21ST ANNUAL PACIFIC-RIM REAL ESTATE SOCIETY CONFERENCE
KUALA LUMPUR, MALAYSIA, 18-21 JANUARY 2015

A CORRELATION ANALYSIS OF MEDIAN RESIDENTIAL PROPERTY PRICES IN SYDNEY NSW

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ABSTRACT

Since 2011, Sydney has experienced strong growth in residential property prices. But there have been mixed opinions in the media as to whether the price surge is likely to continue or decline citing different indicators. This paper identified six primary indicators that most property professionals and economists commonly referred to when they forecasting the property market. These six primary indicators are: unemployment, population, new dwelling approvals, interest rates, proportion of non-first home buyers, and price-to-income ratio. This paper examines these six primary indicators over a long term time period from 1990 to 2014 in order to establish strengths of relationships between the indicators and median price using correlation coefficient calculation.

The relationship between these six primary indicators and property price are first reviewed. Hence, a correlation analysis is performed for each primary indicator against the median residential property prices for single dwellings in Sydney NSW. The strongest correlated primary indicators are found to be population and price-to-income ratio. The weakest correlated primary indicator is found to be unemployment rates. In addition, the results also found that the primary indicator of price-to-income ratios may help in predicting property price ceilings. The participation rate of non-first home buyers was negatively correlated during both price boom periods and price decline periods. Furthermore, the consistency and strength of correlation coefficient values for indicators for the boom period in 2000 -2004 are very similar to the current boom.

Key Words: Sydney property, correlation coefficient, primary indicators, median price

INTRODUCTION

Since December 2011 Sydney residential prices have experienced capital growth rates matched that only to the price boom during 2000 – 2004 as shown in the Table 1. In 2008, the Global Financial Crisis (GFC) and 2011 decline values were included to put the largest boom and decline prices into context. Actually, prices fell more in the 2011 decline than the GFC period.

Table 1: Annualised Median Price Growth Rates (source: adopted from RP Data 2014)

Description	Period	Duration	Residence Type	Annualised Growth Rate
Previous Boom	Sep 2000 - Mar 2004	3yrs 6 months	Single Dwelling	18.65%
GFC Decline	Dec 2007 - Mar 2009	1 yr 3 months	Single Dwelling	-15.88%
2011 Decline	Dec 2010 - Dec 2011	1 yr	Single Dwelling	-17.43%
Current Boom	Dec 2011 - Jun 2014	2 yrs 6 months	Single Dwelling	17.40%

A survey of 25 economists conducted by Fairfax Media (2014), found that there are mixed opinions as to whether the recent price levels will lead to a housing bubble, stabilise or decline. According to the HSBC Bank Australia (cited in The Australian, 2014), Sydney was not currently experiencing a housing bubble but would be at the risk of inflating one if the current market trends continued. They referred to investors; self-managed super funds, low interest rates and even simply the expectation of rising house prices as being some of the drivers of the prices. HSBC expects the price to continue to raise at a rate of 10% for the year ending 2014. Whereas Joye

(2014) who claims to have predicted the 2011 decline and rebound in 2013 expects the Australian house price to fall between 8 to 17 % if the mortgage rates rise to 7 – 8% pa. Joye refers to the household income to median price relationships as one of the primary indicators for the changes to prices.

It is not the aim of this paper to determine whether a property bubble exists in Sydney but to analyse the relationship between demand and supply indicators and property prices using correlation analysis. Establishing some form of relationship will assist in understanding the drivers of residential prices in Sydney. There are a range of indicators used in analysis of residential property markets. This paper will analyse some commonly used indicators to establish which indicators are consistent and could be reliable for future price trending purposes. The paper will focus on the Sydney region comprising of 38 Local Government Areas which captures the city area, the inner and outer suburbs of Sydney.

The paper will look at the relationship between the selected indicators and median prices for single dwellings for Sydney region over six periods from Jan 1990 to Jun 2014 as shown in Figure 1. The periods to be analysed are:

- Long Term (Mar 1991 – Jun 2014)
- 2000 Boom (Sep 2000 – Mar 2004)
- Stable Period (Jun 2004 – Sep 2007)
- 2011 Decline (Dec 2010 – Dec 2011)
- Property Cycle (Sep 2000 – Mar 2009)
- Current Boom (Dec 2011 – Jun 2014)

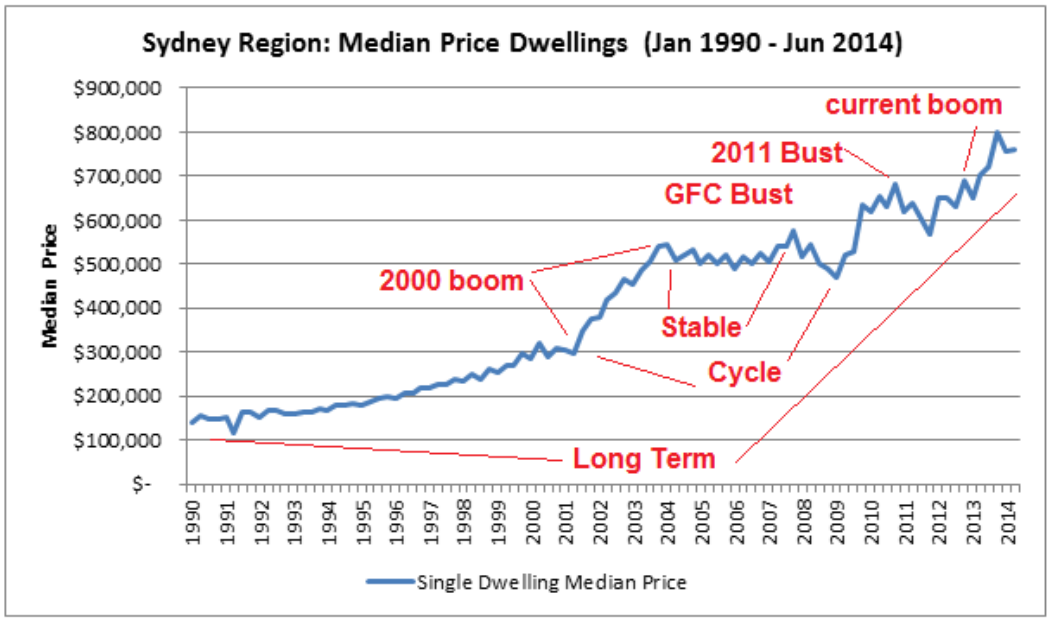

Figure 1: Sydney Residential Median Price for Single Dwellings (source: RPData, 2014)

Analysing these periods should provide insight into possible relationships not only over time but also during specific periods in a property cycle. It should be noted that the period during the Global Financial Crisis was not selected for analysis as this period was much larger national and international economic shock. Although this period did result in a price decline in property, it is less linked to property fundamentals than the period of 2011 which resulted in a price decrease not directly linked to a financial crisis.

LITERATURE REVIEW

There is a general consensus that residential prices are driven by demand fundamentals underpinned by supply constraints (Haylen, 2014). In analysing demand factors, some main indicators include employment, population, households and household income. Current and future housing stock forms the supply sides of the equation (Brett & Schmitz, 2009). The key demand variables listed by Miller & Geltner (2005) for residential property are population, household formations, business and employment growth rates, general employment rates and quality of life. The key supply variables identified include highway accessible land supply, ease of gaining zoning, government subsidies and incentives, cost of capital and profitability.

According to Haylen (2014), the main demand drivers for housing in New South Wales over the last two decades were high population growth, household income growth and fall in interest rates. In addition to this, non-first home buyers have been the largest component of this demand. Housing supply has failed to keep pace with demand despite increase in prices. However, Brown, Schwann & Scott (2006) suggest that Australian household investors are primarily driven by wealth related factors when investing into Australian residential property i.e. they tend to be wealthier, employed full time, earned more than the peers of their age and married with large families. They also found that most of the determinants of property investment did not vary with the property cycle, with the exception of marriage during periods of high property prices relative to income and suggest that the second income is needed to obtain mortgage financing or to meet the running costs of the investment.

From the supply side, REIA (2014a) claim that supply has not kept up with demand in Australia due to land availability, taxation policies, length and cost of planning procedures, zoning policies and environmental regulation. They estimate that the national supply - demand gap is forecasted to reach 375,000 dwellings by 2015. However, caution should be taken with regard to the housing shortfall amounts at state and territory levels. The shortfall amount assumes that the market was in balance in 2001, which was true for Australia nationally it is unlikely the case for each state and territory (National Housing Supply Council, 2012). In fact the supply gap in NSW continually expands and has a massive disparity when compared to the other states and territories.

A study by Karantonis (2010) using regression analysis found that residential prices did not influence new residential commencements in Australia. It was that inferred using trend lines that between 1993 and 2008 Sydney residential prices and Sydney new dwelling approvals were moving in opposite directions. Karantonis (2010) found that residential dwelling prices at a national level had a strong correlation with GDP (0.934), household income (0.962) and construction cost (0.985). Liu & London (2011) also found that between 1996 and 2009 there was a strong correlation between housing construction costs and new housing supply in Australia. A Granger causal link was established where an increase in construction costs decreased residential housing commencements. However, the study found that for the States of NSW and WA the correlation was not as apparent as that of other states.

Price-to-income ratios are an intuitive measure as it gives an indication of relative expense of a home for a typical household (Fox & Finlay 2012). The ratio takes into account growth in real income and overall inflation and is often taken as a summary statistic of over or undervaluation of the housing market. The price-to-income ratios in Australia were relatively stable up to mid-1980's and rising in the late 1980's, 1990's and early 2000's. These periods coincided with financial deregulation and falling interest rates which increased households' borrowing capacity. The extra borrowing capacity seems to have been used to drive up dwelling prices (Fox & Finlay 2012).

The impact of foreign investment has been a popular topic. Haylen (2014) found that between 2010 and 2012 foreign investments as a proportion of total residential purchases in NSW increased from 3% to 13% ($1.9b - $6.9b). However, REIA (2014a) found that the level of foreign investment as a proportion of total dwelling value in NSW for the year 2012 accounted for only 0.33% and claimed that foreign investment had an insignificant impact on residential prices. On the other hand, Karantonis (2011) found that there was a strong correlation (0.909) between residential price and foreign investment for 'off-the-plan' residential properties in Australian Capital Cities. The analysis covered the period from 1989 to 2010. A granger causality test was performed and found that off-the-plan investments did not cause residential prices increases but vice versa residential prices drive off-the-plan investment increases.

A summary of the abovementioned supply and demand indicators are listed in Table 2 below. The indicators in bold are hence selected for the correlation analysis in this paper, and the reasons for their selection in data analysis are noted.

Table 2: Demand and Supply Indicators review and reason for use in this analysis

Demand Indicator	**Notes**	**Supply Indicator**	**Notes**
Unemployment	Selected for analysis as reliable data available.	Current stock	Not selected as due to unavailability of reliable data.
Population	Selected for analysis as reliable data available.	Future stock	Not selected as due to unavailability of reliable data.

Households	Reliable data not available. Household numbers are not measured frequently and estimated using census data.	**New dwelling approvals**	Selected for analysis as reliable data available.
Household income	Incorporated in Price-to-Income ratio analysis.	Ease of gaining zoning	Not a tangible measurement.
Interest Rates	Selected for analysis as reliable data available.	Government Subsidies	Not useful in determining long term trends.
Quality of Life	No measure exists. Not tangible. A very indirect measure.	Cost of capital and profitability	An indirect driver of supply as it relates to factors considered by developers.
Non-First Home Buyers	Analysed in conjunction with First Home buyers to establish proportion of buyer type	Land availability	Not selected as due to unavailability of reliable data.
Household Investors	Represented above in Non-First Home Buyers.	Length & Cost of planning procedures	Not a tangible measurement.
Price-to-Income Ratio	Selected for analysis as reliable data available.	Residential Commencements	Not as reliable as new dwelling approvals.
Foreign Investment	Only data available is in the form of yearly reports issued by Foreign Investment Review Board. Not selected due to insufficient data to perform reasonable analysis	Construction Costs	As per cost of capital. Considered an indirect driver supply.

METHODOLOGY

The aim of the paper is to establish whether a relationship between median prices and six primary indicators exist. The correlation coefficient is the most commonly used statistic to measure the degree of relationship between two variables and describes the extent of linear relationship (Klugh, 2013). The relationship analysis will be performed using correlation analysis and using correlation coefficient as the indicator of the strength of the relationship. Each indicator will be analysed in isolation against median prices and will address the following:

- Strength of correlation coefficient values depending on types of period.
- Correlation Coefficient for each indicator based on types of period
- Most consistent indicators
- Consistency and strength of correlation coefficients between previous boom and current boom period

The correlation coefficient value ranges from – 1.00 to + 1.00. The sign indicates the direction of the relationship i.e. positively or negatively correlated. The strength of the correlation coefficient values are commonly defined in Table 3.

Table 3: Correlation Coefficient Strength (source: biz/ed 2014)

Coefficient Value (+ / -)	Strength
0.0 to 0.2	Very weak to negligible correlation
0.2 to 0.4	Weak, low correlation (not very significant)
0.4 to 0.7	Moderate correlation
0.7 to 0.9	Strong, high correlation
0.9 to 1.0	Very strong correlation

It is noted that the presence of a correlation does not permit us to infer that a causal relationship exists between the variables. Although causality tests such as the Granger method is better at measuring causality than correlation, it does not actually measure causality but rather the uni-directionality of inter-temporal correlation between two phenomena (Klugh 2013). Causality tests are not performed in this paper.

Calculation for non-linear data can be misleading as the measure of association is assumed to be linear when in fact it is not. Klugh (2013) suggest that a graph be constructed so that the assumption of linearity can be subjected to a visual check. As such the usefulness of correlation coefficients for cyclical periods analysed in this paper may limited as the correlation coefficient is best suited for linear relationships.

RESULTS AND DISCUSSIONS

The relationship between median prices for single dwellings in Sydney region against the selected indicators over six time periods are analysed using correlation coefficient calculation. Data was sourced from highly reliable sources including ABS, RBA, REIA and RP Data. A summary of the source of data is provided in Table 4 below. These selected indicators are each plotted against the median price of single dwellings in Sydney for the period from Mar 1990 to Jun 2014 as shown in Appendix A.

Table 4: Data source for selected indicators

Indicator	Source	Targeted Area
Median Price Single Dwelling	RP Data (2014)	Sydney Region
Population	ABS (2014a)	NSW
Bank Lending Rate - Housing	RBA (2014)	National
Unemployment Rate	ABS (2014b)	NSW
New Dwelling Approvals	ABS (2014c)	NSW
Non First Home Buyers	ABS (2014d)	NSW
Median Single Dwelling. Price to Median Household Income Ratio	RP Data (2014), REIA (2014)	NSW

The correlation coefficient value is calculated for each indicator against the six types of periods. The results of the calculated correlation coefficient are listed in Table 5 below.

Table 5: Correlation Coefficient for each period (source: calculated by authors)

Period	Population (NSW)	Bank Lending Rate	Unemployment Rate	New Dwelling Approvals	Non-First Home Buyers	Price-to-Income Ratio
Long Term (Mar 1991 – Jun 2014)	****0.965**	*-0.594	****-0.760**	*-0.500	*0.466	****0.919**
2000 Boom' (Sep 2000 – Mar 2004)	****0.958**	*-0.402	-0.124	*0.579	*0.552	****0.997**
Stable Period (Jun 2004 – Sep 2007)	0.306	0.202	-0.340	0.316	*0.581	0.213
2011 Decline (Dec 2010 – Dec 2011)	****-0.937**	*0.533	-0.334	*0.513	0.123	****0.996**
Property Cycle (Sep 2000 – Mar 2009)	*0.658	0.312	*-0.584	-0.086	0.108	****0.767**
Current Boom (Dec 2011 – Jun 2014)	****0.892**	*-0.651	*0.603	*0.605	****0.765**	****0.996**

Note: ****** - Correlation Coefficient greater than 0.7: Strong correlation
* - Correlation Coefficient from 0.4 to 0.7: Moderate correlation

The median price of Sydney's single dwellings has strong positive correlation with the indicator of population for most of the periods studied, including long term, previous boom and current boom. But in the decline period, prices moves in very strong negative correlation with population. While in the property cycle period, prices move in moderate positive correlation with population. The moderate to strong correlation relationships are expected given that population is commonly identified as being a basic primary driver of demand for residential property.

For the indicator of bank lending rate, it has a moderate negative correlation at the long term, previous boom and current boom period. Also it has a moderate positive correlation at the decline period in 2010. It provides a consistent correlation at long term, booming and decline periods, but weak correlation in stable and cycle period.

For the indicator of unemployment rates, with the exception of the long term period, there is no consistency in the results which implies that the unemployment rates are not a reliable indicator of median price.

The indicator of new dwelling approvals has moderate positive correlation in four periods of study, including the long term, previous boom, decline and current boom period; but weak correlation in stable period. It appears that the short run demand – supply movement holds true for price boom periods i.e. due to supply inelasticity in the short run, a surge in prices triggers new supply.

In the long term period, the indicator of non-first home buyers have a moderate positive correlation with median prices. In both previous and current boom periods, non-first home buyers have a moderate to strong positive correlation with price. The correlation of the non-first home buyers is quite consistent. In periods of price boom there is a positive correlation with non-first home buyers, which implies that there is a strong participation by non-first home buyers during price boom periods.

From Table 5, there are strong to very strong correlations between price-to-income ratios and median prices of single dwellings in Sydney for most periods except the stable period. What will be explored further is the use of the price-to-income ratio used by Joye (2014) in the introduction section of this paper as being a predictive indicator. From Figure 7 in Appendix A, it can be noticed that once the price-to-income ratio reaches a certain value, prices begin to correct and decline. For single dwellings, it can be seen that prices do not surge further once the price-to-income ratio is around 9.5 to 10. A price-to-income ratio of 10 means that the price of the dwelling is 10 times the household income and would have a direct impact on affordability depending on bank lending rates. Further investigation is required to determine why prices are driven to such a ratio before correcting.

The strength of correlation of the primary indicators for the previous boom 2001 – 2004 and the current boom 2011 – 2014 are compared in Table 6 below.

Table 6: Comparison of Strength of Correlation in Previous boom and current boom period

Indicator	**Previous Boom 2000 - 2004**	**Current Boom 2011 - 2014**
Population	very strong	strong
Interest Rate	moderate	moderate
Unemployment Rate	very weak	moderate
New Dwelling Approvals	moderate	moderate
Non-First Home Buyers	moderate	strong
Price-to-Income Ratio	very strong	very strong

With the exception of unemployment rates, most primary indicators from the previous boom period and current boom period produce very similar correlation coefficient strength values. Given the strength and consistency of the correlation coefficient values for both boom periods for the median price of single dwellings in Sydney, it may be possible to predict future periods boom periods using the indicators listed above.

CONCLUSIONS

This paper performed the correlation analysis of median prices for single dwellings in Sydney against six commonly identified primary indicators over six types of period from 1990 to 2014. The correlation coefficient was used to determine the strength of the relationship between median prices and each primary indicator.

The type of period had an impact on the correlation coefficient of various indicators. Boom periods which had the strongest positive correlation coefficient indicators, followed by long term period, and decline period (strong negative slope), while property cycle period and stable period had the weakest correlation coefficient indicators.

Population moves consistently from moderate to very strong positive with median prices except for the decline period. This is expected that population is a primary driver of demand for residential properties. The indicator of Bank lending rates provides a consistent correlation at long term, booming and decline periods, but weak correlation in stable and cycle period. The indicator of unemployment rates is the most unreliable correlation to median price.

The indicator of new dwelling approvals provides a moderate correlation in long term, boom and decline periods, but unreliable correlation for stable and cycle periods. It is noticed that the short run demand – supply movement holds true for price boom periods due to supply inelasticity in the short run.

The indicator of non-first home buyers provides a reliable moderate to strong correlation during boom periods. This shows that the participation rate of non-first home buyers increase during price booms whereas first home buyers decrease. During price declines the participation rate of first home buyers increases whereas the non-first home buyers remains consistent. It could be inferred from the analysis of these periods that non-first home buyers drive up prices during boom periods whereas first home buyers create price floors during price declines.

The price-to-income ratio correlation coefficient values are strong to very strong for all long term, boom and decline periods, except the stable period. This is expected as the price-to-income ratio is a function of dwelling price. A review of price-to-income ratio trends found that prices of single dwellings begin to correct once the price-to-income ratio reaches the value 9.50 – 10. Further investigation is warranted to determine why prices reach such ratio levels then correct. This implies that some level of price ceiling levels could be predicted using the price-to-income indicator in conjunction with bank lending rates as a function of affordability.

A comparison of primary indicators for the boom periods in 2000 – 2004 and 2011 – 2014 were performed. It was found that except for the unemployment rates, all primary indicators were very similar in terms of correlation coefficient strength. These primary indicators may be used to predict future price boom periods.

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APPENDIX A

Population

NSW population data was used against Sydney Region median price data. NSW population data is based on census data from 1996, 2001, 2006 and 2011 and estimated accordingly for the years in between. The data allows for naturals increases, net interstate and overseas migration.

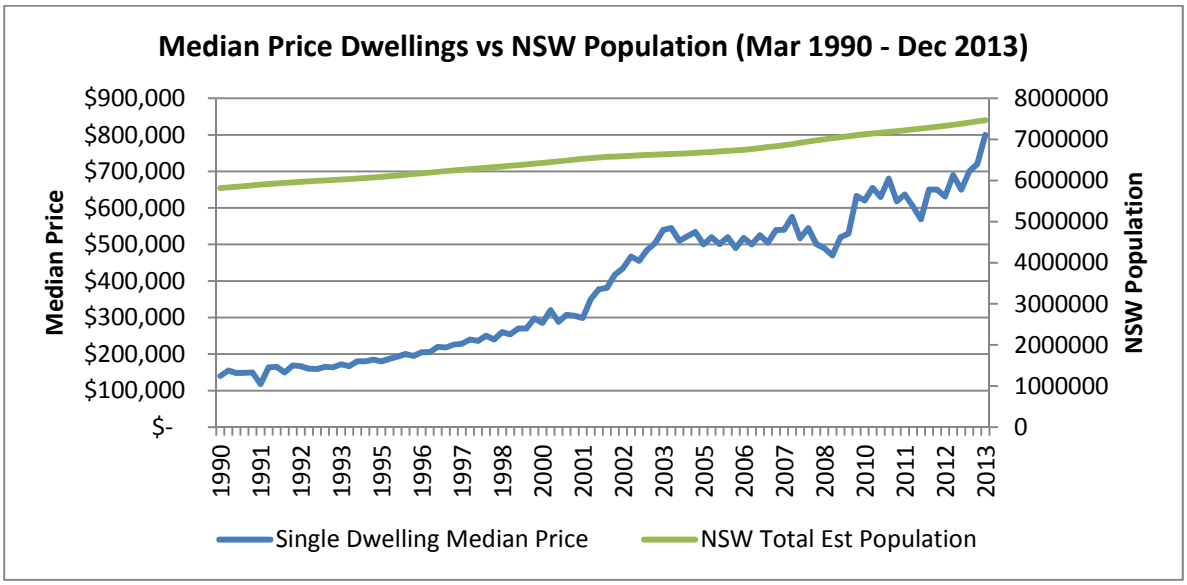

Figure 2: Long term price and population (source: ABS 2014a, RP Data 2014)

Bank Lending Rate

The bank lending rates used in the analysis is the standard variable lending rate offered by banks for housing loans for owner occupiers and in most cases to investment housing purposes. The data is issued by the Reserve Bank of Australia.

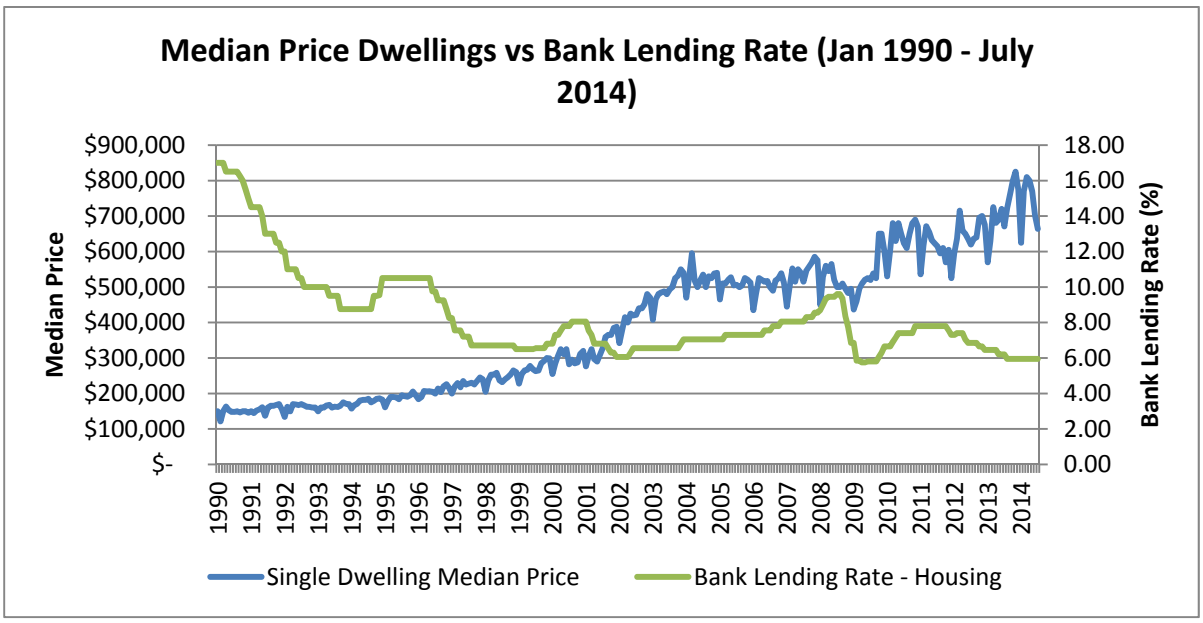

Figure 3: Long term period price and bank lending rate (source: RBA 2014, RP Data 2014)

Unemployment Rate

The data used for unemployment is for the state of New South Wales and is the total unemployment rate for all persons. The data used has not been seasonally adjusted.

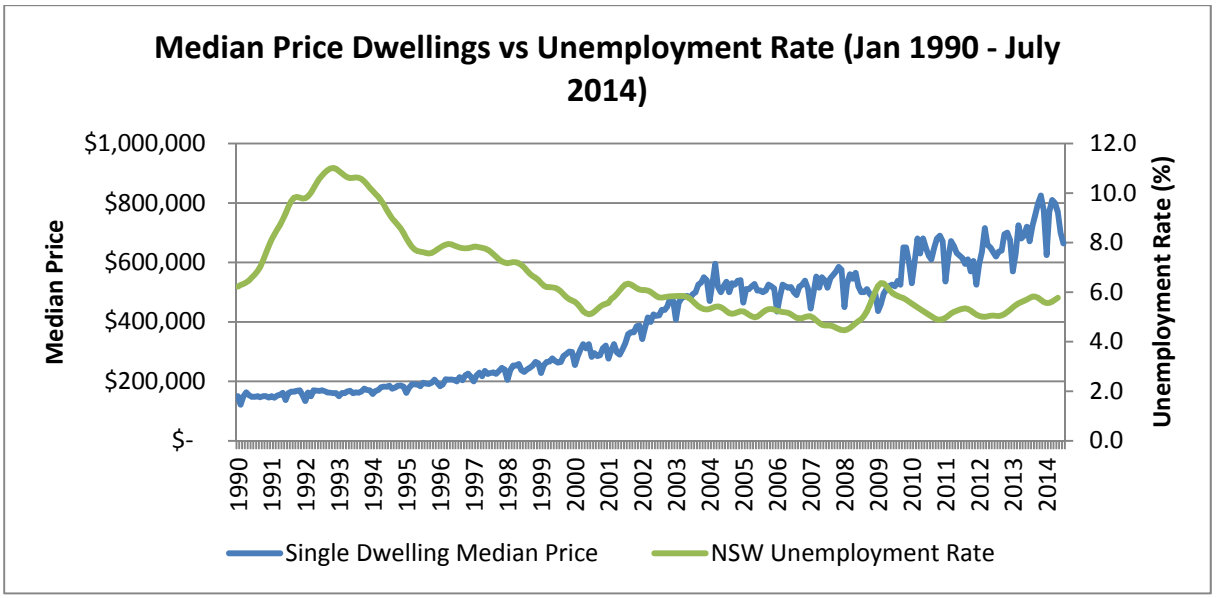

Figure 4: Long term period price and NSW unemployment rate (source: ABS 2014b, RP Data 2014)

New Dwelling Approvals

Data on dwelling commencements were available; however it was based on samples with varying standard errors. As such dwelling approvals data was used as it is based on data gathered from approval bodies i.e. Local councils and Principal Certifying Authorities. It is acknowledged that not all dwelling approvals result in construction of a dwelling. No adjustments were made for such occurrences. Data includes approval for new dwellings only and does not include approvals for refurbishment.

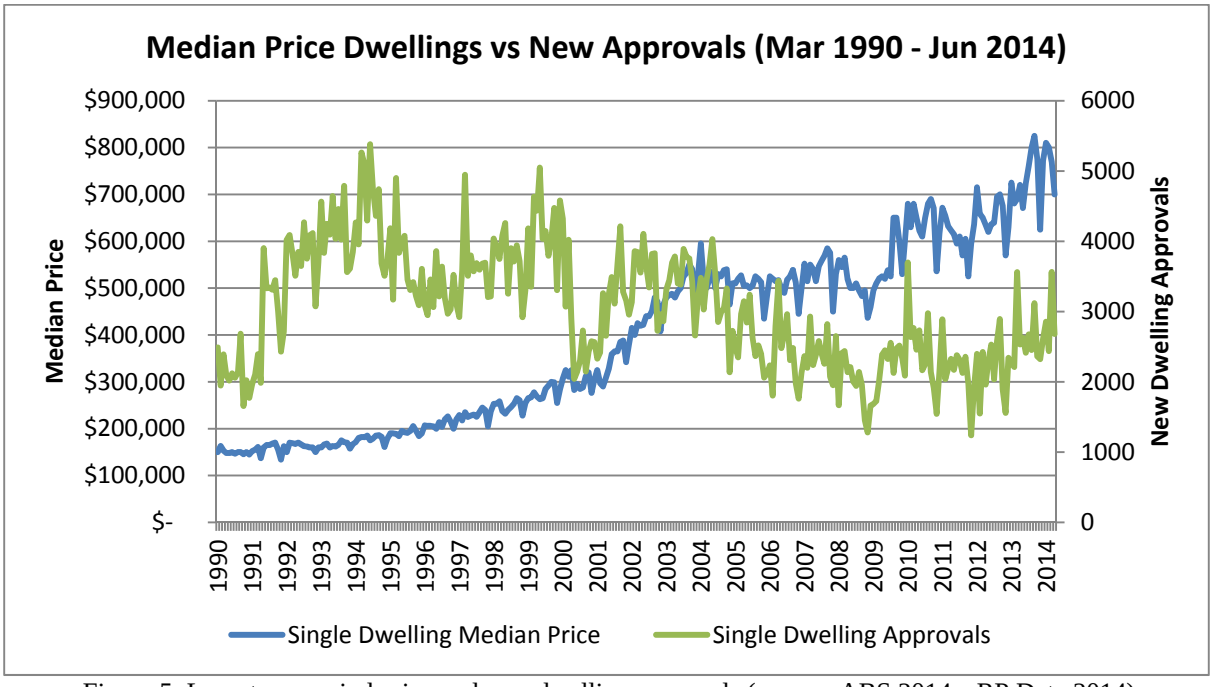

Figure 5: Long term period price and new dwelling approvals (source: ABS 2014c, RP Data 2014)

First vs Non First Home Buyers

The relationship between the number of non-first home against first home buyers dwelling purchases are based on the number financing agreements entered into.

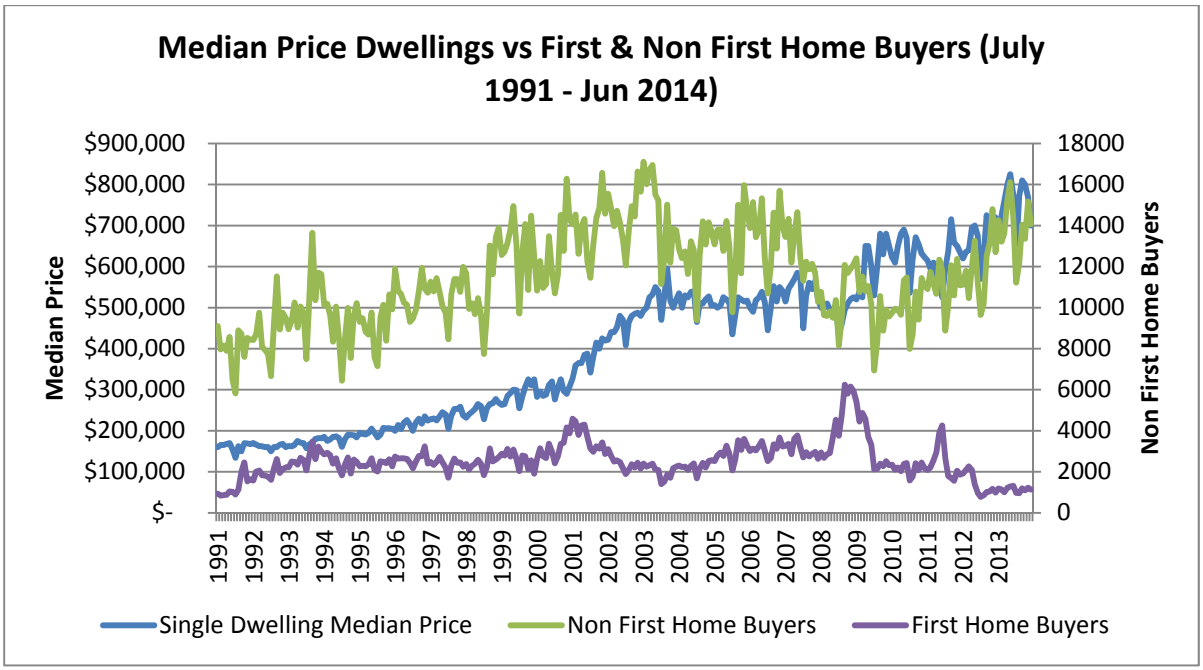

Figure 6: Long term period price and first and non-first home buyer type (source: ABS 2014d, RP Data 2014)

Median Price to Median Household Income Ratio

Weekly household income data purchased from Real Estate Institute of Australia (REIA) and was converted to an annual figure. The median dwelling price was divided by the annualised household income to determine the price – income ratio.

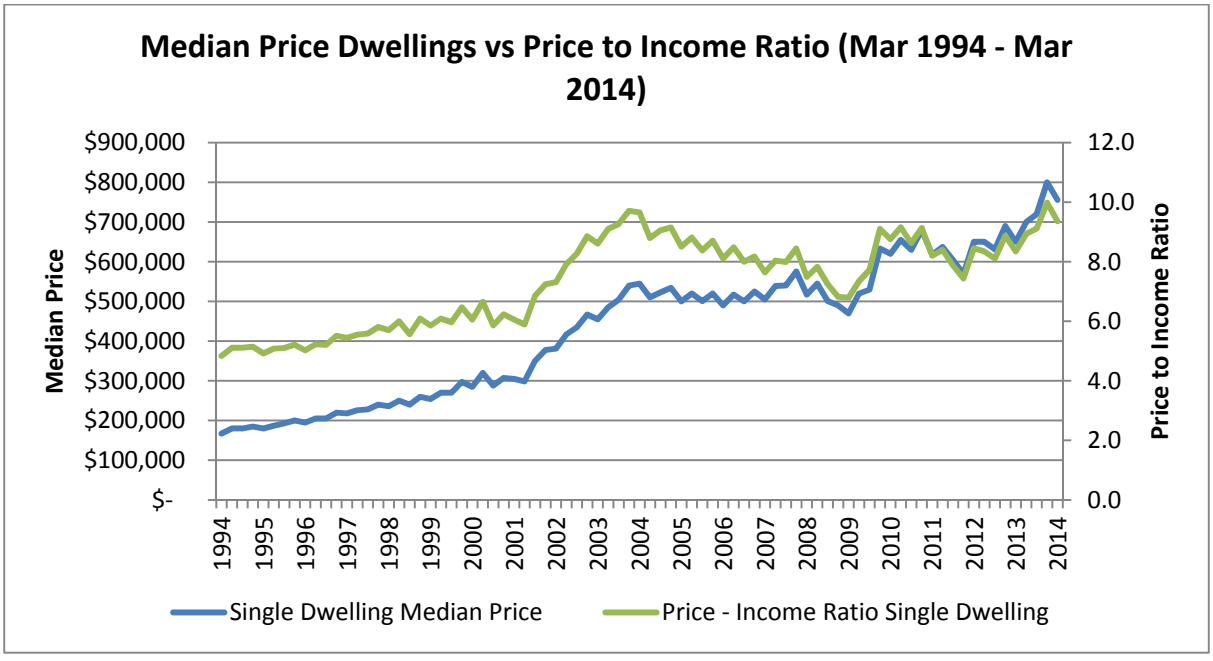

Figure 7: Long term period price to income ratio (source: REIA 2014, RP Data 2014)