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# Measuring Price Change for New Dwellings

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## Introduction

The Australian housing market has experienced strong price growth over the last decade. The most recent house price cycle has raised questions about the nature and drivers of the rate of price change recently observed. One particular area of interest is the market for new dwellings.

This paper aims to take a closer look at the rate of price change for housing by constructing a price index for new dwellings utilising data linkage techniques. Data linking involves creating connections between different sets of information that relate to the same unit (such as individuals and households) from different sources. With respect to new dwellings, links are created between a housing transactions dataset and a building approvals administrative dataset through the use of a common address variable. By linking these datasets, previously unidentifiable new dwellings transactions are captured and then used to construct a price index.

The importance of new housing supply is a critical factor that affects the level of inflationary pressure in the market. In light of the high demand for housing experienced in Australia as well as the supply constraints inherent in bringing new housing to the market, a new price measure could yield some insights into the price cycle. In constructing new dwellings price indexes, some interesting measurement considerations have also been discovered.

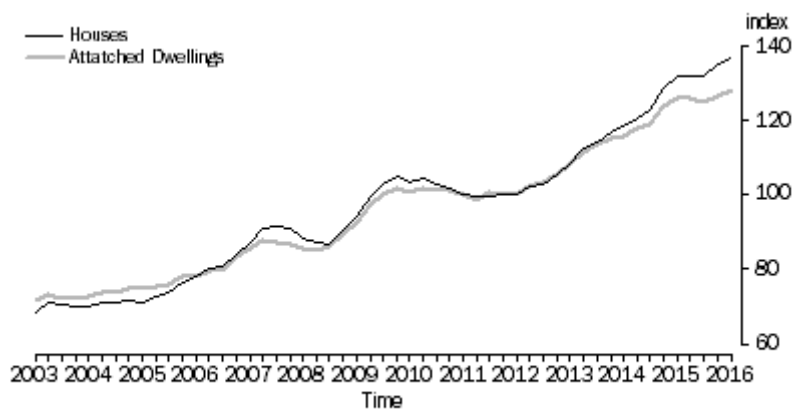
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## Recent history

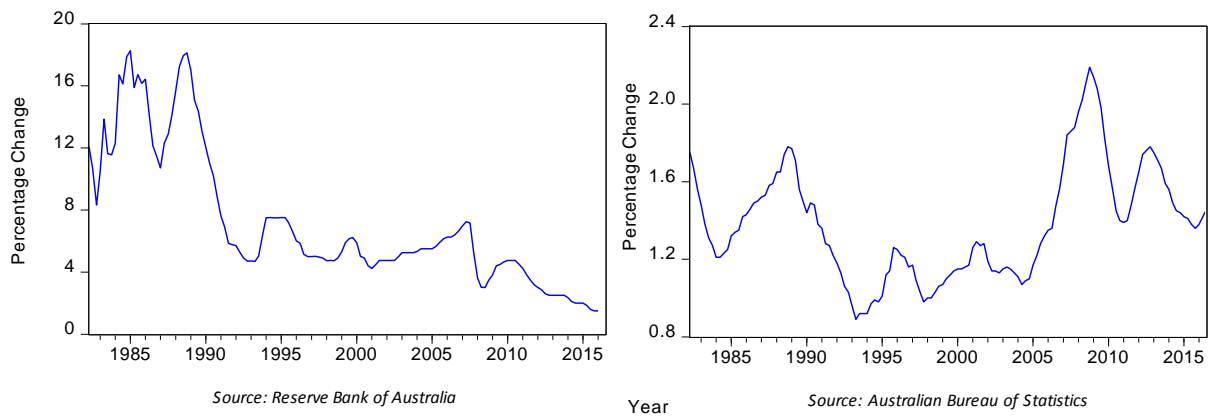
It is well documented that Australian housing prices, particularly the markets for Sydney and Melbourne, have grown strongly in recent years. Australian housing prices have grown by 9.7% per year on average since 2012 and are 37% higher in the December quarter 2016 relative to the same point in 2012. Strong demand for housing has been supported by population growth, changing demographics such as a reduction in the average household size (lower housing utilization rate) over time, as well as low interest rates.

Figure 1: Residential Property Price Indexes, 8 Capital Cities



Source: ABS, Residential Property Price Indexes (cat. no. 6416.0)

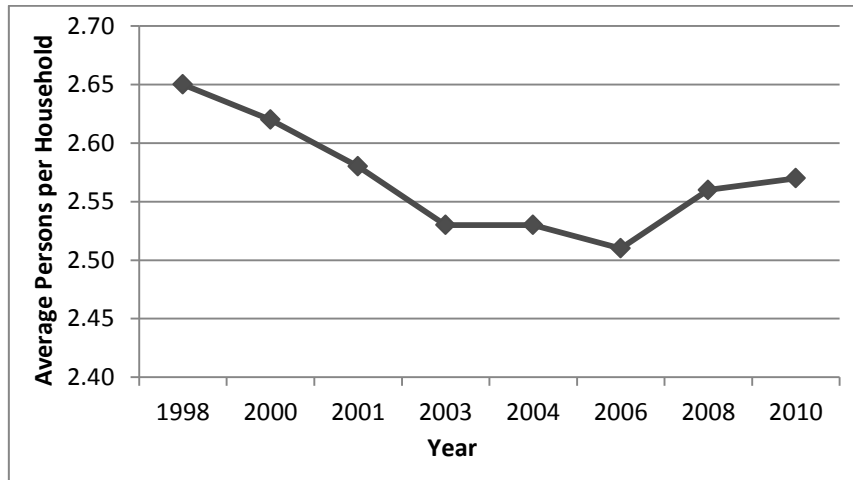
Figure 2: Cash Rate and Population Growth Rate, Australia



Source: Reserve Bank of Australia

Source: Australian Bureau of Statistics

Figure 3: Average Household Size, Australia



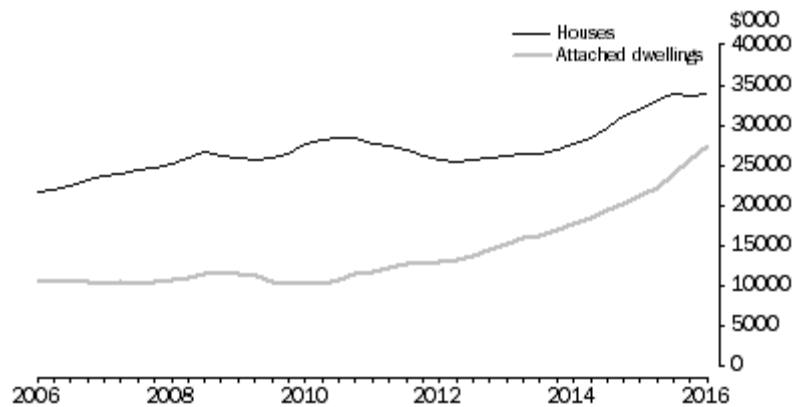
Source: Australian Bureau of Statistics

Considerable attention has been given to the responsiveness of supply as a major contributor to the extent of the price rise, both from established and new housing. Housing supply in Australia does not immediately respond to changes in demand and this is due to a variety of institutional factors as well as the illiquid nature of housing assets themselves. With respect to established dwellings, most people who purchase housing assets hold onto them for extended periods of time before selling. The average hold time for residential property as of 2015 was 10.5 years for houses and 8.7 years for apartments (CoreLogic, 2015). Unlike other assets such as equities, which are traded in large volumes on a daily basis, individuals in the housing market are less inclined to respond to shorter term fluctuations in prices. This suggests a level of price inelasticity from the established housing supply.

As a result of this inelasticity, there is a significant role for the construction of new housing to meet demand and this is especially so given that the primary driver of demand for housing is population growth (Kohler, van der Merwe, 2015). There are however, institutional barriers to supplying new housing to the market. To supply new housing is a complex process with multiple stages. The stages involved in constructing apartments (as illustrated by Shoory, 2016) for instance, involve purchasing a site and then submitting a development application to either the state government or local council. This application is then screened to ensure it meets zoning regulations and community appraisal. Once approved, developers will market the project in order to secure pre-sales to help finance the project. Following this, a building approval is obtained and then construction may commence. The typical apartment project construction time alone will take around one and a-half to two years to complete (ABS, 2016) and this, coupled with the entire approval process, results in a multiple year process to supply new housing to the market. During periods of high demand, the lag in new housing supply response can magnify pricing pressures and this continues to be a key theme of the current price cycle (Stapledon, 2016).

In terms of the value of building activity, there has been a noticeable rise since 2012. Of particular note is the market for attached dwellings such as apartments. As can be seen in Figure 4, an increasing proportion of recent residential building activity is from rises in attached dwellings, and in particular, from high density housing, which now accounts for up to one-third of all residential building approvals since 2010 (RBA Statement on Monetary Policy 2017, ABS 2016).

Figure 4: Value of building activity, Australia



Source: Building Activity, Australia (cat. no. 8752.0), table 21

### Price determining characteristics of new and established housing

Given the aim of constructing price indexes for new dwellings, it is of interest how the price behaviour of these series compares to the currently produced Residential Property Price Indexes (RPPI, cat. no. 6416.0). The RPPI measures price change for houses and attached dwellings for each of Australia's eight capital cities and comprises mainly established dwellings. To help guide and inform our expectations on what the new dwellings price indexes should look like (i.e. whether they would move the same or at different rates), it is useful to analyse the broad price determining features of housing across both dwelling types (new and established). Urban Economic Theory allows us to understand three broad drivers of housing value. The value of a dwelling comprises one part land and one part structure, and it is the economic agents who act upon these (through their preferences) that determines price.

#### 1. Value of Land

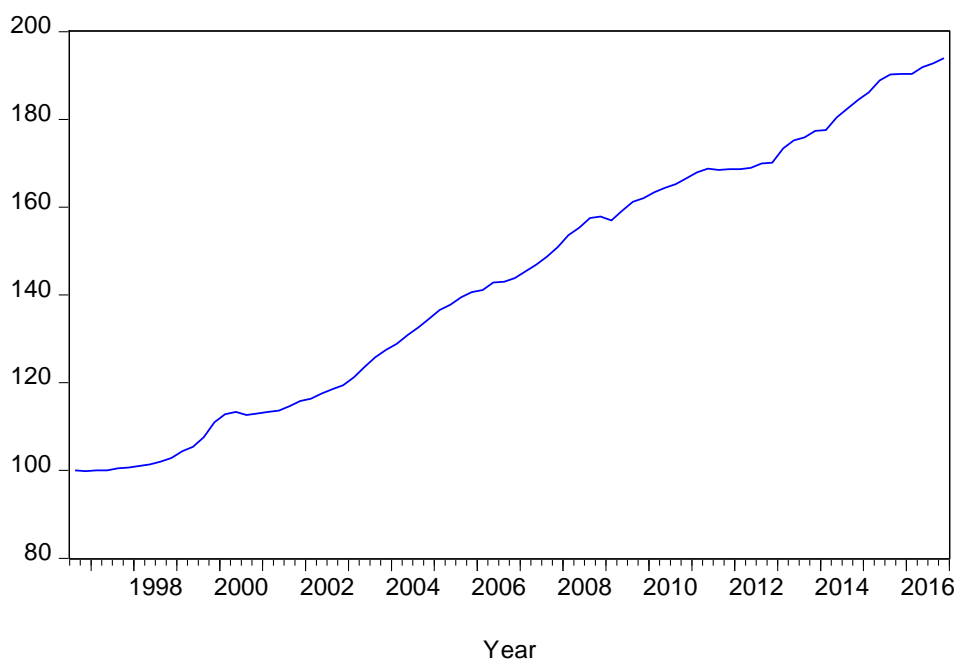
Land is the primary driver of housing value in Australia, especially major cities such as Sydney and Melbourne. It is generally well recognised that various geographic locations across a city differ in terms of desirability and value. A formal economic explanation by Urban Theory states that different geographic areas exhibit a variety of amenities, which depending on how sought after they are, will result in a premium on the price of land obtainable on those regions. In general, the value of land is higher the closer it is towards the centre or "central place" of a city. In Australian cities, this is typically the Central Business District (CBD), the heart of the city where a large degree of employment and consumer activity takes place. Kullish, Richards and Gillitzer (2011) find a positive association between housing prices and proximity to the CBD for Australian cities and attribute this relationship to the premium associated with lower transport costs the closer land is to the centre. Over time, the value of land increases as a result of scarcity, and this is what drives the evolution of cities to grow outwards from the centre to regions further away.

In terms of the price behaviours of new and established dwellings, we would expect the land component to drive price change at the same rate given that the amenities associated with land (distance from the CBD, transport infrastructure etc....) are largely independent of the type of structure attached to it. Travel distance from the CBD for instance will not be affected whether the dwelling is new or established. Therefore, in general, residential property as a function of geographic location may differ in terms of the price *levels* but not in terms of price *change*.

## 2. Value of Structure

With respect to the structure component of housing, there are some differences between new and established dwellings, although these differences do not necessarily imply a divergence in price behaviour. Established housing (with the exception of renovations and improvements) generally depreciates in quality over time. This is because of the fact that the structure component of housing is consumed over the property's life cycle. New dwellings on the other hand are by definition "new" only for a short period of time before being classed as an established dwelling. In terms of the price movements, we would need to compare the constant quality price change of an established structure to the price change of a new structure. One way to gauge the price change of new structures is to examine construction costs.

Figure 5: Output of house construction, Australia (Index)



From the data on output of the house construction, prices exhibit a clear upward trend. Whilst this may be an imperfect measure of the true price of the structure component of a new dwelling, as a broad indicator it suggests higher construction costs and therefore higher prices for new dwelling structures over time.

As for established dwelling structures, whilst we do not currently have a measure for prices, we do expect price to move in line with new dwellings. If new housing becomes more expensive then the substitution effect should also drive higher demand for established dwellings. For a given geographic location, buyers will attempt to purchase housing at the minimum cost and, through their collective effort, will bid up prices for all dwellings (new and established) in the area. This simple no-arbitrage condition ensures that prices will move together, at least in the long run. It might be possible that short run differences arise due to inherent market inefficiency, but we would not expect these to persist or lead to differences in trend or cycle.

### 3. Preferences and behaviour of buyers

The final element driving prices is the preferences and behaviour of the market participants themselves. Ultimately, demand is determined by the preferences and behaviours of market participants. As we have observed, one of the major drivers of price change has been population growth as well as a demographic shift towards smaller household sizes. Whilst population growth on average demands more housing, the demographic shift in this population might lead to a preference for specific dwelling types such as high density apartments (which as stated, are becoming a growing proportion of residential building activity). If this is the case, then the prices of new dwellings may not move at the same rate as established dwellings given that new and established dwellings are imperfect substitutes. Imperfect substitutability means that established dwellings do not exactly meet the housing needs of a growing subset of the population and so the substitution effect described earlier would not lead to the same spill-over in price inflation to the established dwellings market.

Furthermore, there are some institutional factors which directly separate buyers between markets. Overseas buyers by law may only purchase new (off-the-plan) residential property in Australia. This was implemented so as to reduce housing price inflation and incentivise new supply. This is perhaps a stronger case of imperfect substitutability, as overseas buyers literally cannot substitute between dwelling types.

## **Evidence – A price index for new dwellings**

In order to gain proper insight into the price behaviour of new dwellings a new series must be created. To date, no such series exists and the only measure on Australian house prices published by the ABS is the Residential Property Price Indexes (RPPI). The RPPI utilises housing transactions data to measure price change. This dataset includes individual records of house and attached dwellings transactions at the address level throughout Australia. The new dwellings price index utilises this dataset, although there is no indication as to the age of the dwelling sold. Using this dataset alone therefore does not allow us to identify and measure price change strictly for “new” dwellings.

### **Data Linkage**

In order to create a price index for new dwellings, a new dataset must be created which contains transactions for new dwellings only. Given that the housing transactions dataset utilised by RPPI does not specify whether a transaction was for a new dwelling, a second data source is utilised and this is an administrative dataset for buildings approvals. The buildings approval dataset records all residential building approvals lodged with a relevant building authority (e.g. state government or local council as mentioned earlier) in Australia. These data specify individual records at the address level, and it is this level of detail which allows us to identify new dwellings transactions through the use of data linkage. This is possible because both datasets have a common address variable and so information corresponding to a given address from each dataset can be tethered.

The aim is to match individual housing transactions at the address level to a corresponding building approval record for the same address in the recent past. In order to identify whether a dwelling is “new”, it is important to specify what new means in this context. Put simply, a dwelling transaction will be identified as new if it is matched to a building approval record for the same address 6 to 48 months in the past. The assumption is if we observe a housing transaction as well as the fact that this dwelling was recently approved to be built, it must have been constructed within a short time of that approval and is new. The reason for 4 year time window is to account for the time it takes for residential property (especially apartment blocks) to be built and then sold following approval. Approvals fewer than 6 months are not linked given that we do not reasonably expect a new structure to be created and sold in such a short time period and limiting matches from this time period should reduce spurious results.

With this definition of new dwellings, individual observations from each dataset are matched using the address variable and the housing transactions which satisfy this definition are then identified and isolated to create a new dataset. With this dataset we are then able to compute a quarterly price index, much like the current RPPI produced by the ABS except for new houses and apartments only.

## Match rate

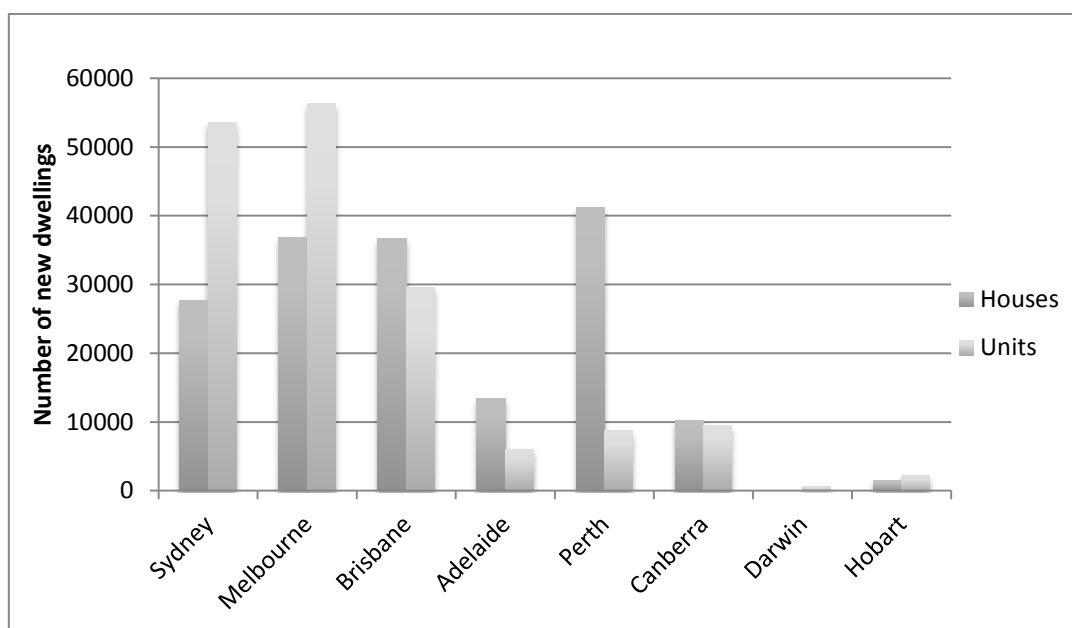
The housing transactions dataset contains approximately 8 million observations ranging 1970 -2017. Similarly, the buildings approval dataset contains approximately 1.6 million observations ranging from the year 2000-2017. With the definition of a 4 year lag in building approval applied to the data, we can reliably yield matches to produce a series spanning 2003-2016

So far, our preliminary results have yielded approximately 340,000 matches. According to the number of residential buildings approvals (1.4 million after filtering for duplicates); this would suggest a match rate of approximately 25% (meaning 25% of all buildings approvals are mapped to a relevant transaction at a later date). To say that spanning a 15 year time period, that only 340,000 new dwellings were sold is most likely a vast understatement of the truth. We must consider however, that a great many developers build apartment blocks with the intention of supplying new housing to the rental market (hence the slow growth in rents over recent years and low housing yields). Secondly, not all buildings approvals actually translate to buildings completions. 95% of all approvals for new houses result in a completed structure, whilst this number is only 85% for apartments (CoreLogic, 2015). Additionally, our matching method does not account for pre-sales. As mentioned earlier, apartments are generally financed through presales. If these pre-sales occur prior to building approval then our current matching method will not detect them given that we specifically match housing transactions to past buildings approvals. To detect presales, we would need to map a transaction to a future building approval, and then decide what reference period the transaction belongs to given that the dwelling would not exist at the time of sale.

The following graph represents the match counts over each capital city and the results are definitely asymmetric. Most new dwellings are constructed and sold in the most popular of cities, Sydney and Melbourne. This is particularly so for apartments given that Sydney and Melbourne are more highly populated and therefore require high density housing. Perth also has a high amount of new houses relative to other cities and this is as a result of the recent mining boom in Australia. High levels of mining investment resulted in a large population shift to Perth, leading to increased demand for housing.



Figure 6: Matched transactions by city



### Index compilation method

The compilation method of the new dwellings price indexes is similar to the method employed by the RPPI produced by the ABS. Like the RPPI, the new dwellings price indexes measures price change for houses and attached dwellings for each of eight Greater Capital City Statistical Areas. A house is defined as a free standing, detached residential dwelling on its own block of land regardless of age, i.e. including new houses as well as second-hand houses. Likewise, an attached dwelling is defined as a dwelling which shares a structural component with one or more other buildings (RPPI: Concepts, Sources and Methods, 2014).

The city level indexes employ stratification techniques in order to subdivide housing transactions across different geographic locations into homogeneous cells so as to better account for changes in the quality mix of the samples over time and maintain homogeneity of the price determining characteristics of dwellings. The strata used in the RPPI are defined using a mix of socio-economic indicators from the Census of Population and Housing (including income levels) as well as the similarity of housing prices in each region. Given that this research is still in a preliminary stage, the new dwellings price indexes have adopted the same stratification pattern as the RPPI due to ease of use.

To calculate the capital city indexes, a price relative is calculated for each stratum. These price relatives are calculated by using the median prices of each stratum. There are some differences between the RPPI method and the method used to compile the new dwellings indexes. The RPPI calculates price relatives for each stratum and then uses these relatives to derive a current period value of the dwelling stock (by price updating quantities from the weight reference period):

$$V_t^s = \sum \left( \frac{p_t^s}{p_{t-1}^s} \right) V_{t-1}^s$$

Where  $V_t^s$  represents the value of the dwelling stock in time  $t$  for stratum  $s$  and  $p_t^s$  is the median price of the stratum. These values are then aggregated in order to derive a city level price relative:

$$I_t = \left( \frac{v_t}{v_0} \right) I_0$$

Where  $I_t$  is the city level price relative,  $v_t$  and  $v_0$  are the city level value aggregates in time  $t$  and the price reference period and  $I_0$  is the price index number in the price reference period. (RPPI: Concepts, Sources and Methods, 2014).

By construction, the city level price index is a weighted average of the movements of each stratum. The new dwellings price indexes do not employ this technique, however. The weighting patterns implied by the value of the dwelling stock of each stratum are not necessarily applicable to new dwellings. This is due to the fact that a new dwelling is only new for a limited period of time and so it is not possible to define a stock of new dwellings given that it is a flow measure by nature. Ideally, to compile new dwellings price indexes, weights would be compiled from value shares based on the number of new dwellings transactions for a given time period (e.g. one year), and new value shares would be re-calculated every year henceforth to take into account the shift in the flow of new housing development between different geographic areas. This method is possible with the data linkage approach we have taken to estimate these price indexes, although this exercise will be pursued once a higher match yield is obtained to ensure robustness.

In developing a weighting pattern, there is the added challenge of observing a low number of transactions in certain regions. This is particularly so for attached dwellings such as apartments, because new apartment blocks take the form of large projects, meaning that the volume is clustered to certain geographic locations where building development takes place. Until these challenges are overcome, the new dwellings price indexes apply equal weights to all of the strata as a preliminary measure.

## Results

Using the available data from the matching process, we are able to produce a set of preliminary price indexes for most of the Australian capital cities. The graphs below plot the new dwellings price series against the published Residential Property Price Indexes (RPPIs). One thing to note is that this is not a true comparison of new dwellings prices to established dwellings prices as the RPPI series includes both. A companion series for established dwellings must be computed in order to verify any true differences between the dwelling types, however this will be produced after the match rate for new dwellings is increased such that we can safely exclude the majority of new dwellings from the transactions dataset. The RPPI series is predominantly established dwellings and so for a preliminary analysis this series will suit our purposes as a general indicator of how appropriate the new indexes look.

Figure 7: Sydney house prices (Index)

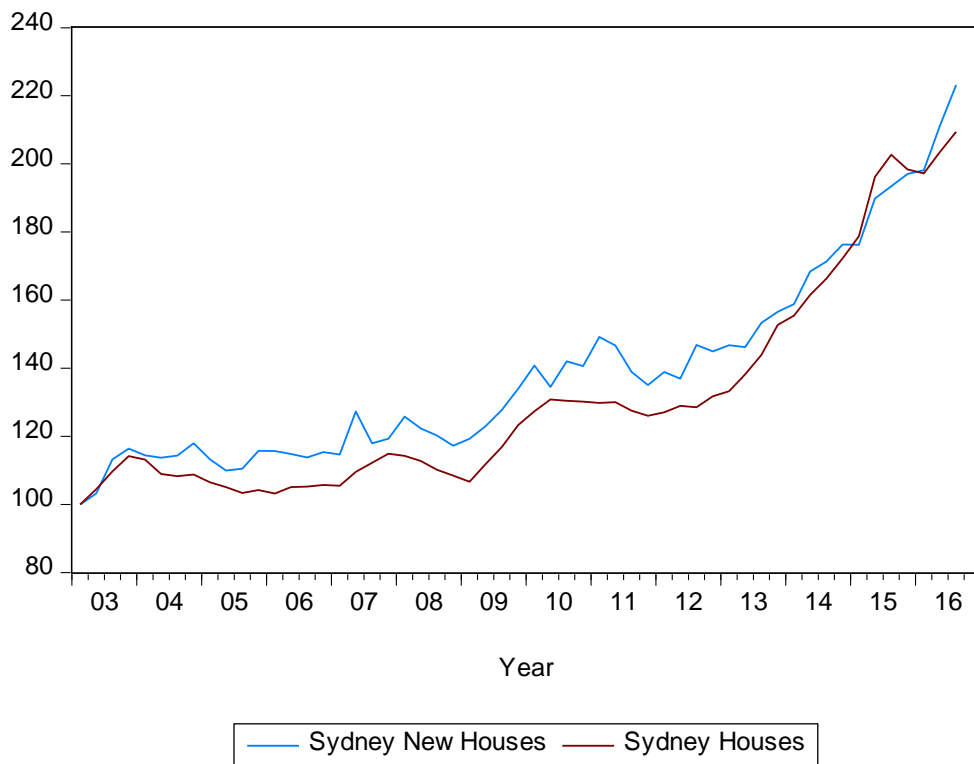


Figure 8: Melbourne house prices (Index)

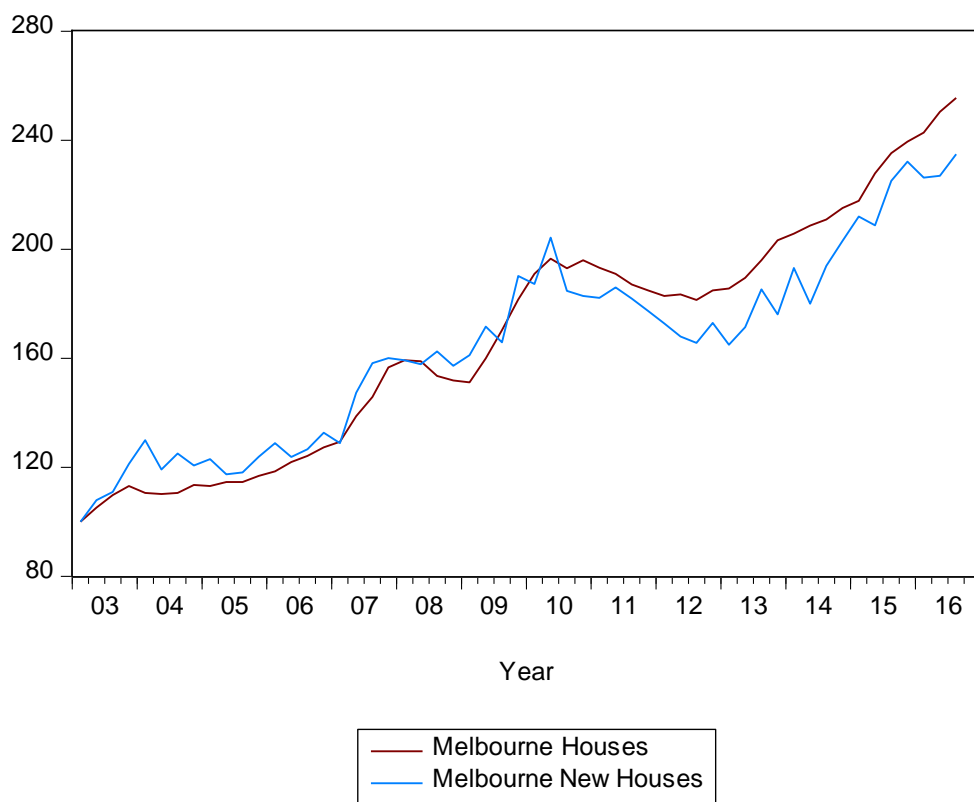
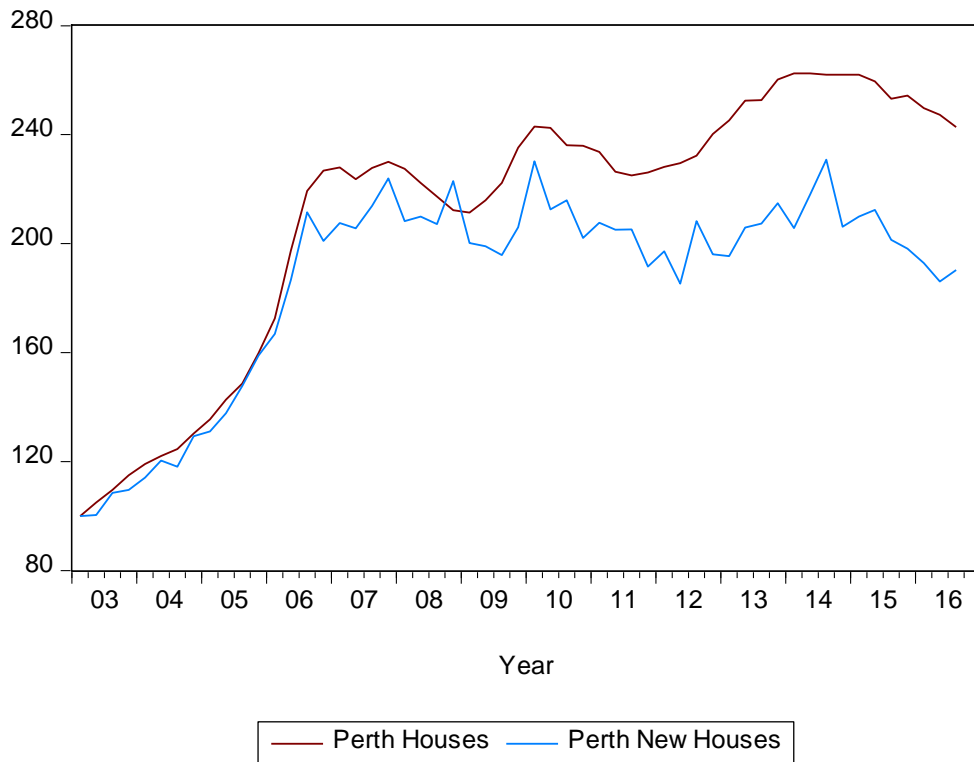


Figure 9: Perth house prices (Index)



New house prices appear to track the RPPI counterparts in both trend and cycle. The main cities to analyse are Sydney, Melbourne and Perth, all of which have active markets and are generally market leaders for all of Australia. The new dwellings price indexes are noticeably more volatile and this is to be expected given that the new dwellings indexes does not account for outliers like the RPPI and uses the data as is. So far this evidence suggests that there is no tangible difference in the growth rates of prices for new and established dwellings.

Figure 10: Sydney attached dwellings/apartment prices (Index)

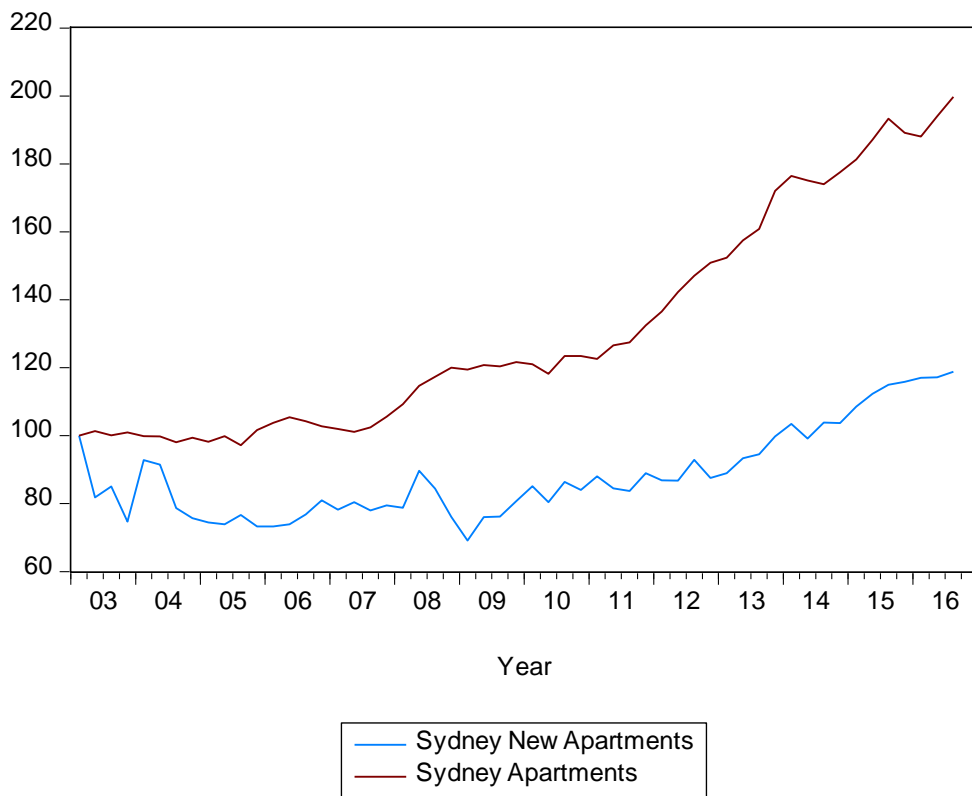
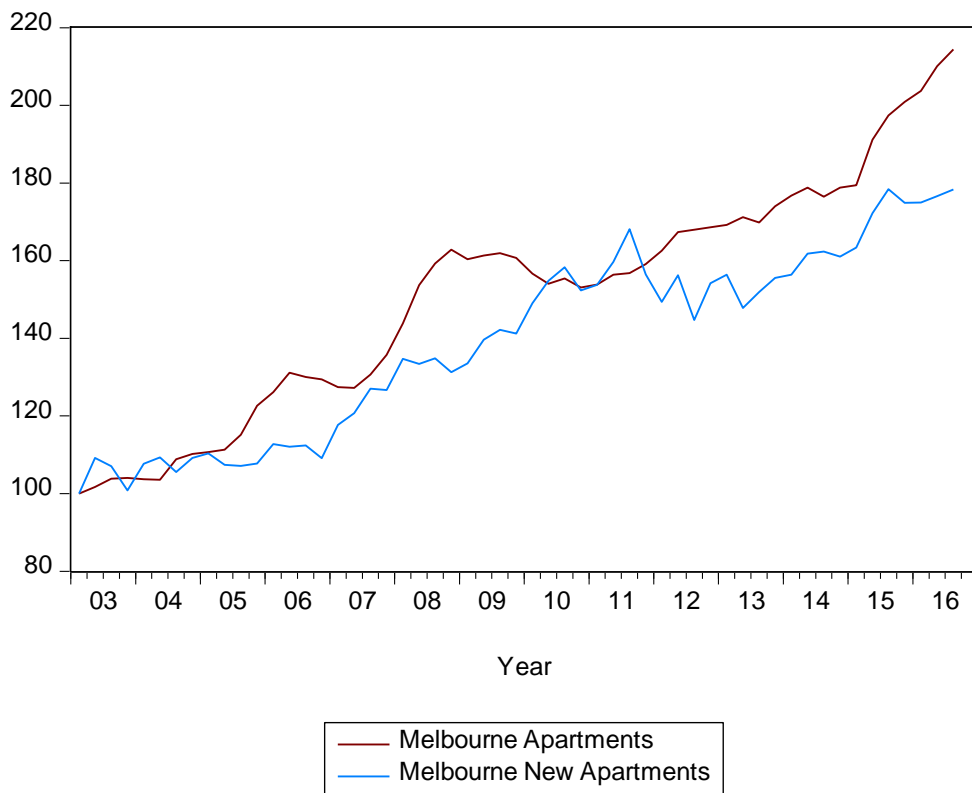


Figure 11: Melbourne attached dwellings/apartment prices (Index)



The comparison of new attached dwellings to the RPPI counterparts is more interesting. The series do not align as well and this is most noticeable for the Sydney market. From 2010 onwards, the Sydney RPPI grew strongly whilst the new attached dwellings series has grown at a more moderate pace. At first impression this would suggest that new attached dwellings are growing more slowly than established dwellings (as estimated by the RPPI). Upon more careful consideration however, the economics of this scenario do not make sense to allow for such behaviour. The arguments we have made thus far would suggest that under usual circumstances, the prices of land and the change in the value of structure for both new and established dwellings should not allow for any noticeable protracted periods of departure. Similarly, if there were a situation where new and established dwellings were for some reason not perfect substitutes, then in the face of high population growth and a demographic shift towards smaller household sizes and high density housing, we would expect new dwellings prices to have risen by as much if not faster than established dwellings.

### **Measurement issues**

The fact that new apartment prices, as indicated by our preliminary series, grow at a slower rate than established dwellings prices signals that this is mainly a result of measurement issues of which there are numerous to consider.

1. Lack of weights and compositional shift:

As mentioned previously, the indexes should be weighted by value shares derived from the number of new dwellings transactions for a given time period and frequently updated to take into account shifts in new building development across different geographic areas of a city. Given that these are preliminary results, no such weighting scheme has been developed. The absence of weights would definitely skew the profiles of the price series and more particularly so for attached dwellings such as apartments. As earlier stated, the definition of a new dwelling is time dependent and so for apartments these take the form of large development projects. The volume of new apartments is therefore clustered in certain regions over time.

There is evidence that across different geographic areas of a city, market leaders may arise. These leading geographic areas respond to changes in conditions first and may experience stronger price growth than the rest of the market in the short run (Signorelli, 2014). Over time, other regions respond to eliminate these differentials in the growth rates as an equilibrium condition. With respect to measurement error, by not adequately representing market leaders with proper weights, the index will be downward biased in every time period. This is due to the fact that less significant, non-leading regions' price growth rates always respond with a lag to those parts of the market in which most market activity is taking place. This feature not as evident in house prices given that new supply is not in the form of large high-density projects and would therefore be more evenly distributed across geographic location (less prone to compositional shift).

## 2. Not accounting for changes in quality:

Over time, the quality of new dwellings is expected to improve. The superior housing services offered by new dwellings was therefore the main argument of why new housing might not be perfectly substitutable compared to a large portion of the established dwelling stock. Unfortunately, this new dwellings price index has not been able to account for quality change at the current stage. This has measurement implications for the attached dwellings series in particular. A key feature of this housing cycle has been a trend towards higher density housing in the form of apartments. One shortcoming of this exercise is not yet being able to quantify the change in housing value as a proportion to the change in the housing size. As a result, over the past decade apartments, whilst going up in price, are becoming smaller. On a constant quality basis therefore, the price paid should actually be higher given that more is being paid for less space. Not being able to account for this change in quality would also lead to downward bias in the new apartments series.

## 3. The RPPI is not a perfect comparison tool:

Fundamentally we are comparing a new dwellings series to a series which incorporates both new and established dwellings. More severely however is the fact that the corresponding series for each city is compositionally different to the new dwellings counterpart. Due to a smaller than desirable matching rate, not all strata were well sampled enough to compile a viable price index. Strata which had insufficient observations below the threshold of 800 were not included in the index. The table below lists the number of strata in each city and the proportion included in each index.

Table 1: Strata utilisation rates for each city level index

Strata Utilisation Rate	Sydney	Melbourne	Brisbane	Adelaide	Perth	Canberra	Darwin	Hobart
Houses	61%	74%	69%	54%	75%	40%	0%	0%
Apartments	75%	77%	78%	25%	40%	43%	0%	25%

Compositional differences in the new dwellings and RPPI series means that the observed differences may not be as pronounced if all of the strata were included in the comparison.

#### 4. Insufficient sample:

Further to the point above, more data is needed to ensure a robust price measure. Not only is there not enough of a distribution of data over all of the strata but also not enough data in total. 340,000 observations is a fairly modest sample. Whilst not all buildings approvals necessarily translate to completions and then sales, recent history indicates the need for a match rate higher than 25%. As discussed previously, pre-sales are not represented in the sample due to the timing challenges associated with detecting them. Transactions that represent pre-sales have not yet been mapped to corresponding building approval records given that the approvals most likely take place after the transaction was observed.

The matching process itself relied on address names (string variables) which are highly non-standard. It is possible that many would be matches were not linked due to formatting differences in the address variables, leaving them undetected. One option to improve this method going forward is to use geo-coding. Geo-coding involves utilising an Australian Government maintained database of geospatial data to assign unique IDs to individual street addresses. This would standardise addresses across both the transactions and approvals dataset and possibly increase the detection rate. Ultimately the results presented in this paper are preliminary and only offer a cursory snapshot into these complex markets.

### **Conclusion**

In summary, the purpose of this exercise was to create a price measure for new dwellings prices in order to gain some insight into the housing market and the current price cycle. Economic theory leads us to believe that the forces driving housing prices, namely the value of land and structure, are the same for both dwelling classes. The one dimension that we hypothesised might lead to different price behaviour was if the preferences and behaviour of market participants did not readily permit the substitution of demand from new housing to established housing. The resulting price indexes provided a variety of results. The house price indexes for Sydney and Melbourne in particular tracked the RPPI quite well in both trend and cycle. These results supported our earlier expectations that new and established dwellings prices move in the same direction due to similarity of the price determining characteristics (land and structure).

The price series for attached dwellings were contrary to earlier expectations and in particular highlighted many measurement challenges. The attached dwellings series for Sydney showed weaker price growth over time compared to the RPPI series. From the results we can postulate the market for attached dwellings (particularly apartments) is more prone to compositional shift and vast quality change. Without adequate weighting patterns and quality adjustment techniques, the new attached dwellings price index appears severely downward biased. These measurement challenges were not as evident in the houses series given that new houses do not often take the form of large developer projects and volume may therefore be more evenly distributed across geographic location and less prone to compositional shift.



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