

# Dynamic Conditional Correlation between the Real Estate and the Stock Markets in Thailand

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## Abstract

With different data frequency and data source from prior major studies, we do not find any long-term relationship between the real estate market and the stock index performance in Thailand, contrasting to other prior well-known findings. In general, low correlation coefficients between the real estate and stock markets prevail. Moreover, the dynamic conditional correlation shows negative correlations between townhouse and stock indices, as well as condominium and stock indices. This suggests a potential of good hedging instruments for portfolio diversification.

**Keywords:** House Price, Real Estate, Stock Market Index, Dynamic Conditional Correlation

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## ความสัมพันธ์เชิงพลวัตแบบมีเงื่อนไขระหว่าง อสังหาริมทรัพย์และตลาดหลักทรัพย์ในประเทศไทย

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### บทคัดย่อ

งานวิจัยนี้ได้ใช้ข้อมูลที่มีความถี่และฐานข้อมูลต่างจากงานวิจัยในอดีต ผลการวิจัยไม่พบความสัมพันธ์ในระยะยาวระหว่างการเปลี่ยนแปลงราคาของอสังหาริมทรัพย์และดัชนีตลาดหลักทรัพย์ในประเทศไทย ซึ่งแตกต่างจากงานวิจัยที่ผ่านมา โดยทั่วไปแล้วพบว่าความสัมพันธ์สหสัมพันธ์ระหว่างอสังหาริมทรัพย์และตลาดหุ้นสามัญมีค่าต่ำ นอกจากนี้ความสัมพันธ์เชิงพลวัตแบบมีเงื่อนไขแสดงค่าความสัมพันธ์ที่เป็นลบระหว่างทาว์นเฮ้าส์และดัชนีตลาดหลักทรัพย์ รวมถึงคอนโดมิเนียมและดัชนีตลาดหลักทรัพย์ ซึ่งผลการศึกษานี้ชี้ว่าอสังหาริมทรัพย์อาจเป็นเครื่องมือในการป้องกันความเสี่ยงในการกระจายการลงทุนในกลุ่มหลักทรัพย์ได้เป็นอย่างดี

**คำสำคัญ:** ราคาบ้าน อสังหาริมทรัพย์ ดัชนีตลาดหลักทรัพย์ ความสัมพันธ์เชิงพลวัตแบบมีเงื่อนไข

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ผู้เขียนขอขอบคุณคณะพาณิชยศาสตร์และการบัญชี มหาวิทยาลัยธรรมศาสตร์ที่ได้สนับสนุนเงินทุนสำหรับงานวิจัยนี้

## 1. Introduction

Markowitz (1952) introduces the concept of an efficient asset allocation among assets in the universe in order to maximize the return of an invested portfolio, given a level of risk taking. Not only financial assets but also physical assets are considered for the investment purpose. Recent research shows that real estate is an important asset in a diversified invested portfolio<sup>1</sup> and that is considered as investment and consumption goods (Benjamin, Chinloy, and Jud, 2004; Piazzesi, Schneider, and Tuzel, 2007). Because of its powerful role, the relationship between the real estate market and stock market performance is of interest among academicians and practitioners. The linkage is due to the fact that real estate is considered as an asset class that help investors diversify their portfolio investments. Time-varying correlation between these assets is important for portfolio diversification, which implicitly shows a level of market integration (Okunev and Wilson, 1997; Ling and Naranjo, 1999; Okunev, Wilson, and Zurbruegg, 2000).

Two widely acceptable theories explain the association between the real estate and equity markets. First, the wealth effect suggests that an increase in constituent stock prices in an invested portfolio causes investors to become wealthier. Wealthy investors increase their demands in other investable assets (such as real estate), which subsequently and almost simultaneously drive the asset prices (Quan and Titman, 1999). Second, the credit-price effect suggests that an increase in real estate prices as a collateral for a loan agreement assists people to access the fund easier or to borrow at a lower cost. People then spend money to some profitable projects, subsequently driving an increase in stock prices (Kapopoulos and Siokis, 2005). In sum, both theories suggest a positive relationship between the real estate and stock markets. A change in stock prices causes investors to rebalance their investment portfolios, which ultimately affects the housing prices, vice versa.

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<sup>1</sup>Most previous studies employ real estate investment trust (REIT) as a proxy of the real estate market. See, for example, Liu, Hartzell, Greig, and Grissom, 1990; Berg, Gu, and Lien, 2007; Liow and Adair, 2009.

Both stock and real estate markets are crucial sectors of the economy in Thailand, especially the real estate market is an important vehicle to drive and support the sustainable growth for the entire economy.<sup>2</sup> In addition, property listed companies are counted as a large and an important part in the Stock Exchange of Thailand (SET).<sup>3</sup> In 1997, Thailand experienced the severe problem in the real estate markets, subsequently causing the crisis in this region (so called Tom Yum Goong crisis). Since then, the real estate sector has been highly regulated and monitored by government agencies. The important role and significant impact of the real estate market are emphasized again in the 2008 global financial crisis, in which the root of the problem is from mortgage markets. In Thailand, to accelerate and sustain the economy, recently, the government policies support and promote various channels of metropolitan transportations, such as sky trains and undergrounds, which encourage the demand growth in property and property development. Huge amounts of condominiums, houses, and other types of living places are built along the ways. As suggested by the wealth effect and the credit-price effect, the association between real estate assets and stock market performance should exist, which provides us an opportunity to study in an empirical work.

Although there are numerous studies on the linkage between the real estate and stock markets especially in developed markets (Liu et al., 1990; Giliberto, 1990; Gyourko and Keim, 1992; Liow, 2006), the evidence in Thailand is scant. Only few published papers are available. For example, Ibrahim, Padli, and Baharom (2009) and Ibrahim (2010) find that the relationship is well explained by the wealth effect. There exists both the short- and long-term relationship between these two markets with and without macroeconomic variables. Then, we set up two research questions as follows. First, we revisit whether the association between real estate market and stock market performance exists or not. Second, if existing, the relationship is time-varying or static manner.

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<sup>2</sup> See more explanations in Mera and Renaud (2000), the summer 2012 report of the European Public Real Estate Association (EPRA), and the European Association for Investors in Non-listed Real Estate Vehicles (INREV) ([http://www.epra.com/media/Real\\_estate\\_in\\_the\\_real\\_economy\\_-\\_EPRA\\_INREV\\_report\\_1353577808132.PDF](http://www.epra.com/media/Real_estate_in_the_real_economy_-_EPRA_INREV_report_1353577808132.PDF))

<sup>3</sup> The market capitalization of property and construction sector is approximately 12% of the total market capitalization of the SET as of 21 August 2015.

This paper contributes prior literature at least three distinct dimensions. First, we show that there exists no long-term relationships between the real estate and stock markets in Thailand. Our results contradict to prior literature, which finds a strong association (Ibrahim, 2010). Moreover, we apply the dynamic conditional correlation (DCC) model suggested by Engle (2002) in this study, which not many other papers employed it. Inclusion of macroeconomic variables as control variables in the model improves the quality of our estimations. The results are robust because both static (VAR) and dynamic (DCC) models show the same results. We suggest that investors might consider the real estate as a potential diversified asset (or a hedging instrument) in their invested portfolios. Second, because of limited evidence on developing markets shown in prior empirical works, we provide additional evidence. Our findings in Thailand are crucial because the market capitalization of the Thai stock market is the second largest in AEC (USD 429 million) following only the Singaporean stock market.<sup>4</sup> Thus, such evidence yields important information to both domestic and international investors for their portfolio allocations (probably even diversifications). Third, in this paper the frequency of data is monthly basis, which is different from prior literature (quarterly basis). A high frequency data better captures the information flows to our variables, thus our results shed some more powerful and interesting results (O'Hara, 2015). With superior methodologies designed and high frequency data, we believe that our results are unique and give insights to investors.

The organization of this paper is as follows. Section 2 shows literature review. Section 3 describes the data employed in this study. Section 4 presents methodologies. Section 5 discusses empirical results and the last section is conclusion.

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<sup>4</sup> Source: [www.bangkokbiznews.com](http://www.bangkokbiznews.com) (As of 12 August 2015).

## 2. Literature review

Real estate is considered as an alternative asset class for diversification in portfolio management. Liu, Hartzell, Greig, and Grissom (1990) find the segmentation between the commercial real estate market and the U.S. stock market. Giliberto (1990) and Gyourko and Keim (1992) also find insignificant relationships, but there are positive relations between securitized real estate (such as REIT) with stock and unsecuritized real estate, respectively. Quan and Titman (1997, 1999) explore the association in international markets. Quan and Titman (1997) investigate the relationship of changes in real estate prices and rental incomes with stock returns in 17 countries. The results show insignificant relationships in the U.S., but the positive and significant ones are mainly presented in Asia/Pacific. They claim that changes in political and economic fundamentals cause the positive relationship. After including macroeconomic variables, such as gross domestic product (GDP), inflation, and interest rate, they find a weak linkage, and the GDP plays a major role on real estate prices. Moreover, real estate is a good hedging instrument over a long term (Quan and Titman, 1999).

Previous studies show that real estate is a good alternative for portfolio diversification. One of popular methodologies is to investigate a lead-lag relationship. Using data of Singapore Stock Exchange's Straits Time Industrial Index and Urban Redevelopment Authority's quarterly transaction-based residential and office property price indices from 1985 to 2002, Liow (2006) employs autoregressive distributed lag (ARDL) methodology. The findings show that, in the long run, the office property market influences the stock market, but in short run the residential property market has a stronger impact on the stock market. Once control variables are included, the relationship of the property on stock market is weakening. Ibrahim, Padli, and Baharom (2009) also apply ARDL, and find the positive relationship between housing prices and the stock returns in Thailand.

Another aspect of the studies is the causality of these two asset classes. Ibrahim (2010) applies Granger causality method to investigate the relationship of real estate prices, stock price, GDP, and consumer price index in Thailand. Types of real estate used in the study includes single house, single house with land, townhouse, and townhouse with

land. The results from quarterly data over the period of 1995 to 2006 show that changes in stock prices cause changes in house prices. Lean and Smyth (2014) employ both ARDL and Granger causality to examine the association between house prices, stock prices, and interest rate in Malaysia with quarterly data. They find that stock prices Granger cause house prices in the area of Kuala Lumpur, Penang, and Selangor. Lin and Lin (2011) focus more on the Asian region including China, Hong Kong Japan, Singapore, South Korean, and Taiwan. They finds that the real estates are not integrated with the stock markets in Singapore and South Korea, but integrated in Japan. Moreover, prices of real estate Granger cause prices of stock markets in Singapore and Taiwan. Li, Chang, Miller, Balcilar, and Gupta (2015) use a new technique, so called the wavelet analysis, to study causality between the U.S. housing and stock markets during 1890 to 2012. They find structural breaks in these two markets, and the causality effect is not constant through time. The relationship of these two asset classes in the long run is lower than that of in the short run, but the causality effects are noted in a longer period.

Another issue in this area of study is time varying correlation of the real estate and stock markets. Berg, Gu, and Lien (2007) employ REIT data in different regions in the U.S. to find a dynamic correlation with S&P 500 stock index and treasury bonds. Interestingly, they demonstrate that real estate acts as a hedging instrument in financial markets. Heaney and Srianthakumar (2012) also apply the Dynamic Conditional Correlation (DCC) technique with REIT data of listed in Australian market (A-REIT), and direct investment in commercial and residential property comparing to the Australian Securities Exchange All Ordinaries Index. This data is on quarterly basis starting from September 1986 to September 2009. The correlations are time varying and increase during the global financial crisis. Case, Yang, and Yildirim (2012) also use DCC-GARCH to find dynamic linkage between REIT and stock markets. Monthly prices of FTSE NAREIT All-REIT Index and CRSP value-weighted Cap-based Portfolio market index from January 1972 to September 2008 are employed. The findings also confirm time varying correlations, and suggest that including this asset class in an invested portfolio can make an investment more efficient.

With a long time series data, an issue of structural break is of interest. Chan, Treepongkaruna, Brooks, and Gray (2011) use Markov switching model on the monthly data of many asset classes including stock, and real estate markets in the U.S. Two regimes are observed in the study, tranquil and crisis periods. However, they do not find a significant relationship between real estate and stock markets in both regimes, but do find a negative relationship between real estate and one-year Treasury bond markets. Hui and Ng (2011) employs the CUSUM test to identify structural breaks in Hong Kong markets. The relationship between real estate and stock markets are detected in the sub-periods of 1984-1989 and 1990-1994, but weakening during 1995-2006.

Although many literature explores the linkage of real estate and stock markets in various countries, the results are still inconclusive, especially in emerging markets. This study will fill the gap by examining dynamic correlations of these two assets in Thailand with different data set from the previous studies.

### 3. Data

Monthly real estate prices are from the Bank of Thailand (BOT). The data includes prices of single house, townhouse, condominium, and land.<sup>5, 6</sup> The stock market index (SET index) is from SetSmart. Frequency of data in this study is different from other previous literature, which most of them are based on quarterly basis. This allows us to capture more dynamic behaviors of the variables.

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<sup>5</sup> The indices are constructed from 17 commercial banks' mortgage loan in Bangkok and vicinities (Bangkok, Samut Prakan, Nonthaburi, Pathum Thani, Nakhon Pathom and Samut Sakhon). The indices of single house, town house, and condominium are created with hedonic regression method (seasonally adjusted, 3-month moving average), controlling four housing characteristics (age, floor, entrepreneur, and location). Land price index is calculated by mix adjustment method with fixed weight. (seasonally adjusted, 3-month moving average) (See <http://www2.bot.or.th/statistics/ReportPage.aspx?reportID=680&language=eng>)

<sup>6</sup> Data source and frequency of data are distinguished from Ibrahim (2010).

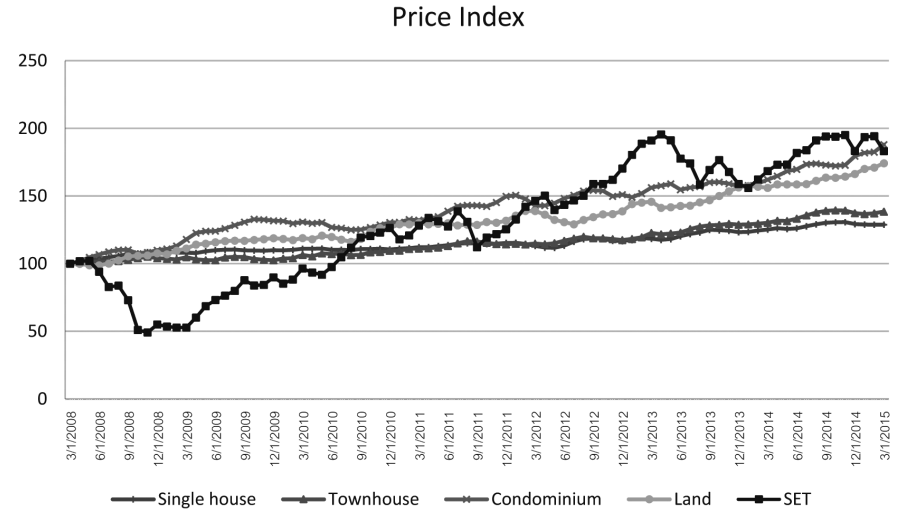


Prior literature suggests that inclusion of macroeconomics factors in an empirical model, such as GDP, interest rate, and inflation, reduces the degree of the relation between the real estate and stock markets (see Quan and Titman, 1999; Chan et al., 2011; Hui and Ng, 2011; Li et al., 2015). We include interest rate, inflation, and real effective exchange rate (REER) as control variables in our models. One-year Treasury bill interest rate is from the Thai Bond Market Association (ThaiBMA). Inflation is calculated from a change in the core consumer price index (CPI) provided by the Bureau of Trade and Economic indices. REER is obtained from the BOT, which is calculated from a weighted average between Thai Baht and currencies of 25 trading partners adjusted with the comparative inflation. The study period covers from March 2008 to March 2015.<sup>7</sup>

Figure 1 depicts the price indices of five assets; namely house, townhouse, condominium, land, and the SET index. All price indices are adjusted to 100 at the beginning of the observed period, which is considered as the base period. It is obviously seen that the SET index is more volatile than all property indices. It is also important to note that the stock market performance is bad during the crisis period, while the performance in real estate is relatively stable over the time period of study. However, the performances in the stock and real estate markets significantly improve since midyear 2010. Due to the fluctuation in the stock prices, from a bird's eye view, it seems that property can be considered as a hedging instrument in an investment portfolio.

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<sup>7</sup>The database starts from March 2008 onwards.



**Figure 1 Price indices of real estate and the stock market index of Thailand**

The figure above illustrates the price indices of real estate single house, townhouse, condominium, and land, and the stock market index (SET). The monthly data starts from March 2008 to March 2015. All price indices are adjusted to 100 at the beginning of the study period.

#### 4. Methodology

The methodology used in this study is the dynamic conditional correlation (DCC) model developed by Engle (2002) to capture dynamic correlation between the property price indices and stock index. We start from a bivariate vector auto regression (VAR) as shown in equation (1). A bivariate VAR is designed to estimate residuals that will, later, proceed with DCC-GARCH model.

$$r_t = \alpha + \sum_{k=1}^K \beta_k r_{t-k} + \lambda' x_t + \varepsilon_t \tag{1}$$

where  $r_t$  is a  $2 \times 1$  vector of changes in price index of real estate and stock index at time  $t$ .

$\alpha$  is a  $2 \times 1$  vector of constants

$\beta_k$  is a  $2 \times 2$  matrix of parameters of auto regressive of assets at the AIC (Akaike information criterion) optimal lag  $k$

$\lambda'$  is a  $2 \times 3$  vector of parameters of control variables

$x_t$  is a  $3 \times 1$  vector of control variables

$\varepsilon_t$  is a  $2 \times 1$  vector of error terms, and  $\varepsilon_t | \Omega_{t-1} \sim N(0, H_t)$

The covariance matrix is represented as  $H_t = D_t R_t D_t$  where  $D_t = \text{diag}[\sqrt{h_{ii,t}}]$ .  $h_{ii,t}$  is the standardized disturbance variances. The conditional variances are assumed to follow GARCH (1,1) process as shown in equation (2).

$$\begin{aligned} h_{11,t} &= c_{11} + a_{11}h_{11,t-1} + b_{11}\varepsilon_{1,t-1}^2 \\ h_{22,t} &= c_{22} + a_{22}h_{22,t-1} + b_{22}\varepsilon_{2,t-1}^2 \end{aligned} \tag{2}$$

$R_t$  is the correlation matrix of  $\varepsilon_t$  defined by  $\rho_{ij,t}$ , which can be computed from equation (3) as follows.

$$R_t = \text{diag}(q_{11,t}^{-1/2}, q_{22,t}^{-1/2}) Q_t \text{diag}(q_{11,t}^{-1/2}, q_{22,t}^{-1/2}) \tag{3}$$

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

$Q_t$  is a  $2 \times 2$  symmetric positive definite, and  $Q_t = (q_{ij,t})$

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

Then, we estimate parameters by maximizing the log likelihood function demonstrated as follows.

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

## 5. Empirical results

Table 1 presents the descriptive statistics on the monthly price index changes of the five assets, namely house, townhouse, condominium, land, and the SET index. The stock market performance is the best investment asset, generating on average almost 1.0% monthly return. Among real estate assets, changes in condominium price index are highest at 0.77% monthly return, followed by land, townhouse, and single house, respectively. On average, both real estate and stock markets provide positive return to investors. The classical concept on risk-return tradeoff works well, which the SET shows the highest return volatility. First difference in our variables confirms the normality as shown by Shapiro-Wilk, except for the stock market index, and meets the presumption of the models. Table 2 shows Pearson unconditional correlation coefficients of the five assets. A remarkable result is low correlations between the stock market and properties. Although, they are not statistically significant, the magnitudes are small and, in some cases negative. The small and negative correlations promise a potential instrument for portfolio diversification and hedging tool. Looking at among real estate assets, it is surprising that the correlations are still low, though the magnitudes are larger than the stock market. We note statistically positively significant between single house and townhouse (0.4591) and single house and condominium (0.221). Prices among different types of living places are correlated. Households or investors may consider them as a substitution product. However, land does not show any relationship with other variables, showing that developed real estate adds some value on the undeveloped land. The existence of some significant static correlation guarantees the relationship among variables over a certain period of time, and thus allows us to explore in-depth on a time-varying perspective.

**Table 1 Descriptive statistics**

	<b>Mean</b>	<b>Standard</b>	<b>Skewness</b>	<b>Kurtosis</b>	<b>Shapiro-Wilk</b>
Single house	0.30475%	0.75511%	0.26446	0.25667	0.98926
Townhouse	0.39219%	0.92124%	0.14742	-0.46099	0.98996
Condominium	0.76615%	1.53740%	-0.37308	0.44083	0.98096
Land	0.67251%	1.38300%	-0.05976	0.35866	0.99051
SET	0.95094%	6.56070%	-1.46499	5.27719	0.91040***

The table shows the summary statistics on monthly returns of the properties and shock market indices in Thailand. The monthly data starts from March 2008 to March 2015. Shapiro-Wilk is a normality test. Mean and standard deviation are shown in percentage. \*, \*\*, and \*\*\* present the statistical significance at 10%, 5%, and 1% levels, respectively.

**Table 2 Unconditional correlations**

	<b>Single house</b>	<b>Townhouse</b>	<b>Condominium</b>	<b>Land</b>	<b>SET</b>
Single house	1.00000	0.45911***	0.22071**	0.02273	-0.03104
Townhouse		1.00000	0.15176	0.03932	-0.15548
Condominium			1.00000	0.02118	0.14056
Land				1.00000	0.01199
SET					1.00000

The table illustrates Pearson unconditional correlation coefficients of monthly returns of five assets, including single house, townhouse, condominium, land, and SET index. The monthly data starts from March 2008 to March 2015. The null hypothesis is that the correlation between two assets is zero. \*, \*\*, and \*\*\* present the statistical significance at 10%, 5%, and 1% levels, respectively.

Before performing a next step, we have to check the stationary property of all variables. Table 3 presents Phillips and Perron unit root test of several lag lengths. First difference in our interested variables is stationary. The AIC optimal lag length of a bivariate VAR is equal to three. For the rest of our analysis we analyze the results from the models with three optimal lag length specification. Later we check whether a long term relationship between the real estate and stock markets exists or not. Table 4 presents the trace statistic from a bivariate cointegration as suggested by Johansen (1988). The results explicitly show the rejection of both rank = 0 and rank = 1 of all variables. This implies that we cannot conclude the existence of the bivariate cointegration, but reconfirms the stationarity of the variables.

**Table 3 Unit root test**

Lag length	Single house	Townhouse	Condominium	Land	SET
3	-41.0044***	-66.7340***	-47.0632***	-52.7625***	-56.9446***
6	-28.3994***	-57.8361***	-38.2294***	-42.6876***	-61.2745***
9	-25.6100***	-52.2378***	-39.0701***	-34.0971***	-58.4936***
12	-22.0075***	-51.2992***	-36.5789***	-32.3184***	-53.5442***

The table shows the Phillips-Perron unit root test. The results show that first differences (returns) of every asset in this study are stationary, and the statistics values are 1% statistically significant. We show the test for several lag length, though the AIC optimal lag length is three. For further analysis, we employ the model with three-lag length specification. \*, \*\*, and \*\*\* present the statistical significance at 10%, 5%, and 1% levels, respectively.

**Table 4** Cointegration rank test

H0: Rank=r	Trace			
	Single house	Townhouse	Condominium	Land
0	72.8737***	62.6631***	47.768***	53.4085***
1	17.6788***	18.2749***	13.9632***	17.6440***

The table reports the trace statistic of Johansen's cointegration test. The null hypotheses of rank = 0 and rank = 1 are rejected at 1% significant for all variables. \*, \*\*, and \*\*\* present the statistical significance at 10%, 5%, and 1% levels, respectively.

Table 5 presents the results of the bivariate VAR with three-lag specification. In general, the evidence is very weak for the interactions between the real estate and stock markets, which the insignificance of most coefficients prevails. More specifically, we do not observe any statistically significant relationship across markets. This hints or implies that the real estate market can be a potential asset for portfolio diversification. Additionally, the macroeconomic variables presented in the model as control variables show a weak determination on the real estate returns. Our finding contradicts to prior evidence showing the power of the control variables.

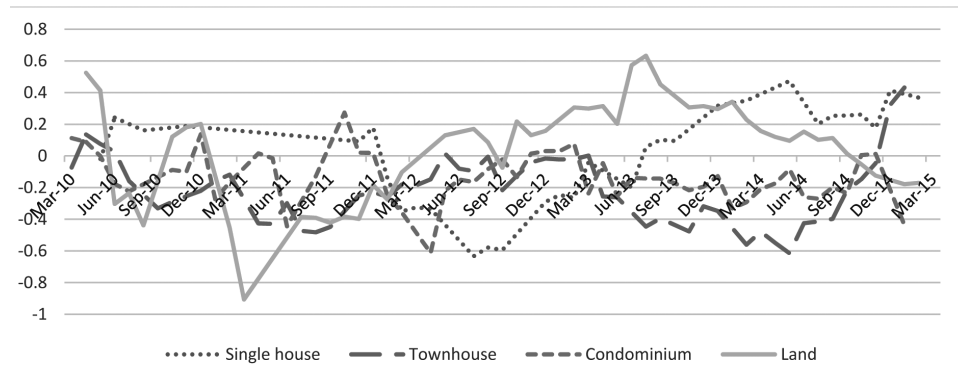
Later, for a better clarification, we plot the correlations between the real estate and stock markets obtained from the bivariate DCC-GARCH method over the time period of study, which is presented in Figure 2. The dynamic conditional correlations are estimated with rolling 24-month data. Thus, the correlations are time varying in nature. It is clearly seen that the land correlations show a larger swing than the other types of real estate. It is also important to note that the correlation patterns of townhouse and condominium are relatively similar. The housing correlations seem to have a similar pattern of the land correlations since September 2012. Townhouse and condominium are likely to become better hedging instruments because their correlations with the stock markets are not as high as those of the other two properties. Importantly, most of them are negative correlated to the stock markets, which investors can include the real estate assets for their stock portfolio diversification.

**Table 5** Vector auto regression

	$\alpha$	$\beta_{1,m\_RE}$	$\beta_{1,m\_SET}$	$\beta_{2,m\_RE}$	$\beta_{2,m\_SET}$	$\beta_{3,m\_RE}$	$\beta_{3,m\_SET}$	Inflation	REER	Interest rate
Single house	-0.00075 (-0.14)	0.41007 (2.00)**	-0.00208 (-0.12)	0.03222 (0.09)	-0.01764 (-0.47)	-0.43947 (-1.94)*	-0.00407 (-0.42)	-0.00295 (-0.14)	-0.06789 (-1.48)	0.18288 (0.99)
SET	0.03595 (0.92)	0.26154 (0.10)	0.08956 (0.39)	-0.15496 (-0.08)	-0.29200 (-2.76)**	-0.27716 (-0.37)	0.22557 (1.98)**	-0.07580 (-2.90)**	0.53804 (0.21)	-0.36790 (-0.31)
ownhouse	0.00225 (0.52)	0.08647 (0.71)	-0.02560 (-1.25)	0.06663 (0.63)	0.00744 (0.44)	-0.21730 (-1.87)	0.01315 (0.85)	0.00409 (0.77)	0.01717 (0.27)	0.05909 (0.32)
SET	0.03094 (1.58)	-0.0058 (-0.01)	0.04718 (0.43)	-0.00290 (-0.01)	-0.1226 (-1.22)	-0.03130 (-0.05)	0.09835 (0.95)	-0.10730 (-4.02)**	0.02649 (0.07)	-0.01320 (-0.02)
Condominium	0.00378 (0.45)	0.05309 (0.31)	0.02663 (0.77)	0.00854 (0.07)	-0.02780 (-0.90)	-0.04070 (-0.29)	0.02340 (0.81)	-0.00520 (-0.54)	-0.00330 (-0.03)	-0.01080 (-0.03)
SET	-0.0018 (-0.06)	0.00732 (0.01)	0.04521 (0.36)	-0.00120 (0.00)	-0.03080 (-0.21)	-0.00930 (-0.02)	0.03484 (0.31)	-0.04550 (-1.07)	0.00510 (0.01)	-0.00690 (-0.01)
Land	0.00989 (1.78)*	0.27058 (2.61)**	0.00901 (0.38)	0.09101 (0.82)	-0.00070 (-0.03)	-0.33850 (-3.25)**	0.01204 (0.55)	-0.00070 (-0.09)	-0.21500 (-2.35)**	-0.12870 (-0.61)
SET	0.08276 (1.13)	-0.41870 (-0.41)	0.28969 (1.66)*	0.28577 (0.46)	-0.29870 (-0.89)	-0.45430 (-0.76)	0.28508 (1.80)*	-0.04220 (-0.76)	0.27546 (0.30)	-2.79200 (-1.01)

The table above shows the bivariate vector auto regression of real estates and stock indices.  $\beta_{1,m\_RE}$  represents the coefficient of lag 1 of real estate return on the return of asset m. For example,  $\beta_{1,m\_RE} = 0.41007$  in the first row demonstrates the relation of lag one of return of single house on a current return of single house. The AIC optimal lag of the bivariate VAR specification is three. Inflation, REER, and interest rate are control variables in the model. The numbers in parenthesis are *t*-values. \*, \*\*, and \*\*\* present the statistical significance at 10%, 5%, and 1% levels, respectively.





**Figure 2 Dynamic conditional correlations**

The figure above displays the dynamic correlations between returns of the stock index and single house, townhouse, condominium, and land, which are estimated from DCC-GARCH model, and rolling 24-month data, respectively.

## 6. Conclusion

Because of inconclusive findings on the relationship between the real estate market and stock market performance from the previous studies, and an increasing role of Thailand as the center of the economies in South East Asia, understanding the interaction of these two markets calls for attention to both academicians and practitioners. Thus, this study aims to investigate the existence of the relationship in Thailand.

Our paper contributes to prior studies in several ways. First, in this paper we employ monthly data rather a common use of quarterly data in previous literature. With a higher frequency data, we do not find the significant relationships over the period of the study, though we control with major macroeconomic variables. Both static and dynamic correlations are low, in general. We conclude that there exists no long term relationship between these two markets. Incorporation of the real estate into a stock portfolio might assist investors to diversify their stock portfolio risk. Alternatively, the real estate market is a possible hedging instrument in stock portfolio management. Second, though we do not observe the long term relationship, the time varying correlation presents some interesting issues. The dynamic conditional correlation does show a slight positive correlation

between the land and stock market as well as the single house and stock market. It seems that prices of land and single houses co-move with the stock market index. However, townhouse and condominium show negative correlations with the stock market index. This implies that both assets could be considered as acceptable hedging instruments in a financial (stock) portfolio investment.

The limitation of this study is a short study period due to data availability. We will encounter to this problem even if real estate investment trusts (REITs) and property funds are employed. The data start from March 2009, which is shorter than our data used in the study. Nevertheless, a study of the relationship between the REITS and stock market performance would be interesting. Conducting study is worthwhile for future research.

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