Appendix For

"Are Business Cycles in Emerging Market Economies Alike?"

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Appendix A: Data

A.1. Aggregate Macroeconomic Data

The Brazilian real GDP and real trade balance (real export minus real import) are collected from Brazilian Institute of Geography and Statistics (known as IBGE) database, and runs from 1996Q1 to 2018Q4. Real GDP and real trade balance in Mexico, which runs from 1994Q1 to 2018Q4, are obtained from Federal Reserve Economic Data (FRED) database. These sample data are seasonally adjusted, quarterly, real, chain weighted, and measured in local currency units.

A.2. World Real Interest Rate

The world real interest rate data is not readily available. It measures the interest rate at which emerging market economies (EMEs) borrow at the international bond market. According to the conventional EMEs literature, the world real interest rate is constructed as an ex-post global real interest rate plus a risk premium component as

$$\textit{world real interest rate} = \textit{U.S. treasury bill rate - U.S. inflation rate} + \textit{EMBI+ spread},$$

where EMBI+ spread is the emerging market bond index plus spread that measures the risk premium component.[1]

The EMBI+, conducted by J.P.Morgan Chase, is a weighted index tracking the rate of return for actively traded and dollar denominated external debt in EMEs. Its spread

[1] Akinci (2013), Neumeyer and Perri (2005), and Uribe and Yue (2006) use the same algorithm to construct the world real interest rate.

is the difference between the weighted average rate of return for the EMBI+ as a whole, and the yield on U.S. treasury bills over the same maturity. The EMBI+ spread data are recorded in basis points. The rise and fall in EMBI+ spread is based on the overall performance of dollar denominated external debt of an EME, which essentially reflects the risk premium charged by foreign investors for their loans. Therefore, the EMBI+ spread measures the risk premium component. The quarterly EMBI+ spread data is obtained from Global Economic Monitor (GEM) database of World Bank, and is recorded as basis points from 3-month U.S. treasury bill rate.

Since the U.S. treasury bill is frequently traded in the international bond market and are considered as a safe asset, it represents the fixed global interest rate faced across all EMEs. The 3-month U.S. treasury bill rate data is gathered from the Federal Reserve Economic Data (FRED) database under the category 'constant maturity rate' at monthly frequency. I use the last monthly rate of a quarter as the quarterly 3-month U.S. treasury bill rate. The U.S. inflation rate is calculated as the percentage change rate between two consecutive quarters of the U.S. GDP deflator. The U.S. GDP deflator data is also acquired from the FRED database under the category 'implicit price deflator' at quarterly frequency.

A.3. Tobin's Q

Tobin's Q embodies the financial market conditions in Brazil and Mexico. Tobin's Q, by definition, is a ratio of the market value of capital to the replacement cost of capital. As a proxy, I measure Tobin's Q by taking the ratio of the equity price index to the producer

price index

$$\text{Tobin's Q} = \frac{\text{Equity Price Index}}{\text{Producer Price Index}}.$$

The quarterly equity price index and producer price index data are drawn from international financial statistics (IFS) database. The Brazilian and Mexican equity price indexes are the average and end of month indices of daily share prices in Sao Paulo security exchange and Mexico City stock exchange, respectively. The Brazilian and Mexican producer price indexes are the prices of a sample of merchandise at the wholesale level in business to business transactions in Brazil and Mexico, respectively.

A.4. Discussion on Sample Size

There is a need to shorten the Brazilian and Mexican samples in search for the stationary trade balance-output ratio for two reasons. First, the first difference of the Brazilian trade balance-output ratio appears to have structural breaks shown by the episodes of large spikes, as shown in figure 1. The structural breaks may lead to badly behaved impulse response functions (IRFs) and FEVDs computed by the SVARs. Second, the Mexican trade balance-output ratio, which will be discussed next, has no unit roots. In order to make a point-by-point comparison with the Brazilian and Mexican business cycles, I estimate SVARs on both samples including the trade balance-output ratio. The augmented Dickey-Fuller test rejects the null of a unit root in the Brazilian trade balance-output ratio from 1999Q1 to 2018Q4 at the 10% significance level.[2] Therefore, the Brazilian sample is shortened to run from 1999Q1 to 2018Q4.

[2]The small sample critical value for the Brazilian trade balance-output ratio equals -3.160 at the 10% significance level.

There is also an issue in the Mexican trade balance-output ratio, which experiences a sharp drop in its conditional mean from 0.02 to -0.02 at 1997Q1, as displayed in figure 2. I sidestep potential problems of this shift in the trade balance-output ratio might have on the SVARs estimated on the Mexican data by starting the sample in 1997Q1 and ends with 2018Q4.

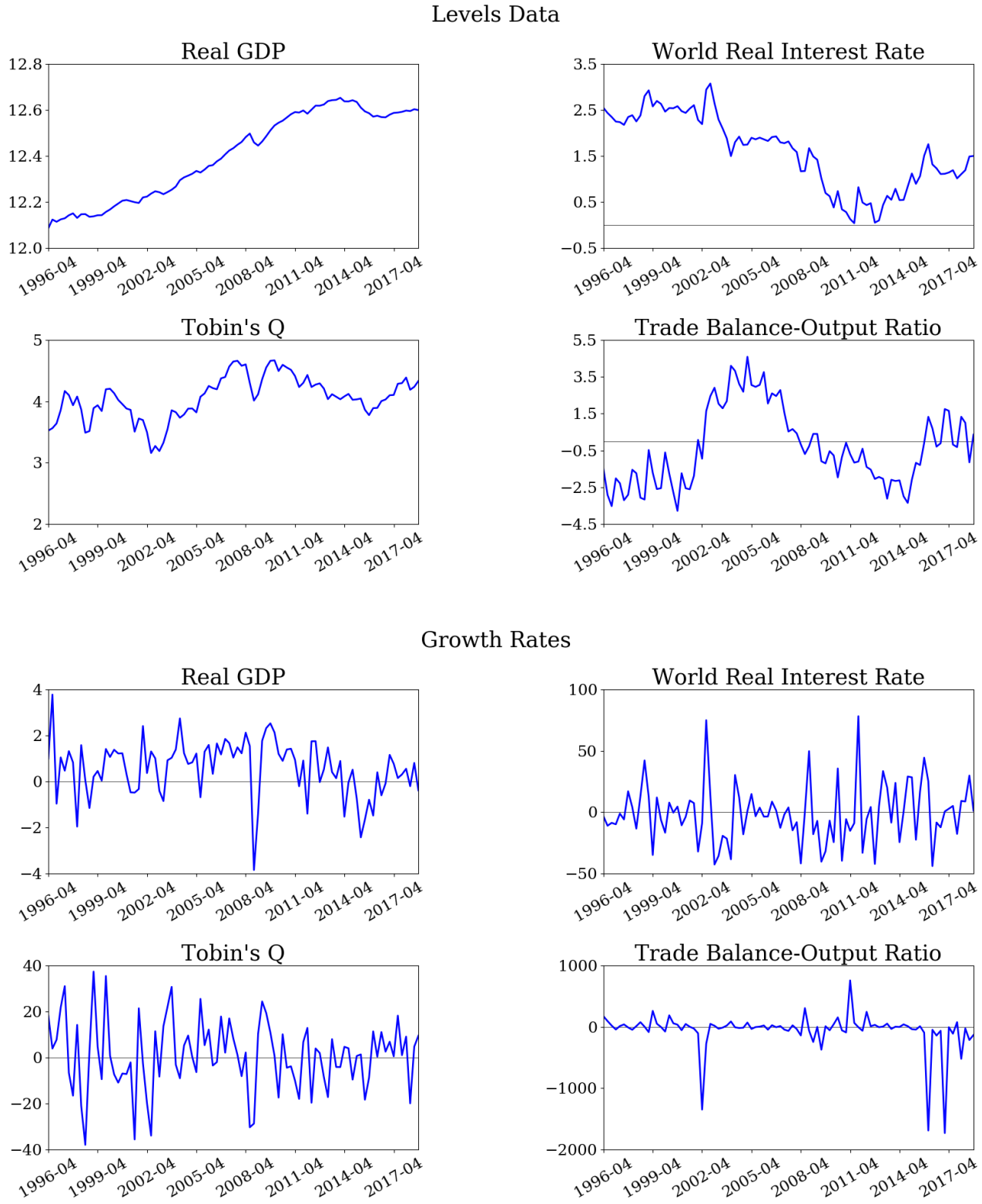
Appendix B: IRFs

The IRFs of real GDP, the world real interest rate, and Tobin's Q are constructed by accumulating the IRFs of real GDP growth, the world real interest rate growth, and Tobin's Q growth. The IRF of trade balance is computed from multiplying the IRF of the trade balance-output ratio with the IRF of real GDP.

The confidence bands on IRFs are bootstrap sup-t confidence bands. The IRFs computed by the SVARs are correlated across forecast horizons for the Brazilian and Mexican samples due to their small sample sizes ($T_{Braz} = 80$ and $T_{Mexi} = 88$). The bootstrap sup-t confidence bands can address the issue of correlation by taking account of the IRFs from all forecast horizons simultaneously.

The IRFs estimated on the Brazilian sample from 1999Q1 to 2018Q4 under short- and long-run restrictions are shown in figure 3 and 4, respectively. The IRFs estimated on the Mexican sample from 1999Q1 to 2018Q4 under short- and long-run restrictions are presented in figure 5 and 6, respectively.

Figure 1: Brazilian Sample from 1996Q2 to 2018Q4



Notes: The top four graphs present log real GDP, the log world real interest rate, log Tobin's Q, and the trade balance-output ratio. Growth rates are the first differences of the log levels. The first difference of the trade balance-output ratio is computed as $100*(\frac{TB_t}{Y_t}-\frac{TB_{t-1}}{Y_{t-1}})/\frac{TB_{t-1}}{Y_{t-1}}$.

Figure 2: Mexican Sample from 1994Q2 to 2018Q4

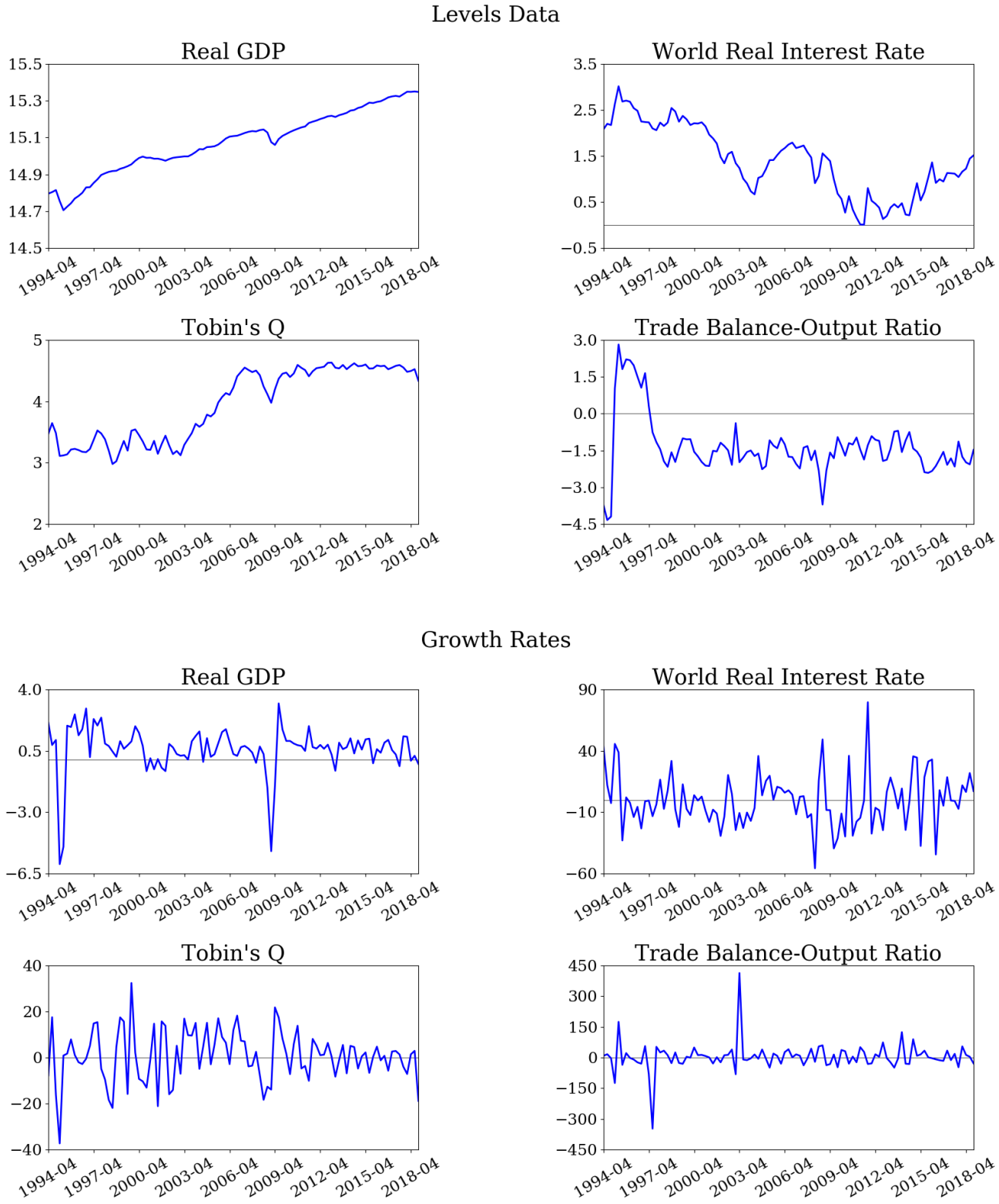


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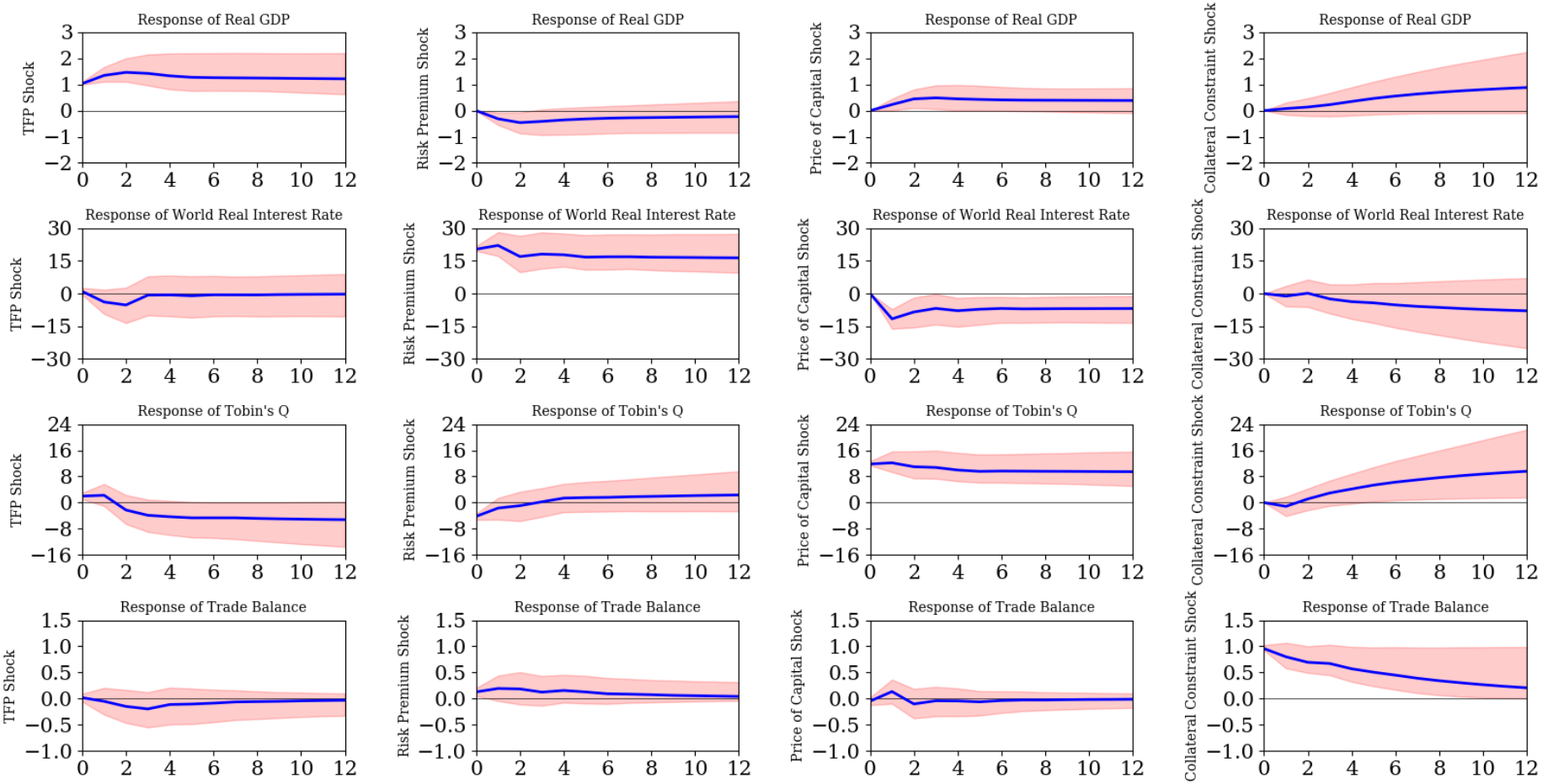
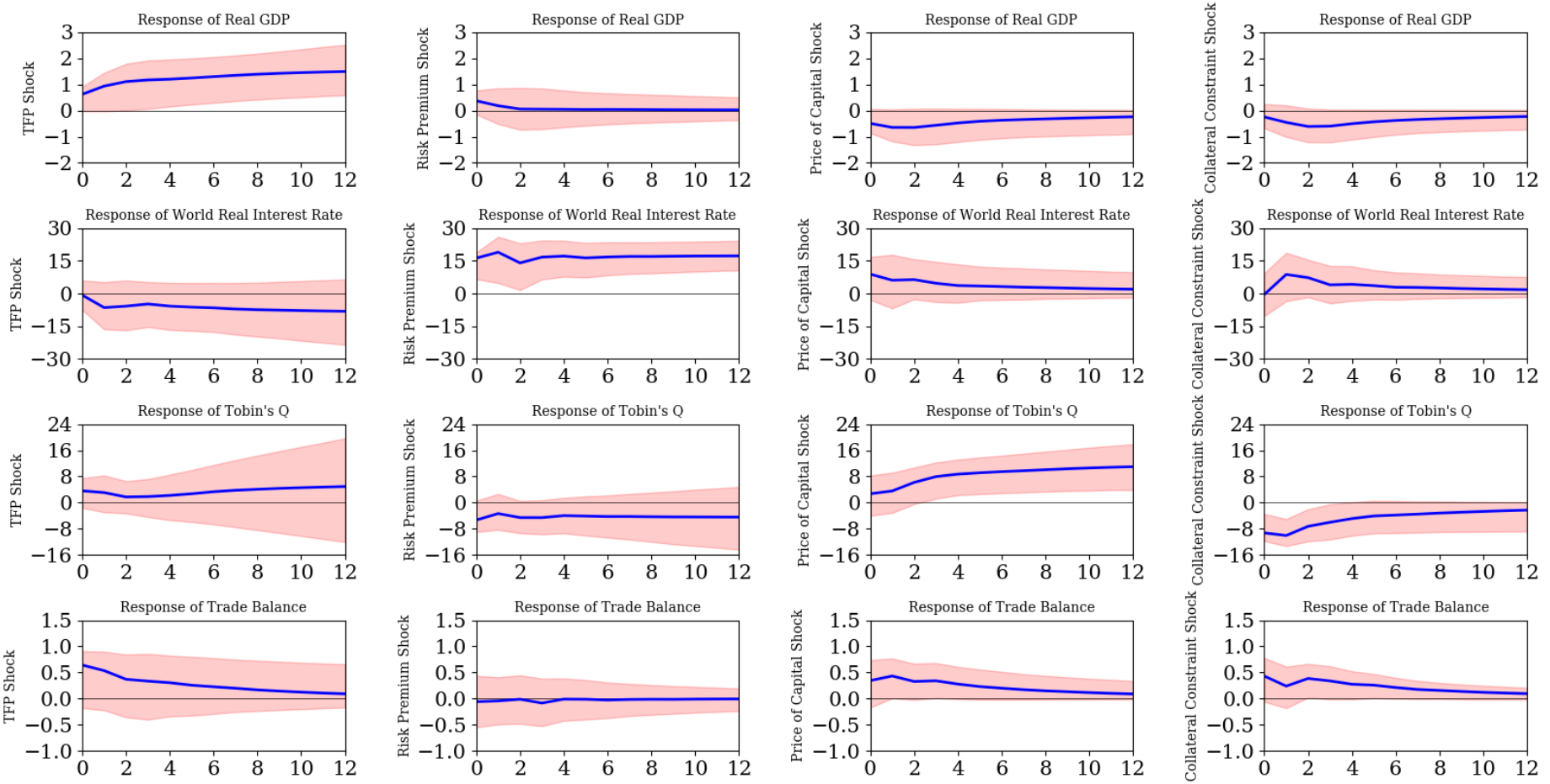
Figure 3: IRFs Estimated on the Brazilian Sample from 1999Q1 to 2018Q4 Under Short-Run Restrictions



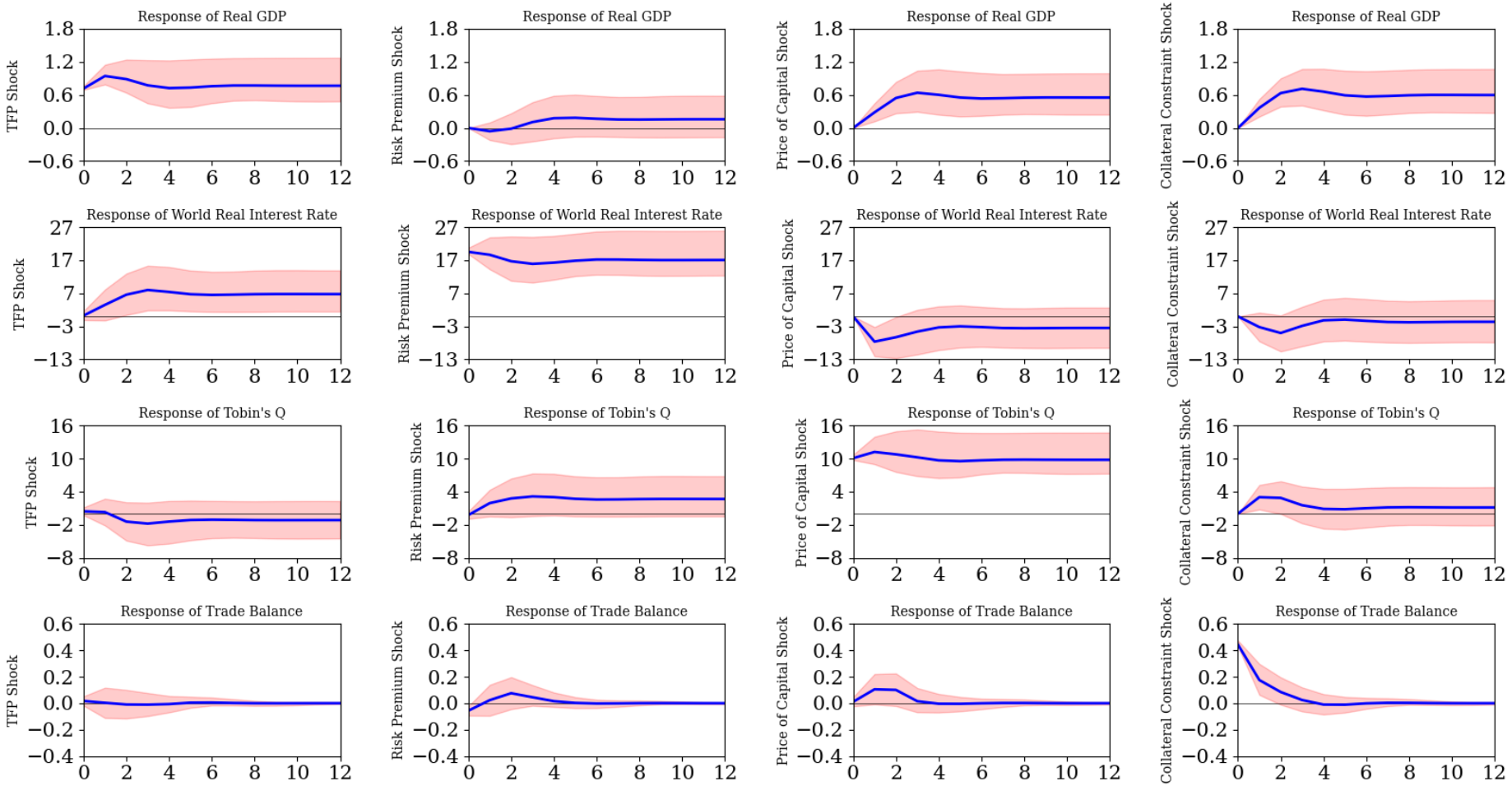
Notes: The blue solid lines trace the IRFs. The red shadings trace 90% bootstrap sup-t confidence bands. The units of real GDP are in log levels; the trade balance are in millions of local currency units; the world real interest rate and Tobin's Q are in percentages.

Figure 4: IRFs Estimated on the Brazilian Sample from 1999Q1 to 2018Q4 Under Long-Run Restrictions



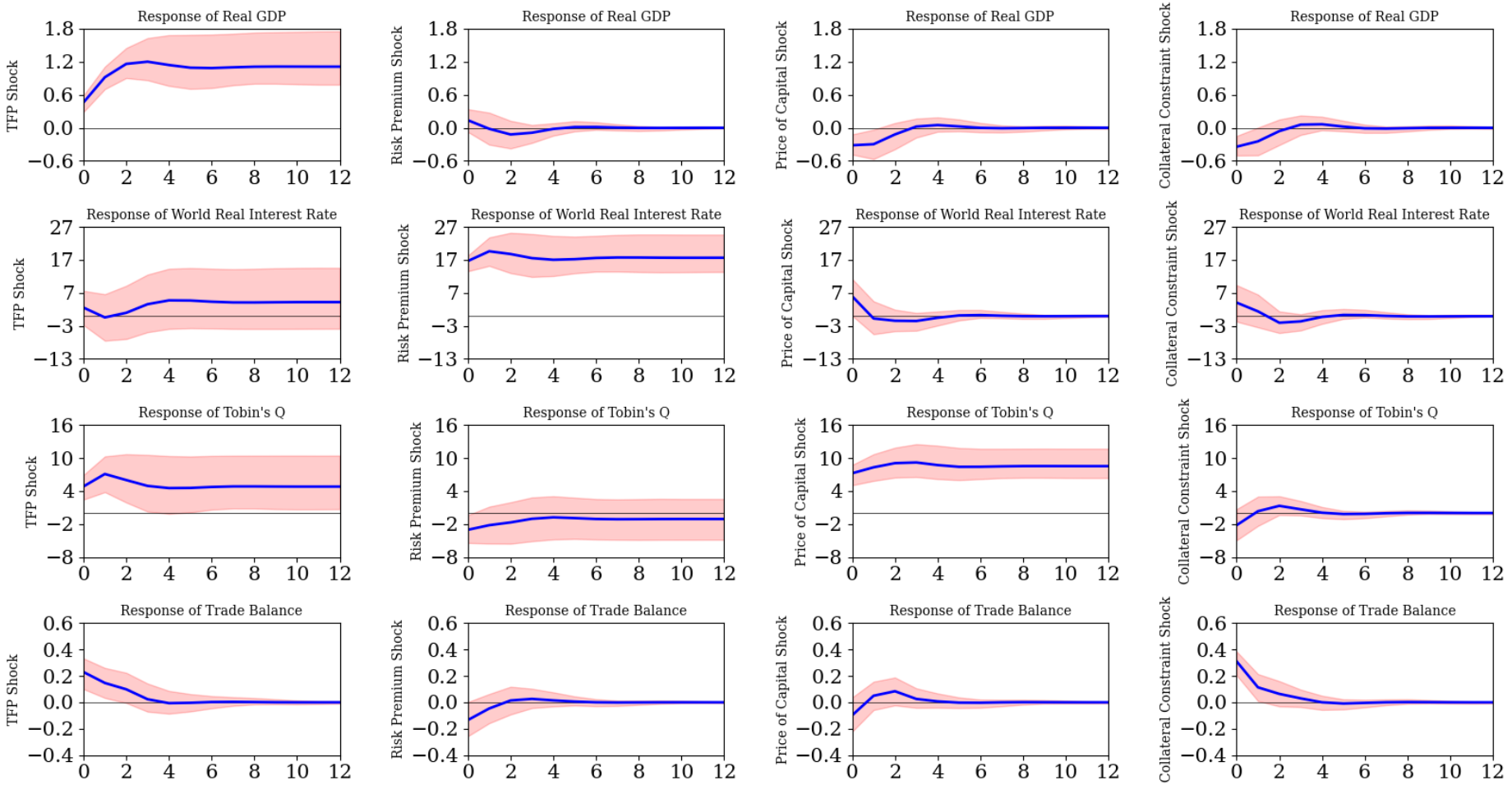
Notes: The blue solid lines trace the IRFs. The red shadings trace 90% bootstrap sup-t confidence bands. The units of real GDP are in log levels; the trade balance are in millions of local currency units; the world real interest rate and Tobin's Q are in percentages.

Figure 5: IRFs Estimated on the Mexican Sample from 1997Q1 to 2018Q4 Under Short-Run Restrictions



Notes: The blue solid lines trace the IRFs. The red shadings trace 90% bootstrap sup-t confidence bands. The units of real GDP are in log levels; the trade balance are in millions of local currency units; the world real interest rate and Tobin's Q are in percentages.

Figure 6: IRFs Estimated on the Mexican Sample from 1997Q1 to 2018Q4 Under Long-Run Restrictions



Notes: The blue solid lines trace the IRFs. The red shadings trace 90% bootstrap sup-t confidence bands. The units of real GDP are in log levels; the trade balance are in millions of local currency units; the world real interest rate and Tobin's Q are in percentages.