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# Monetary news in the United States and business cycles in emerging economies☆

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ABSTRACT

This paper identifies anticipated (news) and unanticipated (surprise) shocks to the U.S. Fed Funds rate using Fed Funds futures contracts, and assesses their propagation to emerging economies. Anticipated shocks are identified as the expected change in the Fed Funds rate orthogonal to expected U.S. business cycle conditions while unanticipated shocks are the one-step ahead forecast error. Anticipated shocks explain around half of the narrative series of U.S. monetary policy shocks. To identify the effects of both shocks, I estimate a Panel VAR using a sample of emerging economies. An anticipated 25 basis points contractionary U.S. interest rate shock induces a fall of 0.5% in GDP from its trend two quarters before the shock materializes. Both anticipated and unanticipated changes in the U.S. interest rate cause significant and quantitatively similar effects. The increase of the U.S. BAA corporate spread in response to both shocks significantly exacerbates the response of emerging economies. After accounting for anticipation, U.S. interest rate shocks explain 14% of business cycle fluctuations in emerging economies.


## 1. Introduction

Over the last decades most emerging economies have increasingly opened their borders to financial flows. This integration has improved their access to international financial markets and substantially increased their interdependencies with developed economies. In this context, movements in the international interest rate have been identified as an important source of business cycle fluctuations in emerging economies. Fluctuations in the international interest rate may affect borrowing conditions, commodity prices, exchange rates, flows of capital, and the macroeconomic conditions of emerging economies. Although this topic has been widely studied, there is no consensus on the macroeconomic effects of variations in the U.S. interest rate on these economies.[1] Understanding the transmission of U.S. interest rate shocks is crucial not only for explaining business cycle fluctuations in emerging economies but also for designing monetary and macroprudential policies.

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 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, the Fed Funds Future contracts provide a market-based unbiased expectations indicator of interest rate's evolution (Owens and Webb, 2001; Hamilton, 2009). Capital flows, financial markets, and exchange rates may react to an expected movement before any change in the U.S. interest rate. Hansen and Sargent (1991) demonstrate that, in the case of anticipation, a Vector Autoregressive Model (VAR) with insufficient information (i.e. without considering agents' expectations) fails to capture the true dynamics of the variables.

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[1] See for example: Canova (2005); Neumeyer and Perri (2005); Uribe and Yue (2006); Mackowiak (2007); di Giovanni and Shambaugh (2008); Ilzetzki and Jin (2013); Georgiadis (2016); Dedola et al. (2017); Iacoviello and Navarro, (forthcoming); Cormun and De Leo (2018).

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This fact may explain the lack of consensus from previous works about the effects of U.S. interest rate shocks on emerging economies.

This paper develops a novel way of identifying anticipated (news) and unanticipated (surprise) U.S. interest rate shocks and assesses their propagation to emerging economies. To identify both shocks, I exploit the different maturities of the Fed Funds Future contracts. First, I compute the anticipated change of the Fed Funds rate between two consecutive quarters and show that it accounts for 80% of the realized Fed Funds fluctuations. Analogously, the unanticipated change is defined as the one-step ahead forecast error. Then, assuming that the Federal Reserve follows a Taylor rule, I purge the anticipated and unanticipated policy movements of systematic policy changes which relate to current and expected U.S. business cycle conditions. One of the main advantages of this identification strategy is that the identified shocks do not rely on the ordering or on the response of U.S. variables. The identified series of anticipated shocks contains important information to predict the narrative monetary policy shocks of Romer and Romer (2004), updated by Tenreyro and Thwaites (2016).

Using a quarterly sample of emerging economies, I estimate a Panel VAR to identify the effects of the previously identified anticipated and unanticipated shocks on macroeconomic aggregates of emerging economies. The model assumes that these economies are small open economies, which implies that they do not influence the Fed Funds rate. The baseline specification includes international variables (terms of trade and an indicator of global financial conditions), the main macroeconomic variables (GDP, Investment, Trade Balance, CPI inflation, the exchange rate depreciation, and the country interest rate), cross-border bank credit, and the borrowing-lending spread. I incorporate the anticipated and unanticipated U.S. interest rate shocks in an exogenous block. Results show that emerging economies react once they receive the news about the future evolution of the Fed Funds, even before the rate changes. In particular, a two-quarter ahead expected 25 basis points increase of the U.S. interest rate induces a fall of 0.5% in GDP from its linear trend, two quarters before the shock materializes. Unanticipated contractionary interest rate shocks also cause a similar contraction in emerging economies but after the change in the U.S. interest rate. Allowing for the response of the U.S. BAA corporate spread to these shocks is important for explaining the observed output and investment responses, accounting for 42% of the total effect. After accounting for anticipation, U.S. interest rate shocks explain around 14% of output fluctuations in emerging economies.

The international macroeconomics literature has so far assessed the propagation of U.S. monetary policy to emerging economies without reaching a conclusive evidence. On the one hand, Canova (2005) and Ilzetzki and Jin (2013), using different identification schemes, find that a contractionary shock induces an increase in the domestic interest rate, a depreciation of the exchange rate, and a delayed positive effect on economic activity emerging economies after 1990. On the other hand, Uribe and Yue (2006) estimate the effects of changes in the U.S. real interest rate and find that an increase in this rate induces a contraction of GDP in emerging economies. Mackowiak (2007), Dedola et al. (2017) and Iacoviello and Navarro (forthcoming) show that U.S. monetary policy shocks induce heterogeneous effects on real activity. In this paper, I show that anticipation is key to understand the effects of U.S. interest rate shocks and that a contractionary U.S. interest rate shock induces a decline in output on emerging economies. The response of the U.S. BAA corporate spread significantly amplifies the response of emerging economies to both shocks.

Sharp declines in capital inflows, called Sudden Stops, have been considered a major concern for emerging economies (see, for example, Calvo et al., 2006). Usually, they induce immediate output collapses and severely affect the banking sector. The transmission channels and macroeconomic effects identified in this paper are consistent with the findings in this literature (see, for example, Chari et al., 2005; Kehoe and Ruhl, 2009). More recently, Rey (2013) and Miranda-Agrippino and Rey (2018) show that capital flows, especially credit flows, are largely driven by a *Global Financial Cycle*, which is determined by monetary conditions and by changes in risk aversion and uncertainty. Akinci (2013) shows that the effect of global financial conditions in emerging economies is largely driven by risk aversion, proxied by the U.S. BAA corporate spread, while changes in the U.S. interest rate account for a negligible part of business cycles fluctuations in these economies. Anticipated and unanticipated U.S. interest rate shocks may be key determinants of the *Global Financial Cycle* since they induce large declines in cross-border bank credit and increases in sovereign spread. In fact, both shocks explain a significant fraction of U.S. BAA corporate spread fluctuations.

There has been a renewed interest in the effects of news shocks, understood as shocks that are observed before they materialize (Beaudry and Portier, 2006). 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, in an open economy framework, Ben Zeev et al. (2017) highlight the role of terms of trade news shocks to account for business cycles fluctuations in emerging economies. Regarding monetary policy, previous studies have analyzed the effects of anticipated shocks to the interest rate rule in a closed-economy. Estimating DSGE models, Milani and Treadwell (2012) and Gomes et al. (2013) find that anticipated (news) shocks in monetary policy are more important than unanticipated (surprise) ones to explain U.S. output fluctuations. Ben Zeev et al. (2016) find that a significant fraction of the U.S. interest rate rule residuals is anticipated by the private sector. This paper shows that anticipated U.S. interest rate shocks have significant effects on 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 them 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 presents the empirical results. Section 4 reports the results from additional robustness exercises and extensions. Finally, Section 5 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 partially the expected reaction of the Federal Reserve to anticipated changes in U.S. business cycle conditions. 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

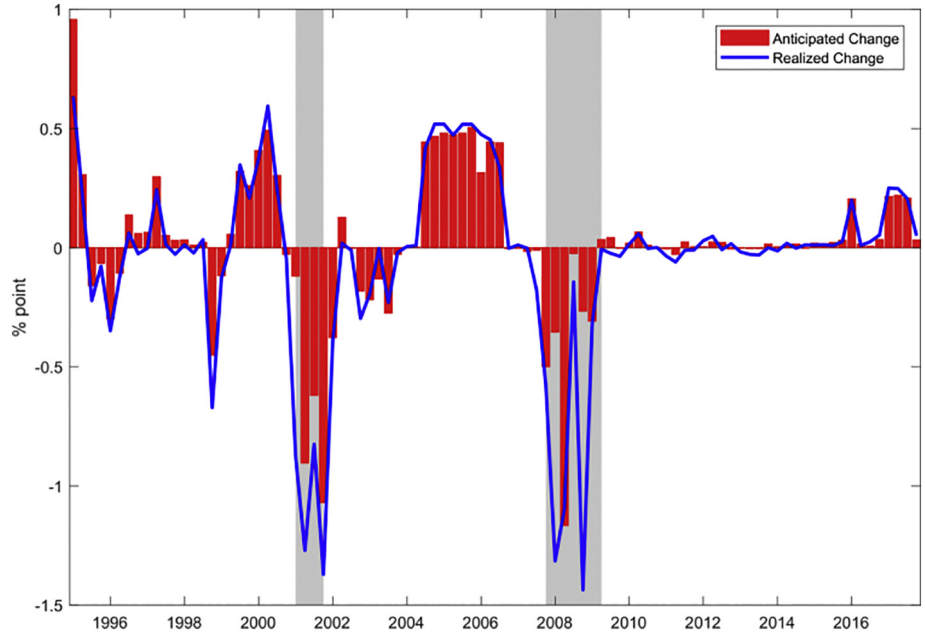


**Fig. 1.** Anticipated and realized changes in the Fed Funds rate. Note: Anticipated Change is computed as difference between market expectations regarding the value of the Fed Funds rate in the current quarter and the realized value of the previous quarter (i.e. $\Delta i^a_{t,t}$ as defined in eq. (1)). 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.

(i.e. potential time varying parameters in the Taylor rule, see Cochrane and Piazzesi, 2002).[2]

The price of the Fed Funds future contracts is based on the average monthly Fed Funds interest rate. At the beginning of a month, this price is based primarily upon future expectations about the Fed Funds effective rate in that month. One potential source of concern is that the risk premia may drive a wedge between the price of Fed Funds future contracts and the expected rate. Sack (2004) documents the existence of a time varying risk premia in Fed Funds futures but its impact on prices is fairly limited, especially in short maturities. Moreover, the risk premia does not vary significantly across short-term maturities, like the ones used in this paper. Piazzesi and Swanson (2008) show that these excess returns are strongly countercyclical and can be predicted by macroeconomic indicators. Considering that I use the difference in the price of these contracts across maturities (not the level) and that there is no consensus on how to effectively remove the premium, I do not adjust future prices by risk premia. However, as I show in Section 2.2, I purge the anticipated and unanticipated movements in the interest rate from expected and unexpected business cycle fluctuations.

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:

$$\Delta i^a_{t,t+j} = \mathbb{E}_{t-1}\left(i_{t+j} - i_{t+j-1}\right) \qquad \text{for } j = \{0,1,2,3\} \tag{1}$$

where $\Delta i^a_{t,t+j}$ denotes the anticipated movement in the Fed Funds rate in quarter $t+j$ 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. On the other hand, I define an unanticipated (surprise) movement as:

$$\Delta i^u_t = i_t - \mathbb{E}_{t-1} i_t \tag{2}$$

where $\Delta i^u_t$ denotes the unanticipated movement in the Fed Funds rate, which is defined as the difference between the realized rate and the one agents were expecting at the beginning of the quarter. Fig. 1 displays the dynamics of the anticipated movements of the interest rate at the beginning of the quarter and the realized ones.

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 is 0.74. This fact reinforces the relevance of considering anticipation to assess the effects of interest rate shocks. As expected, unanticipated movements (i.e. $\Delta i^u_t = \Delta i_t - \Delta i^a_{t,0}$), which correspond to the difference between the line and the bars in Fig. 1, occur mostly during recessions, when it is more difficult to predict the evolution of monetary policy.

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 computed at the beginning of both current and previous three quarters. Since the objective is to assess the predictive power of forecasts to explain the evolution of the interest rate, Table 1 displays the adjusted $R^2$ and the F-Statistic from these specifications.

The predictive power of forecasts about the change in the Fed Funds rate declines 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. Thus, in the empirical analysis, I consider two quarters ahead anticipation for changes in the U.S. interest rate.

[2] These contracts have been also used as a proxy for market expectations by Kuttner (2001) and Gürkaynak et al. (2005), among others. In particular, they define monetary policy surprises as the change in expectations in tight windows around FOMC dates. However, these measures of monetary policy surprises do not distinguish the exact timing of the monetary policy path (i.e. in which particular month markets are expecting a change in the U.S. interest rate). Moreover, markets may have incorporated all the important information by the time of the FOMC meetings from speeches or other announcements. Although monetary policy surprises would be zero in this case, this fact does not mean that there is no expected change in the U.S. interest rate which may affect emerging economies. Finally, aggregating the surprises at the quarterly frequency yields autocorrelated series of shocks and weak instruments for monetary policy shocks (see, for example, Ramey, 2016; Dedola et al., 2017).

[3] For 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.

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

| | $\Delta i_t$ | | | |
|---|---|---|---|---|
| | $\Delta i^a_{t,t}$ | $\Delta i^a_{t-1,t}$ | $\Delta i^a_{t-2,t}$ | $\Delta i^a_{t-3,t}$ |
| Adj. $R^2$ | 0.80 | 0.31 | 0.09 | 0.01 |
| F-Stat | 357.0 | 41.4 | 9.4 | 1.9 |

Note: OLS estimates of the projection of $\Delta i_t$ on the expected change in the interest rate ($\Delta i^a_{t,t+j}$), as defined in eq. (1). $\Delta i_t$ denotes the contemporaneous change in the Fed Funds rate. $\Delta i^a_{t-j,t}$ denotes the expected change in the interest rate for period $t$ with respect to $t-1$, conditional on the information available at the beginning of time t-j. *Adj.* $R^2$ and F-Stat correspond to the adjusted R-squared and the value of the F-Statistic, respectively.

**Table 2**
Correlation between different shocks.

| Series | TT(2016) | $s^u_t$ | $s^a_{t,t}$ | $s^a_{t-1,t}$ | $s^a_{t-2,t}$ |
|---|---|---|---|---|---|
| $s^u_t$ | 0.52*** | | | | |
| $s^a_{t,t}$ | 0.70*** | 0.11 | | | |
| $s^a_{t-1,t}$ | 0.52*** | 0.17 | 0.61*** | | |
| $s^a_{t-2,t}$ | 0.20 | 0.12 | 0.27*** | 0.54*** | |

Note: Contemporaneous correlation between the different shocks and their significance levels. ***, **, and * denote 1%, 5% and 10% confidence level. TT(2016) denotes the monetary policy shocks series of Tenreyro and Thwaites (2016), who update the series of Romer and Romer (2004). $s^a_{i,j}$ denotes the anticipated U.S. interest rate shock for quarter $j$, conditional on the information available at the beginning of quarter $i$. $s^u_j$ is the unanticipated U.S. interest rate shock in quarter $j$.

### 2.2. Identifying U.S. 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 the U.S. economy). Although every change in the U.S. interest rate is exogenous for a small open economy, the fluctuations in the interest rate related to U.S. business cycle conditions cannot be considered an interest rate shock since they capture the systematic response of the Federal Reserve to demand or supply shocks, which may affect emerging economies in different ways. Thus, I purge anticipated and unanticipated changes in the U.S. interest rate from the ones that are due to expected and unexpected macroeconomic dynamics assuming that the Federal Reserve follows a Taylor rule. In particular, I assume that the evolution of GDP, unemployment, and inflation are the key indicators that the Federal Reserve is likely to consider when settling the policy. Then, I identify anticipated and unanticipated shocks by estimating the following equations:

$$\begin{aligned}\Delta i^u_t = {} & \alpha_0 + \alpha_1 i_{t-1} + \alpha_2(\hat{y}_t - \mathbb{E}_{t-1}\hat{y}_t) + \alpha_3(\hat{u}_t - \mathbb{E}_{t-1}\hat{u}_t) \\ & + \alpha_4(\hat{\pi}_t - \mathbb{E}_{t-1}\hat{\pi}_t) + (\varepsilon_t - \mathbb{E}_{t-1}\varepsilon_t)\end{aligned} \tag{3}$$

$$\begin{aligned}\Delta i^a_{t,t+j} = {} & \gamma_{0,j} + \gamma_{1,j}\mathbb{E}_{t-1}(i_{t+j-1}) + \gamma_{2,j}\mathbb{E}_{t-1}\left(\hat{y}_{t+j} - \hat{y}_{t+j-1}\right) \\ & + \gamma_{3,j}\mathbb{E}_{t-1}(\hat{u}_{t+j} - \hat{u}_{t+j-1}) + \gamma_{4,j}\mathbb{E}_{t-1}(\hat{\pi}_{t+j} - \hat{\pi}_{t+j-1}) \\ & + \mathbb{E}_{t-1}(\varepsilon_{t+j} - \varepsilon_{t+j-1}) \qquad \forall j = \{0,1,2\}\end{aligned} \tag{4}$$

where $\mathbb{E}_{t-1}(x_{t-1})$ for $x = \{\hat{\pi}, \hat{y}, \hat{u}\}$ denotes the expectations about the variable $x$ in the quarter that has just ended, conditional on the information available at that moment. Eq. (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 ($s^u_t \equiv \varepsilon_t - \mathbb{E}_{t-1}\varepsilon_t = \varepsilon_t$). Eq. (4) expresses an anticipated change as a function of expected changes in the same macroeconomic variables for the different horizons ($j = \{0,1,2\}$) plus the anticipated interest rate shock ($s^a_{t,t+j} \equiv \mathbb{E}_{t-1}(\varepsilon_{t+j} - \varepsilon_{t+j-1})$).

Anticipated and unanticipated changes in the U.S. interest rate are computed using market's expectations. Thus, to estimate Eqs. (3) and (4) with the same information set, I need to consider private sector's expectations about the evolution of the main macroeconomic variables mentioned before. For this reason, I use the Survey of Professional Forecasters (SPF) data set, a quarterly survey of macroeconomic forecasts published by the Federal Reserve Bank of Philadelphia. This data set, which has been widely used in previous studies, reports the forecasts for the main U.S. macroeconomic variables made by professional forecasters, during the first month of the quarter, for each quarter up to one year ahead conditional on the information available from the previous quarter. In particular, I use expectations about GDP growth, Unemployment rate and CPI inflation rate.

All equations are estimated by OLS. One source of concern is the potential feedback between expected changes in the rate and in macroeconomics dynamics. However, each equation contains macroeconomic forecasts for the same horizon. Considering that there is some lag in the effects of monetary policy (see, for example, Romer and Romer, 2004), this makes it unlikely that the estimated coefficients are biased due to simultaneity. In this context, the identified series of shocks (i.e. $s^u_t \equiv \varepsilon_t$ and $s^a_{t,t+j} \equiv \mathbb{E}_{t-1}(\varepsilon_{t+j} - \varepsilon_{t+j-1})$ for $j = \{0,1,2\}$) capture a variety of factors like perceived overreaction or underreaction and/or temporary shifts in the priorities of the FED.

### 2.3. Comparison with series of monetary policy shocks

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 (2016) (TT(2016)), is one of the most popular ones. This series is defined as changes in the reference interest rate at Federal Open Market Committee (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. The Online Appendix B contains a more detailed comparison between the series of shocks.

The first fact that emerges is that the anticipated series about the current quarter is highly and significantly (0.7) correlated with TT(2016) series. Moreover, the correlation of TT(2016) 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 (2016) series, which means that a fraction of TT(2016) is considered unanticipated. Finally, an important fact for the analysis is that surprise and anticipated shocks are orthogonal. Considering that the anticipated series are computed at the beginning of each quarter, before the realization of TT(2016) series for the same quarter, these facts confirm that almost half of the narrative series of U.S. monetary policy shocks are anticipated by the market before they occur. In this context, a VAR with insufficient information (i.e. without considering agents' expectations) would fail to capture the dynamics of the variables (see, for example, Hansen and Sargent, 1991). Thus, including only the current value of unanticipated U.S. interest rate shocks or the narrative series 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. First, I specify the empirical model used to assess the effects of both types of shocks on emerging economies. Second, I describe the estimation method and

the data set. Finally, I present the Impulse Response Functions (IRFs) and Forecast Error Variance decomposition (FEV) of the main macroeconomic variables of emerging economies to both types of shocks.

### 3.1. Empirical model

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

$$X_{i,t} = B_i + C(L)X_{i,t-1} + D(L)s^u_t + E(L)s^a_{t,t} + Fs^a_{t,t+1} + Gs^a_{t,t+2} + \varepsilon_{i,t} \quad (5)$$

where $X_{i,t}$ is a vector of endogenous variables for country $i$, $C(L)$, $D(L)$, $E(L)$ denote P-order lag polynomials, and $s^u_t$ and $s^a_{t,t+j}$ are the surprise and anticipated interest rate shocks, respectively. Following the results of Table 1, I consider only two quarters as the anticipation horizon for U.S. interest rate shocks. Finally, $\varepsilon_{i,t}$ is a white noise vector of disturbances. This system is similar to the one proposed by Mertens and Ravn (2011) and Mertens and Ravn (2012) to study the effects of anticipated and unanticipated tax shocks in the U.S. In order to allow for persistence in the changes in U.S. interest rate, the baseline specification of the system includes one lag of both shocks (i.e. $D(L)$ and $E(L)$). However, results are robust to not including any lags or to allowing for more lags.

In the baseline specification, $X_{i,t}$ is a set of variables necessary to capture both the macroeconomic effects (both on economic activity and inflation) and the transmission channels (financial and trade channels). In particular, $X_{i,t}$ consists of foreign (exogenous) and domestic variables. The foreign variables are the country-specific terms of trade index, defined as the ratio between the export and import price indexes, and the U.S. corporate bond (BAA) spread. The corporate spread, which is defined as the difference between Moody's BAA corporate yield and the yield on 10-Year Treasury constant maturity, constitutes a good indicator of global financial conditions for emerging economies (Akinci, 2013). The domestic macroeconomic variables consists of eight indicators: external bank credit to financial and non-financial firms, GDP, investment, trade balance-to-GDP ratio, the annual depreciation rate of the multilateral nominal exchange rate, the annual consumer price inflation rate, the country interest rate, and the banking sector borrowing-lending spread. The country interest rate is defined as the ten-year U.S. government bond yield plus the country spread, proxied by the JP Morgan EMBI Global Index. Following Akinci (2013), the banking sector borrowing-lending spread is defined as the difference between the domestic lending rate to the corporate sector and the deposit interest rate. External credit, output, and investment are expressed in real terms and in percentage deviations from a linear trend. Terms of trade are expressed in percentage deviation from its mean. CPI inflation, exchange rate depreciation, U.S. BAA corporate yield, trade balance-to-GDP ratio, country interest rate, and the borrowing-lending spread are expressed in percentage points. Precise definitions of the variables, sample periods for each country, and data sources are included in Data Appendix A.

This specification is in line with small open economy models and with previous empirical studies that consider changes in the U.S. interest rate as exogenous for emerging economies. The estimated effects of these shocks do not rely on the ordering of the variables. In particular, there is no need to impose zero or sign restrictions on the response of domestic variables to changes in U.S. interest rate, nor to identify the other shocks in the system.

### 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 using the least square estimator with country dummies (Least Square Dummy Variable (LSDV)). The sample begins in the first quarter of 1995 and ends in the third quarter of 2017. Prior to 1995 there is no availability of continuous series of future contracts for one up to nine months ahead. In order to maintain comparability with previous studies, the choice of the representative sample of emerging economies is similar to Uribe and Yue (2006) and Akinci (2013). However, in Section 4 I present the main results using an extended sample of 13 emerging economies.

The Least Square Dummy Variable (LSDV) estimator, which has been widely used to estimate Panel VARs with a large time series dimension, imposes that $C(L)$, $D(L)$, $E(L)$, $F$ and $G$ are the same across countries but allows for a different intercept for each country (i.e. country fixed effect). The rationale for pooling data is to gain efficiency. Considering the Bayesian Information Criterion (BIC) and the Hannan-Quinn (HQ) information criteria, I estimate a VAR with 2 lags, which yields uncorrelated reduced form residuals. As the time 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 data set is large (91 observations), the inconsistency problem is likely not to be a major concern.

### 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. Fig. 2 displays the response of macroeconomic variables to a two-quarter ahead anticipated 25 basis points contractionary U.S. interest rate shock.[4]

The anticipated contractionary shock induces an immediate contraction of GDP and investment of approximately 0.5% and 1%, respectively, from their linear trends. These results are coupled with an immediate fall in the terms of trade, an increase in the banking sector borrowing-lending spread, a reduction in the cross-border bank credit, and a depreciation of the nominal exchange rate. The response of the terms of trade could be explained by the fact that most of these countries are commodity exporters and that commodity prices are sensible to U.S. monetary policy (see, for example, Frankel, 2006). The country interest rate and the U.S. BAA corporate spread also increase and reach their peaks at $t = -1$, one quarter before the change in the international interest rate materializes. The trade balance-to-GDP ratio improves only when the change in the international interest rate materializes. This response could also be explained by the previous 3.5 percentage point depreciation of the nominal exchange rate. Finally, the contractionary shock induces a slight increase in consumer price (CPI) inflation. An important fact to highlight is that a significant fraction of the adjustment of both macroeconomic and financial variables occurs within the first two quarters, before the change in the U.S. interest rate materializes.

Macroeconomic variables display comparable qualitative dynamics than in case of a Sudden Stop (Calvo, 1998). This phenomenon is characterized by a sudden slow down in private capital inflows that is followed by a sharp decrease in GDP and investment, a real exchange rate depreciation, and an improvement in the current account. Although I do not consider capital inflows in my analysis, the fast decline of macroeconomic variables, the sharp increase in the country interest rate, and cross-border bank credit dynamics are consistent with the findings of this literature. In particular, Cavallo et al. (2015) show that the Sudden Stops dominated by banking flows are associated with larger output losses, which may contribute to explain the fast decline in GDP. Thus, anticipated movements in the U.S. interest rate may trigger Sudden Stops.

Fig. 3 displays the IRFs to an unanticipated 25 basis points contractionary U.S. interest rate shock. To compare to the previous responses,

[4] The impulse responses of the U.S. economy to the contractionary anticipated and unanticipated U.S. interest rate shocks are presented in the Online Appendix C.

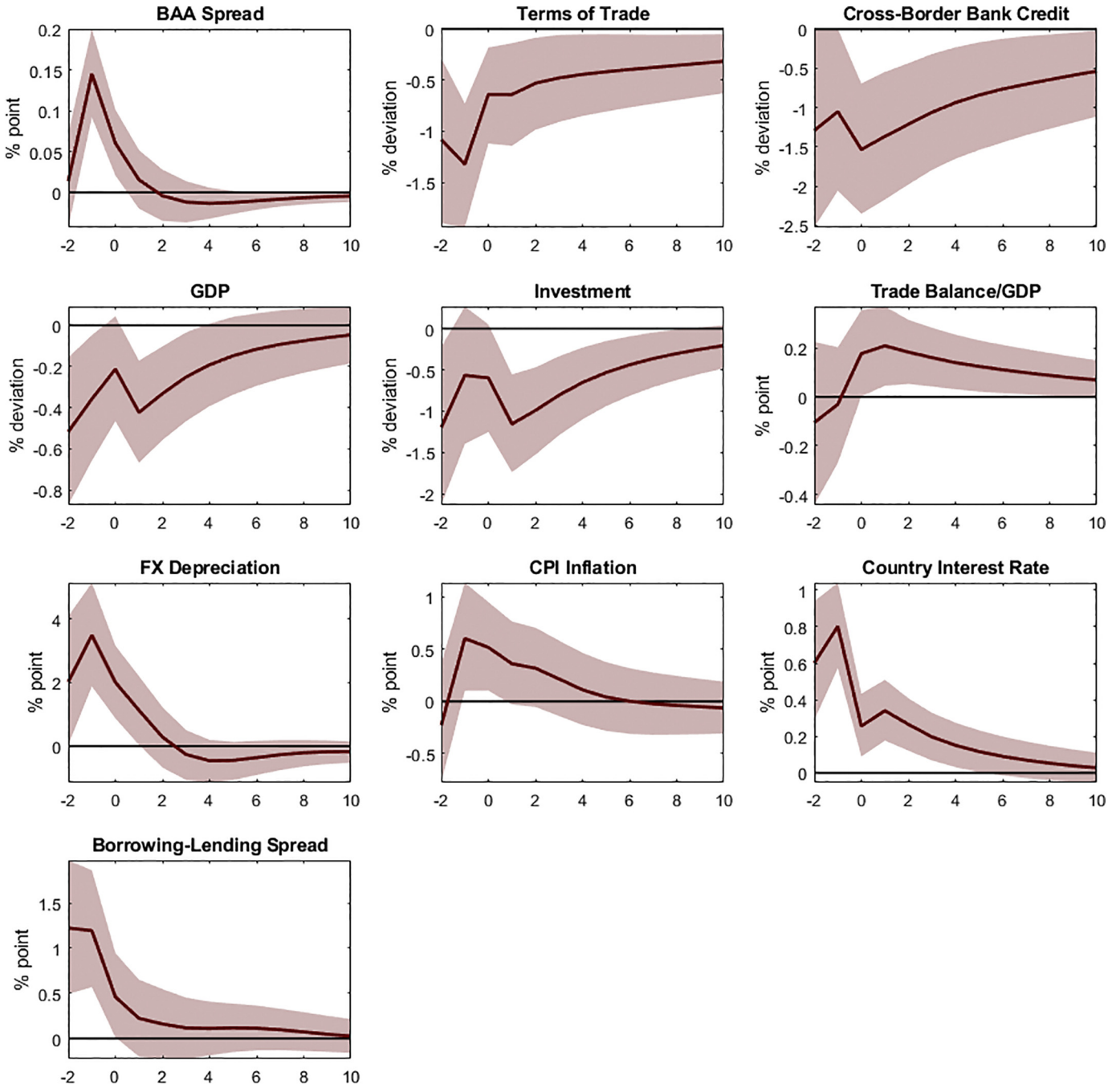


**Fig. 2.** IRFs to a two-quarter ahead anticipated 25 bps contractionary U.S. interest rate shock. Note: Solid lines denote point estimates of impulse responses from the VAR system (5); 90% confidence bands are depicted with light-red shaded areas. The responses of cross-border bank credit, GDP, and investment are expressed in % deviations from their respective linear trend. The response of terms of trade is expressed in % deviations. The responses of U.S. BAA corporate spread, trade balance-to-GDP ratio, country interest rate, exchange rate depreciation, CPI inflation, and borrowing-lending spread are expressed in annualized % points. $t = 0$ denotes the period when the U.S. interest rate increases. The previous two periods show the adjustment of the variables before the change in the U.S. materializes (i.e. $s^a_{t-2,t} = 0.25$, $s^a_{t-1,t} = 0.25$ and $s^a_{t,t} = 0.25$). Confidence bands are computed through 10,000 bootstrap replications. Horizon is in quarters.

this figure also contains the median IRFs to an anticipated 25 basis points contractionary shock once it materializes (i.e. from $t = 0$ onwards). The response of most of the variables to an unanticipated shock is immediate and quantitatively similar to the anticipated shock. In particular, the responses of output, investment, trade balance-to-GDP ratio, exchange rate depreciation, and CPI inflation to both shocks are not statistically different. While the response of the country interest to an unanticipated shock is less persistent, the one of the U.S. BAA corporate spread is faster and slightly stronger. Country interest rate dynamics are in line with the findings of Albagli et al. (forthcoming), who show that U.S. monetary policy surprises have a significant impact on long-term yields in emerging economies. Unlike the findings of Uribe and Yue (2006) and Akinci (2013), the country interest rate does not display a delayed response to the unanticipated shock. This fact, which coincides with the findings of Canova (2005) and Mackowiak (2007), is consistent with the idea that financial variables react on impact to the new flow of information. Finally, unlike the previous case, the terms of trade do not react significantly to changes in the U.S. interest rate.

Although the effects of both shocks are comparable, the differential response of some variables suggests that both shocks are transmitted through different channels. First, the response of the U.S. BAA corporate

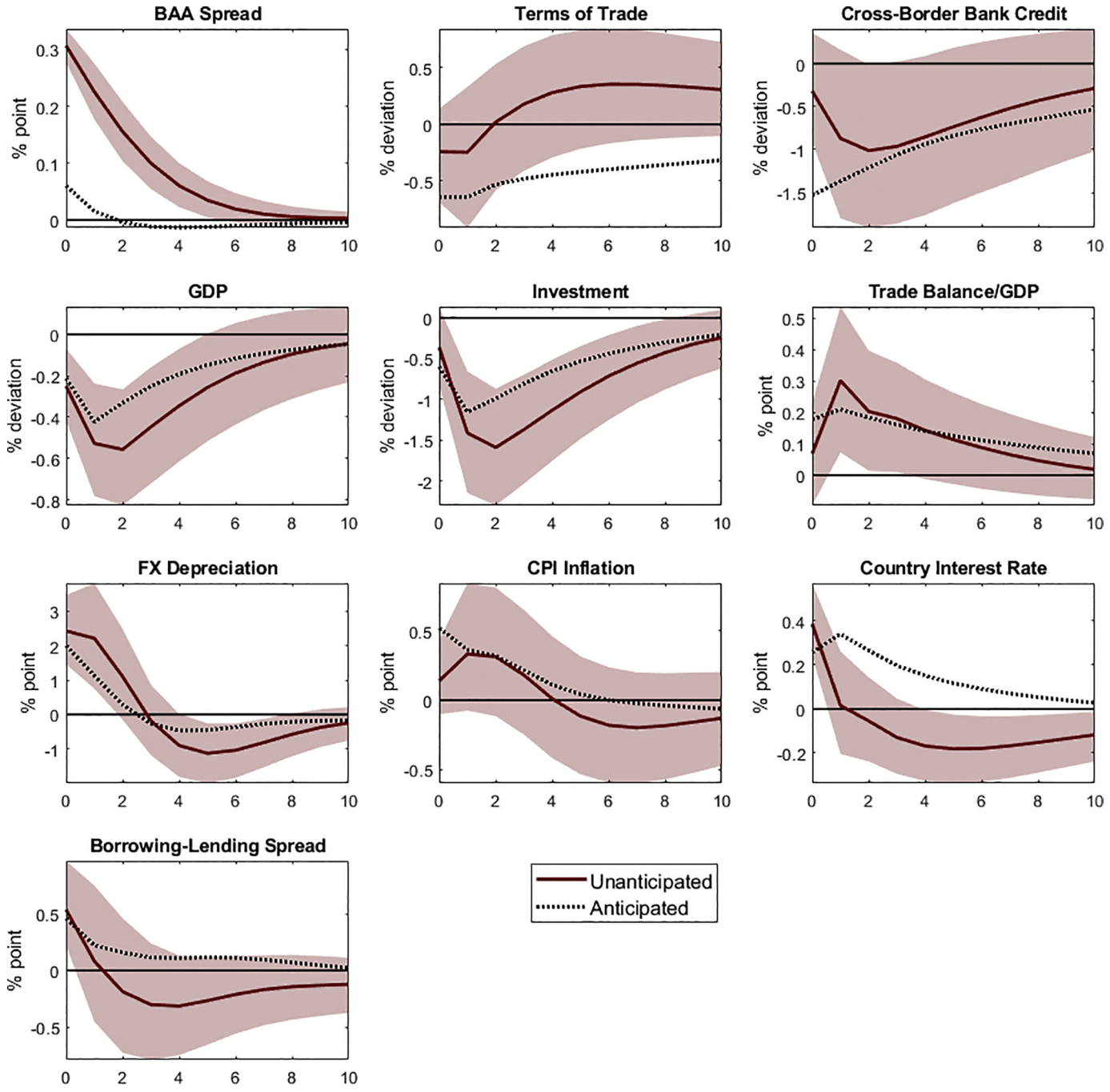


**Fig. 3.** IRFs to an unanticipated 25 bps contractionary U.S. interest rate shock. Note: Solid lines and light-red shaded areas denote point estimates and 90% confidence bands of the impulse responses to an unanticipated U.S. interest rate shock from the VAR system (5), respectively. Dotted lines denote the median IRFs to a 25 bps anticipated U.S. interest rate shock after the shock materializes (i.e. from period $t = 0$ onwards). The responses of cross-border bank credit, GDP, and investment are expressed in % deviations from their respective linear trend. The response of terms of trade is expressed in % deviations. The responses of U.S. BAA corporate spread, trade balance-to-GDP ratio, country interest rate, exchange rate depreciation, CPI inflation, and borrowing-lending spread are expressed in annualized % points. Confidence bands are computed through 10,000 bootstrap replications. Horizon is in quarters.

spread to the unanticipated shock is stronger and more persistent. Second, the responses of the terms of trade and cross-border bank credit are statistically significant before the anticipated shock materializes (i.e. $t = -2$ and $t = -1$) and they converge slowly to their previous values. While foreign corporate credit seems more significant for the transmission of unanticipated shocks, the banking channel and terms of trade appear more significant for the anticipated ones. Section 3.4 assesses the role of U.S. interest rate shocks as a driver of business cycle fluctuations in emerging economies and the relevance of each transmission channel.

### 3.4. Forecast error variance decomposition

In order to understand the contribution of U.S. interest rate shocks to explain business cycle fluctuations in emerging economies, I compute the FEV decomposition of the variables included in the baseline VAR. The first three rows of Table 3 display the FEV explained by anticipated, surprise, and both shocks, respectively. Unanticipated U.S. interest rate shocks explain 5 percent of the variation in output, which is consistent with the findings of Mackowiak (2007) and Akinci (2013). A similar result holds using the same identification strategy proposed in this paper

**Table 3**
Share of forecast error variance explained by U.S. interest rate shocks.

| Specification | Shock | BAA | TOT | Credit | GDP | I | TB | NEER | CPI | R | BLS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline | Ant | 10.1 | 8.4 | 9.9 | 9.0 | 8.9 | 3.7 | 11.9 | 2.3 | 26.4 | 10.4 |
| | Surp | 31.1 | 0.4 | 1.7 | 5.0 | 6.3 | 1.9 | 3.7 | 0.4 | 2.4 | 0.9 |
| | Total | 41.2 | 8.8 | 11.6 | 14.0 | 15.2 | 5.6 | 15.6 | 2.7 | 28.8 | 11.3 |
| No BAA | Ant | – | 9.4 | 7.8 | 7.0 | 6.9 | 3.5 | 11.5 | 3.7 | 29.2 | 10.8 |
| | Surp | – | 0.1 | 0.2 | 1.1 | 2.6 | 1.4 | 2.4 | 2.2 | 1.3 | 0.5 |
| | Total | – | 9.5 | 8.0 | 8.1 | 9.5 | 4.9 | 13.9 | 5.9 | 30.5 | 11.3 |
| No Bank | Ant | 10.1 | 8.4 | – | 6.6 | 6.0 | 2.3 | 9.1 | 1.1 | 25.2 | – |
| | Surp | 31.1 | 0.4 | – | 5.0 | 6.4 | 1.7 | 3.0 | 0.2 | 2.3 | – |
| | Total | 41.2 | 8.8 | – | 11.6 | 12.4 | 4.0 | 12.1 | 1.3 | 27.5 | – |
| No TOT | Ant | 8.4 | – | 7.1 | 7.7 | 7.3 | 2.6 | 10.6 | 2.8 | 26.4 | 11.1 |
| | Surp | 31.0 | – | 1.7 | 5.0 | 6.3 | 1.8 | 3.4 | 0.4 | 2.4 | 0.9 |
| | Total | 39.4 | – | 8.8 | 12.7 | 13.6 | 4.4 | 14.0 | 3.2 | 28.8 | 12.0 |

Note: Estimated contribution of the Anticipated (Ant) and Unanticipated (Surp) U.S. interest rate shocks and of both shocks (Total) to explain the two year variation in the variables included in the baseline VAR and in the baseline specification when U.S. BAA corporate spread does not react to the shocks (No BAA), when banking sector variables (total cross-border credit and banking sector borrowing-lending spread) do not react ("No Bank"), and when the terms of trade do not react to the shocks (No TOT). Shares are expressed in percent. Column variables are: U.S. BAA corporate spread (BAA), terms of trade (TOT), cross-border bank credit (Credit), output (GDP), investment (I), trade balance-to-GDP ratio (TB), annualized nominal exchange rate depreciation (NEER), annualized consumer price inflation (CPI), the country interest rate (R), and borrowing-lending spread (BLS).

but considering U.S. interest rate shocks, without disentangling between the anticipated and unanticipated components (see Online Appendix G). However, accounting for anticipated shocks increases the contribution of U.S. interest rate to 14%. Similar results hold for investment and the exchange rate depreciation. Thus, accounting for anticipation is important for measuring the importance of U.S. interest rate shocks as a source of business cycle fluctuations in emerging economies. While anticipated shocks are particularly important to explain fluctuations in external credit, country interest rate and borrowing-lending spread, unanticipated shocks explain a significant fraction of the variation in the U.S. BAA corporate spread.

To quantify the role of credit and terms of trade channels, I perform counterfactual exercises similar to Uribe and Yue (2006), Akinci (2013) and Caballero et al. (2016). These exercises trace out the response of each variable in the case some variables do not react to each shock. Specifically, using the baseline estimates of Section 3.3, I set all the estimated coefficients from the equation that corresponds to the variable that does not react to both shocks equal to zero and recompute the IRFs.[5] Following previous results, I perform three experiments. For ease of exposition, I present only the FEV of all the variables to anticipated and unanticipated U.S. interest rate shocks for the three exercises in Table 3, leaving the impulse responses for the Online Appendix E. First, I assume that the U.S. BAA corporate spread does not change in response to both shocks ("No BAA" - rows four to six). Second, I assume that banking sector variables are not affected by both shocks ("No Bank" - rows seven to nine). In particular, I assume that the cross-border bank credit and the banking sector borrowing-lending spread do not change. Third, I assume that the terms of trade do not react to both shocks ("No TOT" - rows ten to twelve).

While the amplification though the U.S. BAA corporate spread is key to explain the dynamics of GDP, investment and cross-border bank credit, the responses of the borrowing-lending spread and the country interest rate remain almost unchanged. In particular, output and investment (conditional) volatilities are reduced by 42% when the U.S. BAA corporate spread does not amplify the effects of interest rate shocks. The importance of U.S. BAA corporate spread fluctuations, which are partially explained by U.S. interest rate shocks, is consistent with the findings of Akinci (2013). Assuming that banking variables or the terms of trade do not react reduces the (conditional) volatility of output and investment by around 17% and 10%, respectively. On the one hand, the U.S. BAA corporate spread is the only variable, from the three considered in the analysis, that affects output and investment responses to the unanticipated U.S. interest rate shock. Closing the responses of banking variables and the terms of trade leaves output and investment responses to the unanticipated shock almost unchanged. On the other hand, banking variables are as important as the U.S. BAA corporate spread to explain the response of output to anticipated U.S. interest rate shocks.

[5] The results from these exercises are subject to the Lucas' critique (Lucas, 1976). A small open economy model that includes news about the international interest rate and the different transmission channels would be useful for these exercises.

## 4. Alternative empirical specifications

Both anticipated and unanticipated contractionary U.S. interest rate shocks induce a contraction of economic activity in emerging economies. In this section I assess whether the results are robust to enlarging the sample of emerging economies and to alternative specifications of the baseline model.

### 4.1. Extended sample of emerging economies

In the baseline specification, I use data for a representative set of emerging economies, very similar to the ones used by Uribe and Yue (2006) and Akinci (2013), to maintain comparability with previous studies. To entertain the hypothesis that results could be driven by the particular sample of countries, I estimate the same VAR but extending the sample to the following emerging economies that belong to the JP Morgan EMBI Global index: Bulgaria, Colombia, Hungary, Republic of Korea, Malaysia, and Peru. The period of the sample remains 1995:Q1–2017:Q3 and varies for each country depending on data availability. Data Appendix A contains a detailed description of the data set. Figs. 4 and 5 display the IRFs to a two-quarter ahead anticipated and to an unanticipated U.S. interest rate shock using this extended sample of emerging economies. To compare with previous findings, both figures also contain the median IRFs using the baseline sample (dashed line). The responses of macroeconomic and financial variables to both shocks remain almost unchanged to extending the sample of countries.

### 4.2. Other alternative specifications

Previous conclusions could be due to the large number of variables included in the baseline VAR, the specific measure of external credit to emerging economies, the zero lower period after 2007, the definition of the U.S. interest rate shock, the indicator of global financial conditions, global changes in economic activity that affect the U.S. interest rate, the exchange rate regime, and/or the particular set of countries considered in the analysis. In order to evaluate the sensitivity of the

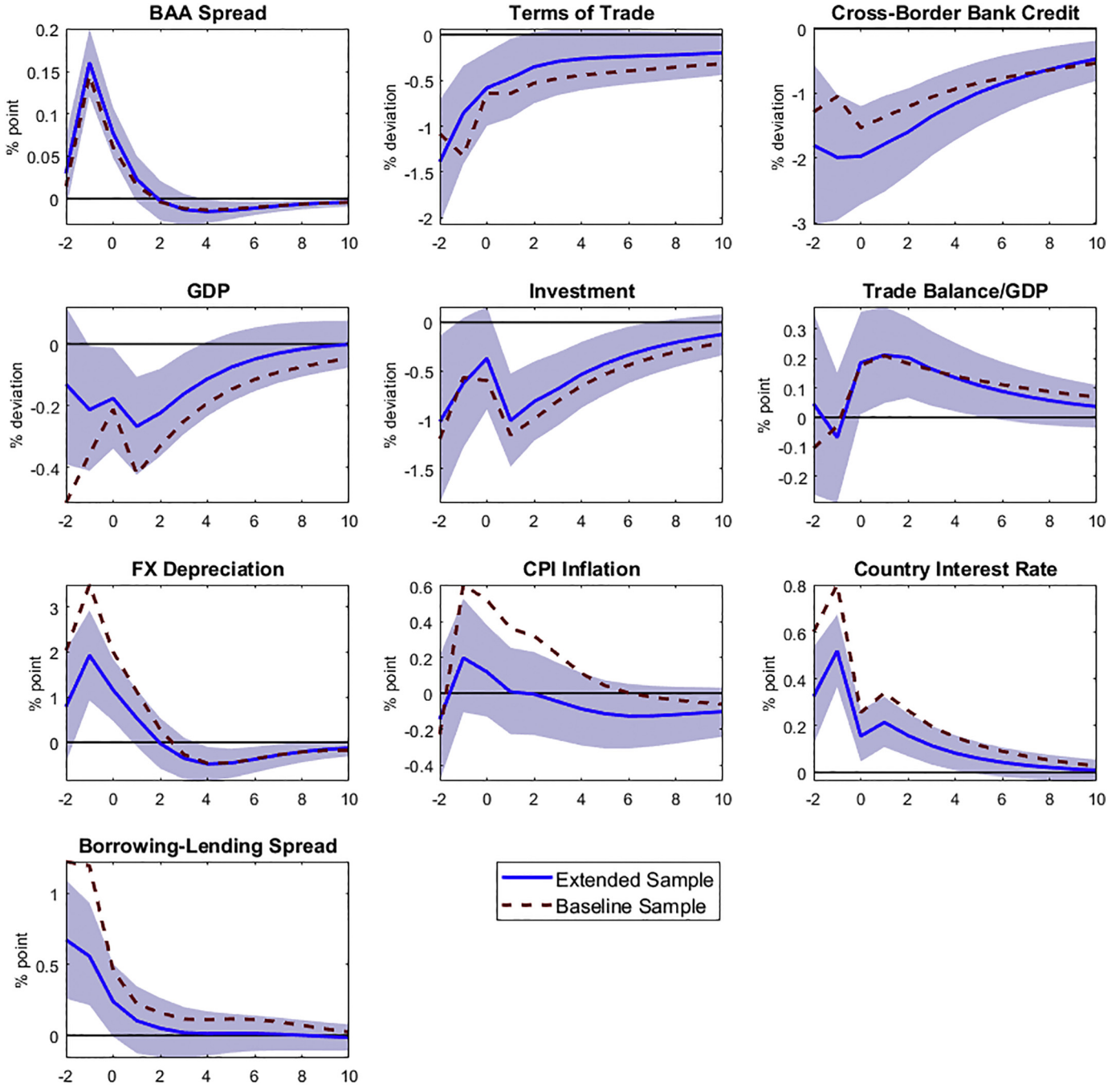


**Fig. 4.** IRFs an anticipated 25 bps contractionary U.S. interest rate shock - Extended sample. Note: Solid blue lines denote point estimates of impulse responses from the VAR system (5) using an extended sample (13 emerging economies); 90% confidence bands for the extended sample are depicted with light-blue shaded areas; dashed lines denote the median impulse responses using the baseline sample (7 emerging economies). The responses of cross-border bank credit, GDP, and investment are expressed in % deviations from their linear trends. The response of terms of trade are expressed in % deviations. The responses of U.S. BAA corporate spread, trade balance-to-GDP ratio, country interest rate, exchange rate depreciation, CPI inflation, and borrowing-lending spread are expressed in annualized % points. $t = 0$ denotes the period when the U.S. interest rate increases. The previous two periods show the adjustment of the variables before the change in the U.S. materializes (i.e. $s^a_{t-2,\,t} = 0.25$, $s^a_{t-1,\,t} = 0.25$ and $s^a_{t,\,t} = 0.25$). Confidence bands are computed through 10,000 bootstrap replications. Horizon is in quarters.

results to these explanations, I estimate the following VAR specifications: considering only 6 variables (U.S. BAA corporate spread, output, investment, trade balance, exchange rate depreciation, and country interest rate), including the net equity issuance instead of the cross-border credit, using the pre-ZLB sample (1995:Q1–2007:Q4), employing the changes in the U.S. interest rate as defined in Section 2.1 instead of the U.S. interest rate shocks defined in Section 2.2, augmenting the baseline VAR with VIX and global GDP, and using a subsample of countries with fix exchange rate regime. Finally, I re-estimate the baseline VAR dropping one country at the time to test if the results are driven by an outlier. For ease of exposition, the detailed description of each specification and the results are presented in the Online Appendix F. The main conclusions in all these specifications remain unchanged: anticipated and unanticipated U.S. interest rate shocks induce a significant contraction of economic activity in emerging economies.

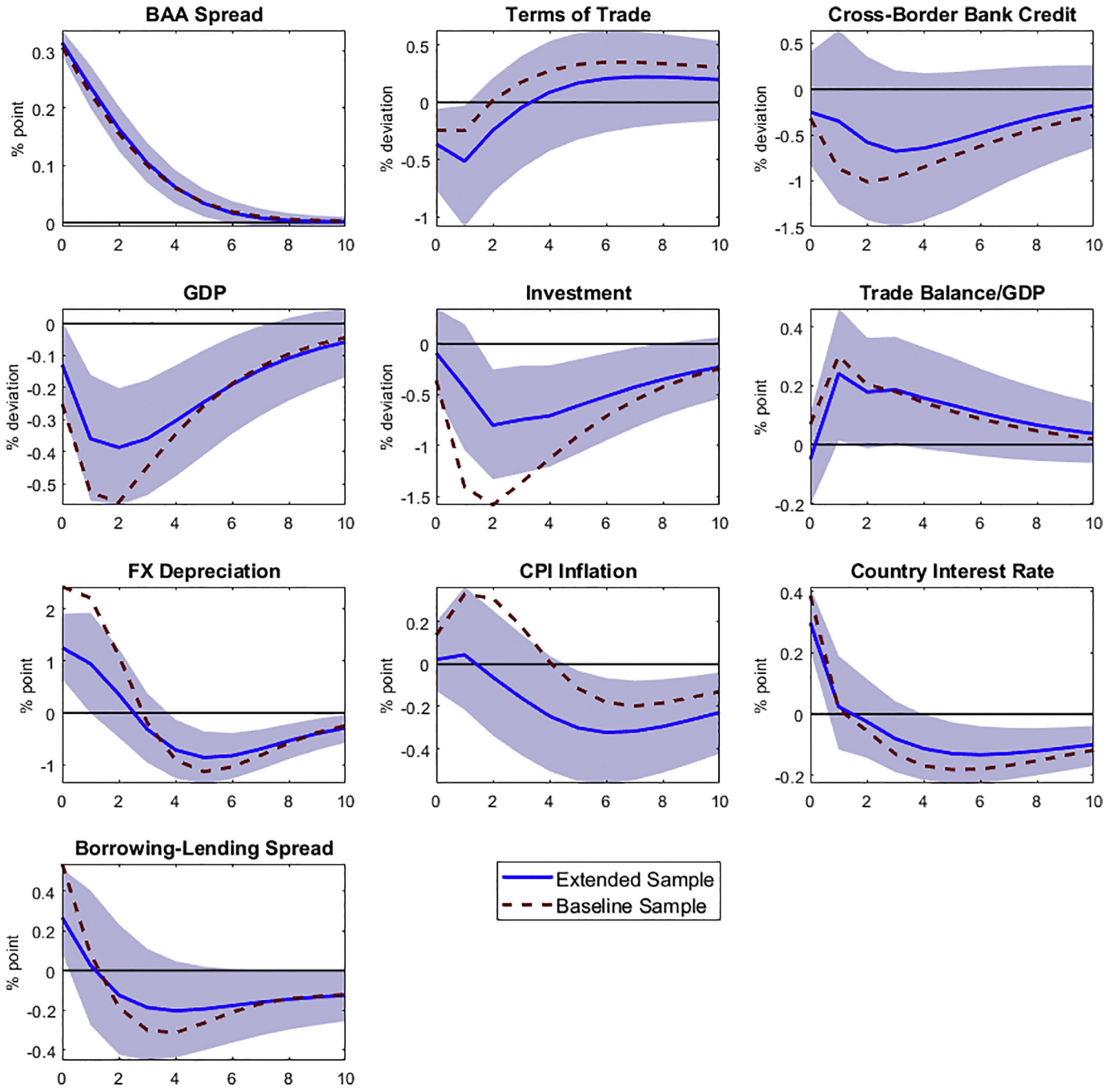


**Fig. 5.** IRFs to an unanticipated 25 bps contractionary U.S. interest rate shock - Extended sample. Note: Solid blue lines denote point estimates of impulse responses from the VAR system (5) using an extended sample (13 emerging economies); 90% confidence bands for the extended sample are depicted with light-blue shaded areas; dashed lines denote the median impulse responses using the baseline sample (7 emerging economies). The responses of cross-border bank credit, GDP, and investment are expressed in % deviations from their linear trends. The response of terms of trade is expressed in % deviations. The responses of U.S. BAA corporate spread, trade balance-to-GDP ratio, country interest rate, exchange rate depreciation, CPI inflation, and borrowing-lending spread are expressed in annualized % points. Confidence bands are computed through 10,000 bootstrap replications. Horizon is in quarters.

## 5. Conclusions

This paper has explored the role of anticipation in assessing the effects of U.S. interest rate shocks on emerging economics. Anticipation accounts for 80% of the effective quarterly fluctuations in the Fed Funds and explains around half of the narrative series of monetary policy shocks. Three major conclusions can be derived from the analysis. First, monetary news induce an immediate response of macroeconomic variables, even before the change in the U.S. interest rate materializes. In particular, an anticipated 25 basis points increase in the U.S. Fed Funds rate generates an immediate 0.5% decrease in GDP and 1.1% fall in investment from their trends. Second, unanticipated contractionary U.S. interest rate shocks induce a comparable contraction of economic activity to anticipated ones after the change in the rate. Finally, the response of the U.S. BAA corporate spread significantly amplifies the response of emerging economies to both shocks. Overall, anticipated and unanticipated U.S. interest rate shocks explain around 14% of output fluctuation in emerging economies.

Results show that anticipation is crucial for assessing the effects of U.S. interest rate shocks, since a significant part of the adjustment in emerging economies occurs before a change in the interest rate materializes. These findings help in understanding the adjustment of these economies to the current FED's liftoff. From a policy perspective, movements in the international interest rate pose a significant trade-off to emerging economies. On the one hand, they induce pressures to tight monetary policy in order to avoid large currency depreciations that may affect the banking sector. On the other hand, they create incentives to lower the interest rate to boost economic activity. Aoki et al. (2016) show that macroprudential policies are complementary to an inflation targeting regime to enhance welfare but that inflation targeting alone can reduce welfare. However, their theoretical framework considers only a one production sector subject to sticky prices, disregards the anticipation effects of interest rate shocks, and does not include the country spread in the analysis. Thus, it would be interesting to study optimal policy in this framework considering a policy rule that could react to expected and current foreign interest rate. This topic constitutes a promising opportunity for future research.

## Appendix A. Data Appendix

For the analysis, I consider emerging economies included in the J.P. Morgan Emerging Market Bond Index Global (EMBI Global). The baseline sample, which is very similar to the ones used by Uribe and Yue (2006) and Akinci (2013), includes quarterly data for Argentina (1995:Q1–2001:Q3), Brazil (1997:Q1–2017:Q3), Chile (1999:Q2–2017:Q1), Mexico (1995:Q1–2017:Q1), Philippines (1998:Q1–2014:Q3), South Africa (1995:Q1–2016:Q4), and Turkey (1999:Q3–2017:Q3). The sample for Argentina ends in 2001:Q3 since after its sovereign default the country interest rate was not allocative. The choice of countries and sample period is guided by macroeconomic, sovereign spread, and borrowing-lending spread data availability. The extended sample of emerging economies, which consists of 13 economies in total, also includes data for: Bulgaria (2000:Q2–2013:Q4), Colombia(2001:Q1–2017:Q1), Hungary (1999:Q1–2017:Q3), Republic of Korea (1996:Q3–2004:Q1), Malaysia (1996:Q4–2017:Q1), and Peru (1997:Q1–2012:Q3).

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. Terms of trade are computed as the ratio between export price index and import price index. In case these indexes are not available, I use the export and import price indexes computed by the national central banks. CPI Inflation denotes the change in the Consumer Price Index with respect to the same quarter of the previous year. All these variables are seasonally adjusted using the X13-ARIMA-SEATS before any transformation.

For exchange rate, I use the nominal exchange rate index computed by the Bank of International Settlements (BIS). These indexes is calculated as a geometric weighted average of bilateral exchange rates. For the analysis, I use the quarterly average. The depreciation of the exchange rate corresponds to the change in this index with respect to the same quarter of the previous year.

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). The spread is computed as an arithmetic, market-capitalization-weighted average of US-dollar denominated bond spreads issued by sovereign and quasi-sovereign entities 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.

Credit market variables are downloaded from the FRED, BIS and IMF IFS. In particular, the U.S. BAA corporate spread is defined as the difference between Moody's BAA corporate yield and the yield on 10-year Treasury constant maturity (series: BAA10Y from FRED). Cross-border bank credit denotes total foreign claims (all instruments, in all currencies) outstanding to all the sectors deflated by the U.S. consumer price index. This Locational Banking data set is complied by the Bank of International Settlements. Finally, the borrowing-lending spread is computed as as the difference between the domestic lending rate in domestic currency to the corporate sector and the deposit interest rate in domestic currency. Information for both interest rates come from IMF International Financial Statistics (IFS) database.

To identify anticipated and unanticipated interest rate shocks in the U.S., I use data from the CBOT Fed Funds future 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 1 to 12 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. See Owens and Webb (2001) and "Reference Guide: CBOT Fed Fund futures" for a detailed description on how this market works. The daily effective fed funds rate is calculated and reported by the Federal Reserve Bank of New York. The quarterly average of this series comes from from St. Louis Fed FRED database and is used as the realized value of this variable, to identify unanticipated shocks.

Expectations about the evolution of business cycle conditions in the United States are proxied by the Survey of Professional Forecasters (SPF) data set. In particular, I use expectations about GDP growth, Unemployment rate and CPI in inflation rate. See https://www.philadelphiafed.org/research-and-data/real-time-center/survey-of-professional-forecasters/ for more detailed information about this survey.

## Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jinteco.2018.12.002.

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