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Exchange rate and oil price pass-through to inflation in BRICS countries: Evidence from the spillover index and rolling-sample analysis

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Abstract

This paper investigates the pass-through of exchange rate and oil price to inflation for BRICS countries through the analysis of Diebold and Yilmaz (2012) spillover index and rolling-window. Using the monthly frequency data, our results provide the following novelties: (i) There is strong evidence of directional spillover in all the countries; (ii) the total spillover is low, with Brazil (India) having the highest (lowest). This suggests that a greater percent of shocks is explained by idiosyncratic shocks; (iii) the net spillover of oil price (output growth) is positive (negative) for all the countries, indicating that oil price (output growth) contributes to the forecast error variance decomposition of other variables more (less) than it receives from other variables. In addition, the net spillover of exchange rate is positive only for Russia and China while consumer price index is positive only for Brazil and China; (iv) the historical events and crises interrupt the extent of spillover in all the countries; (v) even though the spillover exhibits significant bursts, there is no clear-cut evidence of trends. Therefore, our findings have policy implications for the attainment of monetary policy objectives in these countries.

JEL Classification Numbers: C32, C58, E31.

Key Words: Exchange rate; Oil price; Pass-through; Inflation; Diebold-Yilmaz spillover index

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1. Introduction

The role of the exchange rate and oil price shocks on inflation has been a course of concern for the government and policy makers as well as economists over the years. This role has been rekindled following the disintegration of the system of adjustable peg in the early 1970s, which led to large fluctuations in the bilateral exchange rates of most countries, particularly the developing countries. Theoretically, an increase in the exchange rate and oil price causes the cost of inputs to increase and hence increase the cost of production of goods and services. On the other hand, an increase in the exchange rate and oil price creates inflationary pressure on the price level. Therefore, to curtail this pressure, the monetary authority has to increase interest rate, which subsequently reduces investment and hence economic growth (Ghosh, and Kanjilal, 2014; Misati *et al.*, 2013).

While several studies examine the relationship between the exchange rate and inflation (See Dornbusch 1987; Taylor, 2000; Bhundia, 2002; Bailliu and Fujii, 2004; Delatte and Lopez-Villavicencio, 2012; Kurtovic *et al.*, 2018), others investigate the relationship between oil price and inflation[1] (See Chen, 2000; Kanjilal, 2014; Ajmi *et al.*, 2015; Sek, 2017; Balcilar *et al.*, 2017; Balcilar *et al.*, 2018). In the case of the relationship between exchange rate and inflation, a significant amount of studies suggests an incomplete pass-through with different pass-through sizes across the countries of the world. For example, Herzberg *et al.* (2003) applied the Smooth Transition Autoregressive (STAR) model to analyze the extent through which the UK import prices respond to shocks in the exchange rate. The finding shows that the pass-through is incomplete and probably explained by the combination of the sticky prices and pricing to market. Karoro *et al.* (2009) examined the exchange rate pass-through (ERPT) to import prices in South Africa, considering the role of asymmetries. The result reveals that the magnitude and speed of the ERPT to import prices in South Africa is incomplete but relatively high; however, the ERPT is higher in the periods of depreciation than appreciation of the rand. More so, Jiang and Kim (2013) used the structural VAR model to investigate the pass-through of the exchange rate to inflation in China with emphasis on the producer price index (PPI) and retail price index (RPP). The finding indicates that the pass through to the PPI and RPP are generally incomplete with PPI having the highest pass-

[1] The relationship between exchange rate and inflation or oil price and inflation is known as exchange rate pass-through (ERPT) or oil price pass-through (OPPT). Therefore, ERPT is defined as the percentage change in domestic prices that is attributed to a change in the nominal exchange rate, while OPPT is defined as the percentage change in domestic prices that is attributed to a change in the oil price.

through compared to RPP. The recent study by Kurtovic *et al.* (2018) reported that the pass-through of the exchange rate to import prices of seven countries in Southeast Europe is incomplete, and has not reduced over time. However, the pass-through in the transitional countries is higher than in the developed countries.

Turning to the pass-through of oil price to inflation, Chen (2009) investigated the pass-through of oil price into inflation for 19 industrialized countries with the aim of finding the main determinants of the decline in oil shocks on inflation. The result shows that monetary policy is more active in responding to inflation during appreciation of domestic currency. Ghosh and Kanjilal (2014) found that the effect of negative oil shocks in India is greater than the effect of positive shocks. Ajmi *et al.* (2015) using a novel asymmetric causality approach, provided evidence that causality runs from oil prices to price level in South Africa, while both positive and negative oil price shocks caused positive price level shocks, with negative shocks having more stronger effect. In addition, Balcilar *et al.* (2017) focused on the role of oil price shocks on the South African business cycles using quarterly data over the period 1960Q2 to 2013Q3. The finding indicates that oil price has a predictive power for real output growth under the low growth episode, but the low growth episode is shorter than the long growth episode. Adding a pinch of salt to the literature, Balcilar *et al.* (2018) further investigated the dynamic relationship between the exchange rate and inflation in South Africa using a long period data spanning from 1922M01 to 2013M07. The finding shows that oil price has a positive relationship with inflation; however, the positive shocks have higher impact on inflation than the negative shock of the same magnitude.

Clearly, even though the literature on pass-through is quite large, most of the existing studies that investigated either the exchange rate-inflation nexus or oil price-inflation nexus, provided mixed results. Therefore, the main aim of this paper is to use the spillover index and rolling window approach recently proposed by Diebold and Yilmaz (2012) to reconsider the pass-through of the exchange rate and oil price to inflation in Brazil, Russia, India, China and South Africa countries (henceforth BRICS countries). We focus our analyses on the BRICS countries, being the fast-growing economic hub in the emerging markets for the past two decades (IMF, 2011).

The contributions of this paper to the bulk of literature are in several ways: First, on the scope of analysis, this is the first time, to the best of our knowledge, that the pass-through of the exchange rate and oil price to inflation is examined for BRICS countries using a time-series approach. Second, on the methodological basis, our paper uses a spillover index recently proposed by Diebold and Yilmaz (2009) and its extension by Diebold and Yilmaz (2012). This methodology uses a generalized vector autoregressive (VAR) framework, where the forecast-error variance decompositions are invariant to the variable ordering. Third, we apply the rolling window approach, which allows all the historical events, crises as well as other factors that characterize the behaviours of the spillovers to be analysed. Fourth, unlike the previous studies, the gross shocks transmitted to a particular variable, and those received from all other variables as well as the net spillovers are considered in our results. Therefore, given the primary objective of the Central Bank in maintaining low and stable inflation, which is central to achieving the goal of strengthening the macroeconomic policy and building a resilience to external shocks in BRICS countries, it is important to understand the channels through which exchange rate and oil price movements are passed to inflation. To this extent, the findings of this paper will assist in timing the current account adjustments and the proper conduct of monetary policy (See McCarthy 2000; Krugman and Obstfeld, 2003).

The rest of the paper is structured as follows: section 2 describes the data employed and presents preliminary analysis as well as model used, which is based on the Diebold and Yilmaz (2012). Section 3 discusses the empirical results while section 4 concludes the paper.

2. Data and methodology

2.1 Data and preliminary analysis

In this study, we use monthly data to analyze the exchange rate and oil price pass-through to inflation in BRICS countries. The data spans from 1986M01 to 2018M04 for Brazil and India, 1990M01 to 2018M04 for China and South Africa and 1995M01 to 2018M04 for Russia.[2] The seasonally adjusted consumer price index (CPI) data is obtained from the International Financial Statistics database, while the exchange rate, which corresponds to the nominal broad effective exchange rate (NEER) and the measure of output growth, which corresponds to the seasonally adjusted industrial production index (IPI) are generated from Thomson Reuters DataStream[3]. Finally, the spot price for crude oil (in national currency) is

[2] The period covers for each of the countries is due to data availability.
[3] Note that for South Africa, manufacturing production index (MPI) is used to measure output growth due to data availability

extracted from the database of the U.S Energy Information Administration (EIA)[4]. The four variables in this study (CPI, IPI, NEER and Oil price) are expressed in their natural logarithms. Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests (see Appendix A) show that all series are nonstationary in levels but stationary in firs difference. Therefore, all analysis are performed using log growth rates.

Therefore, to compute the log growth rate in percent of the log level variables, the following equation is applied:

$$\pi_t = \ln\left(\frac{y_t}{y_{t-1}}\right) \cdot 100\#(1)$$

where π_t denotes the log growth rate of each of the variables, y_t is the log level variable, y_{t-1} is the previous value of the log level variable. Table 1 summarises the descriptive statistics of the CPI, IPI, NEER and oil price variables. While Panel A of Table 1 shows the log levels, Panel B displays the log growth rate (%) of these variables. Based on the result of Panel A, we find that for Brazil, the NEER and CPI have the highest and lowest sample mean, while in Panel B, the highest and lowest sample mean are the CPI and IPI. For the rest of the countries, we find that oil price has the highest sample mean both in Panel A and Panel B respectively. The standard deviation of the variables shows that Brazil is the most volatile country compared to the rest of the countries. This volatility is more conspicuous in their growth rate in percent (Panel B) across BRICS countries with oil price having the highest volatility. The skewness of the variables shows that some of the variables are positively skewed, while others are negatively skewed. In addition to the pattern of their skewness, all the variables exhibit positive kurtosis in both panels with more evidence of positive excess kurtosis. Consequently, the null hypothesis of a normal distribution is rejected at one percent level of significance for all the countries. The rejection of the null hypothesis implies that the distribution of all the variables deviates from normality in the BRICS countries.

Figures 1-5 examine the time plots of the macroeconomic variables (inflation, exchange rate, oil price and output growth) for the possible existence of the drift, trend, and structural breaks. Specifically, Figure 1 presents the time plots for all the variables for Brazil. Based on this figure, the CPI shows an upward movement, which is peculiar to a time trend. The NEER shows a downward slope, which is peculiar to a negative trend. This series eventually settles

[4] The spot price of crude oil in national currency is obtained by multiplying the nominal exchange rate (national currency per dollar) by the spot price for crude oil in US dollars.

down to a constant zero value since the early 1990s. This, therefore, implies that the series is constant as the time varies. Finally, the plots of the IPI and oil price show upward random movements with a time trend. These series are suspected to have sudden breaks.

Figure 2 shows the time plots of the variables for Russia. The CPI shows an upward movement with a time trend. The NEER exhibits structural breaks and eventually settles down at the constant zero value. The IPI and oil prices exhibit upward random movements with a time trend. Furthermore, the time plot of the variables for India is shown in Figure 3. Based on this figure, it is clear that the CPI and IPI variables slope upward with a time trend. The NEER has negative and downward movements with a time trend, while the time plot of the oil price indicates more than one breaks at various points.

In the case of China, Figure 4 shows that all the variables exhibit random movements with the evidence of structural breaks. Particularly, the plot of the IPI shows several breaks at several time points with no particular pattern of movements. The figure further shows a jump in the CPI and a sudden fall in the NEER in 1995. These are attributed to a significant change in the exchange rate policy in 1994. Finally, Figure 5 presents the time plots of the variables for South Africa. The CPI indicates an upward movement to a time trend. The NEER shows a downward slope, which is peculiar to a negative trend. The time plots of IPI and oil prices exhibit structural breaks, which are more noticeable in oil price.

2.2 Diebold-Yilmaz (2012) Spillover Index

The spillover index developed by Diebold and Yilmaz (2012) is based on the framework of the generalized vector autoregressive (VAR) proposed by Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998) (henceforth KPPS). In this index, the forecast error variance decomposition is invariant to the ordering of variables (See Zhou *et al.*, 2012; Antonakakis and Kizys, 2015; Salisu *et al.*, 2018). Therefore, following the pioneering study of Diebold and Yilmaz (2009) and its extension by Diebold and Yilmaz (2012), we consider the general form of VAR(p) with covariance stationary N variables[5].

$$y_t = A_0 + \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t \#(2)$$

[5] See Lukepohl (2005) and Juselius (2006) for a detailed discussion on the VAR model.

where N represents the number of variables, y_t is $(N \times 1)$ a vector of the dependent variables, A_i denotes the $N \times 1$ matrix of the autoregressive coefficients, and ε_t is a zero mean white noise process with covariance matrix Σ, $\varepsilon_t \sim iid(0, \Sigma)$. Equation (2) can be written in terms of a moving average as follows:

$$y_t = \sum_{i=0}^{\infty} C_i \varepsilon_{t-i} \tag{3}$$

where the $(N \times N)$ coefficient matrices, C_i obey the recursion $C_i = A_1 C_{i-1} + A_2 C_{i-2} + \cdots + A_p C_{i-p}$. C_0 denotes the $(N \times N)$ identity matrix, where $A_i = 0$ for $i < 0$. Based on the generalized forecast error variance decomposition of the moving average in equation (3), we provide three main dimensions of the growth rate spillovers – directional, total and net spillovers. According to Diebold and Yilmaz (2012), "the own variance shares" are measured as the fractions of the H-step-ahead error variances in forecasting y_{it} for $i = 1,2, \ldots, N$ and "cross variance shares" being the fractions of the H-step-ahead error variance in forecast y_{it} owing to the shocks to y_{jt}, for $j = 1,2, \ldots, N$, such that $i \neq j$. Therefore, following Pesaran and Shin (1998), the KPPS H-step-ahead generalized forecast error variance decomposition is defined as:

$$\theta_{ij}^{g}(H) = \frac{\sigma_{jj}^{-1} \sum_{\square=1}^{H-1} \left(e_i' C_h \Sigma e_j\right)^2}{\sum_{\square=1}^{H-1} (e_i' C_h \Sigma C_h' e_i)^2} \#(4)$$

where Σ represents the variance matrix of the error vector ε_t, σ_{jj} denotes the standard deviation of error terms for j-th equation, e_i shows the selection vector with one as the i-th element, and 0 otherwise. It is clear that the sum of the own variance and cross variance shares contributions is not equal to unity under the generalized decomposition i.e. $\sum_{j=1}^{N} \Theta_{ij}^{g}(H) \neq 1$. Hence, we follow Deiebold and Yilmaz (2012) by normalizing each entry of the variance decomposition matrix by the sum of the row as:

$$\tilde{\theta}_{ij}^{g}(H) = \frac{\theta_{ij}^{g}(H)}{\sum_{j=1}^{N} \theta_{ij}^{g}(H)} \#(5)$$

$\sum_{j=1}^{N} \tilde{\theta}_{ij}^{g}(H) = 1$ and $\sum_{i,j=1}^{K} \tilde{\theta}_{ij}^{g}(H) = N$. Therefore, the total growth rate spillover index can be constructed as follows:

$$S_T^g(H) = \frac{\sum_{i,j=1,i\neq j}^{N} \tilde{\theta}_{ij}^g(H)}{\sum_{i,j=1}^{N} \tilde{\theta}_{ij}^g(H)} = \frac{\sum_{i,j=1,i\neq j}^{n} \tilde{\theta}_{ij}^g(H)}{N} \#(6)$$

where $S_T^g(H)$ denotes the total growth rate spillover. The index is applied to measure the average contributions of the spillover from the shocks across the variables of interest to the total forecast error variance decomposition. Furthermore, to compute the directional spillover, we focus on two main dimensions: the directional spillovers transmitted by variable i from all other variables j, and the directional spillovers received by variable i to all other variables j. Therefore, the former is computed as:

$$DS_{i\to j}^g(H) = \frac{\sum_{j=1,j\neq i}^{n} \tilde{\theta}_{ij}^g(H)}{\sum_{i,j=1}^{n} \tilde{\theta}_{ij}^g(H)} = \frac{\sum_{j=1,j\neq i}^{n} \tilde{\theta}_{ij}^g(H)}{N} \#(7)$$

and the latter is computed as:

$$DS_{i\leftarrow j}^g(H) = \frac{\sum_{j=1,j\neq i}^{n} \tilde{\theta}_{ji}^g(H)}{\sum_{i,j=1}^{n} \tilde{\theta}_{ij}^g(H)} = \frac{\sum_{j=1,j\neq i}^{n} \tilde{\theta}_{ji}^g(H)}{N} \#(8)$$

where $DS_{i\to j}^g(H)$ and $DS_{i\leftarrow j}^g(H)$ represent the directional spillovers, either as transmitter or receiver. Finally, to compute the net spillovers from variable i to all other variables j, we subtract equation (7) from equation (8) as:

$$NS_i^g(H) = DS_{i\to j}^g(H) - DS_{i\leftarrow j}^g(H) \#(9)$$

where $NS_i^g(H)$ is simply the net spillover, which is expressed as the difference between the gross shocks transmitted to and those received from all other variables.

3. Empirical findings and discussion

3.1 Analysis of spillover table

This section contains the results of the directional, total and net spillovers constructed based on a generalized VAR framework of Diebold and Yilmz (2012). The spillover table for the growth rate (%) of the oil price, NEER, CPI and IPI in BRICS countries is reported in Table 3. The computation of this table is based on the first order VAR with four variables. The Schwarz Information Criterion (SBC) is used in selecting the optimal lag length of the model, which is 1. The spillover analysis is performer using $H = 12$-step ahead forecast error variance decomposition. The sum of the off-diagonal elements (column) gives "the contribution to others" which technically implies the total contribution of a variable under consideration to other variables' forecast error variance decomposition. Furthermore, the sum of the off-diagonal elements (row) offers "the contribution from others", which technically measures the overall contribution of shocks to other variables to the forecast error variance decomposition of a variable under consideration. With exception of the main diagonal elements, the individual elements found in each column capture the contribution of each variable to the forecast error variance decomposition of other variables. Similarly, the individual elements, except the main diagonal, measures the contributions of other variables to the forecast error variance of a particular variable. The total spillover index, which appears at the lower right-hand corner of Table 2, is computed as the sum of all elements in the (4×4) matrix excluding the sum of the diagonal elements.

Therefore, starting with Brazil, the result of the directional spillover, with exclusion of the main diagonal from others indicates that CPI terrifically has the largest contribution to the forecast error variance decomposition of the NEER. Specifically, the contribution of the CPI to the forecast error variance decomposition of the NEER is about 36.3%. This is distinctly followed by the OILPRICE with about 21.4% and IPI estimate at 7.3%. Similarly, the oil price has the largest contribution to the forecast error variance decomposition of the NEER. Particularly, the oil price explains about 28.5% to the forecast error variance decomposition of the NEERI, followed by the CPI with about 26.8% and the least is the IPI with about 3.3%. The implication for this result is that the spillover between CPI and oil price is apparently bidirectional. Furthermore, the contribution from the other variables to the forecast error variance decomposition of the CPI is absolutely dominated by the OILPRICE estimated at 26.8%. This is followed by the NEER with 13.2% and the IPI with 1.5%. By contrast, the contribution of other variables to the forecast error variance decomposition of NEER is captured largely by CPI price rather than OILPRICE. Finally, the IPI receives the lowest contribution from the other variables with CPI having the largest contribution estimated at 7.3%. This is followed by the oil price with about 3.3% and the NEER with just about 1.4%.

For Russia, the NEER and IPI are the only contributors to the forecast error variance decompositions of the oil price with as low as about 0.2% for each. The results further show that oil price has the largest contribution to the forecast error variance decompositions of the NEER and CPI than IPI. Specifically, the oil price explains about 23.7% and 21.7% of the forecast error variance decomposition of the CPI and NEER, respectively. Notably, even though the shocks in the CPI are not likely affecting the behaviours of the oil price, our results reveal that oil price explains about 23.7% to the forecast error variance decomposition of the CPI. In the case of India, our results suggest that only the CPI contributes to the forecast error variance decomposition of the oil price with as low as 0.1%. However, the contribution of the oil price to the forecast error variance decomposition of the CPI is estimated at 0.8%, which is larger than 0.1%. In addition, the oil price contributes as high as about 4.1% to the forecast error variance decomposition of the NEER and 1.1 in the case of the IPI.

The directional spillover for China indicates that CPI has the largest contribution to the forecast error variance decomposition of the IPI with about 6.6%. This is followed by the NEER with 4.0% and oil price with 0.5%. The largest contributor to the forecast error variance decomposition of the CPI is the NEER with about 4.0%, followed by IPI with 2.9% and last but not the least, the oil price with 1.5%. In contrast, like the CPI, the contribution of the other
variables to the forecast error variance decomposition of the IPI is dominated by the NEER with about 12.7%, tracked by the CPI with 6.6% and 0.6% for the oil price. The lowest contribution from other variables is received by the oil price with CPI having dominance. Finally, in South Africa, the contribution to the forecast error variance decomposition of the CPI mainly comes from two variables – the NEER with about 3.3% and oil price with about 2.6%. The result also suggests that oil price has the largest contribution to the forecast error variance decomposition of the NEER as it explains about 5.2%. This is followed by the CPI with about 0.9%. Likewise, the contribution from the other variables to the forecast error variance decomposition of the IPI is dominated by the oil price. In other words, the forecast error variance decomposition of the IPI is influenced by the shocks to the oil price estimated at 1.0%. This is closely followed by the CPI with about 0.4% and NEER estimated at 0.3%. There is also evidence that oil price has about 2.6% to the forecast error variance decomposition of CPI.

The total spillover index as provided in the lower right-hand corner of Table 3 is estimated as the average of the spillover from other variables. The result reveals that the total spillover index is 34.5% for Brazil, 24.7% for Russia, 2.6% for India, 8.9% for China and 3.8% for South Africa. Apparently, these results imply that the forecast error variance decompositions are due to the spillovers among the variables captured in our study. The implication for the results is that the pass-through measured by the total spillovers is incomplete and very low in all the countries with Brazil having the highest. Our results, therefore, align with the hypothesis advanced by Taylor (2000) that the pass-through has significantly declined in the recent years owing to a stable and low inflation.

The result for Brazil suggests that CPI and oil price receive the largest contributions to the forecast error variance decomposition from other variables with about 65.1% and 58.5%, respectively; whereas about 41.5% and 26.1% are received by the CPI and oil price from the other variables. By implication, the oil price and CPI contribute about 32.5% and 23.6% to the forecasting of other variables than they receive from other variables, hence they are referred to as "net transmitters or givers". The contributions of the rest of the variables to the forecast error variance decomposition of other variables are smaller than what they receive from other variables; hence their net spillovers are negative. For example, in Table 3, the NEER and IPI net spillovers are about -47.7% and -8.37%, respectively. In Russia, the net spillovers of the oil price and NEER are estimated at 47.6% and 21.9%, while those of the CPI and IPI are -59.1% and -10.3%, respectively. In the case of India, the net spillovers for the oil price and CPI are estimated at 5.8% and 1.9% and for the NEER and IPI are -5.9% and -1.8% respectively. Furthermore, the net spillovers for China are 2.3% for oil price, 10.8% for NEER, 2.6% for CPI and -15.8 for IPI. Finally, the results of the net spillovers in South Africa indicate that oil price is about 7.7%, NEER is about -1.4%, CPI is about -4.7% and IPI is estimated at -1.5%.

3.2 Rolling-Sample analysis for overall spillovers indexes

The full-sample spillover table and spillover index computed based on static analysis in the preceding section are not be able to adequately describe the numerous changes that occur during the period of the study. The reason is that, this spillover measure is based on the one-time estimation of a VAR model; hence, the parameters are fixed over the estimation period (Diebold and Yilmaz, 2012). To circumvent this shortcoming, we apply the rolling window approach, which captures all the historical events, crises as well as other factors that characterize the behaviours of the spillovers.

Figures 6(a–e) present the time-varying measure of the overall spillover indexes for the sample period using a 60-month (5 years) rolling samples with 12-step horizons for BRICS countries. This approach allows us to analyze how overall spillover changes over time in each country. Based on these figures, we observe large fluctuations in the overall spillover for

BRICS countries. These fluctuations are more conspicuous in India, South Africa, and China. However, there is no straightforward evidence of trend movements among these countries. In addition, there is evidence of responsiveness of the overall spillover to historical events such as economic policies, crises etc. In Brazil, as presented in Figure 6(a), the overall spillover begins at a value slightly below 50% in the first window. This continues to fluctuate in the early 1980s, owing to various economic problems occasioned by a significant fall in the price of crude oil. Notably, the fluctuations in the overall spillover before the year 2000 plunged between 40% and 50%. However, from 1999 through 2018, the overall spillover declines with an evidence of low fluctuations between 10% and 20%. In 1995, there is a slight fall in the overall spillover, which is attributed to the "Plano Real" or Real Plan designed in 1994 to track the hyperinflationary process that ensued the economy of Brazil. This subsequently led to a managed peg or crawling peg system of the exchange rate. As noted by Alemán (2011), this policy is able to stabilize the economy as the overall spillover suddenly declines from above 40% to 10% between 1998 and 1999. Nevertheless, the effect of this policy is short-lived as a result of the Asia financial crisis of 1997 that erupted and spread to Brazil. In addition to this financial crisis is a fall in the price of oil to almost $10 per barrel in 1998 as well as the slowdown of commodity prices in 2001. These are all responsible for the sharp upward movement of the overall spillover in the late 2001. Furthermore, the upward movement of the overall spillover during 2005 to 2007 could be traceable to the effects of the dollar crisis in March 2005 that spread to several developing and developed countries, while the jump up of the overall spillover in 2008 coincides with the global financial crisis of 2007-2008 all the way to 2009. Finally, the shocks in the overall spillover in the late 2013 are traceable to the effects of the drop in the crude oil prices in the international market.

In Russia, the overall spillover indexes as graphically displayed in Figure 6(b) begins at a value slightly above 40%, and it is relatively stable in the first and second windows. This is as a result of an exchange rate corridor system introduced in 1995. The sharp decline in the overall spillover in 2004 is attributed to the introduction of a managed floating exchange rate in the late 2003. This marks a move from the system of an authorization-based to flow controls in Russia. More so, the shocks in the overall spillover in 2005 are traceable to two major incidents: first, a dual-currency basket introduced as an operational indicator for the exchange rate policy and second, the dollar crisis of March 2005, which affected most economies in the emerging and advanced countries. More so, the sharp spike in 2008 is occasioned by the global financial crisis of 2007-2008. Finally, the 2014 spike on the total spillover is owed to a significant fall in the crude oil price as well as a step taken towards a free floating of rubble by abolishing the dual currency soft peg on the 10th November 2014.

In the case of India, the overall spillover indexes are presented in Figure 6(c). The figure shows that the fluctuation of the overall spillover is high in the first window. The overall spillover starts at a value little above 8% and rose to about 20% in 1995. The spike in 1991 has been traceable to the India crisis that arises from the budget deficit, and the subsequent upward movement and fluctuations in the overall spillover within the first window are attributed to episodes such as the European Exchange Rate Mechanism (ERM) crisis of 1992-1993, the 2000-2001 European Union and US recessions, and the 2002-2003 Iraq crisis. By the end of 1994, the overall spillover reaches its peak at 20% and subsequently witnesses a sharp decline in 1995, which could be attributed to the effects of two major policy shifts. First, the liberalized exchange rate management system is put in place in March 1992 and second, the dual exchange rate system (managed floating exchange rate), which replaced the liberalized exchange rate management system in March 1993. The increase in the overall spillover in 2005 is accounted for by the US dollar crisis in March 2005. This crisis pushes India and the rest of the emerging countries to consider the option of diversifying the central bank reserve away from the US dollar. Additionally, the upward movement and subsequent spike in the overall spillover during 2007-2008 is traceable to the global financial to two main factors: the rise in the intensity of the war with Pakistan and the effects of the global financial crisis. However, the overall spillover stays well below 8% after the end of the financial crisis until a significant fall in the crude oil prices jacked up overall spillover plot to 16% in 2014.

The overall spillover index for China is presented in figure 6(d). Based on this figure, we observe that the overall spillover plot starts at 16% and rises to its peak at 24% at the end of 1999. The increase in the overall spillover is mainly attributed to the Asia crisis of 1997, which mounted pressure of devaluation on the Chinese currency, and subsequently led to the financial crisis in China in the 1990s. The sharp downward slope of the overall spillover index in 1998 is traceable to the tight monetary policy adopted by the Chinese government in late 1997 to track the overheated economy. Furthermore, the European Union and US recessions of 2000-2001 are traceable to the upward movement, characterized by high fluctuations in the overall spillover index. However, the overall spillover plot gradually slopes downward due to the revaluation of the yuan on 21st July 2005 by 2.1% against the US

Dollars. This ends the fixed exchange rate regime in China. By 2008, there is a sudden rise in the overall spillover index, which is attributed to the global financial crisis of 2007/2008. This upward movement reaches the peak of 24% in 2010. By and large, the overall spillover starts to exhibit downward sloping with high fluctuations in 2011. This is exacerbated by the Chinese stock market turbulence of 2015 and early 2016.

Finally, the overall spillover index for South Africa is presented in the graph marked as figure 6(e). The figure starts at a value somewhat above 8% and reaches the climax at 20% in 1998. The overall spillover index as observed is characterized by high fluctuations over the sample windows. The high fluctuations and upward movement of the overall spillover are traceable to the era of apartheid and episode of the first general elections that held between 26th and 29th April 1994. The jump up of the overall spillover index with the exhibition of high fluctuations, which started in 2001, is caused by the decline in world demand for South African exports. However, the high spike in the late 2007 and 2008 is significantly caused by the European Union debt crises of 2007-2010 and the global financial crisis that erupted the world's economy in 2008, while the upward sloping of the total spillover in 2014 is attributed to the effect of the crude oil price oscillations and volatilities. In total, a careful examination of the plot for the total spillover index indicates no straightforward evidence of trends; rather what it possesses is the occurrence of bursts over the sample windows.

3.3 Rolling spillover estimates from nominal effective exchange rate and oil prices

In this subsection, we examine the bivariate rolling spillover estimates from the NEER and oil price for BRICS countries. The estimations are based on 60-month windows and 12-step horizons. Figure 7 presents the graphical estimates of the rolling spillovers from the NEER and oil price for Brazil. We observe that the spillover of the NEER to oil price and to the rest of the variables significantly witnessed up and down movements with no clear-cut trending movements. The spillover, however, declines in 1996 and sharply increases to its climax at 25% in 1998 due to hyperinflationary pressure, which surged to almost 5000 percent per year in the mid-1994. Furthermore, the spillover from the oil price to NEER and from the oil price to CPI is very high between 2000 and 2004. This is traceable to the high demand for oil due to the September 11, 2001 attack in the U.S. and the 2003 Iraq war. Additionally, the spillover of the oil price to IPI continues to slope upwards with evidence of fluctuations between 2000 and 2013. By 2014 the spillover sharply declines to about 4% from 28% in 2013. This could be traceable to a significant fall in the oil price.

The estimates of the rolling spillover from the NEER and oil prices for Russia are presented in Figure 8. The spillover from the NEER to oil price is characterized by constant fluctuations with no clear-cut evidence of a trend. The spillover spikes to its peak in 2008, indicating the effect of the global financial crisis. More so, we observe that the spillover from the NEER to CPI and from NEER to IPI exhibits fluctuations with a spike in 2015 owing to the introduction of a free-floating exchange rate of rubble on the 10^{th} November 2014. Furthermore, we observe that spillover from the oil price to IPI exhibits more fluctuations than from oil price to NEER and/or to CPI. The result provides that the spillover from the oil price to NEER and from the oil price to CPI drastically declines from their peak at 60% to slightly above zero line in 2004. This is attributed to Iraq war in the late 2003, which led to the shortage of oil supply in the international oil market. Finally, the spillover from oil price to IPI slopes upward with a sharp decline in 2008 and 2014 due to the 2007–2008 strong demand for oil and the subsequent breakdown of oil prices in 2014.

The case of India as presented in Figure 9 reveals that the spillovers from both the NEER and oil price fluctuates randomly with no clear pattern of movements. We found that a spike occurs in 1991 on the spillover from the NEER to oil price, NEER to CPI and NEER to IPI. The NEER records no spillover to oil price between 1993 and 1996 owing to the efficacy of the liberalized exchange rate management system and managed floating exchange rate system introduced in 1992 and 1993. In addition, there is a sharp increase in the spillover in 1998. This is traceable to the effects of the Asia crisis in 1997. Furthermore, the spillover from the oil price to NEER, oil price to CPI and oil price to IPI reveals a spike in 1997, which is traceable to the East Asian crisis of 1997. We observe that the spillover randomly fluctuates and without any clear pattern of movement.

The rolling spillover results are presented in Figure 10 for Chia. For China, we observe that the spillover from the NEER to oil price, NEER to CPI and NEER to IPI fluctuates over the sample windows with evidence of spike particularly from the NEER to oil price in 2008 due to the global financial crisis. We observe further that there no evidence to support the spillover from the NEER to oil price between 1996 and 1999. However, the spillover from the NEER to oil price is less than 2% before the year 2000 and not greater than 2% between 2005 and 2009. There is evidence that the spike on the spillover in 2009 is attributed to the global financial crisis of 2007/2008 and sudden decline in the spillover from the NEER to the oil price in 2014 is attributed to crude oil price oscillations and upheavals. In comparison, the spillover of the NEER to CPI witnesses more fluctuations than the spillover from the NEER to IPI. Regarding the spillover from oil price to NEER, oil price to CPI, and oil price to IPI, we observe evidence of a spike from the oil price to NEER in 2008 and 2014 owing to the global financial crisis and the oil price fluctuations. However, the spillover from oil price to NEER and oil price to CPI is higher after the global financial crisis, while in the case of oil price to IPI, the spillover increases after the event of 2008 and decline in oil price in 2014.

Finally, as presented in Figure 11 for South Africa, there is a spike in the spillover from the NEER to the oil price in 1995, 1999 and 2008 respectively. These spikes are attributed to the first and second presidential elections in South Africa after the era of apartheid. The spike in 2008 is caused by the global financial crisis. Between 2002 and 2009, the spillover of the NEER to oil price is very low, slightly above zero percent, owing to a significant decline in the South African exports. More so, the spillover of the NEER to CPI and NEER to IPI highly fluctuate over the sample windows with no evidence a trend. The only spike identified in the spillover occurs in 1999 from the NEER to CPI and a sharp decline in 2006 from the NEER to IPI. In the case of the spillover of the oil price to NEER, we observe an upward sloping from 1995 to its peak of 35% in 1998. This could be attributed to the Iraqi invasion of Kuwait in the 1990s and the subsequent 1991 Gulf war. There is evidence that the spillover of the oil price to NEER, oil price to CPI and oil price to IPI is characterized by high fluctuations with no clear pattern of the movement. This is due to the events such as the general elections of 1994 and 1999, the September 11, 2001 attack in the U.S, the 2003 Iraq war, Union debt crises of 2007-2010 and the global financial crisis of 2008, and the oil price fluctuations in 2014.

4. Conclusions and policy implications

In this study, we examined the pass-through of the exchange rate and oil price on inflation through the Diebold and Yilmaz (2012) connectedness index and rolling-sample approaches for the BRICS countries. Using the monthly frequency data, we computed the directional spillover, the total spillover and the net spillover indexes for the variables employed. The results showed that: (i) there is strong evidence of the directional spillovers in all the countries. (ii) the total spillover is low with Brazil having the highest and India having the lowest. This suggests that a larger percentage of shocks is explained by idiosyncratic shocks and (iii) the net spillover of oil price (output growth) is positive (negative) for all the countries, indicating that oil price (output growth) contributes to the forecast error variance decomposition of all other variables more(less) than what it receives from other variables. In the case of exchange rate, the net spillover effect is only positive for Russia and China while consumer price index is positive only for Brazil and China. In addition, we estimated the overall spillover indexes and the bivariate version of the spillover estimates from the NEER and oil price for all the countries through the rolling-spillover approach. The overall spillover enables us to identify how total spillover changes over time and the bivariate version of it tracks the time evolution of the spillover from the NEER and oil price to other variables in the model. The findings of the rolling-sample windows revealed that the spillovers in BRICS countries are interrupted by the structural changes over time. However, even though the spillover exhibits significant fluctuations, there is no clear-cut evidence of trends among the variables. Therefore, the findings of this paper have policy implications for the attainment of the recent monetary policy objectives of inflation targeting as well as low and stable prices. Finally, our paper suggests an extension of our analysis by introducing regime dependent Diebold and Yilmaz indices in the future research.

Table 1: Descriptive Statistics

Country	Variable	Obs.	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	J-B	Prob.
Brazil	***Panel A: Log levels***										
	LCPI	388	1.018997	4.075663	5.070877	-16.57065	6.396228	-1.691848	4.378926	215.8384	0.000000
	LIPI	388	4.360285	4.340856	4.661645	3.854554	0.171673	-0.053943	1.940456	18.33742	0.000104
	LNEER	388	7.669047	4.579227	24.15897	3.989513	6.045022	1.680257	4.300968	209.9333	0.000000
	LOILPRICE	388	1.029656	4.217415	5.526531	-16.65770	6.514840	-1.616267	4.168795	191.0150	0.000000
	Panel B: Log growth rate (%)										
	CPI	387	5.592126	0.618144	60.09785	-0.511013	10.22331	2.265599	8.301609	784.3009	0.000000
	IPI	387	0.088113	0.014175	25.04676	-28.65762	3.830480	-0.203315	15.53172	2535.002	0.000000
	NEER	387	-5.171851	-0.991641	23.24798	-48.75259	10.78120	-1.581341	5.248093	242.7857	0.000000
	OILPRICE	387	5.567258	3.911372	59.28725	-33.03097	13.61654	0.791329	4.517514	77.52346	0.000000
Russia	***Panel A: Log levels***										
	LCPI	280	3.994640	4.218929	5.145201	1.426907	0.951375	-0.855137	2.711300	35.09782	0.000000
	LIPI	280	4.478483	4.529146	4.774316	4.041075	0.220185	-0.343405	1.569245	29.38564	0.000000
	LNEER	280	4.781331	4.682733	6.000754	3.983573	0.493661	1.227443	3.707925	76.15559	0.000000
	LOILPRICE	280	6.994150	7.416477	8.320565	4.279885	1.186111	-1.073785	2.860546	54.03423	0.000000
	Panel B: Log growth rate (%)										
	CPI	279	1.332722	0.796805	32.51945	-0.541475	2.431510	8.427774	100.4034	113594.1	0.000000
	IPI	279	0.148411	0.278738	36.87810	-36.37963	3.916431	0.121407	56.82635	33681.52	0.000000
	NEER	279	-0.706954	-0.110797	12.84716	-75.22282	5.555069	-8.961018	118.0875	157708.5	0.000000
	OILPRICE	279	1.448272	1.415102	81.86996	-26.96859	9.186072	2.147879	23.31527	5012.278	0.000000
India	***Panel A: Log levels***										
	LCPI	388	4.026699	4.053521	5.124215	2.788211	0.666429	-0.096055	1.975092	17.57872	0.000152
	LIPI	388	3.958581	3.895726	4.972909	2.913711	0.583388	0.007951	1.695562	27.51264	0.000001
	LNEER	388	4.807077	4.754699	5.790924	4.259280	0.364154	0.836282	3.081124	45.33218	0.000000
	LOILPRICE	388	7.157390	7.196706	8.867119	4.984887	1.027749	-0.191852	1.822644	24.78992	0.000004
	Panel B: Log growth rate (%)										
	CPI	387	0.596989	0.621764	4.473589	-4.207775	0.866835	-0.328521	6.519883	206.7432	0.000000

	IPI	387	0.528334	0.467177	20.19156	-11.33461	2.624107	0.881922	14.31522	2114.719	0.000000
	NEER	387	-0.380438	-0.263247	6.334198	-19.31782	1.989631	-3.991808	38.19138	20997.51	0.000000
	OILPRICE	387	0.710185	1.231999	40.94007	-41.07009	8.864054	-0.349374	5.910145	144.4348	0.000000
China	***Panel A: Log levels***										
	LCPI	340	4.644574	4.627910	4.849684	4.582925	0.052615	2.027565	7.027911	462.7988	0.000000
	LIPI	340	4.719602	4.718006	4.868343	4.385381	0.047909	-0.682358	9.265864	582.5829	0.000000
	LNEER	340	4.583393	4.586730	4.881276	4.211068	0.154223	-0.353737	2.610152	9.243750	0.009834
	LOILPRICE	340	5.696524	5.615523	6.951132	4.476394	0.644509	0.140261	1.672392	26.08417	0.000002
	Panel B: Log growth rate (%)										
	CPI	339	-0.007157	0.000000	2.245092	-2.607971	0.700642	-0.109977	4.171660	20.07399	0.000044
	IPI	339	0.085124	0.024691	24.82882	-23.85232	3.724733	0.022520	17.63733	3026.329	0.000000
	NEER	339	-0.018894	0.135452	5.899195	-39.70609	2.499935	-11.81161	188.7983	495491.7	0.000000
	OILPRICE	339	0.315347	1.147736	39.15444	-33.18515	8.502249	-0.313888	5.155114	71.17049	0.000000
S/Africa	***Panel A: Log levels***										
	LCPI	340	4.240805	4.293636	5.020643	3.176699	0.484056	-0.299998	2.173486	14.77755	0.000618
	LIPI	340	4.491540	4.505920	4.705532	4.176192	0.118836	-0.535070	2.226985	24.68897	0.000004
	LNEER	340	4.782962	4.760198	5.590149	3.945015	0.438962	0.149618	2.001726	15.38632	0.000456
	LOILPRICE	340	5.513011	5.631227	7.022546	3.793362	1.006921	-0.227718	1.554696	32.53128	0.000000
	Panel B: Log growth rate (%)										
	CPI	339	0.543936	0.478470	2.666847	-1.141886	0.499469	0.594338	4.194314	40.10560	0.000000
	IPI	339	0.079609	-0.018259	9.690183	-9.609447	2.329628	-0.057542	5.561979	92.89985	0.000000
	NEER	339	-0.416090	-0.303963	8.894686	-17.64327	2.986058	-1.146915	8.462187	495.7471	0.000000
	OILPRICE	339	0.780077	0.967010	38.57859	-41.74234	8.738280	-0.350976	5.382956	87.16842	0.000000

Notes: The table summarizes descriptive statistics, which contains the sample mean, median, maximum, minimum, standard deviation, skewness, kurtosis, Jarque–Bera test statistic, and the p-value of the Jarque–Bera test statistic. The variables used include CPI, IPI, NEER and Oil price in the national currency of each of the BRICS countries. Panel A summarizes the log levels and Panel B summarizes the log growth rate (%).

Table 2: Spillover index

Brazil

	OILPRICE	NEER	CPI	IPI	From others
OILPRICE	**73.9**	3.5	21.4	1.2	26.1
NEER	28.5	**34.2**	36.3	1.0	65.8
CPI	26.8	13.2	**58.5**	1.5	41.5
IPI	3.3	1.4	7.3	**88.0**	12.0
Contribution to others	58.6	18.1	65.1	3.7	145.4
Contribution including own	132.5	52.2	123.6	91.7	Total Spillover
Net Spillover	32.5	-47.7	23.6	-8.3	Index = 35.4%

Russia

	OILPRICE	NEER	CPI	IPI	From others
OILPRICE	**99.6**	0.2	0.0	0.2	0.4
NEER	21.7	**77.0**	1.2	0.1	23.0
CPI	23.7	41.0	**35.3**	0.0	64.7
IPI	2.6	3.7	4.4	**89.4**	10.6
Contribution to others	48.0	44.9	5.6	0.3	98.7
Contribution including own	147.6	121.9	40.9	89.6	Total Spillover
Net Spillover	47.6	21.9	-59.1	-10.3	Index = 24.7%

India

	OILPRICE	NEER	CPI	IPI	From others
OILPRICE	**99.8**	0.0	0.1	0.0	0.2
NEER	4.1	**93.2**	2.6	0.1	6.8
CPI	0.8	0.3	**98.6**	0.3	1.4
IPI	1.1	0.6	0.5	**97.8**	2.2
Contribution to others	6.0	0.9	3.3	0.4	10.5
Contribution including own	105.8	94.1	101.9	98.2	Total Spillover
Net Spillover	5.8	-5.9	1.9	-1.8	Index = 2.6%

China

	OILPRICE	NEER	CPI	IPI	From others
OILPRICE	**98.9**	0.1	0.5	0.4	1.1
NEER	1.2	**94.0**	4.0	0.8	6.0
CPI	1.5	4.0	**91.5**	2.9	8.5
IPI	0.6	12.7	6.6	**80.1**	19.9
Contribution to others	3.4	16.8	11.1	4.1	35.4
Contribution including own	102.3	110.8	102.7	84.2	Total Spillover
Net Spillover	2.3	10.8	2.6	-15.8	Index = 8.9%

South Africa

	OILPRICE	NEER	CPI	IPI	From others
OILPRICE	**98.8**	1.0	0.0	0.2	1.2
NEER	5.2	**93.9**	0.9	0.0	6.1
CPI	2.6	3.3	**94.0**	0.1	6.0
IPI	1.0	0.3	0.4	**98.3**	1.7
Contribution to others	8.9	4.7	1.3	0.2	15.0
Contribution including own	107.6	98.5	95.3	98.6	Total Spillover

Net Spillover	7.7	-1.4	-4.7	-1.5	Index = 3.8%

Figure 1: Time series plot of data in levels for Brazil

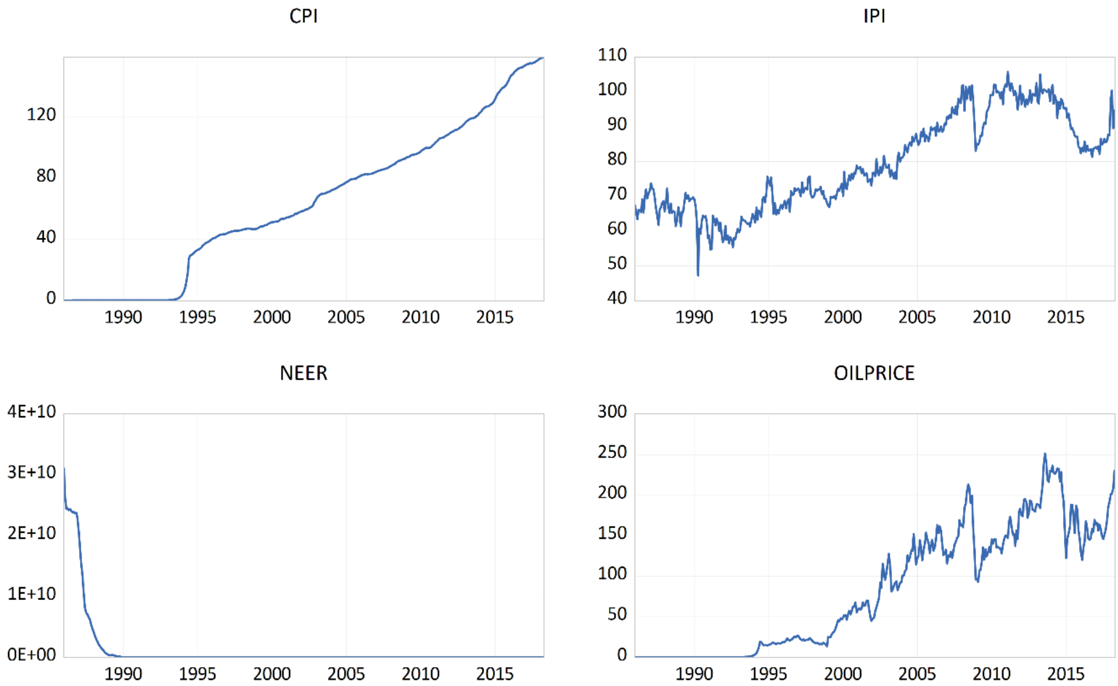


Figure 2: Time series plot of data in levels for Russia

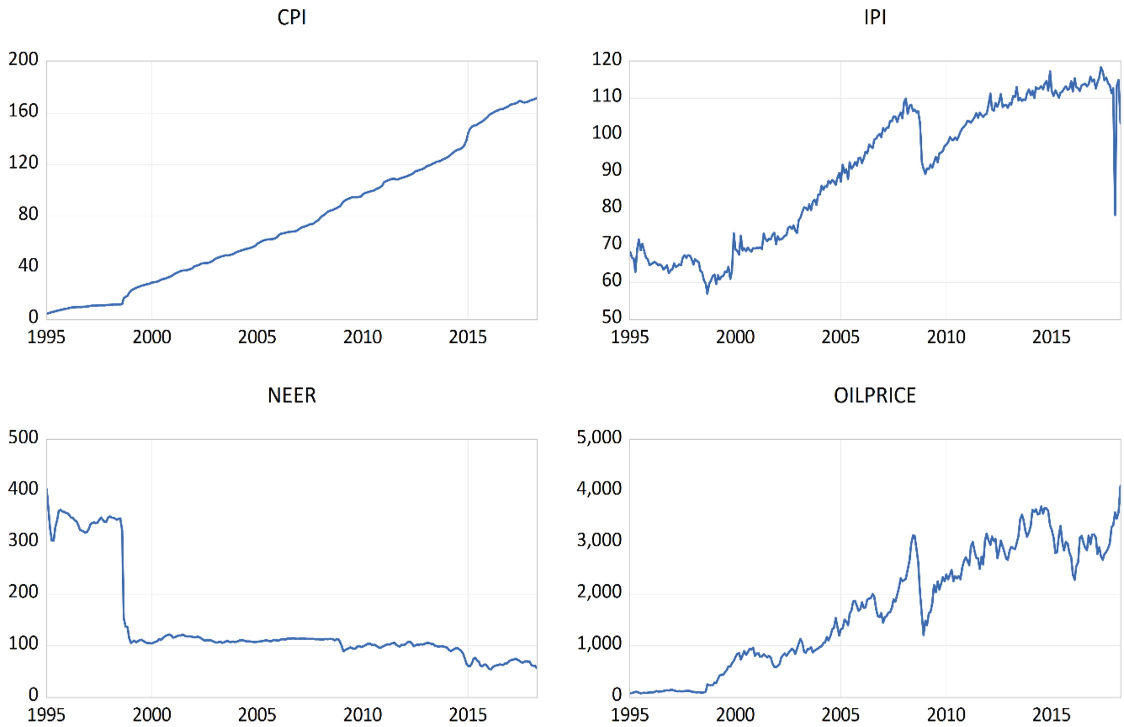


Figure 3: Time series plot of data in levels for India

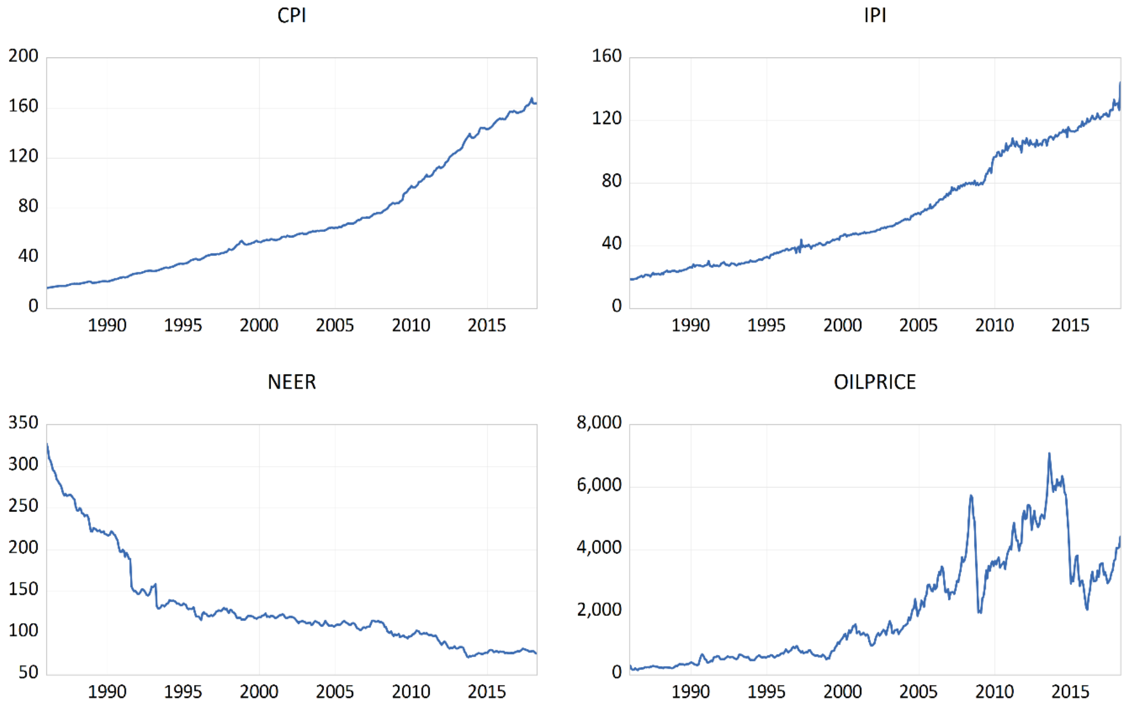


Figure 4: Time series plot of data in levels for China

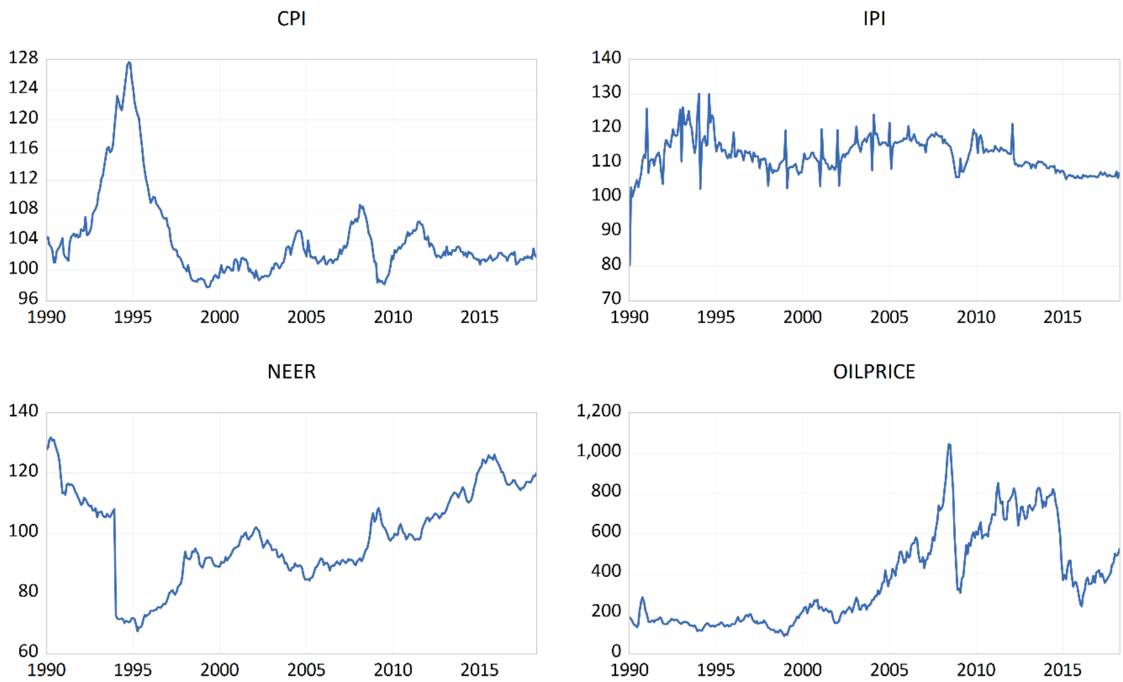


Figure 5: Time series plot of data in levels for South Africa

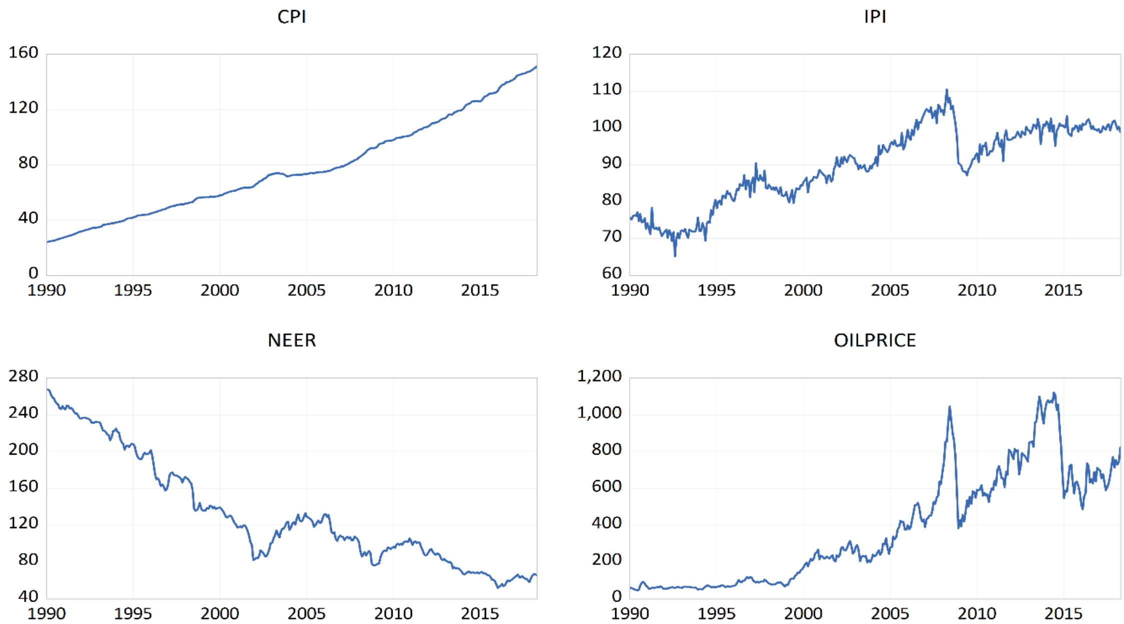
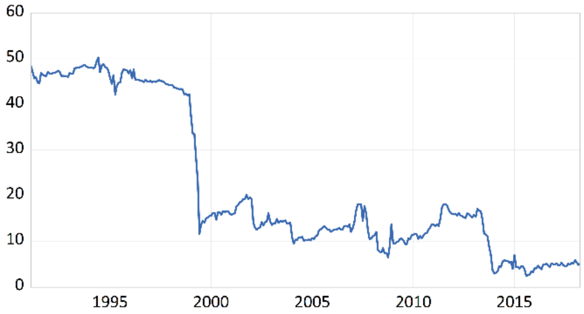
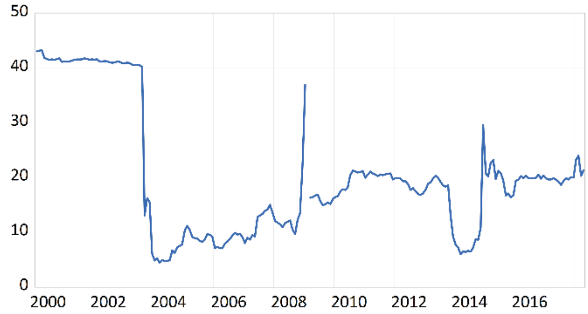


Figure 6: Overall spillover indexes

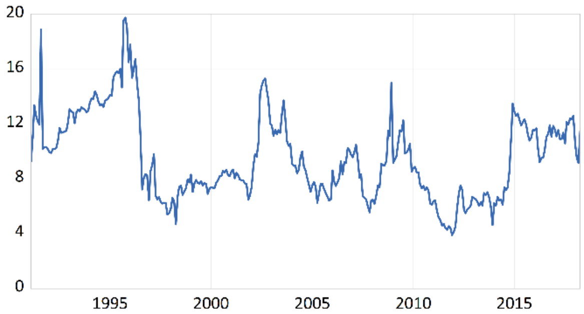
(a) Brazil



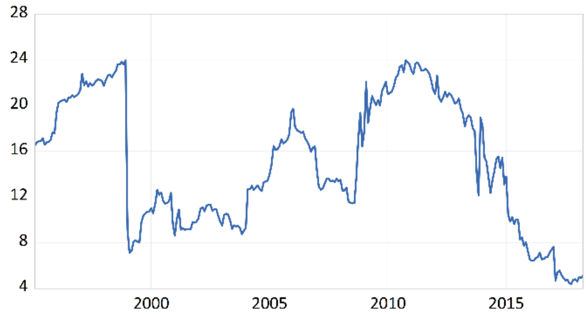
(b) Russia



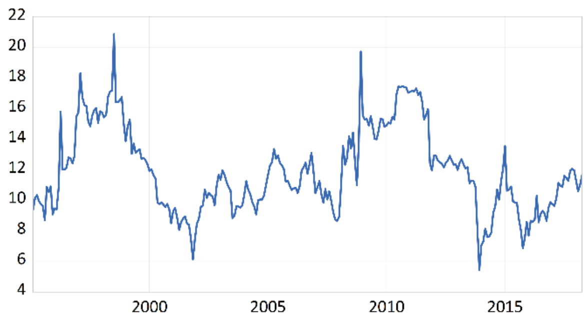
(c) India



(d) China

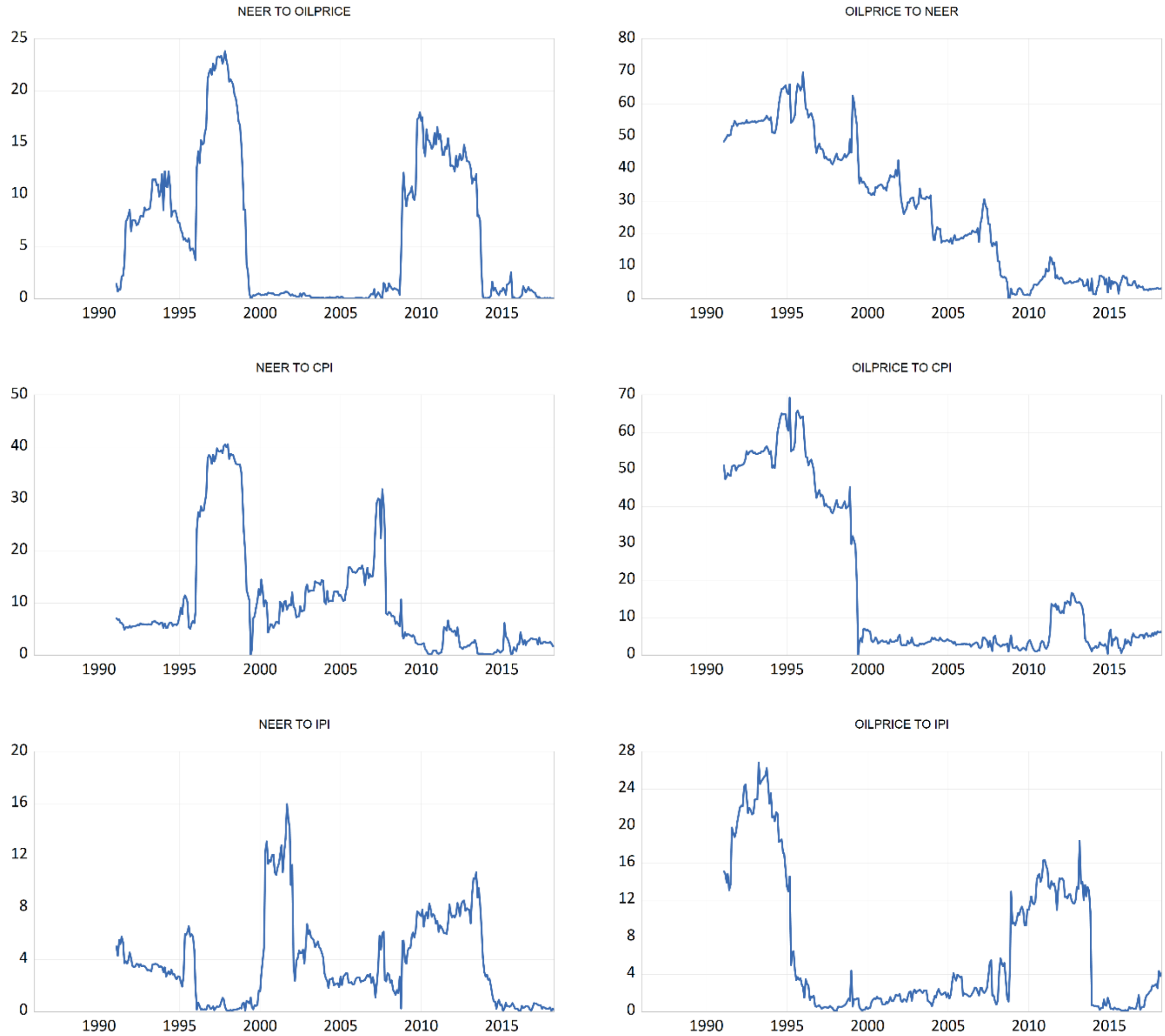


(e) South Africa



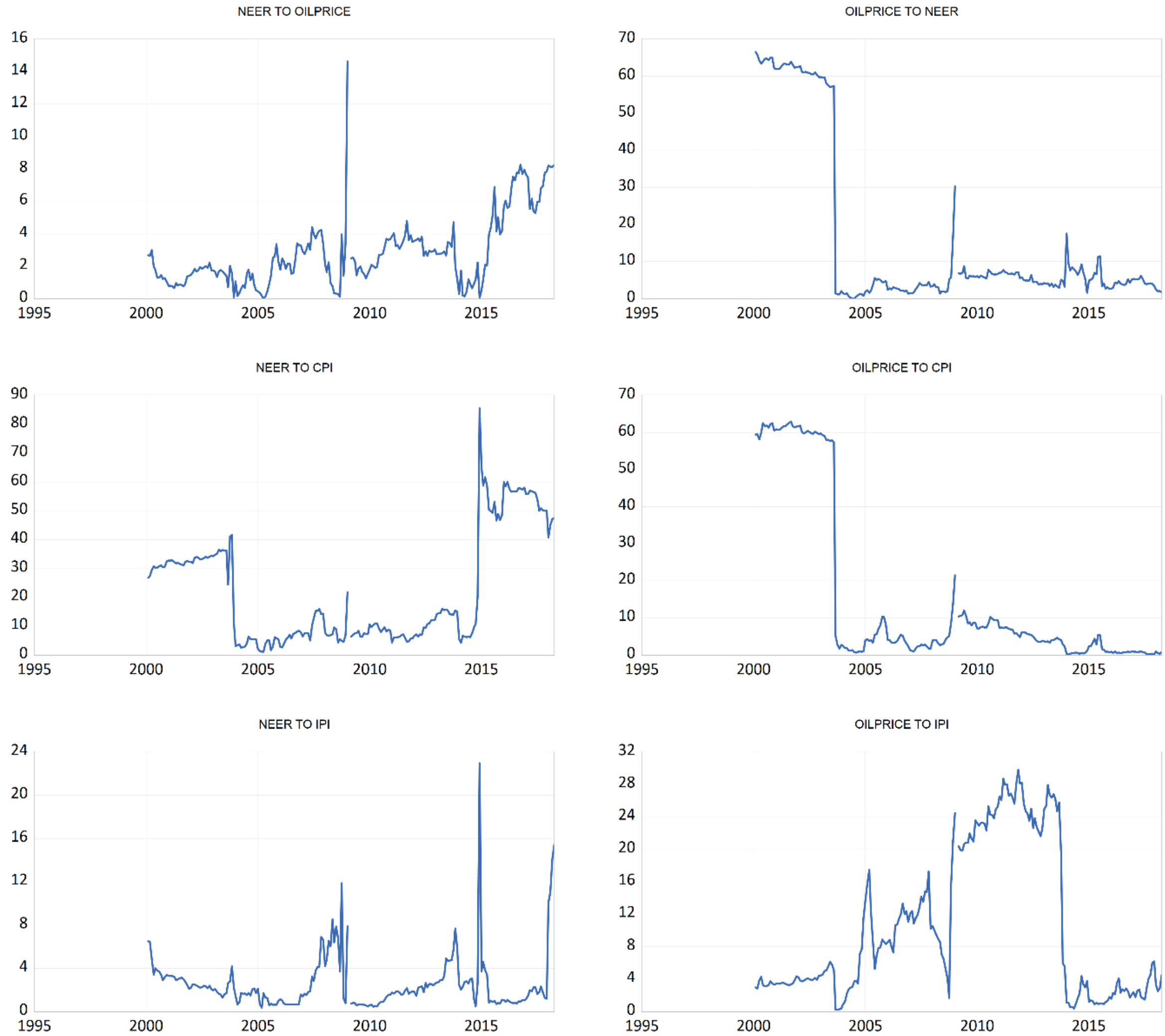
Note: Overall rolling spillover index is estimated with a 60 months windows and 12 step horizons.

Figure 7: Rolling spillover estimates from nominal effective exchange rate and oil prices for Brazil



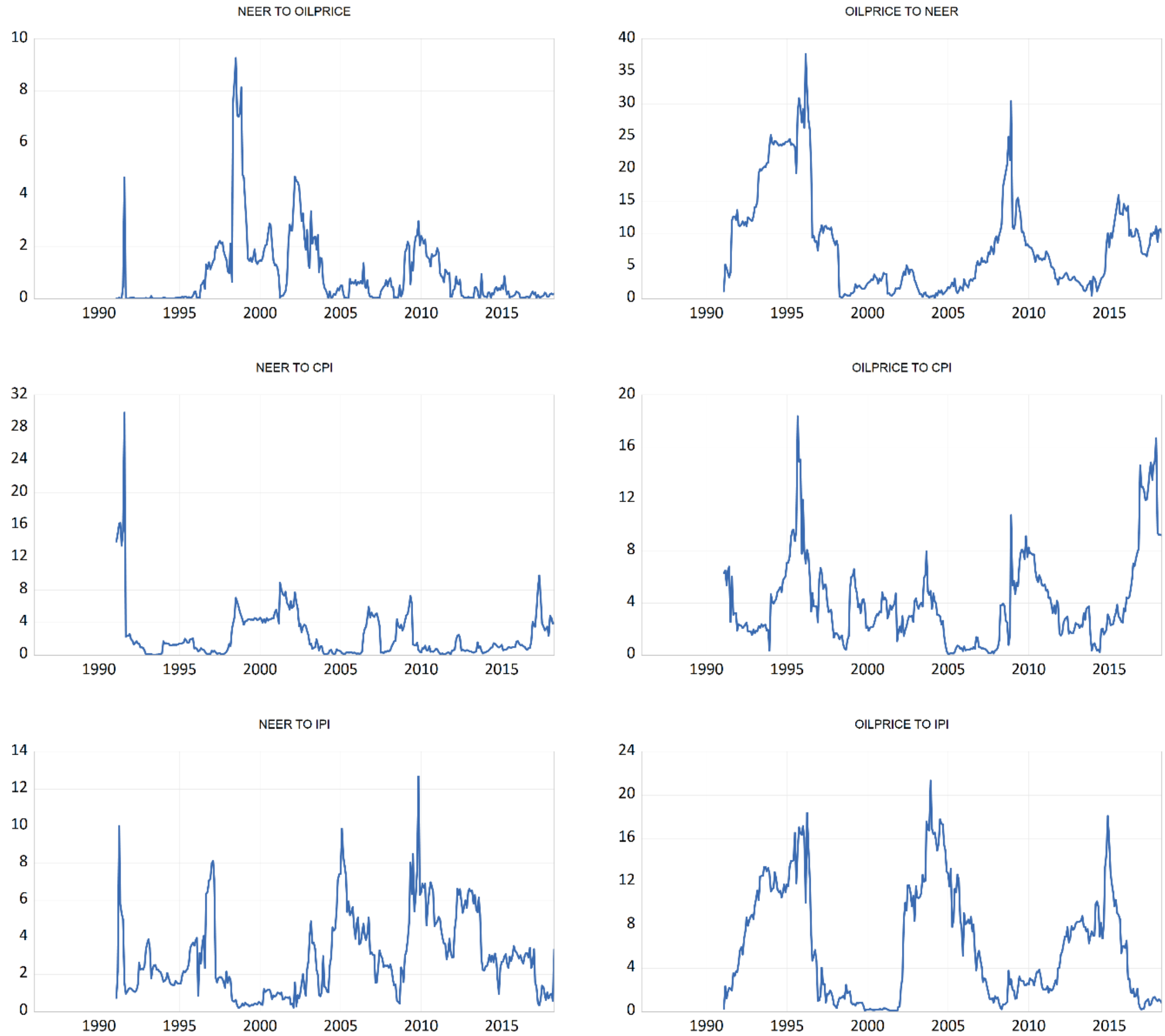
Note: Rolling spillover index is estimated with 60-month windows and 12-step horizons.

Figure 8: Rolling spillover estimates from nominal effective exchange rate and oil prices for Russia



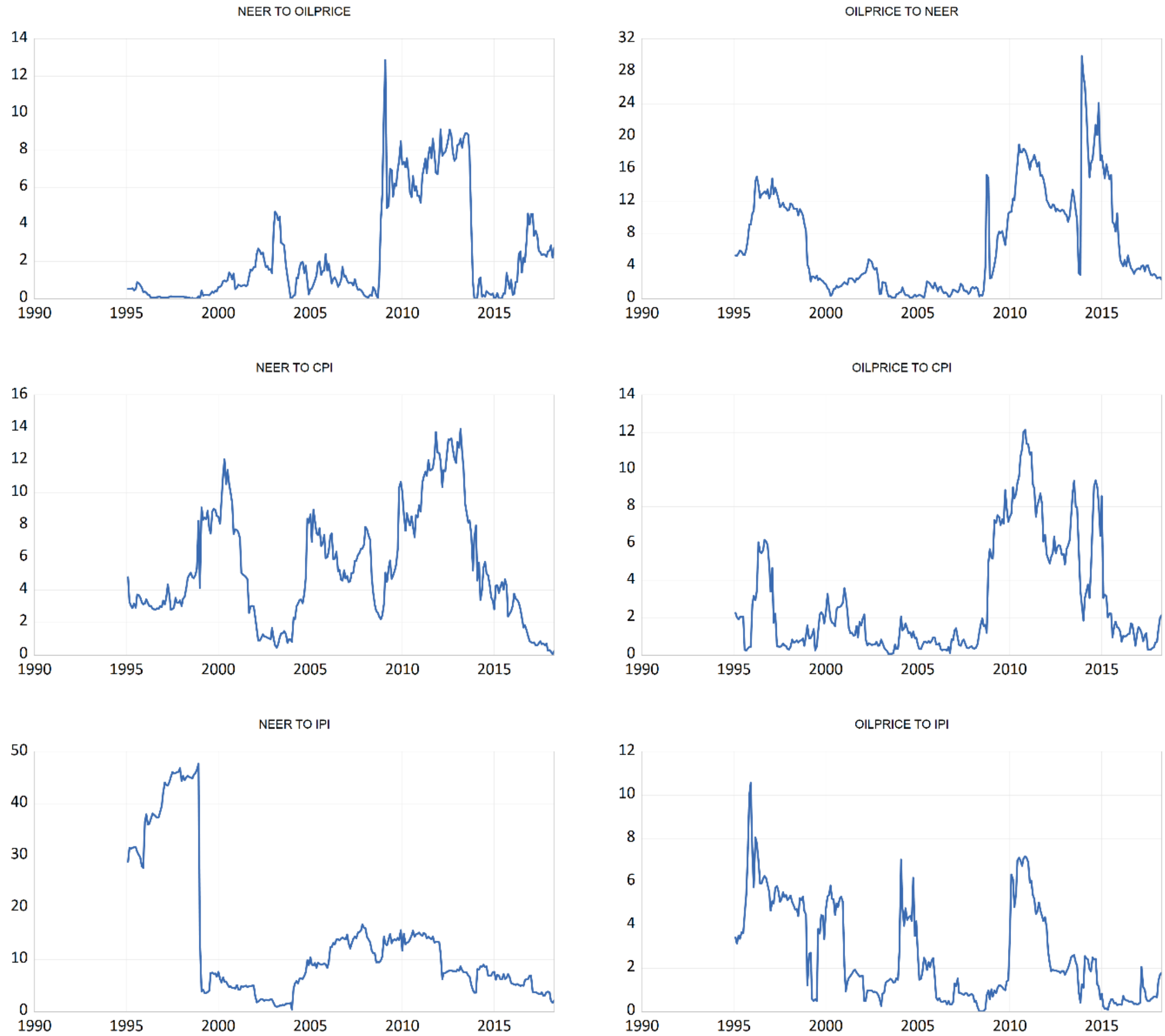
Note: Rolling spillover index is estimated with 60-month windows and 12-step horizons.

Figure 9: Rolling spillover estimates from nominal effective exchange rate and oil prices for India



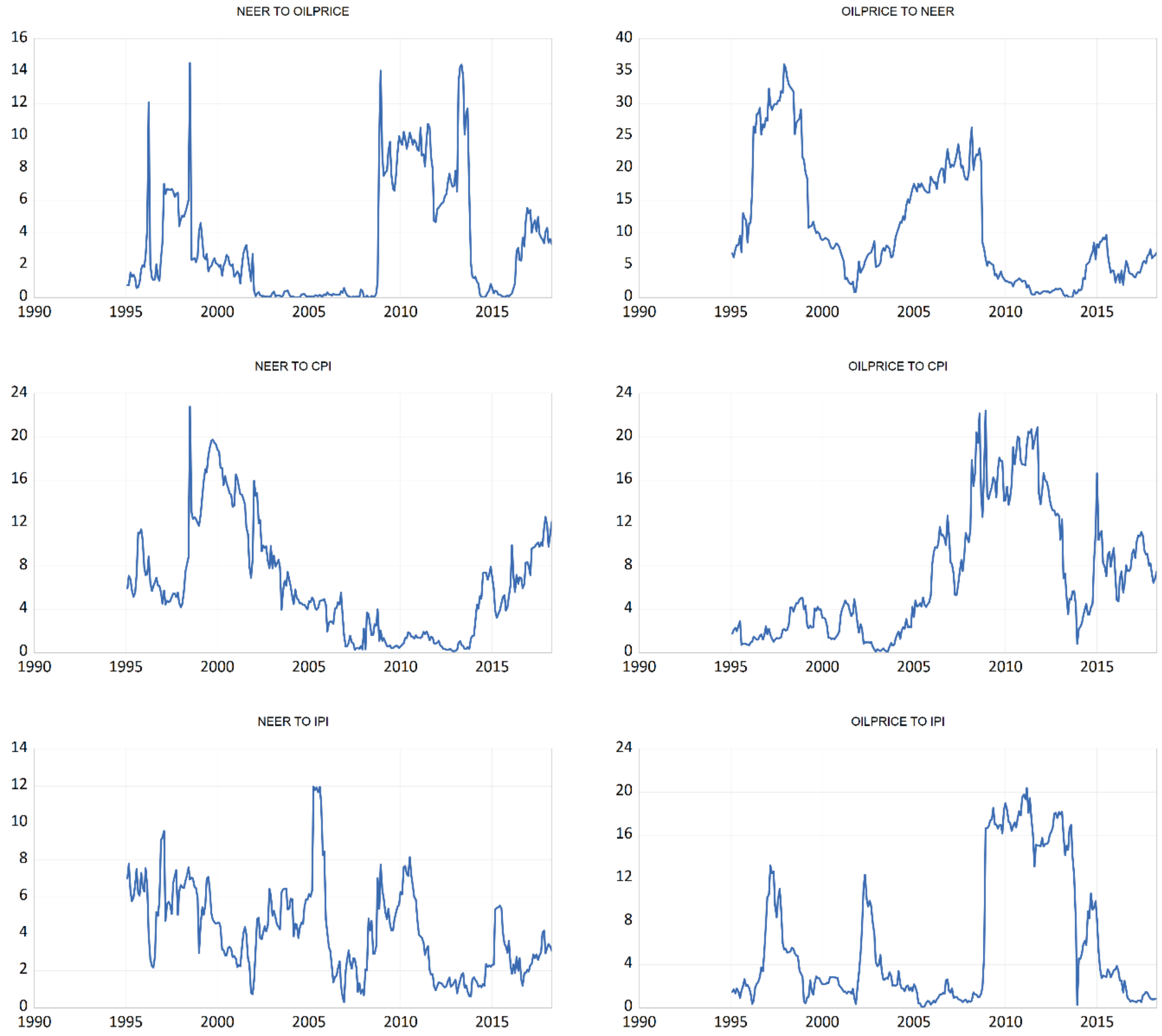
Note: Rolling spillover index is estimated with 60-month windows and 12-step horizons.

Figure 10: Rolling spillover estimates from nominal effective exchange rate and oil prices for China



Note: Rolling spillover index is estimated with 60-month windows and 12-step horizons.

Figure 11: Rolling spillover estimates from nominal effective exchange rate and oil prices for South Africa



Note: Rolling spillover index is estimated with 60-month windows and 12-step horizons.

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Appendix A: Unit Root Test

		ADF at Level		ADF at First Difference		PP at Level		PP at First Difference	
Country	Variable	Constant	Constant & Trend	Constant	Constant & Trend	Constant	Constant & Trend	Constant	Constant & Trend
Brazil	LCPI	-4.0204***	-2.5957	-3.8179***	-4.9733***	-4.9203***	-2.2379	-3.2385**	-4.2717***
	LIPI	-1.3423	-3.0194	-19.0718***	-19.0463***	-1.4701	-3.8500**	-33.9359***	-33.8790***
	LNEER	-4.1486***	-2.1794	-4.3206***	-7.2699***	-4.8194***	-2.1423	-5.6629***	-7.1113***
	LOILPRICE	-5.4725***	-2.5467	-7.8758***	-9.4712***	-4.7792***	-1.8822	-12.7085***	-13.4337***
Russia	LCPI	-2.9529**	-2.1489	-6.0588***	-6.5156***	-4.9588***	-3.5335**	-11.5212***	-12.2573***
	LIPI	-0.9550	-1.7404	-18.8856***	-18.8574***	-1.1317	-3.6201**	-29.1702***	-29.3109***
	LNEER	-1.7620	-2.4344	-12.2546***	-12.2400***	-1.9859	-2.4633	-12.2131***	-12.1986***
	LOILPRICE	-2.2109	-1.7946	-14.2205***	-14.2817***	-2.1279	1.9370	-14.1991***	-14.2924***
India	LCPI	-1.2143	-1.9576	-3.7336***	-3.8661**	-1.7658	-1.5355	-12.8164***	-12.8026***
	LIPI	-0.8036	-2.4742	-20.4269***	-20.4153***	-0.3321	-4.5876***	-35.9359***	-36.0356***
	LNEER	-2.7724*	-2.9380	-16.6481***	-16.7965***	-3.0834**	-2.9569	-16.5111***	-16.6191***
	LOILPRICE	-1.6547	-3.4506**	-15.8220***	-15.8188***	-1.0503	-2.9462	-15.6921***	-15.7746***
China	LCPI	-1.8768	-2.3128	-5.9446***	-5.9484***	-1.9946	-2.2319	-15.3677***	-15.3494***
	LIPI	-3.6905***	-4.4095***	-7.7957***	-7.7891***	-11.7845***	-12.0457***	-45.3432***	-46.6968***
	LNEER	-1.7106	-2.6311	-16.4236***	-16.5446***	-1.8566	-2.6779	-16.4197***	-16.5410***
	LOILPRICE	-1.6478	-2.8392	-13.4606***	-13.4406***	-1.4345	-2.5687	-12.9425***	-12.9186***
S/Africa	LCPI	-4.2950***	-4.6261***	-6.4612***	-12.7199***	-3.9070***	-4.2830***	-13.0615***	-13.5275***
	LIPI	-1.3204	-2.2489	-11.1353***	-11.1269***	-1.4753	-3.4710**	-30.0709***	-30.0448***
	LNEER	-1.2832	-2.8545	-13.9928***	-13.9856***	-1.2425	-2.6055	-13.9039***	-13.8951***
	LOILPRICE	-0.9977	-2.4097	-16.0355***	-16.0153***	-0.9937	-2.6771	-15.8826***	-15.8622***

Notes: ***, ** and * denote significance level at 1%, 5% and 10%