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ABSTRACT

Housing affordability has become a major policy issue in many countries across the world since the rapid inflation of house prices. This paper empirically investigates how monetary policies affect housing affordability in Australia from 1998 to 2009. Three primary variables associated with the housing sector and monetary policy, which are money supply, interest rates and house prices, are studied for all eight capital cities in Australia in this research. Shocks of such variables are identified by a structural vector autoregression (SVAR) model with restrictions that are consistent with economic theoretical framework. Based upon the analysis using the structural decomposition of impulse response on quarterly data, it can be discovered that the monetary policy plays an active role in housing affordability via adjustments of money supply and interest rates during the observed period in Australia. The empirical results from this research may be used for decision makers to determine money supply and interest rates from the perspective of housing affordability.

Key words: money supply, interest rates, housing affordability, structural VAR.

INTRODUCTION

Housing affordability is currently considered as a sliding scale used to measure whether households in different income group still have enough income left over
to satisfy other basic needs such as medical care and healthy foods after they spend a specific percentage of their income on housing (Mostafa et al., 2006). In other words, housing affordability is a measurement for households’ abilities in satisfying basic living needs after paying housing consumption. Therefore, it is highly related to the changes of housing sector. Studies regarding housing have been presented in a lot of previous academic papers, some of which emphasise on determinants while others concentrate on market dynamics (Wilhelmsson, 2008).

This paper initiates an investigation which analyzes the political dynamics on a variable of property sector which is relevant to housing affordability in Australia. The research findings will be useful for making monetary policies in consideration with housing affordability in a country.

House price is a vital indicator of housing affordability as well as supply (construction) and demand sides of housing sector. An appreciation or depreciation of house prices may mean an increase or decline in housing affordability among households (Hui & Yue, 2006). Quigley (1999) claims that demand for houses can be viewed as a function of house prices, disposable incomes and a vector of exogenous variables, and housing supply is a function of prices and vacant new dwellings. Statistics of Australian Bureau of Statistics (ABS) illustrates that the house prices in Australia significantly increased in this recent decade (ABS, 2009). Although some researchers had paid attention to analysis of this increase within regional and demographic framework (Yates, 2002; Luo et al., 2007), little literature has been concerned with the empirical relation between monetary policy and property sector in Australia. Actually, monetary policy is an important tool which bridges governor and economic departments. In Australia, monetary policies are formulated and implemented by Reserve Bank of Australia (RBA) in accordance with Reserve Bank Act 1959 (RBA, 2007b), aiming to stabilize the currency, economic prosperity and people’s welfare by adjusting money supply and interest rates (RBA, 2007a).

The structure of this paper is laid out as follows: the first section is classified as an
introduction, and the second section is a literature review. Data and methodology will be presented in the section following the literature review. Finally, the SVAR econometric model will be applied to analyze the time-series quarterly data of the variables.

LITERATURE REVIEW

Monetary policy performs as an adjuster which helps to transit governmental interventions to economic activities (RBA, 2007a). As a result, monetary policy theoretically can affect supply of and demand for houses, suggesting that house price is positively related to money supply and negatively affected by interest rates (Elbourne, 2008). Firstly, this is because change of money supply will surely trigger an adjustment of interest rate and payment for interest represents a major part of cost of property purchase. Increase of interest rates can lead to a drop in demand for houses, which in turn depreciates house prices and vice versa. Secondly, housing markets could be taken as substitute for other markets of financial assets (Hui & Yue, 2006). If the return available from other financial assets increases owing to rise of interest rates, asset holders will transfer their portfolio from the assets of housing into the increasingly profitable assets. This behavior will lower house prices until the return from holding the different asset classes is equalized (Elbourne, 2008).

The responsiveness of house prices to shock of monetary policy has been described by some studies. Aoki et al. (2002) used a recursive VAR model to estimate the effect of monetary policy, and found that house prices decreased 0.8% after 50-basis-point shock of interest rates in the UK. Giuliodori (2005) also applied the VAR approach to examine the relations among British money market, GDP, consumption and real house price. He claimed that GDP, consumption and real house prices would fall up to 1.8% responding to a money-market shock. In addition, Iacoviello (2002) argued that house prices would correspondently go down following a tightening of money supply. In order to better understand the
transmission mechanism of monetary policy, Elbourne (2008) established a SVAR model to estimate the interactions of UK’s economic variables. According to the result of the approach employed, Elbourne discovered that dramatic fluctuation of real housing prices in the UK was able to be triggered by about 12-15% of the drop in consumption that followed a shock of money supply. Furthermore, as mentioned by Lastrapes (2002), positive shock of money supply resulted in an effective impact on real prices and short-run sales of owner-occupied houses in the US.

Housing supply also expresses an identifiable response after receiving a shock of monetary policy. Iacoviello and Minetti (2007) investigated the relation between interest rates and housing outputs utilizing a vector error correction model. They identified that positive shocks of interest rates lead to an approximate 0.25% fall of housing supply in the UK. Malpezzi and Maclennan (2001), however, proved this relation from a different angle. They estimated the long-run price elasticity of supply of new houses in the UK and the US during a period in which ‘regime shift’ was being operated. Depending upon the methodology used, they concluded that price elasticity with respect to housing supply in the UK in prewar was between 1 and 4, but in the postwar the values decreased to the interval between 0 and 4. Simultaneously in the US, this kind of elasticity was much higher, achieving the level from 4 to 10 and 6 to 13 respectively.

**METHODOLOGY AND DATA**

**Methodology**

The vector autoregression model was proposed by Sims (1980) to replace the simultaneous model. The principals of the VAR do not comprise a priori endogenous or exogenous, zero restrictions and strict economic theory (Charemza & Deadman, 1997). The reduced form VAR can be written as follows:

\[
Y_t = A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + \varepsilon_t, \quad t=1,2,3,\ldots,T \tag{1}
\]
where $Y_t$ stands for a vector with k dimensions; $A_p$ is the $p$-th $k \times k$ matrix; $Y_{t-p}$ is the $p$-th lagged variable articulating to $Y_t$; $\varepsilon_t$ is a vector of reduced form error and $A(L)$ is a finite polynomial. In spite of the advantages of the VAR, it has been criticized as ‘athoretical’ due to its ‘incredible’ identifying assumption (Cooley & Leroy, 1985). Moreover, from Equation (1), it is easily to know that the reduced form VAR can not reflect the contemporaneous relations among variables. In order to solve these problems, the structural VAR has been created and developed.

There is a hypothesis that matrix $A$ and matrix $B$ are two invertible matrixes, and let both sides of Equation (2) multiply the matrix $A$. Then a new equation is shown in Equation (3).

$$ A(A(L)Y = A\varepsilon_t \quad (3) $$

If the condition of $A\varepsilon_t = Bu_t$ can be fulfilled, the AB-model SVAR will be described in Equation (4).

$$ AA(L)Y = Bu_t \quad (4) $$

Here, $A$ is a $k \times k$ matrix with ones on the main diagonal; $A(L)$ is a finite polynomial; $Y_t$ is a $k$-dimension vector; $B$ is a symmetric matrix and $u_t$ is the vector of (orthogonalized) structural shocks. Every SVAR model in this study is the three-variable SVAR, which means that SVAR models in this paper contain three variables ($M_1$, INT, and HPI). As a result, the matrix $A$, vector $Y_t$ with $M_1$, INT and HPI, matrix $B$ and the vector $u_t$ are indicated as follows.

$$ A = \begin{pmatrix} 1 & -b_{12} & -b_{13} \\ -b_{21} & 1 & -b_{23} \\ -b_{31} & -b_{32} & 1 \end{pmatrix} \quad (5) $$
\[
Y_t = \begin{pmatrix}
M_t \\
INT_t \\
HPI_t
\end{pmatrix}
\]  
(6)

\[
B = \begin{pmatrix}
\gamma_{11} & 0 & 0 \\
0 & \gamma_{22} & 0 \\
0 & 0 & \gamma_{33}
\end{pmatrix}
\]  
(7)

\[
\mathbf{u}_t = \begin{pmatrix}
\mathbf{u}_{1t} \\
\mathbf{u}_{2t} \\
\mathbf{u}_{3t}
\end{pmatrix}
\]  
(8)

To make the SVAR be just identified restrictions for the matrix \(A\) and the matrix \(B\) must be placed. Herein short-run restrictions will be set up so as to avoid any potentially serious misspecification problems. Because of the issue that all SVAR models in this study are the one with three variable, three \([k*(k-1)/2=3*(3-1)/2]=3\] contemporaneous restrictions will be installed into the matrix \(A\). These restrictions are based on two hypotheses, namely the changes of money supply will not lead to a contemporaneous response of interest rates, and the increase or decrease of house price will not trigger contemporaneous movements of money supply and interest rates.

As a result, the contemporaneous response of the INT to the shock of the \(M_t\) \((b_{21})\), the contemporaneous response of the \(M_t\) to the shock of the HPI \((b_{13})\) and the contemporaneous response of the INT to the shock of the HPI \((b_{23})\) are treated as zero.

**Data Collection and Description**

Eight capital cities’ quarterly house price indexes (HPI) compiled and published by the ABS (2009) will be used in this paper. Besides, because of the primary interest of this paper, variables for measuring the shocks of monetary policy must be introduced as well. Therefore, data of money supply \((M_t)\) and interbank rates \((INT)\) referred from the RBA (2009a; 2009b) will be employed in the following analytical section.
As mentioned above, house prices in Australia have soared up since 1990s. Figure 1 shows the movements of the HPI from the September quarter of 1998 to the June quarter of 2009 in Australia’s sub-national markets. This figure indicates that the HPI show a significant propensity of increase during observed period. In the housing markets, the average increase rates of eight capital cities’ HPI between 1998Q3 and 2009Q2 are as much as 162%. In Darwin, the HPI even jumped up from 189.2 to 484.4 in recent ten years. Figure 2 demonstrates the changing propensity of the M₁ and INT in Australia’s money market. It can be found that Australian money supply which corresponds to the left vertical axis keeps an upward trend during observed period, increasing by 246.6 billion dollars from 109.7 billion dollars. The interbank rates, on the other hand, fluctuated from 4.97% to 4.24% between 1998 and 2002. Then it commenced to move up and achieved the peak of 7.25% in 2008Q2. The turning point of the interest rates come up in 2008Q3, from which interbank rates was lowered to 3.02 in 2009Q2.

![Figure 1. House Price Indexes of Eight Capital Cities in Australia.](image-url)
FINDINGS AND ANALYSIS

The prerequisite of the VAR model is the data imported must be stationary. Otherwise, a phenomenon of spurious regression will be triggered. Thus, testing the stability of the time-series data is the first procedure of the analysis depending upon the VAR. Table 1 shows the unit-root-test results of the M1, INT and HPI. The results illustrates that such variables are not stationary at the level form but stationary after the first difference at the 1% and 5% significance levels. In other words, all data are I (1) denoting that the time series integrated at the first difference level.
### Table 1. PP tests of the variables for 1998Q3 – 2009Q2.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>Model specification (lags)</th>
<th>PP Test Statistics (5%, 1% sig. level)</th>
<th>First Difference</th>
<th>Model specification (lags)</th>
<th>PP Test Statistics (5%, 1% sig. level)</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(M1)</td>
<td></td>
<td>Trend &amp; Intercept (1)</td>
<td>-2.28 (-3.52, -4.19)</td>
<td>None</td>
<td>(2)</td>
<td>-4.31 (-1.95, -2.62)</td>
<td>I (1)***</td>
</tr>
<tr>
<td>ln(INT)</td>
<td></td>
<td>None</td>
<td>-0.72 (-1.95, -2.62)</td>
<td>None</td>
<td>(2)</td>
<td>-4.31 (-1.95, -2.62)</td>
<td>I (1)**</td>
</tr>
<tr>
<td>ln(HPI_ADE)</td>
<td></td>
<td>Trend &amp; Intercept (4)</td>
<td>-1.65 (-3.52, -4.19)</td>
<td>Intercept (1)</td>
<td>-3.36 (-2.93, -3.60)</td>
<td>I (1)**</td>
<td></td>
</tr>
<tr>
<td>ln(HPI_BRI)</td>
<td></td>
<td>Trend &amp; Intercept (4)</td>
<td>-1.94 (-3.52, -4.19)</td>
<td>None</td>
<td>(5)</td>
<td>-2.06 (-1.95, -2.62)</td>
<td>I (1)**</td>
</tr>
<tr>
<td>ln(HPI_CAN)</td>
<td></td>
<td>Intercept (3)</td>
<td>-1.18 (-2.93, -3.59)</td>
<td>Intercept (1)</td>
<td>-3.35 (-2.93, -3.60)</td>
<td>I (1)**</td>
<td></td>
</tr>
<tr>
<td>ln(HPI_DAR)</td>
<td></td>
<td>Trend &amp; Intercept (4)</td>
<td>-1.80 (-3.52, -4.19)</td>
<td>Trend &amp; Intercept (4)</td>
<td>-5.82 (-3.52, -4.19)</td>
<td>I (1)**</td>
<td></td>
</tr>
<tr>
<td>ln(HPI_HOB)</td>
<td></td>
<td>Trend &amp; Intercept (4)</td>
<td>-1.96 (-3.52, -4.19)</td>
<td>Intercept (3)</td>
<td>-4.52 (-2.93, -3.60)</td>
<td>I (1)**</td>
<td></td>
</tr>
<tr>
<td>ln(HPI_MEL)</td>
<td></td>
<td>Intercept (1)</td>
<td>-1.57 (-2.93, -3.59)</td>
<td>Trend &amp; Intercept (1)</td>
<td>-6.16 (-3.52, -4.19)</td>
<td>I (1)**</td>
<td></td>
</tr>
<tr>
<td>ln(HPI_PER)</td>
<td></td>
<td>Trend &amp; Intercept (4)</td>
<td>-1.66 (-3.52, -4.19)</td>
<td>None</td>
<td>(7)</td>
<td>-1.97 (-1.95, -2.62)</td>
<td>I (1)**</td>
</tr>
<tr>
<td>ln(HPI_SYD)</td>
<td></td>
<td>Intercept (4)</td>
<td>-2.17 (-2.93, -3.59)</td>
<td>None</td>
<td>(3)</td>
<td>-2.84 (-1.95, -2.62)</td>
<td>I (1)***</td>
</tr>
</tbody>
</table>

Note: PP Tests, which are the unit root test similar to ADF Tests, contains three kinds of model specification: only intercept, trend and intercept, and no trend and no intercept. ** and *** denote the 95% and 99% significance level.

One of the challenges other than stationary test in the VAR is the optimal lag term selection. As suggested by the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SIC), the reduced form VAR models with one lagged term were established for detecting the impacts of monetary policy (M1 and INT) on the HPI. In order to set up the SVAR, restrictions of the matrix A and B must be imposed as well. After building up the SVAR models, impulse response function will be applied in the following major analysis. Generally speaking, impulse response is a function which provides a significant platform to trace the systematically dynamic effect of the shock of an endogenous variable to other variables in the VAR.

Figure 3 indicates the results of accumulated response of eight capital cities’ housing prices to the shocks of money supply and interbank rates. In all of the figures, the standard deviation of house price itself would lead to positive increases in future housing prices, implying that current changes in house prices do affect residents’ expectations in the short run. In addition, the responses of house prices to the shocks of money supply and interest rates individually exhibit a similar change trend. Summarily, a shock of money supply has a positive effect
on house prices while interest rates can negatively affect on prices of houses in eight state capital cities of Australia. These results are consistent with the basic economic theory discussed in the literature review.

The findings suggest that fluctuations of responses of housing prices in Brisbane, Canberra and Perth are more sensitive to the shock of money supply, reaching the maximum value of 2.1%, 1.2% and 1.3% in the 5th quarter; however, Adelaide’s house prices is less evident, in which positive shock of money supply is able to result in maximum 0.27% of positive movement of the HPI in the 2nd quarter. In the cases of other four cities, increase trends of the HPI are averagely enhanced up to 0.53% by the shock of the M1 in six quarters. Regarding interest rates, although house prices in such cities as Adelaide, Brisbane, Hobart, Melbourne, Perth and Sydney are slightly positively shifted by the changes of interbank rates at the beginning of two quarters, a shock of the INT still triggers dramatic downward trends of house prices. The decrease trends of the HPI are the most apparent in Sydney where the HPI shows -2.1% of movements in six quarters. Brisbane, Canberra, Hobart and Perth are in the lower tier in which the average values of the responses of the HPI of these four cities to a shock of the INT respectively achieve -1.6%, -1.8%, -1.6% and -1.7% in six quarters. In Adelaide, Darwin and Melbourne, the maximum values of the responses of the HPI to the impulse of the INT are much smaller, as much as 0.05% in average in six quarters.
CONCLUSIONS

This study empirically examines the impacts of monetary policy on the variable associated with housing affordability in Australia’s housing markets between 1998 and 2009 using the SVAR model. According to the structural decomposition of the impulse response function, it can be summarily identified that shocks of the
money supply bring a positive effect on house prices while the interest rates significantly trigger negative influences on property sector in Australia. Such findings are consistent with the economic theories mentioned in literature review. The results indicate that: (1) The values of response of the HPI to the shock of the M₁ are evident in Brisbane (2.1%), Canberra (1.2%) and Perth (1.3%) and less apparent in Adelaide (0.27%); (2) The average value of the response of the HPI to the impulse of the INT is as much as -1.28. The empirical results advise that political behavior, such as the adjustments for money supply and interest rates, would deliver an effective impact on housing affordability in the metropolitan areas of Australia during the period under study.

REFERENCES


