“Modeling the relationships among gold price, oil price, foreign exchange, and the stock market index in Thailand”

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MODELING THE RELATIONSHIPS AMONG GOLD PRICE, OIL PRICE, FOREIGN EXCHANGE, AND THE STOCK MARKET INDEX IN THAILAND

Abstract

This study examines the relationship among the price variables in the Thailand stock market, the foreign exchange market, the international gold market, and the crude oil market. Specifically, the study investigates whether (1) there exists a long-run equilibrium among oil price, gold price, foreign exchange, and the stock market index in Thailand, and (2) there is any dynamic effect of each asset market on other asset markets. All asset price series have shown both upward and downward trends over the study period. All monthly series in four markets from January 2000 to December 2018 are nonstationary and are integrated of order one. Then, the Johansen cointegration test is employed. The normalized cointegrating coefficients are negative. Such empirical result reveals that a significant long-run relationship exists among price variables in all asset markets, so that each asset class acts as a hedge against each other. The Granger causality test shows that the causations run from the stock price to the foreign exchange rate and the international gold price to the foreign exchange rate. Other short-run relationships have no significant causal links.

Keywords cointegration, oil market, gold market, foreign exchange market, the Stock Exchange of Thailand (SET) index

JEL Classification G10, G11

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INTRODUCTION

Abdulkarim et al. (2020), Adaramola (2012), Baur and Lucey (2010), Ciner et al. (2013), Ghazali et al. (2013), Hood and Malik (2013), Jain and Biswal (2016), and Raza et al. (2016) have been interested in studying the relationship between financial market(s) and commodity market(s). However, the empirical studies focusing on emerging financial markets are few. Dee et al. (2013) studied the gold prices and the stock prices of China's capital market from 2002 to 2012. It was found that gold always cannot hedge stock in the short run, but gold is a good hedge for stock in the long run. Jain and Biswal (2016) explored the relationship between global prices of gold, crude oil, the US Dollars-Indian Rupee exchange rate, and the stock market in India from 2006 to 2015. It was indicated that the fall in gold prices and crude oil prices cause a fall in the value of the Indian Rupee and the index of Indian stock market. For Thailand, its emerging economy has grown rapidly, moving from a low-income country to an upper medium-income country in less than a generation. In addition, Thai financial markets and commodity markets have been developing continuously to facilitate international trade and investment. This study focuses on the relationships among Thai stock market, international oil market, international gold market, and foreign exchange market.

Generally, stock market is the market for trading many common stocks to promote savings and investment. It is also an attractive securities market for investors who want to acquire returns higher than the inflation rate. Oil market plays the important role in the production of goods and services in many sectors such as transportation, services, industries, etc. In addition, it also affects the production cost and the price of goods and services. Moreover, oil market is an alternative investment for many hedge funds and foreign investors. For gold market, it is often referred to as the market for safe haven asset, an important tool for risk management in portfolio investment. The foreign exchange market can be considered as the international facilitator between investment in such financial and commodity markets during the globalization era nowadays. The Stock Exchange of Thailand (SET) is one of the most important stock markets in Thailand (another important stock market is the Market for Alternative Investment (MAI), which is the stock market for Thai innovative firms). The SET plays as a financial intermediary by channeling funds, especially in terms of the share ownership, from surplus economic units to deficit economic units in the Thailand economy. The SET index or return from the SET index reflects the investors' sentiments about stock investment in Thailand. Such index is also related to the oil price in the oil market such that oil price has its effect on operation cost and performance of firms listed in the SET. Jiranyakul (2014) pointed out that an increase in real oil price seems to cause a real stock market return to fall, but this result is not statistically significant. However, Wattanaporn and Kanchanapoom (2012) contributed that the impact of oil prices on firm profitability performance is in the same direction as the impact of oil prices on stock returns. Consequently, the performance of the firms listed in the SET relates to investors' decision-making to invest in the stock market, and the SET index. In addition, Thailand is primarily an oil-importing country like many developing countries (Du et al., 2019; Rafiq et al., 2009). Fluctuation in international oil prices also leads to change in exchange rates (especially US dollar) in the foreign exchange market. The change in oil price has important implications for inflation and gold price. In an inflationary economy, investors increase their investment in gold since it acts as a hedge against inflation so that the gold price will be affected (Shahbaz et al., 2014).

This study focuses on the interrelationships among prices in gold market, oil market, foreign exchange market, and stock market. It contributes to the existing literature by providing evidence of the existence of the relationship among asset markets especially in Thailand, which is one of the emerging market countries in Asia. In addition, both unidirectional and bidirectional causal linkages among price variables are examined in this study.

The pattern of long-run relationship among the international oil price, the international gold price, the foreign exchange rate, and the stock price in Thailand is investigated. As a corollary, the study considers the short-run adjustment of each market toward the long-run equilibrium. This study proceeds as follows: literature review, data and methodology, results and discussion, and conclusion.

1. LITERATURE REVIEW

The linkages between financial markets and commodity markets have been studied. Choudhri and Schembri (2014), Cashin et al. (2004), Zou et al. (2017), and Dooley et al. (1995) indicated that the exchange rate reflects the situation of individual country and there exists the relationship between the exchange rate and the commodity prices. A change in the exchange rate will result in an adjustment in the price of internationally traded commodities including the international gold price (Sjaastad, 2008). An appreciation or depreciation of a major currency (i.e., US dollars) has a significant effect on the gold price (Mo et al., 2018; Sjaastad and Scacciavillani, 1996). Gold can also act as a hedge against exchange-rate risk for an investor with dollar holdings (Beckmann, 2017; Dee et al., 2013). Moreover, Dee et al. (2013) found out that gold is significantly a good hedge for stock if gold is held for a long period.

The long-term relationship between the exchange rate and the oil price has been found such that the impact of the oil price changes on output could be balanced by the changes in the exchange rate (Ji et al., 2020; Jain & Biswal, 2016; Rautava, 2002; Camarero

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& Tamarit, 2002). In addition, an increase in the oil price will devalue the currency (especially for the oil-importing country) relative to the oil net exporters. The stock price rationally reflects the impact of news on cash flow including the oil price effect on the firm performance (Bagirov & Mateus, 2019; Al-Tamimi et al., 2011; Basher & Sadorsky, 2006; Jones & Kaul, 1996). Oil represents an important input in the production process of most goods and services, and changes in the oil price affect the cash flows and the stock price of the firm (Kathiravan et al., 2019; Huang et al., 1996). The relation between oil price and gold price can be described by the inflation mechanism (Bouri et al., 2017; Baruník et al., 2016). An increase in oil price affects inflation, and gold is potentially served as an inflation hedge (Aye et al., 2017; Hooker, 2002; Hunt, 2006).

Manu and Bhaskar (2018), and Phylaktis and Ravazzolo (2000) indicated that currency movements may affect the international competitiveness and the balance of trade position, and consequently the real output of the country, which in turn affects current and future cash flows of companies and their stock prices. On the other hand, the stock price can also affect the behavior of exchange rates through the demand for money (Dang et al., 2020; Gavin, 1989).

Potential linkage among the stock market, the foreign exchange market, the gold market, and the oil market such that each asset class can act as a hedge against each other is to be examined. However, there are few attempts to emerging economies, especially in Thailand. Wattanaporn and Kanchanapoom (2012) investigate the impact of crude oil prices on the profitability performance of 11 different sectors in the Stock Exchange of Thailand from 2001 to 2010. Applying the method of panel data regression, oil prices have a significant impact on the profit of energy and food sectors, and the impact of oil prices on firm profitability performance is in the same direction as the impact of oil prices on stock returns. Jiranyakul (2014) studied the impact of oil price uncertainty on the Stock Exchange of Thailand by employing the two-stage approach, which comprises the estimation of the bivariate GARCH (1,1) model to generate volatility series and the use of the standard Granger causality test to determine the directions of causation. It was found that the movement in oil price does not adversely affect stock market return, but there exists volatility transmission from oil to domestic stock market from May 1987 to December 2013. The asset prices of all four markets, which are the oil market, the gold market, the foreign exchange market, and the stock market in Thailand, are empirically tested for the relationship among all series. The next section will provide the empirical procedures for testing the hypothesis.

2. DATA AND METHODOLOGY

This paper investigates the relationship among stock prices of Thailand stock market, exchange rates, gold prices, and crude oil prices. The study period is from 2000 to 2018. This period is chosen to explore the dynamic variation of all series including price series during the financial crisis of 2008-2009. Monthly data for the span of 19 years (2000-2018) were collected from the Thomson Reuters data service. The SET index (STOCK) is used as a proxy for the stock price of Thailand stock market. Thai baht exchange rate per US dollar (BAHT) is used as the exchange rate in this paper. The international spot gold price (GOLD) is measured in US dollars per ounce, and the West Texas Intermediate (WTI) crude oil price (OIL) is measured in US dollars per barrel. WTI is a reference for determining the price of other crudes in the United States, and it is closely related to other crude oil markets such as those for Brent, Maya, Dubai, etc. (Chen et al., 2015; Reboredo, 2011).

The four transformed variables of stock price ($LSTOCK_t$), an exchange rate ($LBAHT_t$), gold price ($LGOLD_t$), and oil price ($LOIL_t$) at time t are determined and expressed in the natural log values of the data. The augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1981; Dickey & Fuller, 1979) and the Phillips-Perron (PP) test (Phillips & Perron, 1988; Phillips, 1987) are conducted to examine the stationarity and the order of integration of such series. Following ADF and PP tests, for instance, the null hypothesis of a series being non-stationary is not rejected, while the null hypothesis of the first differenced series being non-stationary is rejected. It would be concluded that such differenced series is I (1) or the series is said to be integrated of order 1. Higher orders of integration can also be tested applying the same concept.

If all series are found to be integrated of the same order, the long-run relationship can be investigated by conducting the cointegration test (Engle & Granger, 1987; Engsted et al., 1997; Enders & Siklos, 2001). The Johansen cointegration test (Johansen, 1991; Johansen & Juselius, 1990) is employed for testing the existence of cointegrating vectors among series as specified below:

$$\Delta X_t = \alpha_0 + \Pi X_{t-1} + \sum_{i=1}^{p} \Gamma_i \Delta X_{t-i} + u_t. \quad (1)$$

This model contains four variables in the first differenced form on the left-hand side, and $p-1$ lags of the dependent variables (differences) on the right-hand side, each with a Γ coefficient matrix attached to it. Π can be interpreted as a long-run coefficient matrix, and u_t are residual terms. If the cointegrating relation among variables exists, the error correction mechanism (ECM) can be derived as follows:

$$\begin{aligned}\Delta LSTOCK_t &= \alpha_{10} + \alpha_{11} COINT_{t-1} + \\ &+ \sum_{i=1}^{p} \gamma_{11,i} \Delta LSTOCK_{t-i} + \sum_{i=1}^{p} \gamma_{12,i} \Delta LBAHT_{t-i} + \\ &+ \sum_{i=1}^{p} \gamma_{13,i} \Delta LGOLD_{t-i} + \sum_{i=1}^{p} \gamma_{14,i} \Delta LOIL_{t-i} + u_{1t}.\end{aligned} \quad (2)$$

$$\begin{aligned}\Delta LBAHT_t &= \alpha_{20} + \alpha_{21} COINT_{t-1} + \\ &+ \sum_{i=1}^{p} \gamma_{21,i} \Delta LSTOCK_{t-i} + \sum_{i=1}^{p} \gamma_{22,i} \Delta LBAHT_{t-i} + \\ &+ \sum_{i=1}^{p} \gamma_{23,i} \Delta LGOLD_{t-i} + \sum_{i=1}^{p} \gamma_{24,i} \Delta LOIL_{t-i} + u_{2t}.\end{aligned} \quad (3)$$

$$\begin{aligned}\Delta LGOLD_t &= \alpha_{30} + \alpha_{31} COINT_{t-1} + \\ &+ \sum_{i=1}^{p} \gamma_{31,i} \Delta LSTOCK_{t-i} + \sum_{i=1}^{p} \gamma_{32,i} \Delta LBAHT_{t-i} + \\ &+ \sum_{i=1}^{p} \gamma_{33,i} \Delta LGOLD_{t-i} + \sum_{i=1}^{p} \gamma_{34,i} \Delta LOIL_{t-i} + u_{3t}.\end{aligned} \quad (4)$$

$$\begin{aligned}\Delta LOIL_t &= \alpha_{40} + \alpha_{41} COINT_{t-1} + \\ &+ \sum_{i=1}^{p} \gamma_{41,i} \Delta LSTOCK_{t-i} + \sum_{i=1}^{p} \gamma_{42,i} \Delta LBAHT_{t-i} + \\ &+ \sum_{i=1}^{p} \gamma_{43,i} \Delta LGOLD_{t-i} + \sum_{i=1}^{p} \gamma_{44,i} \Delta LOIL_{t-i} + u_{4t}.\end{aligned} \quad (5)$$

In this case, $COINT$ reflects the long-run information in the data, and γ represents the short-run dynamics of the relationship between variables. Then, the Granger causality test is employed to examine the causal relationship among variables by applying χ^2 (Wald) statistics for testing the significance of the lagged endogenous variables.

3. RESULTS AND DISCUSSION

The price movements of four markets consisting of Thai stock market, foreign exchange market, international gold market, and international oil market during 2000-2018 are shown in Figures 1-4, respectively. All asset price series have shown both upward and downward trends over the period of study. The SET index declined sharply during 2008-2009 due to the global financial crisis. After the crisis, the SET index began to rise again and exceeded 1,000 points since 2011 (Forson & Janrattanagul, 2014). The baht exchange rate (baht per US dollar) has appreciated over the period since 2001. In addition, the pattern of the baht exchange rate after the global financial crisis of 2008-2009 was relatively stable following the constant currency order flows during such period (Anifowose et al., 2017). For the international gold price (US dollars per ounce), gold is considered as a safe haven in times of high-level economic policy uncertainties in the world during the period before the global financial crisis of 2008-2009 such that the gold price was positively related to the global economic policy uncertainty during the period (Beckmann et al., 2017). After the global financial crisis, the international gold price rose until 2011 and maintained its previous pattern since 2012 (Singhal et al., 2019). Before the financial crisis, the surge in crude oil prices occurred between mid-2003 and mid-2008 (Baumeister & Kilian, 2016; Kilian & Hicks, 2013). International crude oil prices (US dollars per barrel) are highly fluctuated and declined very sharply during 2008-2009. After the global financial crisis, there was a sharp decline in oil prices between June and December 2014, which was associated with a decline in global real economic activity (Baumeister & Kilian, 2016). Another downfall in oil prices occurred during 2015-2016 (Singhal et al., 2019).

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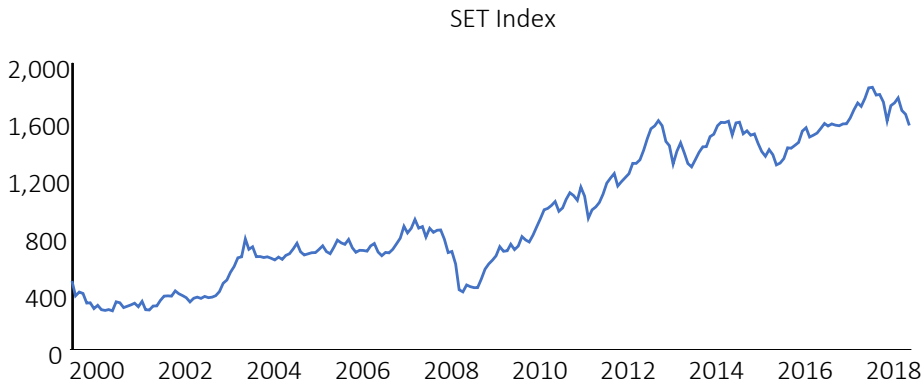

Figure 1. The SET index during 2000–2018

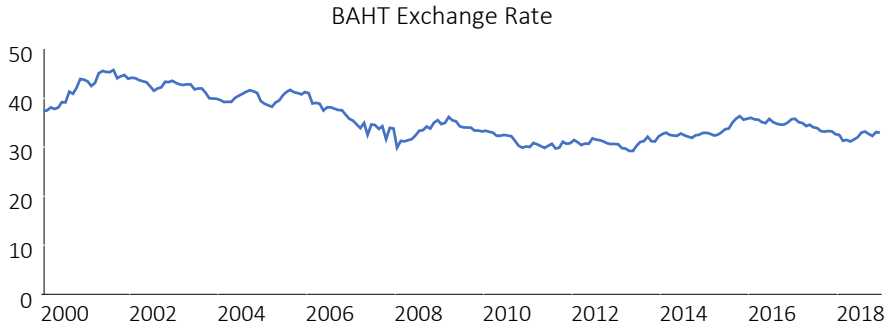

Figure 2. The Thai baht exchange rate (baht per US dollar) during 2000–2018

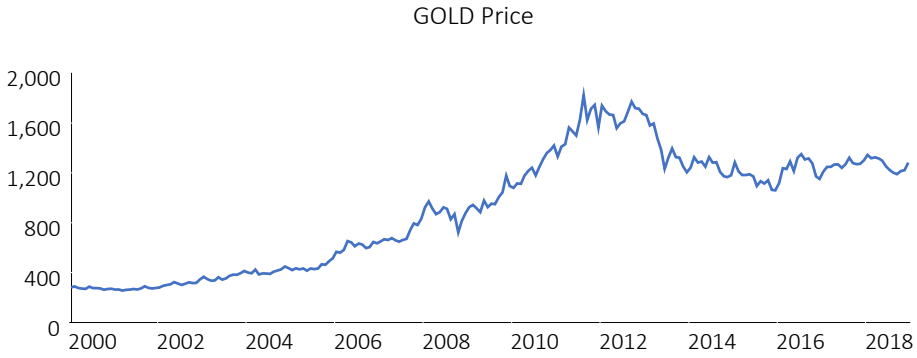

Figure 3. International gold price per ounce in US dollars during 2000–2018

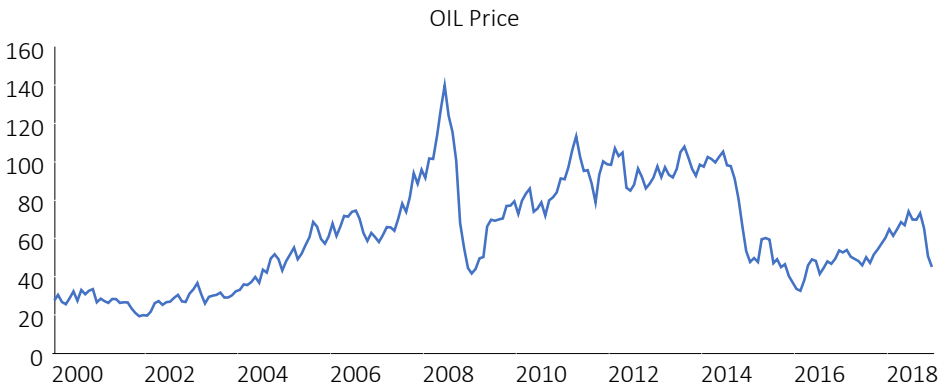

Figure 4. International oil price per barrel in US dollars during 2000–2018

Table 1. Unit root tests

Series	Intercept		Trend and Intercept		None	
	Level	1st Difference	Level	1st Difference	Level	1st Difference
ADF Test						
LSTOCK	–1.3263	–6.9200***	–3.1574*	–6.9023***	0.9913	–6.8278***
	(0.6175)	(0.0000)	(0.0959)	(0.0000)	(0.9150)	(0.0000)
LBAHT	–1.4280	–7.3843***	–2.0836	–7.3664***	–0.5590	–7.3827***
	(0.5681)	(0.0000)	(0.5517)	(0.0000)	(0.4741)	(0.0000)
LGOLD	–1.4369	–16.8627***	–0.5624	–16.9419***	2.1392	–16.8627***
	(0.5637)	(0.0000)	(0.9799)	(0.0000)	(0.9925)	(0.0000)
LOIL	–1.9755	–12.6083***	–1.7815	–12.6322***	–0.0209	–12.6345***
	(0.2976)	(0.0000)	(0.7107)	(0.0000)	(0.6748)	(0.0000)
PP Test						
LSTOCK	–0.9473	–14.8333***	–3.2671*	–14.7972***	0.9413	–14.7655***
	(0.7717)	(0.0000)	(0.0745)	(0.0000)	(0.9077)	(0.0000)
LBAHT	–1.1483	–16.8769***	–2.0879	–16.8404***	–0.4551	–16.8983***
	(0.6967)	(0.0000)	(0.5493)	(0.0000)	(0.5171)	(0.0000)
LGOLD	–1.4876	–16.8627***	–0.5871	–17.0077***	2.1731	–16.5667***
	(0.5383)	(0.0000)	(0.9785)	(0.0000)	(0.9931)	(0.0000)
LOIL	–2.0109	–12.6510***	–1.7345	–12.6856***	0.0948	–12.6769***
	(0.2821)	(0.0000)	(0.7328)	(0.0000)	(0.7118)	(0.0000)

Note: *, **, and *** indicate the 10%, 5%, and 1% significance levels, respectively. *P*-values are included in parentheses.

All four series are tested for the unit root property both in level (the natural log value) and first-differenced terms. The unit root tests (ADF and PP tests) of the series in Thai stock market, foreign currency market, international gold market, and international oil market are shown in Table 1.

Table 1 indicates that all series are nonstationary such that the null hypothesis of unit root is not rejected for all series at 1% and 5% significance levels. However, the null hypothesis is rejected at 1% level for all variables in first-differenced terms. It can be concluded that all series in four markets are nonstationary and are integrated of order one (I (1)). Then, the existence of long-run equilibrium relationship among variables is investigated applying the Johansen cointegration test and the Maximum Eigen test as shown in Table 2 and Table 3, respectively.

Table 2 shows that the trace statistic indicates that there is at least one cointegrating vector among *LSTOCK, LBAHT, LGOLD,* and *LOIL* since the null hypothesis of no cointegrating vector under the Johansen cointegration test is rejected at 5% significance level.

Table 3 shows that the Maximum Eigen statistic is greater than the 5% critical value at the null hypothesis of no cointegration. The Maximum

Table 2. Johansen cointegration test

No. of cointegrating vectors	Eigen	Trace	Critical Value			Prob.
Under the null hypothesis	value	statistic	10%	5%	1%	
None **	0.1281	59.1261	50.5253	54.0790	61.2669	0.0166
At most 1	0.0678	28.2779	32.2684	35.1928	41.1950	0.2291

Note: *, **, and *** indicate the 10%, 5%, and 1% significance levels, respectively. *P*-values are included in parentheses.

Table 3. Maximum Eigen test

No. of cointegrating vectors	Eigen	Max-Eigen	Critical Value			Prob.
Under the null hypothesis	value	statistic	10%	5%	1%	
None **	0.1281	30.8482	26.1212	28.5881	33.7329	0.0253
At most 1	0.0678	15.7999	20.0501	22.2996	27.0678	0.3127

Note: *, **, and *** indicate the 10%, 5%, and 1% significance levels, respectively. *P*-values are included in parentheses.

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Table 4. Normalized cointegrating coefficients

LSTOCK	*LBAHT*	*LGOLD*	*LOIL*	Constant
1.0000	–20.2349	–3.5901	–1.7679	96.3898
	(3.7148)	(0.6253)	(0.5593)	(17.9322)
	[–5.4472]***	[–5.7413]***	[–3.1608]***	[5.3752]***

Note: Standard errors and t-statistics are included in parentheses, and brackets, respectively. *, **, and *** indicate the 10%, 5%, and 1% significance levels, respectively.

Eigen test provides an alternative test statistic, which tests the long-run relationship among series (Ijirshar, 2015; Carrera et al., 2008; Johansen & Juselius, 1990). This confirms the result of the Johansen cointegration test, shown in Table 2. Therefore, it can be concluded that there exists a long-run relationship among the price series in Thai stock market, foreign exchange market, international gold market, and international oil market. Next, the normalized cointegrating coefficients are estimated as shown in Table 4.

Table 4 shows the significant negative relationship between stock price and exchange rate. This implies that the depreciation in domestic currency has a negative effect on Thai stock market. Consistent with the international oil market, the increase in crude oil price also has a negative effect on the SET because Thailand is the net importer of crude oil. The rise in oil price incurs higher operation cost and potentially lower profits for most firms. Hence, the worse performances lower the overall stock price. In addition, the significant negative relation between stock price and gold price strongly confirms that the increase in the international gold price has a negative effect on Thai stock market in the long run. Table 5 provides the estimate of the error correction mechanism.

Table 5 shows that the error correction mechanism is estimated according to the equations (2)-(5). The *p*-values of the estimated coefficients $\widehat{\alpha}_{11}$, $\widehat{\alpha}_{21}$, $\widehat{\alpha}_{31}$, and $\widehat{\alpha}_{41}$ refer to the significance levels of the adjustments of the stock price, the exchange rate, the gold price, and the oil price, respectively toward the long-run equilibrium. The stock price and the exchange rate variables are affected by other variables in the model through the cointegrating vector at the 5% significance levels. Similarly, the international gold price and the

Table 5. Error correction mechanism (ECM)

Variable	$\Delta LSTOCK_t$	$\Delta LBAHT_t$	$\Delta LGOLD_t$	$\Delta LOIL_t$
$COINT_{t-1}$	–0.0143**	0.0039**	–0.0080*	0.0212***
	(0.0104)	(0.0127)	(0.0607)	(0.0081)
$\Delta LSTOCK_{t-1}$	0.0693	–0.1234***	0.0139	0.1389
	(0.3383)	(0.0000)	(0.8028)	(0.1816)
$\Delta LSTOCK_{t-2}$	0.0308	–0.0320	–0.0651	0.1680
	(0.6858)	(0.1317)	(0.2658)	(0.1253)
$\Delta LBAHT_{t-1}$	–0.0846	–0.1466**	–0.1944	–0.0866
	(0.7371)	(0.0377)	(0.3154)	(0.8109)
$\Delta LBAHT_{t-2}$	–0.4283**	–0.0056	–0.0373	–0.1600
	(0.0387)	(0.9223)	(0.8133)	(0.5887)
$\Delta LGOLD_{t-1}$	–0.0702	–0.1110***	–0.1553**	–0.0730
	(0.4677)	(0.0001)	(0.0371)	(0.5984)
$\Delta LGOLD_{t-2}$	0.0282	–0.0133	–0.0402	0.1234
	(0.7755)	(0.6309)	(0.5972)	(0.3855)
$\Delta LOIL_{t-1}$	–0.0420	0.0073	0.0116	0.1577**
	(0.4026)	(0.6009)	(0.7628)	(0.0295)
$\Delta LOIL_{t-2}$	0.0029	0.0152	–0.0547	0.0113
	(0.9530)	(0.2732)	(0.1524)	(0.8742)
Observations	228	228	228	228
R-squared	0.0483	0.3410	0.0253	0.1021
DW Statistic	2.0026	2.0255	1.9686	2.0276

Note: *, **, *** indicate the 10%, 5%, and 1% significance levels, respectively. P-values are included in parentheses.

Table 6. VECM short-run Granger causality

Excluded	Chi-sq	Df	Prob.
Dependent variable: Δ(LSTOCK)			
Δ(LBAHT)	4.3257	2	0.1150
Δ(LGOLD)	0.7014	2	0.7042
Δ(LOIL)	0.7117	2	0.7006
All	5.8854	6	0.4361
Dependent variable: Δ(LBAHT)			
Δ(LSTOCK)	40.1834	2	0.0000***
Δ(LGOLD)	17.1283	2	0.0002***
Δ(LOIL)	1.7398	2	0.4190
All	74.6745	6	0.0000***
Dependent variable: Δ(LGOLD)			
Δ(LSTOCK)	1.3015	2	0.5216
Δ(LBAHT)	1.0174	2	0.6013
Δ(LOIL)	2.0645	2	0.3562
All	4.6542	6	0.5889
Dependent variable: Δ(LOIL)			
Δ(LSTOCK)	4.2100	2	0.1218
Δ(LBAHT)	0.3158	2	0.8539
Δ(LGOLD)	1.2250	2	0.5420
All	7.9663	6	0.2406

Note: *** indicates the 1% level of significance.

crude oil price are affected by other variables at the 10% and 1% significance levels, respectively. The estimated results strongly indicate that all price variables in Thai stock market, foreign exchange market, international oil market, and the crude oil market will adjust toward the long-run equilibrium if any of the variables deviates from the long-run relationship. The R-squared ranges from 0.025 to 0.341. In addition, the Durbin-Watson statistics indicate that there exists no autocorrelation in the model. Then, the short-run Granger causality test is employed and provided in Table 6.

Table 6 shows the Chi-square statistics (Wald statistics) of the short-run Granger causality tests among all price variables in the model. Provided that the exchange rate is the dependent variable, both the stock price and the international gold price Granger cause the foreign exchange rate at the 1% significance level. Therefore, there exist unidirectional causal links from the stock price to the foreign exchange rate, and the international gold price to the foreign exchange rate. Other short-run relationships have no significant causal links.

CONCLUSION

This study investigates the dynamic relationship among the SET index, the Thai baht exchange rate per US dollar, the gold price per ounce in US dollars, and the crude oil price per barrel in US dollars using a long data set (2000–2018). The dynamic relation is investigated by applying the Johansen cointegration test and the Granger causality test. Based on the unit root tests using the ADF and Phillips-Perron tests, all price variables are integrated of order one such that a cointegration test can be applied. The result shows that there exists a significant long-run relationship among all price series in Thai stock market, foreign exchange market, international gold market, and crude oil market. In addition, the normalized cointegrating coefficients are negative. Such a result implies that the Thai baht depreciation has a negative effect on Thai stock market. The increases in the international gold price and crude oil price also have a negative effect on the stock market in Thailand. There exist short-run causal relationships from the stock price to the foreign exchange rate, and the international gold price to the foreign exchange rate. In the long run, it is found out that there exists a significant negative relationship between stock mar-

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ket in Thailand and other asset markets. Thus, it can be concluded that each asset class in the Thailand stock market, the foreign exchange market, the international gold market, and the crude oil market can act as a hedge against each other in the long run. Those relationships have important implications for the portfolio managers diversifying their investment in both financial and commodity markets, and the oil-importing country, respectively. Portfolio managers should take asset prices from the foreign exchange market, the international gold market, and the crude oil market into consideration in their investment in Thailand stock market. Nevertheless, whether those asset classes can be considered as safe havens for each other is to be investigated for further studies.

AUTHOR CONTRIBUTIONS

Conceptualization: Supachok Thakolsri.
Data curation: Supachok Thakolsri.
Formal analysis: Supachok Thakolsri.
Funding acquisition: Supachok Thakolsri.
Investigation: Supachok Thakolsri.
Methodology: Supachok Thakolsri.
Project administration: Supachok Thakolsri.
Resources: Supachok Thakolsri.
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Supervision: Supachok Thakolsri.
Validation: Supachok Thakolsri.
Visualization: Supachok Thakolsri.
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