CESifo Working Papers
9322
2021
September 2021

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CESifo

Impressum:

CESifo Working Papers
ISSN 2364-1428 (electronic version)
Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH
The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute
Poschingerstr. 5, 81679 Munich, Germany
Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de
Editor: Clemens Fuest
https://www.cesifo.org/en/wp
An electronic version of the paper may be downloaded
· from the SSRN website: www.SSRN.com
· from the RePEc website: www.RePEc.org
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CESifo *Working Paper No. 9322*

Oil Prices, Exchange Rates and Sectoral Stock Returns in the BRICS-T Countries: A Time-Varying Approach

Abstract

This paper analyses the effects of oil prices and exchange rates on sectoral stock returns in the BRICS-T countries over the period from 2 January 2001 to 22 March 2021. After estimating a benchmark linear model, the possible presence of structural breaks is investigated using the Bai and Perron (2003) tests, and a state-space model with time-varying parameters is then estimated. The main findings can be summarised as follows. Both the sub-samples and the time-varying estimates indicate a greater role for exchange rate returns. Oil prices have a positive and significant impact on the energy sector in all countries except India; a negative and significant one on the financial sector of Brazil, Russia, India, and South Africa; no effect on the transportation sector of Brazil, China, and South Africa, a negative one on those of India and Turkey, and a positive one in the case of Russia. The vulnerability of energy-dependent sectors to global fluctuations implies that appropriate energy policies should be adopted to reduce risk.

JEL-Codes: G120, C500, C580.

Keywords: oil prices, exchange rates, sectoral stock returns, structural breaks, time-varying parameters.

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September 2021

1. Introduction

Despite the increasing use of natural gas and coal in energy production and recent advances in renewable energy technology, crude oil remains a significant primary energy source, which still accounted for 31.2% of total energy consumption in 2020. For this reason, several studies have been carried out on the impact of oil price volatility on variables such as GDP growth (Hamilton, 1983; Bohi, 1991; Burbidge and Harrison, 1984; Gisser and Goodwin, 1986), inflation (Hamilton, 1983; Bohi, 1991; Burbidge and Harrison, 1984; Gisser and Goodwin, 1986), and exchange rates (Choudhri and Hakura 2006; Goldfajn and Werlang 2000; Hooker, 2002). Since the second half of the 1990s, the effects of oil price fluctuations on financial markets have also been analysed, starting with the seminal studies of Jones and Kaul (1996) and Huang et al. (1996). Higher oil price shocks can affect stock returns through two main transmission channels (Sadorsky, 1999; Moya-Martinez et al., 2014): they can increase production costs and affect corporate earnings and cash flows (Jones et al., 2004); in addition, they can also generate inflationary pressures, with a negative effect on consumer confidence, investment and stock market returns through higher interest rates.

Most studies focus on the developed stock markets. For instance, Jones and Kaul (1996) carried out Granger causality tests and reported that oil price shocks have a greater impact on real cash flows in the US and Canada and on stock prices in the UK and Japan. Apergis and Miller (2009) estimated a vector autoregression (VAR) model and concluded that stock returns are not affected by oil price shocks in a sample of eight countries, i.e. Australia, Canada, Germany, France, Italy, Japan, the UK and the US. By contrast, Park and Ratti (2008) estimated linear and non-linear VAR models for the US and 13 European countries and concluded that oil price shocks are a more important driver of stock market fluctuations than interest rate shocks. Finally, Lee and Zeng (2011) estimated quantile regressions and found that oil price shocks affect stock returns in the G7 only during times of overperformance of the market.

The present study aims to contribute to this area of the literature by examining the impact of oil price fluctuations on the stock markets of the BRICS (Brazil, Russia, India, China, and South Africa) and Turkey (BRICS-T), a group of countries for which little evidence is available (e.g., Catik et al., 2020, and Yurteri et al., 2021) and which includes both oil-importing economies such as China and India and oil-exporting ones such as Russia and Brazil, thus enabling us to test for differences between these two categories. Moreover, our sample includes firms with different ownership structures, various sizes, and several average daily volumes of transactions. This compares favourably to sub-indices including many enterprises but based on restrictive criteria, such as the liquidity of their shares (Sadorsky, 2001, Hammoudeh and Aleisa, 2004). Further, since some sectors (e.g., transportation and energy) are more sensitive to changes in oil price shocks than others, unlike most previous studies, we use sectoral rather than aggregate data. Moreover, in addition to a benchmark linear asset pricing model, we also test for structural breaks and estimate the model over the corresponding sub-samples; finally, a specification allowing for parameter time variation is adopted. Thus our analysis sheds light on sectoral sensitivity to the volatility of oil price returns and on structural changes resulting from various factors such as financial crises and world oil developments.

The layout of the paper is as follows. Section 2 provides a brief review of the relevant literature. Section 3 describes the data and the methodology. Section 4 presents the empirical results. Section 5 summarises the main findings and discusses their policy implications.

2. Literature Review

Studies on the impact of oil price shocks on stock markets mainly focus on the developed countries. For instance, Jones and Kaul (1996) found that fluctuations in stock prices can be explained by changes in oil prices and their effects on current and future cash-flows in the case of Canada, Japan, the UK and the US. Papapetrou (2001) provided evidence of a negative impact of oil price volatility on stock prices in Greece using a VAR model. Apergis and Miller (2009) focused on eight developed countries (Australia, Canada, France, Germany, Italy, Japan, the UK and the US) and reported that all three structural oil market shocks (oil supply, global aggregate-demand, and global oil demand) affect stock market returns in all of them except Australia; however, other variables such as exchange rates and interest rates are more important drivers. Miller and Ratti (2009) found changes in the long-run relationship between the world price of crude oil and international stock markets reflecting various bubbles in several OECD countries over the period from January 1971 to March 2008.

It has been pointed out that the effects of oil price on stock market returns could differ between oil-exporting countries and oil-importing ones (see Wang et al., 2013). Hammoudeh and Aleisa (2004) reported spillovers from the oil market to the stock market using a sample of major oil-exporting countries. Park and Ratti (2008) estimated a statistically significant positive response of real stock returns to oil price increases in an oil-exporting country such as Norway and found little evidence of asymmetric effects of positive vis-à-vis negative oil price shocks on the real stock returns in the case of oil-exporting European countries.

The impact of oil price shocks could also differ across industries (Cong et al., 2008). Nandha and Faff (2008) found a negative effect of higher oil price volatility on stock prices in virtually all of 35 industry sectors based on the standard FTSE Global Classification

System, the only exceptions being mining, oil and gas. El-Sharif et al. (2005) found a significant, positive relationship between oil prices and oil-related stock returns, but also differences across sectors. Boyer and Filion (2007) estimated a multifactor model and reported that the stock returns of energy companies are positively related to stock market returns in Canada; in addition, their movements can be explained by exchange rates, market returns and natural gas prices. Çatık et al. (2020) estimated an augmented asset-pricing model with oil price and exchange rate changes for 12 sectors in the Istanbul Stock Exchange, covering the period between January 3, 1997 and August 9, 2018; they found evidence of parameter time variation and of sectoral differences as well as of a greater impact of exchange rate changes compared to oil price shocks.

Elyasiani et al. (2011) estimated a GARCH model and reported that the volatility of oil returns rather than their changes affects excess returns of the oil-user industries, whose volatility appears to be time-varying and to exhibit long memory. Narayan and Sharma (2011) examined the relationship between oil prices and returns for 560 US firms listed on the NYSE and found differences depending on their sectoral location and size (see also Sawyer and Nandha, 2006). Cong et al. (2008) estimated a vector autoregression (VAR) and showed that oil price shocks have a significant effect only on the real stock returns of the manufacturing index and of some oil companies in the Chinese stock market; higher volatility in oil prices results in a more speculative attitude in both the mining and petrochemicals sectors, leading to higher stock returns. Arouri et al. (2012) investigated volatility spillovers between oil and stock markets in Europe at the aggregate and sector levels using a VAR-GARCH approach and found unidirectional causality running from oil prices to stock markets.

3. Data and Methodology

3.1 Data

The selected sample reflects data availability and covers the period from 2 January 2001 to 22 March 2021; the data source is Datastream (DS). The benchmark stock market indices are the BOVESPA index for Brazil, the Shanghai Stock Exchange index for China, the NIFTY 500 for India, the MOEX for Russia, the FTSE/JSE index for South Africa, and the BIST 100 index for Turkey. The sectors included in the analysis are energy, industrials, chemicals, transportation, and financial sectors. A few sectoral stock indices are obtained from other sources, in particular: for Russia, the chemicals, transportation, and industrials stock indices are taken from Red Star Financials, and the basic materials stock index from the FTSE; for South Africa, the transportation index also comes from the FTSE; finally, for Turkey, all data have been collected from BIST. Nominal exchange rates vis-à-vis the US dollar are employed. As for interest rates, the following series are used: the Interbank deposit certification rate for Brazil, the 3-month deposit rate for China, the 1-month deposit rate for India, the 3-month deposit rate for Russia, the 1-month deposit rate for South Africa, and the 1-month deposit interest rate for Turkey. Finally, the Europe Brent Spot Price Free on Board (USD Per Barrel) is chosen as a proxy for the global oil price.[6]

The CAPM model, as originally developed by Sharpe (1964) and Lintner (1965), is concerned with the excess returns of an asset above the risk-free rate. Thus, before proceeding to the estimation, the excess returns on total and sectoral stock prices, Rex_{it}, are computed using the following formula:

$$Rex_{it} = \frac{SP_{it} - SP_{it-1}}{SP_{it-1}} - int_t \quad (1)$$

[6] The dataset is described in detail in Table 1 in the Appendix.

where SP_{it} is the sectoral stock price of sector i, and int_t is the daily risk-free interest rate. Excess returns for the stock market as a whole, Rm_t, oil prices, $Roil_t$, and exchange rates, Rer_t, are also calculated in the same way.

Descriptive statistics and unit root tests for all series are reported in Table 1. Average returns are positive for most sectors but vary across countries. The highest volatility is exhibited by Brazil's energy sector (0.025), China's chemical sector (0.017), India's transport sector (0.022), Russia's finance sector (0.021), South Africa's energy sector (0.022), and Turkey's chemical sector (0.027), and the lowest by the industrial sectors of all countries, excluding China. All sectoral return series exhibit a high degree of negative skewness and excessive kurtosis. The Jarque-Bera test statistics confirm that these series, as well as oil prices and exchange rates, are not normally distributed. Finally, all variables are found to be stationary at the 1% significance level using the augmented Dickey-Fuller and Phillips-Perron unit root tests.

<Insert Table 1 about here>

3.2 Methodology

In its linear form, the multifactor asset pricing model employed in this paper can be written as follows:

$$Rsi_{it} = \alpha_{i0} + \beta_{im}Rm_t + \beta_{ioil}Roil_t + \beta_{ier}Rer_t + u_{it}, \qquad (2)$$

where Rs_{it} is the excess return for the i-th sector and Rm_t, $Roil_t$ and Rer_t are the excess returns for the stock market as a whole, oil prices, and exchange rates, respectively. The parameter β_{im} stands for the market beta, which quantifies the systematic risk of sector *i*'s returns relative to the market; β_{ioil} and β_{ier}, on the other hand, measure the sensitivity of sectoral returns to oil price and exchange rate shocks.

The endogenous Bai and Perron (1998, 2003) structural break tests are also carried out. Specifically, *m* breaks are allowed for by adopting the following specification:

$$\begin{array}{ll} Rex_{it} = \alpha_{i0} + \beta_{im}Rm_t + \beta_{ioil}Roil_t + \beta_{ier}Rer_t + u_{it}, & t = 1, \dots, T_1 \\ \vdots & \vdots \quad , \\ Rex_{it} = \alpha_{i0} + \beta_{im}Rs_t + \beta_{ioil}Roil_t + \beta_{ier}Rer_t + u_{it}, & t = T_m, \dots, T_1 \end{array} \quad (3)$$

where $(T_1,...,T_m)$ corresponds to the timing of the endogenously determined structural breaks. The model is estimated using OLS in the following form:

$$\sum_{i=1}^{m+1}\sum_{T_{t-1}+1}^{T_1}(Rex_{it} - \alpha_{i0} - \beta_{im}Rm_t - \beta_{ioil}Roil_t - \beta_{ier}Rer_t)^2. \quad (4)$$

Bai and Perron (1998, 2003) suggested three tests to specify the maximum number of breaks, namely $supF_T(k)$, $UD_{max} - WD_{max}$ and $supF_T(l+1/l)$. $supF_T(k)$ is an F-statistic used to test the null hypothesis of no structural breaks with a given number of breaks (k) as the alternative. Given an upper bound $M(1 \leq m \leq M)$, UD_{max} and WD_{max} test the null hypothesis of no structural breaks against the alternative of an unknown number of breaks. The sequential $supF_T(l+1/l)$ test is employed to test the null hypothesis of l versus $l+1$ breaks. Having established the number of breaks, the linear version of the asset pricing model is re-written in the form of a time-varying state-space model as follows:

$$Rex_{it} = \beta_{i0,t} + \beta_{is,t}Rm_t + \beta_{ioil,t}Roil_t + \beta_{ier}Rer_t + \mu_{it} \qquad \mu_{it} \sim nid\left(0, \sigma^2_{\mu,t}\right), \quad (5)$$

$$\alpha_{i0,t} = \alpha_{i0.t-1} + \varphi_{\alpha.t} \qquad \varphi_{\alpha.t} \sim iid\left(0, \sigma^2_{\varphi\alpha.t}\right), \quad (6)$$

$$\beta_{im.t} = \beta_{im.t-1} + \varphi_{m.t} \qquad \varphi_{m.t} \sim iid\left(0, \sigma^2_{\varphi m.t}\right), \quad (7)$$

$$\beta_{ioil.t} = \beta_{ioil.t-1} + \varphi_{oil.t} \qquad \varphi_{oil.t} \sim iid\left(0, \sigma^2_{\varphi oil.t}\right), \quad (8)$$

$$\beta_{ier.t} = \beta_{ier.t-1} + \varphi_{er.t} \qquad \varphi_{er.t} \sim iid\left(0, \sigma^2_{\varphi er.t}\right). \quad (9)$$

(5) is the measurement equation, whilst (6)-(9) are the transition equations with the time-varying coefficients. As in Inchauspe et al. (2015), Moya-Martinez et al. (2014) and Karlsson and Hacker (2013), the coefficients are assumed to follow a random walk without a drift. The variances of the transition equations are denoted by $\sigma^2_{\mu,t}$, $\sigma^2_{\varphi\alpha.t}$, $\sigma^2_{\varphi m.t}$, $\sigma^2_{\varphi oil.t}$ and $\sigma^2_{\varphi er.t}$.

Finally, the error terms are assumed to be independently and identically distributed with a zero mean and constant variance.

The time-varying parameter model presented above is estimated with the Kalman (1960) filter using the maximum-likelihood method. Following Durbin and Koopman, (2001), the state-space model is re-written in matrix form as follows:

$$Rex_{it} = \psi(z_t)\xi_t + \varepsilon_t \qquad \varepsilon_t \sim nid(0, \sigma_{\varepsilon t}), \qquad (10)$$

$$\xi_t = \psi(z_t)\xi_{t-1} + \xi_t \qquad \vartheta_t \sim N(0, Q_t), \qquad (11)$$

where $\psi(z_t) = [1 \quad Rs_t \quad Roil_t \quad Rer_t]$ is the matrix of explanatory variables, and $\xi_t' = [\alpha_{i0.t} \quad \beta_{im.t} \quad \beta_{ioil.t} \quad \beta_{ier.t}]$ is the vector of state variables that includes the time-varying coefficients. The vector of the error terms of the measurement equation is denoted by $\varepsilon_t = \mu_{it}$, whilst $\vartheta_t' = [\varphi_{\alpha.t} \;\; \varphi_{m.t} \;\; \varphi_{oil.t} \;\; \varphi_{er.t}]$ is the vector of the error terms of the state equations with a $Q_t = [\sigma^2_{\varepsilon\alpha.t} \;\; \sigma^2_{\varepsilon m.t} \;\; \sigma^2_{\varepsilon oil.t} \;\; \sigma^2_{\varepsilon er.t}]$ variance-covariance matrix.

The estimation of state-space models with Kalman filtering includes three steps, namely prediction, updating, and smoothing. In the first step, the estimated value of the dependent variable is derived using the available information at $t-1$ with the state vector, $\xi_t|\mathrm{t}-1$, and its covariance matrix, $P_t|\mathrm{t}-1$. In the updating stage, the inference about ξ_t obtained in the first step is updated by comparing the actual and the predicted value of the state variables. The final stage of the estimation process is completed with the smoothing step, in which corrected coefficient estimates are obtained using information based on the entire forecast sample.[7]

[7] Further details of Kalman filtering can be found in Kim and Nelson (1999) and Commandeur and Koopman (2007).

4. Empirical Results

Table 3 reports the results for the benchmark linear asset pricing model. It can be seen that the market return (market beta) coefficients are highly significant for all industries, whilst the oil price and exchange rate return ones are significant only in some cases. Oil prices have a positive and significant impact on the energy sector in all cases except for India, and a negative and significant one on the financial sector of Brazil, Russia, India and South Africa, but none on those of China and Turkey. They also have a positive and significant effect on the industrial sector of the oil-exporting countries in our sample, namely Brazil and Russia, whilst in the case of India and South Africa their effect is negative and significant at least in one regime, and there is no impact in the case of China and Turkey (similarly to the financial sector). As for the transportation sector, no impact is found in the case of Brazil, China and South Africa, a negative one in the case of India and Turkey, and a positive one in the case of Russia.

It is well known that overlooking nonlinearities and structural breaks when modelling asset-pricing behavior may lead to biased parameter estimates (Choudhry, 2005; Karlsson and Hacker, 2013; Moya-Martinez et al., 2014). For this reason; next, we test for structural breaks using the Bai and Perron (1998, 2003) approach. The results presented in Table 3 suggest that there are at least two significant structural breaks in all sectoral asset pricing models. In particular, the energy sector exhibits most breakpoints in Brazil, the chemical sector in China, and the financial sector in India. There are various breaks in all sectors in Russia, and at least two in each case in South Africa; further, industrials and transportation are the sectors with the highest number of breaks in Turkey. As for the sub-sample estimation results, a consistent pattern emerges, namely, despite differences in the size of the estimated coefficients across sub-samples, it is clear that in most cases exchange rate returns are a more important determinant of sectoral returns than oil price changes, as already found in previous studies (El-Sharif et al., 2005; Park and Ratti, 2008).

The following step is to estimate a model with time-varying parameters to analyse in greater depth how the effects of risk factors on the sectoral stock returns in the BRICS-T countries evolve over time. In line with previous studies (e.g.. McSweeney and Worthington, 2008; Gogineni, 2010; Narayan and Sharma, 2011; Moya-Martinez et al., 2014), we extend the time-varying state-space model given by (5)-(9) to include up to five lags of exchange rates and oil prices (corresponding to the five working days in a week). The estimated time-varying parameters are shown in Figures 1-5. The cumulative sum of the oil and exchange rate parameters up to the fifth lag are plotted along with their two-standard deviation confidence intervals to assess their significance over time. These results are generally consistent with those of the Bai and Perron's (2003) structural break tests, in both cases evidence being found that the effects of oil prices and exchange rates on sectoral stock returns have varied significantly over time and across sectors and countries. This is also supported by the descriptive statistics for the time-varying parameters presented in Table 4.

It is noteworthy that the time-varying coefficients on the exchange rates are larger than those on oil prices in most sectors across the countries examined. The sectoral market return coefficients are positive and significant for all countries, their estimated value being below one in most cases. However, it is above one in the case of the energy sector in Brazil, the chemical and industrial sectors in China, the financial and industrial sectors in India, the energy and industrial sectors in South Africa, and the financial sector in Turkey, which implies that risk for these sectors is greater than for the market as a whole.

Figure 1 displays the results for the chemicals industry, which is expected to be significantly affected by oil prices owing to the heavy use of petroleum products as an input into the production process. However, there are clear differences across countries. In Brazil there was a negative and significant effect in the early 2000s, but none in the following periods. In the case of China initially, there was no effect, but the 2008 global financial crisis and changes in oil prices in 2010 and 2018 had a positive and significant effect. In India (Russia) the effect was initially positive (negative) and significant but then became insignificant. The South African chemical industry appears to be the most affected by changes in oil prices. The time-varying parameter on oil price changes has an average value of 0.099 and ranges between -0.059 and 0.330. Oil prices had a positive and significant impact between 2015 and 2019. However, this effect disappeared during the Covid-19 pandemic, before becoming positive and significant again at the beginning of 2021 when it reached its highest value. In Turkey, oil prices had a negative and significant effect in the early part of the sample period, though the cumulative impact of the estimated parameters was insignificant. Exchange rate fluctuations have had the greatest impact on Brazil and Russia. In the former, the effect was negative and significant before the 2008 global financial crisis. In the latter, it was negative and significant till 2011. In India, there was a negative and significant impact in 2004 and during the global financial crisis, but none at other times. In China, there was instead a positive and significant impact between 2008 and 2011, and a negative one during the Covid-19 pandemic. Finally, in South Africa, the effect was positive and peaked in early 2017.

Figure 2 shows the results for the energy sector. It appears that oil prices play a more important role than exchange rates in all countries considered except India and Turkey. Their effect was positive and significant in Brazil in 2004-2009 and 2015-2019, and in China in 2010-2013 and 2015-2020, but insignificant in India throughout the sample period. It was most significant in Russia and especially in South Africa, where the average value of this parameter is 0.254 and its range is between -0.047 and 0.761 (it peaked in March 2020, during the Covid-19 pandemic). In Turkey, the effect was positive and significant only during the 2008 global financial crisis, whilst it was insignificant at other times. The exchange rate had a positive effect in Brazil in the initial period, and then a negative one in 2014-2015. In China, this effect was significant and negative in 2005-2006 and positive in 2015-2016 (and it was greater than the corresponding impact of oil prices). In India, it was significant and negative for most of the sample period. It was positive and most significant in 2008-2014 in Russia, where it peaked in 2018-2019. Finally, Turkey is the country with the least significant impact (this coefficient was significant and positive only in 2018-2019).

Figure 3 shows the findings for the financial sector. Oil prices appear to have a negative and significant impact in all countries except Russia. The biggest estimates are obtained for Brazil and South Africa. In the former this parameter has an average value of -0.049 and ranges between -0.104 and 0.012; its lowest values coincide with the 2005-2009 period including the 2008 global financial crisis. In the latter, this parameter is highly significant between 2005 and 2016, it has an average value of -0.095 and ranges between -0.169 and 0.026. The exchange rate also has a negative effect in all countries except Russia and is most significant in Brazil and South Africa and the least significant in Turkey, where it was negative and significant only during the 2018 global financial crisis.

Figure 4 displays the time-varying parameters for the industrial sector. In Brazil, both oil prices and the exchange rate had a negative and significant impact only during the 2008 global financial crisis. In China, only oil prices had a negative and significant effect during 2008-2013. In India, it was instead the exchange rate that had a negative and significant impact between 2001 and 2004. In South Africa this effect was most significant and negative (especially between 2005 and 2007), its average being -0.354 and ranging between -0.687 and -0.187, with a peak in April 2020 during the Covid-19 pandemic. In Russia, there was a negative impact at the start of the sample period but this became positive in 2005-2006. No effect can be detected in Turkey.

Finally, Figure 5 shows the results for the transportation sector. Oil prices generally have a negative impact except in the case of Russia. China, India, and Turkey were the most affected countries. More specifically, in China the effect was negative till 2018, reaching its highest absolute value during the 2008 global financial crisis period, with an average value of -0.016 and a range between -0.027 and -0.002. In India, a negative effect is estimated until the 2008 financial crisis. In Turkey transportation is the sector most adversely affected by oil price fluctuations – the average value of this parameter is -0.104, and it ranges between -0.279 and 0.076. The exchange rate has a negative and significant effect in all countries except China (where it was positive and significant between 2001 and 2012), especially in Russia, South Africa (in 2004-2019), and India. In Turkey, there was an effect only during the 2008 global financial crisis.

5. Conclusions

This paper analyses the effects of oil prices and exchange rates on sectoral stock returns in the BRICS-T countries. For this purpose, capital asset pricing models, including market returns, oil prices, and exchange rate returns as the main risk factors that may affect stock returns, are estimated using daily data covering the period from 2 January 2001 to 22 March 2021. Next, the possible presence of structural breaks is investigated using the Bai and Perron (2003) tests, and a state-space model with time-varying parameters is estimated using the Kalman (1960) filter.

The main findings can be summarised as follows. The Bai and Perron (2003) tests confirm the presence of structural breaks, which implies that inference based on the benchmark linear model would be misleading. According to the parameter estimates for the sub-samples identified through these tests, most sectors were significantly affected by exchange rate returns during the period under examination, whilst oil prices changes had a much lower impact; these findings are consistent with the results reported in earlier studies (El-Sharif et al., 2005; Park and Ratti, 2008).

The time-varying parameter estimates obtained from the state-space models indicate that the effects of oil prices and exchange rates vary significantly across countries and sectors, and over time; moreover, exchange rates play a more important role, as already implied by the sub-sample estimates. Despite differences in the size of the estimated coefficients, oil prices have a positive and significant effect on the energy sector in all cases with the exception of India; a negative and significant impact on the financial sector of Brazil, Russia, India, and South Africa; no effect on the transportation sector of Brazil, China, and South Africa, a negative one on those of India and Turkey, and a positive one only in the case of Russia.

Our results imply that domestic and global economic developments can affect the direction and magnitude of the effects of oil prices and exchange rates on sectoral stock returns. The significant impact of both those variables on returns suggests that energy-dependent sectors in particular are vulnerable to the risks associated with global market fluctuations. Consequently, policymakers would be well advised to adopt policies aimed at increasing the share of domestic energy production and also the range of energy import countries to minimise reliance on individual ones thereby reducing risk.

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Table 1. Descriptive Statistics and Unit Root Tests for the Individual Variables

		Descriptive statistics								Unit Root Tests	
		Mean	**Median**	**Maximum**	**Minimum**	**Standard Deviation**	**Skewness**	**Kurtosis**	**Jarque-Bera**	**ADF**	**PP**
Brazil	*Chemicals*	1.86E-05	-0.0003	0.209622	-0.2667	0.023471	-0.89972	20.05536	64645.82***	-70.52762***	-70.51639***
	Energy	-1.66E-06	-0.00019	0.189577	-0.3068	0.025162	-0.57965	13.15557	22963.75***	-73.82749***	-73.82626***
	Finance	6.96E-05	-0.00022	0.137337	-0.12501	0.017084	0.023727	8.796237	7384.695***	-70.87539***	-70.85700***
	Industry	0.000234	-0.00017	0.12389	-0.19675	0.015536	-0.7979	18.29645	51986.85***	-76.11361***	-76.05549***
	*Transportation**	0.000251	-0.00031	0.198928	-0.31049	0.023447	-0.63566	17.08089	41559.96***	-73.59158***	-73.89075***
	Oil Price	-0.0001	-0.00017	0.411924	-0.6438	0.026401	-2.19671	92.60571	1768990***	-14.62029***	-71.82693***
	Exchange Rate	-0.00011	-0.00031	0.096324	-0.11823	0.010336	0.098999	12.82273	21215.43***	-52.71477***	-69.39031***
	Market Return	7.10E-05	-0.00018	0.13643	-0.16005	0.017551	-0.39891	10.53871	12631.14***	-74.24936***	-74.37085***
China	*Chemicals*	7.59E-05	-4.65E-05	0.091961	-0.10678	0.017695	-0.41439	6.225801	2438.078***	-67.76169***	-67.89306***
	Energy	-7.62E-05	-5.37E-05	0.095333	-0.21697	0.01759	-0.1626	13.34428	23541.84***	-73.47607***	-73.47313***
	Finance	6.50E-05	-5.37E-05	0.095311	-0.10073	0.01664	0.028516	7.805093	5075.467***	-72.43106***	-72.43085***
	Industry	-0.00017	-4.65E-05	0.095419	-0.09678	0.016783	-0.4407	7.614171	4850.236***	-69.20481***	-69.49298***
	*Transportation**	-2.29E-05	-4.65E-05	0.095388	-0.10143	0.016422	-0.38608	8.518657	6824.93***	-70.14588***	-70.21242***
	Oil Price	0.00016	-3.00E-05	0.411993	-0.64373	0.0264	-2.2018	92.66956	1771526***	-15.23942***	-73.60711***
	Exchange Rate	-9.63E-05	-4.65E-05	0.018054	-0.02036	0.001465	-0.15834	27.74074	134557.4***	-72.67852***	-74.15676***
	Market Return	4.37E-05	-3.00E-05	0.093944	-0.09266	0.014975	-0.4112	8.51943	6844.411***	-71.86523***	-71.97042***
India	*Chemicals*	0.000298	-8.31E-05	0.106747	-0.78447	0.018521	-14.7332	616.0587	82797554***	-66.01078***	-66.68978***
	Energy	0.000308	-0.00015	0.164529	-0.16486	0.017455	-0.48297	13.39837	23970.31***	-67.69010***	-67.66820***
	Finance	0.000367	4.63E-05	0.18436	-0.17775	0.017811	-0.42571	12.90567	21725.81***	-66.12179***	-65.99390***
	Industry	0.000426	0.000428	0.158362	-0.14548	0.015794	-0.38082	10.78236	13439.2***	-67.08889***	-67.84868***
	*Transportation**	0.000587	-0.00018	0.536884	-0.17945	0.022601	2.597465	67.6495	924563.5***	-73.16672***	-73.17471***
	Oil Price	2.65E-05	-0.00012	0.411889	-0.64383	0.026402	-2.20066	92.64192	1770432***	-15.22583***	-73.60094***
	Exchange Rate	-0.0001	-0.00021	0.032223	-0.03075	0.00381	0.285943	9.925052	10612.29***	-29.39284***	-69.87863***
	Market Return	0.00031	0.000603	0.150232	-0.13723	0.01371	-0.74798	14.53979	29760.79***	-66.96861***	-67.42992***

Table 1. Descriptive Statistics and Unit Root Tests for the Individual Variables (continued)

		Mean	Median	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis	Jarque-Bera	ADF	PP
Russia	*Chemicals*	-0.00026	-0.00016	0.166838	-0.31308	0.018989	-1.07741	25.00889	107485.7***	-67.03673***	-66.91031***
	Energy	0.000333	-0.00012	0.274335	-0.2218	0.020154	-0.02479	21.88886	78419.8***	-72.20315***	-72.24832***
	Finance	0.000761	-0.00013	0.282688	-0.23297	0.021968	0.034755	18.53708	53058.97***	-71.05757***	-71.21666***
	Industry	0.000415	0.00012	0.289416	-0.21502	0.017448	0.02636	33.74066	207701.2***	-70.09713***	-70.11805***
	*Transportation**	0.000173	-0.00016	0.26049	-0.35759	0.020113	-1.19085	44.52597	380256.9***	-28.54720***	-71.46407***
	Oil Price	-2.12E-06	-0.00011	0.411854	-0.64387	0.026402	-2.20409	92.63816	1770297***	-15.22103***	-73.60188***
	Exchange Rate	-3.07E-05	-0.00027	0.142189	-0.15584	0.008001	0.491958	61.62323	755567.1***	-23.10169***	-70.21631***
	Market Return	0.00039	2.47E-05	0.252013	-0.20687	0.018656	-0.33517	22.97416	87788.42***	-71.79977***	-71.79883***
South Africa	*Chemicals*	0.000219	-0.00021	0.188049	-0.13936	0.017632	0.351354	11.87069	17403.73***	-71.87626***	-72.11109***
	Energy	0.0001	-0.00017	0.219603	-0.43112	0.02218	-1.32668	36.19141	243685.2***	-66.15029***	-66.36340***
	Finance	5.61E-05	-0.00016	0.082132	-0.14597	0.014343	-0.38762	10.43623	12286.02***	-53.15837***	-70.39292***
	Industry	-3.07E-07	-0.00016	0.087919	-0.26074	0.013814	-1.26304	30.45868	167120.8***	-72.97377***	-73.06246***
	*Transportation**	-0.00014	-0.00029	0.112698	-0.11681	0.016982	-0.13169	7.275732	3833.882***	-69.63830***	-69.63348***
	Oil Price	6.24E-06	-0.00014	0.411932	-0.64379	0.026401	-2.20089	92.6369	1770235***	-69.89177***	-70.06675***
	Exchange Rate	-7.90E-05	-0.00029	0.09774	-0.08549	0.010613	0.291111	7.486476	4498.575***	-68.74306***	-68.71332***
	Market Return	0.000191	-2.90E-06	0.072473	-0.10244	0.011911	-0.32055	8.373772	6437.357***	-68.64136***	-68.60314***
Turkey	*Chemicals*	0.000796	-0.00025	0.190421	-0.21579	0.027415	0.170284	9.867737	10392.15***	-69.68784***	-69.66614***
	Energy	-0.00011	-0.00019	0.153094	-0.18159	0.020717	-0.15028	8.678852	7107.998***	-72.64625***	-72.65235***
	Finance	0.000118	-0.00028	0.146418	-0.20715	0.023144	-0.13104	8.066951	5658.025***	-70.62921***	-70.62585***
	Industry	4.09E-05	-7.74E-05	0.128052	-0.19857	0.019475	-0.38593	10.89913	13845.12***	-71.04924***	-71.05671***
	*Transportation**	0.000189	-0.00022	0.122326	-0.18447	0.023904	-0.34155	7.666853	4889.515***	-47.90689***	-72.20865***
	Oil Price	-0.00024	-0.00019	0.411724	-0.64396	0.026402	-2.20097	92.61152	1769235***	-15.22020***	-73.64404***
	Exchange Rate	1.58E-05	-0.00035	0.373248	-0.16389	0.01165	7.050994	229.8018	11349581***	-54.58345***	-65.46092***
	Market Return	5.75E-05	-3.50E-06	0.12549	-0.20116	0.018968	-0.40855	10.9553	14056.65***	-72.41393***	-72.41930***

Note: This table shows the sectoral data of 6 countries and descriptive statistics of oil price, exchange rate and market returns from January 2, 2001 to March 22, 2021. Jarque-Bera test is determined by the coefficients of skewness and kurtosis, and shows the normal distribution in error terms. Augmented Dickey-Fuller (ADF) and Phillips-Perron unit root tests are employed for unit root tests. *, ** and *** show the statistical significance at the level of 10%, 5% and 1%. (* Brazil- The data for the transport sector starts from 05-02-2002, ** South Africa- The data for the transport sector ends on 20-03-2020).

Table-2. OLS Estimation Results

		Oil Price	Exchange Rate	Market Return	R^2
Brazil	*Chemicals*	0.008	-0.047	0.626***	0.228
	Energy	0.137***	0.003	1.060***	0.608
	Finance	-0.022***	-0.152***	0.790***	0.790
	Industry	0.020***	-0.027*	0.587***	0.459
	*Transportation**	-0.007	-0.215***	0.654***	0.275
China	*Chemicals*	0.010***	-0.047	0.996***	0.714
	Energy	0.010*	0.227**	0.903***	0.590
	Finance	-0.005	-0.107	0.985***	0.787
	Industry	-0.004	-0.0,05	1.034***	0.851
	*Transportation**	-0.003	-0.088	0.892***	0.662
India	*Chemicals*	-0.012	-0.040	0.743	0.303
	Energy	0.007	-0.043	0.999***	0.624
	Finance	0.000	-0.302***	1.121***	0.792
	Industry	-0.011***	-0.062**	1.040***	0.821
	*Transportation**	-0.008	-0.021	0.799***	0.234
Russia	*Chemicals*	-0.004	-0.059**	0.325***	0.105
	Energy	0.045***	0.045***	0.953***	0.800
	Finance	-0.019***	-0.355***	0.913***	0.648
	Industry	0.023***	0.011	0.820***	0.782
	*Transportation**	0.020**	0.042	0.474***	0.196
South Africa	*Chemicals*	0.052***	-0.019	0.465***	0.119
	Energy	0.127***	0.049**	1.130***	0.432
	Finance	-0.037***	-0.328***	0.803***	0.539
	Industry	-0.018***	-0.233***	0.709***	0.435
	*Transportation**	0.012	-0.296***	0.619***	0.253
Turkey	*Chemicals*	0.011	-0.045	0.777***	0.299
	Energy	0.016**	0.094***	0.895***	0.646
	Finance	2.09E-05	-0.056***	1.113***	0.852
	Industry	0.000	0.062***	0.842***	0.651
	*Transportation**	-0.027***	-0.001	0.873***	0.477

Table 3. Bai-Perron Estimation Results

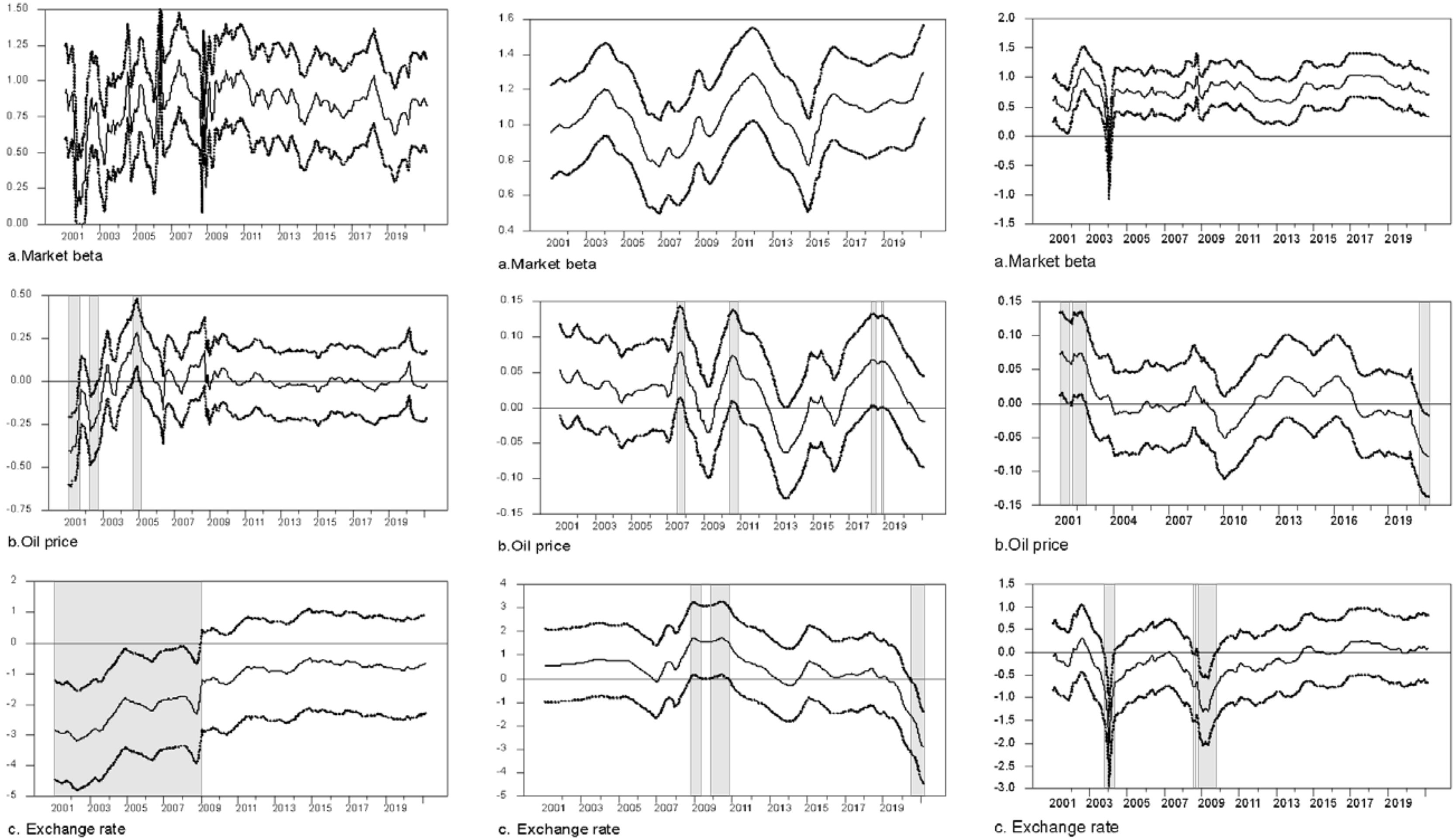
Countries	Sectors	Breaks	Sub Samples	Constant (c)	Oil Price	Exchange Rate	Market Return	R^2
Brazil	*Chemicals*	4	1/02/2001 - 1/09/2009	-0.000	-0.033*	-0.179***	0.505***	0.249
			1/12/2009 - 5/19/2014	0.000	-0.006	-0.044	0.784***	
			5/20/2014 - 2/07/2018	0.001	0.052*	0.173**	0.471***	
			2/08/2018 - 3/22/2021	0.000	0.009	0.09	0.940***	
	Energy	5	1/02/2001 - 2/18/2005	0.000	0.070***	0.115***	0.606***	0.679
			2/21/2005 - 10/29/2008	0.000	0.241***	0.211***	0.996***	
			10/30/2008 - 10/25/2013	0.000	0.061***	-0.062	1.052***	
			10/28/2013 - 12/06/2016	0.000	0.256	-0.035	1.758***	
			12/07/2016 - 3/22/2021	0.000	0.083***	-0.023	1.311***	
	Finance	3	1/02/2001 - 12/15/2005	8.20E-05	-0.007	-0.232***	0.515***	0.744
			12/16/2005 - 5/27/2014	6.30E-05	-0.035***	-0.042*	0.845***	
			5/28/2014 - 3/22/2021	0.000	-0.037***	-0.143***	0.984***	
	Industry	4	1/02/2001 - 3/27/2006	0.000	0.011	0.000	0.378***	0.502
			3/28/2006 - 12/20/2011	0.000	0.000	-0.087***	0.613***	
			12/21/2011 - 8/01/2016	0.000	-0.011	0.041	0.508***	
			8/02/2016 - 3/22/2021	0.000	0.016*	-0.021	0.873***	
	*Transportation**	4	2/05/2002 - 10/19/2005	0.000	-0.010	-0.311***	0.230***	0.325
			10/20/2005 - 10/30/2008	-3.94E-05	-0.046	-0.059	0.782***	
			10/31/2008 - 12/02/2013	0.000	0.003	-0.055	0.436***	
			12/03/2013 - 3/22/2021	0.000	-0.016	-0.241***	0.983***	
China	*Chemicals*	4	1/02/2001 - 1/18/2006	0.000	0.004	0.691	1.064***	0.723
			1/19/2006 - 11/20/2009	0.000	0.005	0.256	0.871***	
			11/23/2009 - 8/27/2015	0.000	0.059***	0.166	1.016***	
			8/28/2015 - 3/22/2021	4.40E-05	0.001	0.062	1.169***	
	Energy	3	1/02/2001 - 4/30/2008	0.000	0.017	0.644*	1.015***	0.599
			5/01/2008 - 6/26/2015	0.000	0.002	0.128	0.888***	
			6/29/2015 - 3/22/2021	0.000	0.017**	-0.019	0.723***	
	Finance	3	1/02/2001 - 4/10/2012	-5.32E-06	-0.008	-0.223	1.008***	0.791
			4/11/2012 - 4/24/2015	0.000	-0.013	0.049	1.129***	
			4/27/2015 - 3/22/2021	1.84E-05	0.002	-0.216**	0.871***	
	Industry	3	1/02/2001 - 6/30/2004	-0.001***	-0.012	-8.642	0.858***	0.857
			7/01/2004 - 1/13/2011	-5.15E-05	-0.008	0.416***	1.016***	
			1/14/2011 - 3/22/2021	-1.71E-05	-0.003	0.031	1.117	
	*Transportation**	3	1/02/2001 - 2/15/2007	3.98E-05	0.004	0.065	0.791***	0.668
			2/16/2007 - 7/29/2015	-2.66E-05	-0.011	0.304	0.961***	
			7/30/2015 - 3/22/2021	0.000	-0.001	-0.293***	0.814***	

Table 3. Bai-Perron Estimation Results (continued)

Countries	Sectors	Breaks	Sub Samples	Constant (c)	Oil Price	Exchange Rate	Market Return	R^2
India	*Chemicals*	2	1/02/2001 - 1/29/2004 1/30/2004 - 3/22/2021	0.000 0.000	-0.060*** -0.009	0.537 0.557	0.469*** 0.805***	0.313
	Energy	2	1/02/2001 - 1/13/2004 1/14/2004 - 3/22/2021	0.001*** 0.000	0.008 0.006	0.014 -0.021	0.922*** 1.016***	0.625
	Finance	4	1/02/2001 - 1/28/2004 1/29/2004 - 2/14/2008 2/15/2008 - 2/05/2015 2/06/2015 - 3/22/2021	0.000** 9.83e-05 0.0000 -5.90E-05	0.000 -0.003 -0.039*** 0.003	-0.134 -0.331*** -0.079** -0.155**	0.748*** 1.078*** 1.333*** 1.196***	0.814
	Industry	3	1/02/2001 - 1/15/2004 1/16/2004 - 2/07/2007 2/08/2007 - 3/22/2021	0.000 0.000** 2.90E-05	0.001 0.001 -0.014***	-0.417* -0.069 -0.063**	1.128*** 0.958*** 1.041***	0.824
	*Transportation**	3	1/02/2001 - 11/27/2007 11/28/2007 - 1/28/2014 1/29/2014 - 3/22/2021	0.001 0.000 0.000	-0.047** 0.004 -0.010	0.374* 0.080 -0.067	0.635*** 0.783*** 1.168***	0.251
Russia	*Chemicals*	4	1/02/2001 - 9/29/2005 9/30/2005 - 4/15/2009 4/16/2009 - 12/27/2012 12/28/2012 - 3/22/2021	0.000 0.000 0.000 0.000*	-0.034 -0.040* 0.101** -0.010	-0.344 -0.335*** 0.092 0.009	0.103*** 0.349*** 0.692*** 0.196***	0.148
	Energy	4	1/02/2001 - 4/04/2006 4/05/2006 - 9/16/2011 9/19/2011 - 12/25/2014 12/26/2014 - 3/22/2021	0.000 0.000 4.15E-05 -8.75E-05	0.065*** 0.039*** 0.037 0.029***	-0.452*** 0.118*** 0.035 0.065***	0.819*** 1.015*** 0.874*** 1.074***	0.807
	Finance	4	1/02/2001 - 10/24/2005 10/25/2005 - 3/13/2009 3/16/2009 - 7/26/2012 7/27/2012 - 3/22/2021	0.001*** 0.000 0.000 -6.78E-05	0.001 -0.071*** -0.055* -0.025***	-0.649*** -0.132 -0.270*** -0.331***	0.649*** 0.982*** 1.170*** 0.959***	0.670
	Industry	4	1/02/2001 - 11/23/2005 11/24/2005 - 10/13/2011 10/14/2011 - 1/04/2018 1/05/2018 - 3/22/2021	0.000*** 0.000 -8.58E-05 6.19E-05	0.014 0.013 0.008 0.013**	-0.279** -0.030 0.056*** 0.058*	0.507*** 0.943*** 0.832*** 0.961***	0.822
	*Transportation**	4	1/02/2001 - 10/21/2008 10/22/2008 - 12/12/2014 12/15/2014 - 1/29/2018 1/30/2018 - 3/22/2021	0.000 0.000 0.000 0.000	0.025 0.014 0.058* -0.011	-0.405** -0.094 0.301*** -0.211***	0.356*** 0.644*** 0.411*** 0.392***	0.222

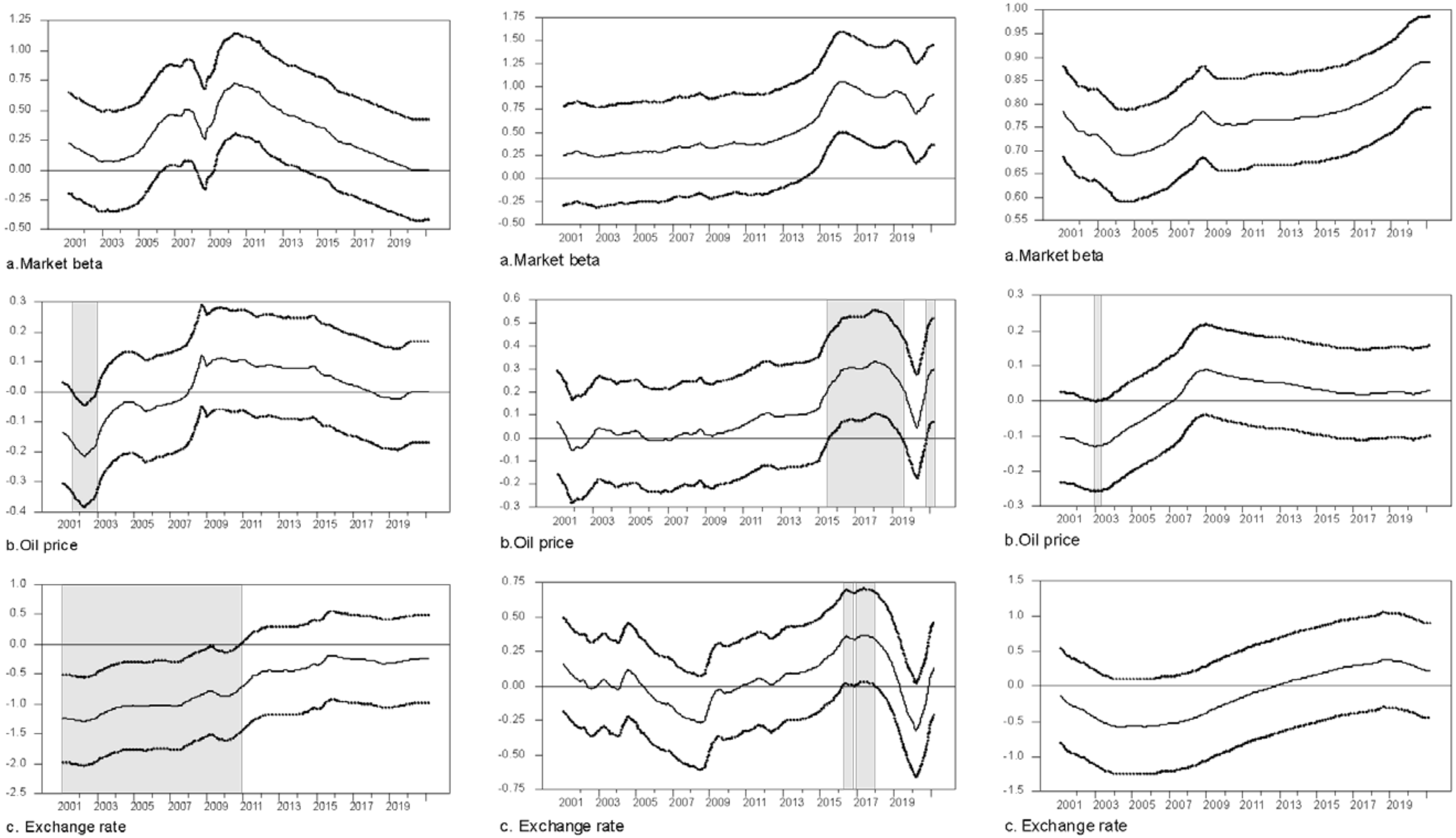
Table 3. Bai-Perron Estimation Results (continued)

Countries	Sectors	*Breaks*	*Sub-samples*	Constant (c)	Oil Price	Exchange Rate	Market Return	R^2
South Africa	*Chemicals*	3	1/02/2001 - 2/24/2015	0.000	0.009	-0.072***	0.309***	0.167
			2/25/2015 - 3/07/2018	-8.46e-05	0.203***	0.247***	1.101***	
			3/08/2018 - 3/22/2021	0.000	0.037***	0.011	0.806***	
	Energy	4	1/02/2001 - 5/04/2004	0.000	0.102***	0.208***	0.834***	0.442
			5/05/2004 - 10/02/2014	7.11E-05	0.122***	0.014	1.102***	
			10/03/2014 - 3/07/2018	0.000	0.224***	0.218***	1.164***	
			3/08/2018 - 3/22/2021	0.000*	0.096***	-0.041	1.359***	
	Finance	4	1/02/2001 - 10/19/2005	0.000	-0.014	-0.232***	0.655***	0.575
			10/20/2005 - 1/30/2009	0.000	-0.133***	-0.305***	-0.730***	
			2/02/2009 - 10/19/2015	0.000	-0.059***	-0.147***	0.869***	
			10/20/2015 - 3/22/2021	0.000	-0.028***	-0.583***	0.997***	
	Industry	4	1/02/2001 - 6/10/2005	-9.19E-05	-0.022*	-0.166***	0.559***	0.462
			6/13/2005 - 3/07/2013	1.77E-06	-0.013	-0.081***	0.681***	
			3/08/2013 - 8/15/2016	4.80E-05	-0.047***	-0.326***	0.977***	
			8/16/2016 - 3/22/2021	0.000**	-0.021***	-0.483***	0.820***	
	*Transportation**	4	1/02/2001 - 1/12/2006	0.000	0.007	-0.089**	0.232***	0.284
			1/13/2006 - 4/29/2013	-9.19E-05	-0.018	-0.223***	0.677***	
			4/30/2013 - 9/26/2016	0.000	0.004	-0.505***	1.018***	
			9/27/2016 - 3/20/2020	0.000	0.007	-0.336***	0.700***	
Turkey	*Chemicals*	3	1/02/2001 - 7/01/2005	-4.49e-05	-0.012	-0.056	0.737***	0.310
			7/04/2005 - 1/20/2009	0.002***	0.043	-0.540***	0.774***	
			1/21/2009 - 3/22/2021	0.000	0.006	0.180***	0.803***	
	Energy	3	1/02/2001 - 2/06/2004	0.000	-0.041**	0.152***	0.950***	0.651
			2/09/2004 - 12/01/2015	-7.83E-05	0.021*	-0.036	0.804***	
			12/02/2015 - 3/22/2021	0.000	0.025***	0.076**	0.946***	
	Finance	3	1/02/2001 - 5/03/2004	0.000	0.012	-0.032**	1.076***	0.854
			5/04/2004 - 1/08/2018	-8.43e-05	-0.007	-0.002	1.164***	
			1/09/2018 - 3/22/2021	0.000	0.001	-0.185***	1.065***	
	Industry	4	1/02/2001 - 2/24/2005	2.46E-05	-0.007	0.041**	0.986***	0.675
			2/25/2005 - 9/10/2008	9.31E-05	-0.001	-0.158***	0.587***	
			9/11/2008 - 6/12/2013	0.000	-0.005	-0.220***	0.756***	
			6/13/2013 - 3/22/2021	-3.19E-06	0.006	0.187***	0.732***	
	*Transportation**	4	1/02/2001 - 1/19/2004	0.000	-0.077***	0.068**	0.797***	0.501
			1/20/2004 - 9/09/2009	6.67E-05	-0.023	-0.235***	0.665***	
			9/10/2009 - 7/15/2016	0.000	-0.113***	-0.069	1.012***	
			7/18/2016 - 3/22/2021	0.000	-0.009	0.074	1.291***	



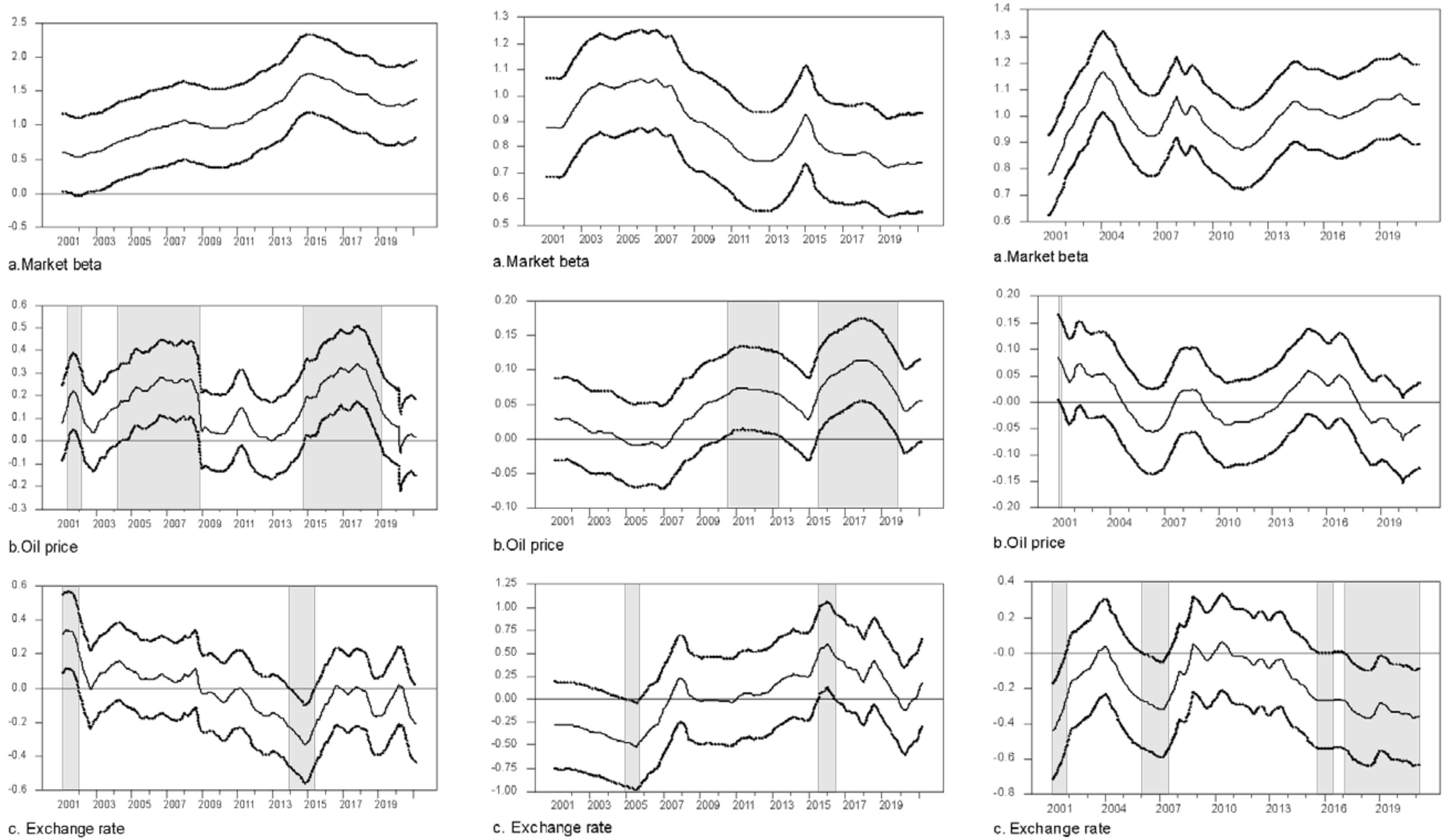
I) Brazil II) China III) India

Figure 1. Time varying parameters: Chemical



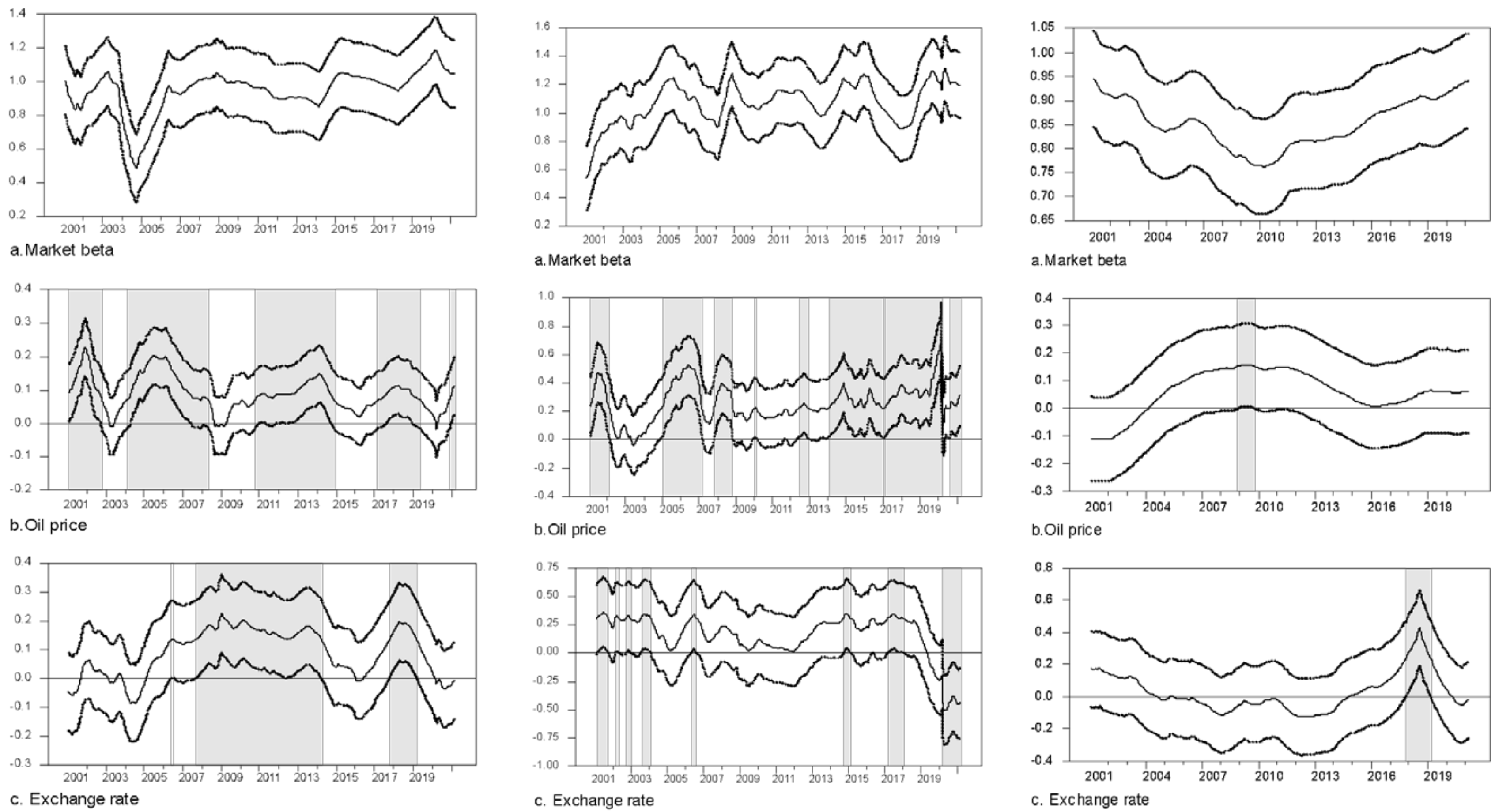
IV) Russia V) South Africa VI) Turkey

Figure 1. Time varying parameters: Chemicals (Continued)



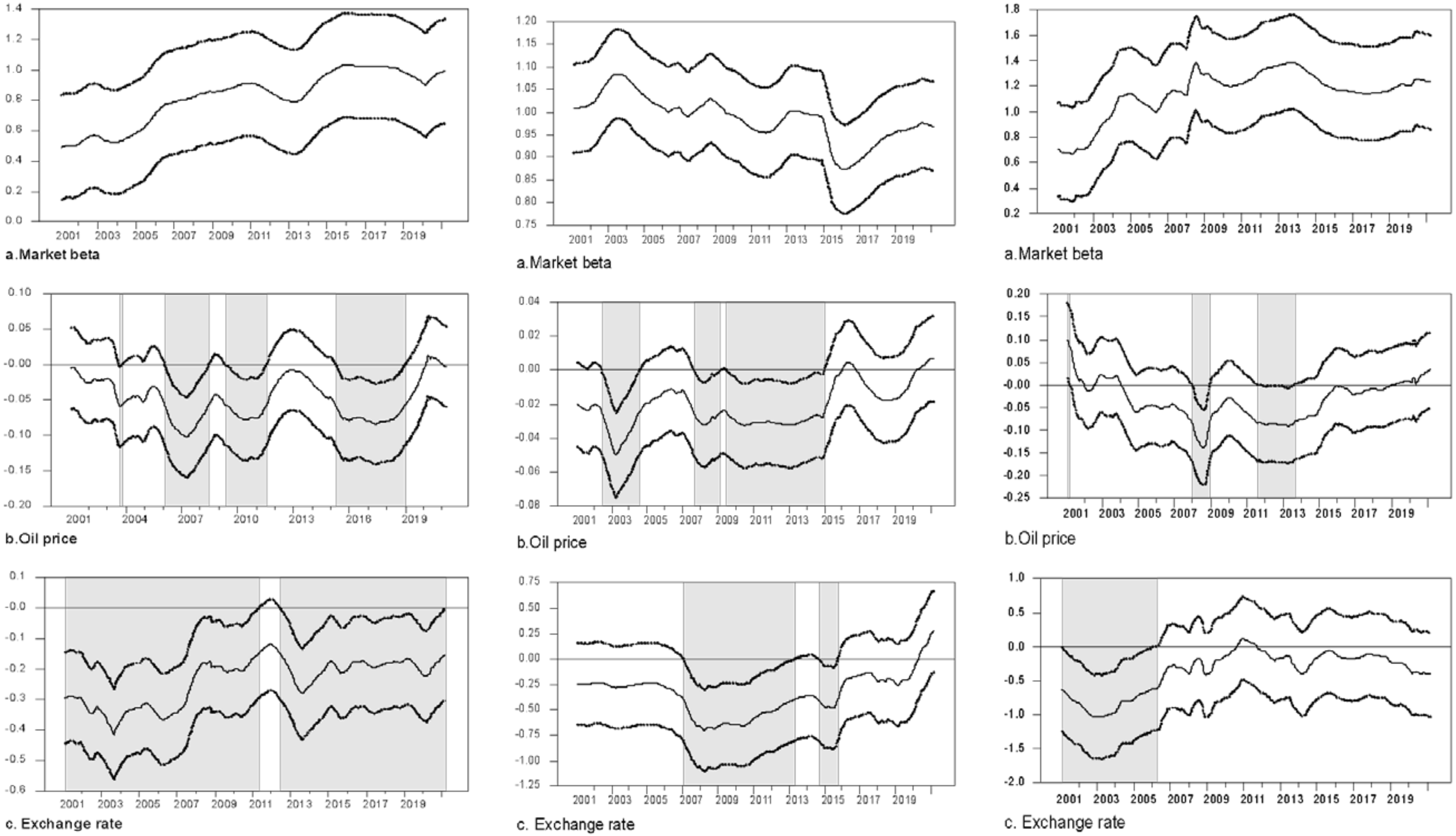
I) Brazil II) China III) India

Figure 2. Time varying parameters: Energy



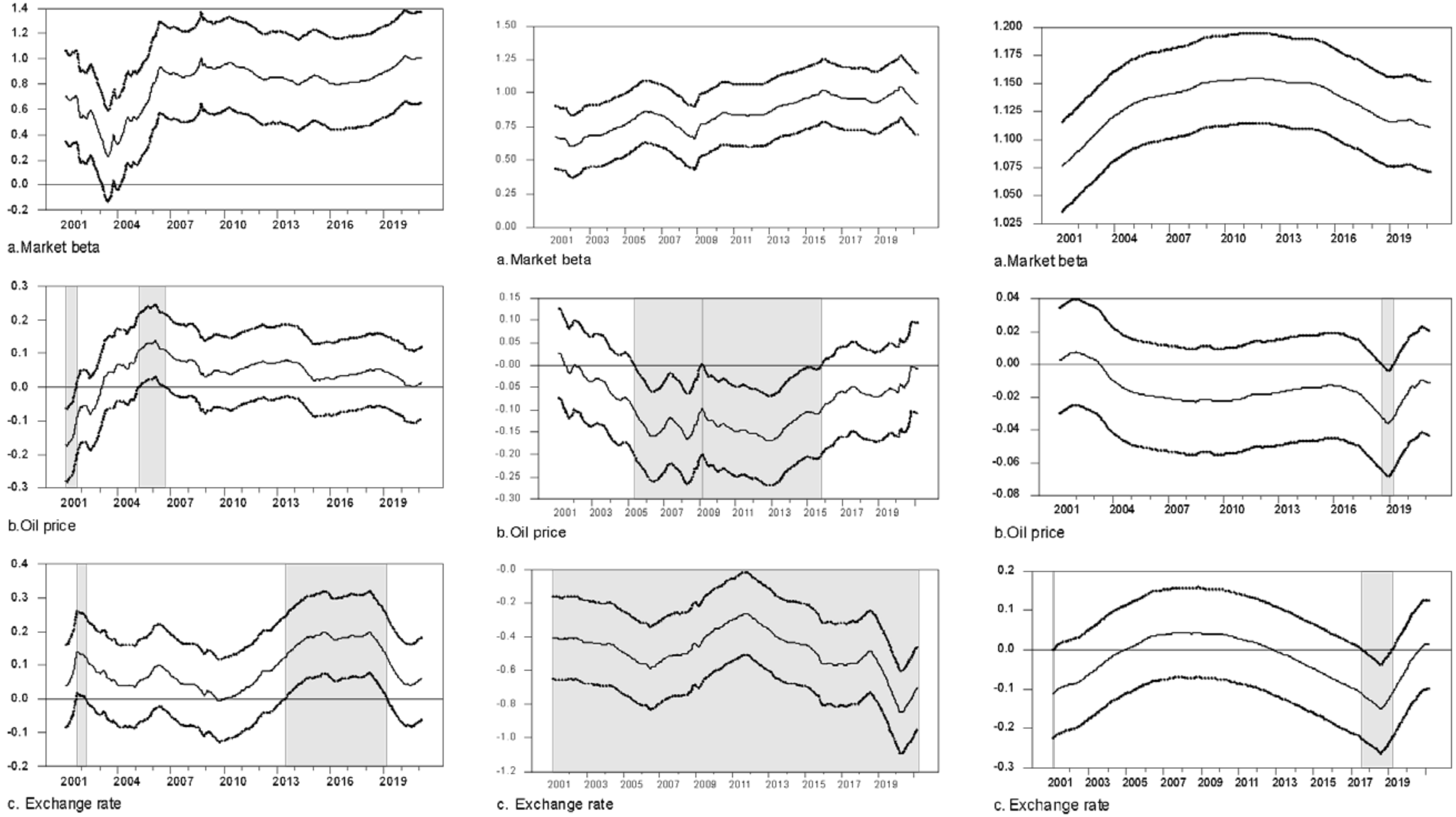
IV) Russia V) South Africa VI) Turkey

Figure 2. Time varying parameters: Energy (Continued)



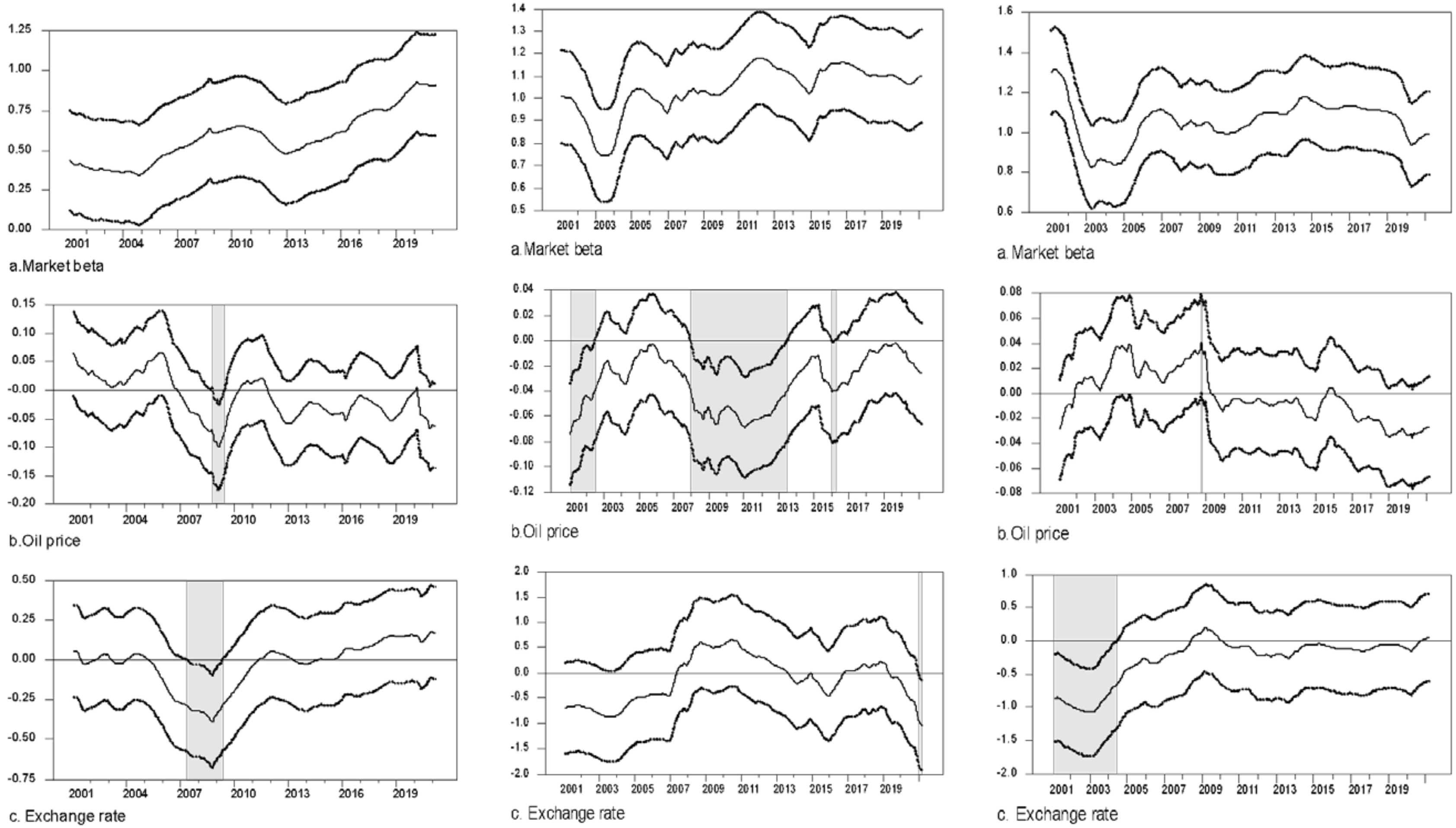
I) Brazil II) China III) India

Figure 3. Time varying parameters: Financial



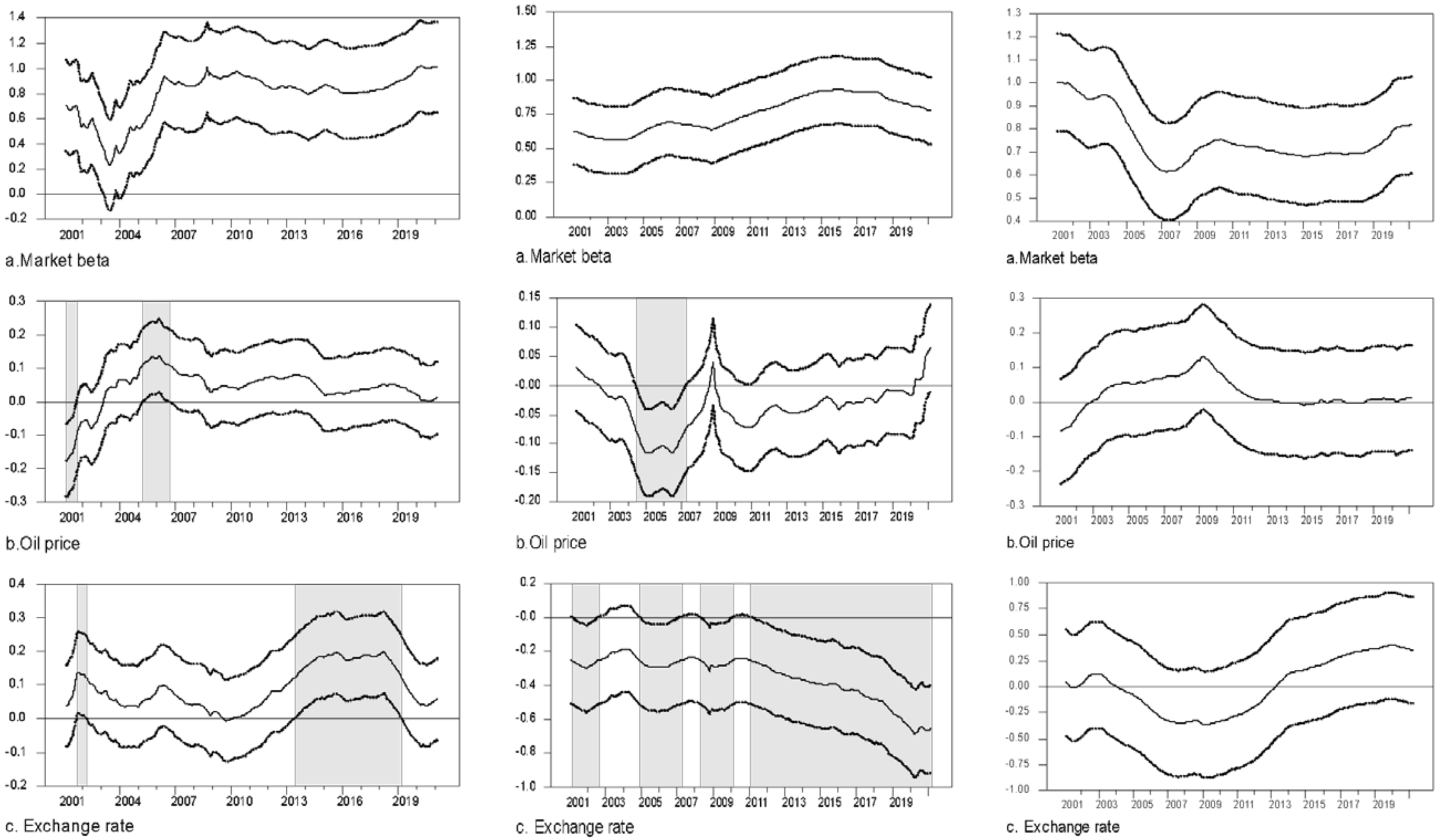
IV) Russia V) South Africa VI) Turkey

Figure 3. Time varying parameters: Financial (Continued)



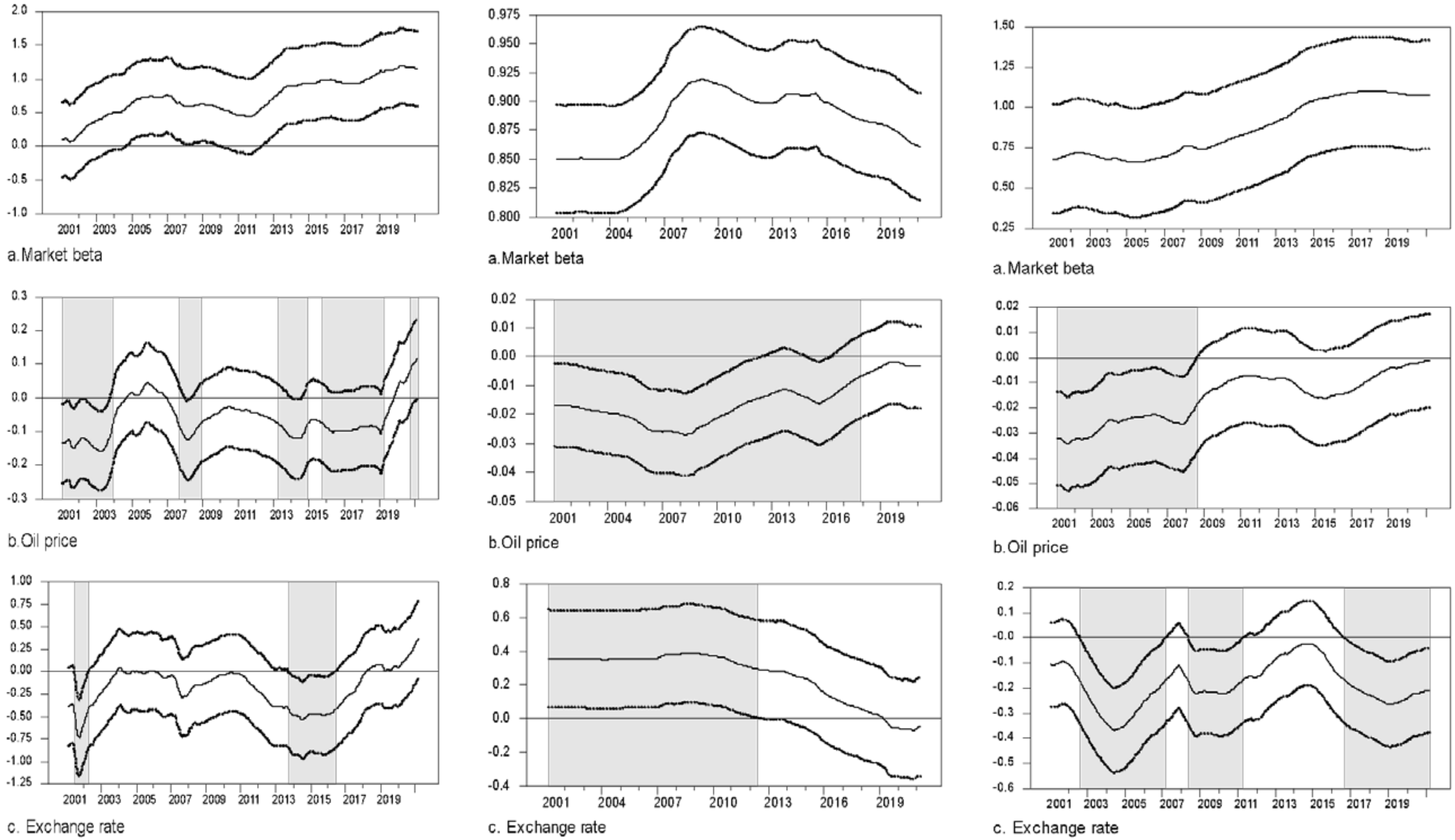
I) Brazil II) China III) India

Figure 4. Time varying parameters: Industrials



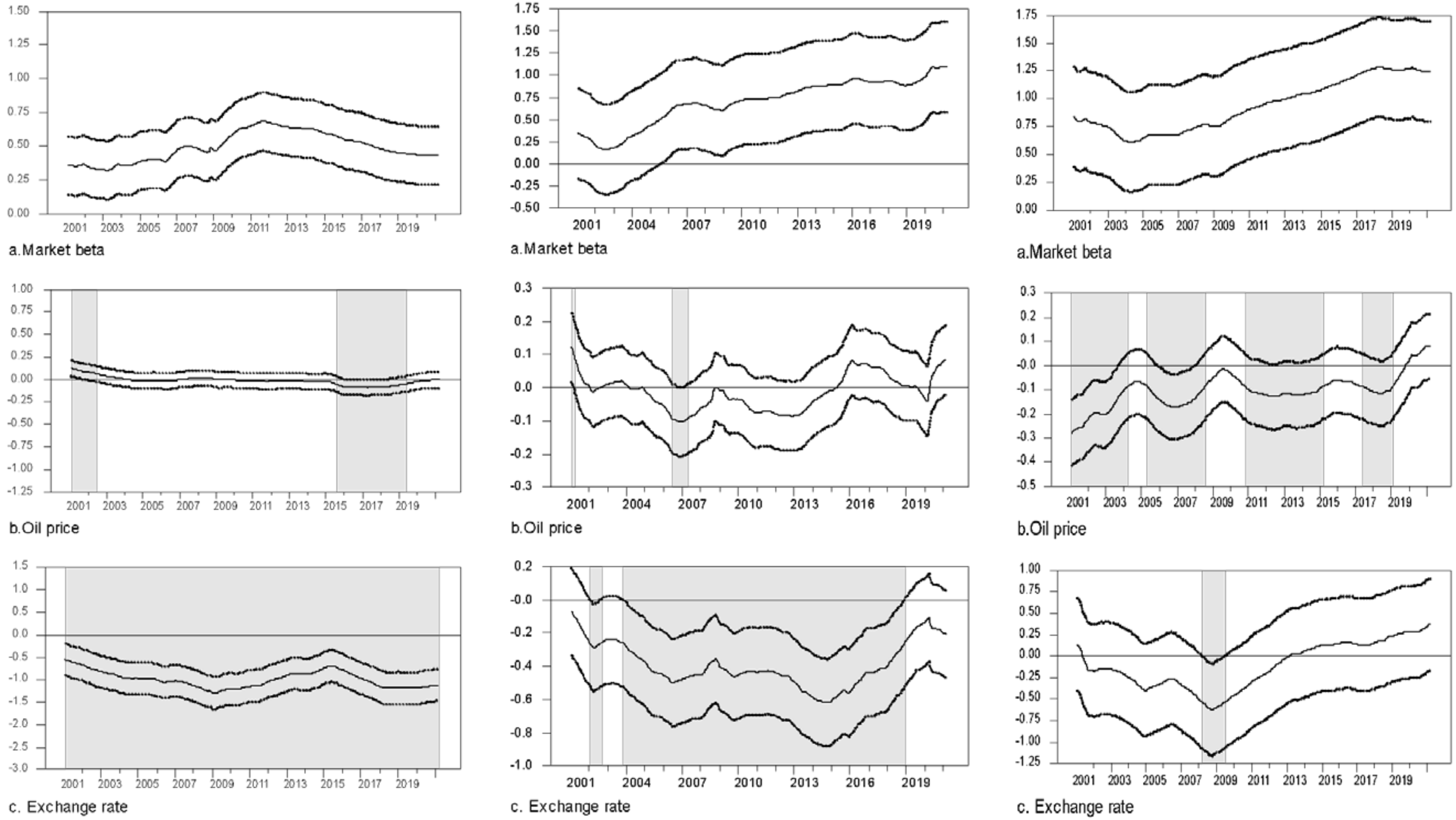
IV) Russia V) South Africa VI) Turkey

Figure 4. Time varying parameters: Industrials (Continued)



I) Brazil II) China III) India

Figure 5. Time varying parameters: Transportation



IV) Russia V) South Africa VI) Turkey

Figure 5. Time varying parameters: Transportation (Continued)

Table-4. Descriptive Statistics for the Time-Varying Parameters

		Brazil					China			
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.825	0.164	0.117	1.595	$\beta_{im.t}$	1.047	0.131	0.761	1.300
Chemical	$\beta_{ioil.t}$	-0.008	0.099	-0.417	0.284	$\beta_{ioil.t}$	0.020	0.032	-0.064	0.079
	$\beta_{ier.t}$	-1.443	0.806	-3.210	-0.508	$\beta_{ier.t}$	0.391	0.770	-2.928	1.716
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	1.125	0.347	0.526	1.760	$\beta_{im.t}$	0.871	0.116	0.721	1.061
Energy	$\beta_{ioil.t}$	0.151	0.102	-0.053	0.340	$\beta_{ioil.t}$	0.047	0.036	-0.013	0.114
	$\beta_{ier.t}$	-0.023	0.138	-0.332	0.342	$\beta_{ier.t}$	0.005	0.287	-0.521	0.595
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.817	0.171	0.483	1.030	$\beta_{im.t}$	0.985	0.049	0.873	1.083
Financial	$\beta_{ioil.t}$	-0.049	0.028	-0.104	0.012	$\beta_{ioil.t}$	-0.021	0.012	-0.050	0.006
	$\beta_{ier.t}$	-0.241	0.075	-0.418	-0.121	$\beta_{ier.t}$	-0.347	0.201	-0.710	0.272
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.575	0.158	0.342	0.928	$\beta_{im.t}$	1.040	0.104	0.741	1.178
Industrial	$\beta_{ioil.t}$	-0.014	0.037	-0.100	0.066	$\beta_{ioil.t}$	-0.033	0.020	-0.074	-0.002
	$\beta_{ier.t}$	-0.033	0.145	-0.391	0.173	$\beta_{ier.t}$	-0.136	0.450	-1.049	0.637
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.703	0.278	0.042	1.192	$\beta_{im.t}$	0.884	0.023	0.849	0.918
Transportation	$\beta_{ioil.t}$	-0.062	0.059	-0.160	0.113	$\beta_{ioil.t}$	-0.016	0.007	-0.027	-0.002
	$\beta_{ier.t}$	-0.181	0.215	-0.739	0.355	$\beta_{ier.t}$	0.246	0.145	-0.076	0.382

Table-4. Descriptive Statistics for the Time-Varying Parameters (Continued)

	India					Russia				
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.774	0.188	-0.730	1.157	$\beta_{im.t}$	0.301	0.210	-0.003	0.717
Chemical	$\beta_{ioil.t}$	0.003	0.030	-0.077	0.075	$\beta_{ioil.t}$	0.003	0.085	-0.216	0.121
	$\beta_{ier.t}$	-0.220	0.368	-2.229	0.301	$\beta_{ier.t}$	-0.686	0.368	-1.304	-0.194
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.994	0.076	0.773	1.164	$\beta_{im.t}$	0.948	0.123	0.485	1.188
Energy	$\beta_{ioil.t}$	-0.001	0.040	-0.074	0.084	$\beta_{ioil.t}$	0.086	0.051	-0.018	0.227
	$\beta_{ier.t}$	-0.180	0.135	-0.444	0.063	$\beta_{ier.t}$	0.087	0.081	-0.090	0.224
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	1.140	0.184	0.662	1.384	$\beta_{im.t}$	0.789	0.181	0.226	1.019
Financial	$\beta_{ioil.t}$	-0.036	0.042	-0.139	0.098	$\beta_{ioil.t}$	0.041	0.054	-0.176	0.137
	$\beta_{ier.t}$	-0.375	0.308	-1.039	0.112	$\beta_{ier.t}$	0.090	0.061	-0.007	0.198
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	1.053	0.105	0.825	1.316	$\beta_{im.t}$	0.789	0.181	0.226	1.019
Industrial	$\beta_{ioil.t}$	-0.002	0.020	-0.037	0.040	$\beta_{ioil.t}$	0.041	0.054	-0.176	0.137
	$\beta_{ier.t}$	-0.275	0.329	-1.077	0.191	$\beta_{ier.t}$	0.090	0.061	-0.007	0.198
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.869	0.169	0.657	1.101	$\beta_{im.t}$	0.490	0.108	0.320	0.681
Transportation	$\beta_{ioil.t}$	-0.016	0.009	-0.034	-0.001	$\beta_{ioil.t}$	-0.020	0.043	-0.096	0.120
	$\beta_{ier.t}$	-0.187	0.084	-0.369	-0.022	$\beta_{ier.t}$	-1.003	0.178	-1.299	-0.550

Table-4. Descriptive Statistics for the Time-Varying Parameters (Continued)

		South Africa					Turkey			
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.516	0.272	0.225	1.043	$\beta_{im.t}$	0.767	0.049	0.689	0.888
Chemical	$\beta_{ioil.t}$	0.099	0.113	-0.059	0.330	$\beta_{ioil.t}$	0.002	0.064	-0.130	0.088
	$\beta_{ier.t}$	0.032	0.169	-0.326	0.363	$\beta_{ier.t}$	-0.126	0.337	-0.581	0.373
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	1.066	0.139	0.517	1.312	$\beta_{im.t}$	0.852	0.049	0.762	0.945
Energy	$\beta_{ioil.t}$	0.254	0.126	-0.047	0.761	$\beta_{ioil.t}$	0.058	0.076	-0.115	0.157
	$\beta_{ier.t}$	0.151	0.185	-0.509	0.356	$\beta_{ier.t}$	0.024	0.118	-0.131	0.432
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.841	0.116	0.601	1.047	$\beta_{im.t}$	1.132	0.020	1.076	1.155
Financial	$\beta_{ioil.t}$	-0.095	0.050	-0.169	0.026	$\beta_{ioil.t}$	-0.016	0.009	-0.036	0.007
	$\beta_{ier.t}$	-0.484	0.123	-0.851	-0.262	$\beta_{ier.t}$	-0.028	0.057	-0.153	0.044
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.749	0.123	0.555	0.932	$\beta_{im.t}$	0.757	0.105	0.614	1.001
Industrial	$\beta_{ioil.t}$	-0.039	0.037	-0.116	0.064	$\beta_{ioil.t}$	0.025	0.044	-0.086	0.131
	$\beta_{ier.t}$	-0.354	0.128	-0.687	-0.187	$\beta_{ier.t}$	0.003	0.256	-0.369	0.394
		Mean	S.E.	Min	Max		Mean	S.E.	Min	Max
	$\beta_{im.t}$	0.695	0.254	0.161	1.092	$\beta_{im.t}$	0.933	0.225	0.608	1.281
Transportation	$\beta_{ioil.t}$	-0.017	0.052	-0.105	0.119	$\beta_{ioil.t}$	-0.104	0.067	-0.279	0.076
	$\beta_{ier.t}$	-0.392	0.131	-0.620	-0.074	$\beta_{ier.t}$	-0.115	0.268	-0.634	0.364

Appendix

Table 1: Data Sources and Description

Countries/ Variable	**Brazil**	**China**	**India**	**Russia**	**South Africa**	**Turkey**
Sectoral stock index	-DS	-DS	-DS	-DS -Red Star Financials -FTSE	-DS -FTSE	-DS -BIST
Exchange rate	Brazilian real to US dollar	Chinese yuan to US dollar	Indian rupee to US dollar	Russian rouble to US dollar	South Africa rand to US dollar	New Turkish lira to US dollar
Benchmark Stock index	Brazil Bovespa	Shanghai stock exchange	Nifty 500	Moex Russia	FTSE/JSE all share	Bist national 100
Oil price	Europe Brent Spot Price Free on Board (Dollars Per Barrel)	Europe Brent Spot Price Free on Board (Dollars Per Barrel)	Europe Brent Spot Price Free on Board (Dollars Per Barrel)	Europe Brent Spot Price Free on Board (Dollars Per Barrel)	Europe Brent Spot Price Free on Board (Dollars Per Barrel)	Europe Brent Spot Price Free on Board (Dollars Per Barrel)
Interest rate	Interbank deposit certification rate	The 3-month deposit rate	The 1-month deposit rate	The 3-month deposit rate	The 1-month deposit rate	The 1-month deposit interest rate