STOCK MARKET REACTION TO MONEY SUPPLY: A DYNAMIC APPROACH
การตอบสนองของตลาดหลักทรัพย์ต่อปริมาณเงิน: วิธีพลวัต

ชัยยุทธ ผดุงศักดิ์สวัสดิ์ อนุชนาฏ เจริญจิตรกรรม
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Abstract

In this paper we revisit dynamic relationships between the money supply and stock market performance in Thailand. Due to new definitions of the money supply, we provide new empirical evidence, which has not been investigated in the past. The results show that the correlations are time-varying, showing different patterns in different time periods. However, the results show both positive and negative money supply-stock return relationships. We conclude that different results are driven from differences in variables definitions, in econometric models, and in time period of study.

Keywords: Money supply, Stock market index, Dynamic conditional correlation

บทคัดย่อ

งานวิจัยนี้ เป็นการศึกษาความสัมพันธ์ระหว่างปริมาณเงินและผลการดำเนินงานของตลาดหลักทรัพย์ในประเทศไทย เนื่องจากคำนิยามใหม่ของปริมาณเงิน นักวิจัยนี้ได้แสดงหลักฐานใหม่เชิงประจักษ์ที่มิได้มีการศึกษาในอดีตที่ผ่านมา ผลการศึกษาแสดงถึงค่าสัมประสิทธิ์สหสัมพันธ์ในเชิงพลวัต ซึ่งมีรูปแบบที่แตกต่างกันในช่วงระยะเวลาต่างๆ อย่างไรก็ตาม ผลการศึกษานี้ แสดงความสัมพันธ์ของปริมาณเงินและอัตราผลตอบแทนของตลาดหลักทรัพย์ ที่เป็นทั้งค่าบวกและค่าลบ นักวิจัยสรุปว่า ผลการศึกษาที่แตกต่างกันนั้น มาจากความแตกต่างในคำนิยามที่ใช้ในตัวแปรต่างๆ ความแตกต่างในแบบจำลองเศรษฐมิติ และความแตกต่างในช่วงระยะเวลาในการศึกษา

คำสำคัญ: ปริมาณเงิน ดัชนีตลาดหลักทรัพย์ Dynamic conditional correlation

Introduction

Since seminal works of Homa, & Jaffee (1971), Hamburger, & Kochin (1972), Rozeff (1974) there exists several studies on the association between the stock market and money supply in economic and finance literature. However, the evidence remains mixed. For example, some evidence in the early 1970s shows that the stock return is explained by the past money supply

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(Homa, & Jaffee (1971); Hamburger, & Kochin (1972)) while some later findings show the reverse, for example, the stock return causes the change in money supply (Cooper (1974); Pesando (1974); Rozeff (1974)).

Due to the recent 2008 global financial crisis, lots of efforts, notably known as the "quantitative easing (QE)" policy, were introduced and implemented to alleviate the economic downturn, which the monetary policy is one of the popular policies to support the growth and the stability of financial markets. An increase in the USD supply in financial markets tremendously affects the rest of the world, Thus, changes in money supply would be expected in order to react such the event. Moreover, the BOT applied the new definition of money supply from the Monetary and Financial Statistics Manual (MFSM2000) since 1997, which is classified as the broader money supply and the narrower money supply. Our research sheds a new light to provide additional evidence of the new money supply definition, which has not been studied in the past. In sum, an understanding the interaction between changes in monetary policy (via the money supply) and stock market performances is important for both academicians and practitioners.

This paper contributes to prior studies at least twofold. First, we provide new evidence of the relationship between money supply and stock market movement using the new definition of the money supply. Second, we employ the dynamic condition correlation (DCC) to capture the time varying relationship. This technique is superior to other traditional methodologies such as cointegration and error correction models, which is able to capture time varying movement of the relationship.

In this study we investigate the relationship of the stock market performance and money supply in Thailand. We employ the new definition of money supply, which is classified into the broad money and narrow money. This makes our paper distinguish from other studies in this topic. The BOT adopted the new definition in year 1997, then our study starts since then. Our results, in general, show the intertemporal behavior of the relationship, though the results remain mixed when using different money supply definitions. It is interesting to note that there is a structural shift in the relationship because the results from the subperiods are not the same. Moreover, there exists equilibrium conditions in the relationships. We conjecture that our mixed results are consistent to prior literature, which we doubt that inconclusive results are from differences in measures of money supply, in model specifications, and in time period of study.

The remaining of the paper is presented as follows. Section 2 summarizes literature in the relationship between money supply and stock market performance. Section 3 suggests the data used and Section 4 introduces the dynamic conditional correlation, which is the main methodology in this study. Section 5 presents and discusses results. Last section is conclusion.

Literature review

Prior literature investigates the relationship of stock returns and macroeconomics variables, or focuses on the causality of money supply and stock market movement. Additionally,

most of the stock market-money supply relationships are widely studied in the U.S. markets. Thus, due to extensive evidence in the U.S., we focus our review to the evidence in other countries and summarize the effects of the quantitative easing program to the rest of the globe.

The topic of the relationship of the money supply and stock market performances has been of interest among practitioners and academicians for a long time. We limit our review on major and important evidence since the mid 1990's, because during this time the research has regained attention in terms of the persistence as well as predictability of either money supply or stock market returns. Kennickel et al. (1997) find the shift of the individuals' portfolio allocation, which moves from depositing money at financial institutions to investing in mutual funds and is later supported by Carlson and Schwarz (1999). Moreover, from survey data, Laderman (1997) finds the decline in the households' deposit in their portfolio allocation because of the change in investors' preferences. These findings provide the different results, which contradicts to prior premise on the impact of age profile of the population on the shift in the preferences. Thus, empirical evidence shows inconclusive findings on the relationship between money supply and stock market activity, mainly by the time period of study, frequency of data, and econometric models.

In the 2008 global financial crisis, the quantitative easing (QE) program is one of the major remedies, which injects large amounts of the USD into financial markets in order to, hopefully, stimulate the entire economy. Certainly, impacts of the QE are not limited in the U.S., but it significantly affects international financial markets. Several attempt to investigate the outcome of the QE on an individual country. For example, Parhizgari and Nguyen (2011) investigate the relationship between money supply and stock markets during the crisis and confirm the existence. Moreover, they show that M2 is a superior measure of predictability to the M1, contradicting to prior evidence in 1990's.

We classify the evidence on the relationship between money supply and stock market return based on the level of market development, namely the developed and developing markets. First, in developed markets, Joyce, Lasaosa, Stevens, and Tong (2011) and Joyce, Tong, and Woods (2011) show that equity prices in England fall immediately after the initial QE announcements, but rise significantly thereafter. Moreover, the balance of risks perceived by market participants in equity prices becomes less negative. However, the effects of the QE in Japan are opposite, which Kurihara (2006) finds a positive relationship during the quantitative easing policies. Gan et al. (2006) employing innovation accounting analysis find the unidirectional relationship that macroeconomic variables cause New Zealand stock index (NZSE40) returns.

Second, in developing markets, Bilson et al. (2001) studying in several emerging markets and employing the principal component analysis of macroeconomic variables find that a change in money supply is one of the important macroeconomic variables in explaining the variation in stock market returns. Later, the study is reinvestigated and supported by Wongbangpo and Sharma (2002), who find Granger causality between stock markets and macroeconomics variables (including M1 money supply) of five ASEAN countries including Indonesia, Malaysia, Philippines, Singapore,

and Thailand. The bidirectional relationship between the growth in money supply and the change in stock market prices is statistically positive. Recently, Hosseini et al. (2011) find both short-term and long-term relationships between the macroeconomic variables (crude oil price, money supply, industrial production, and inflation rate) and stock market performance during 1999-2009. Notably, the impact of money supply in China is positive, but that of India is not.

As seen in previous literature, the results of the relationships between the macroeconomics variables (including money supply) and stock market performances remain inconclusive, which is potentially different from sample data, period of study, methodology, and estimation techniques. This leaves us a question on to the true relationship.

Methodology

This study employs the DCC-GARCH model to investigate the time-varying relationship of money supply and the stock return. The dynamic conditional correlation (DCC) model is developed by Engle (2002). The model starts from obtaining the residual returns in a bivariate vector autoregression (VAR) as presented in equation (1).

$$r_t = \alpha + \sum_{k=1}^{K} \beta_k r_{t-k} + \varepsilon_t \quad (1)$$

where r_t is a 2x1 vector of changes in the stock index (the difference in natural logarithms of the stock exchange of Thailand index) and money supply (the difference in narrow money supply or broad money supply) at time *t*.

α is a 2x1 vector of constants.

β_k is a 2x2 matrix of parameters of autoregressive of the stock index and money supply at the SIC (Schwarz Information Criterion) optimal lag *k*.

ε_t is a 2x1 vector of residuals.

The standard GARCH model assumes that $\varepsilon_t | \Phi_{t-1} \sim N\ (0, H_t)$, where Φ_t is an information set at time *t*. Moreover, the time-varying variance matrix is presented as $H_t = D_t R_t D_t$, where $D_t = diag\left[\sqrt{h_{ii,t}}\right]$, and $h_{ii,t}$ is the *i*-th variance in H_t. R_t is a 2x2 correlation matrix of ε_t , and $R_t = \left\{\rho_{ij,t}\right\}$, which are specified in equation (2).

$$R_t = diag\left(q_{11,t}^{-1/2}, q_{22,t}^{-1/2}\right) Q_t diag\left(q_{11,t}^{-1/2}, q_{22,t}^{-1/2}\right) \quad (2)$$

where Q_t is a 2x2 symmetric positive definite, and $Q_t = \left(q_{ij,t}\right)$,

$Q_t = (1 - \phi - \gamma)\bar{Q} + \phi \varepsilon_{t-1} \varepsilon_{t-1}' + \gamma Q_{t-1}$,

$\bar{Q}$ is a 2x2 unconditional variance matrix of $\varepsilon_t, \phi, \gamma$, and $\phi + \gamma < 1$

We also assume that the conditional variance of ε_t follows GARCH (1,1) process, which can be shown in equation (3).

$$h_{ii,t} = c_i + a_{ii} h_{ii,t-1} + b_{ii} \varepsilon_{i,t-1}^2 \quad (3)$$

Then, the parameters from previous equations are estimated by maximizing the log likelihood function given below.

$$L(\theta) = -\frac{1}{2}\sum_{t-1}^{T}(N\ln(2\pi) + ln|H_t| + \varepsilon_t' H_t^{-1}\varepsilon_t) \quad (4)$$

To deal with a possibility of changes in structural regime in time series, we employ Bai and Perron (1998, 2003) structural break test to identify break dates of the data. This model has some advantages as follows. First, it allows multi structural breaks, and does not require to set break dates. This technique is different from the Chow (1960) structural break test, which the Chow test obliges to identify a break date in the data. Second, the Bai and Perron's structural break test requires less restricted assumptions, which is easier and better than the structural break test of Liu, Wu, and Zidek (1997). The mechanism of the Bai and Perron structural break test begins with comparing the null hypothesis of no break to the alternative hypothesis of one break. If the null hypothesis is rejected, then the next step is to compare the model with one break (null hypothesis) to the model with two breaks (alternative hypothesis), until it reaches to the optimal breaks.

Data

Monthly data of the stock market index and money supply (broad money and narrow money)[a] in this study covers from January 1997 to July 2015, equivalent to 223 observations. Both broad money and narrow money data (money supply) are from the Bank of Thailand (BOT), and the stock index (SET) data are from the Stock Exchange of Thailand. The BOT applied the new definition of money supply from the Monetary and Financial Statistics Manual (MFSM2000) since 1997,[b] so we conduct the study since then, which makes our study distinguish from other studies focusing on traditional definitions.

Figure 1 depicts the movement of price indexes of the broad money, narrow money, and the SET index, respectively, over the entire sample period. Some interesting evidence should be noted as follows. First, clearly, the stock market movement fluctuates more than the money supply

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[a] The Bank of Thailand adopts the Monetary and Financial Statistics Manual (MFSM2000) framework issued by the International Monetary Fund (IMF), which defines meanings of the broad money and narrow money as follows. "Narrow money comprises financial instruments whose properties are closest to money (near money), for example, cash, coins, call deposits that is transferable immediately to other party. Broad money, itself inclusive of narrow money, comprises other deposits and financial instruments of high liquidity almost like cash, for example savings deposits, fixed deposits, and money market debt instruments." (Source: Fourth Quarter 2006, Economic and Financial Statistics, Bank of Thailand)

[b] The new definition of money supply excludes the data of Financial Institution Development Fund (FIDF), but includes accrued interest items.

movements. Especially during the crises, for example the 1997 Tom Yum Kung crisis and the 2008 credit crisis, the stock market moved downward significantly, whereas the movement of money supply was not affected by financial crisis. Second, over the entire period of study, it seems that money supply has a positive time trend, increasing gradually during at the beginning of the study and accelerating during a more recent period. Third, narrow money is relatively more volatile than broad money. Thus, the effect of the other deposits and financial instruments of high liquidity helps stabilize the movement of broad money.

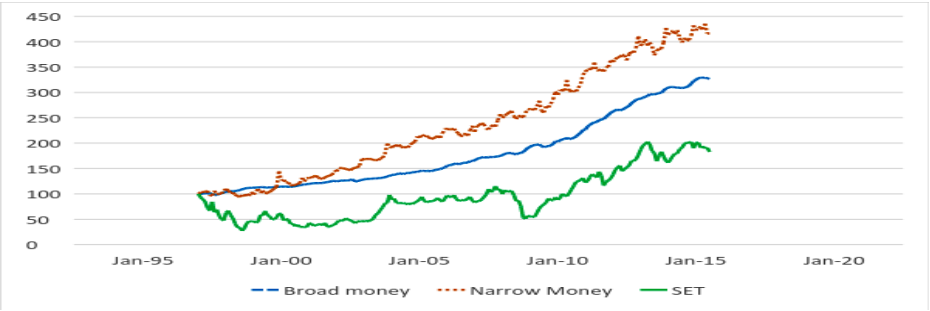

Figure 1: Price indices of broad money, narrow money, & the stock market of Thailand.

Note: The figure above displays the monthly indices of broad money supply, narrow money supply, & the stock market index (SET). The data start from January 1997 to July 2015, & the base value is set as 100.

Panel A of Table 1 shows the descriptive statistics of the first difference of logarithm of broad money, narrow money, & the stock index, respectively. Consistent with the graph depicted in Figure 1, the stock return shows the highest uncertainty (highest standard deviation), followed by narrow money, & broad money, respectively. However, the average percentage change of stock market index is less than that of broad money and narrow money. This makes intuitive sense, because the movement of money supply shows a positive time trend, but the stock market does not. Broad money, & the SET index show negative skewness, while narrow money shows positive skewness. The Shapiro-Wilks normality test is all rejected, meaning that the data is not normally distributed. Panel B of Table 1 indicates Pearson correlation coefficients of these variables. We find the significant positive correlations between broad money and narrow money, & broad money and stock index, but do not find the significant correlation between narrow money and the stock index. Due to the significant relationship of the broad money and the stock market, we infer that broad money could be a better indicator of the capital market growth or more closely to financial market than narrow money.

TABLE 1: Descriptive statistics of the returns of narrow money, broad money, & the stock market of Thailand.

Panel A: Descriptive statistics

	Mean	Standard deviation	Skewness	Kurtosis	Shapiro–Wilk (normality test)
Broad money	0.5335%	0.8353%	-0.9362	4.1351	0.9396
Narrow money	0.6420%	3.6421%	0.8953	7.9447	0.9238
SET	0.2716%	8.7275%	-0.4116	2.5344	0.9527

Note: The table above presents the descriptive statistics of the percentage changes of broad money, narrow money, & the stock index (SET). The monthly data is from January 1997 to July 2015. The values of mean and standard deviation are presented in percentage. The normality is tested with Shapiro–Wilk. *, **, *** show the statistical significance at 10%, 5%, & 1% levels, respectively.

Panel B: Correlation coefficients

	Broad money	Narrow money	SET
Broad money	1.0000	0.3471***	0.1238*
Narrow money		1.0000	-0.0095
SET			1.0000

Note: The table above shows Pearson unconditional correlation coefficients of the returns of broad money, narrow money, and SET index. The monthly data is from January 1997 to July 2015. *, **, *** show the statistical significance at 10%, 5%, and 1% levels, respectively.

Empirical results

Cointegration

We begin the analysis by validating the stationarity property of the data used in this study. We perform the stationarity test using augment Dickey-Fuller and Phillip-Perron unit root tests. Table 2 shows the results of the stationarity test for both in level and first difference forms. As expected, the stationary only exists in the first difference form that the null hypothesis of nonstationarity is statistically rejected. Thus, it fulfills the assumptions of econometric models in further steps. The optimal lag length is determined by Schwarz Information Criterion (SIC).

TABLE 2: Unit root test

	Price level			First difference		
	lag	ADF	PP	lag	ADF	PP
Broad Money	13	0.3913	0.6117	28	-15.0835**	-235.4272***
Narrow money	15	-0.6881	-0.4447	14	-101.0119***	-225.7046***
SET	4	-2.3572	-2.5944	2	-178.8944***	-211.8027***

Note: The table above reports augmented Dickey-Fuller and Phillip-Perron unit root test. Only the first differences of broad money, narrow money, and SET index are stationary. The numbers of lags in the table are the SIC optimal lags. The monthly data is from January 1997 to July 2015. *, **, *** show the statistical significance at 10%, 5%, and 1% levels, respectively.

After validating the presumptions of the model, Table 3 exhibits the bivariate cointegration rank test suggested by Johansen (1988). For both broad money and narrow money, the trace statistics at rank equal to 0 and 1 are strongly statistically significant, confirming the stationarity of the data.

TABLE 3: Cointegration rank test

H0: Rank=r	Trace	
	Broad money	Narrow money
0	270.4840***	375.2380***
1	119.5040***	128.6650***

Note: The table above presents the trace statistics of Johansen (1988) cointegration test. The null hypotheses of rank equals 0 and 1 are rejected at 1% significant level, which implies the stationarity of the data. The monthly data is from January 1997 to July 2015. *, **, *** show the statistical significance at 10%, 5%, and 1% levels, respectively.

Dynamic conditional correlations

TABLE 4: Vector autoregression

	α	$\beta_{t-1,\ SET}$	$\beta_{t-1,\ MS}$	ρ
SET	0.0049	0.0612	0.2345	0.0589
	(1.1469)	(0.8517)	(1.8000)*	(0.6827)
Narrow money	0.0051	-0.0045	-0.3565	
	(2.6968)***	(-0.2055)	(-5.6778)***	
SET	0.0036	0.0249	-0.0044	0.2335
	(0.5056)	(0.0910)	(-0.0042)	(2.2434)**
Broad money	0.0043	-0.0176	0.118	
	(2.3622)**	(-2.7349)***	(0.8366)	

Note: The table above shows the results from bivariate-VAR between the stock return and changes in money supplies. The SIC optimal lag equals one. $\beta_{1,SET}$ represents the coefficient of the first lag of SET index on a dependent variable of the system of equations. $\beta_{1,MS}$ represents the coefficient of the first lag of money supply on a dependent variable of the system of equations. The monthly data is from January 1997 to July 2015. The numbers in parenthesis are t-values. *, **, *** show the statistical significance at 10%, 5%, and 1% levels, respectively.

Table 4 presents the bivariate vector autoregression results between the SET index return and narrow money and the SET index return and broad money with the DCC-GARCH model. The SIC optimal lag length is equal to 1 in all pairwises. Our results are quite interesting. In general, we observe unidirectional bivariate intertemporal relationships in both cases, but in different magnitude and direction. Specially, changes in the SET price index negatively cause changes in broad money. Investors find a safer place to keep their money, when the stock markets are up for a certain period. They fear a potential crash in the market. Thus, the flight to quality is a possible explanation. Changes in narrow money positively cause changes in the SET price index. The positive relationship is possible from the fact that when economy prospers, investors expand their investment both in money and stock markets, subsequently driving entire financial market upward. In sum, our results show mixed effects of the money supply, which is consistent to prior literature as discussed in the literature review.[c] A possible explanation for the discrepancy is the new definition of the money supply. It seems that broad money is a better measure of the relationship, because it possesses relatively highly statistically significant. Our conjecture goes along with the correlation obtained by the DCC-GARCH technique, which only the correlation between broad money and the stock market is statistically significant.

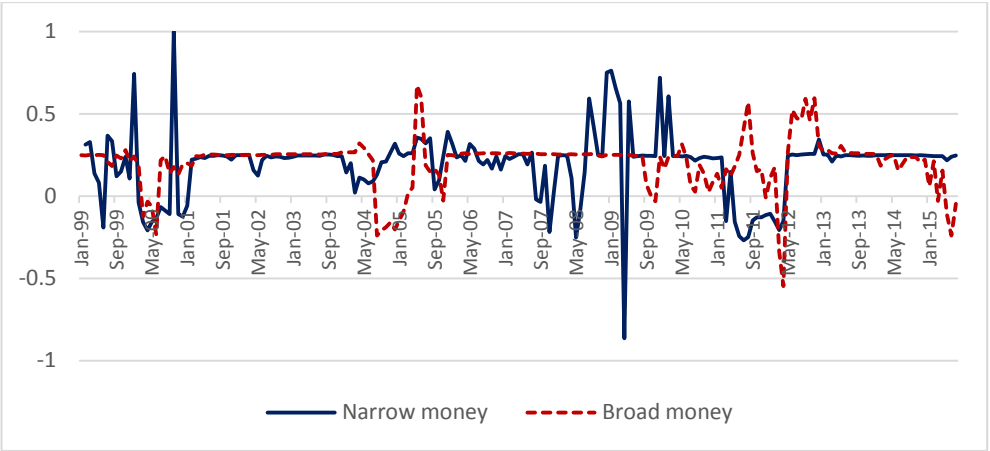

Figure 2 Dynamic conditional correlations of money supply and the stock market of Thailand.

Note: The figure above presents the time-varying correlations of the returns of narrow money and the stock index, & the returns of broad money and the stock index, which are estimated by DCC-GARCH model.

Clearly seen in Figure 2, the correlations between money supplies and the stock market are dynamic. Extreme movements are easily to notice during financial turmoils, for example the Dot

[c] Parhizgari and Nguyen (2011) show that M2 is a better indicator than M1, which literature before 1990's emphasizes the role of M1.

Com crisis in 2000, Credit crisis in 2008, and Debt crisis in 2011. The correlations of the relationship between the stock market and narrow money are more volatile than those of between the stock market and broad money. More volatility in narrow money casts doubt on the coefficient estimations.

Structural breaks

To take a potential of regime switching in the time series, we adopt Bai and Perron multi-structural breaks test for the relationship between the SET index and narrow money supply as well as the SET index and broad money supply. The results show five optimal breaks for both definitions of money supply. However, there is only one common break, which is the 190th observation as of November 2012.[d] Then, we re-analyze our evidence by separating the data into two sub-periods as shown in Panels A (January, 1997 to October, 2012) and B (November, 2012 to July, 2015) of Table 5. The break is consistent with the premise of the financial recovery after the global crisis in 2008. An increase in the Stock Exchange of Thailand was noted. In general, the results are less statistically significant than the results of the whole sample, which we only find the significantly negative relationship of broad money supply and the SET index in the first sub-period as shown in Panel A of Table 5. This confirms the existence of the short term relationship between SET index and broad money supply. However, the correlations of both money supply definitions and the SET index are statistically significant, and stronger than those of the whole sample. Thus, we conclude the existence of time-varying correlation between the SET index performance and money supply in the Thailand economy.

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TABLE 5: Structural Break VAR

Panel A: The first sub-period

	α	$\beta_{1,\,SET}$	$\beta_{1,\,MS}$	ρ
SET	0.0239	0.0144	0.0123	0.2198
	(4.4413)***	(0.1699)	(0.0891)	(1.9551)*
Narrow money	0.0260	0.0021	-0.0219	
	(4.4931)***	(0.0518)	(-0.0903)	
SET	0.0167	0.0241	-0.0033	0.2436
	(2.3413)**	(0.2087)	(-0.0040)	(2.7414)***
Broad money	0.0055	-0.0166	0.0998	
	(21.1539)***	(-2.5015)**	(1.7696)*	

[d] After financial crisis in 2008-2009, Thai GDP growth is about 5% in 2012.

Panel B: The second sub-period

	α	$\beta_{1,\ SET}$	$\beta_{1,\ MS}$	ρ
SET	0.0121	0.0171	0.0092	0.2465
	(1.2931)	(0.0814)	(0.0423)	(0.3480)
Narrow money	0.0015	0.0051	-0.0194	
	(0.2492)	(0.0431)	(-0.0538)	
SET	0.0023	0.0001	0.0000	0.2531
	(0.4421)	(0.0010)	(0.0000)	(1.1048)
Broad money	0.0054	0.0008	0.0002	
	(3.0454)***	(0.0366)	(0.0016)	

Note: The tables above show the results from bivariate-VAR between the stock return and changes in money supplies. Structural breaks are identified with Bai and Perron (1998, 2003). The first sub-period starts from January 1997 to October 2012, & the second sub-period is from November 2012 to July 2015. Numbers in parenthesis are *t*-values. *, **, *** show the statistical significance at 10%, 5%, & 1% levels, respectively.

Conclusion

One of long-standing relationships in finance and economic studies is the association between money supply and stock market performances, although results are not conclusive. In this paper we reinvestigate the relationship between the money supply and the SET index performance by using the new definitions of the aggregate measure of money supply, namely broad money and narrow money, as well as employing a new estimation technique (the dynamic conditional correlation suggested by Engle, 2002) in order to capture the time varying effect of the relationship. These two issues have not been investigated in the past, thus our paper fills the gap in prior literature in this regard.

Using the data of the Stock Exchange of Thailand and the Bank of Thailand, we show the equilibrium relationships between money supply and stock market return using cointegration and vector autoregression specification models. Our results also support vast amounts of prior literature of mixed results of the relationship. Moreover, we also investigate the relationship in different subperiods determined by the Bai and Perron (1998, 2003) structural break tests, & find that the relationships are weaker than the entire sample data, but still statistically significant. We conclude that the association between the SET index performance and money supply is time varying, which contributes to prior literature showing the static relationship. Nevertheless, we claim that choices of the measure of money supply, econometric model, as well as the time period of study could be reasons for inconclusive evidence. However, in general, our results lend support to the existence of the relationship. Future research is also recommended to validate such the true relationship.

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