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Exchange Rate Regimes and the Sources of Real Exchange Rate Fluctuations: Evidence from East Asia[*]

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Abstract

This paper investigates how the sources of real exchange rate (RER) fluctuations differ under different exchange rate regimes using data of two East Asian countries, namely, Korea and Thailand, which have adopted different exchange rate regimes over the last few decades. The sources of RER fluctuations are decomposed into supply, demand, monetary, and exchange rate-specific shocks, among which the last captures changes in the RER that are not related to fundamentals. These shocks are identified by means of a structural VAR identified by sign restrictions which are drawn from a standard dynamic stochastic open economy macro model. Our main findings are as follows. Exchange rate-specific shocks are much more important to the fluctuations of the RER in the floating regime than in the peg one. They are also an important source of fluctuations of the interest rate, output, and the price level. Demand shocks are the most important source of RER fluctuations in both exchange rate regimes. The findings imply a tradeoff in designing the exchange rate regime, i.e. the tradeoff between the need to allow the (nominal and real) exchange rate to adjust to fundamental shocks and the need to limit the undesirable fluctuations of the exchange rate that do not come from fundamentals.

JEL Classification Codes: E32, F33, F41.

Keywords: Real exchange rate, Exchange rate regime, VAR, sign restriction, East Asia.

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1. Introduction

This paper studies the relationship between the type of exchange rate regimes and the sources of real exchange rate (RER) fluctuations using data of East Asian countries. I wish to consider the relationship between the two in both directions: how the former affects the latter, and given estimated results regarding the latter, what implications can be drawn for the choice of the former in East Asia.

The real exchange rate (RER), the relative price of the home and foreign goods baskets when converted to the same currency, is an important variable in international macroeconomics because it is one channel through which shocks are transmitted internationally, and changes in it affect the allocation of resources between countries. The RER is also a key concept in considering the choice of exchange rate regimes. Friedman (1953), in his well-known argument about the case for flexible exchange rates, insightfully conjectures that because the domestic and foreign price levels are highly sticky, in order for the RER to change quickly in response to various kinds of shocks that hit the economy, the only way is to allow the nominal exchange rate to change, and thus a flexible exchange rate regime is desirable. The theory of optimum currency areas, started from Mundell (1961), also places an important role for the nominal exchange rate in adjusting internal and external imbalances caused by disturbances. Many studies in the New Open Economy Macroeconomics literature pioneered by Obstfeld and Rogoff (1995), with a much more rigorous framework, also examine the role of the RER and the choice of exchange rate regimes (see e.g. Engel 2002, Corsetti and Pesenti 2002, and Devereux and Engel 2007). This literature shows that the aforementioned conjecture of Friedman is correct under certain conditions, and that in general, so long as fudamental shocks such as a TFP shock or a monetary shock are concerned, a floating regime performs better than a fixed one because it allows the nominal exchange rate and the RER to respond to shocks.[1]

On the other hand, since the time the capitalist countries moved to the flexible exchange rate regime after the collapse of the Bretton Woods system, we observe that the exchange rate (both nominal and real) is too volatile that can hardly be explained from fundamentals. This has been pointed out in the influential work of Mussa (1986). Some people even argue that when allowed to float, the fluctuations in the nominal exchange rate sometimes, if not often, are caused by non-fundamentals factors or irrational behavior of investors in the foreign exchange market, and in such a case those

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[1] This literature also identifies the factors that could affect the choice of exchange rate regime, such as the extent and the source of price stickiness, the elasticity of substitution between home and foreign goods, and the degree of home bias in production and consumption.

fluctuations themselves are a source of undesirable shocks to the economy (see e.g. Buiter 2000). If this is the case, then a policy that limits or fixes the exchange rate is optimal. This may also be an explanation for the phenomenon of fear of floating pointed out by Calvo and Reinhart (2002).

The above analysis suggests that it is crucial to know the sources of RER fluctuations when one wishes to consider the choice of exchange rate regimes in reality. In the empirical literature, there have been several papers attempting to study the sources of RER fluctuations *under a floating regime*. Clarida and Gali (1994) use a structural VAR with zero long run restrictions a la Blanchard and Quah (1989) to identify and analyze the importance of three types of shocks to the RER, namely supply, demand, and monetary shocks for the case of Canada, Germany, Japan, and the UK. More recently, the some studies investigate whether the exchange rate is a shock absorber or a source of shocks, by considering one more type of shocks, namely exchange rate-specific shocks, i.e. those that are not related to fundamentals. Artis and Ehrmann (2005) analyze the case of Canada, Denmark, Sweden, and the UK using a structural VAR method with zero short run restrictions. Farrant and Peersman (2006) investigate the same issue for Canada, the Euro area, Japan, and the UK using the structural VAR method with sign restrictions based on Uhlig (1999) and Canova and De Nicolo (2002).

In this paper, I go further to ask a different question: How do the sources of RER fluctuations differ under different exchange rate regimes? I focus on the importance of exchange rate-specific shocks in RER fluctuations across different exchange rate regimes to see whether the exchange rate plays the role of shock absorber or itself is a source of shock. The main difference with the previous studies thus is that they focus only on the flexible exchange rate regime, while this paper studies both flexible and peg regimes.

To investigate the question raised above, I choose as a case study two East Asian countries, namely Korea and Thailand. The crucial point here is that, these countries have adopted different exchange rate regimes over the last few decades: a US dollar peg regime before the Asian crisis in 1997-1998, and a much more flexible exchange rate regime after this crisis. Thus they offer a good natural experiment for the question I wish to investigate.

The choice of exchange rate regimes has been a hotly-debated issue in East Asia since the Asian crisis. In the debate so far, little attention has been paid to the sources of RER fluctuations. Thus by studying the case of East Asian countries, I also wish to shed some new light on the issue.

For the purpose of the paper, I adopt the method of structural VAR with sign restrictions similar to that used in Farrant and Peersman (2006). As noted by these authors, this method imposes only qualitative restrictions and thus is more flexible and can overcome some shortcomings of structural VAR with the traditional long run or short run zero restrictions.[2] I assume that the RER is buffeted by four types of shocks, namely supply, demand, monetary, and exchange rate-specific shocks. The first three reflect the exogenous changes in fundamentals of the economy, while the last is introduced to capture the exogenous movements of the exchange rate that are not related to fundamentals and therefore are a source of undesirable shocks to the economy. The last type of shocks is of particular interest in this study. The four types of shocks are identified by imposing sign restrictions on the IRFs of output, the price level, the nominal interest rate, and the RER in the VAR. The sign restrictions imposed are based on an extended version of the stochastic rational-expectations open economy model in Obstfeld (1985). The relative importance of each type of shocks in explaining the fluctuations of the RER and other macro variables are quantified by means of variance decompositions.

Some of the main findings of the paper are that exchange rate-specific shocks are much more important to the fluctuations of the RER in the floating regime than in the peg regime, that they are the main sources of interest rate changes, and that they also play a nonnegligible role in the fluctuations of output and the price level. Demand shocks are the most important sources of RER fluctuations in both exchange rate regimes, while supply shocks play a smaller role, and monetary shocks play an even smaller role. These findings imply a tradeoff in designing the exchange rate regime, the tradeoff between the need to allow the (nominal and real) exchange rate to adjust to fundamental shocks and the need to limit the undesirable fluctuations of the change rate that do not come from fundamentals.[3]

The rest of the paper is organized as follows. Section 2 describes the theoretical open economy macro model to see how macro variables respond to various types of structural shocks, and these results will be used to imposed as sign restrictions on the

[2] Canova and Pina (1999) criticize restrictions of zero contemporaneous impact of nominal shocks on output for their lacking theoretical justification. Faust and Leeper (1999) point out estimation problems of zero long run restrictions in small samples. Peersman (2005) also shows that results using long run restrictions might be misleading.

[3] Regarding this point, Devereux and Engel (2007), using a theoretical model with fundamental shocks, also show a tradeoff between the need to smooth fluctuations in RER to reduce distortions in consumption allocations, and the need to allow flexibility in the nominal exchange rate to facilitate terms of trade adjustment. The differences with their study are that our study is an empirical one, and that we consider also non-fundamental shocks.

impulse response functions (IRFs) in the VAR. Section 3 explains the structural VAR method using sign restrictions. Section 4 explains the data and section 5 analyzes the results. The final section concludes.

2. A theoretical model

In this section we describe briefly a theoretical open economy macro model which we will use to see how macro variables respond to structural shocks. Our main interest is in four macro variables: output (y_t), the price level (p_t), the nominal interest (i_t), and the RER (q_t), and four structural shocks: aggregate supply, aggregate demand, monetary, and exchange rate-specific shocks, which will be incorporated into the VAR later. The model can be seen as a dynamic stochastic rational-expectations version of the textbook Mundell-Fleming model.[4] It is originally developed by Obstfeld (1985) and extended by Clarida and Gali (1994). Here we extend further to introduce one more type of shock, namely the exchange rate-specific shock. Below, all variables, except the interest rate, are in logs. In addition, all variables, except the nominal and real exchange rates, are expressed as the differences between the home country and the foreign country. The subscript *t* is used to denote time as usual.

The IS equation (1) assumes that aggregate demand (y_t^d) depends on an exogenous demand component (d_t), the real interest rate ($i_t - (E_t p_{t+1} - p_t)$), and the RER ($q_t \equiv s_t - p_t$, where s_t is the nominal exchange rate),

$$y_t^d = d_t - \sigma[i_t - (E_t p_{t+1} - p_t)] + \eta q_t \qquad (1)$$

The parameters σ and η are positive and denote, respectively, the real interest rate elasticity and real exchange rate elasticity of aggregate demand.

Price stickiness in the short run is introduced by assuming the price setting equation (2), in which the parameter θ satisfies $0 \le \theta \le 1$.

$$p_t = (1-\theta)E_{t-1}p_t^e + \theta p_t^e \qquad (2)$$

Here the price level is a weighted average of its value expected in the previous period ($E_{t-1}p_t^e$) and the price level that would prevail under flexible prices (p_t^e). Thus $1-\theta$ denotes the degree of price stickiness.

The LM equation (3) shows the equilibrium of money market in which real money supply in the left-hand side equal to real money demand in the right-hand side.

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[4] We could build a model with firmer micro-foundations like those in the New Open Economy Macroeconomics that yield the same results with the present model as summarized in Table 1. I have built such a model in a previous joint work (see Shioji, Vu, and Takeuchi (2011)). Such a model, however, will be much more complicated, and it is not possible to obtain its closed-form solution.

$$m_t^s - p_t = y_t - \lambda i_t \qquad (3)$$

The parameter $\lambda > 0$ denotes the interest rate elasticity of money demand. The nominal money supply m_t^s is an exogenous variable and will be specified in more detail later.

To model exchange rate-specific shock, we introduce an exogenous component ξ_t, which can also be interpreted as a risk premium, to the conventional interest parity condition as follows.

$$i_t = E_t s_{t+1} - s_t + \xi_t \qquad (4)$$

Shocks to ξ_t will cause the nominal exchange rate to change, and these shocks are to be distinguished from aggregate supply, aggregate demand, and monetary shocks which reflect changes in the fundamentals of the economy. In other words, we can interpret that ξ_t captures the shocks that are generated by exogenous changes in the nominal exchange rate itself.

As described above, there are four exogenous components in the model, and they are assumed to obey the stochastic processes specified in (5)-(8), where ε_t^s, ε_t^d, ε_t^m, ε_t^{er} are supply, demand, monetary, and exchange rate-specific shocks, respectively, and y_t^s is the potential level of output.

$$y_t^s = y_{t-1}^s + \varepsilon_t^s \qquad (5)$$

$$d_t = d_{t-1} + \varepsilon_t^d - \gamma\varepsilon_{t-1}^d \qquad (6)$$

$$m_t^s = m_{t-1}^s + \varepsilon_t^m \qquad (7)$$

$$\xi_t = \xi_{t-1} + \varepsilon_t^{er} \qquad (8)$$

Note that following Clarida and Gali (1994), we assume that a fraction $\gamma < 1$ of the demand shock is reversed in the next period (t+1). Given (1)-(8), the model can be solved by first solving for the long run equilibrium in which prices are flexible and output is supply determined, and then solving for the short run equilibrium in which prices are sticky and thus output is demand determined. Below are the solutions in the long run (denoted by a superscript e) and those in the short run for the four macro variables output, the price level, the nominal interest rate, and the real exchange rate.

$$y_t^e = y_t^s$$

$$p_t^e = -y_t^s + \alpha\gamma\varepsilon_t^d + m_t^s + \lambda\xi_t$$

$$i_t^e = \lambda^{-1}\alpha\gamma\varepsilon_t^d + \xi_t$$

$$q_t^e = (y_t^s - d_t + \sigma\xi_t)/\eta + [\eta(\eta+\sigma)]^{-1}\sigma\gamma\varepsilon_t^d$$

$$y_t = y_t^s + (\sigma+\eta)\nu(1-\theta)(-\varepsilon_t^s + \alpha\gamma\varepsilon_t^d + \varepsilon_t^m + \lambda\varepsilon_t^{er})$$

$$= [1-(\sigma+\eta)\nu(1-\theta)]\varepsilon_t^s + (\sigma+\eta)\nu(1-\theta)(\alpha\gamma\varepsilon_t^d + \varepsilon_t^m + \lambda\varepsilon_t^{er}) + y_{t-1}^s$$

$$
\begin{aligned}
p_t &= p_t^e - (1-\theta)(-\varepsilon_t^s + \alpha\gamma\varepsilon_t^d + \varepsilon_t^m + \lambda\varepsilon_t^{er}) \\
&= -\theta\varepsilon_t^s + \alpha\gamma\theta\varepsilon_t^d + \theta\varepsilon_t^m + \lambda\theta\varepsilon_t^{er} + (-y_{t-1}^s + m_{t-1}^s + \lambda\xi_{t-1}) \\
i_t &= i_t^e + (1-\nu)(1-\theta)(-\varepsilon_t^s + \alpha\gamma\varepsilon_t^d + \varepsilon_t^m + \lambda\varepsilon_t^{er}) \\
&= (1-\theta)[1-(\sigma+\eta)\nu]\lambda^{-1}\varepsilon_t^s + [(\sigma+\eta)\nu(1-\theta)+\theta]\alpha\gamma\lambda^{-1}\varepsilon_t^d \\
&\quad + [(\sigma+\eta)\nu(1-\theta)+\theta]\varepsilon_t^{er} - (1-\theta)\lambda^{-1}\varepsilon_t^m + [(\sigma+\eta)\nu(1-\theta)+\theta]\xi_{t-1} \\
q_t &= q_t^e + \nu(1-\theta)(-\varepsilon_t^s + \alpha\gamma\varepsilon_t^d + \varepsilon_t^m + \lambda\varepsilon_t^{er}) \\
&= [\eta^{-1} - \nu(1-\theta)]\varepsilon_t^s + [(\eta+\sigma)^{-1}\sigma\gamma + \nu(1-\theta)\eta\alpha\gamma - 1]\eta^{-1}\varepsilon_t^d + \nu(1-\theta)\varepsilon_t^m \\
&\quad + [\eta^{-1}\sigma + \nu(1-\theta)\lambda]\varepsilon_t^{er} + \eta^{-1}y_{t-1}^s - \eta^{-1}d_{t-1} + \eta^{-1}\gamma\varepsilon_{t-1}^d + \eta^{-1}\sigma\xi_{t-1}
\end{aligned}
$$

with $\alpha \equiv \lambda/[(1+\lambda)(\eta+\sigma)]$ and $\nu \equiv (1+\lambda)/(\eta+\sigma+\lambda)$.

Looking at the *qualitative* responses of the four variables to the four shocks we could see that this model possesses many properties in common with a large class of open economy macro models that feature price stickiness, including the Mundell-Fleming model. For example, in the short run a (positive) monetary shock lowers the interest rate, increases output and depreciates the home currency. A supply shock raises output and lowers the price level. A demand shock raises output, the price level, and the nominal interest rate, and appreciates the RER. An exchange rate-specific shock causes a rise in the nominal interest rate, a depreciation of the home currency, an increase in output, and an increase in the price level. In addition, in the long run the nominal shocks ε_t^m and ε_t^{er} do not affect real variables such as y_t^e and q_t^e. When $\eta+\sigma<1$, the model also exhibits overshooting of the nominal exchange rate relative to its long run level in response to a permanent change in the money supply, a well-known result established by Dornbusch (1976).

We summarize in Table 1 the qualitative results regarding the sign of the responses in the *short run* of the four variables to the four structural shocks,[5] and we will use these results as sign restrictions to impose on the IRFs in the VAR below. It is important to note that the sign restrictions imposed as in Table 1 are enough to identify the four types of shocks. That is, the IRF of the price level helps distinguish supply shocks with other three types of shocks because the price level decreases in response to the former while increases in response to the later. Likewise, the IRF of the nominal interest rate helps distinguish monetary shocks with demand and exchange rate-specific

[5] The results in Table 1 are straightforward from the solutions obtained above if we recall that all parameters here are positive and in addition $\theta \le 1$ and $\gamma < 1$. An exception is the negative response of the RER to the demand shock which requires some calculations. We rearrange terms to obtain $\partial q_t/\partial\varepsilon_t^d = [(\eta+\sigma+\lambda)(\eta+\sigma)]^{-1}\{[(1-\theta)\gamma-1]\eta\lambda - \eta(\eta+\sigma) + (\gamma-1)\sigma(\eta+\sigma+\lambda)\}$, which is indeed negative.

shocks, and the last two shocks are identified by the IRF of the RER.

3. Empirical method and estimation

We utilize the method of structural VAR identified by sign restrictions developed by Uhlig (2005) to analyze the effects of structural shocks on macro variables of an open economy. The sign restrictions imposed here are similar to those in Farrant and Peersman (2006). The difference with their paper is that our paper explicitly introduces the exchange rate-specific shock into the theoretical model and derives the closed-form solutions of the four macro variables as shown in the previous section. As noted in Farrant and Peersman (2006), the sign restriction approach here has several important advantages over the existing ones, e.g. those which use long run and short run zero restrictions. It imposes only sign restrictions in the short run (i.e. several periods after the shock) and thus avoiding imposing zero long run restrictions which might lead to distortions in the estimation results due to small-sample biases and measurement errors (see Faust and Leeper 1997). In addition, the short run sign restrictions imposed here are based explicitly on a theoretical model explained in the previous section, while short run zero restrictions are lacking such theoretical background to justify them and might be inconsistent with a large class of macro models (see Canova and Pina 1999).

For sake of concreteness, we summarize the estimation procedure to identify the four types of structural shocks in the following steps.[6]

Step 1: Estimate the following four-variable reduced-form VAR for a country *j* (later *j* will be an East Asian country)

$$x_t = B_0 + B_1 x_{t-1} + B_2 x_{t-2} + ... + B_p x_{t-p} + u_t$$

where $x_t = (y_t^j - y_t^{US}, p_t^j - p_t^{US}, i_t^j - i_t^{US}, q_t^j)'$, t denotes quarter *t*, B_0 is a 4×1 vector of constant terms, B_s ($s = 1,..., p$) are coefficient matrices of size 4×4, *p* is the lag length, and u_t is a 4×1 vector of residuals with the variance-covariance matrix denoted by Σ. The four endogenous variables in the VAR model are defined in a way consistent with the theoretical model described in the previous section with the foreign country here being the United States. Let ε_t be the column vector containing the four structural shocks, namely, supply, demand, monetary, and exchange rate-specific shocks, and *A* be the matrix that relates the residual vector and the shock vector, i.e. $u_t = A\varepsilon_t$.

Step 2: Based on the estimated matrices $\hat{\Sigma}$ and $\hat{B}$ obtained in step 1, randomly

[6] In my previous work (Vu 2009), I apply this method to a different issue.

generate the matrix Σ from the inverse Wishart distribution $invW(\hat{\Sigma}^{-1}/T,T)$ with T being the sample size, and conditional on Σ, randomly generate the column-wise vectorized form $vec(B)$ of the matrices B from the normal distribution $N(vec(\hat{B}),\Sigma\otimes(X'X)^{-1})$ with X being the data matrix.

Step 3: For each draw (B,Σ) generated in step 2, randomly generate a large number (n_A) of matrix A using $A=A_0Q$ where A_0 is the Cholesky decomposition of Σ, and Q is an orthonormal matrix obtained by Q-R decomposing a matrix randomly generated from the standard normal distribution $N(0,1)$.

Step 4: For each draw (B,Σ,Q), calculate the IRFs of the endogenous variables to structural shocks, and check if the signs of these IRFs are consistent with those drawn from the theoretical model (summarized in Table 1) in the first n_{restr} months after the shock. If they are, call the draw (B,Σ,Q) a valid draw and use it to compute the series of the three shocks from data and store them. Otherwise, discard the draw (B,Σ,Q).

Repeating steps 2 through 4 many times we obtain a certain number of valid draws (n_{valid}), and a set of the matrices B,Σ and structural shocks, which are then used for variance decompositions. In the analysis below, I set $n_{valid}=200$, $n_A=500$, and $n_{restr}=3$. Given these two parameters, $n_{\Sigma B}$ becomes "endogenous". In addition, the lag length is chosen $p=3$, following the Schwarz information criterion.

4. Data

We study the case of two East Asian countries, namely, Thailand and Korea. The data set used for the analysis in the VAR model consists of monthly data of real output, the CPI, the nominal interest rate, and the RER. The first three variables are defined as the log-difference of the corresponding variable between an East Asian country (the home country) and the U.S. (the foreign country). Real output and CPI data are seasonally adjusted series. The use of monthly data increases substantially the sample size as compared to the case of quarterly data, which are used in previous studies such as Farrant and Peersman (2006). Since real GDP are not available at the monthly frequency, industrial production index is used as a proxy for real output. For the case of Thailand, the series Value Added Production Index (VAPI) is used. Nominal interest rate data is the three-month money market rate series. The real exchange rate, as defined above, is computed as the product of the nominal exchange rate of the home currency against the US dollar and the U.S.'s CPI divided by the home country's CPI.

The data sources are the International Financial Statistics (IFS) online database of International Monetary Fund and the CEIC database.

The sample period is 1980M1-2012M5 for Korea and 1987M1-2012M7 for Thailand. The sample for each of the two countries is divided into two sub-samples which correspond to the pre- and post-Asian currency crisis periods, with the former period ends in 1996M12, and the latter period starts from 1999M1. As seen from Figure 1, the pre-crisis period is characterized by soft peg exchange rate regimes with very limited movements of the nominal exchange rate against the US dollar, while the post-crisis is characterized by much more flexible exchange rate regimes in the two countries. This fact can be confirmed in Table 2, which shows that the volatility of the nominal exchange rate is about three times higher in the floating regime than in the peg one in both countries.[7] The crisis period 1997M1-1998M12 is excluded from the sample because this was a chaotic period and thus is not the subject of our analysis.

5. Results and analysis

This section reports and analyzes the results obtained using the VAR method and the data of Korea and Thailand described above.

Impulse response functions (IRFs)

Figures 2 and 3 show the graph of IRFs obtained from the estimated structural VAR. Looking at the shaded areas in each box, we can see that, by construction, the IRFs are consistent with the qualitative results of the theoretical model in Table 1. Note that the period in which we impose sign restrictions here is three months. Beyond this period, we observe that the effects of monetary shocks on output, and of exchange rate-specific shocks on CPI and the RER are persistent in the case of Korea, but temporary in the case of Thailand, in both pre- and post-crisis periods. On the other hand, supply shocks seem to have long lived effects in both countries. The effects of demand shocks on CPI in Thailand are persistent in both the pre- and post-crisis periods.

Variance decomposition for the RER

[7] We also observe from Table 2 that, in both countries, the volatility of the RER is almost the same of that of the nominal exchange rate. In addition, the correlation between the nominal exchange rate and the RER is high in both regimes, but much higher (an almost perfect correlation) in the floating regime. This latter result is also observed in floating regimes in advanced countries as shown in Mussa (1986).

Now we turn on the results of our main interest in this paper. Figures 4 and 5 display the variance decomposition for the RER for Thailand and Korea in the pre- and post-crisis periods. Note again that the former period is characterized by peg exchange rate regimes, while the latter is characterized by much more flexible exchange rate regimes in the two countries. From these figures, we can see how the sources of RER fluctuations are different across different exchange rate regimes.

The following facts can be observed from these figures. First, and most importantly, exchange rate-specific shocks play a much more important role in RER fluctuations in the flexible exchange rate regime than in the peg: their contribution to the RER forecast error variances at the one month horizon is about 40% in Korea and 30% in Thailand in the former regime, but only about 10% in both countries in the latter. These results and those in Table 2 suggest a positive correlation between the volatility of the RER and the contribution of exchange rate-specific shocks in the fluctuations of the RER at short horizons. This finding is quite intuitive and it implies that we face a cost of suffering more undesirable fluctuations of the RER due to exchange rate-specific shocks when letting the nominal exchange rate to float more. Or in other words, there is a benefit of removing this cost if we adopt are a policy that restricts the movements of the nominal exchange rate. Second, across all horizons, demand shocks are the most important sources of RER fluctuations in both countries and both sample periods. For example, the contribution of demand shocks at the one month horizon is about 66% in the peg regime in Korea, and about 55% in the floating regime in Thailand. Third, supply shocks play a smaller role, explaining about 10-23% of RER fluctuations in both countries. Fourth, the contribution of monetary shocks is even smaller, if not negligible, especially in Thailand in both regimes with the number varying from 4% to 10%.

Variance decompositions for other variables

Tables 3 and 4 show the variance decompositions for output, the price level, and the nominal interest rate for Korea and Thailand in the pre- and the post-crisis periods. We focus on the role of exchange rate-specific shocks and summarize our findings as follows. First, exchange rate-specific shocks tend to be more important in explaining the fluctuations of output and the price level in the floating regime than in the peg. Recall that these fluctuations do not reflect the changes in fundamentals of the economy and thus are not desirable. The finding shows that these fluctuations in output and the price level can be reduced under the peg regime. Second, exchange rate-specific shocks are one of the main sources of interest rate changes, accounting from 54% to 63% of the interest rate forecasting error variances in the post-crisis period in Thailand.

This is consistent with the fact that these shocks are also risk premium shocks. Notice that in the case of Thailand, the contribution of exchange rate-specific shocks to interest rate changes is much higher in the floating regime than in the peg one. This may reflect the inflation targeting policy in Thailand in the post-crisis period: the Bank of Thailand heavily controls inflation by navigating the nominal interest rate to respond to changes in the exchange rate caused by exchange rate-specific shocks. This is also suggested by the fact that the contribution of exchange rate-specific shocks in the fluctuations of the price level is rather small compared to that of supply and demand shocks in Thailand.[8]

The role of exchange rate-specific shocks in RER fluctuations: A comparison with previous studies

Table 5 shows a comparison of the variance decomposition results for the RER of this paper and those of Farrant and Peersman (2006) who study the case of Canada, the Euro area, Japan, and the UK. Since these authors focus only on periods of flexible exchange rate regimes, we use our results for the post-crisis period of Korea and Thailand to compare with theirs. Although the details are more or less different across countries, we could see that our results are comparable to those of Farrant and Peersman (2006). In particular, there are two things in common with their study. First, demand shocks are the most important source, or one of the most important sources, of RER fluctuations in both short and long horizions. Second, exchange rate-specific shocks are an important source of RER fluctuations at short horizons, say 3 months. There is, however, a difference between our results here and theirs, which is that at the 12 month horizon the contribution of exchange rate-specific shocks in RER fluctuations is higher in the case of Korea than in the cases of the OECD countries analyzed in Farrant and Peersman (2006).

Implications for the choice of exchange rate regimes in East Asia

The Asian currency crisis in 1997-98, beginning with a sharp fall of the home currency's value against the US dollar, brought about a series of bankruptcies in the financial and real sectors, and as a result, a sharp fall of output and a surge in unemployment, and even political and social instability in a number of East Asian countries. The two countries studied in this paper, Korea and Thailand, and Indonesia were the countries that were the most severely affected.[9] After this crisis, many East

[8] See Grenville and Ito (2010) for more details about the inflation targeting policy in Thailand.
[9] For more details about the impact of this crisis see Pernia and Knowles (1998).

Asian countries have abandoned the dollar pegs and moved to regimes with more flexibility of the nominal exchange rate against the US dollar. However, the debate on the optimal choice of exchange rate regimes for East Asian countries is still going on until the present. So far several proposals have been made and some of them have actually been implemented, e.g., a float with inflation targeting, a dollar peg, a currency basket peg, and a common currency.[10]

Based on the findings above about the sources of RER fluctuations of two East Asian countries, we could also draw some implications on the choice of exchange rate regimes for East Asia. The first implication is that, the policy maker would face a tradeoff between the following two needs when choosing an exchange rate regime: (i) the need to have the RER adjust flexibly to shocks that come from fundamentals; and (ii) the need to limit the undesirable fluctuations of the RER that do not come from fundamentals. Notice that one of our findings is that demand shocks are the most important sources of RER fluctuations, and therefore there should be flexibility in the nominal exchange rate and thus the RER to adjust to these shocks (the first need). But as the same time, since the contribution of exchange rate-specific shocks is much larger in the flexible regime than in the peg one, it would be desirable to reduce these fluctuations of the RER by limiting the changes in the nominal exchange rate (the second need). The second implication, which is related to the first, is that, rather than choosing a completely free float or a complete fix, the policy maker may choose a regime in between these two extremes, e.g. a managed float, a crawling peg, or a regime of pegged exchange rate within bands. With such a regime the policy maker can achieve, although incompletely, the above two competing objectives.

6. Concluding Remarks

In this paper we have investigated how the sources of RER fluctuations would differ under different exchange rate regimes. We used data of two East Asian countries, namely Korea and Thailand. Over the last few decades, these countries have changed their exchange rate regimes from US dollar pegs to regimes with much more flexibility of the nominal exchange rate, and thus they provide a good natural experiment for the question we wish to study.

Our main findings are as follows. Exchange rate-specific shocks are more important to the fluctuations of the RER in the floating regime than in the peg one.

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[10] See Cavoli (2010), Bayoumi et al. (2000), Ito et al. (1998), Kawai (2004), McKinnon (1999), Ogawa and Ito (2002), Shioji (2006), Yoshino et al. (2004), Zhang et al. (2003), among others.

These shocks are also the main source of interest rate changes, and they also play a nonnegligible role in the fluctuations of output and the price level. Demand shocks are the most important source of RER fluctuations in both exchange rate regimes in the two countries, while supply shocks play a smaller role, and monetary shocks play an even smaller, if not negligible, role in RER fluctuations.

These findings imply a tradeoff faced by policy makers in East Asia in designing the exchange rate regimes for their countries. That is the tradeoff between the need to allow the (nominal and real) exchange rate to adjust to fundamental shocks and the need to limit the undesirable fluctuations of the exchange rate that do not come from fundamentals. In practice, rather than choosing the two extremes of a completely free float and a complete peg, it might be preferable to choose an intermediate regime such as a managed float, a crawling peg, or a regime of pegged exchange rate within bands.

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Table 1: Sign restrictions drawn from the theoretical model and imposed on IRFs of the VAR

	Supply shock	Demand shock	Monetary shock	Exchange rate-specific shock
Output	≥0	≥0	≥0	≥0
Price level	≤0	≥0	≥0	≥0
Interest rate		≥0	≤0	≥0
Real exchange rate		≤0	≥0	≥0

Notes: A blanked cell means that the sign of the response is ambiguous in the theoretical model and no sign restriction is imposed on the corresponding IRFs of the VAR.

Table 2: Volatility of the nominal and real exchange rates against the USD and their correlation in Korea and Thailand in the pre- and post-Asian currency crisis periods

		Korea		Thailand	
		Pre-crisis period (1980-1996)	Post-crisis period (1999-2012)	Pre-crisis period (1987-1996)	Post-crisis period (1999-2012)
Volatility	NER	0.009	0.026	0.006	0.018
	RER	0.009	0.025	0.008	0.019
Corr(dlogNER,dlogRER)		0.801	0.994	0.800	0.973

Notes: Volatility is measured as the standard deviation of the log-difference (dlog) of the corresponding variable.

Source: International Financial Statistics online database and the author's calculations.

Table 3: Variance decompositions for other variables, Korea

Period	Variable	Horizon	Supply shock	Demand shock	Monetary shock	Ex. rate specific shock
Pre-crisis (1980-1996)	Output	3 months	33.4	33.6	23.4	9.6
		12 months	33.4	32.7	23.5	10.4
		36 months	33.0	30.5	25.0	11.6
	Price level	3 months	46.3	36.0	10.4	7.3
		12 months	42.0	38.4	8.5	11.2
		36 months	33.7	43.3	6.4	16.6
	Nominal interest rate	3 months	6.1	5.1	38.7	50.2
		12 months	6.1	6.3	37.2	50.3
		36 months	6.8	8.1	36.0	49.1
Post-crisis (1999-2012)	Output	3 months	45.8	26.2	14.7	13.2
		12 months	41.8	28.5	20.7	8.9
		36 months	32.9	23.8	35.4	7.9
	Price level	3 months	43.0	18.6	21.9	16.5
		12 months	35.6	15.0	25.4	24.0
		36 months	30.9	12.5	21.5	35.2
	Nominal interest rate	3 months	12.8	4.8	32.0	50.4
		12 months	19.2	6.4	29.4	45.0
		36 months	25.4	7.5	26.7	40.5

Notes: Numbers are in percentage. Results shown here are the mean values.

Table 4: Variance decompositions for other variables, Thailand

Period	Variable	Horizon	Supply shock	Demand shock	Monetary shock	Ex. rate specific shock
Pre-crisis (1987-1996)	Output	3 months	28.4	22.4	37.5	11.6
		12 months	30.4	25.8	29.6	14.1
		36 months	31.6	23.2	25.6	19.6
	Price level	3 months	44.9	41.3	6.3	7.5
		12 months	42.0	42.7	5.7	9.6
		36 months	37.1	47.0	5.0	11.0
	Nominal interest rate	3 months	7.6	10.5	57.8	24.0
		12 months	8.1	10.4	54.5	27.0
		36 months	9.0	10.8	51.6	28.7
Post-crisis (1999-2012)	Output	3 months	43.2	29.5	14.1	13.2
		12 months	43.8	31.6	13.0	11.6
		36 months	43.1	34.1	11.1	11.8
	Price level	3 months	35.6	31.4	22.3	10.7
		12 months	30.7	40.0	19.0	10.3
		36 months	23.9	51.1	16.0	9.0
	Nominal interest rate	3 months	6.8	5.9	33.8	53.6
		12 months	6.5	8.0	26.6	58.9
		36 months	6.9	11.0	19.4	62.7

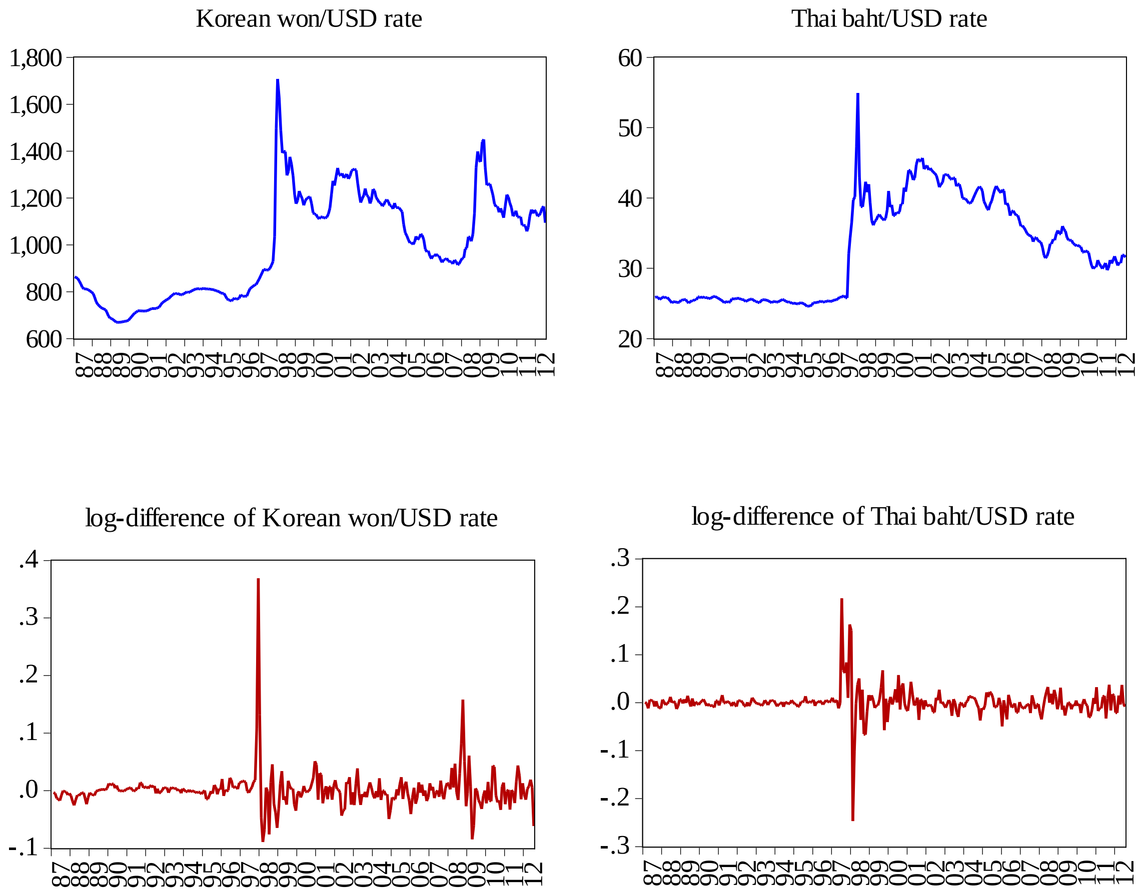
Notes: Numbers are in percentage. Results shown here are the mean values.

Table 5: Variance decomposition for the RER: A comparison with previous studies

	Supply shock	Demand shock	Monetary shock	Ex. rate specific shock
Farrant and Peersman (2006)				
United Kingdom				
3 months	3.0	40.0	4.0	40.0
12 months	5.0	60.0	8.0	15.0
Euro area				
3 months	19.0	24.0	13.0	25.0
12 months	28.0	23.0	15.0	17.0
Japan				
3 months	2.0	43.0	10.0	30.0
12 months	3.0	34.0	35.0	14.0
Canada				
3 months	2.0	71.0	1.0	20.0
12 months	3.0	79.0	3.0	8.0
This paper, post-crisis period				
Korea				
3 months	6.3	50.6	8.0	35.1
12 months	15.6	45.8	6.8	31.8
Thailand				
3 months	11.2	60.8	6.4	21.6
12 months	12.7	70.7	4.6	12.0

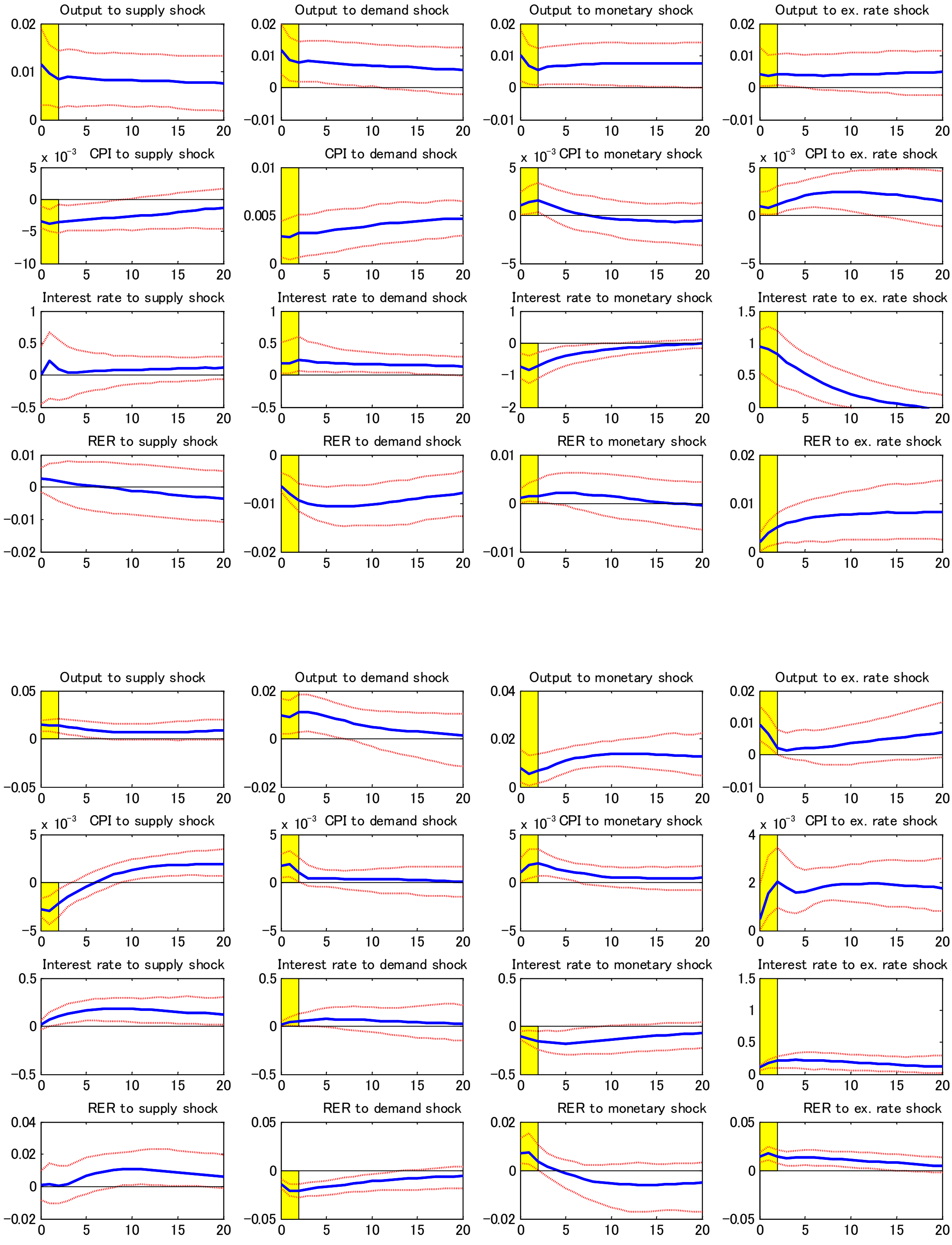
Notes: Numbers are in percentage. Farrant and Peersman (2006) focus only on periods of flexible exchange rate regimes, thus corresponding to the case of post-crisis sample in this paper.

Figure 1: Nominal exchange rate against the USD of Korea and Thailand's currencies 1987-2012



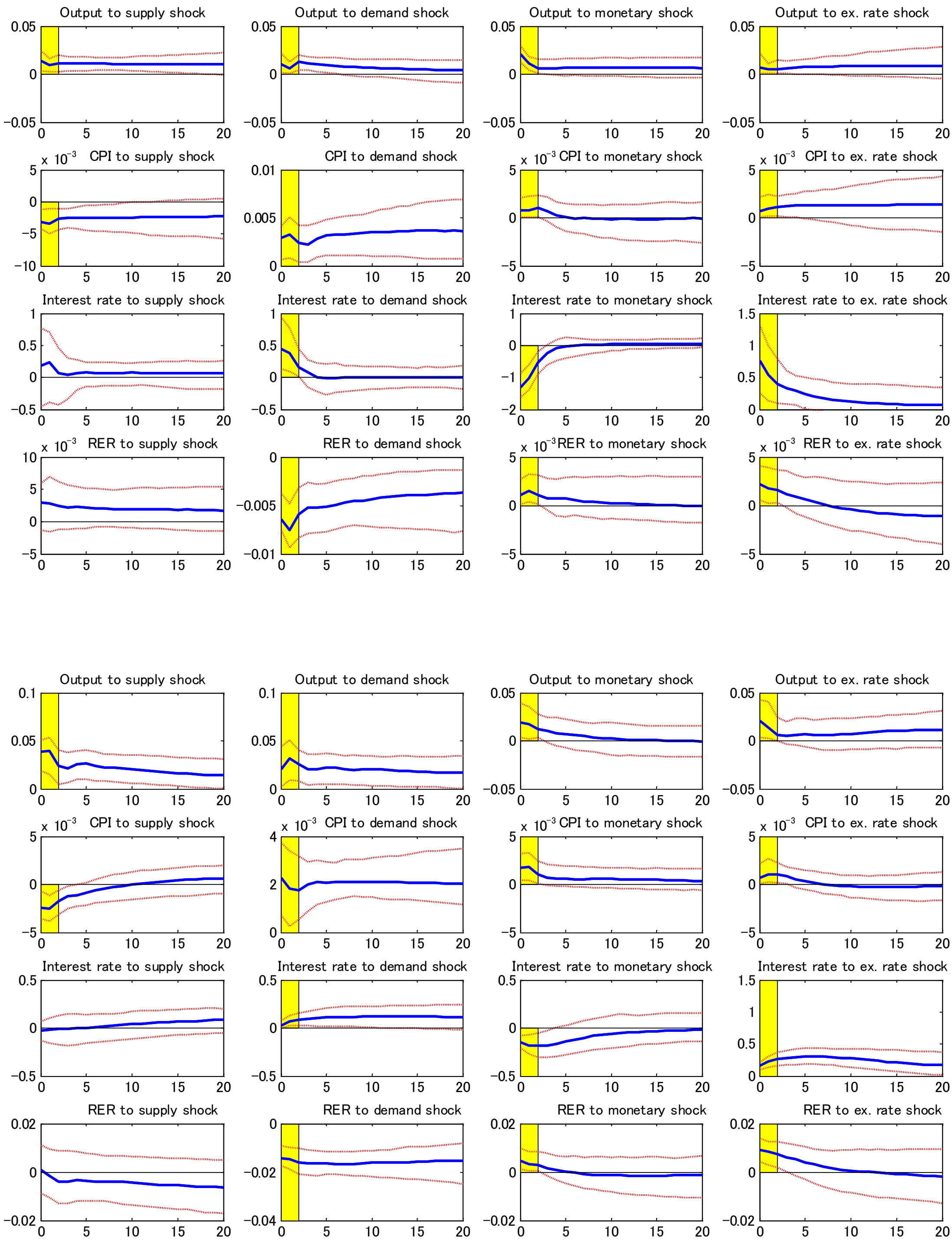
Source: International Financial Statistics online database and the author's calculations.

Figure 2: IRFs to shocks, pre- (upper panel) and post crisis (lower panel), Korea



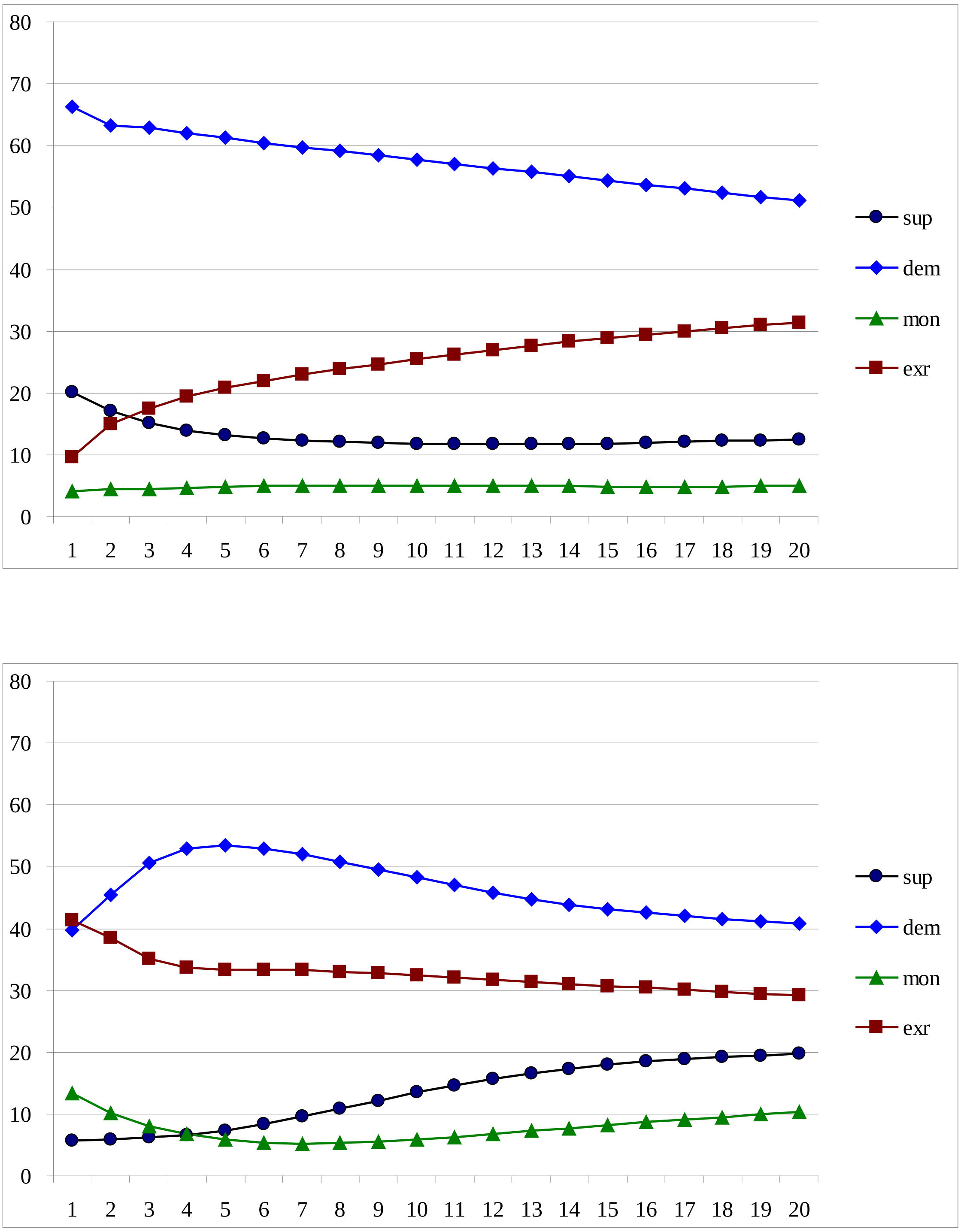
Notes: In each box, the horizontal axis is the number of months after the shock occurs and the vertical axis is the percentage change in the corresponding variable. Dashed lines are 16th and 84th quantiles, and solid lines are 50th quantiles. Shaded areas indicate the sign and period in which restrictions are imposed.

Figure 3: IRFs to shocks, pre- (upper panel) and post-crisis (lower panel), Thailand



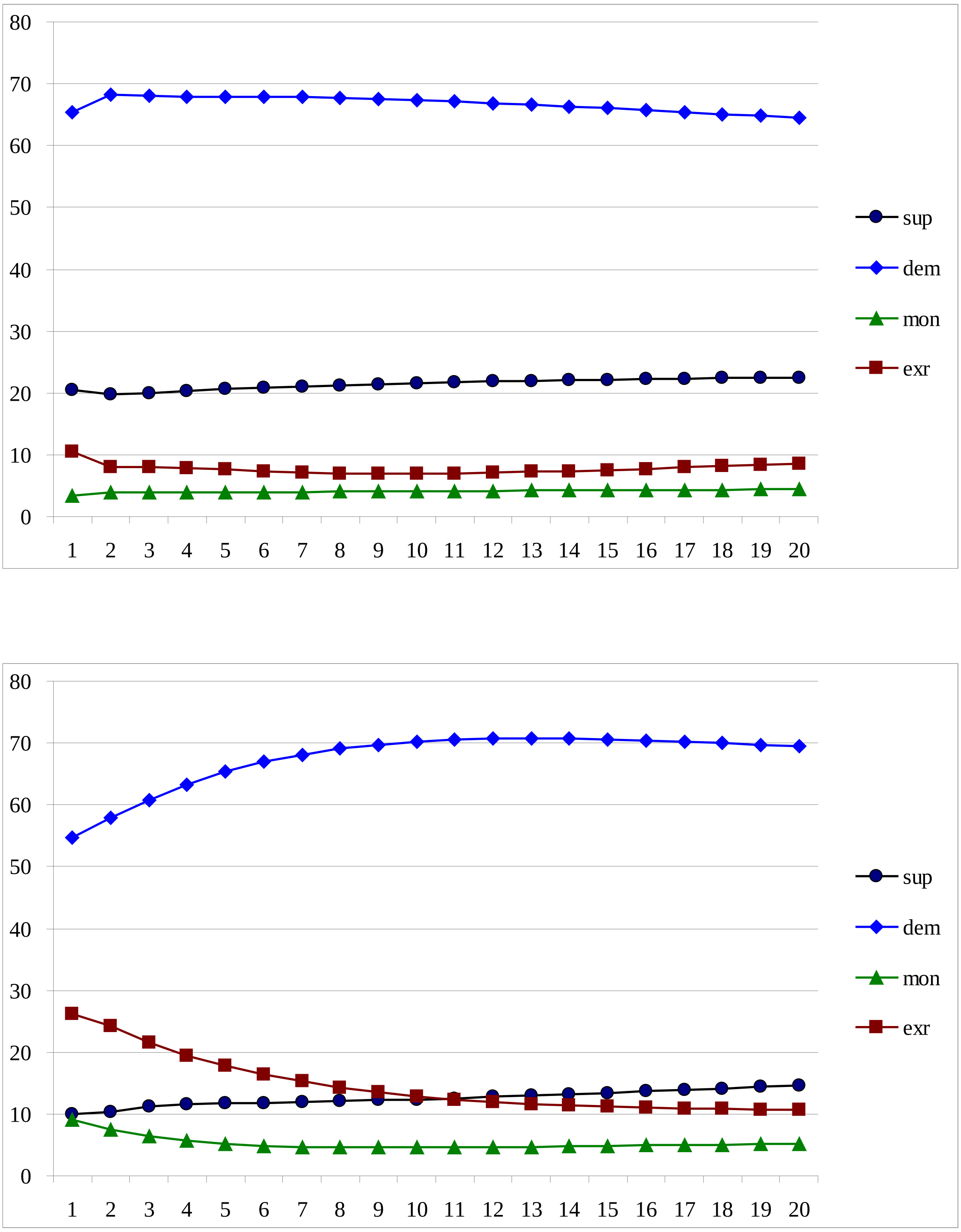
Notes: In each box, the horizontal axis is the number of months after the shock occurs and the vertical axis is the percentage change in the corresponding variable. Dashed lines are 16th and 84th quantiles, and solid lines are 50th quantiles. Shaded areas indicate the sign and period in which restrictions are imposed.

Figure 4: Variance decomposition for the RER in the pre-crisis period (upper panel) and post-crisis period (lower panel) in Korea



Notes: In each panel, the horizontal axis is the number of months after the shock occurs and the vertical axis is the percentage of real exchange rate forecast error variances due to of each shock. Notations: *sup*: supply shock, *dem*: demand shock, *mon*: monetary shock, *exr*: exchange rate-specific shock.

Figure 5: Variance decomposition for the RER in the pre-crisis period (upper panel) and post-crisis period (lower panel) in Thailand



Notes: In each panel, the horizontal axis is the number of months after the shock occurs and the vertical axis is the percentage of real exchange rate forecast error variances due to of each shock. Notations: *sup*: supply shock, *dem*: demand shock, *mon*: monetary shock, *exr*: exchange rate-specific shock.