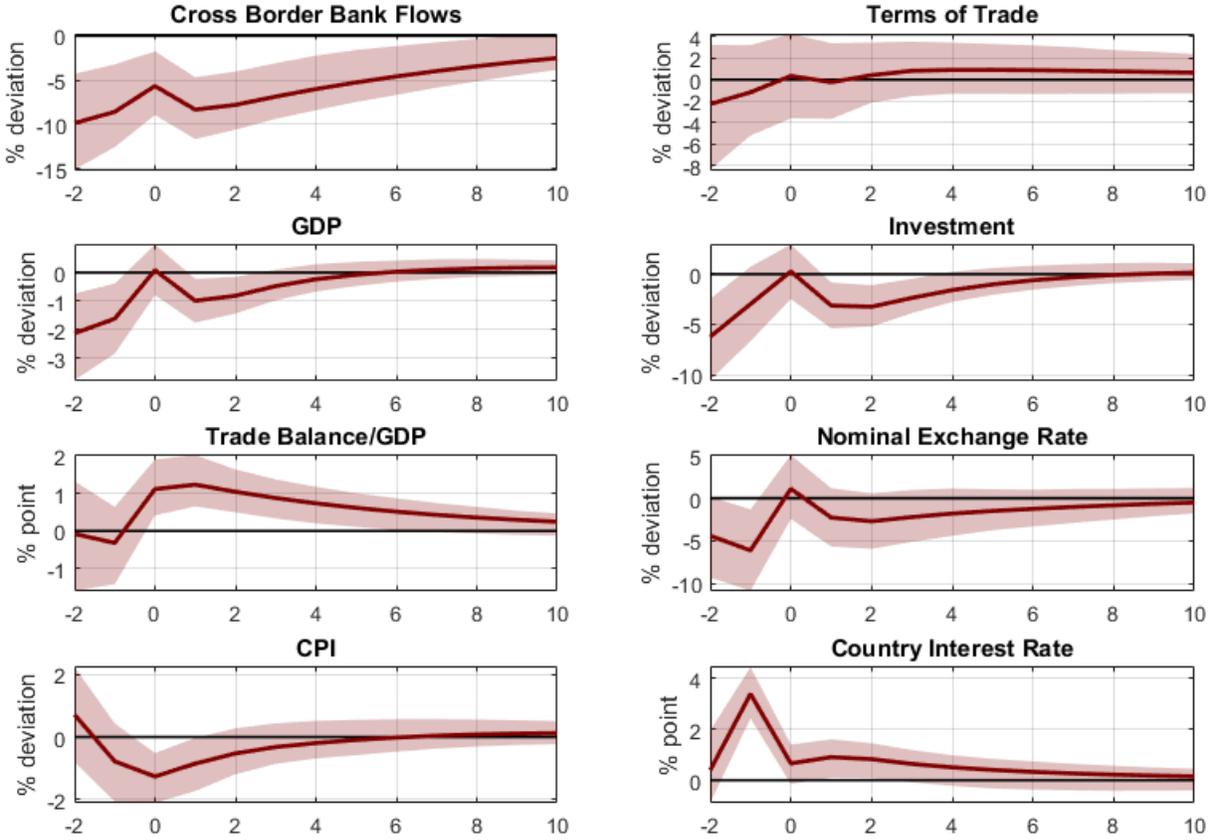
²⁰The data on Cross Border Bank Lending is only available at quarterly frequency. Moreover, at monthly frequency there is no data on Investment.

²¹Country estimates are consistent with the main conclusions but estimates are more imprecise.

²²The Akaike Information Criterion (AIC) choose 2 lags while the Bayesian Information Criterion (BIC) and the Hannan-Quinn (HQ) choose 1 lag. Reduced form residuals are not autocorrelated with the two lags specification but not including only one lag.

²³ $t = 0$ in Figure 3 denotes the time when the U.S. interest rate increases by 1%. The previous two periods show the adjustment of the variables before the change in the U.S. materializes (i.e. $\Delta i_{t-2,2}^a = 1$ $\Delta i_{t-1,1}^a = 1$ and $\mathbb{E}_0 \Delta i_{t,0}^a = 1$).

Figure 3: IRFs to a 2 quarters ahead anticipated 1% contractionary interest rate shock



Note: Solid lines denote point estimates of impulse responses; 90% confidence bands are depicted with light-red shaded areas. The responses of Cross Border Bank Flows, GDP, Investment, and CPI are expressed in % deviations from their respective log-linear trend. The responses of Terms of Trade and Nominal Exchange Rate are expressed in % deviations. Trade Balance to GDP ratio and Country Interest Rate are expressed in annualized % points. Confidence bands are computed through 1,000 bootstrap replications.

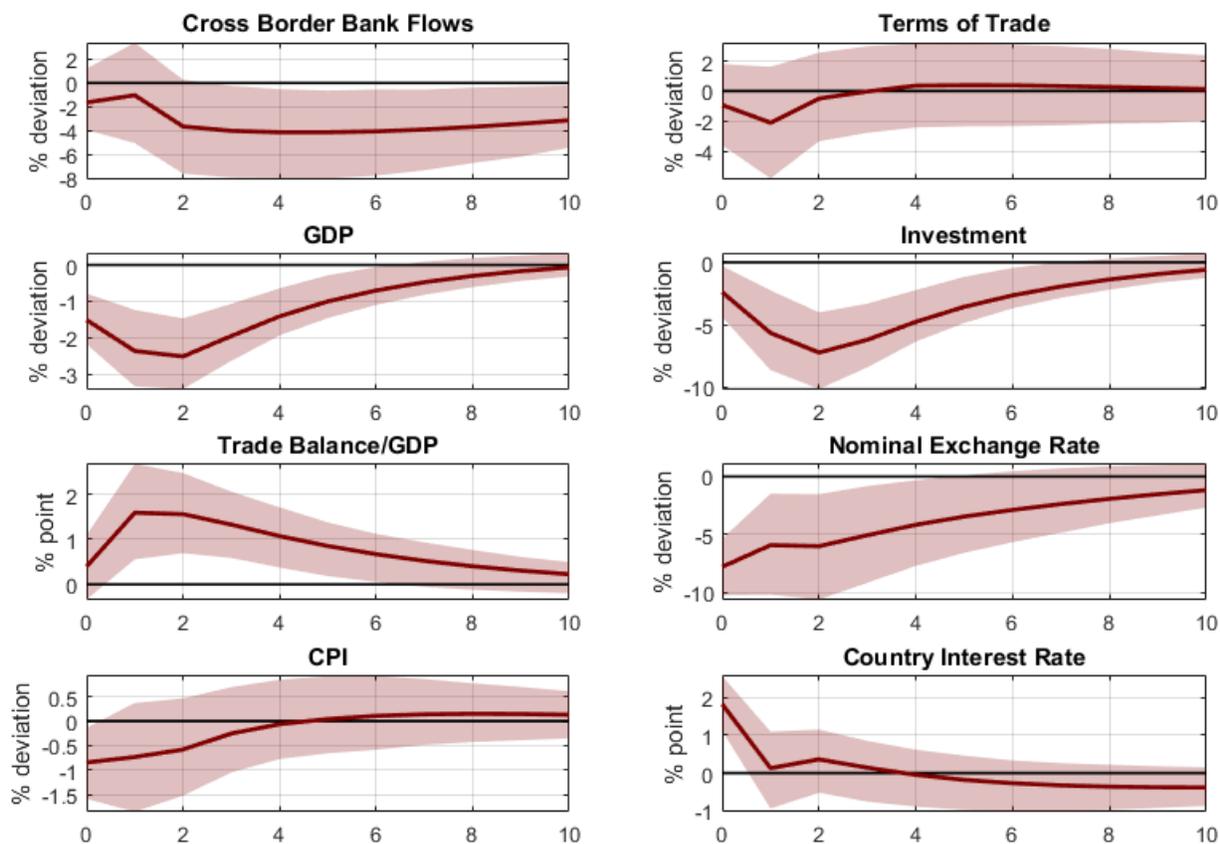
The anticipated contractionary shock induces an immediate contraction of GDP and investment of approximately 2% and 5%, respectively, from their log-linear trends. These results are due to the immediate reduction in the cross border bank flows and the depreciation of the nominal exchange rate. The country interest rate also increases and reaches its peak one quarter after the shock, which means that the country spread raises before the change in the international interest rate materializes at $t = 0$.²⁴ An important fact to highlight is that most of the adjustment of these variables occurs within the first two quarters. The trade balance to GDP ratio improves only when the change in the international interest rate materializes and could also be explained by the previous 5% depreciation of the nominal exchange rate. Finally, the contractionary effect does not have any

²⁴The country spread is the difference between the domestic and the U.S. interest rate for the same maturity.

significant effect on terms of trade but reduces significantly the consumer price index. From this analysis, we can conclude that the financial channel (via capital flows and interest rate) is crucial to explain the adjustment of macroeconomic variables.

Figure 4 displays the IRFs to an unanticipated 1% contractionary U.S. interest rate shock.

Figure 4: *IRFs to an unanticipated 1% contractionary interest rate shock*



Note: Solid lines denote point estimates of impulse responses; 90% confidence bands are depicted with light-red shaded areas. The responses of Cross Border Bank Flows, GDP, Investment, and CPI are expressed in % deviations from their respective log-linear trend. The responses of Terms of Trade and Nominal Exchange Rate are expressed in % deviations. Trade Balance to GDP ratio and Country Interest Rate are expressed in annualized % points. Confidence bands are computed through 1,000 bootstrap replications.

In this case, the reaction is also immediate and reaches its minimum two quarters after the shock. For most of the variables the adjustment is quantitatively similar to the anticipated shock. Unlike the previous case where variables converge fast, in this case the shock has a slightly more persistent effect on GDP and investment, taking around six quarters to converge to their trends. The persistence might be induced by the depreciation of the exchange rate and the delayed reduction of cross border bank flows. Unlike the anticipated case and the findings of [Uribe and Yue \(2006\)](#)

and [Akinci \(2013\)](#), country interest rate does not display a delayed reaction to the unanticipated shock. This fact, which coincides with the findings of [Mackowiak \(2007\)](#), is consistent with the idea that financial variables react on impact to the new flow of information. Finally, as in the previous case, terms of trade do not react significantly to changes in the monetary policy stance in the U.S. This fact, which may be surprising at a first sight given that most of these countries are commodity exports and commodity prices are sensible to monetary conditions, could be due to the lack of adjustment of manufacturing prices or to a decline in the price of oil, a relevant input for many of these countries. From these two cases we can conclude that the financial channel is the most relevant transmission channel, confirming the findings of [Canova \(2005\)](#).

3.4 Comparison with Developed Economies

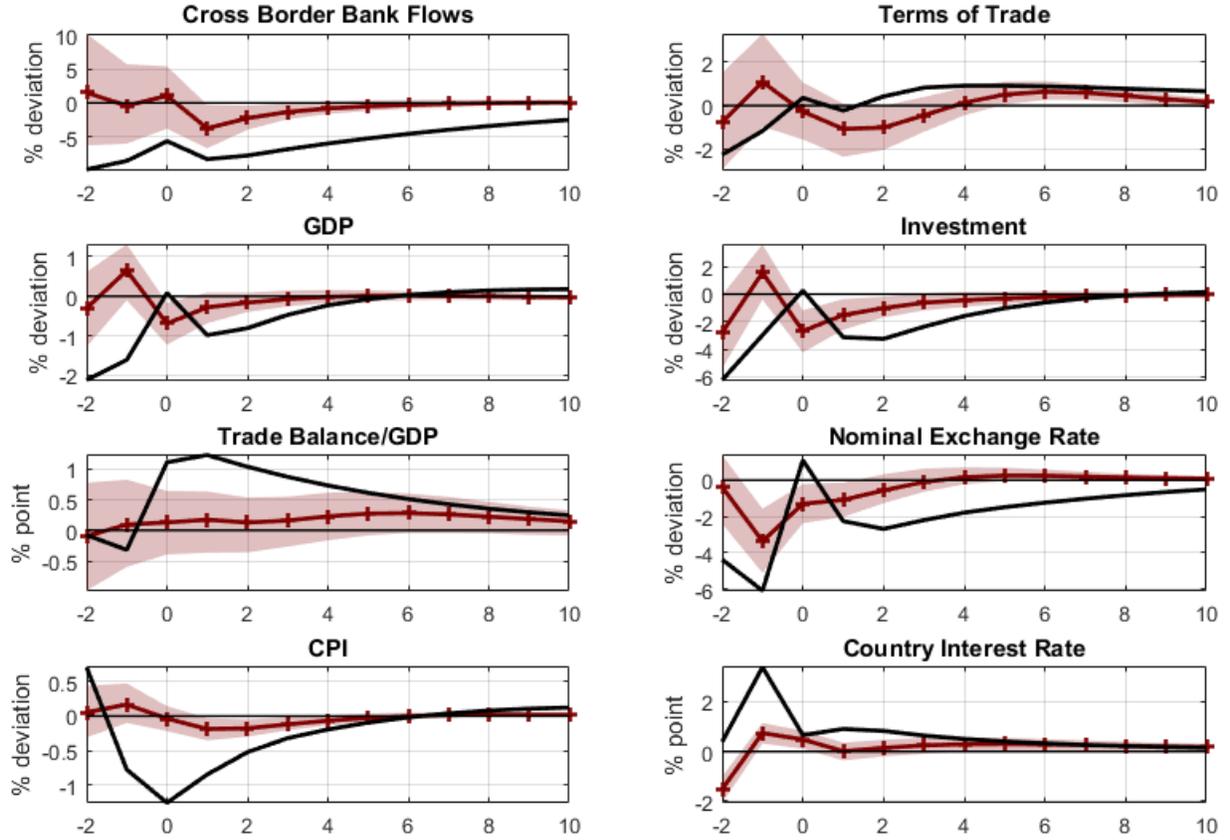
To fully understand the transmission of these shocks, I compare the responses of emerging economies to the ones of small open developed economies.²⁵ For this reason, I estimate the same VAR presented in (5) with data for: Australia, Canada, Denmark, New Zealand, Norway, and Sweden for the period 1995:Q1-2014:Q2. Appendix A describes the data sources and variables' transformations. Figure 5 displays the IRF to a two quarters ahead anticipated contractionary interest rate shock, including the point estimate of IRFs for emerging economies as a benchmark.

The response of developed economies is more delayed and less strong and persistent than for emerging ones. In particular, GDP and investment decline approximately 1% and 2% from their respective trends, only when the change in the U.S. interest rate materializes at $t = 0$. This fact can be explained by the milder responses of the cross border bank flows, country interest rate and exchange rate. Moreover, the reaction of CPI is also less significant than for emerging economies. Finally, unlike emerging economies, the trade balance does not react to this shock. This fact, together with the lack of reaction in terms of trade, shows that, for this group of countries, the shock is transmitted by the financial channel but the effects are milder compared to emerging economies. Figure 6 displays the IRFs to an unanticipated contractionary shock.

GDP and investment decline in response to an unanticipated contractionary shock, but their reaction is milder and less persistent than for emerging economies. These dynamics might be explained by the milder response of the country interest rate and the cross border bank flows, which remain unchanged. Moreover, the depreciation of the nominal exchange rate is also milder and less persistent than for emerging economies. Finally, like for the anticipated case, the CPI, terms of trade and trade balance do not display any significant reaction to the shock. All these responses are similar to the anticipated case.

²⁵For comparison with other studies and with developed economies, in Appendix D I present the IRFs of both types of shocks on the U.S. economy.

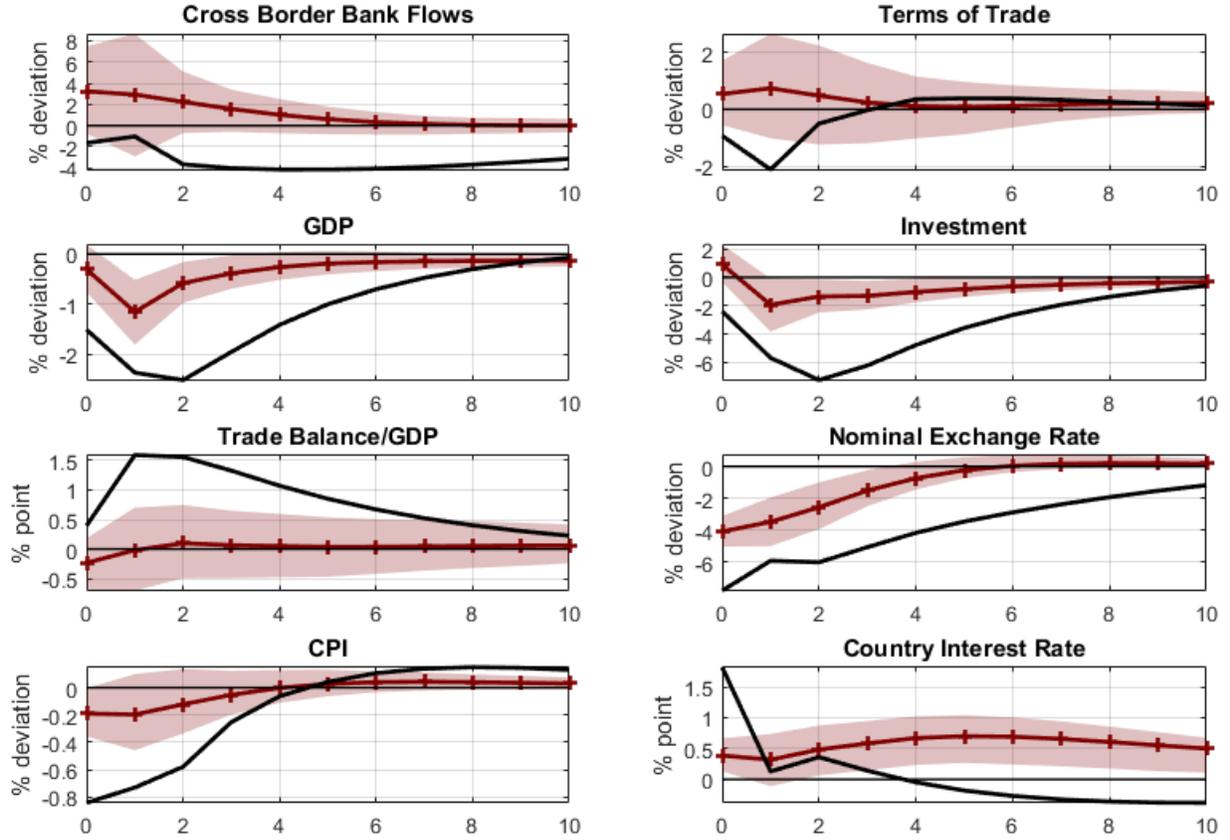
Figure 5: IRFs to a 2 quarters ahead anticipated 1% contractionary interest rate shock



Note: Solid and plus sign lines denote the point estimate of impulse responses for emerging and developed economies, respectively. 90% confidence bands for developed economies are depicted with light-red shaded areas. The responses of Cross Border Bank Flows, GDP, Investment, and CPI are expressed in % deviations from their respective log-linear trend. The responses of Terms of Trade and Nominal Exchange Rate are expressed in % deviations. Trade Balance to GDP ratio and Country Interest Rate are expressed in annualized % points. Confidence bands are computed through 1,000 bootstrap replications.

All in all, the responses of these two groups of economies are different. One of the most important mechanisms to explain this fact is the milder reaction of financial variables (i.e cross border bank flows and country interest rate). Another significant difference is that the trade channel is not significant for developed economies but it is relevant for emerging ones. However, terms of trade do not display a significant reaction for any of the two groups.

Figure 6: IRFs to an unanticipated 1% contractionary interest rate shock



Note: Solid and plus sign lines denote the point estimate of impulse responses for emerging and developed economies, respectively. 90% confidence bands for developed economies are depicted with light-red shaded areas. The responses of Cross Border Bank Flows, GDP, Investment, and CPI are expressed in % deviations from their respective log-linear trend. The responses of Terms of Trade and Nominal Exchange Rate are expressed in % deviations. Trade Balance to GDP ratio and Country Interest Rate are expressed in annualized % points. Confidence bands are computed through 1,000 bootstrap replications.

4 Alternative Empirical Specifications

Both contractionary anticipated and unanticipated U.S. interest rate shocks induce a recession in emerging economies. This fact could be due to the unconventional monetary policies during the crisis of 2008, the definition of the U.S. interest rate shock, global financial conditions (Akinci, 2013), global changes in economic activity that affect the U.S. interest rate, exchange rate regime, and/or the particular set of countries considered in the analysis. In this section, I show that the main findings of the previous section are not due to these reasons. Section 4.1 presents the results for the Zero Lower Bound (ZLB) sample, one of the main concerns. For ease of exposition, I only present the cumulative responses of variables to anticipated and unanticipated shocks for the rest

of the specifications in Tables 4 and 5, leaving the impulse responses for the Online Appendix.

4.1 Pre-Crisis Sample

Since 2008, the Federal Reserve Bank has implemented unconventional monetary policies to boost the economy, which could represent a break in the transmission of monetary policy and could be behind previous findings. In order to examine whether previous results are sensitive to the inclusion of the ZLB period, I estimate the baseline VAR of Section 3.3 but restricting the period of analysis up to 2007.Q4, before reaching the ZLB. Figure 7 displays the IRFs to an anticipated contractionary interest rate shock together with the results from full sample.

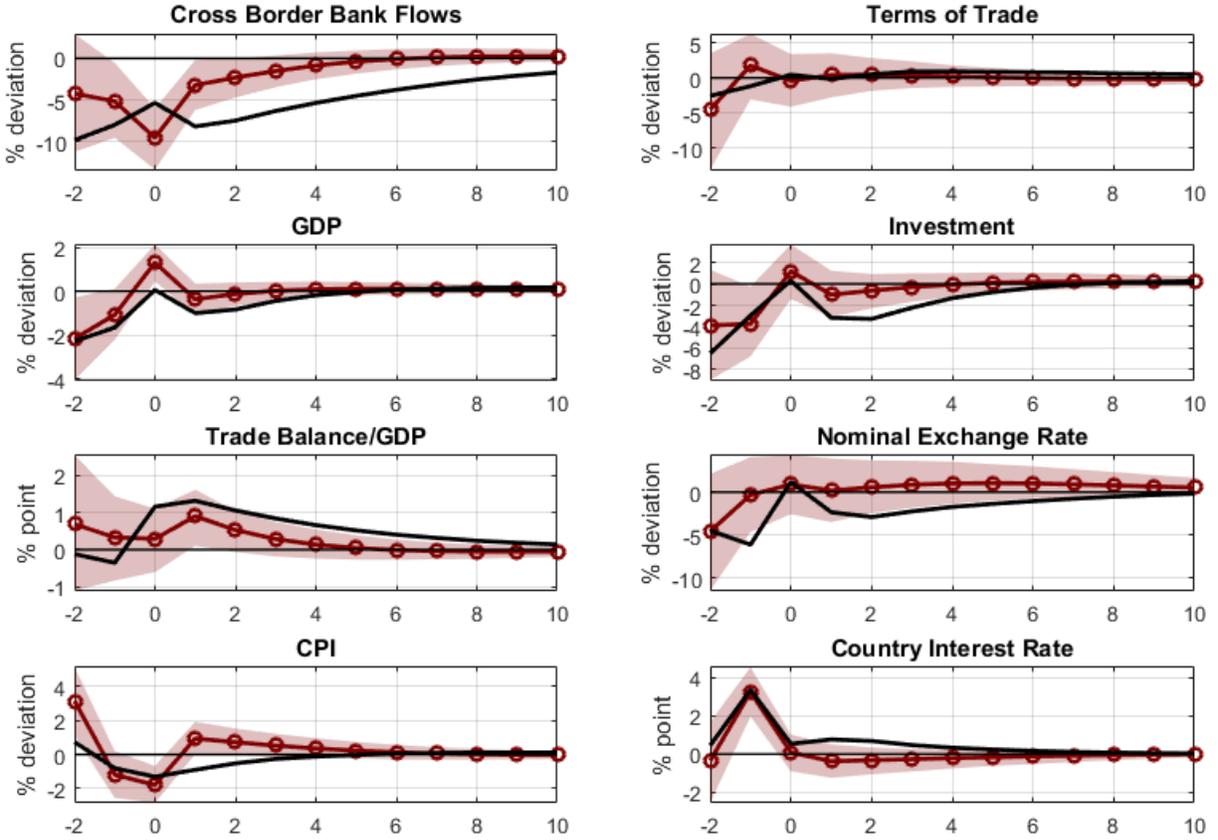
The responses of the main macroeconomic variables to the anticipated shock before $t = 0$ (i.e. the period when the U.S. interest rate increases by 1%) remain unchanged. However, GDP increases slightly when the shock hits the economy, in line with the findings of Ilzetki and Jin (2013) for this period. This reaction could be explained by the lack of response of the nominal exchange rate and the less persistent reaction of cross border bank flows. Thus, missing the anticipation effects in this case distorts the assessment of the effects of these shocks. The remaining responses remain unchanged. Similar to the full sample, most of the adjustment occurs before the change in the U.S. interest rate materializes. Figure 8 displays the response to an unanticipated contractionary interest rate shock.

Responses are also similar for the unanticipated shock but slightly less significant than in the baseline results. This fact can be explained by the lack of depreciation of the nominal exchange rate. However, impact responses are comparable both qualitatively and quantitatively between both samples.

4.2 Definition of the Interest Rate Shock

In Section 2.2, I have orthogonalized anticipated and unanticipated movements in the U.S. interest rate from market's expectations to control for policy reactions due to business cycle conditions. However, any movement in the U.S. interest rate, as defined in Section 2.1, can be considered exogenous for a small open economy since what happens in each of these countries does not affect the international interest rate. To examine whether movements in the U.S. interest rate have the same impact as U.S. interest rate shocks, I estimate the VAR including the anticipated and unanticipated movements in the interest rate, as defined in Section 2.1, instead of the interest rate shock series, as defined in 2.2, (i.e. without orthogonalizing the anticipated and unanticipated movements in the Fed Funds). The second column of Tables 4 and 5 shows the cumulative response of GDP using this alternative definition of interest rate shocks. Results are slightly stronger for the anticipated movement and weaker for the surprise one. Overall, responses are comparable to the ones using the U.S. interest rate shocks.

Figure 7: IRFs to anticipated 1% contractionary interest rate shock 1995-2007



Note: Solid and circled sign lines denote the point estimate of impulse responses for emerging economies using full sample and pre-crisis (1995-2007) sample, respectively. 90% confidence bands for pre-crisis are depicted with light-red shaded areas. The responses of Cross Border Bank Flows, GDP, Investment, and CPI are expressed in % deviations from their respective log-linear trend. The responses of Terms of Trade and Nominal Exchange Rate are expressed in % deviations. Trade Balance to GDP ratio and Country Interest Rate are expressed in annualized % points. Confidence bands are computed through 1,000 bootstrap replications.

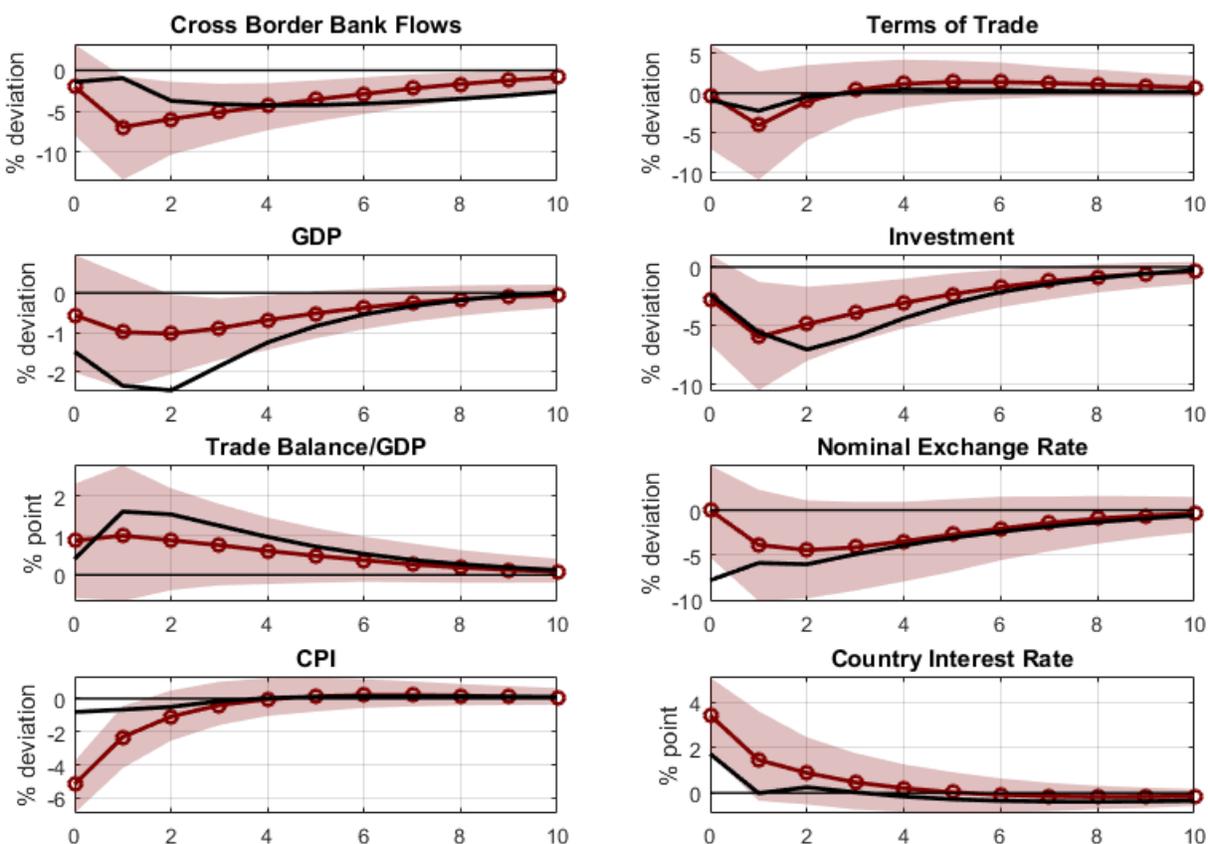
4.3 Global Financial Conditions and Global Shocks

Akinci (2013) shows that global financial risk, proxied by the U.S. BAA corporate spread, explains around 20% of aggregate fluctuations in emerging economies and that the role of risk-free interest rate shocks is negligible. First, I check the effect of the identified interest rate shocks on this variable and find that each contractionary shock increases the BAA Spread reaching its maximum on impact.²⁶ Then, considering that this variable is exogenous for an emerging economy, I estimate the baseline VAR adding the U.S. BAA Spread Indicator in an exogenous block to test whether

²⁶Moody's Seasoned BAA Corporate Bond yield relative to yield on 10-Year Treasury Constant Maturity. Source: FRED. Appendix D displays the IRFs of this variable to both shocks.

financial conditions are driving the results presented in Section 3.3. The third column of Tables 4 and 5 displays the cumulative responses of macroeconomic variables to both types of interest rate shocks. While responses to the anticipated shock are similar both qualitatively and quantitatively to the baseline case, the ones to an unanticipated shock are less statistically significant. This result could be explained by the fact that most of the unanticipated interest rate shocks coincide with recession times, when corporate spread also peaks.

Figure 8: *IRFs to unanticipated 1% contractionary interest rate shock 1995-2007*



Note: Solid and circled sign lines denote the point estimate of impulse responses for emerging economies using full sample and pre-crisis (1995-2007) sample, respectively. 90% confidence bands for pre-crisis are depicted with light-red shaded areas. The responses of Cross Border Bank Flows, GDP, Investment, and CPI are expressed in % deviations from their respective log-linear trend. The responses of Terms of Trade and Nominal Exchange Rate are expressed in % deviations. Trade Balance to GDP ratio and Country Interest Rate are expressed in annualized % points. Confidence bands are computed through 1,000 bootstrap replications.

Alternatively, [Miranda-Agrippino and Rey \(2015\)](#) show that credit flows are largely driven by a global factor, which can be related to monetary conditions in the centre country and changes in risk aversion and uncertainty. Thus, I assess whether the previous results are driven by this global

factor or by the identified shocks by estimating the baseline VAR including the global factor in the exogenous block. The fourth column of Tables 4 and 5 displays the cumulative responses of macroeconomic variables to both types of interest rate shocks. Responses to both shocks remain unchanged, supporting the findings that monetary policy in the U.S. is one of the drivers of this global factor.

Finally, results could be driven by aggregate shocks to global activity and/or changes in global volatility. To assess these hypotheses, I include World GDP and the CBOE Volatility Index (VIX) one at a time in the exogenous block of the VAR.²⁷ Columns five and six of Tables 4 and 5 display the cumulative responses to both types of shocks for these specifications. Responses are comparable for all the variables and for both shocks.

4.4 Extended Sample of Emerging Economies

Results could also be driven by the particular sample of countries. To entertain this hypothesis, I estimate the same VAR but extending the sample to other emerging economies that are part of the EMBI Global index. In particular, I add the following countries to the previous sample: Bulgaria, Colombia, Ecuador, Hungary, Republic of Korea, Malaysia, Peru, and Thailand.²⁸ The seventh column of Tables 4 and 5 displays the cumulative responses to both types of shocks.

The magnitudes of adjustment for most of the variables to an anticipated shock are slightly lower but the persistence is very similar. In particular, cross border bank flows, exchange rate and trade balance to GDP ratio react slightly less than in our baseline specification. Responses to the unanticipated shock are comparable to the baseline ones.

4.5 Exchange Rate Regime

The reaction to both shocks could depend on the exchange rate regime of each country. To evaluate this hypothesis, I estimate the baseline VAR for a subsample of countries with fixed exchange rate regimes to see if responses differ. Following the classification developed by [Ilzetzki, Reinhart, and Rogoff \(2010\)](#), I consider fixed exchange rate regimes countries classified as “Pre-Announced Peg” or “Crawling Peg +/- 2%” in the Coarse Classification.²⁹ The eighth column in Tables 4 and 5 displays the cumulative responses to both types of shocks for this sample of countries.

²⁷For World GDP I use the growth rate of world GDP computed by the IMF.

²⁸The period of the sample remains 1995:1-2014:2. As in the previous case, the periods for each country differ according to EMBI Global index availability.

²⁹The sample consists of: Argentina 1995:Q1-2001:Q4, Brazil 1996:Q1-1998:Q4, Ecuador 2000:Q1-2013:Q4, Peru 1997:Q1-2014:Q2, Philippines 2001:Q1-2006:Q4.

Table 4: *Five quarters cumulative response to a contractionary anticipated interest rate shock*

	Baseline	Alt Shock	Fin Cond	GFC	WGDP	VIX	15 Coun	Fixed FX
Credit	-39.1 ^a	-40.8 ^a	-34.8 ^a	-35.6 ^a	-38.2 ^a	-37.0 ^a	-14.3 ^b	-39.6 ^a
TOT	-2.8	-4.5	-3.2	-2.4	-2.7	-1.7	-5.5	-5.3
GDP	-6.0 ^a	-8.1 ^a	-4.6 ^a	-4.2 ^a	-5.2 ^a	-5.3 ^a	-3.9 ^a	-5.8 ^b
I	-16.5 ^a	-20.4 ^a	-12.8 ^b	-11.7 ^b	-14.6 ^b	-15.1 ^b	-9.8 ^b	-16.5 ^b
TB	3.0 ^b	3.3 ^b	3.3 ^b	3.1 ^b	3.0 ^b	2.8 ^b	-1.0	-5.2 ^b
NEER	-15.3 ^b	-20.4 ^b	-12.2 ^b	-12.3 ^b	-14.2 ^b	-11.4	-6.5 ^b	2.5
CPI	-2.6	-2.7	-2.5	-2.7	-2.6	-3.1 ^b	-0.2	9.4
R	5.8 ^a	6.6 ^a	6.2 ^a	6.2 ^a	5.8 ^a	5.6 ^a	4.4 ^a	3.4

Note: Cumulative five quarters responses to a 1% anticipated contractionary interest rate shock. *a* and *b* denote statistical significance at 90% and 68%, respectively. The five quarters cumulative response to an anticipated shock denotes the sum of the responses between periods -2 and 2. All responses are expressed in %. Confidence bands are computed through 1,000 bootstrap replications.

Table 5: *Five quarters cumulative response to a contractionary surprise interest rate shock*

	Baseline	Alt Shock	Fin Cond	GFC	WGDP	VIX	15 Coun	Fixed FX
Credit	-12.1 ^b	-9.2	0.6	-7.8	-4.4	-5.7	-5.2	-3.0
TOT	-2.8	-9.9 ^b	-2.5	-2.6	-0.3	-1.3	-7.1 ^b	-24.3 ^b
GDP	-8.0 ^a	-7.1 ^a	-1.7	-4.4 ^a	-4.7 ^a	-5.9 ^a	-5.4 ^a	-0.6
I	-21.5 ^a	-14.3 ^a	-7.9	-13.0 ^a	-15.3 ^a	-18.2 ^a	-10.3 ^a	0.3
TB	6.3 ^a	5.4 ^a	6.9 ^a	6.0 ^a	6.4 ^a	5.8 ^a	3.5 ^b	2.6
NEER	-28.3 ^a	-25.8 ^a	-16.9 ^b	-21.5 ^a	-25.0 ^a	-17.7 ^a	-18.6 ^a	-2.6
CPI	-2.4	-3.0 ^b	-2.6	-2.1	-2.8 ^b	-3.3 ^b	-0.1	-7.4 ^b
R	3.8 ^b	3.5 ^b	5.1 ^a	2.7 ^b	3.4 ^b	2.5 ^b	8.7 ^a	22.9 ^a

Note: Cumulative five quarters response to a 1% unanticipated contractionary interest rate shock. *a* and *b* denote statistical significance at 90% and 68%, respectively. The five quarters cumulative response to an unanticipated shock denotes the sum of the responses between periods 0 and 4. All responses are expressed in %. Confidence bands are computed through 1,000 bootstrap replications.

For the anticipated shock, there is no significant cumulative response of the nominal exchange rate but the remaining variables react in a similar way to the baseline specification, being slightly less significant partially due to the reduced number of observations.³⁰ The response to the unanticipated

³⁰The subsample of fixed exchange rate countries consists of 194 observations.

shock is less significant for most of the variables. The country interest rate reacts more strongly in this case, which could reflect that markets perceive more risk in these economies relative to the economies with flexible exchange rate regime. Finally, considering that the nominal exchange rate does not adjust, these countries experience a slightly stronger deflation in response to this shock. Then, the results in this subsection confirm the findings of [Dedola, Rivolta, and Stracca \(2015\)](#) that the responses in emerging economies do not depend on their exchange rate regime.

5 Real Interest Rate

Most of the theoretical papers on interest rate shocks have looked at the effects of changes in the international real interest rate instead of the nominal one (for example [Neumeyer and Perri \(2005\)](#); [Uribe and Yue \(2006\)](#)). In order to assess if anticipation is also relevant for this case, I identify anticipated and unanticipated real interest rate shocks deflating the nominal shocks described in [Section 2.2](#) by the expected change in inflation between two consecutive quarters.³¹ In particular, the real interest rate shocks are defined as:

$$\Delta r_{t,j}^a = \mathbb{E}_{t-1} [(i_{t+j} - i_{t+j-1}) - (\pi_{t+j+1} - \pi_{t+j})] \quad \text{for } j = \{0, 1, 2\} \quad (6)$$

$$\Delta r_t^u = (i_t - \mathbb{E}_{t-1} i_t) - (\pi_{t+1} - \mathbb{E}_{t-1} \pi_{t+1}) \quad (7)$$

where $\{\Delta r_{t,j}^a, \Delta r_t^u\}$ denote the anticipated and unanticipated real interest rate shock and π_{t+i} is the U.S. CPI inflation between quarters $t+i$ and $t+i-1$, expressed in annual terms.³² After identifying the real shocks, I estimate the VAR presented in [\(5\)](#) including with the following variables:

$$X_t = [\text{Credit}_t, \text{TOT}_t, \text{GDP}_t, I_t, \frac{TB_t}{GDP_t}, \text{REER}_t, R_t^r]$$

where REER_t denotes the real exchange rate index for each country computed by the Bank of International Settlements (BIS) and R_t^r denotes the real domestic interest rate.³³ [Figure 9](#) displays the IRFs to an anticipated two quarters ahead 1% contractionary real interest rate shock, respectively.³⁴

The domestic real interest rate raises and the cross border credit flows decline persistently on

³¹In particular, I used expectations about inflation based on GDP Deflator published by the SPF. In this case, the real shocks computed using the orthogonalized and non-orthogonalized U.S. interest rate shocks (i.e. the ones defined in [sections 2.1](#) and [2.2](#), respectively) are highly correlated.

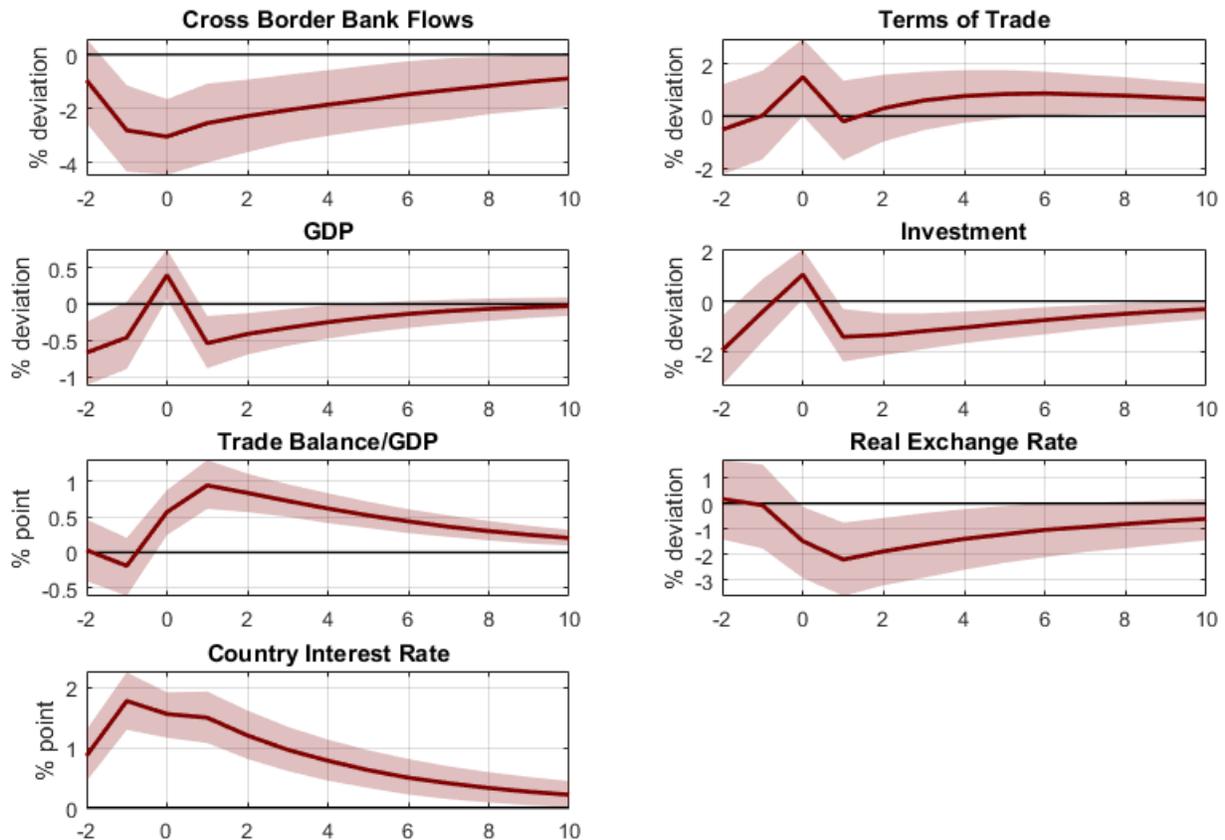
³²The real series computed with the anticipated nominal movements [\(2.1\)](#) and the orthogonalized ones [\(2.2\)](#) are highly correlated. For this section, I use the orthogonalized version of nominal shocks to compute the real ones.

³³ R_t^r is computed as the nominal U.S. interest rate deflated by the expected GDP deflator of the corresponding quarter plus the Country Spread, which is proxied by EMBI+.

³⁴In this case, both Figures display confidence bands at 68% instead of 90%. This is due to the fact that there is uncertainty both about the evolution of the nominal rate and the inflation path.

impact in response to an anticipated contractionary shock. These movements induce a decrease in GDP and investment of 0.5% and 2%, respectively on impact. The real exchange rate reacts like in the nominal case but with a delay, which could be explained by the persistence of prices that delay the real adjustment. Thus, the responses to an anticipated contractionary real interest rate shock are similar to a nominal one but milder. In fact, responses of both macroeconomic and financial variables are approximately half of their nominal counterpart. Figure 10 presents the response to an unanticipated 1% contractionary real interest rate shock.

Figure 9: IRF to anticipated 1% contractionary U.S. real interest rate shock

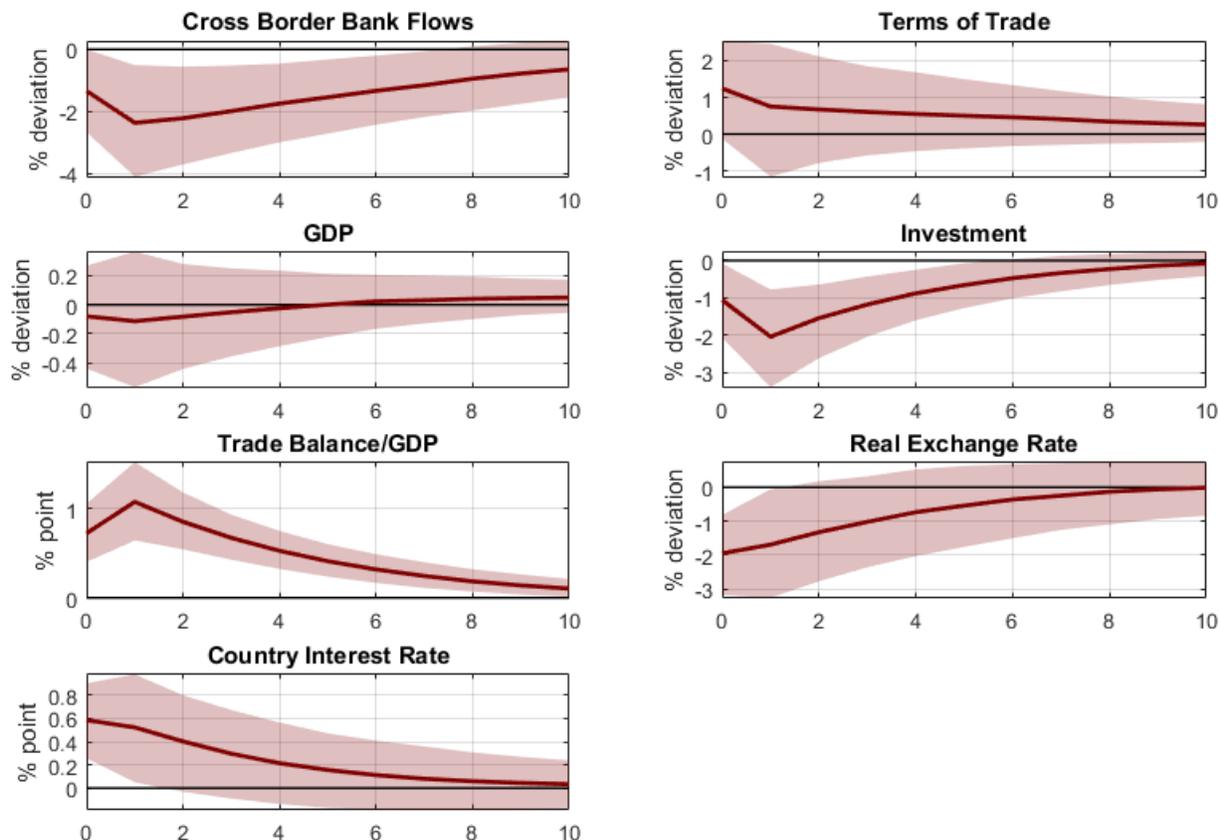


Note: Solid lines denote point estimates of impulse responses; 68% confidence bands are depicted with light-red shaded areas. The responses of Cross Border Bank Flows, GDP, and Investment are expressed in % deviations from their respective log-linear trend. The responses of Terms of Trade and Real Exchange Rate are expressed in % deviations. Trade Balance to GDP ratio and Country Interest Rate are expressed in annualized % points. Confidence bands are computed through 1,000 bootstrap replications.

An unanticipated real interest rate shock also induces similar dynamics to the nominal one. In this case, the reactions of the real exchange rate and the trade balance are comparable to the nominal case. The main difference is that this shock does not induce a significant effect on GDP.

Similar to the anticipated shock, all the responses are milder compared to the nominal case. These results suggest that movements in U.S. CPI inflation, which affect the real interest rate but not the nominal one, have a weaker impact than movements in the nominal interest rate.

Figure 10: *IRF to unanticipated 1% contractionary U.S. real interest rate shock*



Note: Solid lines denote point estimates of impulse responses; 68% confidence bands are depicted with light-red shaded areas. The responses of Cross Border Bank Flows, GDP, and Investment are expressed in % deviations from their respective log-linear trend. The responses of Terms of Trade and Real Exchange Rate are expressed in % deviations. Trade Balance to GDP ratio and Country Interest Rate are expressed in annualized % points. Confidence bands are computed through 1,000 bootstrap replications.

6 Conclusions

This paper explores the role of anticipation in assessing the effects of international interest rate shocks on emerging economics. Using data from FED Funds Future market, I identify anticipated and unanticipated changes of the U.S. interest rate. First, I show that the identified anticipated interest rate shocks contain useful information to predict the narrative series of monetary policy shocks of [Tenreyro and Thwaites \(2015\)](#), who updated [Romer and Romer \(2004\)](#). Then, I analyse

their macroeconomic effects on emerging economies. Five major conclusions can be derived from the analysis. First, anticipated and unanticipated contractionary shocks induce a recession in emerging economies. Second, monetary news generate an immediate reaction of macroeconomic variables, even before the change materializes. In particular, an anticipated 1% increase in the U.S. Fed Funds rate generates an immediate decrease in GDP and investment of 2% and 5% from its log-linear trend, respectively. Third, unanticipated contractionary interest rate shocks have similar effects to anticipated ones. Fourth, the financial channel, via cross border bank flows and country interest rate, is the most relevant for the transmission of both shocks while terms of trade do not display a statistically significant reaction. Finally, the stronger response of the financial channel is relevant to explain the stronger response of emerging economies relative to developed ones. Results are robust to alternative specifications (for example, controlling for global conditions), samples, and across different exchange rate regimes. Moreover, results are similar using the real interest rate shocks instead of the nominal ones.

To conclude, results show that anticipation is relevant for assessing the effects of U.S. interest rate shocks, since a significant part of the adjustment takes place before a change in the interest rate occurs. These findings contribute to understand the adjustment of emerging economies to forward guidance. From a policy perspective, policymakers in emerging economies should consider not only the current value of the reference interest rate but also its expected one when they evaluate external macroeconomic conditions. An interesting extension would be to determine the optimal policy to counteract the effects of these shocks.

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A Appendix- Data

The dataset includes quarterly data for Argentina (1995Q1-2001Q3), Brazil (1996Q1-2014Q2), Chile (2003Q1-2013Q4), Mexico (1995Q1-2014Q2), Philippines (1998Q1-2006Q4), South Africa (1995Q1-2014Q2), and Turkey (1999Q1-2014Q2). The sample for Argentina ends in 2001Q3 since after its sovereign default the country interest rate was not allocative. The choice of countries and sample period is guided by macroeconomic and spread data availability. This sample is very similar to the one used by [Akinçi \(2013\)](#). For the analysis, I consider emerging economies included in the J.P. Morgan Emerging Market Bond Index Global (EMBI Global). The dataset for small open developed economies includes quarterly data for Australia, Canada, Denmark, New Zealand, Norway, and Sweden for the period 1995:Q1-2014:Q2.

Macroeconomic series come from IMF International Financial Statistics (IFS) database. Quarterly series of GDP and Gross Fixed Capital Formation (proxy for Investment) expressed in local currency units and current prices are deflated using the GDP deflator. Trade Balance is expressed as share of GDP at current prices and CPI is the Consumer Price Index that includes all the items. Terms of trade are computed as the ratio between export price index and import price index. All these variable are seasonally adjusted using the X13-ARIMA-SEATS before any transformation. For exchange rate, I use the Nominal Exchange Rate Index and Real Exchange Rate Index (for the case of the real shocks) computed by the Bank of International Settlements (BIS). These indexes is calculated as a geometric weighted average of bilateral exchange rates. They are available at monthly frequency and an increase indicates an appreciation. For the analysis, I use the quarterly average. Finally, the Country Interest Rate is defined as the U.S. interest rate for 10 years plus the Country Spread. For emerging economies, the spread is measured using the J.P. Morgan Emerging Markets Bond Index Global (EMBI Global). This index is computed based on: US-dollar denominated Brady bonds, Eurobonds, traded loans, and local market debt instruments issued by sovereign and quasi-sovereign entities. The spread is computed as an arithmetic, market-capitalization-weighted average of bond spreads over U.S. Treasury bonds of similar duration. Instead of selecting countries according to a sovereign credit-rating level, as is done with the EMBI+, the EMBI Global defines emerging markets countries with a combination of World Bank-defined per capita income brackets

and each country’s debt-restructuring history. <http://faculty.darden.virginia.edu/liw/emf/embi.pdf> contains a detailed description of the methodology used to compute the index. The country spread for developed economies is proxied using the Citigroup World Government Bond Index for 10 year maturities. Results are robust is I compute the spread using the Long Term Interest Rate reported by the Organization for Economic Co-Operation and Development (OECD).

Cross Border Bank Flows denote total foreign claims (all instruments, in all currencies) outstanding to all the sectors deflated by the U.S. consumer price index. This Locational Banking dataset is compiled by the Bank of International Settlements.

All the countries are pooled for estimation. GDP, Investment, Cross Border Bank Flows, and CPI are expressed as deviations with respect to a country specific log-linear trends. Results are robust to detrending using the Hodrick-Prescott filter. Nominal Exchange Rate index (in logs), Country Interest Rate and Trade Balance/GDP are computed as deviations with respect to country-specific means.

To identify anticipated and unanticipated interest rate shocks in the U.S., I use data from the CBOT Fed Futures Market. In particular, I consider the price for each contract at the beginning of each quarter. This data is downloaded from Thomson Reuters Datastream as CBT-30 DAY FED FUNDS CONTINUOUS for different horizons ahead since January 1995. For this reason, the sample starts in January 1995. CBOT Fed Futures Market contracts trade 6 to 9 consecutive months out from a given date. Even if contracts for longer horizon are available, these are not so liquid. The contracts are always settled against the average daily effective fed funds rate for the delivery month. [http://www.jamesgoulding.com/Research_II/Fed%20Fund%20Futures/Fed%20Funds%20\(Futures%20Reference%20Guide\).pdf](http://www.jamesgoulding.com/Research_II/Fed%20Fund%20Futures/Fed%20Funds%20(Futures%20Reference%20Guide).pdf) contains detailed information about these contracts. The daily effective fed funds rate is calculated and reported by the Federal Reserve Bank of New York. I download the quarterly average of this series from St. Louis Fed. FRED database and use it as the realized value of this variable, to identify unanticipated shocks.

B Appendix- Identifying U.S. Interest Rate Shocks

Let’s assume that the U.S. interest rate follows the following process:

$$i_t^{US} = i^{ss} + \beta \hat{y}_t + \gamma \hat{u}_t + \lambda \hat{\pi}_t + \epsilon_t$$

Then, the expectation for the interest rate one quarter ahead conditional on the information available at the beginning of quarter t is given by:

$$\mathbb{E}_{t-1} i_{t+i}^{US} = i^{ss} + \beta \mathbb{E}_{t-1} \hat{y}_{t+i} + \gamma \mathbb{E}_{t-1} \hat{u}_{t+i} + \lambda \hat{\mathbb{E}}_{t-1} \hat{\pi}_{t+i} + \mathbb{E}_{t-1} \epsilon_{t+i}$$

where the last term denotes how much markets expect the Central Bank to deviate from the

systematic response. It follows that:

$$\mathbb{E}_{t-1}(i_{t+2}^{US} - i_{t+1}^{US}) = \beta \mathbb{E}_{t-1}(y_{t+2} - y_{t+1}) + \gamma \mathbb{E}_{t-1}(u_{t+2} - u_{t+1}) + \lambda \mathbb{E}_{t-1}(\pi_{t+2} - \pi_{t+1}) + \mathbb{E}_{t-1}(\epsilon_{t+2} - \epsilon_{t+1})$$

Thus, we can obtain the expected interest rate surprise as the error term of the regression (i.e. $\mathbb{E}_{t-1}(\epsilon_{t+2} - \epsilon_{t+1})$) of the anticipated change of the U.S. interest rate on the expected evolution of macroeconomic variables. An analogous expression holds for the case of $t, t + 1$.

For the case of the current period:

$$\mathbb{E}_{t-1}(i_t^{US}) - i_{t-1}^{US} = \beta \mathbb{E}_{t-1}(\hat{y}_t - y_{t-1}) + \gamma \mathbb{E}_{t-1}(\hat{u}_t - u_{t-1}) + \lambda \mathbb{E}_{t-1}(\hat{\pi}_t - \pi_{t-1}) + \mathbb{E}_{t-1}(\epsilon_t - \epsilon_{t-1})$$

where all the variables dated t-1 are known at the period of computing the expectation. In particular, I take the first release of information for these variables that is available in SPF dataset. As usual, the expected shock is obtained as the residuals from this regression (i.e. $\mathbb{E}_{t-1}(\epsilon_t - \epsilon_{t-1})$).

Finally, for the case of unanticipated shocks:

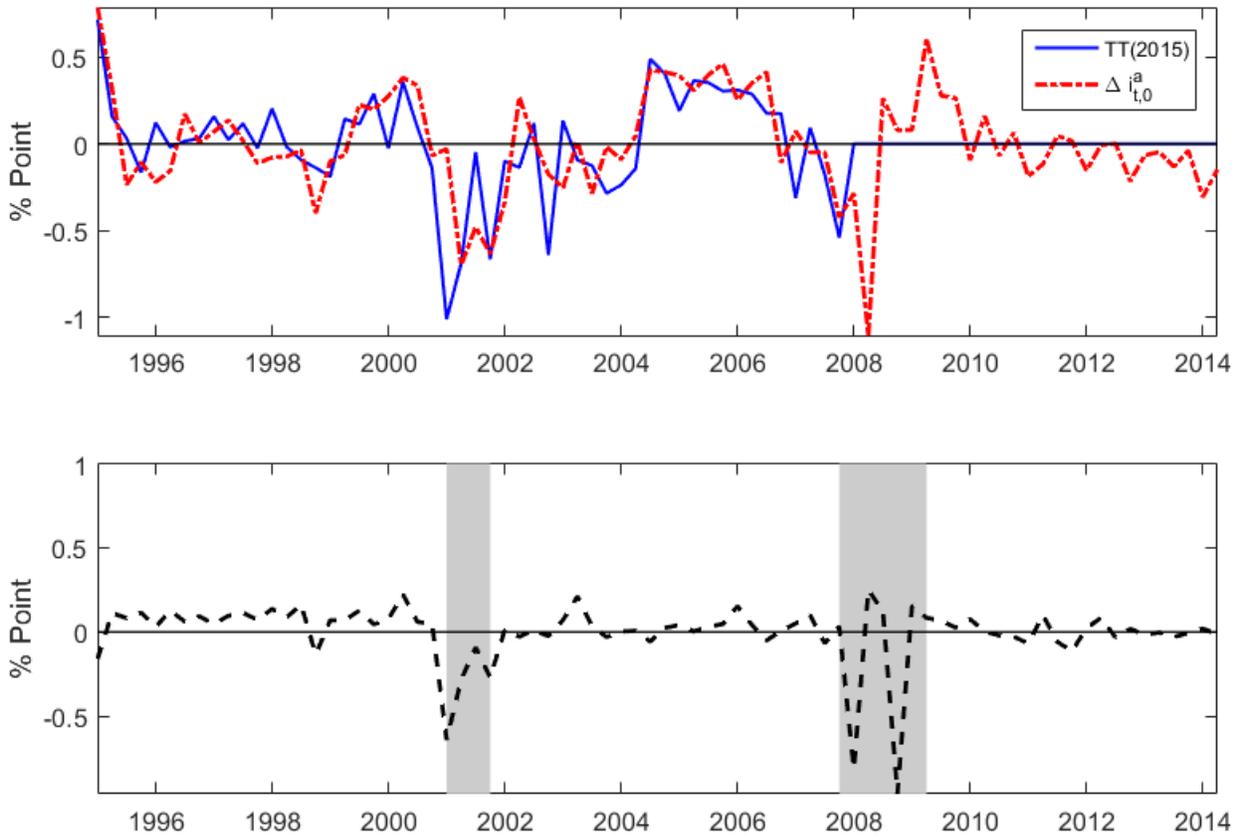
$$i_t - \mathbb{E}_{t-1}i_t = \beta(\hat{y}_t - \mathbb{E}_{t-1}\hat{y}_t) + \gamma(\hat{u}_t - \mathbb{E}_{t-1}\hat{u}_t) + \lambda(\hat{\pi}_t - \mathbb{E}_{t-1}\hat{\pi}_t) + (\epsilon_t - \mathbb{E}_{t-1}\epsilon_t)$$

The same way of obtaining the pure interest rate shocks as before (i.e. $(\epsilon_t - \mathbb{E}_{t-1}\epsilon_t)$). In all the cases, I follow [Romer and Romer \(2004\)](#) and also control for the level of the interest rate of that period to identify the pure monetary policy shock. I have also tried with Taylor rules that include persistence of the interest rate and the series are highly correlated, without affecting the results of the paper.

C Appendix- Identified Shocks

Figure displays the identified anticipated shock made at the beginning of the quarter for the current one ($\Delta i_{t,0}^a$) and the unanticipated one (Δi_t^u)

Figure A.1: *Identified Anticipated and Unanticipated Shocks*



Note: Top figure displays the anticipated shock computed at the beginning of the quarter for the current one ($\Delta i_{t,0}^a$) and the narrative series of monetary policy shocks ($TT(2015)$), updated by *Tenreiro and Thwaites (2015)*. Bottom figure shows the unanticipated shock (Δi_t^u).

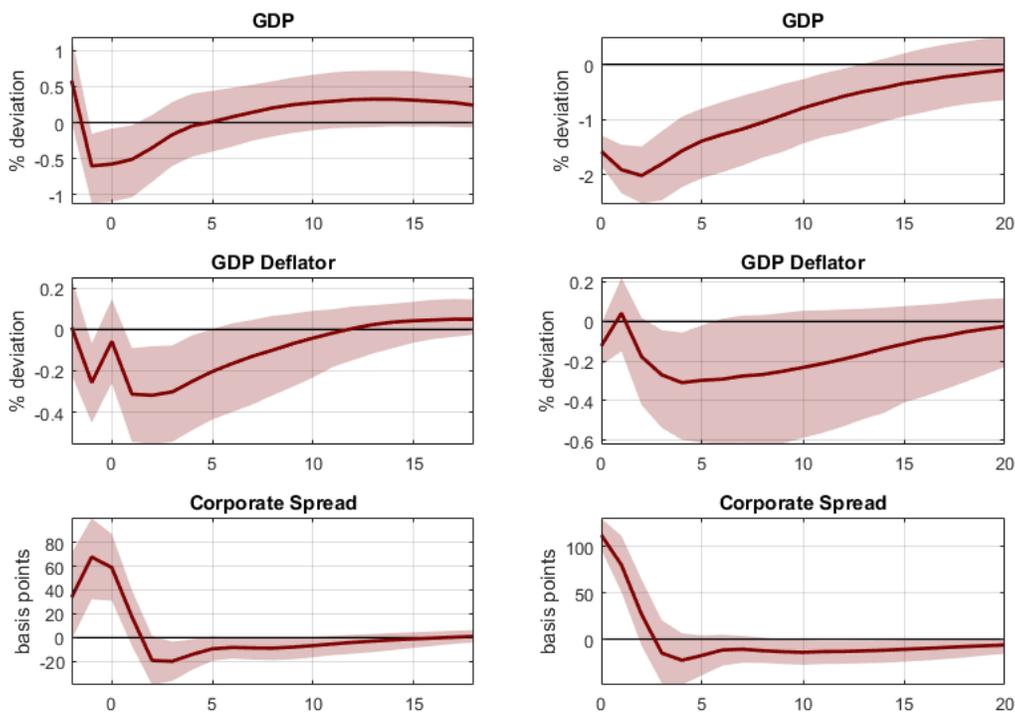
D Appendix- Effects of U.S. Interest Rate Shocks on U.S. Economy

In order to compare with previous monetary policy shocks and to have as a benchmark for the analysis, I estimate the effects of anticipated and unanticipated U.S. interest rate shocks on the U.S. using the empirical model proposed in Section 3.1. Given the short sample (1995:Q1-2014:Q2), I consider three main macroeconomic variables that summarize the macroeconomic effects (vector X_t in expression 5): GDP, GDP Deflator and Corporate Spread.³⁵

³⁵GDP denotes Real Gross Domestic Product, in billions of chained 2009 Dollars, seasonally adjusted (source: FRED). GDP Deflator corresponds to the Implicit Price Deflator, index 2009=100, seasonally adjusted (source: FRED). Finally, I use the Moody's Seasoned BAA Corporate Bond yield relative to yield on 10-Year Treasury constant maturity as a measure of the BAA Corporate Spread.

I estimate the VAR in (log) levels without explicitly modelling the possible cointegration relations among them. In addition to a constant, I include a deterministic linear trend, where dropping it does not affect significantly the results. Following BIC criterion, I estimate a VAR with 2 lags.³⁶ Figure A.2 displays the IRFs to a two quarters anticipated (left column) and unanticipated (right column) contractionary U.S. interest rate shock.

Figure A.2: IRFs to anticipated (right) and unanticipated (left) U.S. interest rate shocks



Note: IRFs to a two quarters ahead anticipated (left column) and unanticipated (right column) contractionary U.S. interest rate shock. Solid lines denote point estimates of impulse responses; 68% confidence bands are depicted with light-red shaded areas. The responses of , GDP, and Investment are expressed in % deviations from their respective log-linear trend. The response of Corporate Spread are expressed in basis points. Confidence bands are computed through 1,000 bootstrap replications.

Both shocks induce similar effects in the U.S. economy than in small open developed economies (see Section 3.4). The anticipated shock induces a contraction of GDP that starts one period before before the change realizes. As in previous cases, this can be explained by the immediate increase in the Corporate Spread. Finally, the price level declines 0.3% with respect to its trend and converges back after 5 quarters. Considering the unanticipated shock, the effect on GDP is slightly stronger and more persistent than for the anticipated shock. Both the magnitudes and signs of the adjustment of all the variables are consistent with previous works in the literature that use different approaches to identify the monetary policy shocks.

³⁶Residuals are not autocorrelated with two lags. Results are robust to a four lag specification.