The Effects of USA Monetary Policy on Central America and the Dominican Republic

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Abstract

This paper estimates the impact of US monetary policy shocks on Central America and the Dominican Republic economies, using a factor augmented VAR model. A sign restriction approach is implemented for the identification of such shocks. Our results indicate that US monetary policy shocks affect these economies mostly through its effects on the real side of the economy due to its impact on external demand and the reduced role of the exchange rate as a shock absorber, where countries with less flexible exchange rate regimes are more affected. Likewise, the flow of remittances is also negatively influenced, revealing another channel through which foreign monetary shocks impact the Central American and the Dominican Republic economies. On the financial side, domestic interest rates will rise and net international reserves will fall as central banks limit volatility in exchange rates.

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1. INTRODUCTION

A year after the end of its unconventional monetary policy strategy, the Federal Reserve decided to increase the federal funds rate (FFR), event that puts an end to seven years of policy interest rates at the zero lower bound. This phenomenon, known as monetary policy normalization, has been a source of concern for policymakers of both advanced and emerging economies, given that a steep path in interest rates could increase financial market volatility. This decision reopens the question of how USA monetary policy shocks spillover to the rest of the world, in particular in the context of historically low interest rate levels. Of particular interest is the question of how this type of shocks affects economies with a low degree of financial linkages with international capital market flows, such as Central American and Caribbean economies.

The main objective of this paper is to quantify the effects of foreign interest rate shocks, measured through the USA FFR (a conventional monetary policy instrument), on the economies of Central America and the Dominican Republic (hereafter CADR). This is a relevant subject for policy makers in these economies because of the important commercial linkage of CADR countries with the USA economy, despite the low degree of financial development and linkages with international capital market flows relative to other Emerging Market Economies in Latin America.

The empirical strategy employed to study this phenomenon intends to measure the country-specific effects of USA monetary policy shocks. We estimate a factor-augmented vector autoregressive model (FAVAR) with a foreign variables block, where the USA is the relevant foreign country for these economies. Common factors are extracted from a country data set of nearly 80 macroeconomic variables of CADR countries[1] for the period 2003-2014.

[1] Countries include: Costa Rica, El Salvador, Guatemala, Honduras, and the Dominican Republic. Nicaragua is excluded from the sample due to lack of data prior to 2007.

Two empirical issues arise in the quantification of the effect of USA monetary policy shocks. One issue is the identification of this type of shock. The proper identification is critical to understanding the transmission mechanism of this type of shock to these economies (see Canova and De Nicoló, 2003; Kim, 2001; Canova, 2005). We address this problem using sign restrictions to identify the effects of a USA MP on the economies under study.

Another issue is the decreasing variability after 2008 of the FFR as it adjusts to the zero lower bound. While the FFR has remained unchanged for the last seven years, the Federal Reserve has employed nonconventional instruments, known as quantitative easing (QE) programs, which have led to a more expansive monetary policy than what can be accounted for by the effective FFR. Therefore, in order to address this issue, we use the shadow federal funds rate (Wu and Xia, 2016) as our measure of the monetary policy instrument.

To date, this is one of the first works that addresses the effects of USA monetary policy shocks for Central America and the Dominican Republic. Other papers have used the FAVAR methodology to study the international transmission of monetary policy shocks. Mumtaz and Surico (2008) extend the model of Bernanke et al.(2004) to the open economy case, analyzing the transmission to seventeen industrial countries. Meanwhile, Cruz-Zuniga (2011) studies the effects of a change in the USA monetary policy for the Mexican and Brazilian case.

Summarizing the main findings, USA monetary shocks have contractive effects on these economies. The evidence suggests an unambiguous fall in real output for each of the considered economies, revealing that foreign interest shocks work as an important driver of the common business cycle in CADR countries. The relative importance of exchange rate stability for monetary authorities in these countries minimizes the response of this variable, hence rising interest rates and falling net international reserves do most of the adjustment. On the real side, exports fall due to the dominance of the income absorption effect over the expenditure switching effect, backed by the limited fluctuation in real exchange rates. However, a recovery in trade balance is observed, as imports decrease more than exports, product of a fall in domestic demand due to the contractionary effects of monetary tightening. Finally, remittances, which are an important source of non-labor income in these economies, respond negatively since the contractionary monetary shock is a signal of a future fall in USA aggregate demand.

The paper is organized as follows: Section 2 presents the literature review; Section 3 describes the exchange rate arrangements in these economies. This is important because it is a characteristic feature of CADR economies that could influence the empirical responses to foreign monetary shocks. Section 4 describes the empirical methodology; Section 5 compares the results for a positive interest rate shock to main Central American and Dominican indicators; Section 6 concludes.

2. LITERATURE REVIEW

Literature related to conventional monetary shocks, measured through interest rate changes, although extensive, focuses on *normal times*, i.e., periods that do not include hyperinflation episodes, currency crises, or massive recessions (Canova, 2005). When studying monetary shocks and their international transmission, two empirical strategies can be distinguished: Those based on the estimation of structural (DSGE) models, which by construction suggests expected paths for variables under this type of shocks, and those which are data oriented, based on empirical relations.

In theoretical models, inspired by the Mundell-Fleming-Dornbusch (MFD) model and the Obstfeld-Rogoff extension (1996), the transmission of monetary shocks to other economies occurs through two main channels: Current account and exchange rate.

A tightening shock in the country of origin is associated with a fall in output and an appreciation of the currency of that country. However, the impact of that shock on other countries is ambiguous, since two offsetting mechanisms work simultaneously, with no clear evidence of which one would dominate: on one side, the exchange rate in the foreign country depreciates, having a positive effect on economic activity (expenditure-switching effect); meanwhile, the interest rate hike shrinks domestic output in the country of origin, leading to a fall in the demand for exports of foreign countries (income-absorption effect; Kawai, 2015). Likewise, intertemporal models also show ambiguous results, even after including future expectations from economic agents as an additional mechanism (Kim, 2001).

Empirical models (see Lastrapes,1992; Eichenbaum and Evans, 1995; Grilli and Roubini, 1995; Kim and Roubini, 2000; Clarida and Galí, 1994) employ strategies that minimize restrictions, using data

to identify transmission mechanisms for the exchange rate case. Kim (2001) compares the empirical results with different theoretical models, finding that an expansive monetary shock in the USA, measured by a drop in the world interest rate, has a positive effect on growth for G6 economies, which matches the results suggested by intertemporal models (see Svensson and van Wijnbergen, 1989; Obstfeld and Rogoff, 1995). Also, the trade link is not significant, which is not consistent with the *beggar-thy-neighbor* theory of the MFD basic model. The paper concludes that the exchange rate response does not depend on whether the identifying strategies are recursive or not, as prompted by Kim and Roubini (2000) and Cushman and Zha (1997). Other findings of Kim (2001) include the exogeneity of USA to non-USA monetary policy.

The international transmission of monetary shocks to industrial countries has been recently addressed by Vespignani (2015). Mumtaz and Surico (2008) explore the effects of a decrease in the international short term interest rates on the United Kingdom, finding a positive impact on GDP, investment and consumption after a year. On the other hand, the study of Jannsen and Klein (1991) finds that an increase in a foreign interest rate (Eurozone, in this case) has a positive impact on domestic interest rates for a set of countries that have not adopted the euro.[2] The increase in the interest rates translates into a contraction in GDP through a reduction in domestic demand. Meanwhile, exports decline, exposing the importance of the income-absorption effect in these economies. Since both exports and imports decline, no significant changes are observed in the trade balance. The response of these variables, as well as the negligible role observed in the exchange rate, is similar to the reaction of countries with a fixed exchange rate regime, revealing the importance of exchange rate stabilization for these small open economies.

For developing economies, the degree of transmission of international monetary shocks varies according to the currency regime, macroeconomic fundamentals and country-specific structural characteristics (see Borda et al., 2000; Arora and Cerisola, 2001; Mackowiak, 2007; Canova, 2005; Cruz-Zuniga, 2011). These authors identify, through different VAR specifications, two key transmission channels: Trade balance and interest rates.

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[2] The set of countries include the United Kingdom, Denmark, Sweden, Norway, and Switzerland.

The research of Borda et al. (2000), related to the contribution of USA monetary policy to Caribbean business cycles, concludes that for countries with a flexible exchange rate regime, a world interest rate shock has a negative effect on output due to an increase in the real exchange rate that augments the cost of inputs. However, it indicates that GDP for Caribbean countries is not mainly driven by the world interest rate, but rather by the exchange rate, highlighted as an important transmission mechanism. This result is consistent with the conclusions of Mackowiak (2007), where the typical response of an emerging market economy to a tightening of the USA monetary policy is exchange rate depreciation, inflation and a fall in economic activity.[3] Meanwhile, the results provided by Canova (2005) suggest that the interest rate channel serves as an amplifier of USA monetary changes, conferring the trade channel an insignificant role in the transmission of monetary shocks from the United States to Latin America.

Since interest rates remained at the ZLB up to December 2015, the study of the international transmission of monetary policy focused on the impact of unconventional instruments adopted by industrial countries after the 2007 international crisis. This approach has been used by different authors, who analyze its spillover effects to emerging economies. Overall, their results confer a more important role to financial linkages and trade channels.

Hausman and Wongswan (2006) explore the channels of USA monetary policy transmission through the Federal Open Market Committee announcements, noting that a country with a higher degree of real and financial integration with the USA has a greater interest rate response, as well as those with less flexible exchange rates. In summary, unlike Ehrmann and Fratzscher (2006), they suggest that real and financial linkages with the USA are more important than those with the rest of the world.

Likewise, Bauer and Neely (2013) distinguishes the relative importance of the signaling and portfolio balance channels to explain the contribution of unconventional policy to the reduction of bond yields in most countries after the international crisis of 2007.[4] Through a dynamic term structure model, they conclude that both channels are

[3] Countries under analysis are Korea, Thailand, Malaysia, Philippines, Singapore, Hong Kong, Mexico, and Chile.

[4] Australia, USA, Germany, Canada, and Japan

important.[5] Nonetheless, Chen et al. (2014) indicate that the spillovers to asset prices and capital markets are larger if they come from signal surprises. They highlight that even if unconventional monetary policies have a greater impact than conventional ones, characteristics such as better fundamentals and a more liquid market structure help to mitigate the effects. Bowman et al. (2014) also demonstrates that although fluctuations of asset prices in emerging markets after a USA monetary shock are bigger than fluctuations in the country of origin (USA), weaker fundamentals explain, in part, this overreaction. For the effects of unconventional monetary policy to other countries, see also Craine and Martin (2008).

More recently, the expectations of an interest rate hike in the USA prompted the study of the international impact of such an event. In this context, research analyzing the spillover effects on foreign countries of this conventional monetary policy instrument has resurged. For the Central American region, Valle and Morales (2016) employ a recursive identification strategy (Cholesky) for a foreign interest rate shock (USA, in this scenario). A VAR is constructed for each economy, where the USA block of variables is exogenous. Their main results include a multiple shock approach (including as well separate growth and remittances shocks), summing an overall positive effect for the normalization of USA monetary policy. Nonetheless, as Fornero et al. (2016) indicate, the identification of foreign monetary shocks is not straightforward in recursive VAR models. For this reason, those authors compare the results from a SVAR model with sign and zero restrictions (SZR) and a DSGE model for the Chilean economy to study the effects of foreign monetary policy on Chilean output and the overall economy. For the SZR model, a one percent positive shock of the foreign interest provokes a statistically significant decrease in local activity and exchange rate depreciation, while inflation (although with no significant change) first increases by the depreciation and later on decreases by the weak demand. The impulse responses derived from this scheme provide results in line with macroeconomic theory. The main differences with the DSGE model come from the length of the propagation of the shock and the impact on inflation, where in this scheme the impact on inflation is statistically significant.

[5] The signal channel is more important for countries with a strong response to conventional monetary policy surprises in the USA; and the portfolio balance is consistent with the degree of substitution of international bonds between countries.

3. EXCHANGE RATE ARRANGEMENTS IN CADR ECONOMIES

One of the peculiarities of these economies is the importance of exchange rate stability as a policy objective. For the region, de facto exchange regimes for most countries are classified between different degrees of managed floating to dollarization. According to the *Annual Report on Exchange Rate Arrangements and Exchange Restrictions 2014* by the International Monetary Fund, Guatemala has shown greater flexibility, being classified as floating for different years in the period under consideration, even though it shares the volatility of its international reserves with the other exchange rate targeters (Jácome and Parrado, 2007).[6] Honduras and the Dominican Republic follow a crawl-like arrangement, while Costa Rica has the least flexible regime after El Salvador, which is a dollarized economy.

Table 1

CLASSIFICATION OF EXCHANGE RATE ARRANGEMENT FOR CADR COUNTRIES

Country	*Exchange rate arrangement*[1]
Costa Rica	Other managed arrangement[2]
El Salvador	No separate legal tender
Honduras	Crawl-like arrangement
Guatemala	Crawl-like arrangement
Dominican Republic	Crawl-like arrangement

[1] Classification according to the *Annual Report on Exchange Rate Arrangements and Exchange Restrictions 2014* by the IMF.
[2] As the report states, "this exchange rate arrangement is characteristic of periods when volatile foreign exchange market conditions hinder the use of more clearly defined exchange rate arrangements". It was previously classified as *stabilized arrangement* in 2013.

[6] The *Annual Report on Exchange Rate Arrangements and Exchange Restrictions 2014* reclassified Guatemala as crawl-like arrangement, previously considered a floating regime.

The exchange rate regime of a country determines the conduct of its monetary policy. Even though price stability is the aim of all regimes, their primary shock absorber is not the same; therefore, it shapes the degree of transmission mechanisms of foreign monetary policy shocks. Likewise, many countries claim to be floaters, while actually adhering to an exchange rate regime. As Canova (2005) explains, the lack of a differentiated transmission mechanism of USA monetary shocks between groups of floaters and non-floaters, for a set of Latin America countries,[7] may arise because floaters may suffer from *fear of floating*, see Calvo and Reinhart (2000), thus using international reserves to offset exchange rate volatility.

4. EMPIRICAL METHODOLOGY

In this section we describe the empirical strategy used to characterize the transmission mechanism of USA monetary policy shocks to CADR economies.[8] The approach consists of two steps. In the first step, we use a multicountry dataset comprising 76 macroeconomic variables for all CADR countries to estimate common factors through Principal Components. These factors sum up the macroeconomic information for the whole sample of abovementioned countries and are used as indicators of the state of the economy (business cycle) for the CADR region. In the second step, we specify a dynamic model between the estimated common factors and a block of foreign variables, where the latter includes the FFR. Once the model is estimated, we address the issue of proper identification of the impact of USA monetary policy shocks on foreign economies and estimate the effects on CADR macroeconomic variables.

4.1 First Step: Data Description and Common Factors Estimation

This section explains how we collect and treat data of the economies under analysis. First we describe the dataset used and its characteristics. Then we discuss the procedure for data reduction through factor estimation.

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[7] Countries under analysis include Argentina, Brazil, Chile, Ecuador, Mexico, Panama, Peru, and Uruguay.

[8] Countries include: Costa Rica, El Salvador, Guatemala, Honduras, and the Dominican Republic. Nicaragua is excluded from the sample due to lack of data prior to 2007.

4.1.1 Data Description

We take a broad sample of data, consisting of the main macroeconomic indicators for a set of small open economies on a monthly basis: Costa Rica (CR), El Salvador (ES), Honduras (HN), Guatemala (GT), and the Dominican Republic (DR), for the 2003-2014 period. The complete set of variables and the transformations performed are shown in Annex A. All variables are expressed in twelve-month variation, and standardized by subtracting the sample mean and dividing by the sample standard deviation.

The dataset comprises three main groups:

a) Real Indicators

This group contains variables from the real sector of the economy, i.e. real activity indicators,[9] exports, imports, trade balance and remittances, all in real terms. From the fiscal sector, we incorporate total fiscal revenue and expenditure, both in real terms. By including this group, we aim to capture the varying responses across sectors and periods to business cycles, and how they might respond differently to a foreign interest shock.

b) Prices and Relative Prices

This group consists of real exchange rates and consumer price indexes (CPI). Finally, nominal and real exchange rates (local currency price of USA dollar) are included.

c) Financial and Monetary Sector Indicators

This set is composed of several measures of interest rates, including lending and deposit rates (in nominal terms). We also include credit growth to the private sector in real terms as an indicator of the business cycle. Finally, to capture the overall evolution of money supply, we include M1.

4.1.2 *Common Factor Estimation*

Instead of estimating a structural VAR model for each country, we address the research question using a data reduction approach to deal with the dimension of the by-country dataset described in the last section.

[9] We utilize a monthly indicator of economic activity called Indicador Mensual de Actividad Económica (IMAE, for its acronym in Spanish).

Our methodology employs the estimation of common factors through principal components analysis summarizing the set of variables described above. This methodology –introduced to forecasters by Stock and Watson (2002) and to macroeconomics by Bernanke et al. (2004)– extracts from a large set of data a smaller group of factors that drive the dynamics of the whole sample. This mechanism allows the researcher to summarize *big data* neatly, avoiding the *curse of dimensionality*, while at the same time accounting for the crucial information.

We use the principal components analysis to estimate these common factors. This analysis extracts a series of factors from N number of variables, which are linear combinations of this data set, and attempts to: *a)* minimize noise, since the extracted factors contain the most important information, leaving aside noisy deviations and *b)* minimize redundancy, since two factors should not contain the same *information* from the dataset, but should express different dimensions along which the data varies.

Suppose we have M series spanning T periods, collected in $M \times 1$ vectors X_t, from which we extract N factors spanning the same T periods in a $N \times 1$ vector F_t, where $N < M$. These factors resume the information shared by the variables in X_t. X_t and F_t are related by the measurement equation:

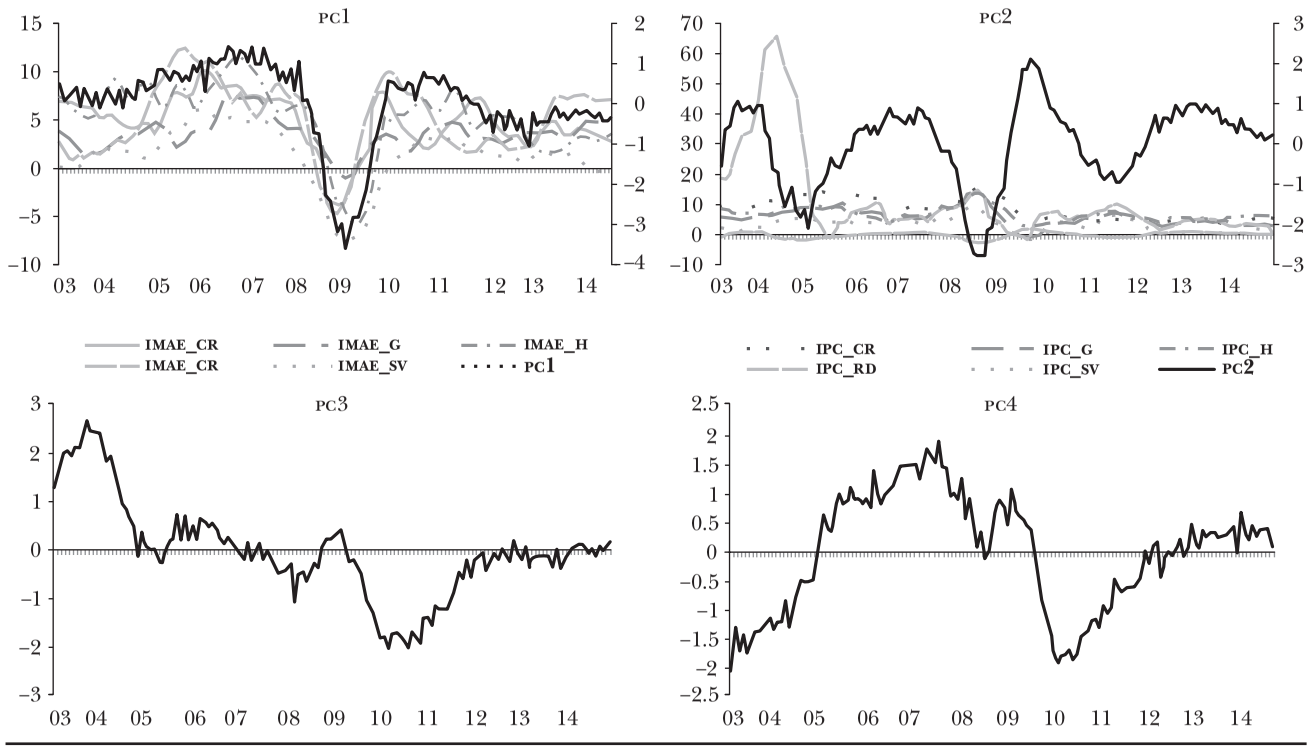
$$X_t = \Lambda F_t, \tag{1}$$

where the matrix Λ is $M \times N$. Its elements are called factor loadings; these associate the value of the factors to the measured variables of the model.

For the empirical exercise, we choose the first four estimated factors, which account for 53% of the common variance of the whole set (76 series). Since the complete dataset is used, we interpret these factors as the *state of the economy* or common cycles between CADR economies. After a visual inspection (Figure 1) we observe a strong correlation between the first factor and GDP growth rates in these economies. Likewise, the second factor could be related to the common behavior of CPI inflation in the countries under study.

Figure 1

ESTIMATED PRINCIPAL COMPONENTS FACTORS



4.2 Second Step: FAVAR Specification and Estimation

In this step we specify a FAVAR model between the set of estimated factors, F_t, as discussed in Section 4.1.2, and a block of foreign variables. The block of foreign variables includes the USA CPI, USA Industrial Production Index (IPI), and Real Balances (M1), which are the typical set of variables used to analyze the impact of MP shocks in the USA (Sims, 1992). As for the measure of the USA monetary policy instrument, the effective FFR remained unchanged for the last seven years. Nonetheless, the Federal Reserve has employed nonconventional instruments, known as quantitative easing (QE) programs, which have led to a more expansive monetary policy than what can be accounted for by the effective FFR. Therefore, in order to address this issue, we consider the Wu-Xia Shadow Federal Funds Rate as our measure of the monetary policy instrument (Wu and Xia, 2016). We also consider the Volatility Index (VIX) as a measure of the international risk premium.

Following Canova (2005), we assume that domestic variables (summarized in the common factors from the first step) do not have an impact on foreign variable dynamics (the small open economy assumption). In addition, we assume that VIX has no impact on USA macroeconomic variables, but the latter have influence on the level of risk perception. This assumption is justified under the argument that the macroeconomic impact of financial risk shocks is difficult to trace, because *1)* it is difficult to rule out the contemporaneous response of uncertainty shocks from financial shocks, and *2)* that the effects of uncertainty shocks seem significant only in cases of tightening financial conditions (Caldara et al., 2016). Expression 2 summarizes the specification of the FAVAR model:

$$W_t = C + \sum_{i=1}^{p} A(i) W_{t-1} + V_t, \qquad (2)$$

where $W_t = \begin{bmatrix} Y_t \\ VIX_t \\ F_t \end{bmatrix}$, $C = \begin{bmatrix} C^Y \\ c^{VIX} \\ C^F \end{bmatrix}$, $A(i) = \begin{bmatrix} A_{10} & 0 & \tilde{O} \\ a_{20} & a_{21} & \tilde{O} \\ A_{30} & A_{31} & A_{32} \end{bmatrix}$, $V_t = \begin{bmatrix} V_t^Y \\ v_t^{VIX} \\ V_t^F \end{bmatrix}$.

Here, Y_t includes USA macroeconomic variables mentioned above. Exogeneity restrictions are represented by the matrix $\tilde{O}$. V_t is the reduced form error term with mean zero and covariance matrix Σ_V. This error is a linear combination of structural shocks.

To assess the dynamic responses of the measurement variables to foreign interest shocks we rewrite Equation 2 in terms of a vector moving average, VMA (∞):

$$W_t = \sum_{i=1}^{\infty} B(i) V_t.$$

From the relation between reduced form residuals and structural shocks:

$$W_t = \sum_{i=1}^{\infty} B(i) DE_t \text{ or } W_t = \sum_{i=1}^{\infty} G(i) DE_t,$$

where D is the matrix of structural coefficients and E is the vector of structural shocks. In particular, E includes the USA monetary policy shock of interest, ϵ_t^{FFR}. Therefore, the impulse response of common factors vector to the shock of interest is:

3
$$\frac{\partial F_{t+s}}{\partial \epsilon_t^{FFR}} = G(s),$$

for $s = 0,1,...K$ and $G(s)$ a vector with the response of each factor in F to the structural innovation on the federal funds rate.

Our concern is on the dynamic response of observables X_t to the monetary shock, so using 1 and 3,

$$\frac{\partial X_{t+s}}{\partial \epsilon_t^{FFR}} = \Lambda \frac{\partial F_{t+s}}{\partial \epsilon_t^{FFR}} = \Lambda G(s).$$

For example, the response of variable i to the foreign interest rate shock is:

$$\frac{\partial x_{i,t+s}}{\partial \epsilon_t^{FFR}} = \lambda_{1i} \frac{\partial f_{1t+s}}{\partial \epsilon_t^{FFR}} + \lambda_{2i} \frac{\partial f_{2t+s}}{\partial \epsilon_t^{FFR}} + \ldots + \lambda_{Ki} \frac{\partial f_{Kt+s}}{\partial \epsilon_t^{FFR}}$$
$$= \lambda_{1i} g_1(s) + \lambda_{2i} g_2(s) + \ldots + \lambda_{Ki} g_K(s).$$

4.2.1 *Identifying USA Monetary Policy Shocks*

To complete the explanation of our empirical methodology, we now discuss the identification strategy of USA monetary policy shocks. To draw a coherent characterization of the transmission mechanism of

interest, it is important to instrument the proper identification of this shock. Recursive (Cholesky) ordering for the foreign variables block leads to wrong measurement of the shock of interest revealed in the traditional puzzles, as discussed in Fornero et al. (2016).

Therefore, we adopt a sign restriction approach, as is common in the literature on the transmission mechanism of foreign monetary shocks. According to the theory, a contractionary foreign interest rate shock leads to a fall in output, diminishing inflation pressures, whereas exchange rate appreciates, as expected from theoretical models.[10]

We rely on this strategy popularized by Canova and De Nicoló (2003), Uhlig (2005) and Gertler and Karadi (2014) for our identification strategy.[11] Our goal is to estimate structural shocks associated with models that produce the expected response of USA variables to exogenous monetary policy movements through the FFR. In particular, we impose the following sign restrictions in the spirit of Canova and De Nicoló (2003), where prices are sluggish and output has a lagged response to monetary innovations. As in Uhlig (2005), we limit sign restrictions on the impulse responses to provide a *minimalistic identification*, therefore not imposing further views beyond the sign restrictions themselves. We impose restrictions on the foreign variables block only on impact, where the horizon for the sign restriction to hold is one period, thus:

$$\begin{gathered}\text{FFR} > 0,\ t=1\\ \text{USA IP growth} < 0,\ t=2\\ \text{USA CPI inflation} < 0,\ t=2\\ \text{USA real balance growth} < 0,\ t=2,\end{gathered}$$

where t denotes the period in months where the sign restriction is imposed. The rationale for this identification strategy for the USA monetary policy shocks is that the transmission of monetary policy innovations to the economy occurs with lags.

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[10] Uhlig (2005) employs an agnostic identification procedure to study the effects of monetary policy on output. He finds no clear effect of interest rate hikes on real GDP.

[11] However, as emphasized by Fry and Pagan (2011), we recognize the multiple model issue arising from the transformations of the new set of structural shocks.

5. RESULTS

In this section we discuss the response to a foreign interest rate innovation of domestic variables (through the associated factor loadings to each of the estimated factors included in the FAVAR model). The shock is calibrated by a one-time 25 basis point unexpected increase to the shadow FFR, our proxy of monetary policy rate in the USA. Table 2 summarizes the qualitative response of macroeconomic variables for each economy. Complete results in terms of impulse response function are shown in Annex B.[12]

Table 2

RESULTS OVERVIEW

Variables	*Costa Rica*	*El Salvador*	*Guatemala*	*Honduras*	*Dominican Republic*
Output	↓	↓	↓	↓	↓
Exports	↓	↓	↓	↓	↓
Imports	↓	↓	↓	↓	↓
Trade balance	↑	-	↑	↑	↑
Remittances	↓	↓	-	↓	↓
CPI inflation	↓	-	-	↓	↑
Real exchange rate	-	-	-	-	-
Nominal exchange rate	-		-	-	-
Net international reserves	↓	-	↑	↓	↓
M1	↓	↓	-	↓	↓
Private credit	↓	-	-	↓	↓
Interest rate	↑	-	↑	↑	↑
EMBI		↑			↑

Source: Author's estimation. ↑ (↓) represents a statistically significant increase (decrease).

[12] In Annex B we also include impulse responses assuming a recursive identification strategy using Cholesky decomposition. The problems to identify monetary policy shocks arise when such approach is used.

According to the estimated impulse response functions, a positive shock to the FFR has a negative impact on main real domestic variables. For all countries under analysis, output, export and import growth rates fall. In addition, financial sector variables such as interest rates and risk premium increase, while money and credit demand decrease. There is no evidence of significant nominal and real exchange rate adjustments to the shock, while we find a decrease in international reserves for three of these economies.

The empirical literature on transmission mechanisms of USA monetary policy shocks (see Canova, 2005) emphasizes the role of the exchange rate regime and the degree of financial integration in the magnitude of the pass-through to domestic macroeconomic variables (real and nominal) of these type of innovations. Therefore, countries with flexible (less-flexible) exchange rate regimes and relative high (low) integrated financial markets show less (more) volatility in domestic variables such as output and interest rates.

Despite that, impulse response results suggest depreciation pressures after a foreign interest shock in CR, GT, and HN are not statistically significant. Instead, our results illustrate that central banks react to the external shock by increasing interest rates across all countries and reducing net foreign reserves in CR, HN and the DR. Risk premium rises in ES and the DR, evidence of a tightening in foreign financial conditions.[13] Likewise, positive inflation pressures are not observed due to interest rate reaction and thus a limited exchange rate pass-through effect.

On the real side, our results show a negative effect on output growth. Similarly, export and import growth fall in all countries. These results are in line with Jannsen and Klein (2011) which emphasizes the importance of the income-absorption effect over the expenditure-switching effect in countries with active exchange rate policies oriented to stabilize this variable. Nevertheless, the fall in import growth exceeds the fall in exports; therefore, trade balance improves for most countries considered, excluding ES whose results are not significant. This finding is opposite to the prediction from theoretical open economy DSGE literature, such as Galí and Monacelli (2005), where the real depreciation induced by a foreign interest rate shock triggers an export increase. Behind this theoretical transmission mechanism is the assumption of relative flexibility in exchange rate markets.

[13] Data for the sample period are only available for these two countries

Finally, remittances are an important inflow of foreign resources to CADR economies, up to 16% of GDP for ES and HN in 2013. This inflow depends on economic and labor market conditions where domestic labor force emigrates. Our results highlight the negative response of remittances flow in all countries (excluding GT where the response is not significantly different from zero). This constitutes an additional channel through which foreign interest shocks impact domestic activity.

6. CONCLUSION

In this document we analyzed the impact of USA monetary policy shocks on the developing economies of Central America and the Dominican Republic. As we mentioned, these economies are different from other emerging economies given their lower financial deepening, their lesser exposure to capital flows and higher weight of exchange rate stability in central bank loss functions.

Using a multicountry dataset of macroeconomic variables which includes real sector and monetary indicators, we identify the transmission mechanism of foreign (USA) interest rate shocks to the domestic economy. Impulse response analysis suggests that this type of shock pushes down real output, exports and imports. In addition, a USA monetary policy shock will have low impact on nominal exchange rates, at the cost of increasing interest rates, falling net international reserves and rising risk premium.

ANNEXES

Annex A. Data Description

All series were directly taken from the *Consejo Monetario Centroamericano/Secretaría Ejecutiva* Database, except for the Miscellaneous series (sources at the end of the Annex). Format is presented as follows: Series name; data span and series description as appears in the database. Nominal variables, except NER and interest rates, were CPI deflated. As for the transformation, the interest rates are presented as year-on-year first-difference values. The rest were one year logged differentiated. All transformed variables are mean detrended and expressed in terms of their standard deviation.

1. IMAE_CR	2003M01:2014M12	Monthly indicator of economic activity (IMAE): trend - cycle, index - Costa Rica
2. IMAE_SV	2003M01:2014M12	Monthly indicator of economic activity (IMAE): trend - cycle, index - El Salvador
3. IMAE_G	2003M01:2014M12	Monthly indicator of economic activity (IMAE): trend - cycle, index - Guatemala
4. IMAE_H	2003M01:2014M12	Monthly indicator of economic activity (IMAE): trend - cycle, index - Honduras
5. IMAE_RD	2003M01:2014M12	Monthly indicator of economic activity (IMAE): trend - cycle, index - Dominican Rep.
6. EXPORTS_CR	2003M01:2014M12	Exports of goods: millions of USD, total FOB - Costa Rica
7. EXPORTS_SV	2003M01:2014M12	Exports of goods: millions of USD, total FOB - El Salvador
8. EXPORTS_G	2003M01:2014M12	Exports of goods: millions of USD, total FOB - Guatemala
9. EXPORTS_H	2003M01:2014M12	Exports of goods: millions of USD, total FOB - Honduras
10. EXPORTS_RD	2003M01:2014M12	Exports of goods: millions of USD, total FOB - Dominica Republic
11. IMPORTS_CR	2003M01:2014M12	Imports of goods: millions of USD, total FOB - Costa Rica
12. IMPORTS_SV	2003M01:2014M12	Imports of goods: millions of USD, total FOB - El Salvador
13. IMPORTS_G	2003M01:2014M12	Imports of goods: millions of USD, total FOB - Guatemala
14. IMPORTS_H	2003M01:2014M12	Imports of goods: millions of USD, total FOB - Honduras
15. IMPORTS_RD	2003M01:2014M12	Imports of goods: millions of USD, total FOB - Dominica Republic
16. REMESAS_CR	2003M01:2014M12	Remittances income: millions of USD - Costa Rica
17. REMESAS_SV	2003M01:2014M12	Remittances income: millions of USD - El Salvador
18. REMESAS_G	2003M01:2014M12	Remittances income: millions of USD - Guatemala
19. REMESAS_H	2003M01:2014M12	Remittances income: millions of USD - Honduras
20. REMESAS_RD	2003M01:2014M12	Remittances income: millions of USD - Dominica Republic

Exchange Rate

21. TCR_CR	2003M01:2014M12	Real exchange rate - Costa Rica
22. TCR_SV	2003M01:2014M12	Real exchange rate - El Salvador
23. TCR_G	2003M01:2014M12	Real exchange rate - Guatemala
24. TCR_H	2003M01:2014M12	Real exchange rate - Honduras
25. TCR_RD	2003M01:2014M12	Real exchange rate - Dominica Republic
26. TCN_CR	2003M01:2014M12	Nominal exchange rate: local currency per USD - Costa Rica
27. TCN_SV	2003M01:2014M12	Nominal exchange rate: local currency per USD - El Salvador
28. TCN_G	2003M01:2014M12	Nominal exchange rate: local currency per USD - Guatemala
29. TCN_H	2003M01:2014M12	Nominal exchange rate: local currency per USD - Honduras
30. TCN_RD	2003M01:2014M12	Nominal exchange rate: local currency per USD - Dominica Republic

Money and credit quantity aggregates

31. BMR_CR	2003M01:2014M12	Narrow monetary base: millions of local currency - Costa Rica
32. BMR_SV	2003M01:2014M12	Narrow monetary base: millions of local currency - El Salvador
33. BMR_G	2003M01:2014M12	Narrow monetary base: millions of local currency - Guatemala
34. BMR_H	2003M01:2014M12	Narrow monetary base: millions of local currency - Honduras
35. BMR_RD	2003M01:2014M12	Narrow monetary base: millions of local currency - Dominican Republic
36. M1_CR	2003M01:2014M12	Monetary aggregate m1: millions of local currency - Costa Rica
37. M1_SV	2003M01:2014M12	Monetary aggregate m1: millions of local currency - El Salvador
38.M1_G	2003M01:2014M12	Monetary aggregate m1: millions of local currency - Guatemala
39. M1_H	2003M01:2014M12	Monetary aggregate m1: millions of local currency - Honduras
40. M1_RD	2003M01:2014M12	Monetary aggregate m1: millions of local currency - Dominican Republic

41. RIN_CR	2003M01:2014M12	Net international reserves: millions of USD - Costa Rica
42. RIN_SV	2003M01:2014M12	Net international reserves: millions of USD - El Salvador
43. RIN_G	2003M01:2014M12	Net international reserves: millions of USD - Guatemala
44. RIN_H	2003M01:2014M12	Net international reserves: millions of USD - Honduras
45. RIN_RD	2003M01:2014M12	Net international reserves: millions of USD - Dominican Republic
46. CREDITOPRIV_CR	2003M01:2014M12	Credit: private sector, millions of local currency - Costa Rica
47. CREDITOPRIV_SV	2003M01:2014M12	Credit: private sector, millions of local currency - El Salvador
48. CREDITOPRIV_G	2003M01:2014M12	Credit: private sector, millions of local currency - Guatemala
49. CREDITOPRIV_H	2003M01:2014M12	Credit: private sector, millions of local currency - Honduras
50. CREDITOPRIV_RD	2003M01:2014M12	Credit: private sector, millions of local currency - Dominican Republic

Interest Rates

51. TASA_ACTIVA_CR	2003M01:2014M12	Interest rate: nominal, lending (per annum) - Costa Rica
52. TASA_ACTIVA_SV	2003M01:2014M12	Interest rate: nominal, lending (per annum) - El Salvador
53. TASA_ACTIVA_G	2003M01:2014M12	Interest rate: nominal, lending (per annum) - Guatemala
54. TASA_ACTIVA_H	2003M01:2014M12	Interest rate: nominal, lending (per annum) - Honduras
55. TASA_ACTIVA_RD	2003M01:2014M12	Interest rate: nominal, lending (per annum) - Dominican Republic
56. TASA_PASIVA_CR	2003M01:2014M12	Interest rate: nominal, deposit (per annum) - Costa Rica
57. TASA_PASIVA_SV	2003M01:2014M12	Interest rate: nominal, deposit (per annum) - El Salvador
58. TASA_PASIVA_G	2003M01:2014M12	Interest rate: nominal, deposit (per annum) - Guatemala
59. TASA_PASIVA_H	2003M01:2014M12	Interest rate: nominal, deposit (per annum) - Honduras
60. TASA_PASIVA_RD	2003M01:2014M12	Interest rate: nominal, deposit (per annum) - Dominican Republic

Fiscal Balance

61. ING_FISCALES_CR	2003M01:2014M12	Government income: total, millions of local currency - Costa Rica
62. ING_FISCALES_SV	2003M01:2014M12	Government income: total, millions of local currency - El Salvador
63. ING_FISCALES_G	2003M01:2014M12	Government income: total, millions of local currency - Guatemala
64. ING_FISCALES_H	2003M01:2014M12	Government income: total, millions of local currency - Honduras
65. ING_FISCALES_RD	2003M01:2014M12	Government income: total, millions of local currency - Dominican Republic
66. GASTOS_FISCALES_CR	2003M01:2014M12	Government expenditure: total, millions of local currency - Costa Rica
67. GASTOS_FISCALES_SV	2003M01:2014M12	Government expenditure: total, millions of local currency - El Salvador
68. GASTOS_FISCALES_G	2003M01:2014M12	Government expenditure: total, millions of local currency - Guatemala
69. GASTOS_FISCALES_H	2003M01:2014M12	Government expenditure: total, millions of local currency - Honduras
70. GASTOS_FISCALES_RD	2003M01:2014M12	Government expenditure: total, millions of local currency - Dominican Republic

Miscellaneous

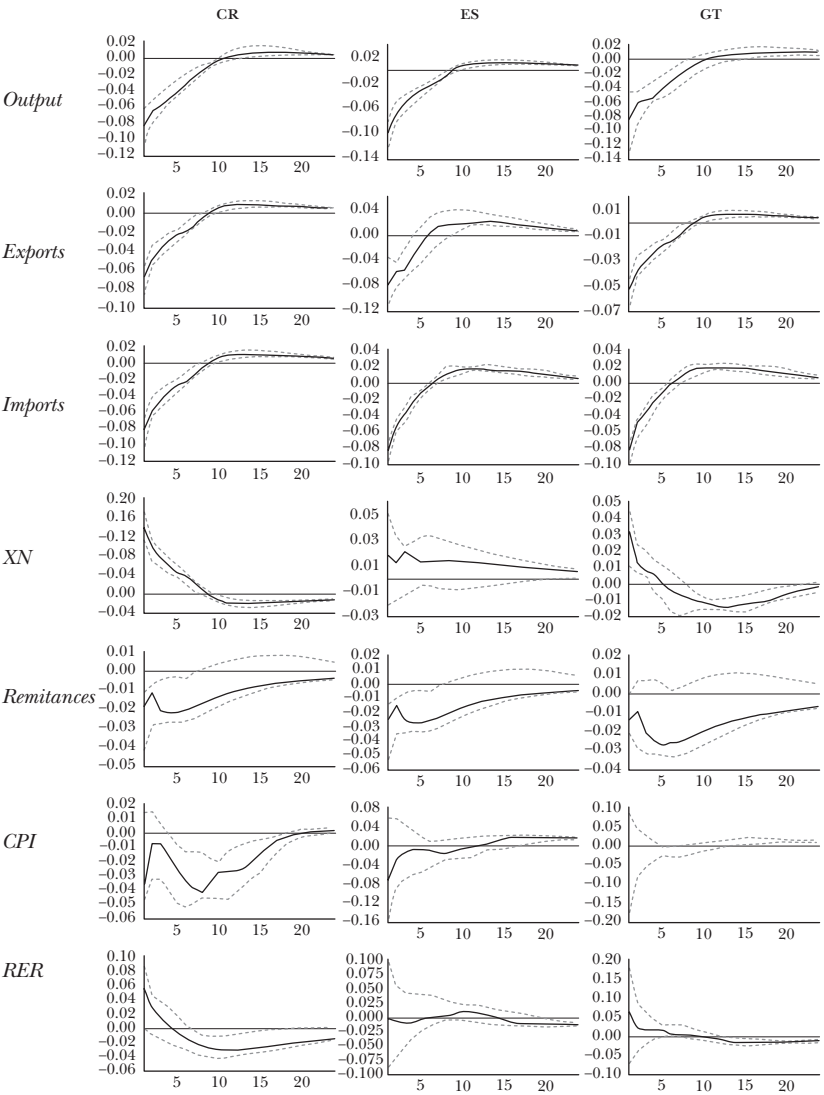
71. EMBI_SV[1]	2003M01:2014M12	Emerging market bond index (JP Morgan Chase) - El Salvador
72. EMBI_RD[1]	2003M01:2014M12	Emerging market bond index (JP Morgan Chase) - Dominican Republic
73. USA_CPI_SA[2]	2003M01:2014M12	Consumer price index for all urban consumers: all items - USA
74. FFR[2]	2003M01:2014M12	Effective federal funds rate (not seasonally adjusted) - USA
75. USA_IP_SA[3]	2003M01:2014M12	Industrial production index(2007=100) - USA
76. USA_M1[3]	2003M01:2014M12	M1 money stock, billions of dollars, seasonally adjusted - USA
77. SHADOW_FFR[3]	2009M01:2014M12	Shadow federal funds rate (Wu-Xia) - USA
78. VIX[3]	2003M01:2014M12	Volatility index, VIX - USA

Sources: [1] JP Morgan Chase; [2] Bureau of Labor Statistics; [3] FRED

Annex B. Impulse Response Functions Figures

Figure B.1

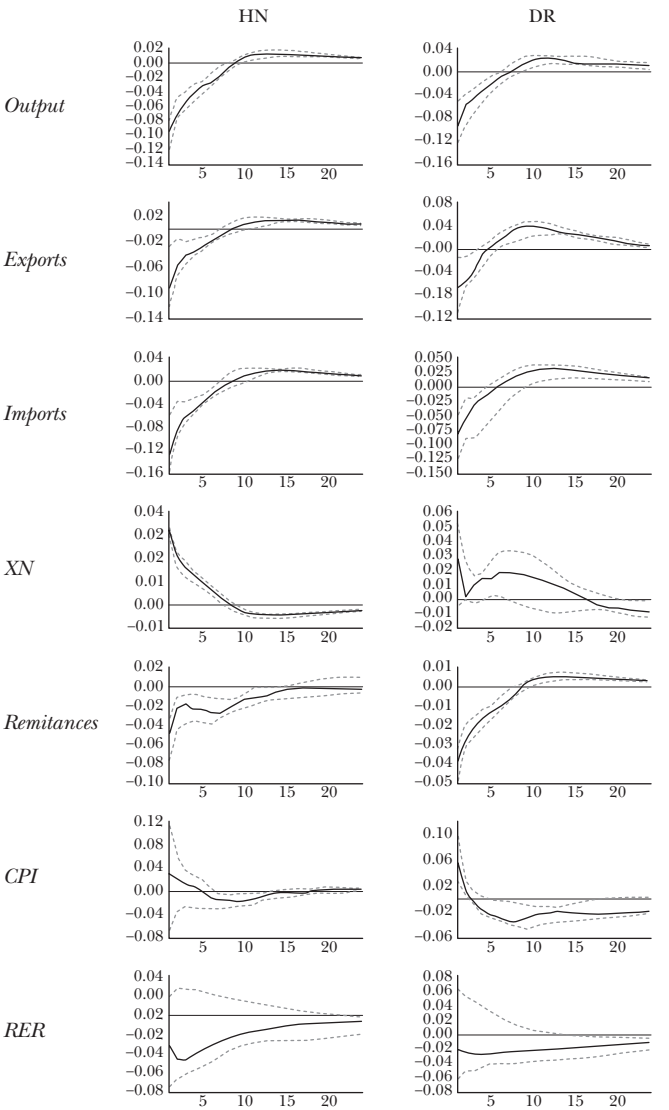
FAVAR WITH SIGN RESTRICTIONS



Note: All results are expressed in terms of a 25-basis points shock to the Wu-Xia Shadow FFR.

Figure B.1 (cont.)

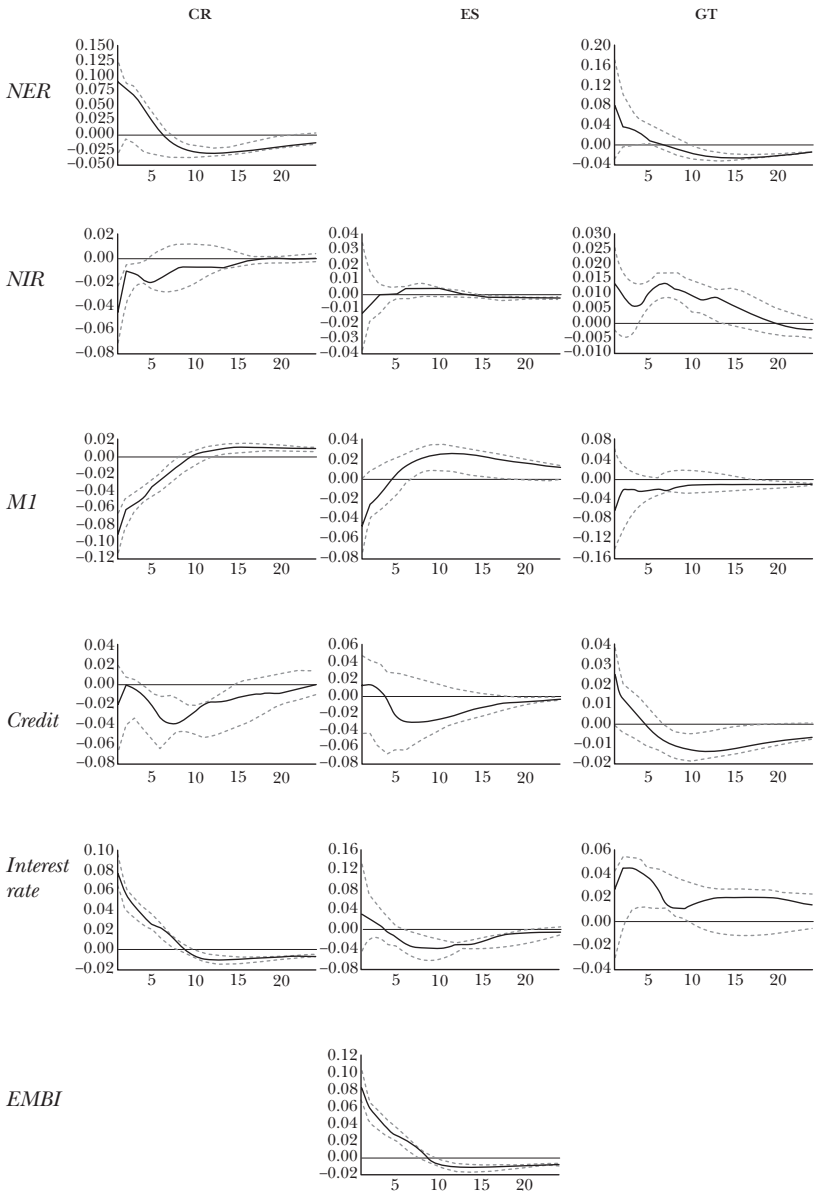
FAVAR WITH SIGN RESTRICTIONS



Note: All results are expressed in terms of a 25-basis points shock to the Wu-Xia Shadow FFR.

Figure B.1 (cont.)

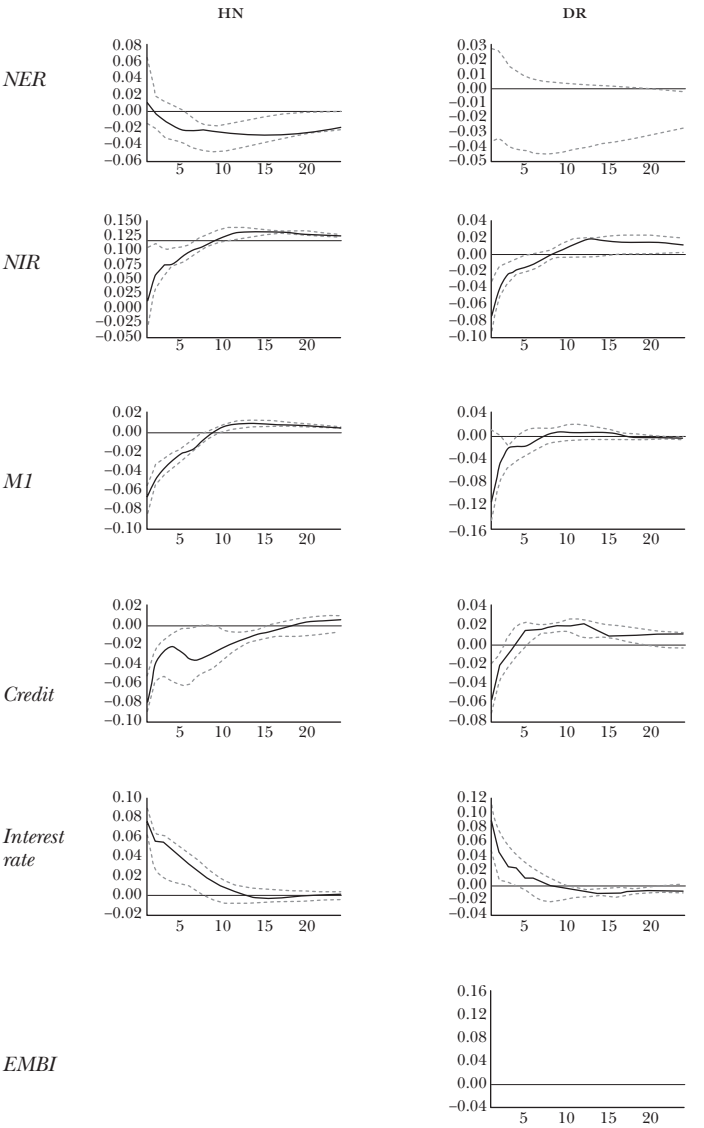
FAVAR WITH SIGN RESTRICTIONS



Note: All results are expressed in terms of a 25-basis points shock to the Wu-Xia Shadow FFR.

Figure B.1 (cont.)

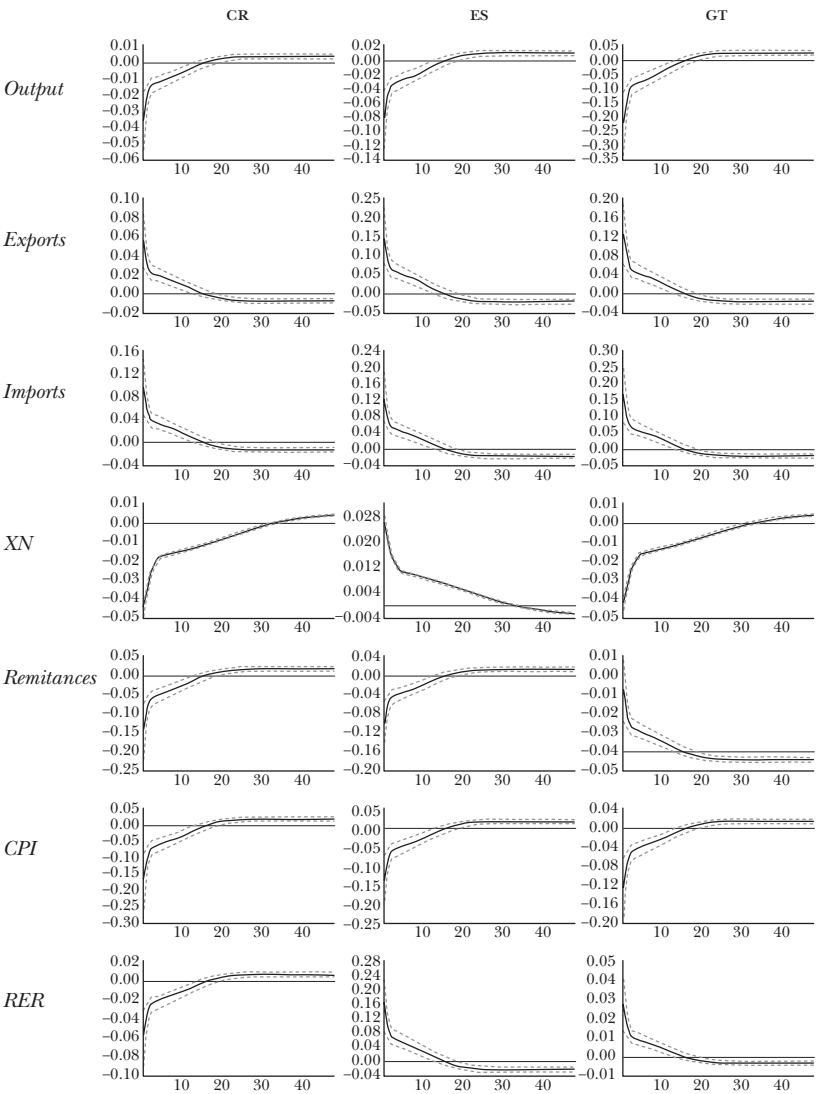
FAVAR WITH SIGN RESTRICTIONS



Note: All results are expressed in terms of a 25-basis points shock to the Wu-Xia Shadow FFR.

Figure B.2

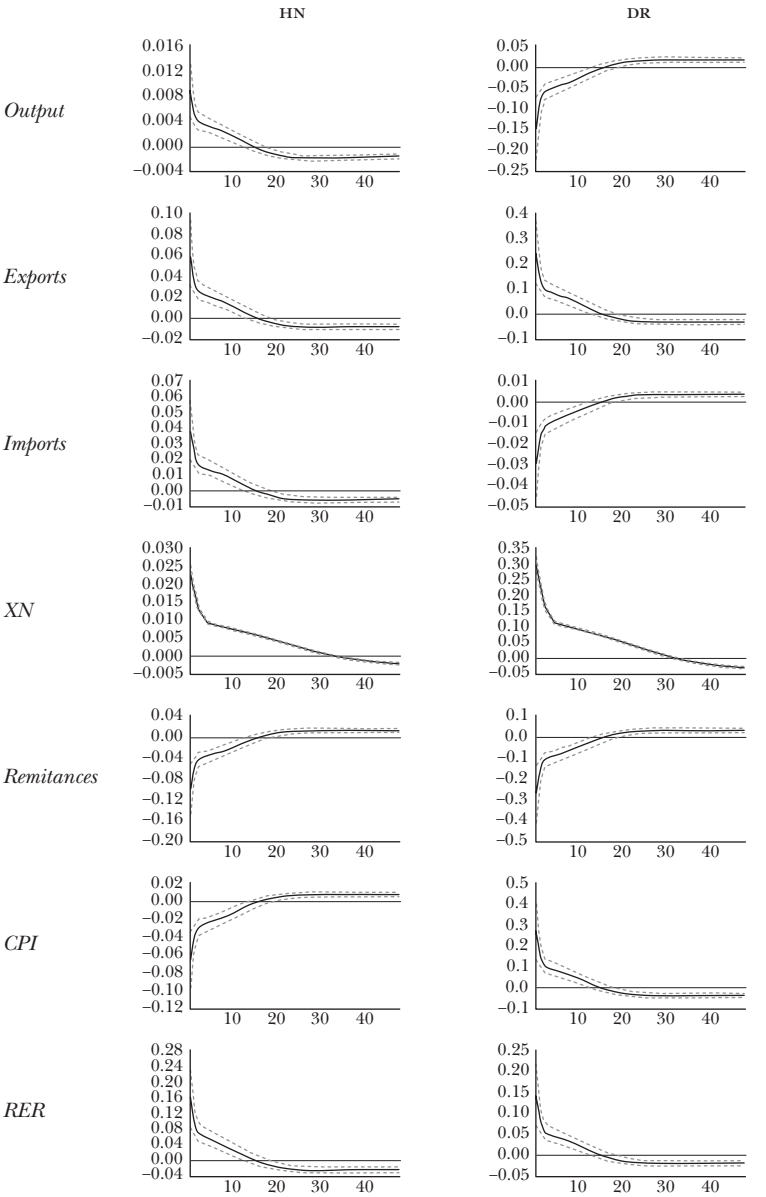
CHOLESKY DECOMPOSITION



Note: All results are expressed in terms of a 25-basis points shock to the Wu-Xia Shadow FFR.

Figure B.2 (cont.)

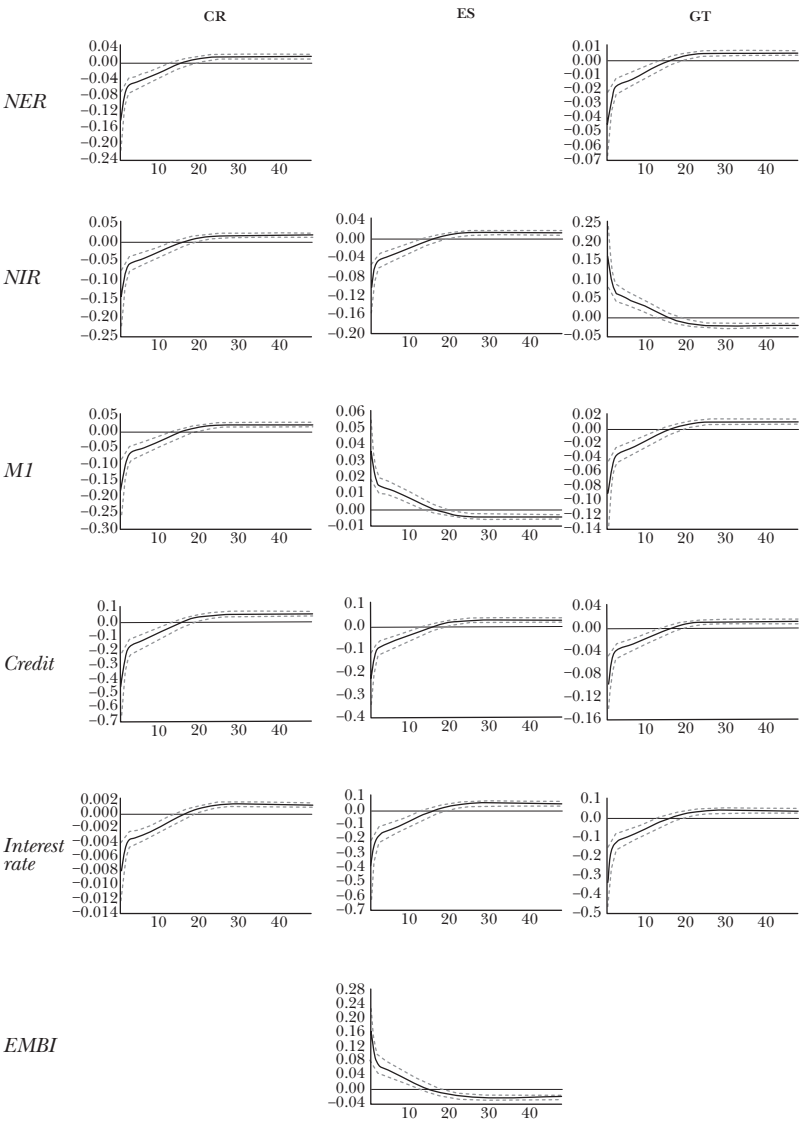
CHOLESKY DECOMPOSITION



Note: All results are expressed in terms of a 25-basis points shock to the Wu-Xia Shadow FFR.

Figure B.2 (cont.)

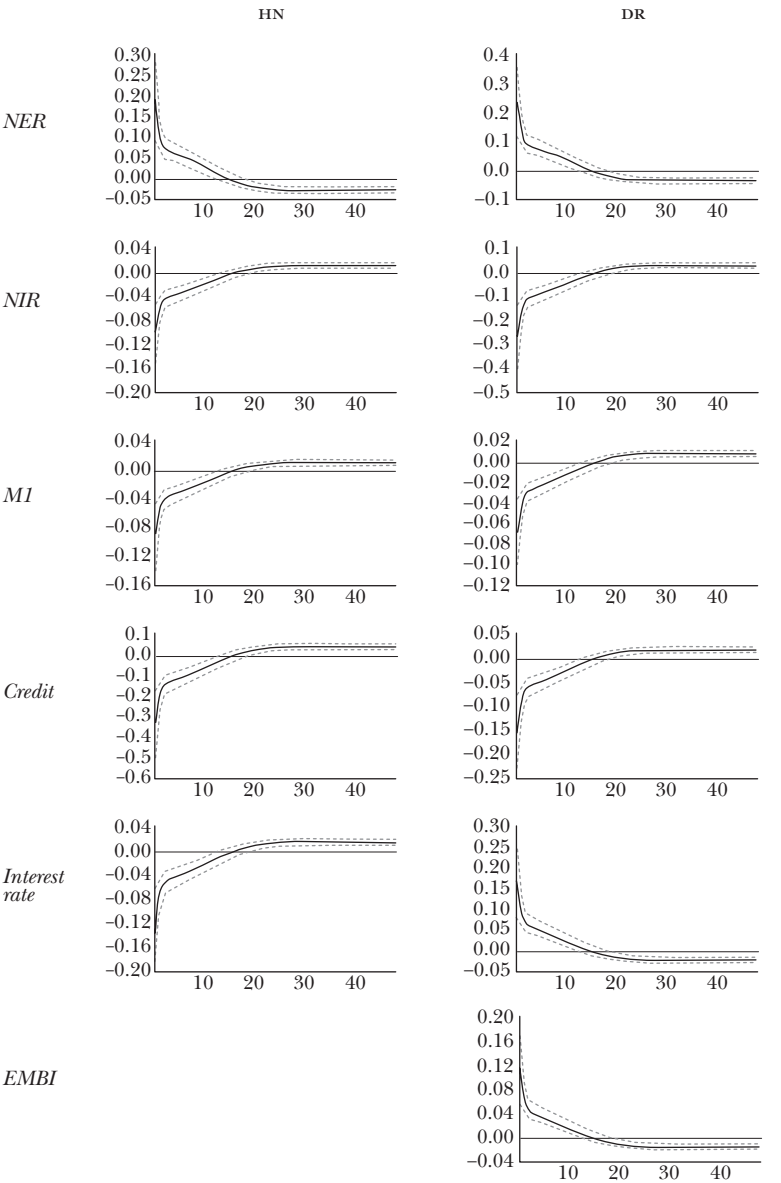
CHOLESKY DECOMPOSITION



Note: All results are expressed in terms of a 25-basis points shock to the Wu-Xia Shadow FFR.

Figure B.2 (cont.)

CHOLESKY DECOMPOSITION



Note: All results are expressed in terms of a 25-basis points shock to the Wu-Xia Shadow FFR.

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