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ABSTRACT

This study analyzes the development of residential housing prices in Australia and its underlying macroeconomic drivers. From the results, implications for other booming economies in Asia-Pacific are highlighted. The research covers different aspects of house price development and is based on data on the national Australian housing market and on the German and Japanese housing markets for comparison. Analyses are conducted using multivariate linear regressions with house price index changes as dependent variable.

INTRODUCTION AND BACKGROUND

The development of housing prices is an important element of the Australian economy. From 1986 to 2004, house prices experienced an unprecedented growth of 300%. Real estate investors, home owners and financial institutions increasingly ask for the underlying drivers of this house price boom. This paper seeks to improve the understanding of house price changes in general and of the movements of the Australian residential real estate market in particular.

In the literature, there are two main types of models for the analysis of house price developments: intrinsic models, which predict house price changes based on historic pricing data, and extrinsic models, which simulate house price changes based on external (macro)economic drivers such as GDP growth.

Intrinsic models are used to measure inertia of housing prices, which is often attributed to inefficiencies in the real estate market (e.g. lack of liquidity and transparency). A number of authors observe house price inertia on US and Japanese data (e.g. [1], [2], [3]).

Extrinsic house price models, which predict house prices by looking at external influence factors, are also widely used (e.g. [4], [5]).

The pre-selection of the macroeconomic indicators under investigation is important for the analysis setup. Sutton ([6]) recognizes (household) income, stock market wealth and interest rates as three major drivers of housing prices. Income and stock prices are sought to increase housing prices due to the "wealth effect": the more

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people own, the more they spend. Long-term interest rates matter, because they determine the discount factor of future cash flows. Just ([7]) identifies five drivers of residential housing prices: real income, long-term interest rates, equity markets, population growth and housing completions. Just adds a twofold interpretation of the impact of equity prices. In addition to the wealth effect, equity and real estate are two competing asset classes and high share prices divert investments away from housing.

METHODOLOGY AND DATA

The goal of the research is to identify cause-effect-relationships between house price changes in Australia and previous changes as well as macroeconomic drivers. Linear regression is selected as analysis method for two reasons: first, there is enough data available for statistical investigations; second, there are already strong hypotheses on potential drivers of house price changes based on the research of other authors discussed in the introduction.

The regressions follow a five-step approach proposed by Backhaus et al. ([8]): (i) model setup and variable definition, (ii) coefficient estimation and regression calculation, (iii) validation of regression function and coefficients with R^2-, F- and t-statistics, (iv) validation of model assumptions by Durbin-Watson test and (v) discussion of results.

The analysis of Australian house price changes is divided into three parts. The first part measures house price inertia in an intrinsic model. The second and third parts analyze macroeconomic drivers of house price changes by extrinsic models for the Australian market and for Japan and Germany as comparisons.

The regression database comprises data from numerous sources, especially the Australian Bureau of Statistics and Thomson Financial Datastream. House price indices (HPI), in most cases the dependent variable, are constructed as chain indices. Macroeconomic variables are included based on the results of previous work and on data availability.

For optimal regression results, data is adjusted in the database, e.g. logarithmic transformations or transformations to inter-period changes instead of absolute values to reduce autocorrelation.

RESEARCH ANALYSES

House Price Inertia

Table 1 presents the results of the regressions with house price changes as dependent variable and the same time series of HPI changes offset by different periods as independent variables. Regressions 1 to 4 have offsets between 1 and 4 quarters, i.e. HPI changes in one period are analyzed along changes of the same HPI 1 to 4 quarters ago respectively. In regression 5, a combination of previous HPI changes is used.

R^2-values of regressions 1 and 5 are comparatively high indicating good predictive power. Evaluation of the F-statistics implies that regressions 1, 2, 3 and 5 are significant at the 99%-level, regression 4 at the 90%-level. Durbin-Watson-Coefficients (d) are used to test the regressions for autocorrelation. For regressions 1 and 5, $d>d_{high}$. It can be assumed that there is no autocorrelation. For regressions 2 to 4, $d<d_{low}$. In these cases, autocorrelation has to be considered.

	Regression				
(Independent) Variables	**1**	**2**	**3**	**4**	**5**
Constant	0.005	0.009	0.013	0.016	0.006
t-value	1.989	2.966	3.771	4.405	2.038
$A = \log(HPI_{t-1})-\log(HPI_{t-2})$	0.747				0.799
Beta	0.738				0.787
t-value	9.097				6.025
$B = \log(HPI_{t-2})-\log(HPI_{t-3})$		0.541			0.066
Beta		0.535			0.065
t-value		5.220			0.400
$C = \log(HPI_{t-3})-\log(HPI_{t-4})$			0.365		-0.186
Beta			0.354		-0.180
t-value			3.098		-1.076
$D = \log(HPI_{t-4})-\log(HPI_{t-5})$				0.222	0.020
Beta				0.214	0.020
t-value				1.784	0.145
R^2	0.545	0.286	0.125	0.046	0.556
F-value	82.752	27.253	9.596	3.183	19.693
No. of datapoints	71	70	69	68	68

Table 1: Regressions with House Price Changes as Dependent Variable

The results show that there is significant inertia in Australian house price changes. From the equation of regression 1, it can be inferred that the mean quarterly logarithmic HPI increase is 0.02, calculated as 0.005/(1-0.747). The regression coefficient of 0.747 implies that if a price change differs from that mean, 75% of that difference continues in the next period.

The regressions show that house price inertia decreases with increasing time lags. R^2-values decrease with increasing offset and the weights of higher offsets in regression 5 is smaller. A major part of HPI changes is driven by the most recent changes, earlier changes have smaller impact.

Macroeconomic Drivers

In the second section, extrinsic regressions models are calculated with HPI changes as dependent variable and macroeconomic parameters for the Australian economy as independent variables. Due to inertia, it can be assumed that changes to the macroeconomic indicators do not immediately take effect. Thus, for most variables an offset period of four quarters (one year) is chosen.

Table 2 presents the regression results. Regression 6 features one, regression 7 three and regression 8 six independent variables. The measured R^2-values are high for all regressions showing good prediction of the dependent variable. F-values are above the threshold for the 97.5%-significance level. The t-values of regression 6 are significant at the 95%-level, of regression 7 at the 90%-level. In regression 8, interest rates and household income are below the 90%-threshold. The Durbin-Watson-Coefficients indicate some weak presence of autocorrelation.

	Regression				
	6	**7**	**8**	**9**	**10**
(Independent) Variables	Australia	Australia	Australia	Germany	Japan
Constant	-0.019	-0.027	-0.038	0.001	-0.026
t-value	-1.497	-2.152	-2.719	0.202	-1.472
Dwelling const. started				0.001	
Beta				0.414	
t-value				2.373	
Dwelling const. completed			0.001		
Beta			0.176		
t-value			1.366		
Long-term interest rate			-0.002		
Beta			-0.07		
t-value			-0.555		
GDP (real)		0.008	0.012	0.006	0.009
Beta		0.247	0.359	0.530	0.494
t-value		1.967	2.489	3.042	2.843
Household income			-0.004		
Beta			-0.213		
t-value			-1.283		
Aust. Stock Exchange		0.001	0.001		
Beta		0.231	0.215		
t-value		1.842	1.715		
Population	0.104	0.105	0.147		0.083
Beta	0.366	0.37	0.519		0.357
t-value	2.784	3.436	3.286		2.052
R^2	0.134	0.253	0.304	0.529	0.476
F-value	7.753	5.423	3.283	8.968	8.622
No. of datapoints	52	52	52	19	22

Table 2: Regression Results

Regression 6 shows that changes in population size have the strongest explanatory power for HPI changes. Both indicators grow steadily in Australia over the observed time span. A growing resident population in Australia (+43% between 1975 and 2004) is widely regarded as key driver of house prices increases.

Stock prices and GDP changes are two other important drivers. Regression 7 includes these three most important variables bringing the R^2-value close to its maximum level: changes in GDP (29% relative weight), in stock prices (27% relative weight) and in population (44% relative weight). It seems as if the increase in wealth – reflected in both increasing GDP and increasing share prices – has fueled the rise of the Australian HPI in addition to the population growth. The GDP grew by almost 4% p.a. between 1991 and 2004.

Interest rates and unemployment are less influential. In regression 8, interest rates – often regarded as a key driver of real estate demand – only have a low influence (about 5% based on beta values). This is justified when looking at the economic environment of the residential real estate market. The boom in the Australian housing market is mainly driven by economic prosperity and population growth. Low interest rates are a precondition or act like an amplifier, but do not carry the boom.

The dynamic housing market is not in equilibrium. Most coefficients have the signs expected from theory with two exceptions: the positive sign for completed housing and the negative sign of household income in regression 8. The positive sign of the completed housing coefficient is explained by the constant growth in the Australian housing market. An increase in housing supply is expected to lower the housing prices. The rising Australian residential housing market is out of equilibrium throughout the observation time, which leads to the unexpected coefficient sign: the supply follows the constantly increasing demand allowing supply and prices to rise at the same time. The negative sign of the household income coefficient is most likely due to the presence of multicollinearity in the data.

International markets

In the last step, data of the German and Japanese housing markets is analyzed in the same way to compare the Australian results in an international context. The German and the Japanese housing markets experienced only moderate growth between 1986 and 2004. The comparison allows analyzing in how far the Australian results are influenced by the market boom 1986-2004.

The analysis follows the same approach as in the previous parts. Results of regressions 9 and 10 are shown in table 2.

R^2-values are high for both regressions. Based on their F-statistics, Regressions 9 and 10 are significant at the 95%-level. The t-statistics obtain similar results. The Durbin-Watson-Test is indifferent at the 95%-level.

The regression results of Germany and Japan confirm the Australian results. Changes in GDP and in population are important drivers in these markets as well, although there is no similar economic growth over the observation period. For the German data, GDP development and dwelling construction already result in a model

with high R^2-value. In the Japanese model, GDP and population drivers are the most important factors and the coefficients bear the theoretically expected signs (e.g. negative signs of interest rate and unemployment rate changes). An explanation for the high quality of the Japanese model is the slow growth in the Japanese residential housing market leading to a more stable market evolution.

A second outcome of the regressions on Australian data was the low weight of interest rate changes. This is also confirmed, which suggests that low interest rates are a necessary precondition of house price booms, but do not drive a long-term increase of housing prices.

Share prices have a weight of 27% in the Australian data. In Japan and Germany, share prices play a minor role, most likely because equity and stocks play a smaller role in the private household wealth structure of these countries.

RESULTS AND DISCUSSION

Between 1986 and 2004, Australia experienced an unprecedented boom in housing prices. According to the results presented in this paper, the increase of the Australian HPI is driven by strong growth in population and economic prosperity, supported by decreasing interest rates. The HPI growth is strong enough to even overshadow an increase in building activities: HPI changes and building activities are positively correlated.

The result that population changes and economic activities are cornerstones of HPI development is confirmed in analyses of the German and Japanese housing markets. However, both parameters do not increase by the same amount as the HPI. A reason might be that especially in the early 1990's there was an adjustment effect in the Australian market to international house price levels. To confirm the impact of the two indicators, further research should be conducted as soon as longer time series are available.

These findings lead to interesting economic implications. Countries with strong population growth and increasing wealth – especially the economies in Asia-Pacific – can expect rising housing prices even in the long-term and even if interest rates increase slightly. Stagnating economies with decreasing populations will experience a slide in housing prices. This effect is already observed in parts of Europe (e.g. Eastern Germany), but will gain further importance.

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