

THE EFFECT OF ECONOMIC AND FUNDAMENTAL FACTORS ON THE AUSTRALIAN PROPERTY PERFORMANCE

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ABSTRACT

This study examines the effect of the trade weighted index (TWI) return on the volatility of Australian Real Estate Investment Trusts (REITs). This study also contributes to the existing literature by measuring the impact of the macroeconomics and fundamental factors on the real estate market for three major states in Australia including New South Wales, Victoria, and Queensland. Using monthly house and unit prices and covering the period from 2009 to 2016, this research uses both fixed and random effect panel data models and the vector autoregressive (VAR) model. The findings of the study suggest that the movement of the TWI has positive and statistically significant impact on Australian REITs suggesting the real estate investors expect risk premium on exchange rate factor. The results also purport that both house and unit prices in Australia are exposed to the fluctuations of the fundamental risk factors. Rental yield, a return component, has a positive relationship with the real estate market in New South Wales and Queensland. The findings of the study provide significant insight to the investors in their portfolio formation since they have the understanding of the priced risk factors.

Keywords: REITs, volatility, TWI, return, house price, rental yield, risk

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INTRODUCTION

Globally, the commercial real estate market has experienced important fluctuations since the 1960s (Yong & Singh, 2013). According to Yong and Singh (2013), the commercial real estate market is booming all over the world since 2009. As a result of the real estate industry indicators, including the house price level and commercial real estate price level, have doubled in many developed nations, such as the United Kingdom, the United States and Canada, and also other developing countries, particularly Australia. The World Liveability Index places three capital cities in Australia, namely: Melbourne, Perth and Adelaide, among the top ten cities that are the most liveable in 2016 in the globe (The Economist Intelligence Unit, 2016). In the nation, Sydney is also ranked well just beyond the top ten list for the year. Among the Australian cities, Sydney was ranked third among the most liveable cities (The Economist Intelligence Unit, 2015). The scale used was a measure used to gauge the liveability scale and was specifically designed to pinpoint cities that highly skilled individuals would be willing to settle within a country. According to Deloitte Access Economics, Sydney's most liveable suburbs are typically its most expensive and out of reach for many. Highly desirable, liveable environments will, all things equal, attract higher demand – driving up prices for dwellings in the area as more people would like to live there.

The equity and real estate markets as well as their lagged values between the troughs and peaks within the economy may also be expected to be related inversely. Lizieri and Satchell (1997) state that in case the profitability in the industrial sector decreases, investors may decide to channel capital into the real estate sector in a bid to gain higher profits. Within the equity market, the changes need to be quicker compared to the direct market that is non-exchange traded. For instance, channelling capital into the real estate industry will result in the reduction of capitalisation rates and therefore lead to a rise in values of capital. The indication materialises after sales completion. In the end, it will be displayed in the property's published net value of assets after reevaluation has been carried out. Additionally, results that conflict have been observed from the research as people conclude that the stock and real estate markets are actually segmented, implying that there is no cooperative movement in the given markets, while the other studies conclude that there is integration between the two markets leading to a significant positive concurrent movement (Gyourko & Keim, 1992).

Over the previous decades, the price of houses in capital cities within Australia have had a dramatic increase. This has resulted in the rise of interested groups to investigate the effect of the economic factors and fundamental factors on the Australian real estate market, including academics and other groups in

the industry. Yong and Singh (2013) undertook research aimed at determining if the entire stock market and resultant interest rates have significant effects on REITs return and the effect of management structure and borrowing on a given period that encompasses the global financial crisis and subsequent recovery of the REIT sector. Their study examines three variables: interest rate, market return and inflation. Reddy and Wong (2017) conducted an analogous study aimed at examining the impact of the interest rate on the Australian REITs by using the ICAPM model. They concluded that the returns of the real GDP, stock market, and interest rates are the key drivers of the Australian REITs. Ratcliffe and Dimovski (2007) concluded that using REIT's defensive traits as a property investment against risks in the market have lowered. REITs have a notable negative relationship with interests that are long-term, with an insignificant positive relationship with rates that are short-term. Newell and Tan (2005) find significant relation between the Australian stock market and the REITs. Liu and Mei (1992) found a significant comparison between the real estate industry and Australian stock exchange.

Trade Weighted Index (TWI) refers to the index representing the Australian Dollar's weighted average value in the bag of currencies. The bag of currencies includes currencies from other nations that are Australia's trading partners that in general are enough to make up at least 90% of the export and import trade in the nation. Currently, the pool is made up of over 23 currencies. The currency weights in the pool are reassessed every October based on trade figures for the past financial year. As the value of the dollar in Australia increases, imports lower in prices, while the exports to other nations become expensive. TWI provides currency weights that are widely used in trade in the globe. Because the currencies are differently weighted, the currency changes will have a huge effect on the dollar and indices that are related. One of the main reasons to use the TWI is because it is one of the best measures of trends in the rates of exchange compared to any other bilateral rate of exchange, including those against the U.S. dollar, because the dollar in Australia might rise in the case of one currency while falling in the case others. The TWI might also be subject to insignificant swings in the value in comparison to the U.S. dollar bilateral exchange rate.

Previous studies examine the effect of fundamental and macroeconomic variables and fundamental variables on the real estate market in Australia, including Yong and Singh (2013), Reddy and Wong (2017), Newell and Tan (2005) and Ratcliffe and Dimovski (2007), who examine the effect of the interest rate on the Australian REITs. But in this study, we examine the relationship between the TWI and the Australian REITs and we consider the real estate market at the state level. Yong and Singh (2013), Reddy and Wong (2017), Newell and

Tan (2005) and Ratcliffe and Dimovski (2007) use quarterly and yearly data. None of the previous studies use panel data. According to the best of our knowledge, none of the previous researchers use TWI and examine the association between the fundamental features and the real estate industry at the house price level and the unit price level. The investigation shall also help in reducing the gap of the Australian academic works in the arena of REITs and macroeconomics.

This study incorporates two aims of the Australian real estate market. First, this research investigates the effect of TWI return on the Australian REITs volatility from 2009 to 2016 by using monthly panel data. We will use fixed and random effect models. In the second aim, we examine the linkage between the fundamental factors and the real estate market for three major states in Australia at unit level and house price level. The four real estate factors are average house price (HP), average unit price (UP), average rental yield (ARY), average auction clearance rate (AAC), and average stock on market (ASM). The states are New South Wales (NSW), Victoria (VIC), and Queensland (QLD). This research uses monthly data covering the period from 2009 to 2016 by applying the VAR model. This research is important for investors, investment managers and operational decision-makers to get a better understanding of how they can manage their investments more effectively during times of any change happening in macroeconomic factors. The findings of this research will help real estate investment and Australian funds to reduce macroeconomics exposure.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Most of the research on real estate industry is based on the connection between the real estate and equity market instead of the connection between the REITs and macroeconomics. Illustrations of such cases encompasses the Schnare and Struyk (1976), Rosen (1985), Miles, Cole and Guillkey (1990), Liu, Hartzell, Grissom and Grieg (1992), Okunev and Wilson (1997), Geltner and Goetzmann (2000), Okunev, Wilson and Zurbruegg (2000) and Yang, Kolari and Zhu (2005). The connections between the equity and real estate markets are based on the nature of the property that is two-dimensional, as a factor of production in industrial markets and as a financial asset in the capital markets (Hakfoort, 1994). A study by Fisher (1992) indicates that the rental income generated from the market is a cash flow that is deemed so in the capital markets. The actual or expected corporate growth in profits leads to an increase in the rental income threshold and the expansion of the business due to the inelastic supply in the short-run in the market. A rise in the rates of the rents paid leads to higher capital values in the market. It then leads

to an increase in the net asset prices and values for property entities, real estate investment trusts and property unit trusts (Lizieri & Satchell, 1997).

Global demand for REITs has led to a significant body of academic literature that explores the risk and return characteristics of REITs. In the literature, most of the studies are associated with the U.S. market. Chan, Hendershott and Sanders (1990) analyse monthly returns of 23 equities in the U.S. market. They examine the relationship between the macroeconomic factors and the REITs. The findings show that REITs do not offer a superior risk-adjusted return and are not a hedge against unexpected inflation. A similar study by McCue and Kling (1994) tests the relationship between the macroeconomic factors and the U.S. REITs returns. The dataset uses daily returns from 1972 to 1992. The results show that prices, nominal rates, output and investment all directly influence the U.S. real estate market. Nominal interest rates, moreover, explain most of the variation in the real estate series. Koop, Pesaran and Potter (1996) and Pesaran and Shin (1998a, 1998b) examine the relationship between macroeconomic shocks and the U.S. REITs. They find a strong relationship between the interest rate and the U.S. REITs. Wilson and Zurbruegg (2002) find that the U.S. economic forces affect international real estate markets. They find that the U.S. GDP and the U.S. term structure of interest rates and inflation have a flow-through effect on the securitised property markets of Australia, Japan and the U.K. Allen, Madura and Springer (2000) study the linkage between the interest rate and the REITs. The findings show a negative association between both variables.

A study by Payne (2003) classifies the comeback of REIT including the real growth output, excess returns to changes that are unexpected in the wider stock market, interest rates, term structure, federal funds rate and the default risk using the general impulse reaction analysis. Conover, Friday and Howton (2000) and Hoesli and Moreno (2007) find the variance and performance of securitised real estate are explained by the variance of stock markets or the state of the market as a bull market. Liow, Ooi and Wang (2003) investigate the effect of the interest level on the Japanese and U.S. real estate market performances. They found a strong connection between the interest rate and the real estate market for both countries. Simpson, Ramchander and Webb (2007) found a positive connection amongst U.S. inflation and REITs returns. The conclusions are similar to the Fama and Schwert (1977) hypothesis. Xu and Yang (2011) investigate the effect of the monetary policy in U.S. on securitised real estate markets within 18 nations. The outcomes show that most international REITs have considerably positive responses to surprise decreases in future or current anticipated federal fund rates, though the responses are variable across nations. For example, Yunus, Hansz and Kennedy (2012) investigate the linkage between macroeconomic factors and

REITs for North America, Australia, Europe and Asia. The outcomes indicate that every property market is integrated with the macroeconomic factors and stock markets in the long-run and influenced in the short-run by the general economy. Chou and Chen (2014) examine the result of monetary policies within the U.S. market. The results contrast with the observed evidence of irregularity relating to stock and output returns, indicating that the responses of REIT to shocks from monetary policy are different compared to returns from stock. Xu, Zhang, Xiong and Zhou (2014) examine how the connection structure between REITs and general changes in stocks when there is a change in macroeconomic conditions. They find strong association amongst equity REITs and the stock market in the short-term. This is because equity REITs offer partial potential for diversification for short-term venture horizons, especially during times of high volatility in stock markets.

There are a few studies that investigate the relationship between the exchange rate exposure and U.S. REITs. Ngo (2017) examines the effect of the exchange rate on the U.S. REITs. She obtains monthly returns data of all REITs companies in the U.S. stock market from 1990 to 2013. Her final sample includes 371 companies listed on the REITs index in U.S. stock market. The findings show that the exchange rate exposures, however, vary significantly among the REIT types and REITs property. US dollar appreciation adversely affects equity REITs returns. To the best of her knowledge, Ngo's (2017) research is the first paper that examines the exchange rate exposures of REITs in the U.S. market.

A number of studies examine the linkage between the macroeconomic factors and the European REITs. For interest rate, Kofoed-Pihl (2009) finds that economic variables have had significant impact on commercial property return to the U.K. Another study by Goslings and Petri (1992) finds REITs performance is relatively stable during economic crisis. This is probably due to the 'lag effect' experienced by the property and construction sectors during the economic cycle transitions. The spillover effect of economic recession is most likely experienced by property sectors in the post-crisis period. Bouchouicha and Ftiti (2012) examine the relationship between the interest rate return and the U.K. REITs performance. The findings show that rising interest rates do not negatively impact REITs performance. This is probably because commercial real estate has the pricing power to cover the rising costs by increasing the rents during the high interest period. Increasing interest rates is always associated with economic expansion, which rental and cash flow would increase while the real estate value would appreciate. This is also consistent with a study on the property market in Hong Kong, Japan, Singapore and the U.K. by Mueller and Pauley (1995). Except for Singapore, the other three nations show significant positive correlation at 1% and

10% significance levels between interest rates and REITs performance. However, for Swedish and Swiss markets, Rodenholm and Bernardi (2013) found that the correlation between these variables disappeared in the crisis period. A negative relationship exists in the pre-crisis period, to then become almost insignificant in the crisis period. The responsiveness of the Swiss labour market to the real estate stock market seems to be more consistent compared to Sweden, possibly due to the political structure of the Swiss economy that is based on liberal labour politics.

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In spite of those studies in the U.S. and other countries, there are few studies on the Asia-Pacific and Australasian REITs. For Asian countries, Chui and Chau (2005) suggest that there is no association between GDP and Hong Kong real estate investments. This is a contradiction of previous studies in similar markets. The lack of connection is due to the substantial variation in the duration

of the project in Hong Kong. Similar research focussing on the Hong Kong market by Liu, Loudon and Milunovich (2012) show that anticipated stock excess returns are linked with the deviance in growth of GDP, industrial production output growth, exchange rates, unexpected inflation, and are negatively correlated to the variances that are conditional in case of money supply and interest rates.

A study by Newell, Susilawati and Yam (2010) shows that the REITs were only moderately correlated with property stocks in Hong Kong. For Thailand and Taiwanese markets, research by Pham (2011) studies the Thai REITs market from 2003 to 2010 by using daily data. He looks into the connection between the other factors that affect investment and determining the potential for diversification of Thai-REITs in a portfolio of mixed assets. According to the results, before and during the GFC, Thai-REITs played a very small role in the portfolio for mixed assets at levels with low risk due to their poor performance that was adjusted according to the risk. He notes that the Thai-REITs gives a particularly low risk option for investment and a better optimiser for portfolio than property companies for investors of shares. Peng and Newell (2012) provided the benefits of the diversification of portfolio and an important role in the portfolio for mixed assets in the period after GFC.

There is a considerable volume of research on the U.S. and other countries-based REITs, although less attention has been devoted to the Australian REITs. Newell (1996) examines the relationship between inflation and Australian commercial property. He uses quarterly data from 1984 to 1995. The outcomes show that investors can use Australian real estate investments to hedge against actual, expected and unexpected inflation. Liu, Hartzell and Hoesli (1997), Newell (2005) and Newell and Peng (2007) examine the association between the interest rates and REITs. Newell (2005) finds a negative connection amongst the REITs and the Australian interest rate. Newell and Peng (2009) held that the higher gearing levels in Australian REITs are a crucial factor in the underperformance of the sector compared to other sectors. Wilson and Zurbruegg (2008) investigate the linkage between the stock market of the real estate and 10-year yields on government bonds in the U.K. and Australia. The results show that real estate in Australia is affected by the stock market in the short- and long-run, while the bond market only affects REITs in short-term. West and Worthington (2006) propose that the growth in employment in different industries leads to higher prices of property as they fuel demand for business space.

To understand the macroeconomic aspects that influence the real estate industry, the study surveys the literature. Studies by Chan et al. (1990), Lizieri and Satchell (1997), and Brooks and Tsolacos (1998) suggest that the rate of the real

treasury bill, the short-term nominal rate of interest, the interest rate organisation and the unforeseen inflation are the macroeconomic variables that have a systematic influence on the returns of the real estate industry. The macroeconomic factors affect the anticipated yields of the real estate investment. In general, the return on REITs largely depends on the performance of the economy. In a fresh study, Nguyen, Bui and Nguyen (2019) find that the economic development of an economy has positive influence on the real estate returns. The stock return on REITs also depends on the unexpected movement of the macroeconomic variables as the unexpected movement can create uncertainty. This uncertainty leads to a higher risk. Koop et al. (1996) and Pesaran and Shin (1998) study the response of return on REITs to the macroeconomic variable's shocks. The results confirm that the unexpected rather than expected change is influential in determining the stock returns of REITs. The impact of each macroeconomic factor is not same on the stock return of REITs. For example, McCue and Kling (1994) study the connection between the interest rates and the U.S. REITs returns. Since the interest rate enhances the cost of borrowing and riskiness, the REITs have depressing return when the interest rate increases.

A conference paper by Yong, Allen and Lim (2011) examines the linkages between Australian REITs, and business property using the co-integration analysis with various employment indices and industrial production. In a recent paper, Yong and Singh (2013) show that REITs may only be adversely affected by short-term interest rates changes in the lower 5% returns quotient. Changes in the interest rates in the long-term affect Australian REITs, negatively in the upper quantiles. Reddy and Wong (2017) apply temporary capital asset pricing model (ICAPM) by using monthly data from 1995 to 2015. The outcomes show that the rise in interest rates in the short-term lead to positive investment returns while the rise in interest rates in the long-term led to low returns. Wong (2017) investigates the linkage between the macroeconomic risk factors and the Australian REITs performance. His study includes REITs that are listed in the Australian Stock Exchange (ASX) from 1995–2015. The findings show there is linkage between the interest rate risk and the Australian REITs. Su, Lin, Chen and Li (2018) found that the prices of real estate may interfere with the monetary policy effect where the rise in the prices of real-estate leads to monetary policies uncertainties. This paper outlines suggestion for the policy of the local monetary revenue and monetary policy. Garriga, Manuelli and Peralta-Alva (2019) find the framework merges the given disconnect between the rents and prices of houses because in general, the financial shocks and equilibrium might increase prices and decrease rents. Agnello, Castro and Sousa (2018) outline that even though the booms in housing have the same lengths in countries within Europe and beyond, the busts in housing are generally shorter in European nations. Using flexible specifications

of the danger function which is based on cubic splines indicates that it evolves in a manner that is non-linear. From a policy point of view, the study is crucial in predicting the length and timing of cycles of busts in housing booms.

The previous studies mainly reflect the experiences from the U.S., the U.K., European and Asia-Pacific countries, which have different regulations, investor behaviours, and economic situations from those predominant in Australia. There are a few studies investigating the Oceanian countries such as Australia. According to Reddy and Wong (2017), the AUD125 billion Australian real estate investment trusts is ranked as the second biggest listed property sector in the world, aside from the U.S. is the second biggest property sector that is listed in the world, behind the U.S. Australian REITs were previously identified as Listed Property Trusts (LPTs) with a rich history over the centuries, rooted in the Australian stock-market's history from 1971. Australian REITs are a common option for investment for both retail and institutional investors that seek regular capital and income growth. Liu et al. (1997), Newell and Tan (2005), Newell and Peng (2009), Wilson and Zurbruegg (2008), Yong et al. (2011), Yong and Singh (2013) and Reddy and Wong (2017) study the relationship between the interest rate and the Australian REITs. However, none of the of the previous research focusses on the TWI variable. From a data perspective, the previous researchers focus on quarterly data and real estate companies only. However, this study incorporates two kinds of data. First, this study focusses on monthly data to examine the effect of TWI, interest rate, and Australian REITs. Second, this research uses three major states in Australia at UP and HP. These states are NSW, VIC and QLD. To the best of our knowledge, this research is the first paper that examines the exchange rate exposures of REITs in Australia and investigates the effect of the fundamental risk factors on three major states in Australia at UP and HP.

Finally, this study aims to seal the gap by investigating the relationship between the exchange exposure volatility and Australian real estate market. This investigation will give crucial insight on the impact that improvements on macroeconomic factors are likely to have on the REITs within Australia. It will also give the investment managers, investors, and decision makers of operations better insight on the management of their investments in an efficient manner during the occurrence of changes to macroeconomic factors. The study will also contribute to narrowing the gap in the academic literature in Australia in the field of macroeconomics and REITs. The result of this investigation will principally benefit the real estate investment, academic, and Australian funds. Additionally, it will expose practical answers for the reduction of macroeconomics exposure while improving the investments in REITs at the same time.

RESEARCH METHODOLOGY

This section explains two methodologies applied in this study. These two methodologies are the fixed effect and random effect model and the VAR model. For the fixed effect and random effect model, the aim of this methodology is to examine the effect of the macroeconomic variables on the Australian REITs companies. For the vector autoregression (VAR) model, the aim is to examine the relationship between the fundamental factors and the real estate market for three states in Australia.

The fixed effect and random effect model are applied to investigate the effect of the macroeconomic variables on the Australian REITs return. According to Bruce's (2016) panel data, it makes conceptual contrasting assumptions about effects as either random or fixed. The fixed effects model is just a standard regression model and can be estimated by Ordinary Least Squares (OLS) as follows:

$$r_{sr,t} = \alpha + \beta_1 r_{m,t} + \beta_2 r_{ir,t} + \beta_3 r_{twi,t} + \beta_4 r_{oil,t} + \varepsilon_{it} \quad (1)$$

where $r_{sr,t}$ is REITs return, $r_{m,t}$ is the Australian stock market index (ASX200), $r_{ir,t}$ is the long-term Australian interest rate, $r_{twi,t}$ is the TWI, and $r_{oil,t}$ is the oil price return.

According to Taoulaou and Burchuladze (2014), the random effects model, that is equal to the Generalised Least Square (GLS), is required to follow various restrictions for it to be applicable in the regression. The deduction of the required mean value presents an improved and advanced solution as opposed to deducting the entire value of mean in different cross-sectional units. Therefore, applying the random effects model, there is no loss of degrees of freedom, because additional variables are not included, where transformations are done, making it efficient compared to the fixed test. The random effect equation is as follows:

$$r_{sr,t} = \alpha + \beta_1 r_{m,t} + \beta_2 r_{ir,t} + \beta_3 r_{twi,t} + \beta_4 r_{oil,t} + \omega_{it} \quad (2)$$

where $\omega_{it} = \varepsilon_i + v_{i,t}$, $\varepsilon_i \sim IDD(0, \sigma_\varepsilon^2)$ and $v_{it} \sim IDD(0, \sigma_v^2)$

The VAR model is useful to study the bearing of the real estate fundamental factors on the Australian HP and UP for three regions: VIC, NSW and QLD. As Basci and Karaca (2013) note, VAR refers to a stochastic process model that is utilised in the capture of linear interdependencies within various time series. VAR models generalise the univariate autoregressive (AR) model through permitting more than a single variable that is evolving. The VAR model proves to be among the most successful models, since it is easy and flexible to use in the multivariate time series analysis. It is a proper allowance of the univariate AR model to changing multivariate time series. The VAR model proves to be particularly

important in forecasting, and the description of the changing behaviour of the fiscal and commercial time series. Most of the times, it offers proper forecast in the case of elaborate theory-based simultaneous equations models and univariate time series models. VAR models' forecasts are generally flexible since they may be declared conditional as per the potential paths in the future for specific model variables. The VAR equation is as follows:

$$HP_{t,i} = \alpha_1 + \beta_{1,i}HP_{t-1} + \beta_{2,i}HP_{t-2} + \beta_{3,i}ARY_{t-1} + \beta_{4,i}ARY_{t-2} + \beta_{5,i}AAC_{t-1} + \beta_{6,i}AAC_{t-2} + \beta_{7,i}ASM_{t-1} + \beta_{8,i}ASM_{t-2} + v_{1,i} \quad (3)$$

$$ARY_{t,i} = \alpha_2 + \beta_{9,i}ARY_{t-2} + \beta_{10,i}ARY_{t-1} + \beta_{11,i}HP_{t-1} + \beta_{12,i}HP_{t-2} + \beta_{13,i}AAC_{t-2} + \beta_{14,i}AAC_{t-1} + \beta_{15,i}ASM_{t-1} + \beta_{16,i}ASM_{t-2} + v_{2,i} \quad (4)$$

$$AAC_{t,i} = \alpha_2 + \beta_{17,i}AAC_{t-1} + \beta_{18,i}AAC_{t-2} + \beta_{19,i}ARY_{t-2} + \beta_{20,i}ARY_{t-1} + \beta_{21,i}HP_{t-1} + \beta_{22,i}HP_{t-2} + \beta_{23,i}ASM_{t-1} + \beta_{24,i}ASM_{t-2} + v_{3,i} \quad (5)$$

$$ASM_{t,i} = \alpha_2 + \beta_{25,i}ASM_{t-1} + \beta_{26,i}ASM_{t-2} + \beta_{27,i}AAC_{t-1} + \beta_{28,i}AAC_{t-2} + \beta_{29,i}ARY_{t-2} + \beta_{30,i}ARY_{t-1} + \beta_{31,i}HP_{t-1} + \beta_{32,i}HP_{t-2} + v_{4,i} \quad (6)$$

where $HP_{t,i}$ is HP return and UP for three states, the return of HP return is calculated as long first difference of the HP. ARY_i average rental yield (ARY) for HP and UP for three states, AAC_i is average auction clearance rate (AAC) HP and UP for three states, ASM_i is average stock on market (ASM) for HP and UP for three states. $\beta_{i,j}$ is the parameters to be estimated. $v_{1,i}$, $v_{2,i}$ and $v_{3,i}$ are white noise disturbance terms with $E(v_{i,j}) = 0$, ($i = 1,2$), $E(v_{1,j}, v_{2,j}) = 0$.

THE DATA

This study includes the monthly data of price value of 22 REITs that are listed on the Australian stock market, six real estate's factors for three Australian states, TWI, Australian 90-days bank accepted bills and oil prices. The study period starts from January 2009 to 31 December 2016. The six real estate factors are average HP, average UP, ARY, AAC and ASM. The three Australian states are NSW, VIC and QLD. These states are the major states in Australia with a population of more than 65% the Australian total. NSW is Australia's largest state economy, with 33% of the nation's GDP in 2016–2017. The next largest state, VIC, with its capital, Melbourne, contributes 22%.

For oil price, we consider the one-month future price of TWI. Sadorsky (2003) suggests future price should be used rather than spot price because spot prices are more affected by short-run price movement caused by temporary

shortages and supplies. Most studies related to oil price use future price since they are perceived as the efficient price and the trading of crude oil futures is popular. In the model, oil data are used at lag on. The monthly data of oil price value is collected from Datastream.

In this research, panel data is used in the analysis of the effect of macroeconomic variables on the REITs. The panel data is used since it deals with the issue of collinearity within the explanatory variables, adds on to the degrees of freedom and generally ensures that the estimates are efficient. The data obtained from the analysis of both random and fixed panel data are used in dealing with the heterogeneity of the firm, that arises from characteristics which are invariant but differ among entities. Issues such as multicollinearity and heteroscedasticity are also considered. Moreover, our variables are non-stationary and co-integrated.

We consider two methodologies to evaluate the real estate market in Australia. First, REITs is usually used as an estimator of property price changes. For example, the studies of Okunev et al. (2000) and Gyourko and Keim (1992) use excess REITs returns data in their study of real estate and macroeconomic variables. REITs and stocks have similar characteristics. REITs are traded on the stock exchange; they offer a relatively high liquidity and high return. This could be an explanation to why the REIT is closer related to movements in the stock market than other estimators of real estate prices (Eichholtz & Hartzell, 1996). According to Firstenberg, Ross and Zisler (1988), the volatility of REITs is larger compared to real estate prices. Second, the average sales price methodology is another common approach for measuring house prices. For example, the studies of Okunev et al. (2000), Gyourko and Keim (1992) and Case et al. (1991) use excess average house price data in their studies. Finally, these two methodologies are suitable for answering the hypotheses for this study.

The return of a stock is calculated as log first difference of stock price. Three factors are market risk measured as the log first difference of ASX200 index, an interest rate risk measured as the log first difference of Australian 90-days bank accepted bills, and TWI measured as the log first difference of and TWI risk. The equation is as follows:

$$SR_i = \ln\left(\frac{p_t}{p_{t-1}}\right) \quad (7)$$

THE DESCRIPTIVE STATISTICS

The descriptive statistics of 22 REITs monthly companies return (SR), Australian 90-days bank accepted bills (IR), and TWI, and ASX are reported in Table 2.

Based on Table 1, most of the variables return have a positive monthly mean, median and maximum, except that the interest rate has a negative mean. The skewness shows that the variables have a negative skew, except the REITs return. Based on kurtosis, the variables value return series is higher than 3.0 for the five variables, except the Australian market index, which means that the variables show a typical leptokurtic distribution. As part of the measurements of skewness and kurtosis, statistics also reject the null hypothesis of normality in the distribution of the sample return series. These data are non-normal distributions confirmed by the skewness, kurtosis, standard deviation, and the Jarque-Bera statistics.

Table 1

The descriptive statistics of monthly data for REITs, ASX, interest rate, TWI of the Australian dollar and oil price

	SR	ASX	IR	TWI	OIL
Mean	0.006483	0.002238	-0.001648	0.000856	0.001275
Median	0.004766	0.003692	0.001993	0.001788	0.004853
Maximum	0.301030	0.030640	0.078373	0.026188	0.112988
Minimum	-0.204120	-0.039226	-0.105194	-0.031034	-0.101093
Std. Dev.	0.033658	0.016520	0.029114	0.011168	0.037611
Skewness	0.910814	-0.421210	-0.215789	-0.233224	-0.176256
Kurtosis	12.43952	2.443133	4.135798	3.052387	3.806465
Jarque-Bera	8121.662	89.61246	129.7294	19.36040	68.07245
Probability	0.000000	0.000000	0.000000	0.000063	0.000000
Sum	13.67338	4.720313	-3.476293	1.804764	2.688538
Sum Sq. Dev.	2.388001	0.575273	1.786759	0.262904	2.981930
Observations	2109	2109	2109	2109	2109

Note: The table reports summary statistics of the return of stock return (SR), Australian Stock Exchange (ASX), the Australian 90-days bank accept bills (IR), trade weight index (TWI) and oil price (OIL).

FINDINGS

This study contains two individual findings related to real estate market return in Australia: the findings of the effect of the real estate fundamental variables on the

housing and unit price for three major states in Australia by using monthly data from 2009 to 2016 are presented in Tables 2, 3 and 4, respectively. We use a VAR model. Second findings, in this study we use the fixed effect and random effect model to examine the relationship between the REITs and the macroeconomic variables by using monthly panel data from 2009 to 2016, as presented in Tables 5 and 6.

Table 2 represents VAR model findings; this estimation is examining the dynamic structure of the real estate variables at HP and UP for NSW. Table 3 reveals that the lagged value (-2) of NSW HP is significant at the 1% level for NSW HP, while the lagged value of average stock on the market is significant at the 1% level and 10% with rental yield. This suggests that there is causation from rental yield to NSW housing auction clearance rates. This finding is matching with Walzl (2018) finds large temporal and spatial variation in rental yields, decreasing yields when moving from the low end of the distribution to the top end, and systematically larger yields when restricting the analysis to houses bought-to-let. For house auction clearance rates, there is no significant relationship between the auction clearance rate and the lagged value of the three variables. This outcome is not corresponding with Leng (2019), finds a relationship between the auction clearance rate and the Malaysian auction price. Table 3 shows that there is causality from the auction clearance rate to the stock on the market.

For NSW units, the outcomes show that there is a negative relationship between the NSW UP return and the lagged value (-2) of UP at the 1% level, while it is positive with rental yield return at the 5% level of significance. The lagged value (-2) of the rental yield is positively significant at the 1% level. Baur and Heaney's (2017) study also observes the similar results. For auction clearance rate for NSW units, the results show that the rental yield lagged (-1) is positively significant at the 1%, which means that when the rental yield goes up, the auction clearance rate will increase. For the average stock on the market for NSW units, the UP and average auction clearance impact negatively on the stock on the market. Overall, the average rental yield impacts positively on the average NSW real estate price and auction clearance rate, which means that the rental yield makes buyers more confident to invest their money in the NSW real estate market.

Table 2
VAR model estimation for NSW real estate from 2009 to 2016

	NHP	ARY	AAC	ASM	NUP(-1)	ARY	AAC	ASM	NUP	ARY	AAC	ASM
NHP(-1)	-0.093582 (0.1029)	0.003171 (0.0061)	0.049335 (0.1452)	-0.000628 (0.0085)	NUP(-1)	-0.026669 (0.1047)	0.147050 (0.1767)	0.002652 (0.0021)	-0.026669 (0.1047)	-0.012859 (0.0087)	0.147050 (0.1767)	0.002652 (0.0021)
	[-0.9599]	[0.4745]	[0.3303]	[-0.0732]		[-0.2556]	[0.8324]	[1.2301]	[-0.2556]	[-1.8749]	[0.8324]	[1.2301]
	0.3656	0.6369	0.7348	0.9416		0.7992	0.2602	0.215	0.7992	0.2670	0.2602	0.215
NHP(-2)	-0.268945 (0.1022)	-0.010689 (0.0069)	0.108961 (0.1400)	0.002393 (0.0854)	NUP(-2)	-0.361019 (0.1022)	-0.474340 (0.1771)	-0.010380 (0.0017)	-0.361019 (0.1022)	0.001378 (0.0090)	-0.474340 (0.1771)	-0.010380 (0.0017)
	[-2.6132]	[-1.5913]	[0.7545]	[0.2804]		[-3.4304]	[-2.6718]	[-4.7926]	[-3.4304]	[0.1976]	[-2.6718]	[-4.7926]
	0.0094***	0.1109	0.4529	0.7794		0.0007***	0.2602	0.00***	0.0007***	0.0620*	0.2602	0.00***
ARY(-1)	2.098990 (1.5028)	0.695575 (0.0976)	0.244852 (2.1124)	0.047467 (0.1265)	ARY(-1)	-0.861395 (1.6219)	1.136582 (2.7306)	-0.019524 (0.0337)	-0.861395 (1.6219)	0.702590 (0.1067)	1.136582 (2.7306)	-0.019524 (0.0337)
	[1.3966]	[7.1222]	[0.1156]	[0.380]		[-0.5310]	[0.4156]	[-0.5859]	[-0.5310]	[6.616]	[0.4156]	[-0.5859]
	0.1634	0.0000***	0.9080	0.7036		0.5956	0.007***	0.59	0.5956	0.8418	0.007***	0.59
ARY(-2)	-1.472383 (1.5119)	0.102723 (0.0985)	-1.414409 (2.1299)	-0.173777 (0.1240)	ARY(-2)	1.757970 (1.6556)	-2.773549 (2.7861)	0.003364 (0.0339)	1.757970 (1.6556)	0.177508 (0.1026)	-2.773549 (2.7861)	0.003364 (0.0339)
	[-0.9738]	[1.0455]	[-0.6646]	[-1.3883]		[1.0643]	[-0.9949]	[0.0989]	[1.0643]	[1.6399]	[-0.9949]	[0.0989]
	0.3308	0.2965	0.5071	0.1667		0.287	0.6780	0.9212	0.287	0.0000***	0.6780	0.9212
AAC(-1)	-0.038194 (0.0572)	-0.005675 (0.0057)	0.983321 (0.1207)	0.013655 (0.0071)	AAC(-1)	0.012952 (0.0392)	0.785031 (0.1083)	0.001208 (0.0012)	0.012952 (0.0392)	0.003466 (0.0019)	0.785031 (0.1083)	0.001208 (0.0012)
	[-0.4457]	[-1.0186]	[8.1475]	[1.9069]		[0.2064]	[7.2804]	[0.851]	[0.2064]	[0.8727]	[7.2804]	[0.851]
	0.6562	0.3090	0.0000***	0.0556		0.2879	0.1020	**0.3590	0.2879	0.1020	0.3202	**0.3590

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Table 2: (continued)

	NHP	ARY	AAC	ASM	NUP	ARY	AAC	ASM
AAC(-2)	0.038080 (0.0852) [0.4469]	0.005086 (0.0055) [0.9178]	-0.141529 (0.1201) [-1.1786]	-0.017083 (0.0070) [-2.4144]	0.013434 (0.0644) [0.2080]	-0.001126 (0.0042) [-0.2667]	0.010415 (0.1086) [0.0956]	-0.002477 (0.0013) [-1.8690]
ASM(-1)	0.6555 1.397955 (1.3914)	0.3593 -0.152865 (0.0992)	0.2396 -1.447285 (1.9110)	0.0162 0.425273 (0.1104)	0.8395 4.373779 (4.8705)	0.4087 0.107646 (0.3124)	0.0000 -12.38144 (8.1611)	**0.0625** 0.519337 (0.1024)
ASM(-2)	0.3184 -1.584994 (1.3812)	0.0936* 0.274620 (0.0874)	0.4633 0.361623 (1.9556)	0.0003*** 0.244992 (0.1154)	0.8349 -2.639703 (4.8108)	0.7898 0.339425 (0.3162)	0.9237 5.726302 (8.2286)	**0.0000** 0.152595 (0.0910)
C	0.2519 -0.025612 (0.0546)	0.0024*** 0.008382 (0.0036)	0.8527 0.131915 (0.0715)	0.0332 0.010094 (0.0054)	0.3698 -0.055421 (0.0484)	0.7362 0.003685 (0.0027)	0.1327 0.183126 (0.0848)	0.1245 0.001999 (0.0010)
R-squared	0.113371	0.682779	0.745825	0.441542	0.137479	0.711853	0.666245	0.521047
Adj. R-squared	0.029923	0.652923	0.721903	0.388981	0.056301	0.684733	0.634832	0.475970
Sum sq. resids	0.068833	0.000291	0.136612	0.000474	0.053015	0.000228	0.150872	2.25E-05
S.E. equation	0.028457	0.001849	0.040090	0.002360	0.024974	0.001637	0.042130	0.000514
F-statistic	1.358587	22.86903	31.17692	8.400603	1.693544	26.24854	21.20971	11.55883
Log likelihood	205.9302	462.8897	173.7133	439.9563	218.2022	474.3488	169.0468	583.2387

Note: The VAR model is estimated by equations (3), (4), (5), (6) for HP, UP, ARY, AAC and ASM. () and [] denote standard error and *t*-statistics respectively. ***, **, * denote the significance of the coefficients at 1%, 5% and 10%.

Table 3 shows the results of the VIC real estate fundamental variables covering the period starting from 2009 to 2016 by the applied VAR model. The outcomes indicate the auction clearance rate is negatively affected by the VIC HP at the 5% level of significance. While the lagged value (-2) of the stock on the market is affected positively by the VIC house rental yield at the 5% significance level. For the auction clearance rate, the both HP lagged value is negatively significant on the auction clearance rate at the 5% level of significance. These outcomes are consistent with the findings of the study by Chinloy, Cho and Song (2018).

This result is consistent with our previous results. The previous results show that there is a negative relationship between the auction clearance rate and the VIC HP. Table 4 indicates that the HP is negatively affected by the average stock on the market. For VIC unit fundamental variables, the results display that there is no relationship between the five fundamental variables and the UP volatility. The outcomes show that the VIC HP is negatively significant with unit rental yield at the 5% level of significance. For auction clearance rate, the lagged value of the UP volatility is negatively significant at the 5% level of significance. While stock on the market is negatively significant at the 5% significance level.

For the stock on the market, Table 6 indicates that there is a negative relationship between the average UP volatility and the stock on the market at the 5% significance level. This result is consistent with VIC HP outcomes. In summary, the VIC real estate price negatively effects the rental yield and the auction clearance rate, which means that when the VIC real estate price increases, the average rental yield and the auction clearance rate decrease.

Tables 4, 5 and 6 provide outcomes from the VAR model. The results demonstrate that there is a negative relationship between the auction clearance rate and the QLD HP for the period from 2009 to 2016, while the average clearance rate is not significant with QLD unit prices return. For QLD rental yield, the average auction clearance lag value is positively significant at the 1% level of significance, while it is insignificant with QLD unit rental yield. The QLD auction clearance outcomes show that the lag value of QLD house and unit prices returns negatively effects the QLD auction clearance at the 5% level of significance, which means that when the HP goes up, the QLD auction clearance rate drops down. Table 5 displays that there is a positive relationship between the QLD house and unit prices returns and the average stock on the market. The lag value of QLD average stock on the market significantly effects the average stock on the market at the 5% significance level.

Table 3
VAR model estimation for VIC real estate from 2009 to 2016

	VHP	ARY	AAC	ASM	VUP	ARY	AAC	ASM
VHP(-1)	-0.087034 (0.10658) [-0.81659]	-0.009756 (0.00592) [-1.64723]	-0.359878 (0.11014) [-3.26748]	-0.017444 (0.00785) [-2.22072]	VUP(-1) (0.10023) [-0.69215]	-0.010786 (0.00370) [-2.91649]	-0.335282 (0.20354) [-1.64724]	-0.005555 (0.00229) [-2.42806]
VHP(-2)	0.4147 -0.375843 (0.11290) [-3.32889]	0.1004 -0.002227 (0.00627) [-0.35503]	0.0012** -0.223312 (0.11667) [-1.91402]	0.0270** -0.003285 (0.00832) [-0.39483]	0.4893 -0.301770 (0.08424) [-3.58232]	0.8893 -0.007529 (0.00311) [-2.42253]	0.0020 0.100822 (0.17106) [0.58939]	0.4876 -0.001296 (0.00192) [-0.67377]
ARY(-1)	0.0010** -1.285013 (1.89836) [-0.67691]	0.7228 0.616526 (0.10549) [5.84433]	0.0565* -2.246522 (1.96172) [-1.14518]	0.6932 0.127182 (0.13991) [0.90906]	0.0004** -0.606603 (2.80686) [-0.21611]	0.0038 0.646369 (0.10356) [6.24132]	0.1004* 2.810824 (5.69982) [0.49314]	0.0157 0.005746 (0.06407) [0.08967]
ARY(-2)	0.4989 0.222185 (1.87088) [0.11876]	0.0000*** 0.122819 (0.10396) [1.18135]	0.2529 -0.182756 (1.93332) [-0.09453]	0.3640 -0.198131 (0.13788) [-1.43698]	0.8290 0.318485 (2.78457) [0.11437]	0.0159 0.148631 (0.10274) [1.44667]	0.5560 -2.035524 (5.65456) [-0.35998]	0.5009 -0.013534 (0.06356) [-0.21292]
AAC(-1)	0.9055 -0.251419 (0.11237) [-2.23737]	0.2383 0.004444 (0.00624) [0.71173]	0.9247 0.569750 (0.11612) [4.90644]	0.1516 0.001097 (0.00828) [0.13241]	0.9090 -0.071601 (0.05212) [-1.37366]	0.0000*** 0.000375 (0.00192) [0.19523]	0.6222 0.949649 (0.10585) [8.97187]	0.9286 5.36E-06 (0.00119) [0.00450]
	0.0259**	0.4771	0.0000***	0.8947	0.1705	0.1489	0.7191	0.8315

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Table 3: (continued)

	VHP	ARY	AAC	ASM	VUP	ARY	AAC	ASM
AAC(-2)	0.164109 (0.10996) [1.49238]	-0.004624 (0.00611) [-0.75668]	0.146043 (0.11363) [1.28520]	-0.005108 (0.00810) [-0.63034]	0.066870 (0.05192) [1.28796]	-0.001232 (0.00192) [-0.64318]	-0.219009 (0.10543) [-2.07725]	-0.000754 (0.00119) [-0.63656]
ASM(-1)	0.1365 2.563592 (1.67109) [1.53409]	0.4498 -0.141673 (0.09286) [-1.52563]	0.1996 1.101366 (1.72686) [0.63779]	0.5289 0.487849 (0.12316) [3.96122]	0.1986 5.596446 (4.65121) [1.20322]	0.8453 -0.240752 (0.17161) [-1.40288]	0.0000*** -8.537645 (9.44510) [-0.90392]	0.9964 0.542233 (0.10617) [5.10713]
ASM(-2)	0.1259 -0.980202 (1.69291) [-0.57900]	0.1280 0.291061 (0.09407) [3.09394]	0.5240 1.534384 (1.74941) [0.87709]	0.0001** 0.287399 (0.12476) [2.30353]	0.2297 -3.907503 (4.65189) [-0.83998]	0.5205 0.292624 (0.17164) [1.70489]	0.0385 -0.849675 (9.44649) [-0.08995]	0.5248 0.234251 (0.10619) [2.20601]
C	0.5630 0.074542 (0.06884) [1.08282]	0.0021** 0.010215 (0.00383) [2.67021]	0.3811 0.212270 (0.07114) [2.98393]	0.0219** 0.006929 (0.00507) [1.36576]	0.2297 0.011264 (0.08084) [0.13934]	0.1616 0.009272 (0.00298) [3.10851]	0.3667 0.114080 (0.16416) [0.69491]	0.0000*** 0.001225 (0.00185) [0.66369]
R ²	0.157533 0.078242	0.631714 0.597052	0.613528 0.577154	0.447451 0.395446	0.161735 0.082839	0.671855 0.640971	0.657107 0.624834	0.553128 0.511070
Adj. R ²	0.073048 0.029315	0.000226 0.001629	0.078005 0.030294	0.000397 0.002160	0.070530 0.028806	9.60E-05 0.001063	0.290840 0.058495	3.68E-05 0.000658
Sum sq. resids	1.986773	18.22488	16.86731	8.604065	2.049987	21.75401	20.36131	13.15139
S.E. equation	203.1366	474.8076	200.0506	448.2677	204.7855	514.9519	138.1988	560.0889
F-statistic								
Log likelihood								

Note: The VAR model is estimated by equations (3),(4),(5),(6) for HP, UP, ARY, AAC and ASM. () and [] denote standard error and *t*-statistics respectively. ***, **, * denote the significance of the coefficients at 1%, 5% and 10%.

Table 4
VAR model estimation for QLD real estate from 2009 to 2016

	QHP	ARY	AAC	ASM	QUP(-1)	QUP	ARY	AAC	ASM
QHP(-1)	-0.277977 (0.10553) [-2.63422]	0.023990 (0.01532) [1.56594]	-0.653789 (0.18861) [-3.46641]	-0.027903 (0.01892) [-1.47466]	QUP(-1)	-0.180327 (0.10566) [-1.70667]	0.010294 (0.02000) [0.51470]	-0.989016 (0.38283) [-2.58346]	-0.021652 (0.00718) [-3.01474]
QHP(-2)	0.0088*** -0.434913 (0.10940)	0.9036 0.017943 (0.01588)	0.0148 -0.152038 (0.19552)	0.1412 -0.021954 (0.01962)	QUP(-2)	0.0888 -0.247969 (0.07232)	0.6071 0.015541 (0.01369)	0.0039*** -0.012031 (0.26204)	0.0028*** -0.006369 (0.00492)
ARY(-1)	0.0001*** 0.569172 (0.74265)	0.9036 0.656021 (0.10781)	0.0006*** 0.442634 (1.32735)	0.2638 0.147074 (0.13316)	ARY(-1)	0.0007 0.133696 (0.58448)	0.2571 0.631225 (0.11064)	0.0102** 1.331438 (2.11768)	0.1960 0.017892 (0.03973)
ARY(-2)	0.4440 -0.275050 (0.74045)	0.1183 0.151241 (0.10750)	0.4374 -0.210274 (1.32342)	0.7166 -0.048236 (0.13277)	ARY(-2)	0.8192 -0.064568 (0.57507)	0.0000*** 0.124270 (0.10885)	0.9634 0.600443 (2.08359)	0.6528 0.010776 (0.03909)
AAC(-1)	[-0.37146] 0.7105 -0.146923 (0.06243)	[1.40696] 0.2594 0.010578 (0.00906)	[-0.15889] 0.7390 0.921334 (0.11159)	[-0.36331] 0.4802 -0.007913 (0.01119)		[-0.11228] 0.9107 -0.030489 (0.03043)	[1.14161] 0.2571 0.007276 (0.00576)	[0.28818] 0.9634 0.813425 (0.11024)	[0.27568] 0.7830 -0.001194 (0.00207)
	[-2.35324] 0.0192	[1.16700] 0.0000	[8.25641] 0.8739	[-0.70681] 0.6465		[-1.00210] 0.3170	[1.26346] 0.2073	[7.37900] 0.5300	[-0.57717] 0.5642

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Table 4: (continued)

	QHP	ARY	AAC	ASM	QUP	ARY	AAC	ASM
AAC(-2)	0.095085 (0.06233) [1.52545] 0.1281	-0.006712 (0.00905) [-0.74171] 0.1604	-0.125931 (0.11141) [-1.13036] 0.0000***	-0.005130 (0.01118) [-0.45897] 0.0001***	0.038470 (0.03025) [1.27169] 0.2044	-0.001052 (0.00573) [-0.18371] 0.8544	-0.180128 (0.10961) [-1.64342] 0.7734	-0.000906 (0.00206) [-0.44056] 0.6598
ASM(-1)	0.140545 (0.61516) [0.22847] 0.8194	-0.079676 (0.08931) [-0.89216] 0.2440	0.471425 (1.09949) [0.42877] 0.2591	0.438046 (0.11030) [3.97128] 0.0001	1.542315 (1.57124) [0.98159] 0.3270	-0.126706 (0.29742) [-0.42602] 0.6704	1.209701 (5.69287) [0.21249] 0.0000***	0.576157 (0.10680) [5.39452] 0.0000***
ASM(-2)	-0.330149 (0.61810) [-0.53413] 0.5936	0.193232 (0.08973) [2.15341] 0.4588	0.162443 (1.10474) [0.14704] 0.6684	0.322856 (0.11083) [2.91306] 0.0038***	-0.304750 (1.54839) [-0.19682] 0.8441	0.325718 (0.29309) [1.11131] 0.2672	4.349879 (5.61008) [0.77537] 0.1012	0.255911 (0.10525) [2.43144] 0.0156**
C	0.002448 (0.02019) [0.12125] 0.228012	0.007178 (0.00293) [2.44855] 0.725423	0.039086 (0.03609) [1.08304] 0.739401	0.001408 (0.00362) [0.38884] 0.530311	-0.008644 (0.01823) [-0.47423] 0.168458	0.010039 (0.00345) [2.90941] 0.665725	-0.013662 (0.06604) [-0.20686] 0.617922	-0.000451 (0.00124) [-0.36363] 0.585358
R ²	0.155354	0.699580	0.714874	0.486105	0.090195	0.634264	0.581962	0.546333
Adj. R ²	0.014072	0.000297	0.044952	0.000452	0.009196	0.000330	0.120725	4.25E-05
Sum sq. resids	0.012867	0.001868	0.022997	0.002307	0.010402	0.001969	0.037687	0.000707
S.E., equation	3.138165	28.07084	30.14638	11.99635	2.152469	21.16022	17.18348	14.99952
F-statistic	280.5429	461.9453	225.9557	442.0962	300.5347	456.9962	179.5240	553.2656
Log likelihood	-5.777508	-9.637135	-4.616079	-9.214812	-6.202866	-9.531834	-3.628170	-11.58012
Akaike AIC								

Note: The VAR model is estimated by Equations (3), (4), (5), (6) for HP, UP, ARY, AAC rate and ASM. 0 and [] denote standard error and t-statistics respectively. ***, **, * denote the significance of the coefficients at 1%, 5% and 10%.

Table 5 reports the Hausman’s test to compare the fixed effect model and the random effect model.

Table 5

Hausman’s test: Comparison between fixed and random effect model

Correlated Random Effects – Hausman Test

Equation: Untitled

Test cross-section random effects

Test summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.368905	4	0.9849

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var (Diff.)	Prob.
ASX	0.669344	0.669533	0.000000	0.5436
IR	-0.025477	-0.025531	0.000000	0.5436
TWI	0.344843	0.344819	0.000000	0.5436
OIL	-0.051974	-0.052098	0.000000	0.5436

We compared the random effect model to the fixed effect model by using Hausman’s test, the outcomes show that we reject the ALT hypotheses: the fixed effect model is appropriate, and we accept the null hypothesis which means that the random effect variable is appropriate to our study.

Table 6

Estimation outcomes of fixed and random effects models

Variables	Fixed effect model		Random effect model	
	Coefficient	p-value	Coefficient	p-value
ASX	0.669344	0.0000	0.669533	0.0000
IR	-0.025477	0.3658	-0.025531	0.3648
TWI	0.344843	0.0000	0.344819	0.0000
OIL	-0.051974	0.0237	-0.052098	0.0234
R-squared	0.127012		0.116926	

Note: Fixed and random effect models are estimated by Equations (2) and (3) respectively for Australian stock market index (ASX), Australian 90-day bank accepted bills (IR), TWI, oil price (OIL). ***, **, * denote the significance of the coefficients at 1%, 5% and 10% respectively.

Based on Hausman’s test, in order to test whether the cross-section random effects model is well specified, we ran the Hausman test. The results show that the random effect model is appropriate in this study. Table 7 shows that the market

risk is significantly positive at the 1% level for both models, suggesting that when the market index goes up by one point, this would increase the REITs companies return by one percentage. According to Table 7, which presents the random effect model, it can be observed that the oil price is statistically significant at the 2% significance level. This result is consistent with Nazlioglu, Gormus and Soytaş (2016) and Shaeri, Adaoglu and Katircioglu (2016). They find the relatively new and simple causality-in-variance test shows that there is bi-directional volatility transmission between the oil market and all REITs. While the TWI is positively significant at the 1% level of significance. This finding are corresponding with Hiang, Faishal and Huang (2006). The interest rate is negatively insignificant with Australian REITs companies. This result is consistent with Lee (1997). He tried to forecast excess returns on the Standard and Poor 500 index with short-term interest rate, but he found that there is no relationship between the two variables.

CONCLUSION

This study incorporates two individual aims, each of which make several distinct contributions to the literature review of finance. In the first aim, we investigate the effect of macroeconomic variables on the Australian REITs return from 2006 to 2016 by using monthly panel data. In the second aim, we examine the linkage between the fundamental factors and real estate market for three major states in Australia at unit level and HP level. These states are NSW, VIC and QLD. This research uses monthly data covering the period from 2009 to 2016 by applying the VAR model. The topic is important to highlight since stocks and houses are large components of the Australian wealth. A connection could have a significant impact on the health of the general economy.

Panel monthly data of the REITS, housing market and macroeconomic variables from 2009 to 2016 are applied. The panel fixed, and random effect models analysis concluded that a positive and significant relationship exists between the market risk and TWI with the Australian REITs, hence the hypothesis of a positive connection was accepted. A VAR model indicated that there is a positive relationship between the NSW real estate market and rental yield, while it is negative with auction clearance rate at the 5% level of significance. For VIC, the real estate price has a positively significant effect on the VIC rental yield and average stock on the market, while the auction clearance rate is negative.

For QLD, there is an adverse association between the auction clearance rate and the average stock on the market with QLD's real estate price. The results of this chapter help managers of portfolios in reducing the interest rates risks exposure in the case of property investment, where they are required to choose

REITs that have low debt levels. REITs that are managed internally have high debt levels have benefits that are compounded in the case of market conditions that are favourable, but might also expose the investors to great losses in the case of market reversals. Investors seeking to adopt direct investments in real estate within their portfolios are required to choose REITs that are externally managed or the stapled ones that do not encompass a lot of borrowing.

For further research and improvements, the researchers can develop some of the more common and important factors such as expectation of future house prices, unexpected inflation, expected inflation. This study can be extended further by considering more Asian stock markets and including other important countries.

NOTE

1. We confirmed the non-stationarity using unit root tests on the individual series and panel unit root tests. Co-integration tests suggested that the variables are co-integrated. Of course, this is not surprising, as consumption functions are the classic example for co-integration analysis.

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