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A note on the interaction between stock prices and exchange rates in Middle-East economies

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ABSTRACT

Ample studies have been conducted to analyse the interaction between stock prices and exchange rates in developed and developing countries. However, studies on Middle-East economies are limited. Moreover, many existing studies test for Granger causality in a bi-variate setting which in turn leads to conflicting causality results. The goal of this study is to investigate the causal interaction between stock prices and exchange rates empirically in Iran, Kuwait, Oman and Saudi Arabia from January 2004 to December 2011. Among four Middle-East economies, we find that stock prices and exchange rates have bi-directional causality in Iran, Oman and Saudi Arabia, but the variables do not interact in Kuwait. Additionally, the recursive causality tests reveal that these relationships are stable over the analysis period. Therefore, stock prices and exchange rates affect each other at least in Iran, Oman and Saudi Arabia.

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1. Introduction

Knowledge of the actual direction of causality between stock prices and exchange rates would provide additional information to investors and/or policymakers in forecasting and monitoring stock market performance and/or exchange rates. Therefore, the causality between stock prices and exchange rates has received widespread attention in the finance and economic literature and there is a growing literature on this topic, especially after the 1997 Asian financial crisis.[1] In such a scenario, understanding and foreseeing the relationship between stock prices and exchange rates might enable policymakers to formulate appropriate policies before the spread of the crisis (Parsva, 2012).

Theoretically, there are two competing schools of thought which have essentially rooted this causal relationship. First, the traditional school of thought, also known as the flow-oriented model, articulated that exchange rates Granger-cause stock prices because appreciation (depreciation) in exchange rates would decrease (increase) the competitiveness of a firm in the global markets which in turn decrease (increase) the firm's profits and

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its stock price (e.g. Dornbusch & Fischer, 1980). Second, the portfolio balance school of thought, also known as the stock-oriented model, argued that stock prices lead exchange rates to change rather than the other way around. The model claimed that a stock price increase (decrease) would trigger massive capital inflows (outflows), thus, exchange rates would appreciate (depreciate) owing to an increase (decrease) in the demand for domestic currency (Branson, 1983; Frenkel, 1983). Therefore, the causality should be running from stock prices to exchange rates.

This study attempts to provide further evidence on the causal relationship between stock prices and exchange rates in Middle-East economies, namely Iran, Kuwait, Oman and Saudi Arabia. This study contributes to the existing literature in two directions. First, a number of studies on this topic performed Granger causality tests in a bi-variate framework (e.g. Hatemi-J & Roca, 2005; Lean, Narayan, & Smyth, 2011). Thus, these studies are likely to be biassed owing to the omission of relevant variables influencing stock prices and exchange rates (Lütkepohl, 1982). The omission of a relevant variable from a system has two effects which can force the expected value of the estimated coefficient away from the true value of the population correlation coefficient as follows. First, it might invalidate the causality inference between the variables of the incomplete system. The argument that any change in variable X causes changes in variable Y or vice versa, drawn from bivariate causality tests, may be invalid, as invalid causality inferences can result from omitting important variables (Caporale, Howells, & Soliman, 2004). Second, there is evidence that generally by omitting relevant variables, the entire estimated equation is suspect due to the likely bias in the coefficients of the variables remained in the equation (Studenmund, 2006).

The oil price and inflation rate are two important variables influencing stock prices and exchange rates. If oil is one of the inputs for production, an increase in the oil price would increase the cost of production which in turn affects the cash flow and depresses the stock prices (Arouri & Rault, 2012; Chortareas, Cipollini, & Eissa, 2011; Narayan & Narayan, 2010). Besides, Krugman (1983) articulated that an increase in the oil price would also cause the exchange rate of oil-exporting countries to appreciate via the wealth transfer effect (see also Golub, 1983). Apart from that, a rise in the inflation rate is usually accompanied by an equal rise in the domestic interest rate to cushion the inflationary effect. According to the theory of interest rate parity, the high domestic interest rate may attract foreign capital inflows and lead to domestic currency appreciation. Since inflation would rise together with interest rate according to the Fisher effect hypothesis, an increase in the inflation rate would also affect the firm's cash flow and profit and, thus, depress stock prices. Brown (2002) documented that the Middle-East is an oil-rich region that covered 65 per cent of the world reserves of crude oil. Moreover, numbers of leading oil exporters are located in this region. Therefore, change in the oil price and inflation rate would have significant implications on the stock prices and exchange rates of Middle-East economies. Motivated by these promising reasons, we investigate the causal relationship between stock prices and exchange rates in Iran, Kuwait, Oman and Saudi Arabia within a multivariate framework by including the oil price and inflation rate as additional control variables. Thus, the current plan of this study is to address and clarify the question of what the impact is on the relationship between stock prices and exchange rates of including additional relevant variables.

Beside omission of relevant variable(s), the second contribution of this study to the existing literature pertains to the use of more advanced econometric approaches to test the degree of integration and the causal relationship between stock prices and exchange rates.

Unlike the earlier studies, we employ the standard unit root test, Augmented Dickey-Fuller (ADF), as well as the unit root test with structural break advocated by Perron (1997) to determine the maximal order of integration of the series under investigation. Additionally, the causal relationship between stock prices and exchange rates may not be stable due to changes in the global economic and financial environments over time. This could also be a factor explaining the variation of results provided by the previous studies. Therefore, assessing the stability of the causal relationship between stock prices and exchange rates in Middle-East economies via the time-varying Granger causality test is essential. To the best of our knowledge, the unit root tests with structural breaks and also the time-varying Granger causality test have not been applied to this topic, particularly those relevant to the Middle-East economies.

The balance of this paper is structured as follow. A literature review of the study will be discussed in the next section. Section 3 will report the methodology and results. The conclusion of this study will be provided in Section 4.

2. Review of past literature

In an open economy, the impact of unexpected changes in exchange rates on the present value of a firm's assets, liabilities and cash flows exposes the economic value of the firm to exchange risk. This implies that exchange rates play a significant role in the movements of stock prices. In other words, stock prices of the firms that involve foreign direct investment (FDI), export and import of goods and services are likely to be influenced by exchange rate fluctuations (Soenen & Hennigar, 1988). Generally, the economic exposure of firms to exchange rate risks has increased and stock markets may respond to the excess movement and increase the volatility of exchange rates. On the other hand, exchange rates have been more sensitive to stock market movements and global portfolio investments over the past decades.

The first era of theoretical studies on the relationship between stock prices and exchange rates was sparked after the Bretton Woods agreement on the floating exchange rate system was abandoned by most countries in 1973 (Stavarek, 2005). Thus far the existing studies for the causality between stock prices and exchange rates have mainly concentrated on developed and developing economies in the Americas, Europe and Asia regions (e.g. Ajayi, Friedman, & Mehdian, 1998; Ajayi & Mougouė, 1996; Caporale, Hunter, & Menla Ali, 2014; Hatemi-J & Irandoust, 2002; Hatemi-J & Roca, 2005; Lean et al., 2011; Tsagkanos & Siriopoulos, 2013). Not much attention has been given to Middle-East economies (e.g. Chortareas et al., 2011; Parsva, 2012; Parsva & Lean, 2011). Moreover, the causality results are inconclusive among the existing studies. The plausible reasons for the conflicting causality results may be due to the omission of relevant variables and/or the instability of the causal relationship between stock prices and exchange rates. For example, Hatemi-J and Roca (2005) found that before the Asian financial crisis period, exchanges rate Granger-cause stock prices in Indonesia and Thailand, but stock prices Granger-cause exchange rates in Malaysia. During the crisis period, they failed to find any evidence of causality between stock prices and exchange rates in the ASEAN economies. In addition to that, Parsva and Lean (2011) employed the Johansen cointegration and Granger causality tests to analyse the relationship between stock prices and exchange rates in six Middle-East economies in the period before and during the global financial crisis. In sum, they found that the causality

results pre-crisis and during crisis periods are inconsistent among the Middle-East economies, except for Egypt and Oman. Clearly, the Granger causality test is very sensitive to the choice of the analysis period.

3. Methodology and Results

This study covers monthly data (from January 2004 to December 2011) of stock prices, nominal exchange rates in terms of local currency relative to the euro, crude oil price in US dollars per barrel, and the inflation rate for Iran, Kuwait, Oman and Saudi Arabia.[2] All data are obtained from Datastream, *International Financial Statistics* (IFS) and the Tehran Stock Exchange website. With the exception of the inflation rate, all data are transformed into natural logarithms.

Prior to the Granger causality test between stock prices and exchange rates, it is necessary to determine the order of d_{max}. ADF test indicates that all variables are stationary at the first difference, but there are non-stationary at the level. Therefore, the ADF test in Table 1 suggests that all variables under investigation are belong to $I(1)$ process. Nonetheless, if the series contain structural breaks, these ADF results may be not accurate (Perron, 1989). To confirm the order of integration of each series, we also employ the Perron (1997) unit root test with a break. The results of Perron test are presented in Table 2. Importantly, the Perron test finds no additional evidence against the standard ADF test. We affirm that the order of integration for all variables under investigation are $I(1)$ processes, suggesting the choice of

Table 1. The results of ADF unit root test.

	Middle-East economies			
Variables	Iran	Kuwait	Oman	Saudi Arabia
$\ln SP_t$	−1.018 (1)	−2.031 (1)	−2.745 (2)	−2.599 (0)
$\Delta \ln SP_t$	−6.831 (0)***	−5.874 (0)***	−4.323 (10)***	−8.014 (0)***
$\ln EX_t$	−3.332 (2)	−3.001 (0)	−3.023 (3)	−2.352 (0)
$\Delta \ln EX_t$	−4.814 (2)***	−11.495 (0)***	−4.651 (8)***	−9.851 (0)***
$\ln OIL_t$	−2.457 (8)	−2.457 (8)	−2.457 (8)	−2.457 (8)
$\Delta \ln OIL_t$	−6.888 (0)***	−6.888 (0)***	−6.888 (0)***	−6.888 (0)***
INF_t	−1.936 (12)	−1.305 (12)	−0.962 (12)	−1.031 (12)
ΔINF_t	−3.802 (11)**	−4.324 (11)***	−4.736 (11)***	−4.114 (11)***

Note: The asterisks *** and ** denotes the significance level at 1 and 5 per cent, respectively. Δ is the first difference operator. The lag order for ADF test is to set by AIC. Figures in brackets denotes the optimal lag order. The critical values are obtained from MacKinnon (1996).
Source: Authors' calculations.

Table 2. The results of Perron (1997) unit root test with breaks.

	Iran		Kuwait		Oman		Saudi Arabia	
Variables	Statistics	TB1	Statistics	TB1	Statistics	TB1	Statistics	TB1
$\ln SP_t$	−4.102 (1)	2008:M7	−4.857 (1)	2008:M8	−4.303 (11)	2007:M9	−4.438 (8)	2008:M8
$\ln EX_t$	−3.712 (0)	2009:M11	−3.881 (0)	2008:M10	−3.448 (0)	2008:M7	−3.456 (0)	2008:M7
$\ln OIL_t$	−5.494 (12)	2008:M9	−5.494 (12)	2008:M9	−5.494 (12)	2008:M9	−5.494 (12)	2008:M9
INF_t	−2.898 (12)	2007:M8	−5.334 (12)	2007:M11	−3.339 (12)	2007:M12	−4.041 (12)	2007:M6

Critical values	$T = 70$	$T = 100$
1 per cent	−6.320	−6.210
5 per cent	−5.590	−5.860

Note: Figures in brackets denote the optimal lag order selected by t-significance. The critical values are collected from Perron (1997). This study used a model with breaks in both intercept and trend function.
Source: Authors' calculations.

$d_{\max} = 1$ is appropriate for Granger causality test introduced by Toda and Yamamoto (1995) and Dolado and Lütkepohl (hereafter TYDL).

Next, we use the TYDL Granger causality test to ascertain the direction of causality between stock prices and exchange rates. To perform this test, we estimate the following augmented VAR models in level:

$$\begin{aligned}\ln \mathrm{SP}_t = {} & \alpha_1 + \sum_{i=1}^{k} \beta_i \ln \mathrm{SP}_{t-i} + \sum_{j=k+1}^{p} \beta_j' \ln \mathrm{SP}_{t-j} + \sum_{i=1}^{k} \delta_i \ln \mathrm{EX}_{t-i} + \sum_{j=k+1}^{p} \delta_j' \ln \mathrm{EX}_{t-j} \\ & + \sum_{i=1}^{k} \phi_i \ln \mathrm{OIL}_{t-i} + \sum_{j=k+1}^{p} \phi_j' \ln \mathrm{OIL}_{t-j} + \sum_{i=1}^{k} \varphi_i \mathrm{INF}_{t-i} + \sum_{j=k+1}^{p} \varphi_j' \mathrm{INF}_{t-j} + \xi_{1t}\end{aligned} \tag{1}$$

$$\begin{aligned}\ln \mathrm{EX}_t = {} & \alpha_2 + \sum_{i=1}^{k} \gamma_i \ln \mathrm{EX}_{t-i} + \sum_{j=k+1}^{p} \gamma_j' \ln \mathrm{EX}_{t-j} + \sum_{i=1}^{k} \eta_i \ln \mathrm{SP}_{t-i} + \sum_{j=k+1}^{p} \eta_j' \ln \mathrm{SP}_{t-j} \\ & + \sum_{i=1}^{k} \lambda_i \ln \mathrm{OIL}_{t-i} + \sum_{j=k+1}^{p} \lambda_j' \ln \mathrm{OIL}_{t-j} + \sum_{i=1}^{k} \theta_i \mathrm{INF}_{t-i} + \sum_{j=k+1}^{p} \theta_j' \mathrm{INF}_{t-j} + \xi_{2t}\end{aligned} \tag{2}$$

where ln is the natural logarithm and the residuals (ξ_{1t}, ξ_{2t}) are assumed to be normally distributed and non-serially corrected. k is the optimal lag structure of the VAR models selected by the multivariate Akaike Information Criterion (AIC), while $p = (k + d_{\max})$. $d_{\max}$ is the maximal order of integration of the series. Here, we specify $d_{\max} = 1$ in our study because our unit root tests results suggest that all variables are $I(1)$. Moreover, the Monte Carlo simulation results in Dolado and Lütkepohl (1996) also confirmed that $d_{\max} = 1$ is superior to other order of $d_{\max}$. From equation (1), $\delta_1 \neq \delta_2 \neq \cdots \neq \delta_i \neq 0$, implying that exchange rates Granger-cause stock prices (i.e. supporting the traditional approach), whereas from equation (2), $\eta_1 \neq \eta_2 \neq \cdots \neq \eta_i \neq 0$, indicating stock prices Granger-cause exchange rates (i.e. supporting the portfolio-balance approach). The results of TYDL Granger causality test are reported in Table 3. The results indicate that stock prices and exchange rates have bi-directional causality in Iran, Oman and Saudi Arabia. Nevertheless, we find that for the case of Kuwait there is no causality flow in any direction.

In addition to the TYDL Granger causality test, we also incorporate the time-varying procedure to verify the stability of the causal relationship between stock prices and exchange rates. One of the advantages of using TYDL Granger causality test is that it can be applied without knowing the unit root and cointegration properties. Toda and Yamamoto (1995) suggested estimating a vector autoregressive (VAR) model in level with lag k then augmented it with an additional lag determined by the maximal order of integration, $d_{\max}$. In doing so, the statistical inference can be made based upon the standard asymptotic distribution.

To this end, we tested the direction of causality with full sample, while the causal relationships between stock prices and exchange rates may be unstable due to the frequent change of

Table 3. The results of TYDL Granger causality test.

	Likelihood ratio (LR) test statistics			
	Iran	Kuwait	Oman	Saudi Arabia
Null hypotheses	$k = 12, p = 13$	$k = 3, p = 4$	$k = 12, p = 13$	$k = 12, p = 13$
$\ln \mathrm{EX}_t \nrightarrow \ln \mathrm{SP}_t$	52.0081***	1.1486	24.8706**	22.9398**
$\ln \mathrm{SP}_t \nrightarrow \ln \mathrm{EX}_t$	41.2179***	2.2231	23.0333**	39.5837***

Note: *** and ** denote rejection at the 1 and 5 per cent significance levels, respectively. The Lagrange Multiplier (LM) test suggest that the selected VAR models for causality test are free from serial correlation problem up to order eight.
Source: Authors' calculations.

global economic and financial environments (Tang, 2008). Policy-making based upon this result may be inappropriate. To address the stability issue for the causality between stock prices and exchange rates, we extend our study by conducting the recursive-based TYDL Granger causality test proposed by Tang (2008). The advantage of using the recursive instead of rolling-based TYDL Granger causality test is that the latter is subjected to the problem of choosing best rolling window where the choice is likely to be arbitrated. Owing to this limitation, some recent studies such as Tang (2013, 2015) and Tang and Tan (2013, 2015) used the recursive-based causality test. To perform the recursive-based TYDL Granger causality test, we set the initial sample size T and adding one new observation to the end of the sample (i.e. T+1). This process will continue until the last observation is consumed. With this procedure, we compute the Likelihood Ratio (LR) statistics for each sub-sample. The plots of 10 per cent normalised LR statistics for H_0: ln EX $\nrightarrow$ ln SPand H_0: ln SP $\nrightarrow$ ln EX are depicted in Figure 1 and Figure 2, respectively.

The null hypothesis of non-Granger causality can be rejected if the normalised LR statistic is above the unity line. By and large, we find that the causal relationship between stock prices and exchange rates are stable because the causality inferences for each sub-sample are consistent. Specifically, we observe that the plots of normalised LR statistics for Iran, Oman and Saudi Arabia fluctuated above the unity line while the normalised LR statistics for Kuwait tended to fluctuate below the unit line in all sub-sample period. Unlike Ajayi et al. (1998), Hatemi-J and Roca (2005) and Lean et al. (2011), we confirm that there is a stable bi-directional causality between stock prices and exchange rates in Iran, Oman and Saudi Arabia. However, there is also a stable neutral causality in the case Kuwait and this is contrary to the finding of Parsva and Lean (2011). In sum, our empirical results show supportive evidence of traditional and also portfolio-balance approaches at least for Iran, Oman and Saudi Arabia.

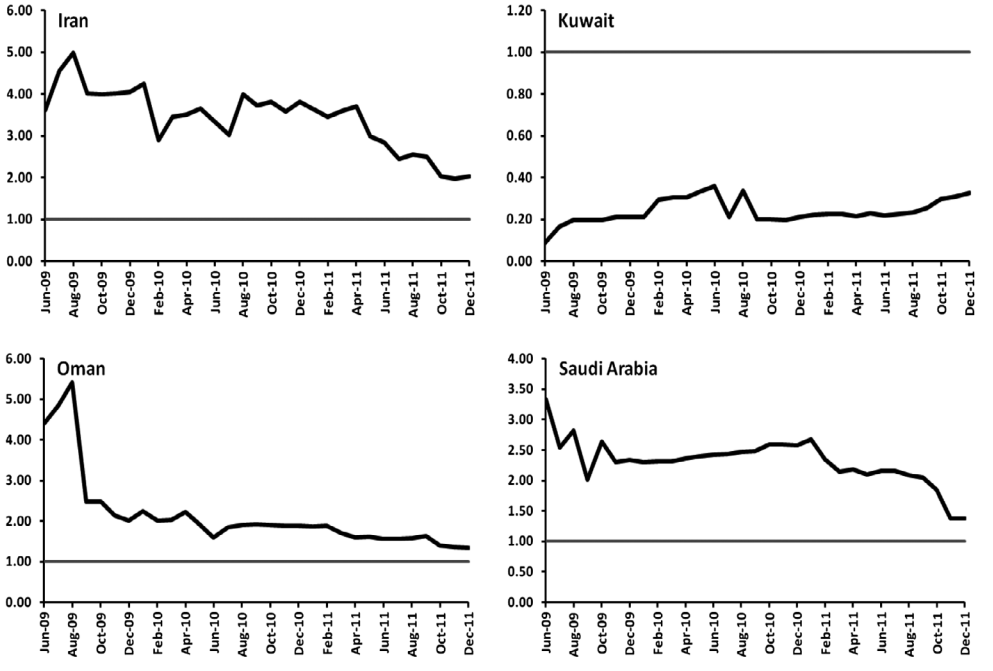

Figure 1. H_0: ln EX $\nrightarrow$ ln SP(Traditional approach view). Source: Authors' calculations.

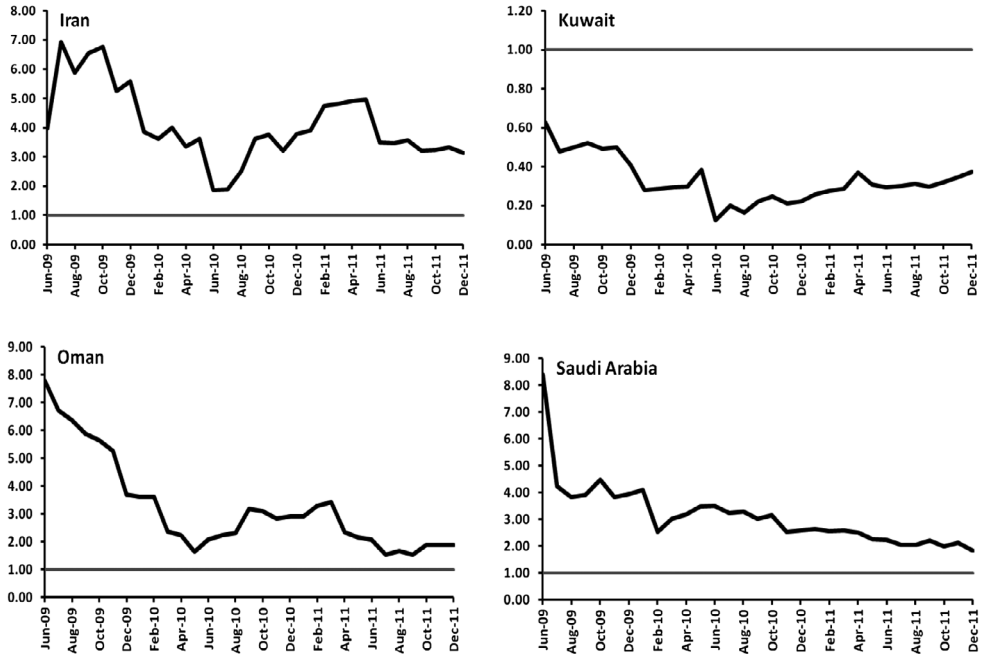

Figure 2. H_0: ln SP $\nrightarrow$ ln EX(Portfolio-balance approach view). Source: Authors' calculations.

4. Conclusion

We examined the causal relationship between stock prices and exchange rates in Iran, Kuwait, Oman and Saudi Arabia using a multivariate framework. The TYDL Granger causality results revealed that stock prices and exchange rates in Iran, Oman and Saudi Arabia are closely interacting. In other words, all sample countries follow both traditional and portfolio-balance approaches. Nevertheless, stock prices and exchange rates in Kuwait interact loosely because we do not find any evidence of causality between them, so Kuwait follows neither traditional nor portfolio-balance approaches. Moreover, the recursive-based causality results affirm that these causal relationships are stable in the selected countries. Therefore, investors may be able to forecast the stock market's performance based upon the exchange rate pattern or the other way around. Furthermore, economic policymakers may be able to stimulate the stock market's performance at least in Iran, Oman and Saudi Arabia by adjusting the exchange rates. It is also worth believing that this close relationship allows policymakers to predict the currency crises based upon the stock market's performance. Therefore, alternative policies could be implemented before such a crisis, such as reinforcing financial market transparency and accountability in the countries under review to prevent high volatility in stock prices and unreliable movements in currency value in the foreign exchange market (Parsva, 2012). Moreover, other monetary and fiscal policies should also be implemented to ensure macroeconomic stability in the Middle-East economies.

However, this study is still imperfect. The newly established markets in some Middle-East countries and the lack of financial and economic data in the global databases are the main reasons that the financial time series in this area are inevitably restricted to domestic resources. Otherwise, more observations may lead the study to get more significant results.

Moreover, the implication of the results could possibly be improved by applying daily data in the multivariate model. The use of higher frequent observations will possibly better capture the dynamic nexus of the stock market and foreign exchange market.

Notes

1. It is believed that the 1997 Asian financial crisis, which started as an exchange rate crisis in Thailand and then led to the depreciation of other currencies in the region, resulted in the collapse of the stock markets (Hatemi-J & Roca, 2005; Khalid & Kawai, 2003).
2. Most of the sample countries in this paper have fixed their currencies to the US dollar. Therefore, the investigation has been conducted by using the monthly time series data of nominal exchange rate against the euro, as the euro is the second most distributed and traded currency in the world after the US dollar (Bank for International Settlements, 2007).

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Disclosure statement

No potential conflict of interest was reported by the authors.

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