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ABSTRACT

This paper examines the macroeconomic implications of exchange rate shocks in a sample of 13 emerging market and 6 advanced economies since the early 1990s. Factor-augmented vector autoregressions are estimated with three separate factors identified. They are: real, monetary and financial factors. The main conclusion is that there is no 'one size fits all' when interpreting the domestic responses to an exchange rate shock. International policies that aim to define a particular exchange rate or exchange rate regime are unlikely to be able to deal with so many idiosyncratic responses. Nor is it the case that a particular monetary policy strategy, such as inflation targeting, can immunize a domestic economy against all external shocks. International cooperation should instead encourage individual economies to seek out the menu of policies that ensure that each one's house is in order.

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1. Introduction

Since the end Bretton Woods there has been considerably more flexibility in exchange rates. In emerging market economies (EME) policy makers have tended to demonstrate greater resistance to floating exchange rates (e.g., see Reinhart and Rogoff (2004), Ilzetzki, et. al. (2017), Frankel 2017). One cannot ignore, however, the fact that there have been large movements in nominal and real exchange rates over the past few decades.[1]

Broadly speaking, between 1999 and 2015, the sample considered in the econometric portion of the study, the ratio of the minimum to maximum nominal EUR/USD exchange rate is 0.56. The same ratio, over the same period, is 0.74 for China's renminbi, and 0.44 for Brazil's real, two large EME. Hence, there is considerable scope for large movements in the level of exchange rates. The last three decades have also seen sizeable fluctuations in many asset, credit and commodity prices. Indeed, when judged against the number and frequency of financial crises of various kinds (e.g., see Reinhart and Rogoff (2009), Laeven and Valencia (2012), and Bordo and Meissner (2016)), there is something to be said for linking USD movements, and exchange rate movements more generally, to boom-and-bust cycles, especially in EME (e.g., Plantin and Shin (2016), Hofmann and Schnabl 2016). However, the implications of exchange rate fluctuations are still not adequately understood (e.g., see Forbes 2016).

The combination of 'original sin'[2], USD pricing of key commodities, together with the coupling and decoupling of business cycles over time, also draw attention to a relationship between USD fluctuations and economic performance in EME (inter alia, Gopinath (2016), Ilzetzki, et. al. (2017), Obstfeld et. al. (2017), and references therein). Finally, ultra-low or negative interest rates may have contributed to enhancing the exchange rate channel (e.g., Brainard 2016).

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[1] A fairly close connection between nominal and real exchange effective rate movements exists (e.g., Burstein and Gopinath 2014). The discussion that follows will focus on nominal effective exchange rates, due to the policy implications of the proposed study.

[2] This refers to borrowing in USD when restrictions and frictions that prevent or limit borrowing in the domestic currency. See Eichengreen, et. al. (2007).

There has been comparatively little recognition given to the role of the financial cycle whose impact contrasts with the trade cycle emphasized by most authors. Under the latter a currency appreciation is contractionary since exports fall while imports rise. In contrast, the financial cycle can lead to an economic expansion since domestic balance sheets are strengthened leading to a potential rise in credit expansion.[3]

More generally, while there is a literature establishing a long-term historical link between credit or financial cycle booms-and-busts and economic activity (e.g., see Schularick and Taylor 2012), assigning a role for exchange rates has sometimes been deemed secondary to other factors. However, this view is undergoing some changes, principally because it has become clear that financial globalization has blunted the ability of a floating regime to insulate against external shocks (e.g., Plantin and Shin 2016). Therefore, and in spite of greater flexibility in exchange rate regimes, EME remain vulnerable to global shocks most notably from the US.

Even the shift in emphasis to focusing on the spillover effects from unconventional monetary policies (UMP) has not diminished interest in the role played by fluctuations in the USD. As Rajan, former Governor of the Reserve Bank of India, put it: "disregard for spillovers could put the global economy on a dangerous path of unconventional monetary tit for tat." (Rajan 2014) Beyond the real economic effects are large movements in capital flows which also react to sizeable fluctuations in the USD exchange rate. This is hardly a new phenomenon. For example, Rodrik (1998, p.2) points out: "Boom-and-bust cycles are hardly a side show or a minor blemish in international capital flows; they are the main story."

Given the prospect, for example, of the continued 'exorbitant' privilege enjoyed by the USD (e.g., see Prasad (2014), McKinnon 2013), it is worthwhile empirically examining how exchange rate movements impact asset, commodity markets, and economic conditions in EME more generally. Indeed, Obstfeld and Rogoff (2000, p. 380) argued that the "…extremely weak short-term feedback between the exchange rate and the economy" is one of the continuing puzzles

[3] The financial channel is now also often referred to as the risk-taking channel (e.g., Bruno and Shin 2015). It is not entirely divorced from the concept of the financial cycle, an old idea revived in the aftermath of the GFC (see, Borio 2014).

of international finance. They argue that a richer model[4] is necessary to make progress in solving this puzzle.

This paper investigates the role of exchange rate fluctuations in creating conditions that lead to drift in fundamentals potentially leading to booms-and-busts in EME. Typically, models of the kind investigated in this study focus on the impact of monetary policy shocks. Given that exchange rate shocks have different real and financial implications the present study is also interested in determining the importance of these shocks for monetary conditions and the macroeconomy more generally. The specifications considered in this paper are distinguished from others not only by the inclusion of financial factors, in addition to separate real and monetary factors, but also because US or global influences are also taken into account.

The data reveal that all EME and AE experience periods of sharp and prolonged deviations in exchange rates away from some estimated trend or equilibrium value and that the real economy and financial assets are not immune to these fluctuations. Estimates also suggest considerable cross-country diversity in the response to an exchange rate shock. Almost none of the economies investigated are immune to an exchange rate shock. Neither the chosen exchange rate regime nor the adoption of a particular monetary policy strategy (e.g., inflation targeting) is associated with a particular set of responses to such a shock. Furthermore, while exchange rate shocks can affect real, monetary, or financial factors they usually do not affect all three. Echoing Frankel's (1999) findings 'one size does not fit all' when it comes to the macroeconomic effects of exchange rate fluctuations.[5]

The rest of the paper is organized as follows. Following a review of the most relevant literature in the next section, section 3 describes the data and the methodology to investigate the main questions of interest. I provide evidence based on select individual country estimates based on factor vector autoregressions (FAVAR). Finally, in view of concerns over the reliability of VAR models with modest sample spans some local projections are also presented for selected cases.

[4] That is, one that moves beyond simple purchasing power or interest rate parity relationships.

[5] An important caveat to the role of inflation targeting is that I am unable to isolate its effects with precision both because adoption dates differ considerably across the countries in the data and the data do not readily permit separate estimation for a sample when the targets were fully in place.

Section 4 describes the main econometric results while section 5 concludes and offers some policy implications.

2. Literature Review

Rodrick (1998) noted almost two decades ago the inevitability of large swings in financial markets, that is, of boom-and-bust cycles, adding that appropriate economic policies can reduce their likelihood but not eliminate them (also see Bordo and Jeanne 2002).

The downplaying of the role of exchange rates began around the late 1990s and continued, until the international financial crisis of 2007-9, aided in no small part by growing evidence of a decline in pass-through effects (e.g., see Mihaljek and Klau (2008), Jašová et. al. (2016) for emerging markets; Bailliu and Fujii (2004), and Choudhri and Hakura (2015), for advanced economies). Since the GFC crisis, however, there has been a revival of interest in the impact of changes in exchange rates. As Shin (2016) notes: "Exchange rates are back in the news". This sentiment is also echoed in a recent speech by the former vice-chair of the FOMC who notes: "[F]or small open economies, the exchange rate may well matter as much for output and inflation as do interest rates." (Fischer 2015)[6]

Contributing to this development in no small part is the recent admission by the Fed that "…the exchange rate channel may have played a particularly important role recently in transmitting economic and financial developments across national borders." (Brainard 2016) The recognition that exchange rate movements feed into investor behavior means that a risk-taking channel also exists and operates on a global scale (e.g., Avdjev and Takats (2016), De Bock and Filho 2015). Shin (2016) relies on this channel to explain how a depreciating US dollar leads to more lending in USD and, consequently, to looser credit conditions. This is particularly relevant for EME. However, the bottom line is that US monetary policy has a significant influence on global financial conditions. Not everyone shares this view. Bernanke (2015), for example, points out

[6] The link between interest rates and exchange rates, of course, has a long history and the GFC does not appear to have dimmed the connection between these variables (e.g., see Hui et. al. 2016, Fong et. al. 2016). Nevertheless, it has proved hazardous for policy makers to combine the two as a way of illustrating, for example, how exchange rate and interest rate movements provide information about the tightening or loosening of the stance of monetary policy. This is reflected in the largely discarded attempt to define a monetary conditions index (e.g., see Siklos 2000, and references therein).

that changes in the Fed's monetary policy stance translated into exchange rate changes that blunted any negative spillover effects. Needless to say, the subject of spillovers (and spillbacks) is the subject of a separate mushrooming literature that cannot be considered here (e.g., see Aizenman, et. al. 2015).

A crucial element in the more recent debate is accounting for the impact of quantitative easing (QE). What is most relevant for the present study are the macroeconomic effects of policies that resulted in considerable easing leading to ultra-loose monetary policies in many advanced economies. Their effects spilled over into EME but the size and persistence of the impact of QE on EME financial markets is a matter that is hotly debated in an emerging literature (see Lombardi, et. al. (2017), and references therein).

Bhattari et. al. (2015) examine data for over a dozen EME and their monthly structural VARs with a Bayesian flavor suggest that QE has significant real and financial effects, as well as contributing to a depreciation in the USD. Indeed, the impact of QE is up to 4 times larger in the group of EME known as the fragile five (i.e., Brazil, India, Indonesia, Turkey, and South Africa).

Tillmann (2016), who also estimates a VAR and considers a slightly different set of EME, also finds that QE has significant effects on financial conditions. Nevertheless, since the precise form of the exchange rate regime adopted by various EME, and their institutional capacity, is rather heterogeneous, so is the impact of QE type shocks. This is precisely the conclusion reached by Bowman et. al. (2015). They rely on an identification scheme that exploits changing heteroscedasticity of financial time series at the time unconventional policies are introduced. Interestingly, they also conclude that spillovers from US monetary policy are not significantly different since the GFC relative to an era when policy was more conventional.[7]

The so-called 'taper tantrum' of May 2013 is an especially important event and, according to the results of Ahmed et. al. (2015), it appears that the vulnerability of EME to external shocks does appear to have changed since the GFC, thus contradicting the Bowman et. al. (2015) findings. Nevertheless, the most important indicator of vulnerability in EME is exchange rate

[7] Except for Brazil and Singapore.

depreciation. Indeed, Glick and Leduc (2015) report that while a surprise easing of policy in the US has always led to a depreciation of the USD the size of the depreciation for a given US monetary policy shocks is three times larger since the GFC. It has long been known that large depreciations can have important economic effects in EME (e.g., Frankel and Rose 1996) but it is not clear that the GFC has changed the magnitude or duration of large exchange rate movements (De Gregorio 2016).[8]

The USD is not the only contributor to this phenomenon. Any 'global' currency has the potential of influencing global financial conditions though, of course, the USD, followed by the euro and the Japanese yen, are the currencies that have the greatest influence (e.g., see Avdjiev and Takats 2016). Beyond any link between exchange rate movements and financial conditions, fluctuations in the former are also seen as having large real economic effect, that is, they significantly impact output and prices (e.g., see Forbes et.al. 2016). Kearns and Patel (2016) is a unique example of a study that explores the balance between the trade and financial effects of USD exchange rate fluctuations. They conclude that the risk-taking channel, whose impact is estimated based on debt-weighted as opposed to the usual trade-weighted exchange rates, can indeed offset the trade channel, particularly in EME. Nevertheless, another possibility is that the duration of swings in exchange rates, including the USD, is the proximate reason for the balance of changes in macroeconomic conditions (e.g., see International Monetary Fund 2015). Obstfeld et. al. (2017) also revisit the role of the exchange rate and financial conditions by using a VIX-like proxy (the VXO index which predates the VIX) and estimate a variety of panel regressions. They conclude that exchange rate regimes matter with fixed variety exchange rate regimes relatively more sensitive to financial type shocks.

If exchange rate movements matter in both real and financial terms then so does the choice of the exchange rate regime. Mody (2004), for example, noted over a decade ago that several EME chose to adopt more flexible exchange rate regimes, coupled with institutions that would

[8] What may also matter is the duration of the depreciation since there are likely different macroeconomic consequences from temporary versus permanent changes in exchange rates.

ensure greater credibility of their macroeconomic policy strategies. [9] This approach fits nicely with views held in advanced economies, and reiterated by several central bankers, such as then Bank of Canada Governor Carney (2008), who argued that "[O]ur floating exchange rate helps to achieve the appropriate adjustments without forcing very difficult changes in the overall level of wages, output, and prices." Ilzetzki, et. al. (2017) reprise an earlier exchange rate indicator, due to Reinhart and Rogoff (2004), and conclude that the USD remains the dominant anchor currency and that exchange rates are less flexible than many believe. Of course, one may quibble with the somewhat *ad hoc* index of exchange rate flexibility. Nevertheless, if *de facto* exchange rate regimes are less flexible than we thought then it is also possible that the exchange rate channel has greater scope for real, monetary, and financial effects.[10]

Bernanke (2015b) has also pointed to the exchange rate as a shock absorber to downplay the impact of global spillovers from the Fed's policies since 2008. The impression that floating regimes buy domestic macroeconomic flexibility continues to be expressed even after the GFC (e.g., see ECB 2015, Shambaugh 2015) no doubt partly reinforced, at least as far as Asian economies are concerned, by the conclusion that exchange rate regime management was significantly to blame for the Asia Financial Crisis (AFC) of 1997-8 (e.g., Goldstein 1999).

The downplaying of the potential influence of exchange rate shocks, at the expense of a focus on monetary and real shocks, suggests that an important channel, namely the exchange rate channel, deserves further study.

3. Data and Methodology

Data used in the estimated models described below are sampled at the quarterly frequency. The sample begins in 1989Q1 and ends in 2016Q1 before any transformation or differencing is

[9] There have long been doubts about the commitment to exchange rate flexibility in EME because of the 'fear of floating' phenomenon (Calvo and Reinhart 2002). More recently, it is the growing importance of China (e.g., see Dizoli et. al. 2016). Kluyev and Dao (2016), and Caporale et. al. (2016), suggest that the pure float often associated with the desire to rely on the exchange rate as a shock absorber does not describe movements in this variable at least in the ASEAN region. The ASEAN is the Association of Southeast Asian Nations.

[10] Frankel (2017) reminds us that various attempts are labelling exchange rate regimes produces indicators that are substantially in disagreement with each other. As a result, he suggests that it is preferable to think of policy makers as trading off exchange rate flexibility against their desire to hold foreign exchange rate reserves.

applied. Two main data sources are employed. They are: *International Financial Statistics* (IFS) CD-ROM from the International Monetary Fund (August and October 2016 editions), and the Bank for International Settlements. The latter is the source for exchange rate and financial asset price data while the IMF provides the bulk of real and monetary variables. For some EME, the samples are shorter for a number of reasons. First, there is often a considerable delay in updating key economic series in the IFS (e.g., real GDP and price data). Second, the availability of financial and monetary series does not always stretch back to 1989. Finally, in at least two cases (viz., Argentina, and Brazil), it was deemed preferable to exclude certain extraordinary economic periods when either macroeconomic or financial data exhibit massive variations that would render econometric estimation difficult.[11]

Table 1 lists the economies under consideration. A total of 13 EME and 6 AE are considered. The sample includes economies that add up to almost 80% of the world's GDP.[12] The AE are included in the analysis to provide some contrast with the results for the EME. The time series used in the empirical analysis are sub-divided into five groups of variables. They are: real economic variables (e.g., output), financial variables (e.g., credit), monetary policy (e.g., a policy interest rate), commodity prices (e.g., oil), and the exchange rate.

To analyze the exchange rate channel I proceed in two steps. In a first stage I apply some univariate techniques to the exchange rate and key EME time series to identify boom-and-bust periods. They are: a threshold-based selection method and a turning point based procedure. The threshold technique is one that has been widely employed in the related literature to identify periods when certain series experience prolonged departures from normal or equilibrium conditions. Hence, deviations in some variable of interest (e.g., here the exchange rate) from some trend (see below) that exceed a threshold, say, 2% or 3% are seen as excessive and, if they persist, they are deemed to be prolonged (e.g., see Filardo and Siklos 2016, and references therein). Next, if these episodes are found to overlap with declines in economic activity (e.g., a recession or when there are two consecutive quarters of negative economic

[11] For Argentina and Brazil the hyperinflation episodes of the 1980s and early 1990s are excluded.
[12] The advanced economies alone make up 52% of the world's GDP in the data set while the EME contribute another 26% to global GDP.

growth or negative growth that again exceeds a 2% or 3% threshold), the result is seen as economically 'painful'. Alternatively, one can identify turning points in economic activity and ask whether or not these take place simultaneously with large exchange rate movements. Turning point identification is based on the Pagan and Harding (2002) technique.[13] Once dates are identified these serve as the basis for some stylized facts prior to the estimation of an econometric model.

An important consideration is how the deviations from fundamentals or trends are determined. For output or the (real) exchange rate I use the filter recently recommended by Hamilton (2017) as an improvement over the better known and more widely used Hodrick-Prescott (H-P) filter. Alternatively, one can simply use rates of change (e.g., real GDP growth). The same applies to the exchange rate variable. One could also use some moving average or deviations thereof. In what follows I adopt a 12 quarters moving average (i.e., 3 years) as this seems suitable for capturing the evolution of trend or equilibrium conditions in many economic time series.

Since the exchange rate variable is central to the analysis some additional discussion is in order. At least three different exchange rate variables are potential candidates for analysis.[14] They are: the bilateral USD-domestic currency unit exchange rate, the nominal and real effective exchange rates. It is well known that the behavior of the last two exchange rate indicators is similar in first log difference form. Indeed, the broad time series properties of the two are similar.[15] Choosing between the bilateral and either the real or nominal effective exchange rates need not be inconsequential.[16] As Hofmann, et. al. (2016) point out the USD exchange rate has a strong (financial) symbolic role as many financial transactions, not to mention prices, are expressed in USD (also see Gopinath (2016)). Nevertheless, examining the weights used in constructing the nominal effective exchange rate (NEER) suggests not only a fairly sizeable

[13] Their methodology is inspired by the so-called Bry-Boschan (1971) business cycle dating method. Also, see Mendoza and Terrones (2008) for a variant on turning point detection.
[14] We do not consider the debt-weighted exchange rate series proposed by Kearns and Patel (2016).
[15] I relegate to the Appendix a series of plots that visually supports this contention.
[16] A Table in the Appendix shows the correlation between bilateral and various proxies used in this study derived from the nominal effective exchange rate. The simple correlations are very high with only the cases of China, Hong Kong and Singapore standing out from the rest.

decline in the relative importance of the USD over the sample used in this study (see the Appendix for the details) but, with the exception of Mexico, the weight of the US is modest. Therefore, it is unclear whether policy makers interested in the overall impact of exchange rates on their economies would want to focus on the USD exchange rate alone as the introduction of the euro and the rise of China ought also to play a role. Moreover, since intervention and other restrictions on bilateral exchange rate movements is prevalent among EME, not to mention the choice of exchange rate regimes (see below), the time series properties of bilateral USD exchange rates can be subject to large, albeit temporary, movements that make it difficult to use in models of the kind estimated here. Hence, all results below are based on the nominal effective exchange rate.[17]

Next, an econometric model is estimated. The usual approach is to estimate a model relying on a few observable variables, such as real GDP growth, inflation, an exchange rate variable and a variable that captures the role of monetary policy (e.g., a policy interest rate). Instead, I estimate factor models where these are estimated via the method of principal components. This serves the dual purpose of recognizing the possibility that multiple economic variables combine to explain real, monetary and financial factors while acknowledging that the curse of dimensionality plagues many attempts to estimate models of the standard variety. In several EME, monetary policy can rely on several instruments. Moreover, an evaluation of the real effects of exchange rate fluctuations might benefit from the recognition that policy makers care not only about output performance but how these interact with expectations and performance of the external sector of the economy (e.g., the current account), particularly since EME are, with the exception of China, open economies. Finally, events of the past decade have reminded the profession that the financial sector can and does create frictions with monetary policy and the real economy. Hence, interest rates and credit, to give two examples, influence and are influenced by the exchange rate as well as the real and monetary variables in an economy.

[17] All models were also re-estimated using the USD bilateral exchange rate. While some of the conclusions discussed below are unchanged, not surprisingly, others are affected. The evidence in Ilzetzki, et. al. (2017) would suggest that existing weights used to construct effective exchange rates may provide a biased interpretation of the exchange rate channel. More precisely, when re-estimating the FAVARs using bilateral USD exchange rates the overall conclusions drawn from the empirical results remain unchanged. Of course, country by country estimates do change (not shown).

Estimation of the factors proceeds as follows. Suppose there are *N* series used to identify real, monetary, or financial factors. Table 2 lists the potential time series that are classified as belonging to each group. Note that not all series are available for all the economies considered (see the appendix).[18]

We apply the method of principal components to estimate via maximum likelihood the number of factors. This, of course, represents nothing more than a linear combination of the series that are labeled as belonging to each one of the identified categories. The Kaiser-Guttman technique is used to identify the prospective number of principal components.[19] The final number of retained principal components is also selected based on each component's explanatory power. As is well known, the first component has the largest explanatory power and this declines with each additional principal component. When more than one principal component is retained a rotation[20] is applied so that the resulting vector consists of orthogonal components. The resulting factor scores serve as proxies for real, monetary or financial factors. A similar procedure was used to estimate global factors. Two versions were examined. They are: all economies in the data set or all AE economies as a group. A selection of factor scores is shown in the appendix.

Finally, all the relevant observed and factor model generated series are combined into a vector autoregressive (VAR) type model. The observed variable is a proxy for exchange rate movements as described above. Estimated factors from US data are treated as exogenous variables, lagged one quarter, in a VAR for each one of the AE and EME in the data set (see Table 1; except for the US). The result is a factor-augmented VAR (or FAVAR).

The factors are estimated for each economy separately according to

(1)

[18] Because of the unbalanced nature of the data set (i.e., availability and coverage varies across economies) the potential length of factor scores can vary. Some sensitivity analysis was conducted wherein, for example, some series in Table 2 were omitted to obtain a longer sample. Generally, the empirical analysis was unaffected. Hence, all reported results below use the full available complement of data for each factor.

[19] Essentially this technique relies on retaining the principal components with eigenvalues that exceed 1.

[20] The Varimax approach is used to rotate the principal components.

where Φ, is the vector of real, monetary, and financial factors (scores) at time t extracted from data for each economy, and *j* are the economies listed in Table 2.

The estimated factor scores then serve as endogenous variables in the VAR where the exchange rate variable is an additional endogenous variable. Recall that this variable is estimated in several ways but the discussion below focuses on two forms. They are: deviations in the logarithm of the NEER either from a 12 quarters moving average or from the application of Hamilton's (2017) filter to the logarithm of the NEER. The bulk of the next section describes the empirical results focus on the case using Hamilton's filter. We can then write

(2)

where the factors have previously been defined, θ is the nominal effective exchange rate variable (i.e., in deviations from Hamilton's (2017) filter), **X** is the vector of US real, monetary and financial factors, presumed exogenous, and κ is either a commodity price indicator or the rate of change in world oil prices.[21] Equation (2) is a factor-augmented VAR or FAVAR model.[22]

Notice that the exchange rate variable is listed first in the VAR. Since a Choleski decomposition is employed, and impulse responses can be sensitive to the ordering of the variables some additional discussion is warranted. It is often the case that an exchange rate variable is last in many standard VARs. The argument is that the exchange rate responds immediately to all shocks in the system while an exchange rate shock can affect the other variables, with a lag. This is sometimes justified by stating that, in doing so, any potential remaining endogeneity is minimized. However, the typical VAR often includes the rate of change in the (bilateral) USD exchange rate and not, as in the present study, deviations from some trend or estimated

[21] In the results reported below I ended up using the world price for energy from IFS. However, the first principal component of a large number of commodity prices (obtained once again from IFS) was also used with similar results. A version of (2), where $\mathbf{X}^{\text{global}}$ replaces $\mathbf{X}^{\text{US}}$, is also estimated. A referee notes that it is not immediately obvious that these factors should be treated as exogenous. That possibility clearly exists. However, the approach adopted here does permit for comparability with the extant literature, as well as avoids a considerable increase in the dimension of the FAVAR which is problematic given the span of the sample.

[22] In the foregoing expressions we exclude other exogenous influences (e.g., the period of the global financial crisis). These can easily be added without jeopardizing the thrust of the discussion.

equilibrium value. It is not clear why the exchange rate should only affect all the other variables with a lag especially since, for example, the real factor includes forward looking variables (i.e., one year ahead inflation and real GDP growth forecasts) and exchange rates are also subject to feedback effects (e.g., Plantin and Shin 2016). Moreover, since the remaining endogenous variables are themselves composites of various real, monetary and financial variables it is not obvious that an exchange rate variable, also a composite indicator, should be viewed as responding immediately to all other shocks in the system.[23] In any case, results presented in the following section also consider the more traditional ordering where, in equation (2), θ is ordered last in the FAVAR.[24]

Finally, since any estimated model is an approximation, Jordà (2005) proposes estimating impulse response by local projections instead of extrapolating at increasingly distant horizons as in standard VAR estimation. I also apply this approach in select cases as a further test of the sensitivity of the basic FAVAR results.[25]

The foregoing estimation strategy is consistent with Obstfeld and Rogoff's (2000) call for specifying broader models to address outstanding puzzles in this area. Equally important, the strategy explicitly recognizes interdependence with US or global economic forces and permits us to estimate the impact of exchange rate fluctuations in a variety of economies where international spillovers (here proxied by US spillovers) are also accounted for.[26] Hence, this provides policy makers with a clearer understanding of the economic effects of large and persistent exchange rate fluctuations away from some trend.

4. Empirical Results

[23] As is clear the estimated impact of exchange rate shocks considered here are not, strictly speaking, of the structural variety.

[24] A referee points out that Generalized Impulse Reponses (GIRFs) could also be presented in which case the ordering of the variables in the VAR is inconsequential. GIRFs have been criticized because their estimation sidesteps the need to impose a structural identification scheme for the model. In some applications this does not create any difficulties. In the present study, however, one of the aims is to investigate the sensitivity of the results to the placement of the exchange rate variable in the model.

[25] The local projections rely on the same VARs as the ones discussed in the following section, using the same lags. It is argued that local projections are more robust to misspecifications.

[26] Although our model(s) estimates US spillover effects I do not discuss below the case when global factors replace US spillovers. More details about the behavior and estimates of global factors are contained in the appendix.

4.1 *A Few Stylized Facts*

I begin with a series of stylized facts to describe the links between exchange rate movements and their potential economic consequences. Figure 1 shows the contrast between movements in the exchange rates, proxied here by deviations in the logarithm of the NEER from Hamilton's (2017) filter, and Reinhart and Rogoff's (2004) exchange rate regime classification for the period. Only the US is excluded.[27] There is little connection between exchange rate regime choice and the behavior of the exchange rate variable. Two interesting examples include Hong Kong (first plot in the second row) and Singapore (third plot in the third row) and they demonstrate that, in spite of an unchanged *de facto* exchange rate regime there can still be considerable movement in the NEER. The same can be said of the experiences of Colombia, Mexico, and Chile. Similarly, greater flexibility in the NEER can be a prelude to more stable NEER movements (e.g., Argentina), as is a less flexible exchange rate regime (e.g., Russia). Assuming that overall exchange rate movements are better interpreted through an analysis of NEER there are few insights offered from some existing exchange rate classifications (also, see Frankel (2017)).

Figure 2 shows for all 19 economies (see Table 1) the three proxies for θ (see equation (2)), namely the series labeled MA1, which represent deviations from a 12 quarters moving average of the logarithm of the NEER, MA2, namely deviations from Hamilton's (2017) filter, while MA3 is the simple 12 quarters moving average of the rate of change in the NEER. It is clear that the proxies can differ from each other. Nevertheless, both the MA1 and MA2 series show clear indications that large, and persistent, deviations in exchange rate movements are a fact of life in most economies. Some events clearly appear to be the culprit for some of the large departures. For example, the impact of the Asian Financial Crisis (AFC) of 1997-98 is evident from the data for Hong Kong, Indonesia, Malaysia, the Philippines, and Thailand. Nevertheless,

[27] Results are comparable when deviations from a moving average are used (not shown). Overall conclusions are also similar when the USD bilateral exchange rate is used. The plot is relegated to the Appendix. The Reinhart and Rogoff 'coarse' index is used and the data end in 2010. At the time of writing raw data for the updated index (to 2015) reported in Ilzetzski, et. al. (2017) were unavailable. Since the paper was revised, Carmen Reinhart has posted an updated exchange rate regime data set (www.carmenreinhart.com/data/browse-by-topic/topics/11/) . While broadly similar with the earlier Reinhart and Rogoff data set there are some changes. In any case most of the exchange rate regime changes of interest take place before the GFC.

the AFC's impact dwarfs other economic events only for Indonesia and Thailand but not the other economies in the region directly impacted by this event. Similarly, the GFC of 2008-9 shows up in the behavior of the NEER for Chile, Korea, South Africa, and the United Kingdom, but this crisis does not appear to dominate exchange rate movements in many other economies. However, it is plausible that the Eurozone sovereign debt crisis of 2010-11 has a noticeable impact on the NEER for several economies including, of course, the Eurozone, Brazil, Chile, Colombia, the U.K., and South Africa. Notice also that the behavior of the NEER proxy suggests that it is unclear whether the exchange rate responds immediately to all shocks as the events mentioned above appear to be prolonged. Hence, it is far from obvious that exchange rate shocks would affect other economic variables with a lag as is assumed in many standard VAR specifications that rely on observable economic time series.

Table 3 considers the joint occurrence of disorderly exchange rate movements with painful business cycle episodes.[28] As explained previously, the literature views disorderly exchange rate movements as taking place when a proxy for exchange rates (i.e., either MA1, MA2, MA3) exceeds the 2% or 3% threshold. Similarly, a 'painful' economic growth episode takes place when there are two or more consecutive quarters of negative real GDP growth rates that exceed 2% or 3%. Table 3 shows the fraction of the sample when both events jointly take place and the count (i.e., number of quarters). Obviously, the higher threshold reduces both the fraction of the time and count of joint occurrences. Nevertheless, what is striking is the diversity of experiences ranging from zero such episodes for China to a high of over 20% for Argentina. It is also not the case that EME are more prone to such joint occurrences since Japan's experience is worse than most other economies except Argentina. Although the picture changes somewhat when the 3% threshold is used it remains the case that EME are not more prone to disorderly NEER movements jointly with painful business cycle movements.

4.2 *Impulse Response Functions: Full and pre-Crisis Samples*

[28] When the same exercise is repeated, using the Bry-Boschan turning points metric, there are also indications that there is a possible link between turning points in exchange rate movements and business cycle activity. The results are in the Appendix.

Next, I turn to the FAVAR estimation results. As noted previously, estimation of equation (2) is preceded by the estimation of the factor scores from equation (1). Table 4 displays the number of principal components used in the FAVAR for each economy. Also shown is the proportion of the variation explained by the first two principal components where relevant. In about half of the economies in the data set two principal components are retained for the real factor. In the case of the monetary and financial factors one principal component usually suffices.[29] Turning to the interpretation of the principal components the factor loadings (not shown) suggest that if the first real factor captures aggregate demand the second factor captures aggregate supply or global economic factors (see below).[30]

In the few cases where two principal components for the monetary variables are found the first largely captures the multiplicity of monetary instruments at the disposal of the monetary authorities. The most prominent, again based on the size of the factor loadings, are the money supply, and foreign exchange reserves, and the size of central bank assets to GDP. In six of the nine economies that formally target inflation the period since IT was introduced also plays an important role in driving the monetary factor. The policy rate, less prominent among the monetary instruments, especially in EME, appears in the second factor (including the US). However, a second factor is estimated for only four economies and the policy rate is also prominent among the factor loadings in 8 other economies. Hence, this variable contributes to the monetary factor in twelve of the twenty economies considered.

Finally, in the case of the financial factor, the first principal component represents overall financial conditions as largely reflected in movements in credit, including household credit, and

[29] Usually, the researcher retains the principal components where the estimated eigenvalue is greater than or equal to one. Estimation of the monetary factor is not unlike the one used to estimate central bank shadow policy rates (e.g., see Lombardi et. al. 2014)

[30] Associating a particular factor with aggregate demand, for example, is based on an interpretation from the size of the factor loadings (see appendix). Expected inflation and economic growth typically have the largest factor loadings on the first factor while real GDP growth and the current account are often the driving force of the second factor. Note, however, that only 8 of 20 economies (US included) have two estimated factors. Moreover, there are cross-country differences in the factor loadings. Therefore, the naming of factors is occasionally seen as only suggestive.

cross-border claims.[31] Only three economies generate a second factor worth retaining and credit and money market interest rate changes generally drive this factor. This could reflect a concern for financial stability (e.g., the US). In the case of the financial factor these are inverted in the sense that a fall in the factor scores produces greater stress for the financial system while looser conditions lead to higher scores.

Figure 3 displays a selection of some scores from the estimation of principal components. The Figures plot the real, monetary, and financial factors for Hong Kong, China, the US, Brazil and Thailand. The real factor scores clearly pick up the impact of the AFC in Hong Kong and Thailand while the GFC is also seen to produce a large downturn for all economies shown with the possible exception of Brazil. For China we can observe why the second principal component also reflects global financial conditions. We can clearly observe the deterioration in global economic conditions in 2008-9 while domestic conditions improve through aggressive policies intended to support the domestic economy. The monetary factors also appear to capture tightening and loosening phases in monetary policy including the rapid loosening of monetary policy, most notably in the US, around the time of the GFC. Finally, financial conditions appear more volatile on the whole than monetary conditions as might be expected since central banks tend to be cautious in changing in the stance of monetary policy.

I now turn to the FAVAR and other companion VAR-type estimates. Given the large number of results it is impractical to present all of them. Accordingly, the results are discussed in two parts. Tables 5 and 6 summarize the response of real, monetary and financial variables to a one standard deviation shock in two of the three proxies for exchange rate movements. As discussed earlier, the placement of the exchange rate variable in a VAR is subject to different interpretations.

The definition of the nominal effective exchange rate is such that a rise signals an appreciation while a decline implies a depreciation. Four general impressions emerge from the results in Table 5. First, it is clear that responses to an exchange rate shock are diverse and there is

[31] Indeed, a growing number of central banks publish financial conditions indexes that are often constructed via the application of a principal components analysis of the kind conducted here.

obvious distinction to be made between responses in AE vis-à-vis ones in EME. Second, there is some sensitivity in the results depending on how the exchange rate variable is defined.[32] In view of the earlier discussion about the construction of these proxies (see Figure 2) this is not surprising. Unfortunately, economic theory does not provide guidance about the best way to measure deviations from trend or equilibrium values. Third, with the exception of Thailand and Singapore, no economy is immune to exchange rate shocks.[33] Finally, we do not find that inflation targeting (IT) economies stand out when it comes to immunity from exchange rate shocks.[34] Since IT economies differ considerably across a variety of dimensions (e.g., see Siklos 2008) this also should come as no surprise.

Turning to some of the individual responses we might conclude that a NEER appreciation would worsen the domestic real economy via the trade response. However, this response is contradicted in a couple of instances for the MA1 proxy and more frequently when the MA2 proxy is considered. Instead, if an appreciation signals lower future inflation, this implies stronger economic activity. Similarly, a NEER appreciation ought to translate into a loosening of monetary and financial conditions but this also ignores the role played by a stronger balance sheet and higher financial asset prices that would result in tighter monetary policy and financial conditions. Once again the results in Table 5 demonstrate that 'one size does not fit all' when it comes to assessing the macroeconomic effects of exchange rate regime choice. Finally, when the exchange rate variable is placed last in the VAR (Table 6), the summary of results suggest far greater immunity from exchange rate shocks than in the case shown in Table 5. And if one is looking for a result consistent with the standard view than an appreciation implies a contraction in real economic activity then the results, when MA1 is the exchange rate proxy, supports this interpretation. In addition to Thailand and Singapore one can now add Colombia,

[32] Except for Thailand and Singapore where the results are the same whether one relies on the MA1 or MA2 proxies.
[33] The well-known fact that Singapore adopted a managed exchange rate regime (e.g., see MAS 2011) may explain this result. In Thailand's case the adoption of an IT policy may also explain its immunity to exchange rate shocks (Bank of Thailand 2013). However, this does not explain why a similar result is not obtained for the other IT economies in the sample (see n. 34).
[34] The IT economies in the sample are: BRA, COL, GBR, IDN, KOR, MEX, PHI, THA, TUR, and ZAF. However, it should be added that this strategy was adopted sometime after the sample begins and, as noted above, leaving too few observations to estimate a separate VAR (even if unbalanced) for an IT only sample.

Japan, and Hong Kong to the list of economies immune to an exchange rate shock regardless of how the exchange rate variable is measured.

Figure 4 shows a selection of impulse responses based on the FAVAR in equation (2). Two polar cases are shown, namely placing the exchange rate variable first (Table 5) or last (Table 6) as in several empirical studies where the exchange rate channel is not the primary concern. To conserve space only three cases are shown (more cases are shown in the appendix). Given the regional or global importance of China, Brazil, and Mexico, I focus on these three countries. Additionally, the IRFs are shown for both the full and pre-crisis samples. The latter period ends in 2007Q3. Regardless of the source (or the sample) the impact of any exchange rate shock is temporary. Beginning with the full sample estimates, a NEER appreciation does indeed lead to a reduction in real activity, a tightening of monetary policy and looser financial conditions. However, the impact on real activity (2^{nd} real factor) is temporary and most pronounced for Mexico, followed by China.[35] In comparing the full and pre-crisis samples there are few notable differences. Overall, however, it is found that exchange rate shocks had a smaller impact (e.g., China, Brazil) or disappear entirely (e.g., Mexico), as seen from the smaller to insignificant IRFs. A similar interpretation applies to other cases not shown here. Although we cannot be certain a plausible reason is the impact from the introduction of financial factors which may have become more important since the GFC.

Next, I also considered the case where external factors are measured on a global scale. The results (not shown) suggest that changing the definition of external sources of shocks has, at best, only a modest impact on the IRFs. This is not surprising since factors measured with a global set of variables mirrors, sometimes quite closely, factors estimated using US data.

4.3 *Local Projections*

Figure 5 provide further evidence of the response to an exchange rate shock. To conserve space only full sample results are shown. Using local projections three separate cases are shown. The first one differs from the previous cases considered by investigating the impact of a shock in the

[35] Results for Brazil are not shown since the IRFs were insignificant for both samples considered.

bilateral exchange rate between Hong Kong and China (the HKG-CNH exchange rate).[36] Perhaps unsurprisingly, a depreciation of the HKG dollar vis-à-vis the Chinese renminbi boosts the Hong Kong economy. However, the interdependence between these two economies goes deeper. Changes in monetary conditions in Hong Kong have real economic effects in China. A tightening of Chinese monetary policy is seen as leading to looser monetary policy conditions in Hong Kong as well as a tightening of financial conditions in China. Finally, improving real conditions in Hong Kong produce looser monetary policy in China whereas tighter financial conditions in Hong Kong have an offsetting effect in China.

Parts (b) and (c) of Figure 5 report that the local projections estimated for two separate panels, namely Brazil and the US, and China and the US, confirm some of the results reported earlier in Table 6. A NEER appreciation leads to a loosening of monetary conditions in Brazil and a negative real effect in China.

5. Conclusions

This study assesses, from a global perspective, whether the influence of exchange rate shocks implies certain policy recommendations for EME. For example, should EMEs seek more international cooperation when it comes to exchange rate policies? From the regional perspective economies in Asia have long grappled with the consequences of living under a dollar standard and, more recently, the rising importance of the renminbi.

Both the stylized and the econometric evidence in this study support Frankel's (1999) conclusion reached almost twenty years ago, despite the fallout from the global financial crisis. Therefore, the one size fits all principle does not apply to how different economies react to exchange rate shocks. Frankel's survey did not make the distinction between real and financial responses to exchange rate fluctuations. While an appreciation does, under normal circumstances, lead to a real contraction the resulting change in financial conditions can actually boost domestic real economic activity. Hence, exchange rate effects operate in ways that are not as predictable as they were once thought to be. Indeed, after examining the

[36] Given the rather special relationship between HKG and mainland China this case has particular policy relevance.

response to an exchange rate shock in 13 emerging market and 6 advanced economies the only result that is found to hold across almost every economy examined is that very few economies are immune in the face of this kind of shock. Moreover, the exceptions cannot readily be classified as being of the managed or floating exchange rate regime varieties. The only other general result is that, other than for Indonesia and Korea, an exchange rate shock usually has real, monetary or financial effects on the domestic economy but never all three factors simultaneously. Relative to the pre-crisis period it is possible that the growing importance of financial factors can explain some of the findings reported in this study.

Almost five decades ago a former US Treasury Secretary, John Connally, warned other countries that "[T]he dollar is our currency but its your problem". The estimates in this paper confirm that this dictum continues to hold in spite of the events of the past decade. Then it was trade, now the problem is due to the influence of financial factors. The introduction and rise of other major currencies, namely the euro and the renminbi, only serves to add to the number of currencies that can create 'problems'. More importantly, the results of this study also suggest that monetary policy regimes such as inflation targeting and the choice of exchange rate regimes cannot, on their own, render an economy immune to exchange rate shocks.

To the extent that greater international cooperation can help, the empirical findings of this paper suggest that it should be sought not to prescribe a particular type of exchange rate regime. The results point in the direction of supporting long held views of several policy makers (and former central bankers; e.g., see Bernanke 2015a) that keeping one's house in order is the best protection against the effects of exchange rate fluctuations. Countries should, therefore, adopt policies that ensure this outcome instead of seeking common exchange rate objectives that are unlikely to be suitable for all economies.

As a cautionary note, there are a number of extensions that can be considered in future research before reaching a definitive conclusion. First, levels of monetary and financial maturity vary across countries. As a result, more testing of the factor models used to extract the real, monetary and financial conditions that enter into the estimated models of this study would be welcome. Second, the impact of the Asian and Global financial crises was only taken into account indirectly. In particular, estimating separate pre and post GFC models might provide a clearer picture of cross-country differences in the response to an exchange rate shock. Third, the exchange rate proxy variables in this study, which seek to identify large and persistent movements in the exchange rate away from the some trend or equilibrium value, appear to behave in an asymmetric fashion. The implications of the asymmetry need to be explored further. Finally, the consequences of using bilateral versus effective exchange rate measures also needs to be examined in greater detail. In particular, it may be enlightening to include bilateral and effective exchange rate indicators simultaneously in some fashion. All of these extensions are left for future research.

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Table 1 Sample of Economies Included in the Data Set

Emerging Market Economies	Share of Global GDP	**Advanced Economies**	Share of Global GDP
1. Argentina: ARG	0.79%	1.Eurozone: EUR	15.64%
2. Brazil: BRA	2.39%	2.Great Britain: GBR	3.85%
3. Chile: CHL	0.33%	3.Hong Kong: HKG	0.42%
4. China: CHN	14.84%	4.Japan: JPN	5.91%
5. Colombia: COL	0.39%	5.Korea: KOR	1.86%
6. Indonesia: IDN	1.16%	6.United States: USA	24.32%
7. Mexico: MEX	1.54%	7. Total	52%
8. Malaysia: MYS	0.40%		
9. Philippines: PHI	0.39%		
10. Russia: RUS	1.80%		
11. Thailand: THA	0.53%		
12. Turkey: TUR	0.97%		
13. South Africa: ZAF	0.42%		
14. Total	25.95%		

Note: the share of each economy's GDP to global GDP is based on 2016 figures from the World Development Indicators data base from the World Bank. See data.worldbank.org/data-catalog/world-development-indicators. The Eurozone figures include 17 countries in the common currency area.

Table 2 Series Used in the Construction of Real Monetary and Financial Factors

Real	**Monetary**	**Financial**
Real GDP growth	Policy Interest Rate§	Credit/GDP
Real GDP Growth Forecast§	Central Bank Assets/GDP§	Short-term market interest rate(s)
Inflation	Foreign Exchange Reserves	Long-term interest rate§
Inflation Forecast§	Reserve requirement§§	Private Sector Non-Financial Assets/GDP§
Current Account Balance/GDP		Stock Index Return
		Property Prices§
		Cross-Border Claims§

Note: § data not available for all economies. See the Appendix for details. §§ for China only.

Table 3 Joint Episodes of Disorderly Exchange Rate and Painful Growth Episodes

Economy	Samples	Painful: 2% Threshold (% OF SAMPLE; [COUNT])	Painful: 3% Threshold (% OF SAMPLE; [COUNT])
ARG	90.1-(15.1)16.2	20.72 [23]	9.01 [10]
BRA	90.1-(15.1)16.2	8.11 [9]	3.60 [4]
CHL	90.1-(15.1)16.2	5.41 [6]	1.80 [2]
CHN	90.1-(15.1)16.2	0	0
COL	90.1-(15.1)16.2	8.11 [9]	5.41 [6]
EUR	90.1-(15.1)16.2	*9.01 [10]*	*1.80 [2]*
GBR	90.1-(16.1)16.2	*9.91 [11]*	*2.70 [3]*
HKG	90.1-16.3	*7.21 [8]*	*5.41 [6]*
IDN	90.1-(15.1)16.2	3.60 [4]	3.60 [4]
JPN	90.1-(15.1)16.2	*16.22 [8]*	*4.50 [5]*
KOR	90.1-(15.1)16.2	*4.50 [5]*	*2.70 [3]*
MEX	90.1-(16.1)16.2	9.01 [10]	3.60 [4]
MYS	90.1-(15.1)16.2	5.41 [6]	2.70 [4]
PHI	90.1-(15.1)16.2	1.80 [2]	0
RUS	94.1-(16.1)16.2	*11.71 [3]*	6.31 [7]
SGP	90.1-(15.1)16.2	*6.31 [7]*	*3.60 [4]*
THA	90.1-(15.1)16.2	9.01 [10]	6.31 [7]
TUR	90.1-(15.1)16.2	10.81 [12]	6.31 [7]
USA	90.1-(16.1)16.2	*5.41 [6]*	*2.70 [3]*
ZAF	90.1-(15.1)16.2	13.51 [15]	1.80 [2]

Note: See Table 1 for codes that identify each economy. Advanced Economies in *italics.* The main body of the text provides the explanation for the calculations which involve 2 consecutive quarters of negative real GDP growth for the thresholds indicated and large movements in the nominal effective exchange rates. Different series are available for different sample lengths. The range of available samples is shown from the beginning to the end with the earliest end of the sample given in parenthesis (in the case of Hong Kong all available data were for the same sample). See also the appendix for greater details. Data are quarterly.

Table 4 Number of Estimated Factors: Real, Monetary, and Financial

Economy	Real	Monetary	Financial
ARG	2 (69,30)	1	1 (85)
BRA	1 (65)	1 (76)	1 (80)
CHL	2 (61,32)	2 (59,41)	1
CHN	2 (59,41)	1 (79)	1 (94)
COL	2 (66,34)	1	1 (89)
EUR	2 (66,34)	1	1
GBR	2 (63,37)	1	1 (84)
HKG	1 (77)	1 (83)	1
IDN	1 (75)	1 (71)	1 (76)
JPN	1	1	1 (67)
KOR	2 (77,23)	1	1 (74)
MEX	2 (55,45)	1	2 (57,43)
MYS	1 (73)	2 (61,39)	1 (64)
PHI	1 (90)	1	1
RUS	1 (72)	1	1 (93)
SGP	2 (66,34)	1	1 (79)
THA	1 (76)	1 (77)	2 (62, 38)
TUR	1	1 (70)	1 (86)
USA	1 (78)	2 (67,33)	2 (59, 29)
ZAF	1	2 (61,39)	2 (58,35)

Note: The number of factors used in the estimation is shown first with the proportion of the explained variation in parenthesis. When no figure appears in parenthesis this means that the single factor explains 100% of the variation. The number of series used to estimate the factors is shown in Table 2. Note that not all series are available for all economies. See the main body of the text and the Appendix.

Table 5 Summary of FAVAR Estimates

	EXCHANGE RATE: DEVIATIONS FROM 3 YR MA			EXCHANGE RATE: DEVIATIONS FROM HAMILTON FILTER		
ECONOMY	REAL	MONETARY	FINANCIAL	REAL	MONETARY	FINANCIAL
ARG	**-**	**0**	**-**	+	**0**	+
BRA	**0**	+	+	**0**	**-**	**-**
CHL	+	**-**	**0**	**0**	**0**	**0**
CHN	**-**	+	**0**	**-**	**0**	**0**
COL	**0**	**0**	**0**	**0**	**-**	**0**
EUR	**0**	**0**	**0**	**0**	**-**	**0**
GBR	**0**	+	+	**0**	+	+
HKG	**-**	**0**	**-**	+	+	+
IDN	**-**	**-**	**-**	**0**	+	**0**
JPN	**-**	**0**	**0**	+	**0**	**0**
KOR	+	+	+	**-**	**-**	**-**
MEX	**-**	**0**	**-**	**0**	+	**0**
MYS	**-**	**0**	**0**	+	+	**0**
PHI	**0**	**0**	**0**	**0**	**-**	**0**
RUS	**-**	**0**	**0**	+	**-**	**-**
SGP	**0**	**0**	**0**	**0**	**0**	**0**
THA	**0**	**0**	**0**	**0**	**0**	**0**
TUR	**0**	**-**	+	**0**	+	**-**
ZAF	**0**	**0**	**-**	**0**	**0**	+

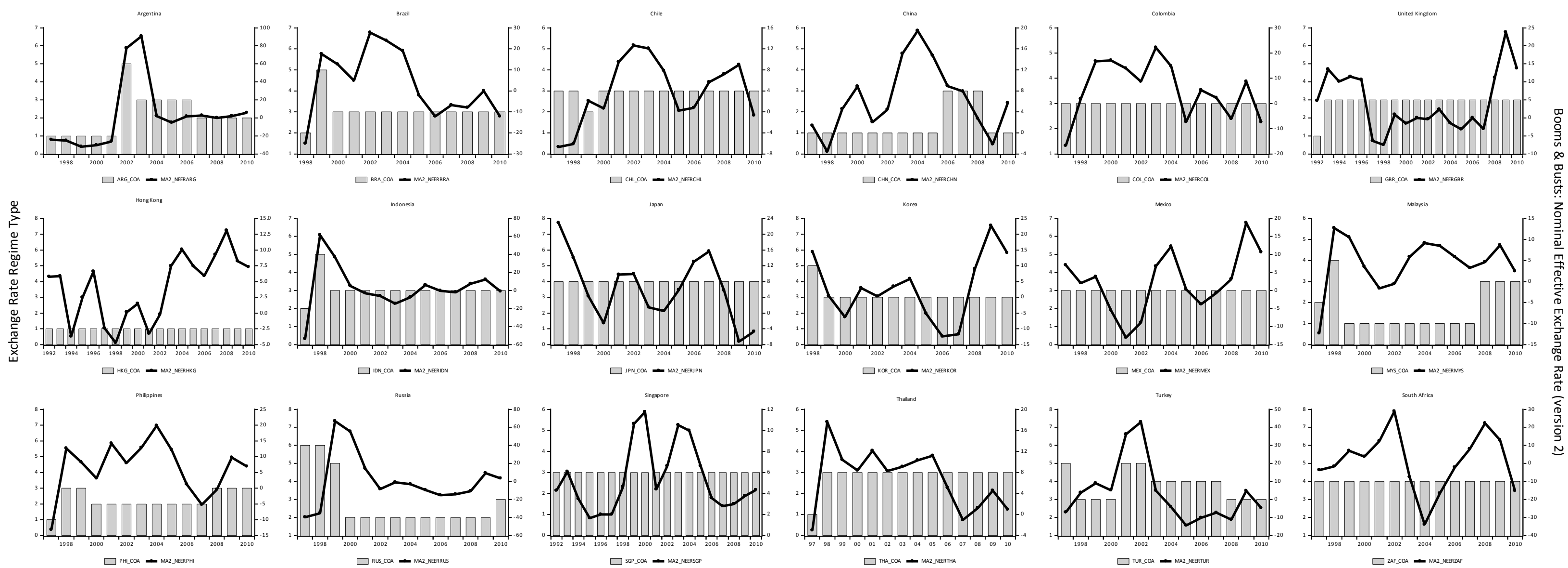
Note: +/- indicates the sign of the response of the three factors to a 1 standard deviation shock in the exchange rate proxy shown at the top of the table. A value different from zero is assigned whenever the estimated response is found to be significant for at least one period after the shock (up to 10 quarters were estimated) based on confidence intervals estimated via Monte Carlo (1000 replications). The proxies are defined in the main body of the text. The exchange rate proxy is the first endogenous series in the FAVAR.

Table 6 Summary of FAVAR Estimates (cont'd)

	EXCHANGE RATE: DEVIATIONS FROM 3 YR MA			EXCHANGE RATE: DEVIATIONS FROM HAMILTON FILTER		
ECONOMY	REAL	MONETARY	FINANCIAL	REAL	MONETARY	FINANCIAL
ARG	**-**	**0**	+	+	**0**	+
BRA	**0**	**0**	+	**0**	**0**	**-**
CHL	**0**	**0**	**0**	**-**	**-**	**0**
CHN	**-**	+	+	**-**	**0**	**0**
COL	**0**	**0**	**0**	**0**	**0**	**0**
EUR	**0**	**0**	**0**	**0**	**0**	+
GBR	**-**	**-**	**-**	**0**	**0**	**0**
HKG	**0**	**0**	**0**	**0**	**0**	**0**
IDN	**-**	**0**	**0**	+	+	**0**
JPN	**0**	**0**	**0**	**0**	**0**	**0**
KOR	**0**	**0**	**0**	**-**	**0**	**0**
MEX	**-**	+	**0**	**0**	**0**	**-**
MYS	**0**	**0**	**0**	**0**	**0**	**0**
PHI	**0**	**0**	**0**	**0**	**-**	**0**
RUS	**-**	**0**	+	+	**0**	**-**
SGP	**0**	**0**	**0**	**0**	**0**	**0**
THA	**0**	**0**	**0**	**0**	**0**	**0**
TUR	**0**	+	+	**0**	**0**	**-**
ZAF	**0**	**0**	**0**	**0**	**0**	+

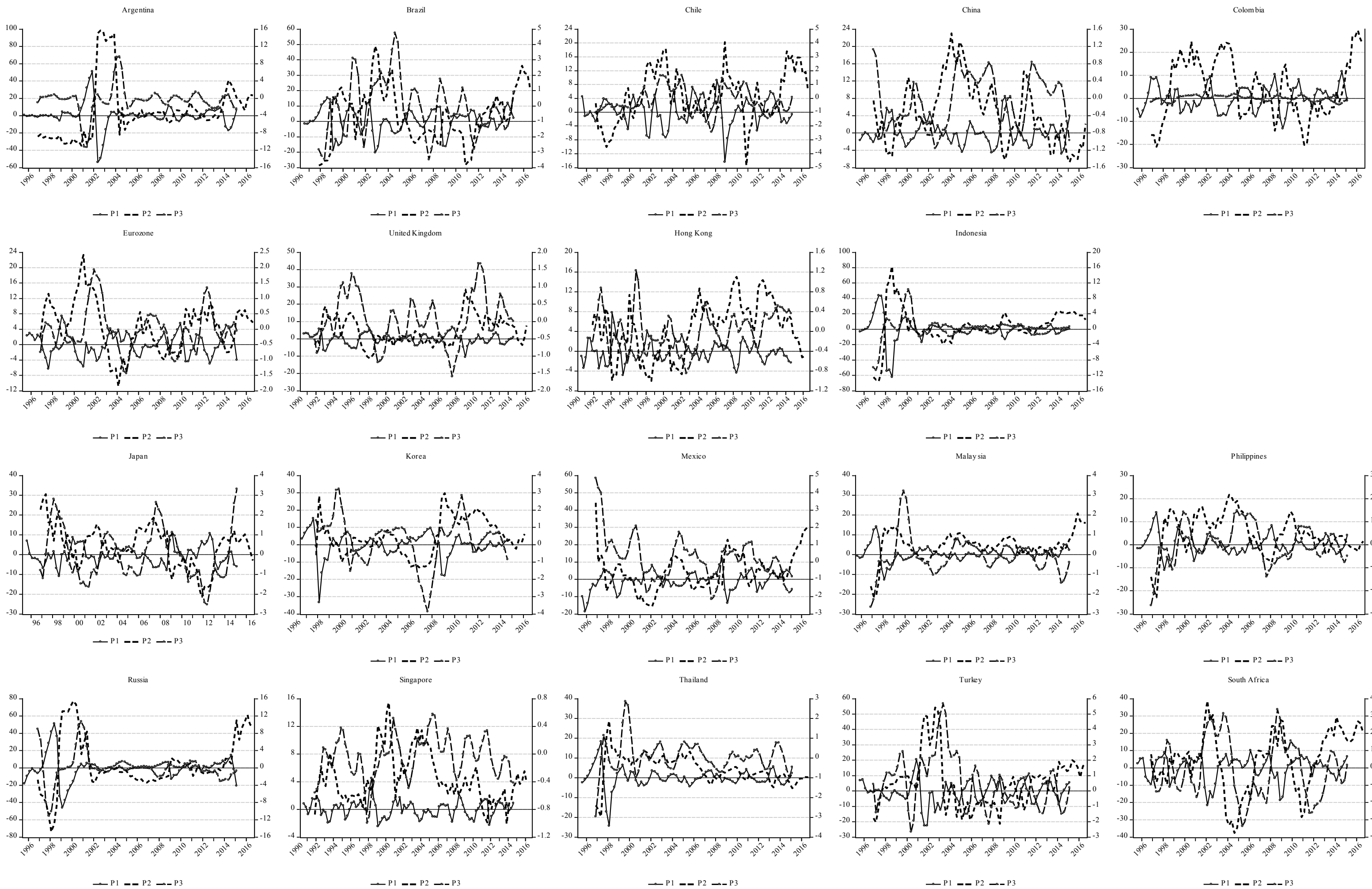
Note: See note to Table 5. The exchange rate variable is ordered last in the FAVAR.

Figure 1 Exchange Rate Movements and Exchange Rate Regimes, 1997-2010



Note: MA2_NEER* is the exchange rate proxy used in estimation derived from deviations from a Hamilton (2017) filter applied to the log of the nominal effective exchange rate (NEER) in economy *. It is plotted on the right hand side axis. The left hand side axis plot as bars the so-called 'coarse' Reinhart and Rogoff (2004) exchange rate regime indicator which ranges from 1 to 15. 4 is a de facto peg while 13 is a freely floating exchange rate. Raw data are annual to match the annual data version of the Reinhart and Rogoff (2004) classification.

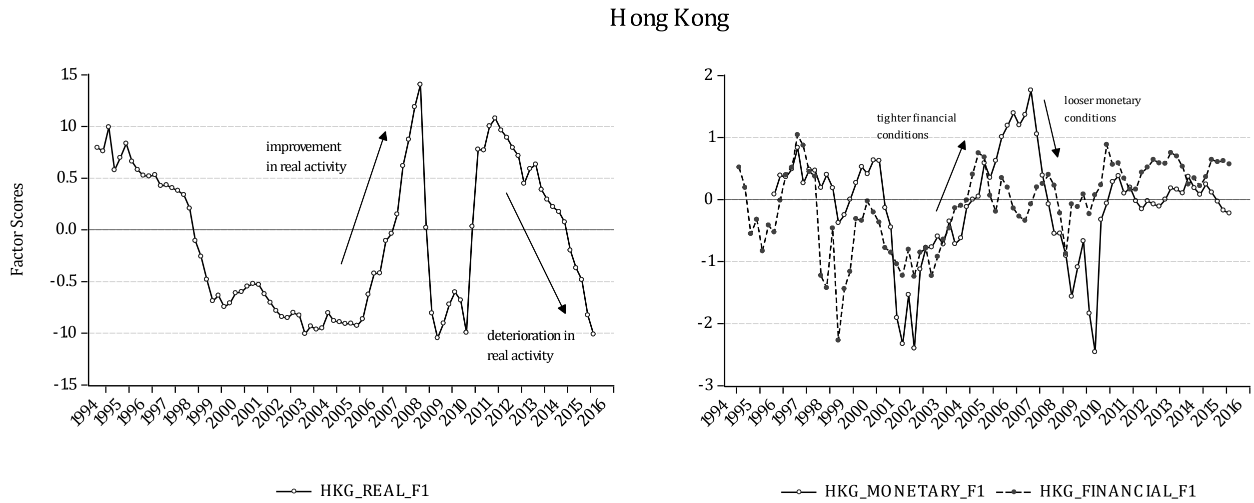
Figure 2 Exchange Rate Indicators, 1996-2016



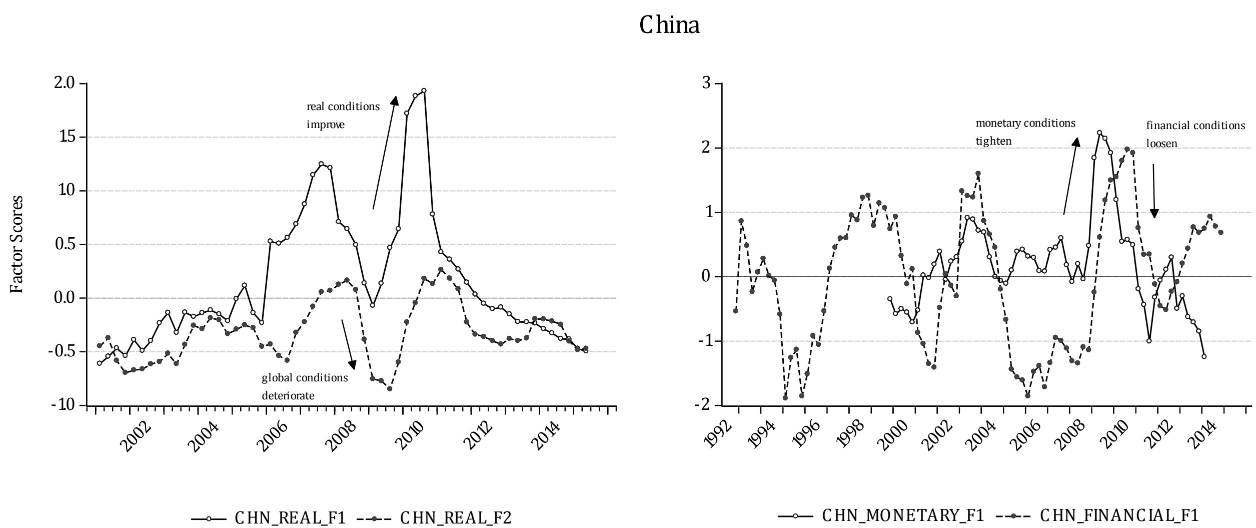
Note: The three exchange rate indicators are P1 (deviation in the log of the nominal effective exchange rate from 12 quarter moving average; MA1), P2 (deviation from a Hamilton trend in the logarithm; MA2), and P3 (12 quarter moving average in the first log difference in the nominal effective exchange rate.

Figure 3 Select Factor Estimates

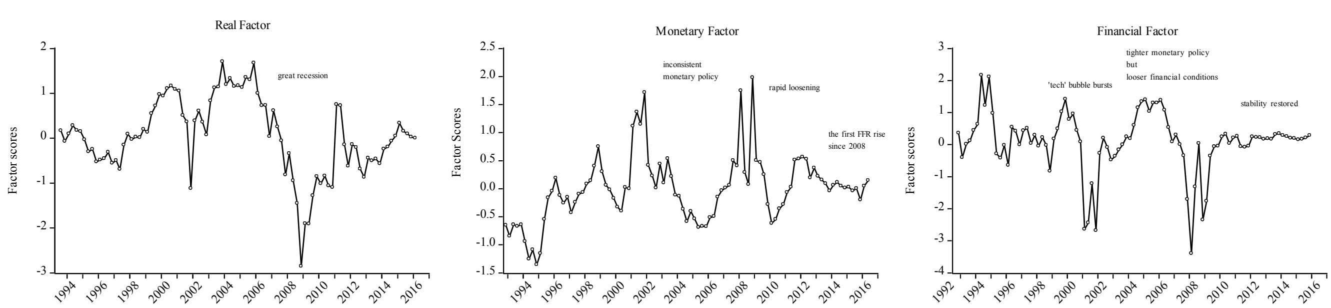
(a) Hong Kong, 1994-2016



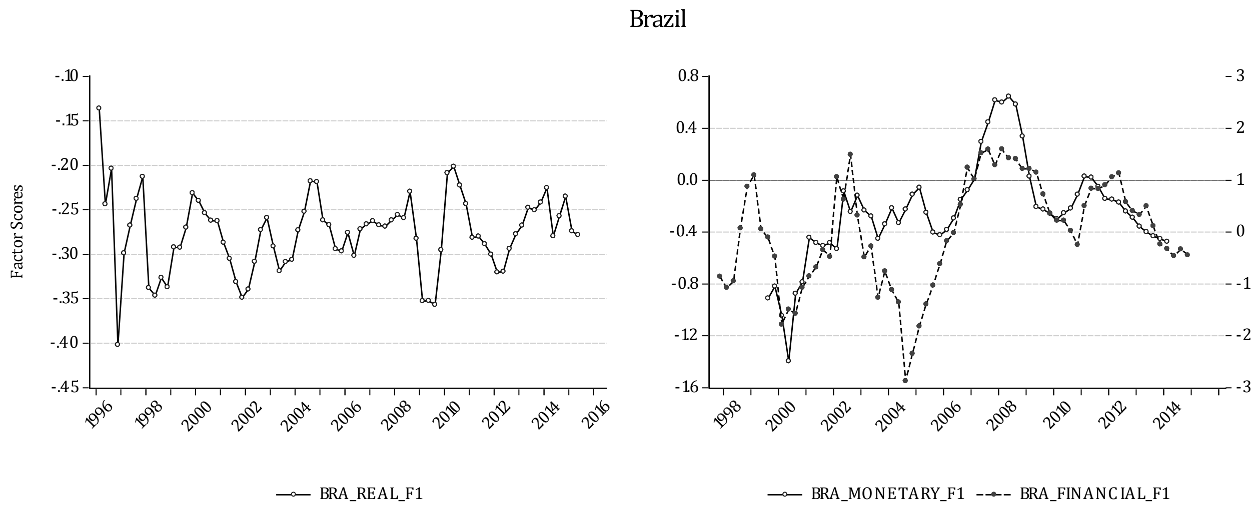
(b) China, 2001-2015



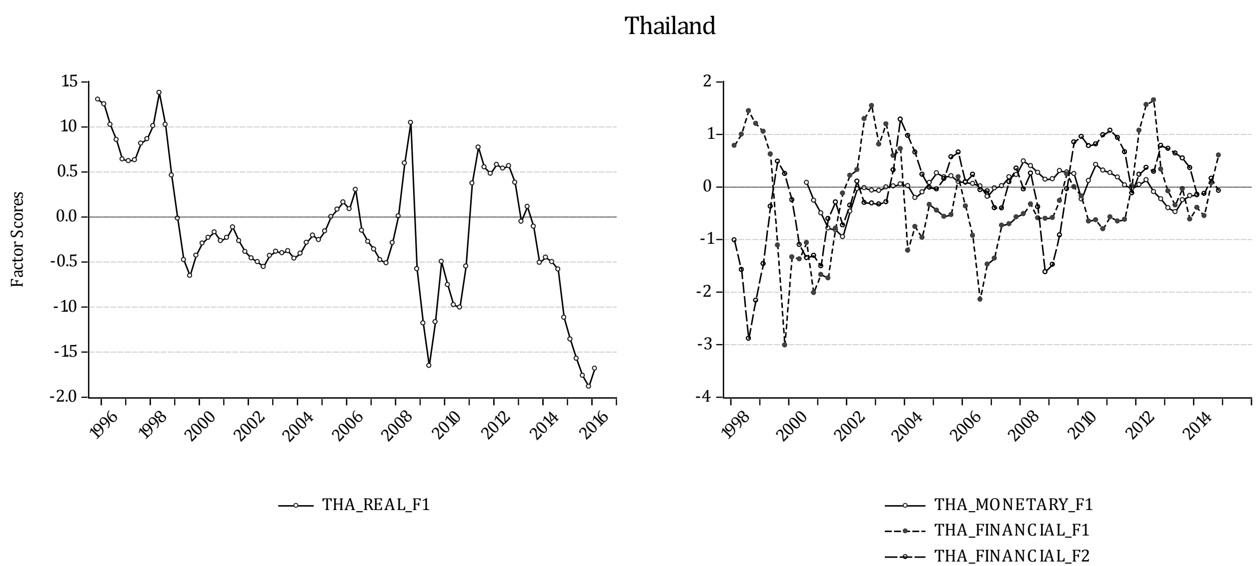
(c) United States, 1993-2016



(d) Brazil, 1996-2015



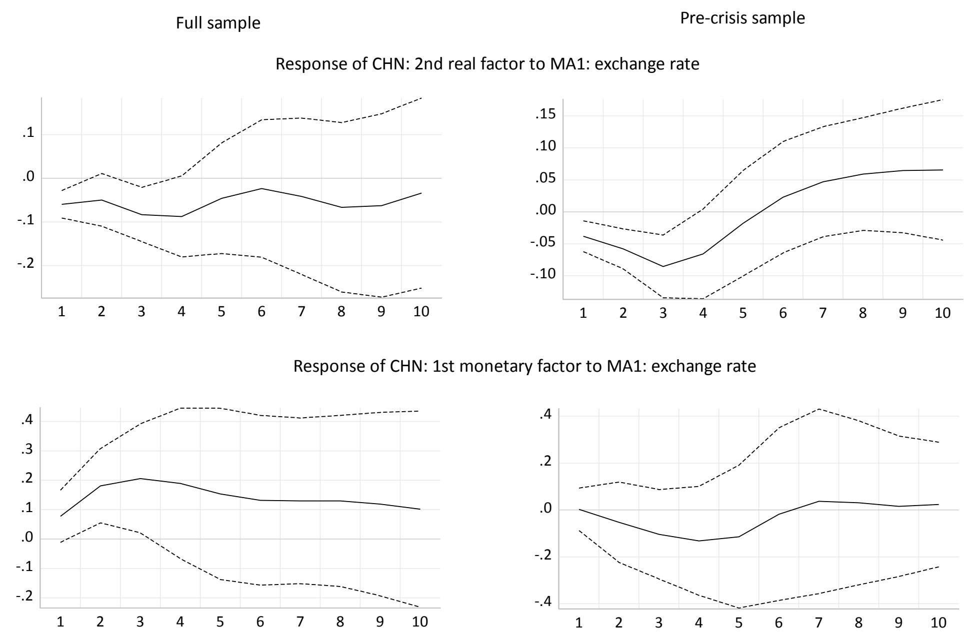
(e) Thailand, 1996-2015



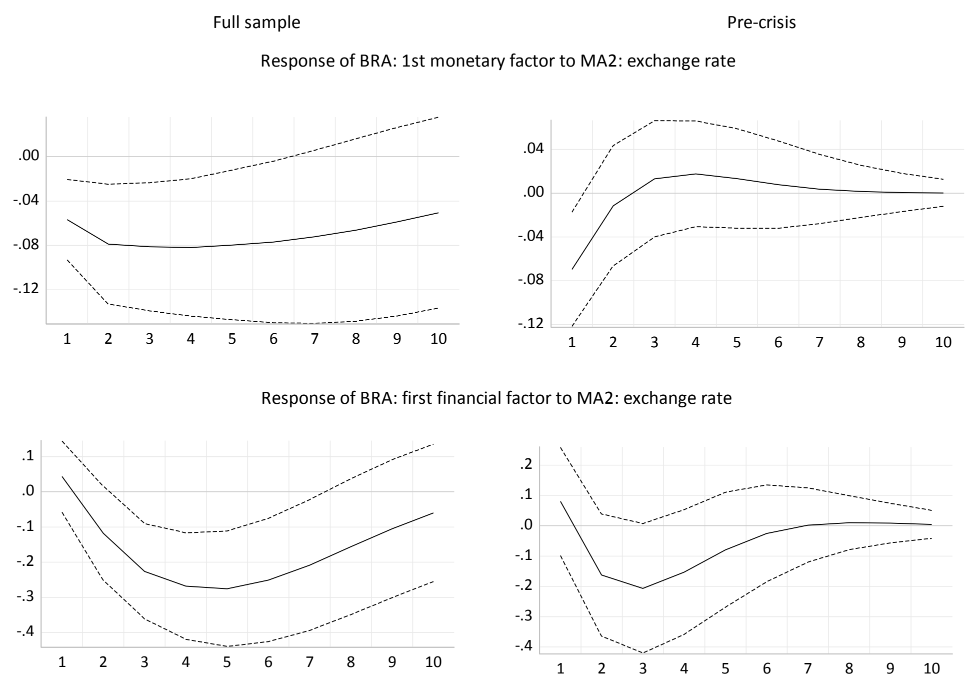
Note: Principal components estimated as detailed in the main body of the text. Number of factors estimated via Kaiser-Gutman method. When more than one factor estimated they are rotated via the Varimax method prior to obtaining the scores. The factors are labelled REAL, MONETARY, and FINANCIAL as explained in the text. F1, and F2 refer to the first and second principal components, where relevant. The first three letters refer to the country codes.

Figure 4 Selected Impulse Response Functions

(a) China



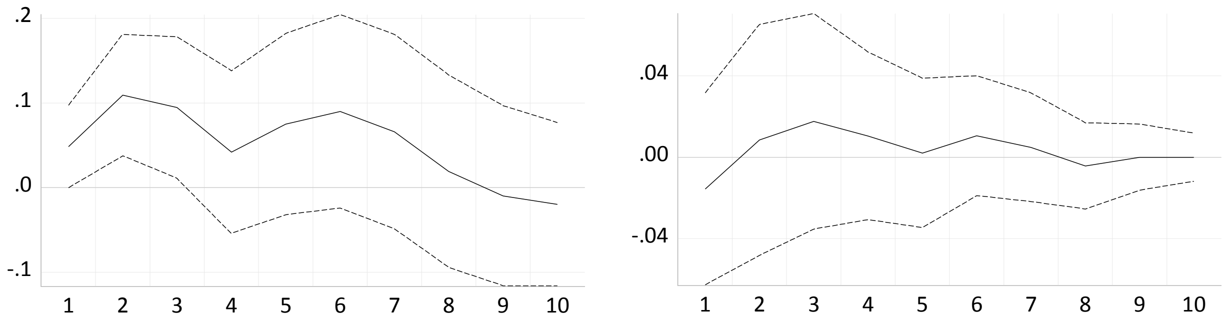
(b) Brazil



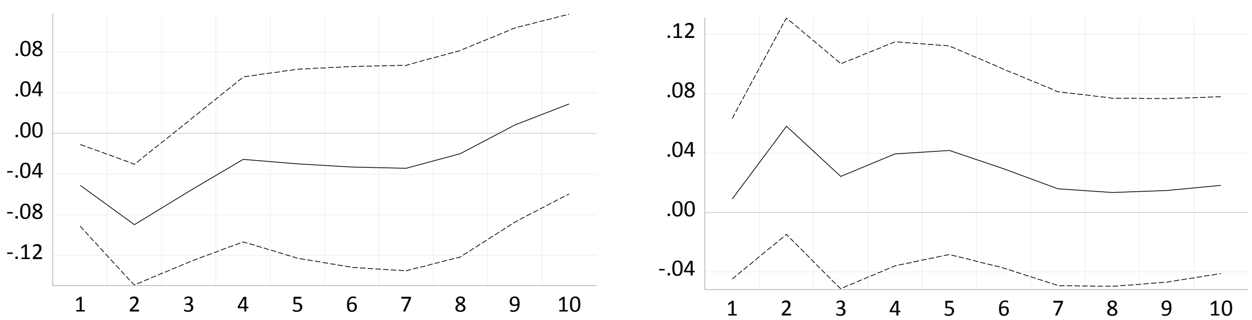
(c) Mexico

Full sample — Pre-crisis

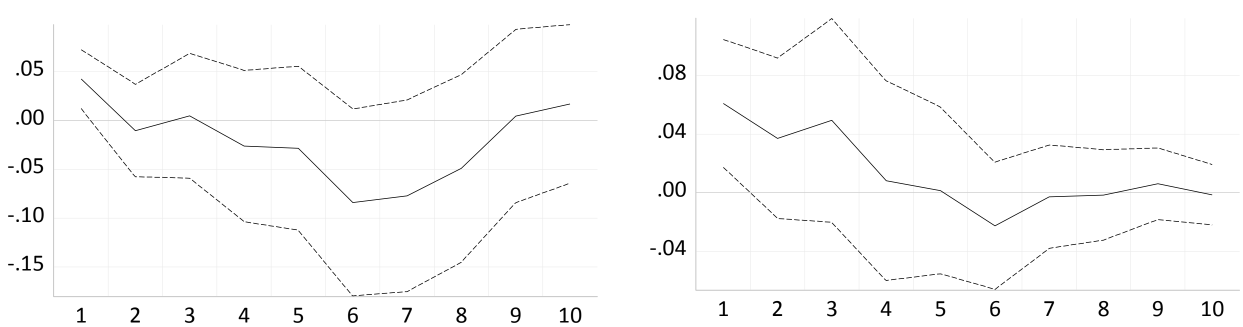
Response of MEX:1st real factor to MA2: exchange rate



Response of MEX: 2nd real factor to MA2: exchange rate



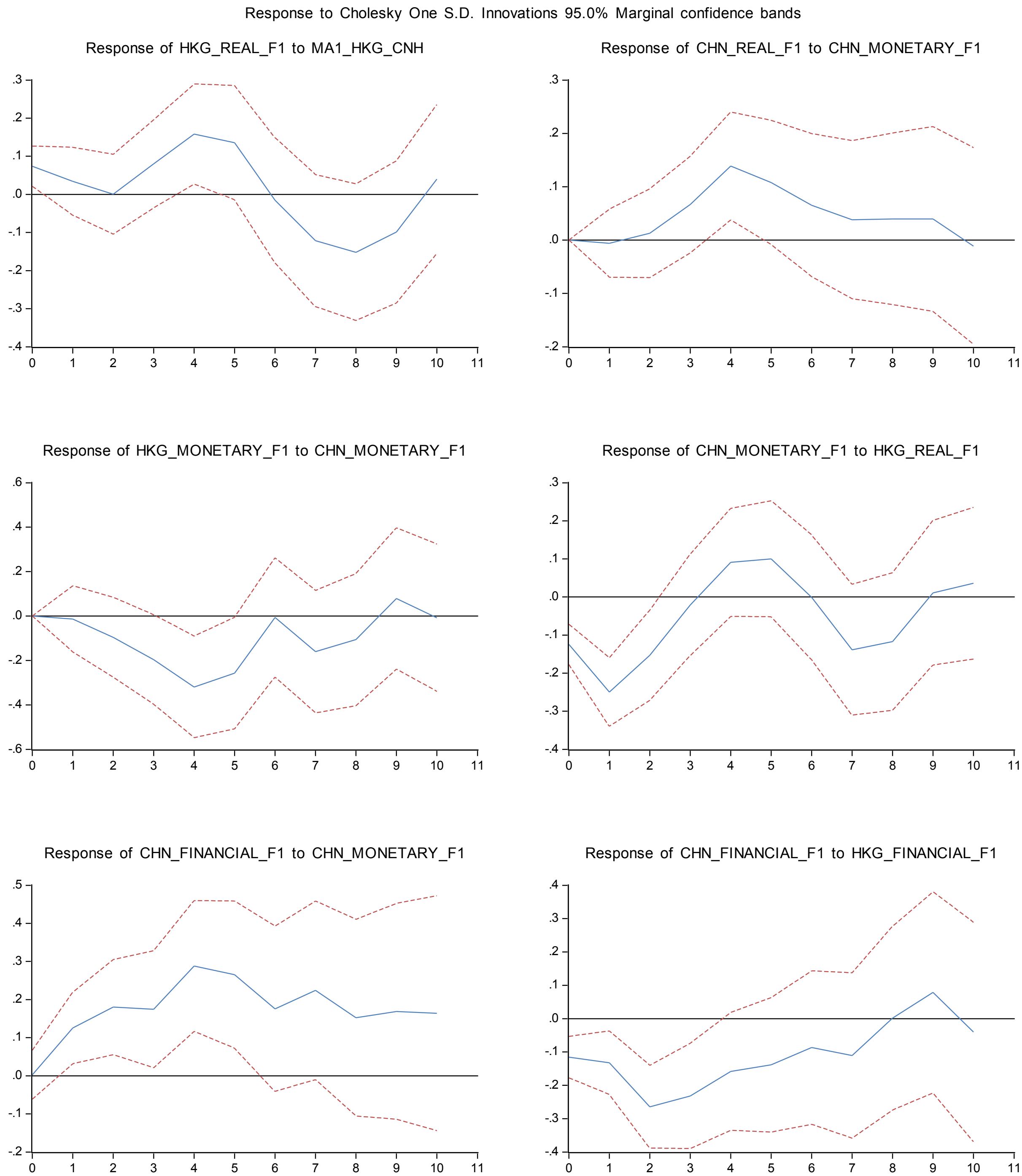
Response of MEX: 1st monetary factor to MA2: exchange rate



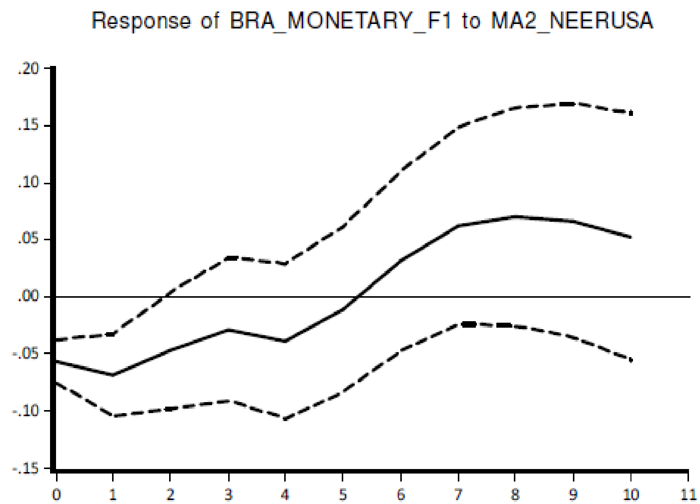
Note: Impulse responses are based on the FAVAR described in the text with the nominal effective exchange rate (NEER) proxy (MA1, MA2; see text and Figure 2) the first series in the VAR. the confidence intervals (dashed lines) are estimated via Monte Carlo (1000 replications). REAL, MONETARY, and FINANCIAL refer to the factors estimated separately. Also, see notes to Figure 3.

Figure 5 Selected Local Projections

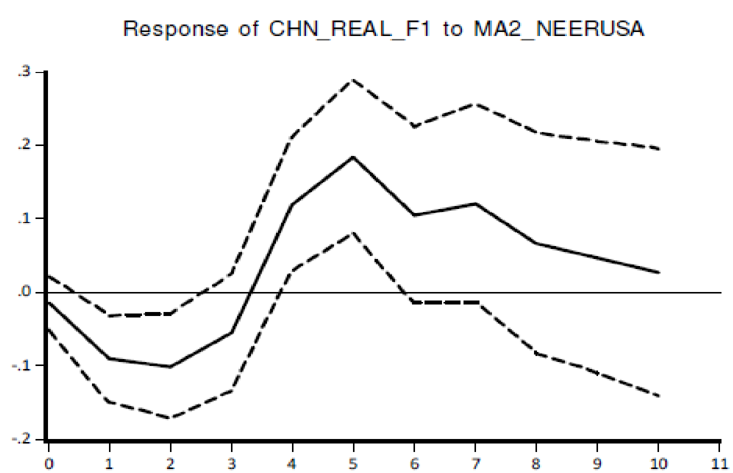
(a) Hong Kong and China



(b) Brazil and the USA



(c) China and USA



Note: Codes for each economy, and variable descriptions are found in Tables 1 and 2, and Figure 2. The local projections are based on the same VARs used in figure 4 for the full sample. The only difference is in part (a) where the VAR is estimated for China and Hong Kong only using the Hong-Kong dollar – Renminbi exchange rate instead of the NEER in terms of the US dollar.