FOREIGN INVESTMENT AND RESIDENTIAL PROPERTY PRICE GROWTH

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ABSTRACT

This study uses fixed effects panel regression techniques to estimate the impact of foreign demand for Australian residential real estate on property prices. All model specifications find a positive relationship between foreign investment approvals and price growth at the postcode level, but the majority of price growth experienced in recent times does not appear to be attributable to increased foreign demand. This is unsurprising given that in the short run the supply of residential property is relatively fixed so any increase in demand, whether domestic or foreign, should result in higher prices. Indeed, there have been many other significant domestic drivers of property prices over the period examined. The majority of foreign investment approvals are for new as opposed to established dwellings. This provides some indication that, in the longer-term, foreign demand is increasing property supply consistent with Australia's foreign investment framework.

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1. INTRODUCTION

Australia has run a current account deficit almost continuously since the Australian Bureau of Statistics began compiling balance of payments statistics in 1959. As such, foreign investment has been critical to the economic welfare of Australian households by financing investment beyond what would be possible from domestic saving alone. But the effects of foreign investment are often poorly understood, particularly with regards to residential real estate. This paper explores the relationship between foreign investment in Australian residential real estate and property prices.

The number of foreign investment approvals has trended up in recent years, which has coincided with strong property price growth in many parts of Australia. While domestic buyers make up the vast majority of demand for property, it may be the case that, at the margin, foreign buyers are affecting property prices. This is because the stock of dwellings is relatively fixed in the short run so any increase in demand, whether from domestic or foreign sources, would be expected to result in higher prices, at least until increased prices have provided an incentive for the construction of additional supply. In the longer term, the high level of house prices in Australian capital cities, relative to those in other countries, likely reflects supply constraints. These constraints include state government land release and zoning policies, infrastructure provision and local government development approval processes. There is a large literature discussing these issues (see, for example, Hsieh, Norman and Orsmond, 2012).

As outlined in Treasury (2014), Australia's policy for foreign investment in residential real estate aims to increase Australia's housing stock. As such, applications from non-residents to purchase new properties are usually approved without conditions, but non-residents are prohibited from purchasing established dwellings.[3] Temporary residents can apply to purchase one established property to use as a residence while they live in Australia. The majority of approvals have been granted for investment into new, as opposed to existing dwellings. This suggests that foreign demand is being channelled into increasing the property supply as intended. While some commentators have argued that foreign demand is pricing out first home buyers, it is not clear that this is the case. The number of foreign investment approvals granted for new properties is especially noteworthy given new properties make up a very small proportion of the total number of properties in Australia and because first home buyers tend to buy established properties (Gauder, Houssard and Orsmond, 2014).

In recent years the level of foreign demand for Australian property has increased strongly. This has been driven largely by increasing applications from Chinese nationals, which rose from around 50 per cent of total foreign investment approvals in mid-2010 to around 70 per cent in early 2015. The increased importance of Chinese demand to Australian real estate increases Australia's exposure to factors affecting the Chinese economy. Further, any change to the relative attractiveness of holding assets outside of China or ability to do so will likely affect foreign demand for Australian property, which may have domestic economic and financial implications.

Over the period of this study, foreign investment in residential real estate has been concentrated in Melbourne and Sydney (Chart 1). But despite Melbourne receiving more foreign investment approvals than Sydney, price growth in Sydney has been much stronger than in Melbourne over the period. As such, it is difficult to directly attribute price growth in Sydney to foreign investors alone. Other factors,

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3   Broadly speaking, a new dwelling is a dwelling built on residential land that has not been previously sold as a dwelling and has not been previously occupied. New dwellings do not include established residential real estate that has been refurbished or renovated, or a single dwelling that has been built to replace one or more demolished established dwellings. An established dwelling is a dwelling on residential land that is not a new dwelling. More detail is available at: www.firb.gov.au/real-estate.

such as the relatively low number of building approvals, commencements and completions in the late 2000s are potential longer term drivers of the recent price growth in Sydney.

Chart 1 — Location of foreign investment approvals (1 July 2010 — 31 March 2015)
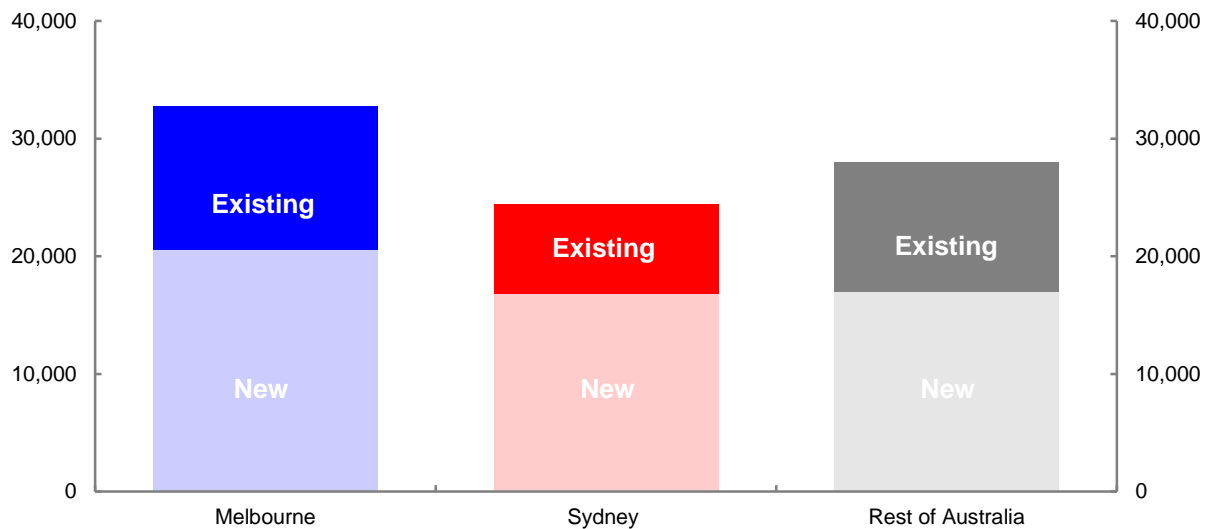
Melbourne postcodes between 3000 and 3207; Sydney postcodes between 2000 and 2234.
Source: Treasury; Authors' calculations

To estimate the sensitivity of property prices to changes in foreign demand we develop a fixed effects model of postcode level price growth using foreign investment approvals data from the Foreign Investment Division of the Treasury as the main explanatory variable. Under almost all model specifications there is a statistically significant and economically meaningful relationship between foreign investment approvals and property price growth, but the majority of price growth experienced in recent times does not appear to be attributable to increased foreign demand. Instead, the fact that property price growth has been strong over an extended period is likely to have been primarily driven by other factors such as impediments to supply, especially in some regions where natural and human-imposed constraints on supply are especially limiting.

The increase in prices attributable to foreign investors is small when compared to the average quarterly increase in property prices of around $12,800 in Sydney and Melbourne during the study period. Across Sydney and Melbourne, the models which we consider to be the best specified indicate that, for a typical postcode, foreign demand increases prices by between $80 and $122 on average in each quarter. This is based on the average postcode in these two cities receiving around 0.6 more foreign investment approvals each quarter over time. Further, for each additional foreign investment approval beyond this typical increase of 0.6, median property prices are estimated to rise by between $145 and $222. Given that the typical increase in the number of foreign investment approvals from one quarter to the next in Sydney and Melbourne is only around 0.6, one additional foreign investment approval beyond this trend increase would be a relatively large spike in the number of approvals. As such, it can be seen that foreign demand has accounted for only a small proportion of the increase in property prices in recent years.

While the results of this study show a consistent, but small positive relationship between foreign investment approvals and property price growth, there are some limitations. This includes the data limitations set out in Section 3, particularly around compliance and that the data reflects intentions to purchase and not actual purchases. The foreign investment data also may not pick up purchases by a citizen or permanent resident on behalf of family members overseas. Quantifying the effect of these limitations is difficult. It is also important to note that while the results suggest the impact across Australia and the capital cities is small, the impacts in certain areas or at particular times may be more intense.

2. LITERATURE REVIEW

Property prices are a function of demand and supply. Domestic demand for properties is affected by interest rates, financial regulation, incomes, demographics as well as the prices of alternative investments such as equities. Foreign demand may also contribute to property price growth. But the impact of changes in demand on prices depends on how supply evolves through time. This, in turn, depends upon both human imposed constraints, such as planning restrictions, and natural constraints imposed by challenging geography. In the longer run, the costs of new property as a close substitute for established property should set the marginal price in the market. If prices remain stubbornly high over time, impediments that increase the cost of bringing new properties to market need to be considered. In addition to these 'fundamental' drivers of property prices some have argued that less rational 'psychological' factors can explain property price movements.

Interest rates affect property prices by affecting the size of the loan that can be serviced at a given level of income. When interest rates are lower, larger loans can be serviced and prices are bid up, because in the short term the quantity of housing is fixed. This has been witnessed in Australia (Tumbarello and Wang, 2010; Williams, 2009; and Otto, 2007). Successful inflation targeting by the Reserve Bank of Australia since the early 1990s has helped to lower nominal interest rates structurally, which has supported property price growth. The impact of interest rates on house prices is generally considered to be cyclical because interest rates typically move to help manage fluctuations in the economic cycle. While some have argued that greater net foreign capital inflows can lower interest rates by reducing bond yields (see Favikulis, Kohn, Ludvigso and Van Nieuwerburgh, 2012 for a discussion of this in the U.S. context), our study does not consider net capital inflows at the national level. As such, we do not consider the effect of capital flows on interest rates. The responsiveness of house prices to interest rates increased after financial market liberalisation in Australia in the 1980s and 1990s because quantity-based controls on lending were relaxed (Williams, 2009).

Financial market deregulation has consistently been found to have supported property price growth (Andrews, 2010; Kohler and Van der Merwe, 2015; and Williams, 2009). Financial market deregulation can structurally lower interest rates by increasing the quantity of funds able to be lent, as well as by increasing competition for borrowers. Lower interest rates can relax credit constraints on households, therefore increasing the demand for dwellings. Additionally, financial market deregulation can loosen borrowing requirements, for instance by increasing the permitted loan-to-valuation ratio, and result in more people being eligible to borrow, again increasing the demand for dwellings. This can be thought of as an outward shift in the supply of credit (Favikulis *et al.*, 2012). Our study does not explicitly address changes in financial market regulation as our data cover a relatively short period of time during which there were few substantial regulatory changes.

Rising incomes enable more to be spent on properties and more people to enter the market for dwellings. This increase in the quantity of funds competing for the same number of properties should result in higher prices, at least in the short term before supply can respond to higher prices. This has been found to be the case internationally as well as in Australia (Andrews, 2010; and Bourassa and Henderschott, 1995). Similarly, higher terms of trade lead to increased national income and, as a result, are associated with house price growth (Tumbarello and Wang, 2010). In addition, changes in the rate of unemployment can impact on incomes and therefore house prices in a number of ways (Andrews, 2010; Hanewald and Sherris, 2013). Firstly, higher rates of unemployment create slack in the labour market and are associated with lower income growth, thus resulting in relatively fewer funds competing for the same quantity of dwellings. This puts less upward pressure on house prices. Secondly, higher rates of unemployment make servicing mortgages more difficult, resulting in pressure to sell, which puts downward pressure on prices. This applies to both owner occupiers and investors. While there is a positive correlation between property prices and female labour force participation in some markets, it is unclear whether greater female labour force participation leads to higher property

prices as a result of increased household income, or whether higher property prices necessitate higher household incomes (Johnson, 2014).[4]

Population growth resulting from natural change and/or net overseas migration can increase the demand for dwellings, as can a reduction in the average number of people per household.[5] Such factors have been found to increase property prices (Andrews, 2009; Kohler and van der Merwe, 2015; Bourassa and Henderschott, 1995). But others have found a negative relationship between house prices and population growth in some Australian cities (Gitelman and Otto, 2012; and Otto, 2007). This may be because, to the extent that population growth is predictable, it should be factored into the planned supply of dwellings. While the natural rate of increase in population in Australia is relatively constant in the short and medium term, net overseas migration can be volatile and is the main contributor to unanticipated population growth. While migrants would likely rent when they arrive in Australia, net overseas migration would have to consistently surpass expectations for it to be a driver of sustained high property prices[6]. To the extent that recent migrants do purchase properties this will be partly captured in the foreign investment approval data for those on a temporary visa.

Equity market returns may affect the demand for properties as some people view them as substitute investments. If investors use past performance as an indicator of an asset class's future performance then a fall in equity returns would decrease expected future returns and thereby reduce the attractiveness of equities vis-a-vis property. This would imply a negative correlation between equity and property returns, as is found by Otto (2007) and Glindro, Subhanij, Szeto and Zhu (2010). But the effect of equity markets on house prices is complicated by wealth effects, whereby increases in equity values flow through to higher property prices (Fry, Martin and Voukelatos, 2010). Our study considers growth in the ASX200 total return index as a control variable under some regression specifications.

Foreign demand for properties is not captured by the factors listed above, but likely contributes to overall demand for properties and therefore price changes. It appears reasonable that an increase in foreign demand for properties will result in price increases, at least in the short run before supply can adjust. Indeed, testing this proposition is at the heart of this study. Previous analysis of foreign investment in residential real estate in Australia at the national level has found that it has probably resulted in a greater stock of housing, but that the delays in the supply response may have at least temporarily resulted in higher prices (Gauder *et al.*, 2014). At the capital city level, it has been suggested that foreign buyers have contributed substantially to price increases in Sydney and Melbourne, but may have resulted in lower prices for new properties in Brisbane and Perth (Guest and Rohde, forthcoming 2017). Our work differs from that of Guest and Rohde (forthcoming 2017) in a number of ways, including that we consider monthly and quarterly property data, mostly at the postcode level, as opposed to yearly and state level. We are unaware of other analysis of the

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4   This study considers married women in the United States. It does not assess the relationship between house prices and female labour force participation in other contexts.

5   However, the average household size may be affected by an increase in the cost of housing. See Richards (2009) for a discussion on average household size in Australia. In addition to changes in population and the average number of people per household, the number of vacant properties and houses being replaced impacts on the overall demand for housing (Kohler and van der Merwe, 2015). Our study does not consider these factors as data disaggregated through time and by postcode does not appear to be available. However, the number of vacant properties and properties being replaced is small and relatively constant through time.

6   We note the strong correlation between net overseas migration and rental price growth.

relationship between foreign investment approvals and property prices at this level of disaggregation either internationally or in Australia.[7]

Importantly, property prices are also affected by changes in the supply of dwellings. If land supply is unrestricted, then in the long run prices will not deviate much from construction costs, even with large increases in demand. When the additional supply of properties is less than the additional demand in a period, prices can be expected to rise. Higher property prices incentivise additional supply, but supply can be slow to respond to price signals. In general, this delayed response results from development processes and the time needed to construct properties (Ellis, Kulish and Wallace, 2012). With most of Australia's population concentrated in major capital cities, the supply of freestanding houses is less responsive to price changes than the supply of higher density properties (Liu and Otto, 2015), probably owing to the limited availability of land as well as zoning constraints. Further, in postcodes which have both houses and units, house prices have grown faster than unit prices (Kulish, Richards and Gillitzer, 2012). There is also evidence that supply is less responsive to prices in postcodes closer to the central business district and that supply has become less responsive to price over time (Gitelman and Otto, 2012).

While it may not be surprising that the supply of freestanding houses is price inelastic in Sydney, it could be expected that higher prices would lead to increased supply in regional areas where land is much less scarce. However, it appears that the supply of houses is relatively unresponsive to price in all parts of regional New South Wales (Liu and Otto, 2014). This suggests that state-wide impediments to supply, likely resulting from state and local government regulation, are resulting in higher house prices. These findings are consistent with the view that there is a relatively fixed quantity of land suitable for properties because of a combination of planning restrictions and geographic characteristics and that this puts upward pressure on property prices (Kulish *et al.*, 2012; Saiz, 2014).

In Australia, the pipeline of new properties is measured at three points: building approvals, commencements and completions. It is unclear at what point this additional supply impacts on property prices. This is because properties can be purchased but not lived in prior to being completed and buyers and sellers can be expected to be somewhat forward looking. However, evidence of previous housing cycles suggests a degree of myopia among market participants. We use completions instead of approvals or commencements as our measure of property supply. This is because a varying proportion of approvals are never commenced or completed, and there can be an indeterminate lead time between commencements and completions.

While much of the literature has focused on demand and supply to understand property prices, some argue that prices are not exclusively a function of economic fundamentals. For instance, Shiller (2007) proposes a psychological theory whereby expectations about future price growth explain property prices. Varying degrees of 'herd mentality' have been found in Australian property markets, with Sydney being the most 'excitable' housing market (Valadkhani and Smyth, 2015). Additionally, Williams (2009) has found that when there is very strong property price growth in a quarter, this is followed by a higher than otherwise rate of price growth in the following quarter.

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7   Internationally, this likely results from the absence of relevant data in jurisdictions which allow foreign investment in residential real estate, and the prohibition of foreign investment in residential real estate in many other jurisdictions. Domestically, data on foreign investment approvals for residential real estate are released on an annual basis, and is disaggregated at the state level only.

3. DATA

We consider the relationship between foreign investment approvals and property prices across postcodes and through time. Our measure of foreign demand for properties in a postcode is the number of foreign investment approvals. The data are sourced from the Foreign Investment Division at the Treasury. The data used are from 2,366 postcodes over the 57 months from July 2010 to March 2015. Such disaggregated data are not publically available to other users and is a key benefit of this study. Postcode level property price data are from CoreLogic. Other demand and supply side factors are examined using a combination of Australian Bureau of Statistics, Reserve Bank of Australia and Bloomberg data (see Appendix A).

Foreign investment and property price data

Foreign investment data

We use monthly postcode level data on the number of foreign investment approvals for residential real estate. We do not include data on advanced off-the-plan foreign investment approvals, nor do we use price data from off-the-plan sales from such developments.[8] Contrary to Guest and Rohde (forthcoming 2017) we do not distinguish between approvals for new and existing dwellings. As the measure of foreign demand, our study uses the number of foreign investment approvals, as opposed to the total dollar value of such approvals as is done by Guest and Rohde (forthcoming 2017). This has the benefit of avoiding discrepancies between the value of the purchase approved and the price actually paid.[9]

Foreign investment approvals are concentrated in a relatively small number of postcodes — more than three quarters of postcodes receive less than one approval every three months. This unequal distribution of approvals is demonstrated by Table 1, which shows that the mean number of foreign investment approvals per month for a postcode is 0.57 or around one approval every two months which is substantially higher than the median figure of 0.04 and the value of the 75th percentile of 0.32.

Table 1: Summary statistics by postcode over 57 months (2,366 postcodes)[10]

	Mean	Median	Std dev	Percentile	
				25th	75th
Average monthly foreign investment approvals	0.57	0.04	2.1	0.00	0.32

Source: Treasury; Authors' calculations

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8   Advanced-off-the-plan approvals are recorded as one approval even though the number of dwellings sold to foreigners is typically higher (Treasury, 2014). As it is difficult to estimate the proportion of foreign buyers in any project we exclude such data from our analysis.

9   In addition, when entering property values some applicants do not correctly distinguish between the dollar value of the property, for example $1,000,000, and the value of the property measured in millions of dollars.

10   There are a small number of postcodes for which the CoreLogic data and foreign investment data to not match up or which have less than 57 months of data. These postcodes tend to have fewer properties and very low numbers of foreign investment approvals. They are excluded from this study.

As outlined in Treasury (2014), care must be taken in interpreting this data for the following reasons:

- Approvals do not represent actual purchases. For example, a foreign person may receive a foreign investment approval but later decide not to purchase a dwelling.[11]

- No data are available regarding properties sold by foreigners. As such, the foreign investment data are an indication of gross foreign demand not net foreign demand. For instance, if a property is sold by one foreign person to another, there is no net change in foreign demand for dwellings but an additional foreign investment approval will be recorded.

- It is unclear when an approval for foreign investment will be acted upon because the approval is valid for 12 months. However, anecdotal evidence suggests that in most cases approvals are acted upon soon after being granted. In some cases an approval may be sought shortly after a contract is entered into but before the conveyancing and settlement period is finalised. As such, we consider leading and lagging relationships in the *Results* section. This yields some insights into the behaviour of foreign investors.

Despite these shortcomings the data from the Foreign Investment Division at the Treasury is preferable to alternative measures of foreign investment in residential property. These alternative measures, such as from the National Australia Bank, are problematic because they are based on survey data from industry participants and it is not clear how these industry participants determine whether property buyers are foreign.

Over the period considered by this study there were no fees associated with foreign investment applications, but on 1 December 2015 fees were introduced. A considerable reduction in the level of applications subsequent to the introduction of fees could indicate that many applications submitted prior to the introduction of fees were not 'serious' applications, as has been suggested by some stakeholders (Property Council of Australia, 2014). The available preliminary data suggest that the level of applications has not changed greatly since the introduction of fees which indicates that the majority of the applications submitted prior to the introduction of fees were 'serious'.[12] The *Results* section includes further evidence that there was unlikely to be a high level of spurious foreign investment applications prior to the introduction of fees in December 2015.

While exchange rate movements may affect the number of foreign investment applications by impacting on the relative attractiveness of Australian residential property, this study does not seek to explain the drivers of foreign investment applications. As such, we do not control for movements in the exchange rate. Additionally, since it is likely that the number of foreign investment applications is correlated with movements in the exchange rate, the introduction of a variable to control for the exchange rate may introduce problems of multicollinearity.

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11   Broadly speaking, a foreign person is an individual not ordinarily resident in Australia, or a foreign trust or company. A detailed definition of 'foreign person' is available at Section 4 of the *Foreign Acquisitions and Takeover Act 1975*. This does not necessarily align with the definition of 'foreign person' for taxation or immigration purposes.

12   There does appear to have been a steep increase in applications just prior to the introduction of fees, and a reduction during the first few months of fees being imposed but this is consistent with 'bring-forward' of applications to avoid fees as opposed to an artificially high number of foreign investment approvals in the period before fees were introduced. Nevertheless, this period following the introduction of fees is excluded from our analysis. This is discussed further in the Results section.

The foreign investment variable is the level change in foreign investment approvals in a postcode, scaled by the total number of properties in that postcode. This is denoted below.

$$\frac{FIA_t - FIA_{t-1}}{Dwellings}$$

As outlined in the introduction, postcodes in Sydney and Melbourne typically see around 0.6[13] more foreign investment approvals in each quarter compared to the quarter before. This would be represented by a value of 0.6 in the numerator of the fraction above.

Property price data

CoreLogic provides suburb level median sale prices over the preceding three months. House prices and unit prices are disaggregated. Each month this three month period rolls forward one month. If there are fewer than ten transactions during the three month period no median sale price is recorded. This results in missing median sale prices for around 59 per cent of monthly observations at the national level. This figure drops to around 21 per cent when only Sydney and Melbourne postcodes are considered, reflecting the higher turnover in these cities than in many parts of Australia.

Given the uncertainty about the timing of purchases relative to the date that the foreign investment approval is granted, this longer three month rolling window is not overly problematic, especially when leading and lagging relationships are explored.

Because the data on foreign investment approvals is aggregated at the postcode instead of suburb level, we have aggregated the suburb level prices to postcode level prices. This provides postcode level prices for houses and units separately. Foreign investment approvals data do not distinguish between houses and units, so in postcodes with price data for both houses and units, we aggregate prices for these two property types. Specifically, this aggregation is weighted by the proportion of houses and units in each postcode.[14] In postcodes where no price data are available for a particular property type at any time — for example, units in a regional postcode — but price data are available for the other property type — for example, houses — we use the available price data as our measure of postcode level prices.

Our dependent variable is the percentage point change in postcode level property prices. This has the benefit of avoiding stationarity problems that would occur if price level data were used. This is also more straightforward than using price level data as some adjustment for a general increase in the level of prices across the economy would likely be necessary.

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13   This is the average level change in the number of foreign investment approvals between quarters. This figure excludes observations for which postcode level price change data is not available because such observations are not included in the regressions estimated.

14   A shortcoming in this construction of postcode level prices is that neither the number of houses nor units changes through time in our dataset despite new supply coming online during this period. This is a feature of the data available from CoreLogic. We could use ABS data on completions or approvals to adjust the number of properties through time, but this would require an assumption regarding how many completions or approvals should be attributed to each postcode. This is somewhat mitigated by the relatively short time series studied.

Table 2: Summary statistics by postcode over 57 months (2,366 postcodes)

|	Mean	Median	Std dev	Percentile	
				25th	75th
Property price ($)	452,905	403,496	245,410	292,773	549,836
Number of dwellings	3,790	1,608	4,963	329	5743
Transactions[15]	47	18	66	3	69

Source: CoreLogic; Authors' calculations

A subset of postcodes accounts for a disproportionately large share of activity in the housing market, though this concentration is not as stark as in the foreign investment approvals data. This is demonstrated in Table 2 as the mean number of properties transacted is considerably higher than the median and there is a large difference between the 25th and 75th percentiles. In this regard, and as outlined earlier, no sale price is recorded for a postcode if fewer than ten transactions occur in a period. As a result 750 postcodes do not record a sale price in any month. For those postcodes that do record at least one price value the mean property price is around $450,000 while the median property price is around $400,000.

We do not control for changes in the quality of properties in each postcode through time. We do not consider this to be a major limitation because of the relatively short time period of our study. However, the lack of hedonic adjustment could be problematic where price data are derived from a small number of sales. That is, where postcode level property markets are relatively illiquid and the quality of transacted properties changes through time even though the quality of properties in the postcode more broadly does not change. This shortcoming could be addressed by tracking individual houses through time, but we do not have such data. As our price observations require at least 10 transactions in a period, the price data that we do have are likely to be sufficiently representative to avoid problems of heterogeneity within postcodes through time.

Chart 2 demonstrates that the majority of postcodes experienced property price growth of between -0.5 and 1.5 percentage points in each month on average.[16] Some postcodes experience considerably higher or lower rates of price growth, but such postcodes generally witness few transactions. Such illiquidity is particularly common in rural and regional areas.

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15   Over the past three months, rolling monthly.

16   A very small number of postcodes have an average monthly percentage change in price greater than ±10 per cent and are excluded from this chart.

Chart 2: Average of monthly percentage change in property price[17]
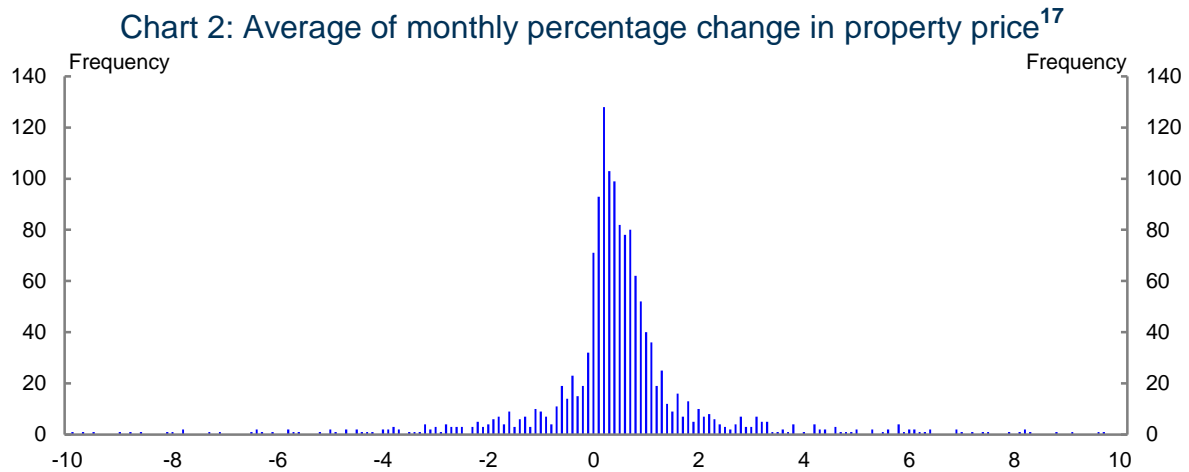
Source: CoreLogic; Authors' calculations

Bivariate analysis

The line of best fit in Chart 3 shows the slight positive correlation between postcode level property price growth and the number of foreign investment approvals in a postcode.[18] Observations on Chart 3 are not as widely dispersed as they may appear. This is because Chart 3 includes around 48,000 data points and many observations overlap each other. Indeed, the majority of data points are clustered around the intersection of the x-axis and y-axis.

Chart 3: Correlation between price growth and foreign investment approvals
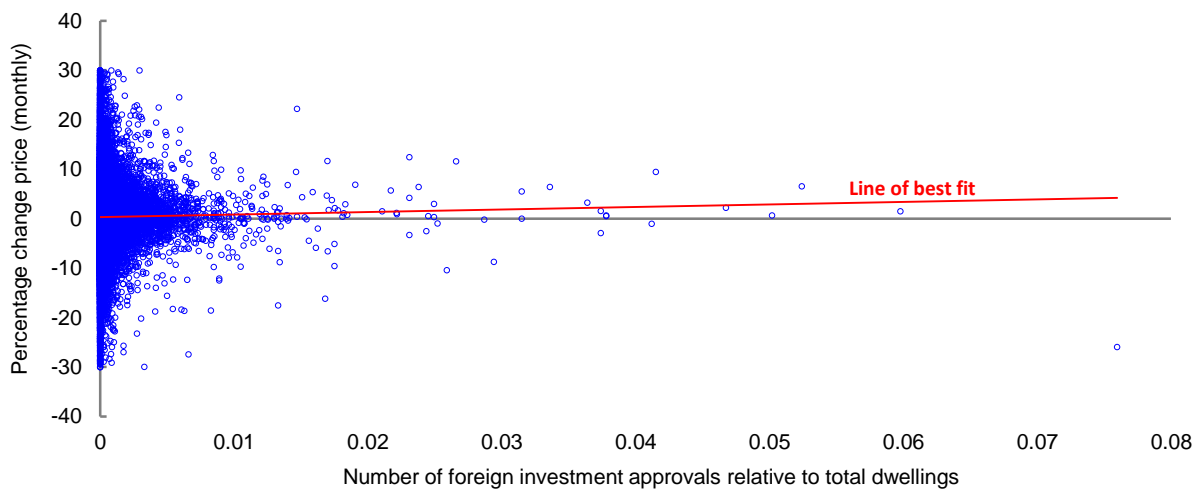
Source: CoreLogic; Treasury; Authors' calculations

Characteristics of suburbs with no price data

As outlined earlier, if fewer than ten transactions occur in a postcode in a period then no sale price is recorded for that period. This serves to reduce the volatility of the price series by ensuring that sale prices are more representative of the postcode.

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17 This is a simple average. Price information at the first and last point of the study period is often unavailable, meaning that compound interest cannot be calculated on a consistent basis.

18 Relative to the total number of properties in a postcode. There are a small number of postcodes, which in some months see prices change by more than ± 30 per cent. We consider these observations to be outliers and exclude them from this chart.

As expected, Table 3 demonstrates that postcodes without price change data have, on average, far fewer dwellings, transactions and foreign investment approvals than postcodes which do have price change data. Each of these differences is significant at the 1 per cent level. As such, estimates presented in the Results section are not applicable to postcodes with relatively low turnover.

Table 3: Characteristics of postcodes with and without price change data

	Postcodes without price change data			Postcodes with price change data		
	Mean	**Std dev**	**Obs**	**Mean**	**Std dev**	**Obs**
Number of dwellings	619	1,316	879	5,678	5,354	1,487
Number of houses	552	1,159	877	4,104	3,960	1,487
Number of units	239	590	252	1,685	2,567	1,388
Average monthly foreign investment approvals	0.02	0.12	879	0.89	2.63	1,487
Average number of transactions[19]	6	16	879	71	72	1,487

Source: CoreLogic; Authors' calculations

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19   During preceding three months.

4. METHODOLOGY

Chart 3 demonstrated a positive correlation between property price growth and the number of foreign investment approvals in a postcode. We now outline a framework to examine whether this relationship persists under a range of regression specifications.

We employ fixed effects regression techniques to take advantage of repeated observations at the postcode level. This allows us to disregard known and unknown factors which are time-invariant and may contribute to changes in postcode level property prices, such as distance to the central business district or the quality of amenities (Allison, 2009). That is, there is no need for us to consider the characteristics of postcodes as is done by Abelson, Joyeux and Mahuteau (2013). Because of this, any change in our dependent variable can be attributed to factors which change through time, such as the number of foreign investment approvals.

The main alternative to the fixed effects specification for panel data regressions is the random effects specification.[20] Random effects can be used when *some* omitted variables vary through time but are constant between postcodes and would allow us to estimate the effect of time invariant characteristics on property prices. But this would require measurement of postcode level characteristics which affect property prices. This would be extremely difficult to do accurately, especially because we consider over 2,000 postcodes. Because we are primarily interested in the relationship between property prices and factors which vary through time, namely foreign investment approvals, we do not pursue a random effects specification.[21]

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20   Another specification, between effects, is used when all omitted variables vary through time but are constant between postcodes. This is equivalent to taking an average of each variable through time for each postcode. This results in a loss of information regarding variation through time the estimates are more likely to be affected by factors not controlled for. For these reasons we do not consider the between effects specification.

21   Hausman tests indicate that for some regression specifications random effects could be used. On such occasions there is little difference between the results of fixed and random effects specifications. We only present the results of fixed effects regressions as we consider it reasonable that postcode specific intercepts are correlated with our foreign investment variable.

The fixed effects regressions estimated are of the form:

$$Y_{it} = \alpha_i + \beta X_{it} + \rho Z_t + \varepsilon_{it} \qquad (1)$$

where:

- Y_{it} is the percentage point change in price for postcode i at time t;

- α_i is the intercept[22];

- X_{it} is the foreign investment approvals variable, which varies by postcode and through time;

- Z_t are independent variables which vary through time but not by postcode for example, interest rates23, though some variables, such as income, vary by state;

- β and ρ are coefficients; and

- ε_{it} is the error term which varies by postcode and through time.

  - Note that $\varepsilon_{it} = u_i + e_{it}$, where u_i are unobserved predictors of Y that are postcode specific and time constant, and e_{it} are unobserved predictors of Y that are specific to the postcode and point in time.

We assume that errors are normally distributed with a mean of 0 and a variance of σ^2, and that the error term is not correlated through space or time. These assumptions are formalised in equations 2, 3 and 4.

$$\varepsilon_{it} \sim N(0, \sigma^2) \qquad (2)$$

$$E(\varepsilon_{it}, \varepsilon_{ik}) = 0 \; if \; t \neq k \qquad (3)$$

$$E(\varepsilon_{it}, \varepsilon_{jt}) = 0 \; if \; i \neq j \qquad (4)$$

We begin by estimating a fixed effects regression with the level change in foreign investment approvals relative to the number of properties in the postcode and time fixed effects being the only independent variables. Lags and leads are then considered. As a check of robustness additional explanatory variables are added in successively.[24] With the exception of the foreign investment variable the control variables are not available at the postcode level at a monthly or quarterly frequency. As such, we do not consider

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22   This is the average value of the fixed effects.
23   Time fixed effects are also included under some specifications. This allows factors which are constant across postcodes at specific points to be considered.
24   While we aim to estimate the impact that foreign investment approvals have on property prices, property price growth could also affect the number of foreign investment applications and therefore approvals. However, we consider that most foreign persons looking to purchase properties in Australia are flexible regarding property characteristics, so long as their budget constraints are not breached. For example, if property prices rise we consider that many foreign persons are likely to purchase smaller properties which remain within their budget constraint, as opposed to giving up on acquisitions entirely. This is because many foreign persons are motivated by a desire to facilitate potential future migration (CBRE, 2015) or diversify personal asset allocations outside of their home country, particularly in jurisdictions like Australia with strong property rights regimes. An instrumental variable approach could also address potential endogeneity problems but we are unable to identify a variable which affects the number of foreign investment approvals but not prices and has frequent data at the postcode level. This is a potential area of future research.

them to be particularly informative. Given this limitation, we consider these variables to be primarily a check on the robustness of the results. We do not consider that emphasis should be placed on the coefficients of these other control variables. After estimating regressions for all postcodes we restrict analysis to capital cities, then to Sydney and Melbourne.

Because of the use of fixed effects regression techniques, this study does not measure postcode level determinants of property prices such as distance to the central business district or average property size. These postcode level characteristics are often correlated with one another. Instead, explanatory variables used in our study for robustness are national and state level and in level change or percentage change form, thus reducing the level of correlation between variables. As such, multicollinearity is less likely to be a problem in this study than in studies which utilise hedonic price models where postcode and property characteristics can be highly correlated.

Time fixed effects are not employed in models which include control variables other than the foreign investment variable. This is because the time fixed effects are likely to capture the same factors as the other control variables, namely changes in income, the standard variable mortgage rate, dwelling completions and equity returns.

5. RESULTS

Across Sydney and Melbourne, the models which we consider to be the best specified indicate that foreign demand typically increased prices by between $80 and $122 on average in each quarter.[25] This is based on the average postcode in these two cities receiving around 0.6 more foreign investment approvals each quarter through time. It is important to note that this is very small when compared with the average quarterly increase in Sydney and Melbourne property prices over the period studied of around $12,800.

Table 4 records, for a range of models, the increase in median property prices in a postcode that occurs if the number of foreign investment approvals in a period increases by one more than usual.[26] This represents the impact of an additional foreign investment approval at the margin, as opposed to the effect of the average foreign investment approval. But once again, it is important to realise that the price increases indicated in Table 4 are small when compared to the average quarterly increase in property prices over the period of the study, which range from around $3,800 for Australia overall to around $12,800 for postcodes in Sydney and Melbourne. Note that these figures relate to foreign investment approvals *at the margin*. As such, multiplying these dollar figures by the total number of foreign investment approvals received in a postcode would be nonsensical and would not give the overall dollar impact of foreign demand on property prices.

While this particular study focuses on a measure of foreign demand, there isn't any inherent reason why an increase in demand for one additional property from a foreign investor should be considered as any different in its impact on prices from an increase in some forms of new domestic demand, for example a first home buyer moving out of the family home to purchase a property for the first time.

Table 4: Estimated price increase attributable to one additional foreign investment approval beyond the trend increase (selected models).

Model 1 (monthly, all postcodes)	Model 9 (quarterly, all postcodes)	Model 11 (quarterly, all capital cities)	Model 13 (quarterly, Syd and Mel only)	Model 14 (quarterly, Syd and Mel only, leads and lags)	Model 15 (quarterly, Syd and Mel only, pre-inquiry)
$117	$127	$195	$145	$222	$155

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25 Models 13, 14, 15 and 16 are included in this range. Model 16 is the only model estimated for which the contemporaneous foreign investment variable is not statistically significant. As such, a dollar value is not calculated for Model 16. We note that Model 16 includes somewhat fewer observations than Model 15. Zero lies below the 95 per cent confidence interval of the contemporaneous foreign investment variable for all monthly and quarterly models, excluding Models 10 and 16.

26 These dollar values do not align with coefficients because the different regression specifications include different postcodes. For instance, Model 9 includes all postcodes while Model 13 excludes postcodes outside of Sydney and Melbourne. The average level of the foreign investment variable changes because the average number of properties in a postcode (the denominator of the foreign investment variable) varies depending on the range of postcodes included in the regression. Also, the monthly coefficient is comparably large because one additional approval is more substantial in a monthly context where the typical increase in approvals through time is around one third of that of the quarterly specification.

Interpreting the coefficient of the foreign investment variable

The following example of the price effect of a marginal foreign investment approval is based on the results of Model 1.

$$\frac{(P_t - P_{t-1}) * 100}{P_{t-1}} = 0.34 + 144.14 \left(\frac{FIA_t - FIA_{t-1}}{Dwellings} \right) + 0.21^{27} + \varepsilon_{it}$$

The numerator of the foreign investment variable is the level change in the number of foreign investment approvals between periods. Most postcodes receive very few foreign investment approvals. Indeed, as noted earlier, the average postcode receives one foreign investment approval roughly every two months. The level change in the number of foreign investment approvals between months is smaller again, with an average of around 0.06.[28] In other words, for the postcodes included in Model 1, each month the average postcode receives 0.06 more foreign investment approvals than it did in the preceding month.[29]

The denominator is the number of properties in a postcode, which is around 5,700 on average for the postcodes which are included in Model 1.

The value of the numerator is small and the value of the denominator is large. On average the foreign investment variable has a value of around 0.00001, as noted in Table 7.

Given that on average the trend increase in the level of foreign investment approvals is 0.06, a 'shock' of one additional foreign investment approval is large — over 15 times the usual increase in the number of foreign investment approvals from one period to the next.

The method to estimate the dollar value of the additional foreign investment approval is outlined below.

- Instead of the numerator being 0.06 it will now be 1.06.

- The denominator will remain at 5,700 as the number of properties in the postcode remains unchanged.

- The value of the variable increases from (0.06/5,700≈0.00001) to (1.06/5,700≈0.00019). The difference between these two values is around 0.00018.

- Given the coefficient value of 144 and the level change in the value of the foreign investment variable of 0.00018, the percentage point contribution of the one additional foreign investment approval to property price growth in that postcode is 144 x 0.00018 ≈ 0.026 percentage points.

- The average property price is around $461,000 across the whole sample. So the increase in prices attributable to the additional foreign investment approval is $461,000 x 0.026 percentage points ≈ $120.[30]

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27 This is the time fixed effects coefficient corresponding to the last month of the study.
28 This figure excludes observations for which price change data is not available because these observations are not included in regressions.
29 Note that the level change in the number of foreign investment approvals is negative in many instances. I.e., a postcode receives less foreign investment approvals in the current period than it did in the previous period.
30 This differs slightly (by $3) form the result in Table 4 because we round the numerator and denominator for ease of exposition in this example.

One standard deviation in the foreign investment variable (0.00014) is roughly equivalent to the increase in the foreign investment variable which occurs when one additional foreign investment approval is received in a postcode (0.00018).

Graphically, the increase in monthly price growth which occurs when the number of foreign investment approvals increases more than usual is displayed in Chart 4.

Chart 4: Property price increase attributable to a beyond trend increase in foreign investment approvals in a postcode

From Chart 4 it can be seen that property prices in the average postcode in Model 1 typically increase by around $1,200 in a month (this is the blue section of the chart).[31] This $1,200 monthly increase *includes* the trend increase in the level of foreign investment approvals of 0.06. But if this average postcode receives one standard deviation more foreign investment approvals then prices will increase by an additional $92 (this is the red part of the chart). While the slope of the red area of the chart would be steeper under some regression specifications, the blue portion of the chart would be much higher because of the greater property price rises, for example in Sydney and Melbourne. As such, the impact of a one standard deviation increase in foreign investment approvals would still result in only a small increase in prices relative to the price rises that would have occurred otherwise.

Since a one standard deviation increase in the number of foreign investment approvals beyond the trend level of foreign investment approvals is uncommon, and its effect on price growth is small, it can be seen that little of the property price growth witnessed in recent times can be attributed to the activity of foreign investors (noting the previous caveats around purchases for which Foreign Investment Review Board approval was not sought and that certain locations might be impacted more than others).

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31   This value of a product of the average property price and the average quarterly percentage point price increase.

Detailed monthly

Considering prices and foreign investment on a monthly basis maximises the number of observations included in the regression. Under all monthly specifications the coefficient on the contemporaneous foreign investment variable is positive and zero is below of the 95 per cent confidence interval.

Chart 3 demonstrated that there is a positive relationship between price growth and the number of foreign investment approvals in a postcode.[32] **Model 1** estimates a regression with contemporaneous foreign investment approvals and time fixed effects as the only explanatory variables and finds that the coefficient on the foreign investment variable is statistically significant at the one per cent level. This is detailed in Table 5.[33,34]

It may be the case that the relationship between property price growth and the number of foreign investment approvals changes once leading and lagging relationships are factored in. That is, depending on the time it takes to find a suitable property or understand the foreign investment regime requirements, foreign investors may 'create' demand in months slightly before or after the foreign investment approval is granted. **Model 2** sees the addition of two lags and one lead of the foreign investment variable. These additional foreign investment variables are not statistically significant.

Most postcodes receive no foreign investment approvals or very few foreign investment approvals in a period. The postcodes that receive most approvals are in capital cities, particularly Melbourne and Sydney. It is these cities where property price growth has been most pronounced. Areas with relatively few approvals, such as rural and regional areas, will have less variation in the foreign investment variable, which can make interpreting regression results that include such postcodes more problematic. For this reason, and because we are principally interested in the effects of approvals in areas where approvals have been concentrated, **Models 3** and **4** employ the same explanatory variables as **Models 1** and **2** but restrict data to capital cities. The coefficients on the contemporaneous foreign investment variables are slightly larger in **Models 3** and **4** than in **Models 1** and **2**.

Models 5 and **6** restrict analysis further and only include postcodes in Sydney and Melbourne. The regression results are little changed from those which include the postcodes from all capital cities.

There is an increase in the level of foreign investment approvals at the end of the study period. This could be attributable to applications being brought forward following the release of the Standing Committee on Economics report into Foreign Investment in Residential Real Estate, which recommended the introduction of application fees and tighter enforcement.[35] This potential bring-forward could reflect foreigners seeking the *option* to purchase a property in Australia in the following 12 months without paying an application fee. So the level of foreign demand for properties immediately after the release of the report may have been lower than the number of approvals

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32   It may be the case that higher numbers of foreign investment approvals in a postcode increase prices in that postcode, and that this price growth forces some domestic buyers to consider properties in adjacent postcodes. We do not consider this potential flow-on impact in our analysis.

33   Observations where postcode level monthly price growth is greater than ±20 per cent are considered to be outliers and are excluded. These outliers may result from a change in the quality of properties transacted in a postcode in a period.

34   The coefficients of the time fixed effects variables are not presented in Table 5 as this would require over 50 additional rows. F-tests indicate that time fixed effects are jointly significant for all monthly models. Full details regarding monthly time fixed effects are available from the authors on request.

35   Note that the actual application of fees and tighter enforcement occurs after the end of our sample regardless.

indicates. It could also be the case that this higher level of approvals more accurately reflects the true level of foreign investment activity and that prior to the release of the report a portion of foreign investors were failing to seek approvals for purchases. If the increase in approvals is because of applications being brought forward artificially, or increased compliance, this constitutes a structural break in the foreign investment series. Alternatively, the increase in approvals could be driven by a genuine increase in intentions to purchase properties ahead of the introduction of the fees which were recommended in the report (but which were not the policy at that time), or greater 'push factors' in foreign jurisdictions leading to an increase in foreign demand.[36]

Because of the possibility of a structural break the results of **Models 5** and **6** may miss-estimate the impact of foreign investment on price growth. To correct for this, **Models 7** and **8** replicate **Models 5** and **6** but exclude the months after the Standing Committee on Economics report was released. While it may be expected that the coefficients on the foreign investment variables would be larger than the previous specifications, they are little changed from **Models 5** and **6**. This may suggest that the increase in applications towards the end of the period was not the result of an increase in compliance, but more likely a genuine increase in the level of foreign demand, potentially spurred by applications being brought forward following the release of the House of Representatives report or greater push factors from overseas.

These monthly regressions have a number of important limitations. Because the property price variable covers a three month period which rolls forward monthly, we cannot be sure whether price changes through time reflect movement in the month falling into the rolling three month period, or movement in the month falling out of the rolling three month period.

The models presented thus far do not control for possible determinants of price growth apart from the change in foreign investment approvals and time fixed effects. Other controls, namely the standard variable mortgage rate, dwelling completions, equity market returns and incomes are considered. The results of regressions which incorporate these variables are presented at Appendix C. We consider the addition of these controls to be useful as a robustness check but we do not interpret the coefficients.[37] This is because the short time series of this study features relatively little variation in these control variables. Additionally, given that these variables are national or state level they are insufficiently disaggregated to be considered alongside the price or foreign investment variables, which are postcode level. The inclusion of such variables on a monthly or quarterly basis and at a more disaggregated level is a potential area of future research. We note that under all such specifications the contemporaneous foreign investment variable remains positive and statistically significant. As mentioned previously, we do not consider time fixed effects and other non-foreign investment control variables simultaneously because there is a high degree of overlap between these additional controls and time fixed effects.

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36   Such evidence may include pressure on pegged currencies in foreign investment source countries.

37   As an additional robustness check we examine whether, when using an OLS specification for specific postcodes, a robust standard errors approach affects the statistical significance of the foreign investment variable. The robust standard error specification shows little effect.

Table 5: Regression output — monthly price growth, postcode level[38]

	Model 1	Model 2	Model 3 (capital city only)	Model 4 (capital city only)	Model 5 (Syd and Mel only)	Model 6 (Syd and Mel only)	Model 7 (Syd and Mel only, pre-inquiry)	Model 8 (Syd and Mel only, pre-inquiry)
$(FIA3m_t - FIA3m_{t-1})$ /dwellings	144.14***	107.71**	180.68***	159.29**	129.52**	152.86**	138.00**	137.46**
	(3.10)	(2.14)	(3.37)	(2.53)	(2.41)	(2.38)	(2.26)	(2.04)
$(FIA3m_t - FIA3m_{t-1})$ / no. properties [lag 1 month]		28.00		15.78		5.25		30.73
		(0.50)		(0.24)		(0.08)		(0.45)
$(FIA3m_t - FIA3m_{t-1})$ / no. properties [lag 2 month]		41.97		-21.25		-1.65		-10.01
		(0.65)		(-0.30)		(-0.02)		(-0.13)
$(FIA3m_t - FIA3m_{t-1})$ / no. properties [lead 1 month]		63.10		18.21		-24.11		-25.74
		(1.10)		(0.27)		(-0.36)		(-0.35)
Constant	0.34*	0.22	0.26	-0.06	0.38	-0.16	0.39	-0.16
Observations	46,155	43,643	26,282	24,865	15,016	14,209	13,954	13,386
Within R^2	0.0085	0.0088	0.0164	0.0166	0.0375	0.0358	0.0351	0.0366
Between R^2	0.0008	0.0009	0.0074	0.0072	0.0819	0.1095	0.0745	0.0663
Overall R^2	0.0079	0.0083	0.0158	0.0159	0.0370	0.0355	0.0348	0.0362

Notes: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively. *t* statistics in parentheses.

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38   Observations where postcode level monthly price growth is greater than ±20 per cent are considered to be outliers and are excluded.

Detailed quarterly

Given that the measure of property prices is a median price over a three month period, considering prices on a quarterly as opposed to a rolling three-monthly basis removes uncertainty regarding which period contributed to property price growth.[39]

Model 9 is a quarterly regression with contemporaneous foreign investment and time fixed effects as the only variables. The foreign investment variable is positive and statistically significant. Quarterly results are detailed in Table 6.

The monthly regressions found that lags and leads of the foreign investment variable did not help to explain price growth. To test whether this is the case in quarterly regressions also, **Model 10** includes two lags and one lead of the quarterly foreign investment variable. As was the case with the monthly regressions, the results of **Model 10** indicate that there is no clear relationship between lags or leads of the foreign investment variable and property price growth. This suggests that foreign investors generally create demand in the same quarter as an approval is received.[40]

Models 11 through **16** consider successively more restricted geographic and temporal ranges. Limiting the postcodes considered to capital cities, then exclusively Melbourne and Sydney does not greatly change the coefficient on the contemporaneous foreign investment variable.

There is relatively little variation in the coefficient of the contemporaneous foreign investment variable in the quarterly models. The coefficients range from a minimum of around 166 in **Model 9**, which is Australia-wide, to a maximum of around 280 in **Model 12**, which only includes capital cities. The coefficients for the models which only consider postcodes in Sydney and Melbourne (**Models 13** through **16**), are between 163 and 257. This indicates that the price impact, measured in percentage points, of a foreign investment approval beyond the trend increase in foreign investment is broadly consistent across geographic areas. The maximum and minimum coefficients correspond to an increase in postcode level prices of between $127 and $234 for each marginal foreign investment approval. As discussed earlier, one additional foreign investment approval in a quarter is a considerable spike in approvals.

Overall, we consider **Models 13** through **16** to be the best specified. The reason for this is twofold. Firstly, and as detailed earlier, the quarterly price data utilised in these models means that fluctuations in price through time can be attributed to a specific period, unlike the monthly price data. Secondly, the results which are specific to Sydney and Melbourne are of most interest because this is where price growth and foreign investment were concentrated over the period of this study.

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39   Although there is some autocorrelation in price changes in around a third of postcodes observed at the monthly frequency, this is not unexpected, given the fairly consistent positive price growth observed over the sample period. There is little autocorrelation in the quarterly series. Inasmuch as the coefficients are roughly equivalent across the monthly and quarterly regressions, autocorrelation in the monthly series does not appear to be having a substantial impact on the results.

40   As noted earlier, foreign investment approvals are valid for 12 months, so it could have been the case that a considerable proportion of foreign investors purchased properties later in this 12 month window. But there is no evidence of this. Similarly, there is no evidence of foreign investors creating demand shortly before receiving foreign investment approval.

These models indicate that foreign investment typically contributed between $80 and $122 to quarterly price growth over the period considered.[41] This is based on postcodes in Sydney and Melbourne typically receiving around 0.6 more foreign investment approvals each quarter over time.

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41   We note that the coefficient on the contemporaneous foreign investment variable in Model 16 is statistically insignificant and it is excluded from this range. As noted previously, Model 16 includes somewhat fewer observations than Model 15.

Table 6: Regression output — quarterly priced growth, postcode level[42]

	Model 9	Model 10	Model 11 (capital cities only)	Model 12 (capital cities only)	Model 13 (Syd and Mel only)	Model 14 (Syd and Mel only)	Model 15 (Syd and Mel only, pre-inquiry)	Model 16 (Syd and Mel only, pre-inquiry)
$(FIAqtr_t - FIAqtr_{t-1})$/ properties	166.14**	210.97*	232.76***	280.28**	167.74**	256.76**	184.98**	162.88
	(2.28)	(1.90)	(2.96)	(2.32)	(2.18)	(2.11)	(2.03)	(1.22)
$(FIAqtr_t - FIAqtr_{t-1})$/properties [lag 1 qtr]		98.50		36.05		54.86		-168.69
		(0.80)		(0.29)		(0.43)		(-1.01)
$(FIAqtr_t - FIAqtr_{t-1})$/properties [lag 2 qtr]		-21.94		150.91		152.35		141.09
		(-0.17)		(1.13)		(1.11)		(0.95)
$(FIAqtr_t - FIAqtr_{t-1})$/properties [lead 1 qtr]		43.49		53.12		71.93		30.55
		(0.49)		(0.57)		(0.77)		(0.28)
Qtr3	-1.58***		-1.16**		-1.04*		-1.08*	
	(-3.52)		(-2.21)		(-1.67)		(-1.74)	
Qtr4	-1.29***		-0.61		-0.39		-0.41	
	(-2.86)		(-1.15)		(-0.63)		(-0.67)	
Qtr5	-2.24***	-0.91**	-1.89***	-1.25**	-2.27***	-1.84***	-2.28***	-1.84***
	(-4.99)	(-2.00)	(-3.62)	(-2.37)	(-3.72)	(-2.97)	(-3.74)	(-2.96)
Qtr6	-1.18***	0.13	-1.03**	-0.42	-1.51**	-1.10*	-1.53**	-1.11*
	(-2.63)	(0.28)	(-1.97)	(-0.80)	(-2.46)	(-1.76)	(-2.48)	(-1.77)
Qtr7	0.23	1.58***	0.65	1.25**	0.58	0.98	0.55	0.97
	(0.51)	(3.45)	(1.23)	(2.35)	(0.93)	(1.56)	(0.88)	(1.52)
Qtr8	-0.63	0.72	-0.23	0.39	-0.23	0.19	-0.25	0.15
	(-1.41)	(1.57)	(-0.45)	(0.73)	(-0.36)	(0.30)	(-0.40)	(0.24)
Qtr9	-0.97**	0.39	0.15	0.75	-0.71	-0.30	-0.75	-0.30
	(-2.16)	(0.85)	(0.28)	(1.41)	(-1.15)	(-0.48)	(-1.21)	(-0.48)
Qtr10	0.90**	2.26***	1.23**	1.86***	1.83***	2.22***	1.82***	2.24***
	(2.01)	(4.97)	(2.36)	(3.51)	(2.95)	(3.53)	(2.94)	(3.56)
Qtr11	0.53	1.85***	0.99*	1.60***	0.92	1.33**	0.92	1.36**
	(1.19)	(4.09)	(1.91)	(3.03)	(1.49)	(2.12)	(1.49)	(2.15)
Qtr12	0.57	1.89***	1.96***	2.56***	1.82***	2.17***	1.79***	2.20***
	(1.30)	(4.23)	(3.82)	(4.88)	(2.94)	(3.46)	(2.90)	(3.48)
Qtr13	0.96**	2.26***	2.07***	2.64***	3.41***	3.75***	3.39***	3.85***
	(2.19)	(5.08)	(4.08)	(5.09)	(5.61)	(6.04)	(5.58)	(6.18)
Qtr14	2.24***	3.51***	3.33***	3.87***	3.64***	3.92***	3.64***	4.04***
	(5.14)	(7.90)	(6.59)	(7.46)	(6.04)	(6.33)	(6.04)	(6.47)
Qtr15	0.80*	2.04***	1.36***	1.89***	1.99***	2.29***	1.95***	2.32***
	(1.84)	(4.59)	(2.67)	(3.64)	(3.25)	(3.68)	(3.20)	(3.69)
Qtr16	0.08	1.38***	1.45***	2.06***	1.58***	1.98***	1.55**	1.99***
	(0.19)	(3.09)	(2.82)	(3.94)	(2.57)	(3.15)	(2.52)	(3.17)
Qtr17	-0.07	1.23***	0.88*	1.49***	1.72***	2.12***	1.70***	2.16***
	(-0.16)	(2.77)	(1.72)	(2.86)	(2.82)	(3.41)	(2.78)	(3.46)
Qtr18	1.09**	2.44***	1.62***	2.20***	2.06***	2.38***		
	(2.49)	(5.46)	(3.16)	(4.22)	(3.37)	(3.82)		
Qtr19	0.50		1.49***		3.06***			
	(1.11)		(2.85)		(4.82)			

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42   Observations where postcode level monthly price growth is greater than ±30 per cent are considered to be outliers and are excluded.

Constant	0.83***	-0.49	0.45	-0.16	0.58	0.18	0.59	0.18
Observations	14,315	12,021	8,315	6,978	4,838	4,066	4,311	3,784
Within R^2	0.0167	0.0172	0.0298	0.0298	0.0576	0.0561	0.0573	0.0596
Between R^2	0.0066	0.0114	0.0219	0.0397	0.0431	0.0765	0.0350	0.0412
Overall R^2	0.0155	0.0162	0.0287	0.0293	0.0563	0.0557	0.0558	0.0583

Notes: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively. t statistics in parentheses.

6. CONCLUSION

Foreign investment has contributed to Australia's sustained economic growth. Recently, foreign investors have accounted for an increasing share of demand for Australian residential real estate. This paper estimates that only a small proportion of the strong property price growth over the study period can be attributed to foreign demand. It is also the case that the majority of foreign investment approvals are for new dwellings, consistent with Australia's foreign investment policy for residential real estate which, in part, aims to increase the total supply of dwellings.

While this paper can help to inform the public discourse on the drivers of property prices, more work is required to better understand and address constraints on property supply in Australia, particularly in areas where little additional supply has eventuated despite prolonged periods of price growth.

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APPENDIX A

Other control variables

Contemporaneous values as well as a range of leads and lags are used under different regression specifications for all control variables.

Standard variable mortgage rate (SVMR)

This is a measure of the cost of borrowing to purchase dwellings. To avoid problems of stationarity we use the level change in the standard variable mortgage rate over rolling three month periods in our regression analysis.

As can be seen in Chart 5, the SVMR has trended lower over the period of this study, broadly in line with movements in the cash rate. However, the regressions which employ lags will include the tail end of the tightening cycle which finished in mid-2010. The quarterly regressions with lags will cover a period which include three interest rate increases and correspond to a period of very high property price growth.

Chart 5: Standard variable mortgage rate and the cash rate
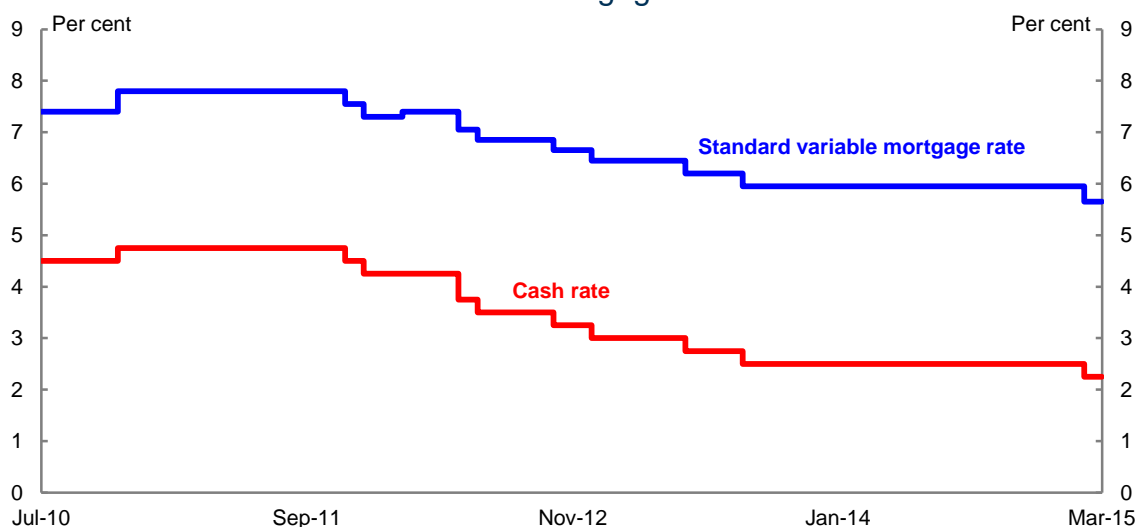
Source: RBA

Income

This is an index of the total remuneration of all employees in a state in a quarter. This is a function of the number of employees and the average level of remuneration in a state and is referred to as compensation of employees (COE). To avoid problems of stationarity we use the percentage change in COE by state in our regression analysis.

As can be seen in Chart 6, COE increased in all states and territories over the study period, with the greatest increase occurring in Western Australia and the smallest increase occurring in Tasmania.

Chart 6: Quarterly COE by state
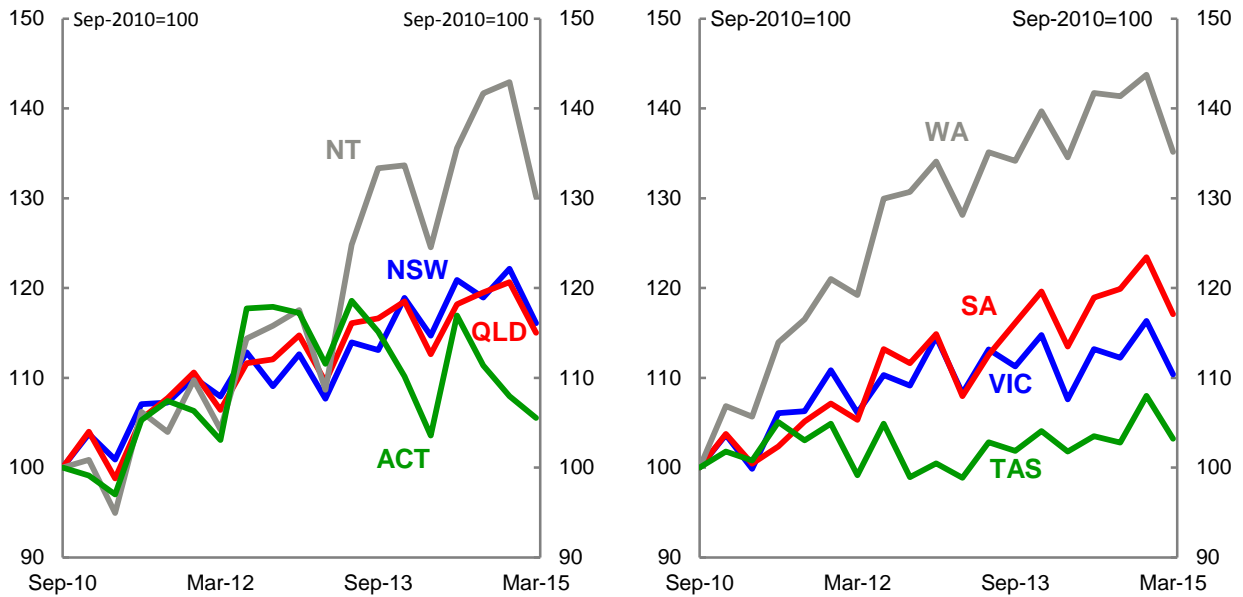
Source: ABS, Authors' calculations

Australian equity market

We use a market capitalisation weighted index of the 200 largest stocks listed on the Australian Stock Exchange with cash dividends reinvested (ASX200 Total Return Index). To avoid problems of stationarity we use the percentage change in the ASX200 Total Return Index in the regression analysis.

Chart 7 shows that the level of the ASX200 Total Return Index increased over the period of this study, though there were fluctuations over this time.

Chart 7: ASX200 Total Return Index
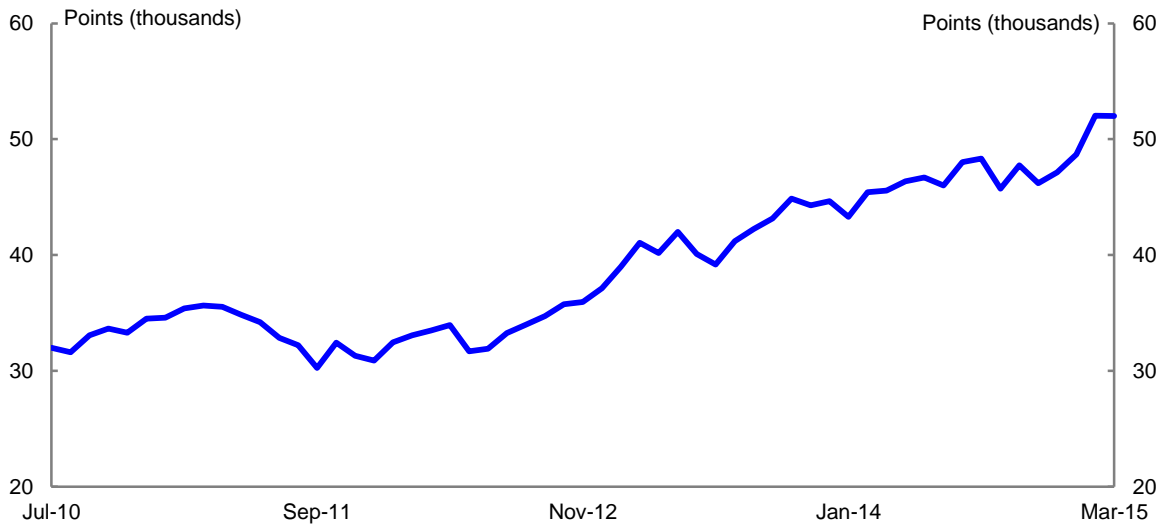
Source: Bloomberg

Property supply

This measures the total number of houses and units completed in each state in a period. To avoid problems of stationarity, we use the percentage change in property completions in the regression analysis.

Chart 8 shows that Victoria recorded more completions than any other state over the period, in part reflecting strong migration from other states and overseas as well as the relative availability of greenfield and brownfield sites in close proximity of the Melbourne central business district. New South Wales also experienced considerable growth in property completions over the period, but Tasmania saw a decline. The number of completions in other states and territories did not change substantially over the period of the study.

Chart 8: Quarterly property completions (houses and units)
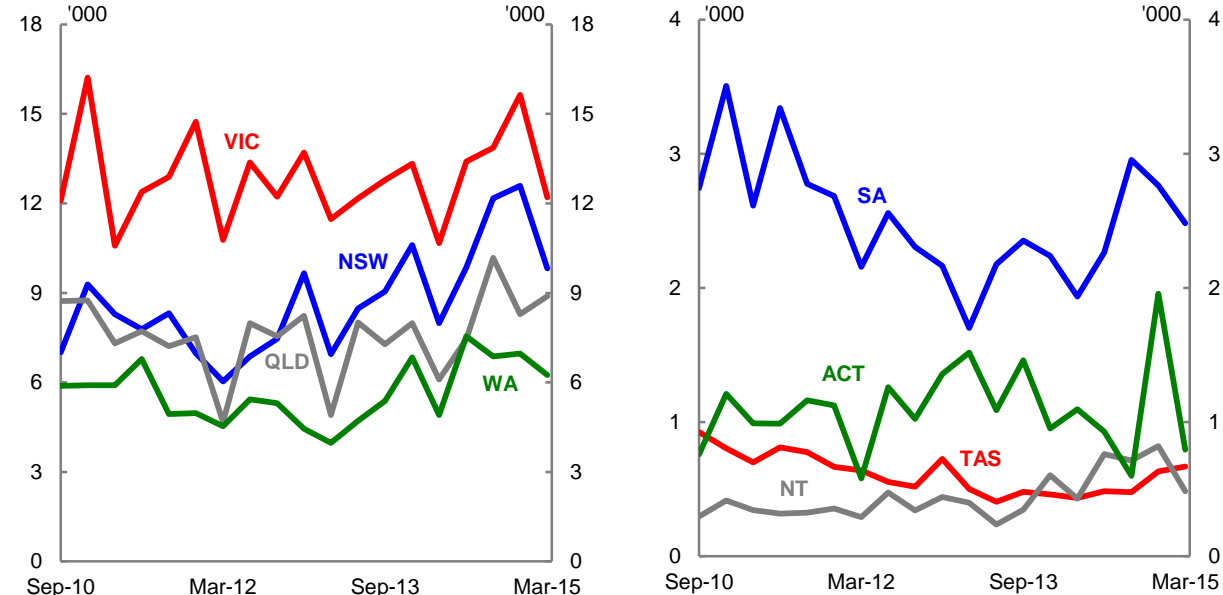
Source: ABS

APPENDIX B

Table 7: Summary statistics of control variables — monthly
Summary statistics for all postcodes with price change data

| | Mean | Median | Std dev | Percentile | |
				25th	75th
Percentage point price change	0.13	0.22	2.26	-0.20	0.67
$(FIA3m_t - FIA3m_{t-1})$/ no. properties	0.0000095	0	0.00014	0	0.00001
$(FIA3m_t - FIA3m_{t-1})$/properties [lag 1 month]	0.0000054	0	0.00015	0	0.00001
$(FIA3m_t - FIA3m_{t-1})$/ no. properties [lag 2 month]	0.00001	0	0.00016	0	0.00001
$(FIA3m_t - FIA3m_{t-1})$/ no. properties [lead 1 month]	0.0000086	0	0.000176	0	0.00001

Table 8: Summary statistics of control variables — quarterly
Summary statistics for all postcodes with price change data

| | Mean | Median | Std dev | Percentile | |
				25th	75th
Percentage point price change	0.78	0.87	4.30	0.03	2.04
$(FIAqtr_t - FIAqtr_{t-1})$/ no. properties	0.000037	0	0.0003	0	0.000038
$(FIAqtr_t - FIAqtr_{t-1})$/properties [lag 1 qtr]	0.000033	0	0.0003	0	0.000038
$(FIAqtr_t - FIAqtr_{t-1})$/properties [lag 2 qtr]	0.000037	0	0.0003	0	0.000031
$(FIAqtrt - FIAqtrt_{-1})$/properties [lead 1 qtr]	0.000023	0	0.0003	0	0.000042

APPENDIX C:

Results of monthly regressions excluding time fixed effects but including other control variables

	Model 17	Model 18	Model 19 (capital city only)	Model 20 (Syd and Mel only)	Model 21 (Syd and Mel only, pre-inquiry)
$(FIA3m_t - FIA3m_{t-1})$/ no. properties	166.39***	130.81***	198.56***	210.87***	192.78***
	(3.59)	(2.60)	(3.15)	(3.27)	(2.84)
$(FIA3m_t - FIA3m_{t-1})$/properties [lag 1 month]		39.94	39.05	21.91	49.79
		(0.72)	(0.61)	(0.33)	(0.73)
$(FIA3m_t - FIA3m_{t-1})$/ no. properties [lag 2 month]		37.96	-29.26	-16.50	-26.17
		(0.59)	(-0.41)	(-0.23)	(-0.35)
$(FIA3m_t - FIA3m_{t-1})$/ no. properties [lead 1 month]		65.63	26.54	11.16	4.71
		(1.15)	(0.40)	(0.17)	(0.06)
$SVMR_t - SVMR_{t-3}$	0.04	-0.04	-0.14	-0.03	0.06
	(0.29)	(-0.34)	(-0.89)	(-0.18)	(0.33)
$SVMR_{t-3} - SVMR_{t-6}$	-0.41***	-0.50***	-0.70***	-0.93***	-0.93***
	(-3.17)	(-3.65)	(-4.28)	(-4.69)	(-4.58)
%Δ $(ASX200_T/ASX200_{t-3})$	0.03***	0.03***	0.03***	0.04***	0.04***
	(6.95)	(6.14)	(5.03)	(5.11)	(4.45)
%Δ $(ASX200_{T-3}/ASX200_{t-6})$	0.02***	0.02***	0.02***	0.02**	0.01**
	(3.26)	(3.65)	(3.32)	(2.23)	(2.00)
Constant	0.09***	0.07**	0.16***	0.23***	0.27***
Observations	46,155	43,643	24,865	14,209	13,386
Within R^2	0.0023	0.0023	0.0038	0.0068	0.0065
Between R^2	0.0008	0.0008	0.0298	0.0305	0.0386
Overall R^2	0.0022	0.0022	0.0036	0.0065	0.0062

Notes: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively. *t* statistics in parentheses.

Results of quarterly regressions excluding time fixed effects but including other control variables

	Model 22	Model 23	Model 24 (capital cities only)	Model 25 (Syd and Mel only)	Model 26 (Syd and Mel only, pre-inquiry)
$(FIAqtr_t - FIAqtr_{t-1})$/ no. properties	175.75**	246.76**	342.45***	341.20***	271.59**
	(2.42)	(2.22)	(2.85)	(2.83)	(2.05)
$(FIAqtr_t - FIAqtr_{t-1})$/properties [lag 1 qtr]		145.10	114.21	154.06	-16.00
		(1.18)	(0.91)	(1.22)	(0.10)
$(FIAqtr_t - FIAqtr_{t-1})$/properties [lag 2 qtr]		4.47	198.83	232.59*	244.53*
		(0.03)	(1.49)	(1.70)	(1.65)
$(FIAqtr_t - FIAqtr_{t-1})$/properties [lead 1 qtr]		71.40	86.08	115.59	98.21
		(0.81)	(0.92)	(1.25)	(0.91)
$SVMRqtr_t - SVMRqtr_{t-1}$	1.59**	2.63***	4.37***	4.30***	4.53***
	(2.50)	(3.55)	(5.08)	(4.05)	(3.96)
$SVMRqtr_t - SVMRqtr_{t-1}$ [lag 1 qtr]	-0.02	2.92***	2.18**	5.12***	5.34***
	(-0.04)	(3.87)	(2.49)	(5.00)	(4.87)
$SVMRqtr_t - SVMRqtr_{t-1}$ [lag 2 qtr]	-1.85***	-1.64**	-2.74***	-1.88*	-1.89*
	(-3.24)	(-2.37)	(-3.38)	(-1.93)	(-1.93)
%Δ $(COEqtr_t/COEqtr_{t-1})$ *100-100	0.12***	0.13***	0.18***	0.30***	0.30***
	(3.15)	(2.86)	(3.38)	(3.63)	(3.55)
%Δ $(COEqtr_t/COEqtr_{t-1})$ *100-100 [lag 1 qtr]	-0.04	0.07	0.04	0.11	0.11
	(-0.95)	(1.43)	(0.66)	(1.17)	(1.08)
%Δ $(COEqtr_t/COEqtr_{t-1})$ *100-100 [lag 2 qtr]	-0.05	0.05	0.01	-0.10	-0.09
	(-1.50)	(1.12)	(0.29)	(-1.19)	(-1.13)
%Δ $(Compl.qtr_T - Compl.qtr_{t-1})$*100-100	0.01	0.00	-0.01	0.00	-0.01
	(1.05)	(0.74)	(-0.95)	(-0.28)	(-0.44)
%Δ $(Compl.qtr_T - Compl.qtr_{t-1})$*100-100 [lag 1 qtr]	0.01***	0.00	0.00	0.01	0.01
	(2.64)	(0.42)	(-0.66)	(0.46)	(0.44)
%Δ $(Compl.qtr_T - Compl.qtr_{t-1})$*100-100 [lag 2 qtr]	0.01***	0.01**	0.00	0.01	0.02
	(2.57)	(2.20)	(0.40)	(0.88)	(0.99)
%Δ $(ASX200qtr_t/ASX200qtr_{t-1})$	0.13***	0.19***	0.21***	0.29***	0.30***
	(6.48)	(8.04)	(7.70)	(8.50)	(8.40)
%Δ $(ASX200qtr_t/ASX200qtr_{t-1})$ [lag 1 qtr]	0.04**	0.07***	0.05	0.10***	0.10***
	(2.12)	(2.97)	(1.64)	(2.86)	(2.79)
%Δ $(ASX200qtr_t/ASX200qtr_{t-1})$ [lag 2 qtr]	0.00	0.02	0.05**	0.05**	0.06**
	(0.24)	(1.01)	(2.43)	(1.99)	(2.09)
Constant	0.35*	0.47**	0.86***	1.15***	1.21***
Observations	14,315	12,021	6,978	4,066	3,784
Within R^2	0.0120	0.0155	0.0255	0.0480	0.0504
Between R^2	0.0091	0.0092	0.0384	0.1000	0.0518
Overall R^2	0.0115	0.0149	0.0254	0.0494	0.0517

Notes: ***, ** and * indicate significance at the 1, 5 and 10 per cent level, respectively. t statistics in parentheses.

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