FIW – Working Paper

FIW Working Paper N° 146
February 2015

On the nature of shocks driving exchange rates in emerging economies

Galina V. Kolev[1]

Abstract

The paper analyzes the sources of exchange rate movements in emerging economies in the context of monetary tapering by the Federal Reserve. A structural vector autoregression framework with a long-run restriction is used to decompose the movements of nominal ex-change rates into two components: one component driven solely by the adjustment of the real exchange rate to permanent shocks and one resulting from transitory shocks such as monetary policy measures. Imposing the restriction that temporary shocks should not affect the real exchange rate in the long run, the analysis shows that the recent depreciation of the Russian ruble and the Turkish lira is largely driven by transitory shocks, like for instance monetary policy measures. Furthermore, the response of the lira to transitory shocks is sluggish and further depreciation is possible in the next months. In Brazil and India, on the contrary, nominal exchange rate behavior is mainly driven by permanent shocks. The recent depreciation is not caused by short-lived shocks but rather by changing long-term macroeconomic fundamentals. The foreign exchange interventions of the central bank to avoid large depreciation are therefore largely misplaced, especially in Brazil. They aggravate the use of nominal exchange rate flexibility as an efficient adjustment mechanism for real exchange rate changes, i.e. changes in relative prices across borders, and efficient allocation of resources.

JEL: F31, E58
Keywords: Exchange rates, emerging economies, SVAR, monetary policy

The author

1 Cologne Institute for Economic Research
E-Mail: kolev@iwkoeln.de, Phone: +49 221 4981 774

On the nature of shocks driving exchange rates in emerging economies

Galina V. Kolev*

Cologne Institute for Economic Research

December 14, 2014

Abstract

The paper analyzes the sources of exchange rate movements in emerging economies in the context of monetary tapering by the Federal Reserve. A structural vector autoregression framework with a long-run restriction is used to decompose the movements of nominal exchange rates into two components: one component driven solely by the adjustment of the real exchange rate to permanent shocks and one resulting from transitory shocks such as monetary policy measures. Imposing the restriction that temporary shocks should not affect the real exchange rate in the long run, the analysis shows that the recent depreciation of the Russian ruble and the Turkish lira is largely driven by transitory shocks, like for instance monetary policy measures. Furthermore, the response of the lira to transitory shocks is sluggish and further depreciation is possible in the next months. In Brazil and India, on the contrary, nominal exchange rate behavior is mainly driven by permanent shocks. The recent depreciation is not caused by short-lived shocks but rather by changing long-term macroeconomic fundamentals. The foreign exchange interventions of the central bank to avoid large depreciation are therefore largely misplaced, especially in Brazil. They aggravate the use of nominal exchange rate flexibility as an efficient adjustment mechanism for real exchange rate changes, i.e. changes in relative prices across borders, and efficient allocation of resources.

Keywords: Exchange rates, emerging economies, SVAR, monetary policy.

JEL Classification Numbers: F31, E58.

*Contact: *kolev@iwkoeln.de*, +49 221 4981 774.

1 Introduction

Speculations about a possible tapering of monetary expansion by the Federal Reserve Bank of the United States (Fed) led in May 2013 to large amounts of capital outflows from emerging economies. Capital flows stabilized after the Fed signalized on September 18, 2013 that the course of monetary expansion would be sustained in the upcoming months. However, the Fed's decision not to taper monetary expansion turned out to be short-lived and the members of the Federal Open Market Committee (FOMC) decided in December to modestly reduce the pace of its asset purchases. This decision initiated a new wave of capital outflows from emerging economies and put the market exchange rates of their currencies under pressure.

The course of monetary policy in the USA and Europe turned out to be one major driver of capital flows and exchange rates in emerging economies over the years. A large amount of capital inflows was accumulated in those countries as a result of loose monetary policies in mature economies. The relatively high default risk was compensated by an interest yield exceeding the US level by several times. Forbes and Warnock (2012) point out that waves of capital flows are primarily associated with global factors. Though, monetary policy in advanced economies was not the only reason for increasing capital flows to emerging economies. Strong growth has raised the attractiveness of these countries for international investors. Emerging economies turned out to be the main driver of global economic growth in the period from 2003 to 2011 and their share in global output increased to over 50 percent. Therefore, it is premature to assert that capital flows and exchange rates in emerging economies are solely driven by monetary policy in industrialized countries. Moreover, deteriorating economic conditions and lacking structural reforms have impaired the prospects of king-size returns on investment in recent years. Economic growth shrank from an annual average of 3.6 percent in 2000-2011 in Brazil to 1.0 percent in 2012 and 2.3 percent in 2013. In Russia, the decline was dramatic as well: from 5.3 percent on average in 2000-2011 to 3.4 percent in 2012 and even 1.3 percent in 2013. Therefore, current capital outflows are not only the result of tapering of monetary expansion by the Fed. They are at least partly due to long-term fundamental changes in the course of economic development in the emerging economies.

Capital flows have led to substantial movements of nominal exchange rates in emerging economies. Figure 1 depicts the development of the US dollar exchange rates of the Brazilian real, the Indian rupiah, the Russian ruble, the South African rand and the Turkish lira in the time period from 2000 to 2014. All currencies appreciated between 2003 and the break-out of the current economic crisis in 2008. The nominal appreciation was modest in India, Russia and South Africa. In Turkey and Brazil, on the contrary, the currencies appreciated from 2003 until the middle of 2008 considerably, by 26 and 53 percent, respectively.

Increasing global uncertainty led to capital outflows and sharp exchange rate depreciation in the second half of 2008 and the beginning of 2009 followed by gradual appreciation in the following months. Capital outflows as a response to the speculations about tapering of ultra-easy monetary policy by the Fed led to sharp depreciation in the summer of 2013, which was reinforced after officially announcing the slowdown of monetary expansion at the end of 2013. Within one year (from March 2013 to March 2014) nominal exchange rates (NER) depreciated by 12 percent in India, 17 percent in Brazil and South Africa, 18 percent in Russia and even 23 percent in Turkey.

The recent development of exchange rates in emerging economies has raised fears of an exchange rate crisis in these countries. Given the large share of emerging economies in world GDP and economic growth, sharpening economic conditions in these countries would heavily affect the global economic stability. Considering the development of exchange rates in emerging economies as dangerous is, however, premature if not misleading, as long as

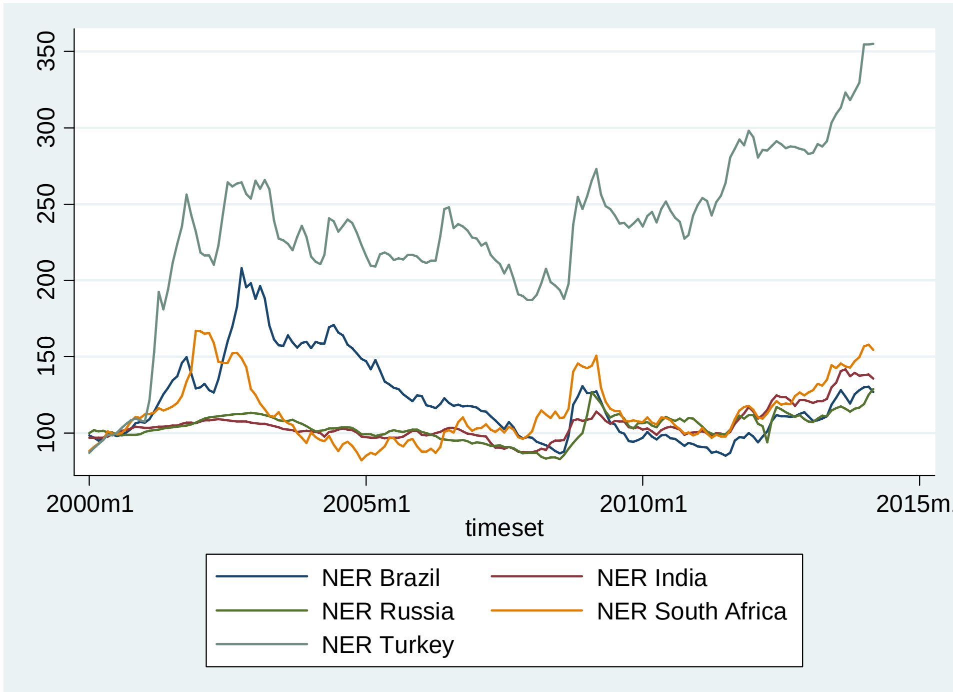

Figure 1: Development of US dollar exchange rates in emerging economies (2000-2013)

Increasing values indicate depreciation of the particular currency, Index, 2000 = 100
Source: own calculations based on data from the IFS database of the International Monetary Fund

the sources of the nominal rate movements are unknown. Moreover, the critical note on exchange rate development bears the risk of self-fulfilling prophecy and can result in further capital flows. Subsequently the financial stability in these particular countries could be jeopardised.

In turn, the response of central banks to the pressure to depreciate was noticable. In all of the emerging economies under consideration foreign exchange reserves decreased substantially in the aftermath of the announcement of the Federal Reserve in May 2013 (see Figure 2). The decline within two months (from April to June 2013) ranged from 2.4 percent in Brazil to 7.8 percent in Turkey. The sell of foreign exchange was reinforced in Turkey and Russia in the beginning of 2014.

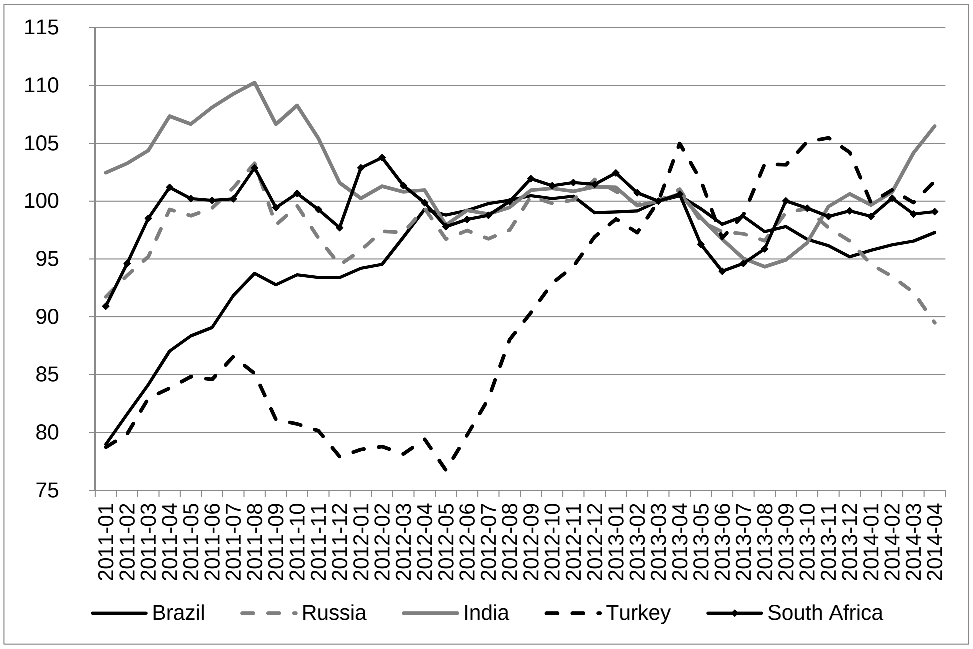

Figure 2: Foreign exchange reserves of central banks in emerging economies

March 2013 = 100.
Source: own calculations; Banco Central do Brasil; Reserve Bank of India; Bank Rossii; South African Reserve Bank; Turkiye Cumhuriyet Merkez Bankasi.

Further reaction of the central banks was observed regarding the central bank interest rate as represented in Figure 3. After reaching a historical low of 7.25 percent at the end of 2012, the CELIC rate was increased gradually in the course of 2013 and 2014 and reached 11 percent in April 2014. In Turkey, the development of the one-week repo lending rate was even more dramatic. It was augmented from 4.5 percent to 10.0 percent at the beginning of 2014.

In spite of its particular relevance for economic theory and practice, there has only been scarce evidence with respect to the driving forces of devaluation in emerging economies in the run-up to monetary tapering in the US. Theoretical and empirical literature confirms the effect of unconventional monetary policy measures on capital flows during the period

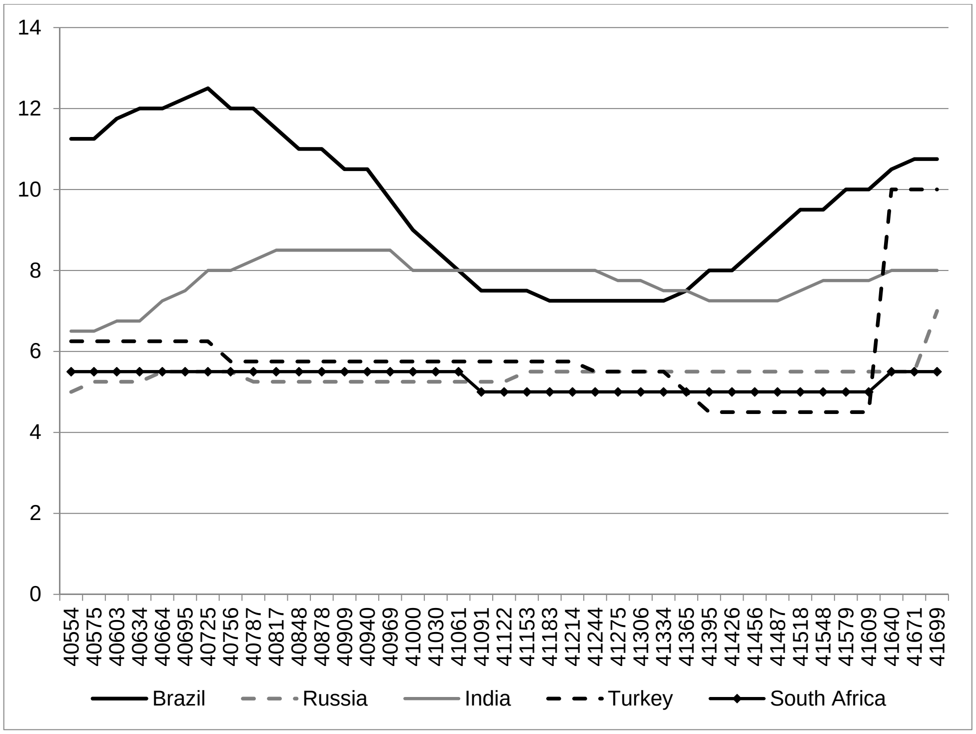

Figure 3: Central bank interest rate

Source: Banco Central do Brasil, Reserve Bank of India, Bank Rossii, South African Reserve Bank, Turkiye Cumhuriyet Merkez Bankasi

of increasing monetary expansion. Fratzscher et al. (2013) show that Fed policies affected pro-cyclically capital flows to emerging economies and counter-cyclically capital inflows into the US. Furthermore, they find no evidence that foreign exchange policies helped countries to protect themselves from monetary policy spillovers. Kiley (2013) demonstrates that long-term uncovered interest party is still valid in spite of unconventional monetary policy. Chen et al. (2012) find that quantitative easing lowered Asian bond yields and put pressure on exchange rates, especially in Korea, Indonesia and Hong Kong SAR. Chinn (2013) analyzes the impact of monetary policy measures over the past years on exchange rates. He concludes that unconventional monetary policy may introduce more volatility into the global market, but it supports global rebalancing by encouraging the revaluation of emerging market currencies.

The effect of monetary tapering has been investigated in Mishra et al. (2014). The authors study the daily exchange rates for 21 emerging markets and find that countries with stronger macroeconomic fundamentals, deeper financial markets and a tighter macroprudential policy stance experience smaller currency depreciations in the run-up to the tapering announcements. Eichengreen and Gupta (2014) analyze the correlation between changes in nominal exchange rates between April and August 2013 and a set of fundamentals. Contrary to Mishra et al. (2014) they point out that macro fundamentals are not important. Chen et al. (2014) use data over a longer time span and find that different fundamentals were important at different time periods. Aizenman et al. (2014) measure the impact of tapering news from Bloomberg and show that exchange rate depreciation as a result of monetary tapering was especially pronounced in emerging economies with robust fundamentals.

The present analysis examines the longevity of current depreciation. The central bank interventions on the foreign exchange market afford detailed knowledge about the driving forces of exchange rate movements. The current episodes of sharp depreciation have been the immediate reaction to the speculations concerning monetary policy in the US. Though, the causation is rather unclear. It is still possible that they are the result of a slowdown in economic activity in these countries. In such a case nominal depreciation is used as an adjustment tool to facilitate the development of real exchange rates and does not afford a reaction by the particular central bank. If, however, exchange rate movements are caused by transitory factors such as monetary policy, then the reaction of the central bank is justified since it is a correction of a transitory shock and lowers the variability of exchange rates. Using a structural vector autoregression framework (SVAR) in the style of Blanchard and Quah (1989), the present analysis investigates the influence of transitory and permanent shocks to the nominal exchange rates in Brazil, India, Russia, South Africa and Turkey in the period from 2000 to 2014. [1] Imposing the long-run restriction that temporary shocks

[1]The paper investigates driving forces of exchange rates in the major emerging economies. China is excluded from the analysis because of lacking variability of the nominal exchange rate in the early 2000s.

should not affect the real exchange rate in the long run, the SVAR analysis indicates that a large share of nominal exchange rate variation has recently been driven by permanent shocks, especially in Brazil and India. Temporary shocks, such as monetary policy measures or other nominal or real short-lived shocks, turn out to be less important for exchange rate variation. Moreover, the results point out that further depreciation of the Turkish lira can be expected in the next few months. Although the uncertainty surrounding monetary policy in the United States is not directly measurable, the analysis indicates that the reaction of the Brazilian central bank was premature, since exchange rate behavior is only partly driven by transitory shocks. The foreign exchange interventions aggrevate the use of nominal exchange rate flexibility as an efficient adjustment mechanism for real exchange rate changes, i.e. changes in relative prices across borders, and efficient allocation of resources.

The next section presents the methodology of the empirical approach for the decomposition of the nominal exchange rate variation into a transitory and a permanent component. Section 3 contains the results of the empirical analysis. Concluding remarks are stated in Section 4.

2 The Empirical Model

The puzzling behavior of nominal and real exchange rates has led to a large body of literature. The leadoff theoretical analysis of exchange rate behavior in the context of monetary policy was the overshooting model presented by Dornbusch (1976). According to his model, the response of the nominal (and real) exchange rate to a contraction of domestic monetary policy is sharp appreciation followed by gradual depreciation toward the long-run equilibrium level. Applying the model to the response of nominal exchange rates to contraction of monetary policy in the foreign country, the outcome should be sharp nominal (and real) depreciation followed by gradual appreciation. The exchange rate overshooting mechanism has been re-examined in a range of recent new open economy macroeconomics analyses, such as Benigno (2004), Bergin (2006) and Steinson (2008).

A further strand of the literature shows that the peak appreciation of nominal and real exchange rates as a response to monetary policy contraction occurs with a pronounced time lag (see Clarida and Gali, 1994, Eichenbaum and Evans, 1995, Kim, 2005, and Scholl and Uhlig, 2008). According to these analyses the impulse response function exhibits a hump-shape pattern, i.e. "delayed exchange rate overshooting puzzle" (see e.g. Binder et al., 2010).

The effect of monetary policy on the nominal and real exchange rate has been mostly analyzed within a vector autoregression (VAR) model. Clarida and Gali (1994) examine, for instance, the role of monetary policy for four countries vis-a-vis the US dollar. Using the approach pioneered by Blanchard and Quah (1989) they estimate a three-equations open macro model in the spirit of Dornbusch (1976) and Obstfeld (1985). They especially show for Germany and Japan that monetary shocks explain a substantial amount of the variance of the US dollar exchange rate: More than 41 percent of the variance of the USD/DM real exchange rate and more than 35 percent of the USD/YEN real exchange rate can be ascribed to monetary shocks at a twelve-month horizon. The main results have been confirmed by Rogers (1999) and Faust and Rogers (2003). In several alternative VAR specifications with five variables Rogers (1999) analyzes the GBP/USD exchange rate using over one hundred years of data. Depending on the specification, the real exchange rate variability in the short run (twelve months) ascribed to monetary shocks ranges between 19 percent and 60 percent, with a median contribution of 40.6 percent. Faust and Rogers (2003) estimate a seven-variables model as in Eichenbaum and Evans (1995) and analyze the effect of monetary shocks over a 48-months horizon. The results point toward a variance share of over 50 percent which can be attributed to monetary shocks. Even in a further specification with fourteen variables the variance share of monetary shocks remains substantial, about one third.

The examination of sources for exchange rate movements using the Blanchard/Quah methodology within a multivariate framework requires imposing a wide range of constraints, many of which are questionable. In the present analysis the methodology is applied in a bivariate framework of the real and nominal exchange rates. Imposing the restriction that, in the long run, the real exchange rate is not affected by nominal and temporary real shocks, the analysis investigates the sources of nominal exchange rate movements in emerging economies.

More specifically, the empirical approach focuses on decomposition of nominal exchange rate variation into two components, permanent and transitory. In their seminal paper Blanchard and Quah (1989) propose a method to identify the dynamic effects of supply and demand shocks on real GNP and unemployment. They apply a bivariate structural vector autoregressive model (SVAR) imposing a long-term restriction as strategy for identification. Lastrapes (1992) introduces a natural extension of the estimation technique applied by Blanchard and Quah (1989) to the study of exchange rate behavior. Using monthly IMF data from the period 1973 to 1989, Lastrapes investigates the driving sources of nominal and real exchange rates between the United States on the one hand and Germany, Japan, Italy, and Canada on the other.[2] His findings indicate that nominal and real exchange rate fluctuations were mainly caused by permanent shocks between 1973 and 1989. Therefore Lastrapes concludes that nominal exchange rate flexibility is required to facilitate the changes in relative prices across borders and efficient allocation of resources.

In the following, a brief overview of the estimation procedure is presented before proceeding to the empirical results regarding emerging economies. Consider the following bivariate stable vector autoregressive process

$$\Delta y_t = A_0 \Delta y_t + A_1 \Delta y_{t-1} + A_2 \Delta y_{t-2} + ... + A_k \Delta y_{t-k} + u_t, \tag{1}$$

where

$$\Delta y_t = \begin{bmatrix} \Delta q_t \\ \Delta e_t \end{bmatrix}$$

represents the vector of the endogenous variables in first differences. e_t is the logarithm of the nominal exchange rate defined as the price of the foreign currency in home currency units. q_t is the log of the real exchange rate,

$$q_t = e_t + p_t^* - p_t, \tag{2}$$

with p_t and p_t^* denoting the logarithms of the price levels in the home and in the foreign country, respectively. $A_0, A_1 ... A_q$ represent matrices of parameters with

$$A_0 = \begin{bmatrix} 0 & a_{0,12} \\ a_{0,21} & 0 \end{bmatrix}.$$

The contemporaneous covariance matrix of disturbances is given by Ω, with

[2]Originally the data set used by Lastrapes included the United Kingdom as well. However these series were dropped from further consideration after investigating the stationarity of the exchange rates. See below.

$$\Omega = E[u_t u_t'] = \begin{bmatrix} \omega_{11} & 0 \\ 0 & \omega_{22} \end{bmatrix}.^3$$

The disturbances contained in the vector u_t are assumed to be white noise and represent two fundamental structural shocks as pointed out in the discussion below. The reduced form of the linear dynamic structural model can be represented as follows:

$$\begin{aligned} \Delta y_t &= (I - A_0)^{-1} A_1 \Delta y_{t-1} + (I - A_0)^{-1} A_2 \Delta y_{t-2} \\ &\quad + ... + (I - A_0)^{-1} A_k \Delta y_{t-k} + (I - A_0)^{-1} u_t \\ &= \Pi_1 \Delta y_{t-1} + \Pi_2 \Delta y_{t-2} + ... + \Pi_k \Delta y_{t-k} + \epsilon_t, \end{aligned} \tag{3}$$

with

$$\Sigma = E[\epsilon_t \epsilon_t'] = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{12} & \sigma_{22} \end{bmatrix}.$$

Equation (3) is a convenient starting point of the analysis because its parameters can be estimated together with the variance-covariance matrix Σ in a straightforward way using ordinary least squares as a vector autoregression model (VAR). The moving average representation of the derived VAR model expresses the endogenous variables in Δy_t as a function of current and past innovations ϵ_t and can be obtained by solving equation (3) for the final form of Δy_t,

$$\Delta y_t = (I - \Pi_1 L - \Pi_2 L^2 - ... - \Pi_k L^k)^{-1} \epsilon_t = \begin{bmatrix} C_{11}(L) & C_{12}(L) \\ C_{21}(L) & C_{22}(L) \end{bmatrix} \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix} = C(L)\epsilon_t. \tag{4}$$

$C(L)$ is the matrix of long-run responses of Δy to exogenous shocks, whereas each element of the matrix is an infinite order lag polynomial.

[3]Placing the zero restrictions in A_0 and Σ is convenient normalization in the VAR literature. For further discussion of VAR and SVAR models see among others Amisano and Giannini (1997), Luetkepohl (2005), Stock and Watson (2001) and Watson (1994).

To demonstrate the interpretation of the elements in $C(L)$ equation (4) can be represented as:

$$\begin{bmatrix} \Delta q_t \\ \Delta e_t \end{bmatrix} = \begin{bmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \end{bmatrix} + \begin{bmatrix} C_{11,1} & C_{12,1} \\ C_{21,1} & C_{22,1} \end{bmatrix} \begin{bmatrix} \epsilon_{1,t-1} \\ \epsilon_{2,t-1} \end{bmatrix} + \begin{bmatrix} C_{11,2} & C_{12,2} \\ C_{21,2} & C_{22,2} \end{bmatrix} \begin{bmatrix} \epsilon_{1,t-2} \\ \epsilon_{2,t-2} \end{bmatrix} + ... \tag{5}$$

The coefficient $C_{11,2}$ represents for instance the response of Δq in period $t+2$ to a unit innovation in ϵ_1 occuring in period t, whereas all other shocks at all other dates are held constant. Therefore, the function $C_{11,s}(s)$ is the impulse response function and shows the response of Δy in time to a unit innovation in ϵ_1.

Although a reduced form VAR can be used to estimate the coefficients in $\Pi_1, ..., \Pi_q$, the information delivered by the VAR estimations is not sufficient to investigate the effect of the structural shocks contained in the vector u_t on the levels of the variables and the first differences. Even though the impulse response functions given by the matrix C show the response of the differenced nominal and real exchange rates to the reduced form disturbances, ϵ_1 und ϵ_2, it is the response to the structural innovations u_1 and u_2 which is of particular interest. The reduced form disturbances are only a linear combination of the structural innovations, as defined in equation (3) above:

$$(I - A_0)^{-1} u_t = \epsilon_t. \tag{6}$$

Therefore, the moving average representation of the model can be rewritten as:

$$\Delta y_t = C(L)(I - A_0)^{-1}(I - A_0)\epsilon_t, \tag{7}$$

or

$$\Delta y_t = \hat{C}(L) u_t, \tag{8}$$

whereas $\hat{C}(L) = C(L)(I - A_0)^{-1}$ contains the impulse response functions of the nominal and real exchange rates in first differences to the structural innovations u_1 and u_2. In order to calculate $\hat{C}$, A_0 needs to be known. A further restriction is needed and it can be derived from the long-run neutrality of transitory shocks on the real exchange rate. Under the assumption that u_1 represents permanent shocks and u_2 transitory shocks, this restriction implies that

$$\lim_{k \to \infty} \frac{\partial q_t}{\partial u_{2,t-k}} = 0. \tag{9}$$

This restriction is equivalent to setting the accumulated effect of the transitory shock on Δq_t equal to zero. It should, however, be kept in mind that the imposed restriction is not testable, since it does not overidentify the structural model. Thus, the methodology introduced by Blanchard and Quah (1989) decomposes the variation of real and nominal exchange rates within a SVAR framework into a transitory and a permanent component.[4]

The estimated coefficients can then be used to decompose the overall nominal exchange rate. The structural shocks can be calculated from the disturbances of the VAR model after imposing the long-run neutrality condition for the transitory shock:

$$u_t = (I - A_0)\epsilon_t. \tag{10}$$

The nominal exchange rate driven by permanent shocks in the absence of transitory shocks can be obtained by replacing the transitory shocks contained in u_2 by zero.

[4]The application of the Blanchard/Quah framework has led in the literature to the interpretation of the transitory (permanent) component as nominal (real) shock. However, there are some potential problems with this interpretation. For further details see Lastrapes (1992).

3 Estimation results

The SVAR estimation is performed using data from the International Financial Statistics database provided by the International Monetary Fund. The data includes monthly, seasonally unadjusted observations on nominal exchange rates and consumer prices between January 2000 and March 2014. The nominal exchange rate is represented as the price of US-dollar in terms of the home currency of the countries under consideration. Both nominal and real exchange rates are expressed as index with 2000 serving as a base. The time series have been converted into logarithms and expressed as first differences. Preconditions for the estimation of the SVAR model are a stationary vector process Δy_t and no cointegrating relationship between q_t and e_t. The results of the ADF test for nonstationarity as well as those of the Engle-Granger test procedure for cointegration are reported in Table 1. In most of the cases nonstationarity of Δy_t and cointegration of the exchange rates in levels appeared nonproblematic. However, the null of nonstationarity can be rejected in Turkey for the levels of the nominal exchange rate. Therefore, the results should be interpreted with caution, since overdifferencing of the exchange rates makes the application of the Blanchard/Quah approach less appropriate.

In the following the dynamic effects of transitory and permanent shocks on exchange rates in the emerging economies are analyzed. The number of lags for the endogenous variables are determined in accordance with the Akaike information criterion (see Table 2). A dummy variable taking the value one since September 2008 is used to control for the effect of the current economic crisis. For Turkey saisonal dummies are included since the time series showed strong saisonal pattern. The unrestricted VAR is estimated with the respective number of lags of the endogenous variables. The Breusch-Godfrey LM test is used to control for autocorrelation of the residuals. The reported values in Table 2 correspond to the LMF statistic suggested by Edgerton and Shukur (1999) to account for a possible small sample bias. In the case of Brazil the optimal lag number according to the Akaike

Table 1: Test statistics from the ADF test for cointegration and nonstationarity of NER and RER in levels and first differences

Country	NER levels (I)	NER Δ (II)	RER levels (III)	RER Δ (IV)	Cointegration test (Engel-Granger) (V)
Brazil	-1.346	-8.496***	-.772	-8.875***	-7.495***
India	.087	-9.204***	-.770	-10.571***	-9.893***
Russia	-1.233	-9.849***	-2.358	-10.037***	-7.075***
South Africa	-1.332	-9.708***	-1.431	-10.077***	-10.103***
Turkey	-3.313**	-8.448***	-1.310	-8.846***	-6.348***

*/**/*** indicate respectively 1%/5%/10% significance level for rejecting the null hypothesis of non-stationarity.

information criterion is 2. However, the LMF statistic indicates further autocorrelation of the residuals. Therefore the number of lags was increased up to 12 to remove remaining autocorrelation. Subsequently, the SVAR model is estimated for all countries placing the neutrality long-term restriction in the equation of the real exchange rates.

Figures 4 to 8 depicts the responses of the nominal and real exchange rates to transitory respectively permanent shocks in the emerging economies. For most of the countries, the impulse-response functions are consistent with the overshooting hypothesis of the 1970s. In Brazil, South Africa, India and Russia, the nominal exchange rate reacts with sharp depreciation to the transitory shock, followed by gradual appreciation toward the long-term value. The time span needed for the nominal exchange rate to reach the long-term value lies between 36 and 48 months in these countries. In Turkey, on the contrary, the transitory shock is followed by a more or less gradual nominal depreciation toward the long-term value, which is reached after approximately three years. Therefore,

Table 2: Model specification and diagnostic

Country	Lags (Akaike)	LMF test statistic
Brazil	2	1.7401***
	12	1.2199
India	15	1.1294
Russia	7	1.2042
South Africa	6	1.3818*
Turkey	3	1.3325

*/**/*** indicate respectively 1%/5%/10% significance level for rejecting the null hypothesis of no autocorrelation.

the adjustment of the nominal exchange rate as response to transitory shocks, like i.e. in the case of shocks stemming from monetary policy measures, is more slower than in the other countries. In all four countries the nominal exchange rate converges to a value different from zero in the long-run. Therefore, temporary shocks to the nominal and real exchange rates translate also into an adjustment of the price levels in the economies.

A similar result can be observed regarding the response of nominal exchange rates to permanent shocks shown in Figures 4 to 8. The immediate reaction exceeds the long-term value in four countries and is followed by a steady adjustment. In Turkey, the pattern of response of the nominal exchange rate to permanent shocks is similar to the response to transitory shocks. In all five emerging economies, the long-term value is again different from zero, therefore indicating that nominal exchange rates respond not only to monetary and other temporary shocks but have also been used as an adjustment mechanism for permanent shocks resulting, e.g. from productivity growth as in the framework proposed by Balassa

Table 3: Forecast error variance decomposition of nominal exchange rates in emerging economies: contribution of permanent and transitory shocks at a 12-month horizon

Country	Relative contribution of transitory shocks to NER (in %) (1)	Relative contribution of permanent shocks to NER (in %) (2)
Brazil	13	87
India	82	18
Russia	3	97
South Africa	29	71
Turkey	13	87

(1964) and Samuelson (1964).

Further information contained in the SVAR estimates can be summarized using the variance decomposition of the forecast errors (FEVD). FEVD is a measure for the relative importance of the shocks under consideration to the system. Table 3 reports the relative contributions of transitory and permanent shocks to the forecast error of nominal exchange rates of the emerging economies. The results in Table 3 reveal that over the time span 2000 to 2014 the variance of forecast errors of nominal exchange rates are mainly driven by transitory shocks in India. In other countries, permanent shocks seem to be more important, especially in Brazil, Russia and Turkey, where the relative contribution of permanent shocks to the variance of nominal exchange rate forecasts exceeds 80 percent.

In the next step the parameters of the estimated SVAR equations are used to decompose the development of the exchange rates into two components - the exchange rate driven solely by permanent shocks and the remaining movements driven by transitory shocks. The structural shocks are calculated from the disturbances in the two SVAR equations. The transitory shocks are replaced by zero and the new time series containing the permanent shocks and the zeroed-out transitory shocks have been used to achieve the movements of the nominal exchange rate that are caused by permanent shocks.

Figure 9 depicts the development of the overall nominal exchange rates and their two components. The results indicate that over the whole time span transitory shocks are the main driving force of the Indian rupiah, the South African rand and the Turkish lira. The pattern of the overall nominal exchange rate (the blue line in Figure 9) differs strongly from the pattern of the exchange rate with zeroed out transitory shocks (the red line). The pattern of the green line which represents the movements of the nominal exchange rate caused solely by transitory shocks is, on the contrary, similar to that of the overall exchange rate. This also applies to the recent depreciation of the Indian and the Turkish currency. Although the exchange rate driven by long-run shocks depreciated slightly, the major share of depreciation stemmed from transitory shocks to the nominal exchange rate.

These results can also be observed to some extent in Russia and South Africa. Especially in the second half of the period under consideration transitory shocks seem to be an important source of nominal exchange rate variability. Turning back to the recent development, though, the contribution of transitory shocks to the overall depreciation is comparable to the other two countries.

In Brazil, on the contrary, the SVAR decomposition shows that the development of the USD exchange rate is driven to a large extent by permanent shocks. The pattern of the exchange rate with zeroed-out transitory shocks is quite similar to that of the overall exchange rate. This conclusion is also applicable to the current episode of exchange rate

Table 4: Sources of nominal depreciation betwen March 2013 and March 2014

	Depreciation (in %)			Contribution to NER depreciation (in percentage points)		
	overall NER (1)	long run (2)	short run (3)	overall NER (4)	long run (5)	short run (6)
Brazil	17.4	10.9	71.6	100	56.0	44.0
India	12.1	8.1	27.7	100	52.7	47.3
Russia	17.6	7.6	69.9	100	36.5	63.5
South Africa	16.9	10.5	30.7	100	42.2	57.8
Turkey	22.6	12.3	26.7	100	15.6	84.4

depreciation. The component driven by transitory shocks has depreciated to a lesser extent than in the other countries and the overall depreciation stems from permanent shocks to the nominal exchange rate.

In Table 4 these results are analyzed in more detail. On the left-hand side the percentage devaluation of the nominal exchange rates and its two components in the time period from March 2013 to March 2014 are shown. On the right-hand side the contribution of the two components to the overall nominal depreciation is calculated.

The results in Table 4 demonstrate that in all countries nominal exchange rate depreciation is partly caused by long run shocks to the real exchange rate. In Turkey and Russia the contribution of long term shocks to the recent devaluation is relatively small. In the other countries under investigation long run shocks contribute substantially to NER development. Especially in Brazil and India the contribution of permanent shocks to the development of the nominal exchange rate exceeds 50 percent.

4 Concluding remarks

The results of the present analysis indicate that temporary shocks such as, for example, those caused by monetary policy measures, are only part of the story driving nominal exchange rates in emerging economies. Recently, they have been especially pronounced in Turkey and Russia and less so in India and Brazil. The gradual adjustment of the Turkish lira to transitory shocks shown by means of the impulse-response function reveals, though, that further depreciation can be expected in the next months.

In Brazil, on the contrary, transitory shocks are less important and the overall nominal exchange rate has been largely driven by permanent shocks, like e.g. productivity development. Even the current episode of nominal exchange rate depreciation is only partly driven by transitory shocks. The development of the US dollar exchange rate of the Brazilian real should be considered as an adjustment of the real exchange rate as a result of changing long-term macroeconomic fundamentals. The interpretation of the behavior of the Brazilian real as a result of transitory shocks stemming from US monetary policy is, therefore, misleading and risky. Capital outflows and the exchange rate are rather a signal for deteriorating economic conditions. The recent economic development in Brazil indicates that the slow-down of economic activity is not overcome. Real GDP shrank in the first half of 2014 and the economic projections show at best stagnating production for 2014 as a whole. Structural reforms are needed to change the course of current economic development.

The results of the present analysis call especially the reaction of the central bank of

Brazil into question. The nominal exchange rate is an effective mechanism for real exchange rate movements. The foreign exchange interventions to avoid large depreciation are therefore largely misplaced. They aggravate the use of nominal exchange rate flexibility as an efficient adjustment mechanism for real exchange rate changes, i.e. changes in relative prices across borders, and efficient allocation of resources.

References

Aizenman, J., Banici, M. and Hutchinson, M.M. (2014). “Transmission of Federal Reserve Tapering to Emerging Financial Markets”, NBER Working Paper No. 19980.

Amisano, G. and Giannini, C. (1997). “Topics in Structural VAR Econometrics”, 2nd ed., Heidelberg.

Balassa, B. (1964). “The Purchasing Power Party Doctrine: A Reappraisal”, *Journal for Political Economy* 72(6):584-596.

Benigno, G. (2004). “Real Exchange Rate Persistence and Monetary Policy Rules”, *Journal of Monetary Economics* 51:473-502.

Bergin, P. R. (2006). “How Well Can the New Open Economy Macroeconomics Explain the Exchange Rate and Current Account?”, Working Paper, University of California at Davis.

Binder, M., Chen, Q and Zhang, X. (2010). “On the Effects of Monetary Policy Shocks on Exchange Rates”, CESifo Working Paper No. 3162.

Blanchard, O. J. and Quah, D. (1989). “The Dynamic Effects of Aggregate Demand and Supply Disturbances”, *American Economic Review* 79:1146-64.

Chen, Q., Filardo, A., He, D. and Zhu, F. (2012). “International spillovers of central bank balance sheet policies”, in: ”Are central bank balance sheets in Asia too large?”, BIS Papers No 66, pp. 230-74.

Chen, J., Mancini-Griffoli, T. and Sahay, R. (2014). “US Monetary Policy Impact on Emerging Markets: Different This Time?”, IMF Working Paper, forthcoming.

Chinn, M. D. (2013). “Global spillovers and domestic monetary policy. The effects of conventional and unconventional measures”, BIS Working Papers No 436.

Clarida, R. and Gali, J. (1994). “Sources of Real Exchange , Rate Fluctuations: How Important are Nominal Shocks?”, *Carnegie-Rochester Conference Series on Public Policy* 41:1-56.

Dornbusch, R. (1976). “Expectations and Exchange Rate Dynamics”, *Journal of Political Economy* 84:1161-76.

Edgerton, D. and Shukur, G. (1999). “Testing autocorrelation in a system perspective”, *Econometric Reviews* 18:343-386.

Eichenbaum, M. and Evans, C. (1995). “Some Empirical Evidence on the Effects of Monetary Policy Shocks on Exchange Rates”, *Quarterly Journal of Economics* 110:975-1009.

Eichengreen, B. and Gupta, P. (2014). “Tapering talk: the impact of expectations of reduced Federal Reserve security purchases on emerging markets”, Policy Research Working Paper Series No 6754, The World Bank.

Faust, J. and Rogers, J.H. (2003). “Monetary Policy’s Role in Exchange Rate Behavior”, *Journal of Monetary Economics* 70:1403-24.

Forbes, K. J. and Warnock, F. E. (2012). “Capital flow waves: Surges, stops, flight, and retrenchment”, *Journal of International Economics* 88:235-251.

Fratzscher, M., Lo Duca, M. and Straub, R. (2013). “On the international spillovers of US quantitative easing”, ECB Working Paper No 1557.

Kiley, M. (2013). ”Exchange rates, monetary policy statements, and uncovered interest parity: before and after the zero lower bound”, Finance and Economics Discussion Paper, No. 2013-17.

Kim, S. (2005). “Monetary Policy, Foreign Exchange Policy, and Delayed Overshooting”, *Journal of Money, Credit, and Banking* 37:775-782.

Lastrapes, W. D. (1992). “Sources of Fluctuations in Real and Nominal Exchange Rates”, *The Review of Economics and Statistics* 74(3):530-39.

Luetkepohl, H. (2005). “Introduction to Multiple time Series Analysis”, New York.

Mishra, P., Moriyama, K., N’Diaye, P. and Nguyen, L. (2014). “Impact of Fed Tapering Announcements on Emerging Markets”, IMF Working Paper No 14/109.

Obstfeld, M. (1985). “Floating Exchange Rates: Experience and Prospects”, *Brookings Papers on Economic Activity* 2:369-450.

Rogers, J. H. (1999). “Monetary Shocks and Real Exchange Rates”, *Journal of International Economics* 48:269-88.

Samuelson, P. A. (1964). “Theoretical Notes on Trade Problems”, *Review of Economics and Statistics* 46(2):145-154.

Scholl, A. and Uhlig, H. (2008). “New Evidence on the Puzzles: Results from Agnostic Identification on Monetary Policy and Exchange Rates”, *Journal of International Economics* 76:1-13.

Steinsson, J. (2008). “The Dynamic Behavior of the Real Exchange Rate in Sticky Price Models”, *American Economic Review*, 98:519-553.

Stock, J. H. and Watson, M. W. (2001). “Vector Autoregressions”, *Journal of Economic Perspectives* 15:101-15.

Watson, M. W. (1994). “Vector autoregressions and cointegrations”, in Engle, R. F., and McFadden, D.L., eds., *Handbook of Econometrics*, Amsterdam.

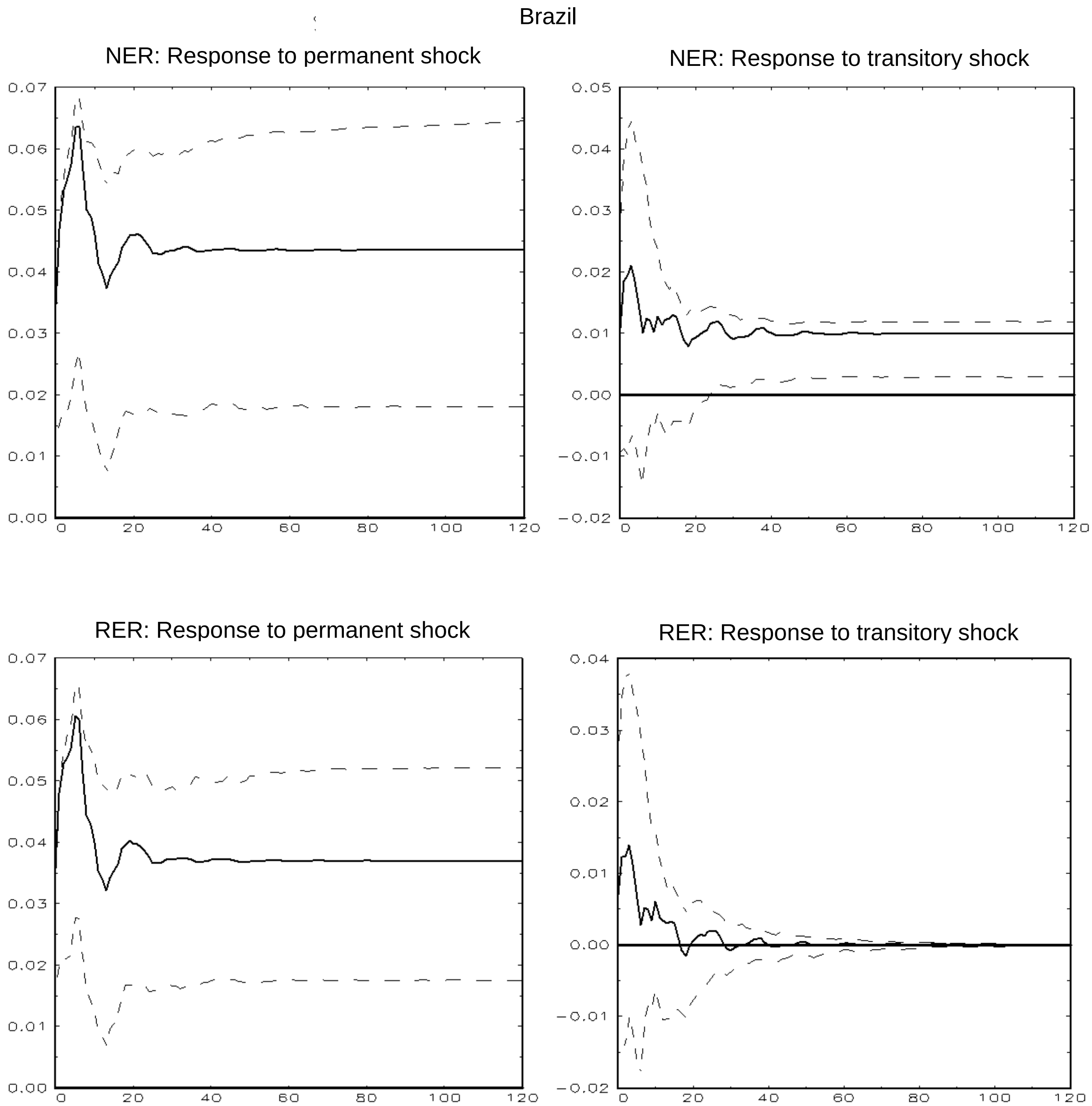

Figure 4: Response of real and nominal exchange rates to transitory and permanent shocks in Brazil

Source: own calculations based on data from the IFS database of the International Monetary Fund

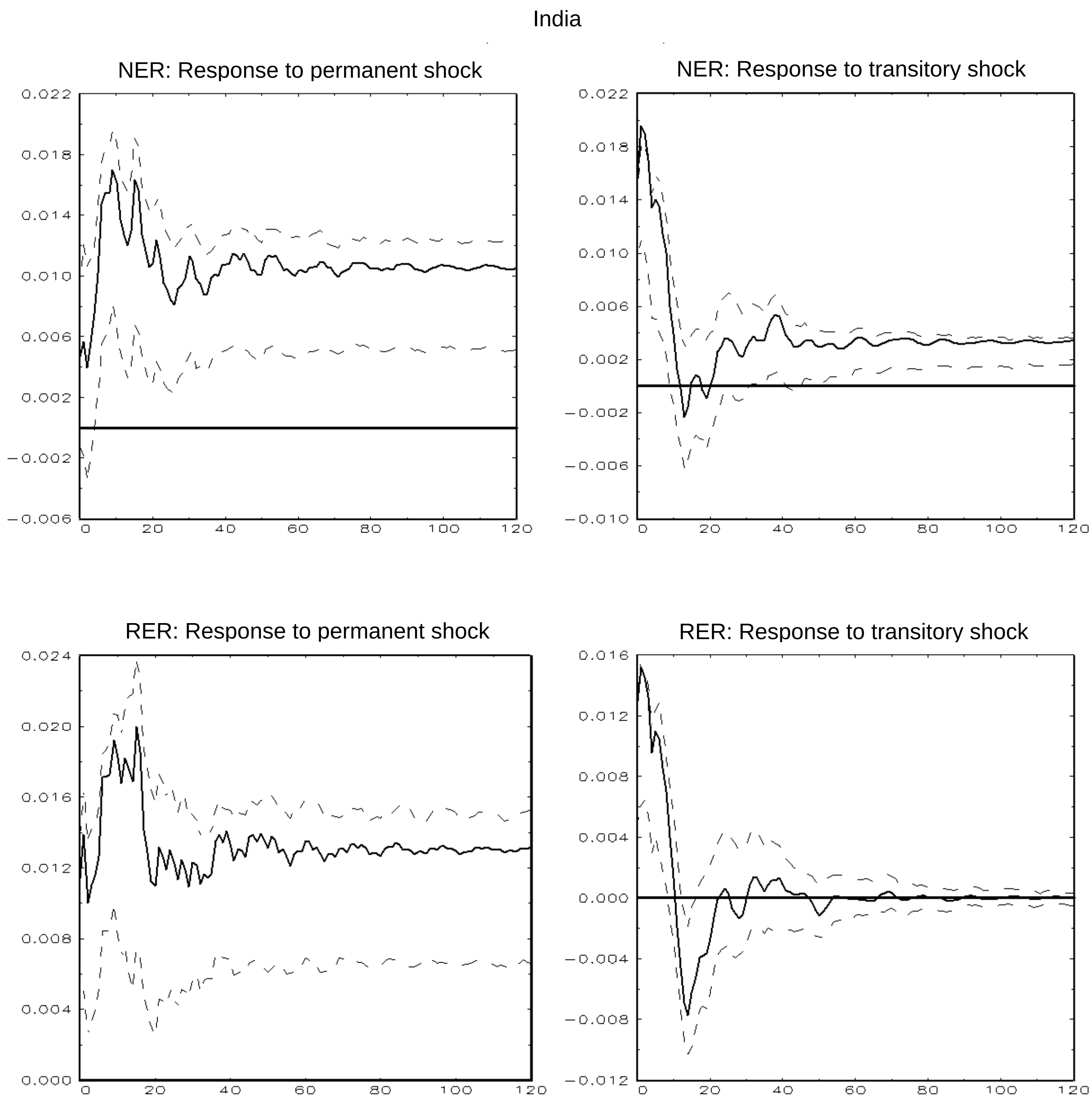

Figure 5: Response of real and nominal exchange rates to transitory and permanent shocks in India

Source: own calculations based on data from the IFS database of the International Monetary Fund

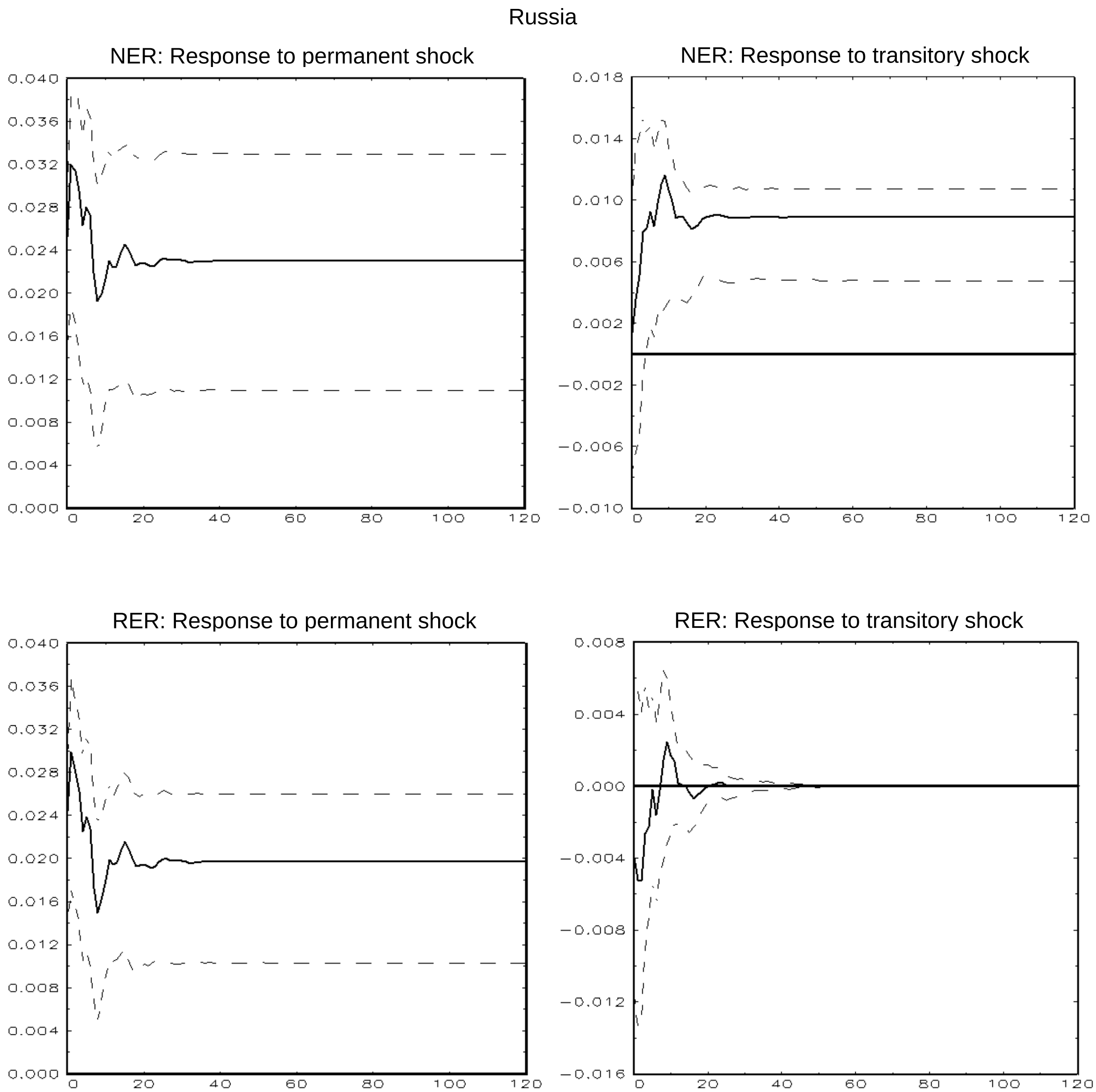

Figure 6: Response of real and nominal exchange rates to transitory and permanent shocks in Russia

Source: own calculations based on data from the IFS database of the International Monetary Fund

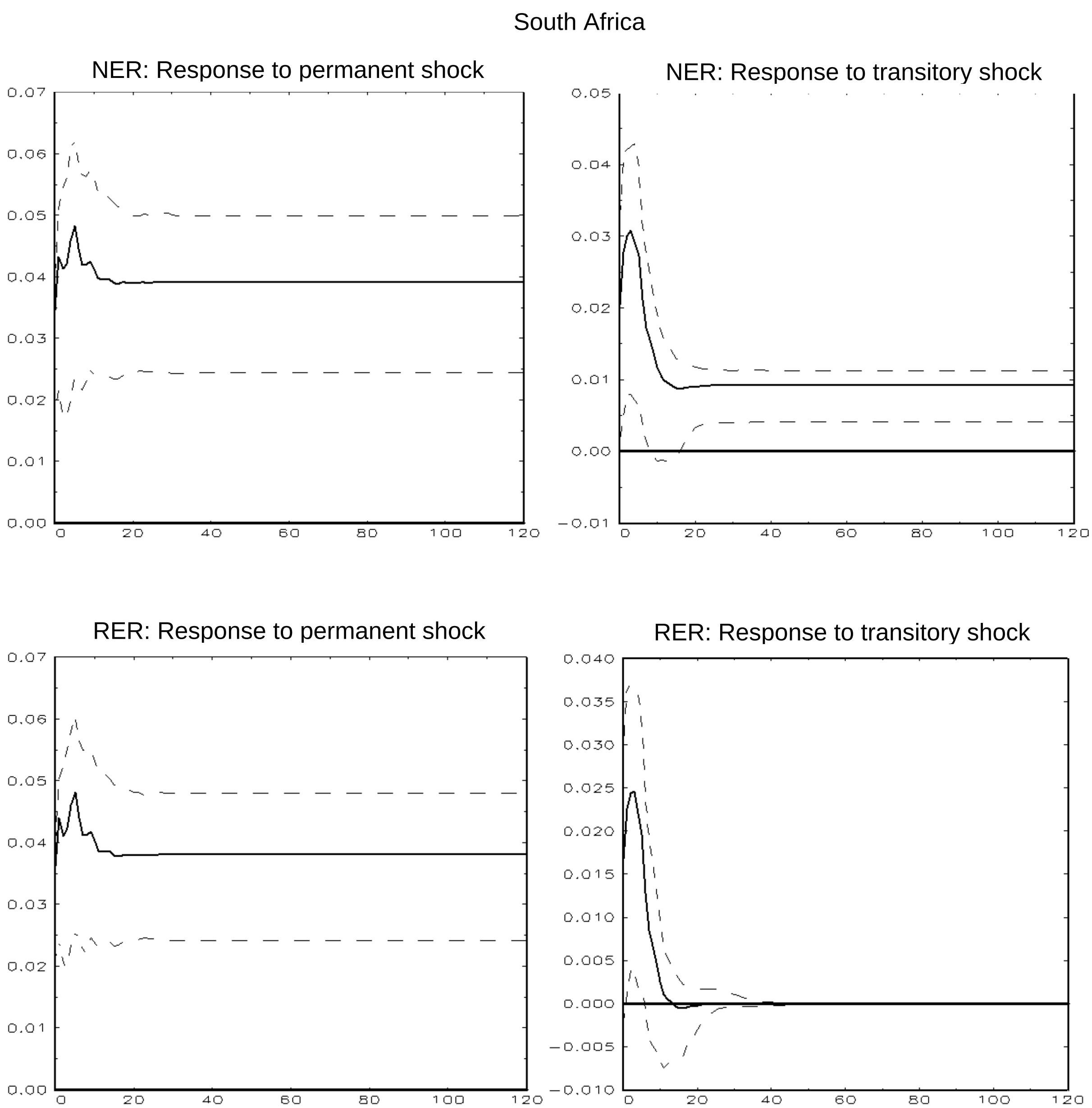

Figure 7: Response of real and nominal exchange rates to transitory and permanent shocks in South Africa

Source: own calculations based on data from the IFS database of the International Monetary Fund

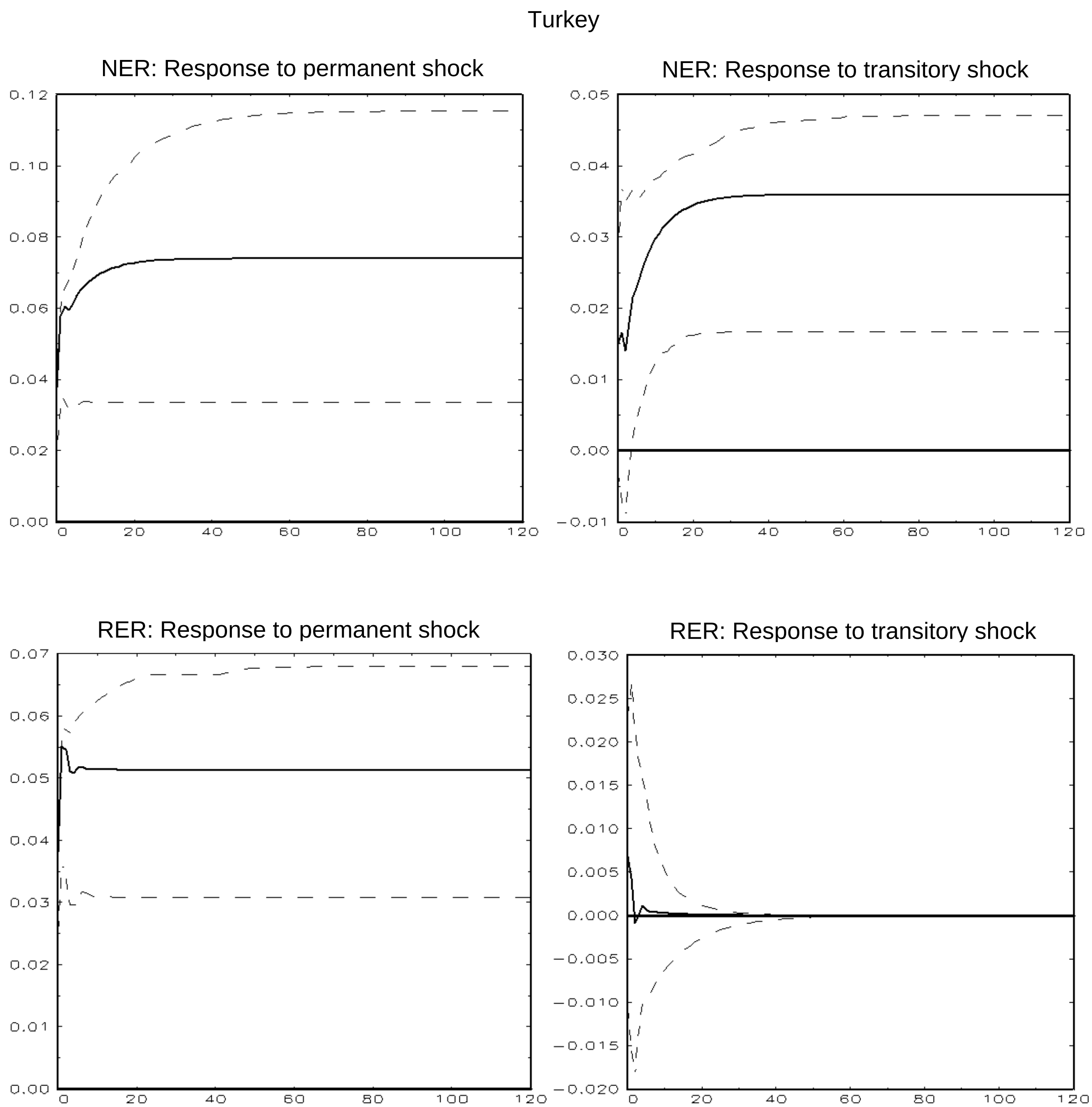

Figure 8: Response of real and nominal exchange rates to transitory and permanent shocks in Turkey

Source: own calculations based on data from the IFS database of the International Monetary Fund

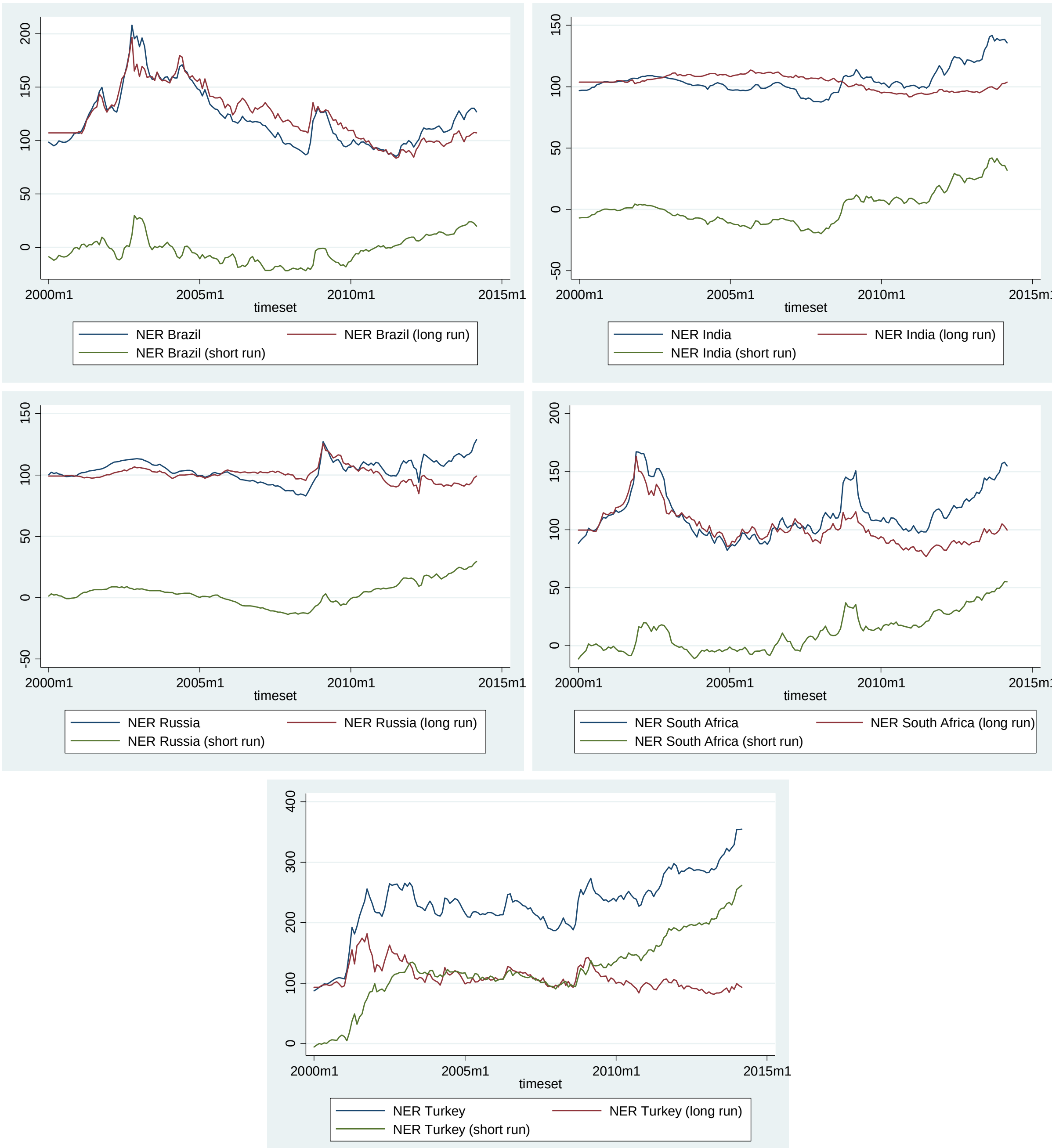

Figure 9: Decomposition of nominal exchange rates

Source: own calculations based on data from the IFS database of the International Monetary Fund