The causality relationship among foreign exchange markets: Evidence from selected ASEAN countries

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ABSTRACT

In this paper, we examined the causality relationship among foreign exchange markets of selected countries from the Association of Southeast Asian Nations – Indonesia, Malaysia, the Philippines, Singapore and Thailand (ASEAN-5). The results derived from the estimations demonstrated firm interdependence between exchange rate changes and volatilities. Moreover, external shocks, such as a sharp fall in oil price, affect the causality relationship between foreign exchange markets. We argue that the external indirect effects will spill over into the foreign exchange markets of other members of the association within two weeks.

Keywords: ASEAN, foreign exchange market, exchange rate, causality.

1. Introduction

Estimation results from Sultonov's (2016) research on the causality relationship between the exchange rates of three major Asian economies (China, Japan and India) and the four major economies of Indonesia, Malaysia, the Philippines and Thailand (ASEAN) revealed significant influences: The Indonesian rupiah (IDR) was influenced by the Indian rupee; the Philippine peso (PHP) was influenced by the Japanese yen and the Indian rupee, and the Thai baht (THB) was influenced by the Chinese RMB and the Indian rupee. Significant influences regarding variances of exchange rate returns were also demonstrated on the exchange rate return volatilities in Malaysia (which was affected by the Japanese yen) and in the Philippines (which was affected by the Chinese RMB). For these estimations, Sultonov (2016) used a logarithmic return series based on the average weekly representative exchange rates for the period from January 2, 2010 to July 25, 2015.

In 2017, Sultonov's research on the response of nominal exchange rates and their volatilities to changes in crude oil prices showed a causality-in-mean from the crude oil prices to ASEAN exchange rates (excluding THB before July 1, 2014) at lags 1–5. For the period in which the crude oil prices decreased (after July 1, 2014), there was causality-in-variance from these prices (West Texas Intermediate, WTI) to the IDR at lag 5 and the Malaysian ringgit (MYR) at lags 1–5. Sultonov (2017) used a logarithmic return series based on the average weekly representative exchange rates for the period from January 4, 2012 to December 29, 2016 for these estimations.

Considering that the direct impact of external shocks on the changes and volatilities of the foreign exchange market is different in each country, we suggest the existence of an indirect impact – that of external shocks on foreign exchange markets – through the foreign exchange markets of other member countries. To assess this suggestion, we use data from Sultonov (2017) to estimate the interdependence among the foreign exchange markets of five countries in the Association of Southeast Asian Nations – Indonesia, Malaysia, the Philippines, Singapore and Thailand (ASEAN-5).

The next section presents data and models used in our estimations. Section three explains our empirical findings, and the last section concludes the paper.

2. Data and methodology

The nominal exchange rates are measured in terms of national currency per US dollar. The exchange rates are the same as those reported by the monetary authorities of Singapore, Thailand, Indonesia, Malaysia and the Philippines.

Table 1. Daily returns from January 4, 2012 to June 30, 2014

Variables	Obs.	Mean	Std. Dev.	Skewness	Kurtosis	Jarque–Bera	ADF
IDR	523	0.0005	0.0046	0.4981	15.416	3381.0***	-3.9660***
MYR	523	4.e29-05	0.0043	-0.6475	6.2985	273.60***	-5.4830***
PHP	523	9.61e-07	0.0032	0.1987	4.5888	58.450***	-5.3820***
SGD	523	-5.79e-05	0.0030	-0.1085	4.4686	48.030***	-5.9450***
THB	523	5.89e-05	0.0034	0.0992	11.445	1555.0***	-4.3220***

Note: In the Jarque–Bera test, *** indicates that the null hypothesis of 'normal distribution' was rejected at a significance level of 1%. The maximum number of lags for the ADF test selected by the Schwarz information criterion (SIC) was 18. For the ADF test, *** indicates a value smaller than the critical value at a 1% significance level.

Tables 1 and 2 show descriptive statistics of the data for two periods – before and after July 1, 2014, which is the date that marks the beginning of the fall in crude oil prices. Exchange rates had a higher rate of depreciation (excluding the IDR) and became more volatile (excluding the PHP and THB) in the second period.

Table 2. Daily logarithmic returns from July 1, 2014 to December 29, 2016

Variables	Obs.	Mean	Std. Dev.	Skewness	Kurtosis	Jarque–Bera	ADF
IDR	518	0.0002	0.0055	-0.3630	5.6458	162.50 ***	-4.9870***
MYR	518	0.0006	0.0066	-0.0957	4.6589	60.190***	-4.7430***
PHP	518	0.0002	0.0027	0.3726	3.7426	23.890***	-5.3040***
SGD	518	0.0003	0.0042	0.0441	7.8333	504.40***	-4.7720***
THB	518	0.0002	0.0030	0.2722	5.2367	114.40***	-5.0060***

Note: In the Jarque–Bera test, *** indicates that the null hypothesis of 'normal distribution' was rejected at a significance level of 1%. The maximum number of lags for the ADF test selected by the Schwarz information criterion (SIC) was 18. For the ADF test, *** indicates a values smaller than the critical value at a 1% significance level.

In the first period, the MYR and the Singapore dollar (SGD) were skewed to the left. Other variables were skewed to the right. In the second period, the IDR and MYR were skewed to the left and all other variables were skewed to the right. In both periods, the kurtosis values were higher than the standard normal distribution. The results of the Jarque–Bera and Augmented Dickey-Fuller (ADF) tests (Dickey and Fuller, 1979, 1981) validate the application of GARCH-type models to the data.

We applied the cross-correlation function (CCF) approach developed by Cheung and Ng (1996) to examine the causality relationship between the variables. First, we used the exponential generalised autoregressive conditionally heteroscedastic (EGARCH) model by Nelson (1991) to calculate the conditional mean and conditional variance. The mean equation was

$$y_t = \omega + \sum_{i=1}^{k} a_i y_{t-i} + \varepsilon_t . \quad (1)$$

The variance equation was

$$\ln(\sigma_t^2) = \omega + \sum_{i=1}^{p} (\gamma_i \varepsilon_{t-i} / \sigma_{t-i} + \alpha_i (| \varepsilon_{t-i} / \sigma_{t-i} | - (2/\pi)^{1/2})) + \sum_{i=1}^{q} \beta_i \ln(\sigma_{t-i}^2) . \quad (2)$$

Next, we used the standardised residuals and their squared values in CCF to test the causality relationship. A generalised version of Cheung and Ng's (1996) chi-square test statistic, suggested by Hong (2001), was used to test the hypothesis of no causality in the cross-correlation coefficients from lags 1 to 10.

3. Empirical findings

Table 3 shows the estimation results for the causality relationship between foreign exchange markets before July 1, 2014.

Table 3. Causality-in-mean and variance

January 4, 2012 to June 30, 2014							
Causality in Mean				Causality in Variance			
From IDR							
MYR	**PHP**	**SGD**	**THB**	**MYR**	**PHP**	**SGD**	**THB**
2.933***	24.16***	1.403*	-0.944	-1.616*	4.996***	-1.528*	-1.424*
From MYR							
IDR	**PHP**	**SGD**	**THB**	**IDR**	**PHP**	**SGD**	**THB**
7.576***	122.0***	0.912	1.032	-1.742**	18.21***	2.152**	-1.486
From PHP							
IDR	**MYR**	**SGD**	**THB**	**IDR**	**MYR**	**SGD**	**THB**
-1.054	-0.626	-0.894	-0.824	-1.480*	-1.058	-1.105	-0.888
From SGD							
IDR	**MYR**	**PHP**	**THB**	**IDR**	**MYR**	**PHP**	**THB**
3.948***	-0.645	120.7***	0.848	1.299*	-1.444*	44.25***	1.780**
From THB							
IDR	**MYR**	**PHP**	**SGD**	**IDR**	**MYR**	**PHP**	**SGD**
3.638***	-0.962	81.77***	-1.430*	-1.789**	-0.973	28.46***	-1.266

Note: The marks *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively, based on the standardised version of Cheung and Ng's (1996) chi-square test statistic proposed by Hong (2001). The table shows only the largest absolute value of chi-square test statistic within 10 lags.

According to Table 3, there was causality-in-mean from IDR to MYR, PHP and SGD; causality-in-variance from IDR to MYR, PHP, SGD and THB; causality-in-mean from MYR to IDR and PHP; causality-in-variance from MYR to IDR, PHP and SGD; causality-in-variance from PHP to IDR; causality-in-mean from SGD to IDR and PHP; causality-in-variance from SGD to IDR, MYR, PHP and THB; causality-in-mean from THB to IDR, PHP and SGD; and, finally, causality-in-variance from THB to IDR and PHP.

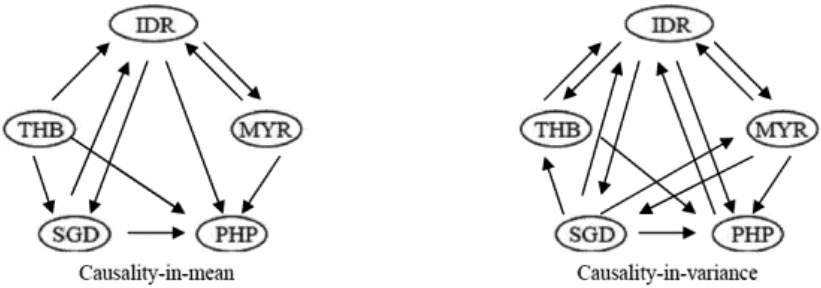

Figure 1. The interdependence among foreign exchange markets from January 4, 2012 to June 30, 2014

Figure 1 illustrates directions of causality-in-mean and variance, as presented in Table 3. It shows the bidirectional causality-in-mean between IDR and MYR, IDR and SGD, as well as unidirectional causality-in-mean between all other pairs. The figure shows the bidirectional causality-in-variance between IDR and all other exchange rates and between MYR and SGD, along with the unidirectional causality-in-variance between all other possible pairs.

Table 4. Causality-in-mean and variance

July 1, 2014 to December 29, 2016							
Causality in Mean				Causality in Variance			
From IDR							
MYR	PHP	SGD	THB	MYR	PHP	SGD	THB
0.793	56.36***	-1.185	1.855*	2.450***	3.762***	-1.528*	-0.958
From MYR							
IDR	PHP	SGD	THB	IDR	PHP	SGD	THB
9.137***	94.49***	-1.257	-0.583	13.67***	23.97***	-1.740**	-1.425*
From PHP							
IDR	MYR	SGD	THB	IDR	MYR	SGD	THB
-1.452*	1.638*	-1.627*	-0.930	-1.243	3.952***	-1.390*	-1.072
From SGD							
IDR	MYR	PHP	THB	IDR	MYR	PHP	THB
4.297***	1.537*	105.1***	3.246***	2.957***	25.41***	13.44***	-1.375*
From THB							
IDR	MYR	PHP	SGD	IDR	MYR	PHP	SGD
6.184***	-0.707	86.71***	-1.215	-1.613*	1.144	5.828***	-1.810**

Note: Here, *, ** and *** indicate significance at 10%, 5% and 1% levels based on the standardised version of Cheung and Ng's (1996) chi-square test statistic, which was proposed by Hong (2001). The table shows only the largest absolute value of chi-square test statistic within 10 lags.

Table 4 shows the estimation results for the causality relationship between foreign exchange markets after July 1, 2014. In this period, there was causality-in-mean from IDR to PHP and THB; causality-in-variance from IDR to MYR, PHP and SGD; causality-in-mean from MYR to IDR and PHP; causality-in-variance from MYR to IDR, PHP, SGD and THB; causality-in-mean from PHP to IDR, MYR and SGD; causality-in-variance from PHP to MYR and SGD; causality-in-mean and variance from SGD to IDR, MYR, PHP and SGD; causality-in-mean from THB to IDR and PHP; and causality-in-variance from THB to IDR, PHP and SGD.

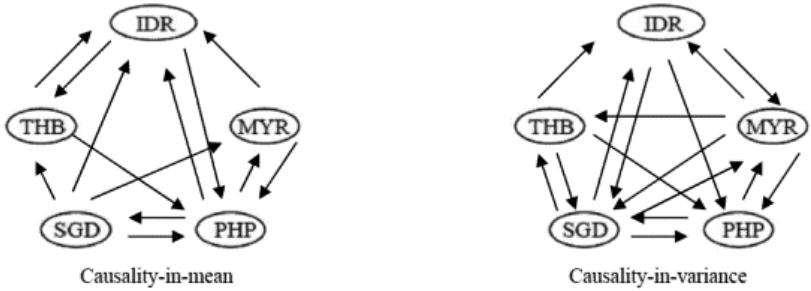

Figure 2. The interdependence among foreign exchange markets from July 1, 2014 to December 29, 2016

Figure 2 illustrates directions of causality-in-mean and variance, as presented in Table 4. This figure shows the bidirectional causality-in-mean between the following pairs: IDR and PHP, IDR and THB, MYR and PHP, and PHP and SGD. The unidirectional causality-in-mean between all other pairs is also shown. The figure displays the bidirectional causality-in-variance between the following pairs: IDR and MYR, IDR and SGD, MYR and PHP, MYR and SGD, PHP and SGD, and SGD and THB. The unidirectional causality-in-variance between all other pairs is shown as well.

The existence of causality-in-mean implies that a change (i.e., an increase or decrease) in exchange rate returns for one currency causes the exchange rate returns of another currency to change (i.e., to increase or decrease). Similarly, the existence of causality-in-variance implies that variations (volatility) in the exchange rate returns of one currency affect the variations (volatility) of the exchange rate returns of another

currency. Figures 1 and 2 demonstrate how the causality-in-mean and variance of all foreign exchange markets in ASEAN-5 spill over into the foreign exchange market of at least one other member of the association (excluding the causality-in-mean from the PHP in the first period). Furthermore, the causality relationship between the markets changes if there are significant changes in related external variables, such as oil prices. These findings, in combination with the results of Sultonov's research (2016; 2017), help illuminate the indirect effects of the foreign exchange markets of three major Asian economies (China, Japan and India) as well as those of the oil price shock on almost all members of the ASEAN-5. That means the causality-in-mean and volatility spillover arising from changes or shocks in external variables to the foreign exchange market of one member of ASEAN-5 may spill over into other foreign exchange markets of ASEAN-5 within two weeks[1].

4. Conclusion

In this paper, we examined the causality relationship between foreign exchange markets of countries in the ASEAN-5. The derived results demonstrated interdependence between these foreign exchange markets. The returns and volatilities in one market affect the returns and volatilities in the foreign exchange market of at least one other member of the association. As previous studies in the literature have already defined the causality-in-mean and variance from external shocks to the foreign exchange markets of some members of the ASEAN-5, we argue that the indirect effects will spill over into the foreign exchange markets of other members of the association within two weeks.

The derived results contribute to the literature dealing with the causality relationship between and the impact of external shocks on the foreign exchange markets of countries in the ASEAN.

[1] Here, 'two weeks' refers to the 10 lags mentioned in the methodology section. Since weekends are not included in the estimations, 10 lags equal two weeks.

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