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When the Fed sneezes, the whole world catches the cold, when the ECB - only Europe

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Abstract

This paper presents evidence that the international spillovers of Fed's conventional monetary policy to emerging markets are global, while their ECB's counterparts are local. The result comes from panel Bayesian Vector Autoregressive model estimated separately for two groups of countries: Central Eastern Europe (CEE) and Latin America (LA). In this setup, we investigate the impact of unanticipated and anticipated Fed and ECB montetary policy shocks, showing that the former affect both regions, while the latter are important for CEE and insignificant for LA.

Keywords: Monetary policy spillovers, international business cycles, emerging economies
JEL Classifications: E32, E58, F44

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1 Introduction

Monetary policy in the US and the euro area (EA) is believed to impact not only domestic economies but also other countries. Since many of them are open to capital flows and their exchange rates float, changes in short-term interest rates by major central banks affect prices and trade globally, see e.g. IMF (2007) or di Giovanni and Shambaugh (2008). This phenomenon has already received well-deserved attention separately in case of Fed's and ECB's policy spillovers to emerging markets. Much less is, however, known about the relative importance of these two for international business cycles.

This paper aims to feel this gap and investigate conventional monetary policy spillovers of both the ECB and the Fed to emerging countries. We focus on conventional monetary policy since, even though major central banks engaged in measures such as quantitative easing and forward guidance, they maintained the short-term interest rate as their main instrument, ready to be used when times normalized. In fact, by the end of 2018, Fed had already increased short-term rates in several steps. Therefore, we find important to understand how the main policy instruments of two major central banks spill over the boundaries. It is also worth to note, that in our analysis we explicitly account for the role of anticipations and distinguish between the impact of short-term interest rate movements that have been anticipated by the markets and (unanticipated) monetary policy surprises. Thus, we go much beyond the standard approach that focuses solely on the former.

We focus on spillovers to two regions: Central and Eastern Europe (CEE) and Latin America (LA). This gives us opportunity to assess the scope of both central banks' impact and at the same time take advantage of similarities within two country groups in our estimation procedure. To investigate the propagation of the US and EA policy shocks to the emerging markets, we estimate a series of panel Bayesian Vector Autoregressions (BVARs) separately for two groups of countries: Poland, Czech Republic and Hungary (CEE) and Brazil, Mexico and Chile (LA). Economies that we consider in both regions seem to have many similarities: they adopted inflation targeting strategy, their trade is strongly linked to one of the advanced economies (either the US or the euro area) and they have substantial financial ties to the world financial system.

To our best knowledge, we are the first to compare Fed's and ECB policy spillovers. There is a reach literature that points to a strong impact of US short-term rates on global economy, see e.g. Vicondoa (2019), Hanisch (2019), Dedola et al. (2017), Georgiadis (2016), di Giovanni and Shambaugh (2008), Mackowiak (2007), Canova (2005). There is also a number of papers that address ECB policy spillovers, see: Potjagailo (2017), Babecká Kucharčuková et al. (2016), Hájek and Horváth (2016). We believe that in case of the European emerging countries, considered in some of this articles, it is natural, however, to ask whether the ECB's policy spills over similarly to the Fed's. Our paper addresses this issue utilizing a consistent framework that accounts for both anticipated and unanticipated policy shocks.

Our paper is closely related to Vicondoa (2019) who investigated the propagation of Fed news (anticipated) and surprise (unanticipated) shocks to a set of emerging markets. In contrast to his paper, in our work we focus on the relative importance of Fed and ECB policy spillovers. Additionally, the shock identification procedure proposed in our paper allows to account for the effective lower bounds episodes. Differently from the previous work, we estimate panel BVAR models with hierarchical priors inspired from Jarocinski (2010) instead of the classical panel model. This setup allows us to account for intra-group similarities within Latin American and European emerging economies. Moreover, using Bayesian approach mitigates the problem of short data samples available for the analysed countries and therefore allows to obtain more reliable results.

Our main finding is that the international spillovers of Fed's conventional monetary policy to emerging markets are global, while their ECB counterparts are local. The latter affect the CEE countries that have not joined the euro area but do not impact significantly LA economies. We also find that the effects of unanticipated shocks to the interest rates are qualitatively very similar to the effects of the anticipated shocks.

The rest of the paper is structured as follows. Section 2 explains how we model conventional policy in the US and the euro area and derives monetary policy shocks. Section 3 describes the empirical model which we use to investigate policy spillovers to emerging countries and presents the main results of the paper. Section 4 concludes.

2 ECB and FED conventional monetary policy

Central banks are believed to have been actively steering private sector expectations about interest rates in recent decades, see e.g. Weidmann (2018). This suggests that one should investigate the spillovers of not only contemporaneous conventional monetary policy shocks but also news shocks about the future monetary policy, see Vicondoa (2019). Therefore, in section 2.1 we analyze the anticipations about the Fed and ECB short-term rates in order to assess the importance of expectations about future policy stance. In particular, we determine the horizon, for which market expectations are an useful predictor of future interest rates both for the Fed and the ECB.[1]. Next, in section 2.2 we describe our conventional monetary policy shocks identification strategy. In section 2.3 we investigate whether and how identified shocks affect the euro area and US economies.

2.1 Anticipated and unanticipated policy changes

We define the anticipated changes in short-term interest rates from period $t-1+j$ to $t+j$ given the information from period $t-1$ as:

$$\Delta R^a_{t-1+j,t+j|t-1} = \mathbf{E}_{t-1}\left(R_{t+j} - R_{t-1+j}\right) \text{ for j} = 0, 1, 2... \tag{1}$$

where E_{t-1} denotes the expectations conditional on the information available by the end of period $t-1$. In particular, one-quarter ahead anticipated movement in the interest rates is given by: $\Delta R^a_{t-1,t|t-1} = \mathbf{E}_{t-1}\left(R_t - R_{t-1}\right)$ and the actual change by: $\Delta R_{t-1,t} = R_t - R_{t-1}$. We define the unanticipated interest rate change as the difference between the actual and anticipated interest rate movement:

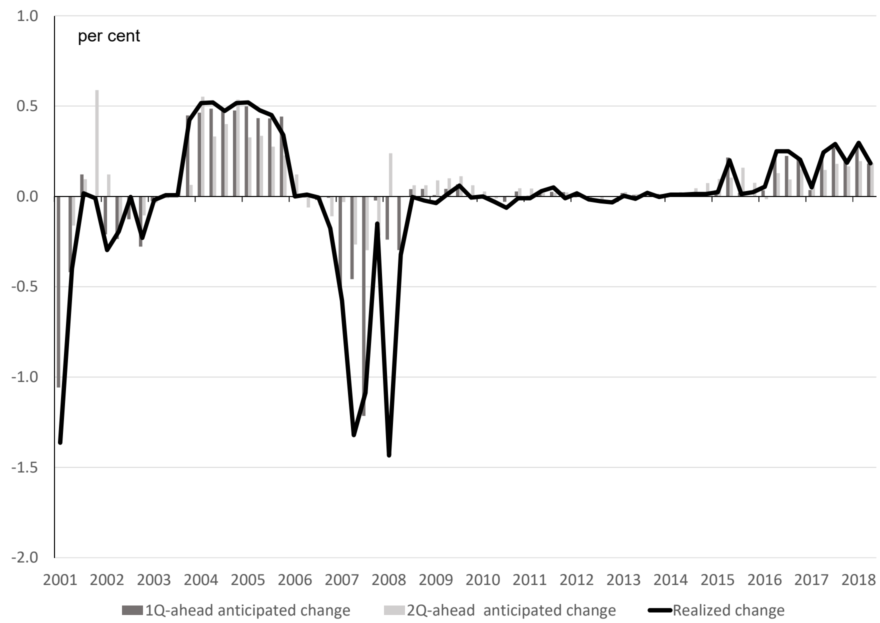
$$\Delta R^u_t = R_t - \mathbf{E}_{t-1} R_t \tag{2}$$

The anticipated interest rate movements in periods $t, t+1, t+2...$ given information from period $t-1$ are calculated using the financial market expectations at the end of period $t-1$. In case of the ECB rates, we use financial market expectations derived from swap rates (3M1D, 6MD1, 9MD1), while for the Fed - 3-month average of monthly Fed fund futures in the appropriate horizon. The data choice was determined by the availability of specific instrument prices in Bloomberg. The actual rates are given by 3-month averages of 1-day interbank interest rates (EONIA and effective Fed Funds rate). Our data spans the period from 2001 Q4 to 2018 Q4.

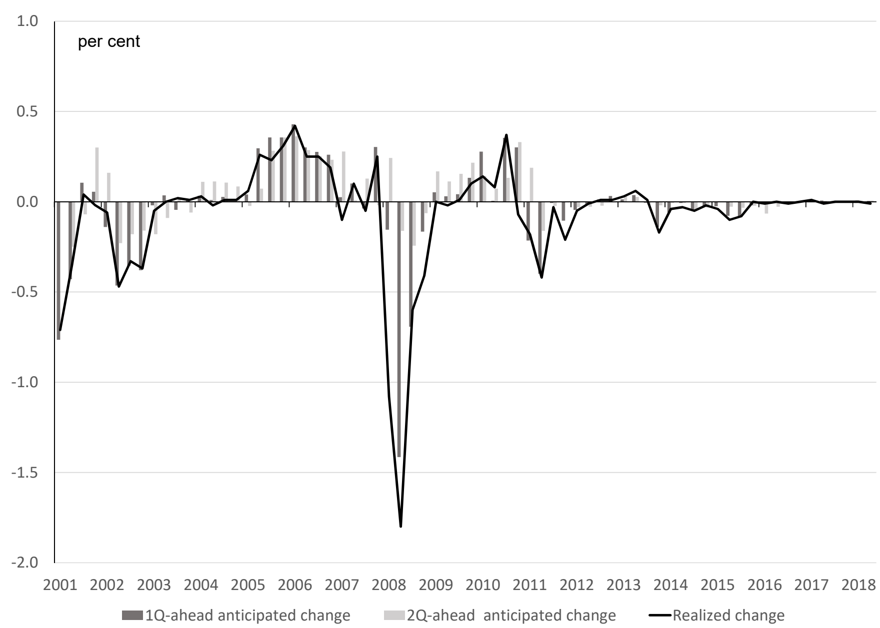
Both for the ECB and the Fed, Figure 1 indicates that the conventional belief that the monetary policy is well-predicted by financial markets is confirmed in the short term. While the realized changes in the interest rates are in line with the changes anticipated one quarter ahead, they are less so for predictions 2 quarters in advance. In order to formally show how

[1] Note, that this is not the same as the verification of Expectation Hypothesis of the interest rates term structure. The latter concerns the question of unbiasedness of market expectations, while we impose stricter and more subjective criterion of predictive power.

Figure 1: Anticipated and realized changes in Fed's and ECB's short-term rates



(a) Fed rates



(b) ECB rates

well anticipated interest rates movements explain actual changes in conventional monetary policy, we estimate a series of OLS regressions of $\Delta R_{t-1,t}$ on $\Delta R^a_{t-1,t|t-1-j}$ (Table 1). We assume that the latter are good predictors of the former if they explain more than 15% of their volatility. Under this threshold, the Fed conventional policy is well-predicted two quarters in advance while the ECB - one quarter. Thus, in our further empirical analysis, we consider two quarter ahead anticipations for movements in the US interest rate and one quarter ahead anticipations for changes in the euro area rate.

Table 1: R^2 statistics for regression of $\Delta R_{t-1,t}$ on $\Delta R^a_{t-1,t|t-1-j}$

	$j=0$	$j=1$	$j=2$
United States	0.78	0.28	0.08
Euro area	0.82	0.12	0.01

2.2 Shock identification

Both unanticipated and anticipated short-term interest rate changes may reflect either macroeconomic developments to which conventional policy reacts in a typical way or deviations from such response. In order to differentiate between these two cases and extract policy shocks we assume that each central bank follows a standard Taylor rule that explicitly accounts for the Effective Lower Bound (ELB):

$$R_t = \begin{cases} \gamma_r R_{t-1} + \gamma_y y_t + \gamma_\pi \pi_t + \gamma_u u_t + \epsilon_t & \text{for } \gamma_r R_{t-1} + \gamma_y y_t + \gamma_\pi \pi_t + \gamma_u u_t + \epsilon_t > \text{ELB} \\ \text{ELB} + \eta_t & \text{otherwise} \end{cases} \quad (3)$$

where y_t stands for GDP growth in period t, π_t - inflation rate, u_t - unemployment rate, ϵ_t denotes interest rate deviation from a typical (historical average) level, while η_t - minor fluctuations of average quarterly observed interest rates from the ELB level driven e.g. by liquidity conditions on the interbank market. Setting the rule, we explicitly account for the ELB case since it was an important policy constraint in the period considered (from 2001 Q4 to 2018 Q4). We assume ELB levels for the ECB and the Fed at the historically lowest values of their policy rates, i.e. -0.5% for the ECB (the lowest level of the deposit rate) and 0.125% for the Fed (the centre of the corridor for the range of targeted federal funds rate). Consequently, in our sample the ELB was binding only in the US for 7 years (from 2009 Q1 to 2015 Q4).

We estimate Taylor rules both for the US and the euro area using the longest available quarterly data series that comprise short-term interest rates, GDP, inflation and unemployment. In case of the euro area we use data from an Area-wide Model database as described in Fagan et al. (2001), which spans the period from 1970 Q1 to 2016 Q4. For the US we utilize Fred data that goes from 1960 Q3 to 2008 Q4 (beginning of the ELB period). Table 2 presents values of the estimated parameters of Taylor rules. Both central bank rules exhibit similar level of persistence and reaction to inflation. On the other hand, the Fed is more responsive to developments in the real economy which is what one might expect given its dual mandate.

Table 2: Estimates of Taylor rule parameters

Response to:	Formula	ECB	Fed
lagged interest rate	$\hat{\gamma_r}$	0.94	0.93
output growth	$\frac{\hat{\gamma_y}}{1-\hat{\gamma_r}}$	1.19	1.84
inflation	$\frac{\hat{\gamma_\pi}}{1-\hat{\gamma_r}}$	1.31	1.40
unemployment	$\frac{\hat{\gamma_u}}{1-\hat{\gamma_r}}$	-0.22	-1.17

The expectation about the interest rate in period $t+j$ conditional on information available by the end of period $t-1$ can be then expressed as follows:

$$\mathbb{E}_{\mathrm{t}-1} R_{t+j} = \begin{cases} \mathbb{E}_{t-1}\left[\hat{\gamma_r} R_{t+j-1} + \hat{\gamma_y} y_{t+j} + \hat{\gamma_\pi} \pi_{t+j} + \hat{\gamma_u} u_{t+j} + \epsilon_{t+j}\right] & \text{for } \mathbb{E}_{\mathrm{t}-1} R_{t+j} > \text{ELB} \\ \text{ELB} + \mathbb{E}_{t-1}\eta_{t+j} & \text{otherwise} \end{cases} \tag{4}$$

It is important to note that we assume that parameters in the Taylor rules are fixed, i.e. in contrast to Vicondoa (2019) we do not estimate them for each j but we assume that the central bank follows one policy rule. Thus, while building their expectations about future interest rates, agents use the historical values of Taylor rule parameters (presented in Table 2).

The above definitions allow us to calculate anticipated and unanticipated interest rate changes given by eq. 1 and 2 and define anticipated i-period ahead ($s^a_{t,t+i}$) and unanticipated (s^u_t) shocks in the following way:

$$s^a_{t,t+i} = \begin{cases} \mathbb{E}_{t-1}\left(\epsilon_{t+i} - \epsilon_{t+i-1}\right) & \text{for } \mathbb{E}_{\mathrm{t}-1}\mathrm{R}_{\mathrm{t+j}} > \text{ELB for } j = i-1, i \\ \mathbb{E}_{t-1}\epsilon_{t+i} - \mathbb{E}_{t-1}\eta_{t+i-1} & \text{for } \mathbb{E}_{\mathrm{t}-1}\mathrm{R}_{\mathrm{t+i}} > \text{ELB and } \mathbb{E}_{\mathrm{t}-1}\mathrm{R}_{\mathrm{t+i-1}} \leq \text{ELB} \\ \mathbb{E}_{t-1}\left(\eta_{t+i} - \eta_{t+i-1}\right) & \text{for } \mathbb{E}_{\mathrm{t}-1}\mathrm{R}_{\mathrm{t+j}} \leq \text{ELB for } j = i-1, i \end{cases} \tag{5}$$

$$s_t^u = \begin{cases} \epsilon_t - \mathbb{E}_{t-1}(\epsilon_t) & \text{for } \mathbb{E}_{t-1}\mathrm{R_t} > \mathrm{ELB} \text{ and } \mathrm{R_t} > \mathrm{ELB} \\ \epsilon_t - \mathbb{E}_{t-1}\eta_t & \text{for } \mathbb{E}_{t-1}\mathrm{R_t} \leq \mathrm{ELB} \text{ and } \mathrm{R_t} > \mathrm{ELB} \\ \eta_t - \mathbb{E}_{t-1}\eta_t & \text{for } \mathbb{E}_{t-1}\mathrm{R_t} \leq \mathrm{ELB} \text{ and } \mathrm{R_t} \leq \mathrm{ELB} \end{cases} \tag{6}$$

We calculate shocks using survey data on expected GDP, inflation and unemployment from 2001 Q4 to 2018 Q4. In case of the US, we utilize expectations from Survey of Professional Forecasters of the Federal Reserve Bank of Philadelphia. In turn, for the euro area we use Thomson Reuters Economic Indicator Polls. Taking parameters in the Taylor rules as given, we calculate ϵ_{t+j} and η_{t+1} as in eq. 4. Then, using definitions 5 and 6 we get series of Fed and ECB policy shocks.

2.3 US and euro area responses to monetary shocks

Before assessing how monetary policy shocks in the US and the euro area propagate to the emerging economies, we investigate their impact on domestic business cycles. This step serves as a validation test for shocks that we computed in section 2.2 and allows us to better understand their transmission. To this end, we estimate two Bayesian VAR models with Minnesota priors, one for the US and one for the euro area, in which endogenous variables comprise of GDP, prices and interest rate spread of each economy. In our estimations, we include as the exogenous variables the lagged values of both unanticipated and anticipated domestic monetary policy shocks. Additionally, our set of exogenous variables contains the linear time trend and the dummy variable for Global Financial Crisis (2009 Q1). The choice of the variables is analogous to the one in the main VAR models and will be discussed in more detail in section 3.1.

GDP in the model is measured as the log of seasonally adjusted real GDP. As a measure of prices, we use the log of HICP for the euro area and log of GDP deflator for the US. In order to capture tensions in financial markets, the set of our endogenous variables include the interest rate spreads: BAA corporate spread in the model for the US and the difference between 10-year government bond yields of Italy and Germany in the model for the euro area. Euro area variables are taken from Eurostat and their US counterpart - from Fred.

Using the Deviance Information Criterion (DIC) (see Spiegelhalter et al. (2002)), we set the number of lags included in the model to one. The posterior distributions of model coefficients are approximated using Gibbs sampler. From the generated sequence of 110 000 draws, the first 10 000 replications are dropped. In order to ensure that the draws used to simulate posterior distributions are not autocorrelated, only every 100th draw is kept. Therefore, the final estimates are based on 1 000 Gibbs replications.

Figure 2: Fed and ECB shocks impact on US and euro area business cycles

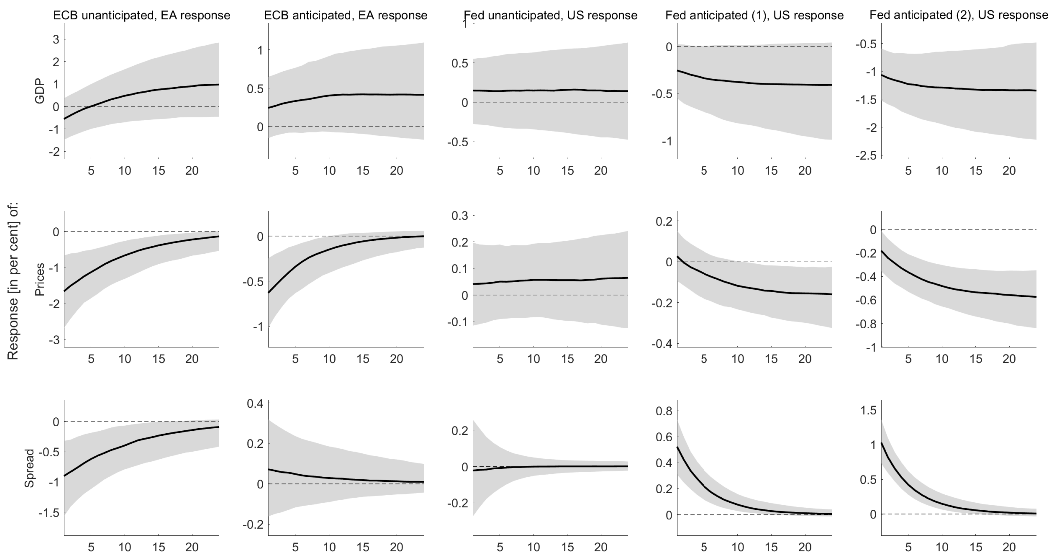


Figure 2 depicts the 16th, 50th and 84th percentiles of the posterior distributions of the impulse responses to the 1 p.p. contractionary unanticipated and anticipated conventional monetary policy shocks in the US and the EA. The response of output and prices are either negative, in line with the common sense and results from previous studies (see e.g. Mackowiak (2007) or Jarocinski (2010)), or statistically insignificant. The intuitive and prevailingly significant responses assure us that the identification strategy brought about reasonable shock estimates.

3 Policy spillovers

Having identified the US and euro area monetary shocks both in unanticipated and anticipated interest rate changes, we move to the analysis of their impact on business cycles in emerging markets. First, in section 3.1 we describe our modelling framework that to large extent follows Jarocinski (2010). Second, in section 3.2 we present the main result of the paper - the response of main macroeconomic variables in LA and CEE regions to ECB and Fed conventional policy shocks.

3.1 Empirical model

In this section, we briefly describe the random effect panel VAR model with a hierarchical prior. In contrast to the standard panel models, this framework allows for the cross-subsectional heterogeneity, i.e. the VAR coefficients and residual variances are unit-specific. At the same time, they are assumed to be similar across the panel since a prior distribution for the each country's coefficients is centered at the common mean. More precisely, for each unit c in the panel, $c = 1$ ... C, we consider the following model:

$$y_{c,t} = A_c^1 y_{c,t-1} + ... + A_c^p y_{c,t-p} + C_c w_t + e_{c,t} \tag{7}$$

where $y_{c,t}$ is a vector of n endogenous variables, w_t is a vector of m exogenous variables common for all units, $e_{c,t}$ is a vector of VAR innovations which are i.i.d. $N(0, \Sigma_c)$, p denotes number of lags and $t = 1$ ... T, denotes time periods. The estimated coefficients are drawn from normal distribution with a common mean for all units in the panel and common variance. The detailed description of the panel BVAR model with the hierarchical prior can be found in Jarocinski (2010) or Dieppe et al. (2016).

We consider two panels, each consisting of three countries:

1. CEE panel: Poland, Czechia and Hungary
2. LA panel: Brazil, Chile, Mexico

Other countries from regions are excluded from the analysis either due to their currency regimes (currency boards in the Baltic countries) or limited data availability. In estimation we use quarterly data. The sample spans the period from 2002 Q1 to 2018 Q4, which gives 68 observations for each country in the panel. We estimate the model using the Bayesian Estimation, Analysis and Regression toolbox (BEAR) presented in Dieppe et al. (2016).

In the model, there are four endogenous variables commonly used in the standard open economy monetary VAR models, i.e. output, prices, exchange rate and domestic short-term interest rate. Our main focus is on the impact of lagged Fed and ECB shocks that are exogenous variables in the system. We do not take contemporaneous policy shocks as in monetary VAR estimations policy shocks are usually assumed to respond as the last one to developments in other variables (see e.g. Christiano et al. (1999)). Since in our case these are foreign policy shocks, it seems even more appropriate to take their lags. Apart from them, we also control for the exogenous impact of US and euro area interest rate spreads and crisis dummy (2009 Q1) that accounts for an extraordinary event that is difficult to capture with standard business cycle regularities.

As in the US and euro area VAR estimations, GDP is measured as the log of seasonally adjusted real GDP. As a measure of prices, we use the log of HICP for CEE countries and log of CPI for LA. Output and prices are taken from Eurostat (CEE countries), IMF International Financial Statistics and OECD (LA) databases. The nominal effective exchange rates for all countries come from the BIS statistics. Finally, as short-term interest rates we use 3-month money market interest rates from Eurostat (CEE) and OECD (LA) datasets. Basing on DIC criterion, we estimate the VAR model with one lag. We use the same number of draws from Gibbs sampler as in section 2.3. For our prior distributions, we choose the values of the parameters which are commonly used in the VAR literature, see Canova (2007) and Dieppe et al. (2016).

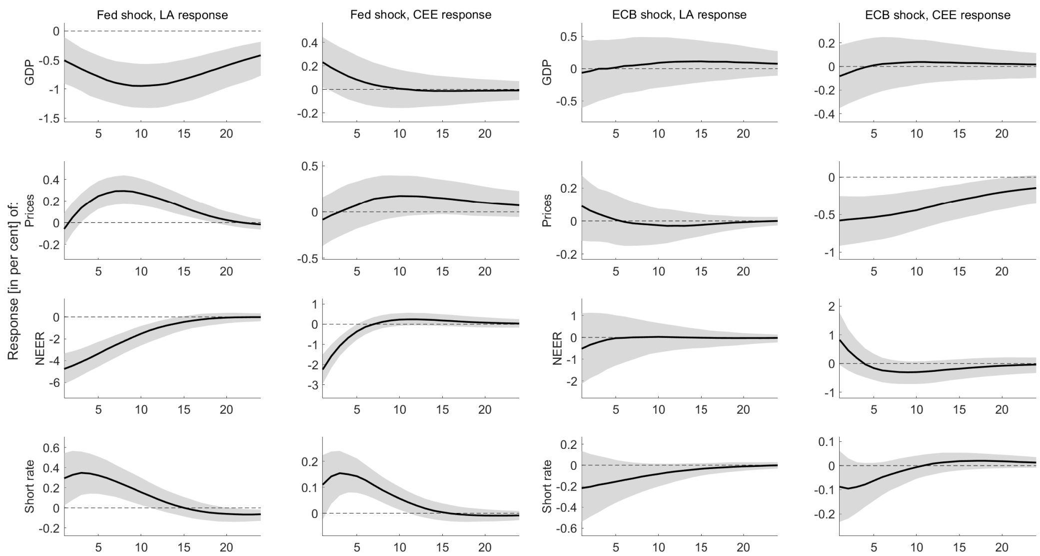
3.2 Results

Figures 3 and 4 present the main result of the paper - the 16th, 50th and 84th percentiles of the posterior distributions of the impulse responses to the Fed's and ECB's interest rate shocks, derived from the mean model for each panel. More precisely, that is the model implied by the mean VAR coefficients $\bar{A}^1$ and $\bar{C}$, which for each draw are computed as the average of the model parameters $\bar{A}^1_c$ and $\bar{C}_c$ of all countries in the panel.

Starting with shocks in one-quarter-ahead anticipated rate changes (Figure 3), we observe that the US contractionary interest rate shocks (by 1 p.p.) result in the decline of GDP in LA. At the same time, they lead to increasing prices driven by exchange rate depreciation. This result is in line with Vicondoa (2019) who investigated impact of similarly-defined Fed policy shocks on a larger panel of emerging markets. However, it does not hold for the CEE countries which experience somewhat weaker depreciation and consequently insignificant responses of GDP and inflation. Prices in CEE region seems to respond more to ECB shocks (by 1 p.p.), notwithstanding the lack of GDP reaction. Importantly, none of LA variables reacts significantly to the ECB shock, suggesting that the latter has rather regional character.

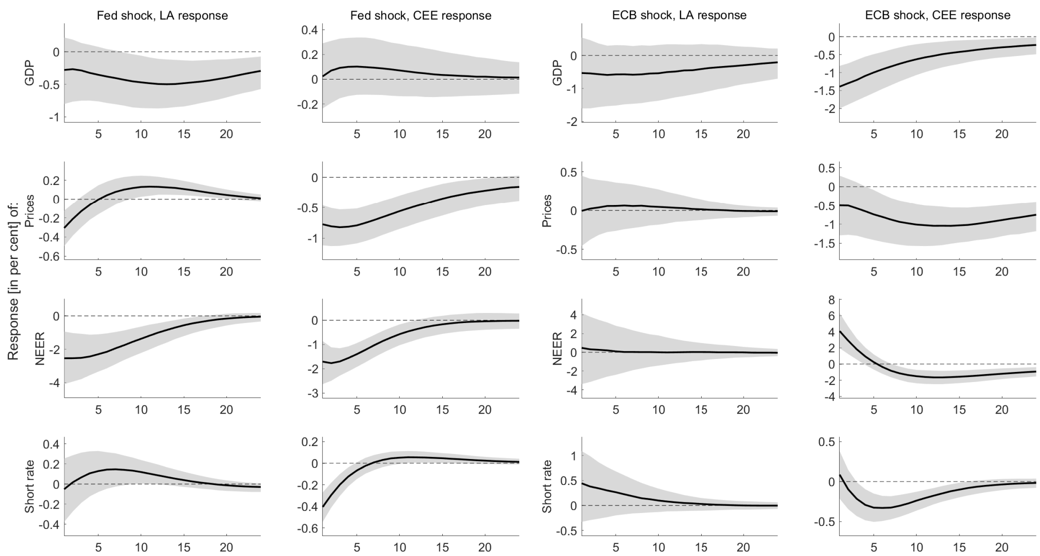
Impulse responses to unanticipated shocks bear substantial resemblance to anticipated ones (Figure 4). Both LA and CEE variables after shocks to unanticipated changes in Fed rates follow the same patterns as observed for anticipated shocks, even though their scale and

Figure 3: Fed and ECB shocks in anticipated rate changes and CEE and LA business cycles



significance is lower. Furthermore, as for ECB rates, again only CEE variables react significantly. Decreasing GDP and price level after ECB rate hike suggest the this foreign policy shock has a contractionary impact on the CEE economies. It may result from strong trade linkages between CEE countries and the euro area. As for the exchange rate response, a temporary NEER appreciation is quickly overturned by persistent depreciation. As the robustness check, we estimated the model in which we replace the nominal effective exchange rate with the bilateral exchange rate of the country's national currencies against the euro and find immediate FX depreciation that persisted over several years. Therefore, the NEER appreciation in the baseline model is likely to result from appreciation of other currencies, not the euro (most notably US dollar depreciating against the euro). Analyzing individual country responses we find similar patterns (Figure 6 in Appendix).

Figure 4: Fed and ECB shocks in unanticipated rate changes and CEE and LA business cycles



Summing up, LA economies do not react significantly to shocks to neither unanticipated nor anticipated changes in ECB interest rates, while both CEE and LA tend to react to Fed monetary shocks. This points towards the global character of conventional policy spillovers of the Fed and their local role in case of the ECB and suggests that the Fed plays a more important role for global financial system while the ECB spillovers are restricted mainly to trade channels.

4 Conclusions

This paper investigates the conventional monetary policy spillovers of the ECB and the Fed to emerging markets. To this end, we propose a novel methodology of monetary policy shock identification which allows to distinguish between the anticipated and unanticipated shocks and explicitly accounts for the effective zero lower bound episodes.

First, we use the future contracts and swap rates to calculate the anticipated and unanticipated changes in the interest rates and show that the markets forecast well Fed's rate 2 quarters in advance, while ECB's - only 1 quarter. Next, we assume that the central banks follow Taylor rules while conducting their monetary policy and estimate the coefficients of such rules on the long historical samples. We then take the results of these estimations together with the survey data on market expectations about GDP, inflation and unemployment and use them to calculate the anticipated and unanticipated policy shocks in both economies. Finally, we show that these shocks have plausible impacts on the US and the euro area business cycles.

In the next step, we estimate the Bayesian random effect panel VAR model with a hierarchical prior, separately for the group of three CEE and three LA economies. In each model, we include the previously identified Fed and ECB policy shocks as exogenous variables. Overall, in line with the previous studies, we find that both unanticipated and anticipated Fed shocks have significant impact on LA and CEE economies. More importantly, however, we show that the ECB policy affects CEE economies that have not joined the eurozone but does not impact LA countries. Therefore, we conclude that the Fed plays a more important role for global financial system while the ECB spillovers are local and restricted mainly to trade channels.

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Appendix

A Individual country responses to Fed and ECB shocks

Figure 5: Fed and ECB shocks in anticipated rate changes and countries' median responses

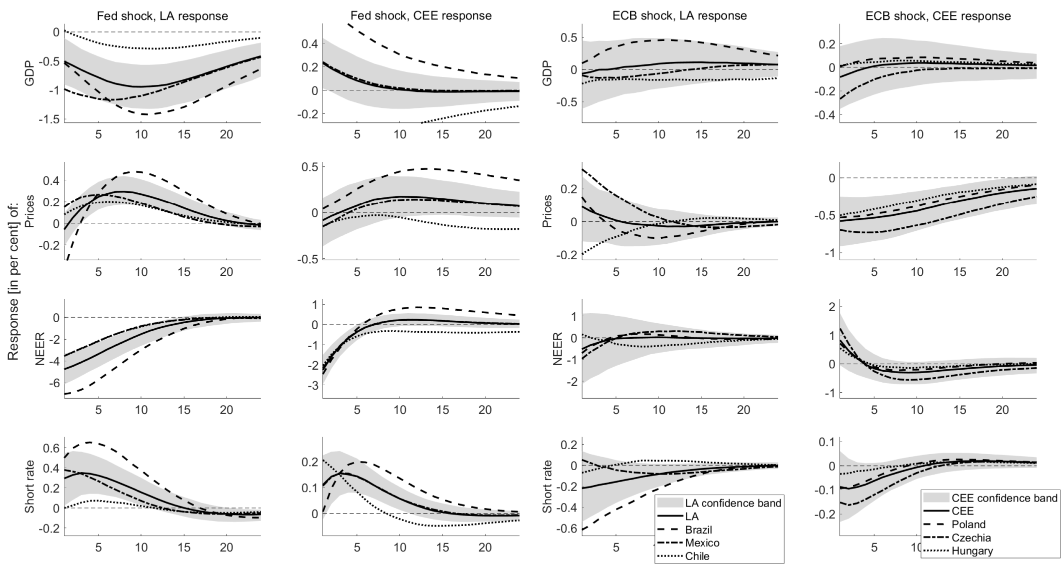

Figure 6: Fed and ECB shocks in unanticipated rate changes and countries' median responses