CHOW TEST ANALYSIS ON STRUCTURAL CHANGE IN NEW ZEALAND HOUSING PRICE DURING GLOBAL SUBPRIME FINANCIAL CRISIS

RITA YI MAN LI[1]

Hong Kong Shue Yan University

ABSTRACT

The global sub-prime crisis in 2007-2009 seriously affected the economy of many countries. Whilst the United States is not a close trading partner of New Zealand, it affects her trading partners and indirectly affects her economy and real estate prices. To locate the date of structural change in housing prices in New Zealand during the global financial crisis, quarterly data include Housing Price Index and building permit, Gross Domestic Product, unemployment rate, currency exchange rate, building permit in New Zealand from 1988 to 2010 is collected. The Chow test shows that there was a structural break in the first quarter of 2008 in New Zealand housing prices.

Keywords: chow test, subprime crisis, New Zealand, housing price

INTRODUCTION

The Financial Tsunami in 2007-2009 led to a loss of confidence in the financial market. The former Federal Reserve Chairman Alan Greenspan described it as *"a once in a half century, probably once in a century type of event"* (Chen, 2008). The United States President Barack Obama also held a pessimistic view that the economy entered into a "lost decade" which would be comparable to the Japanese recession in the 1990s (Meckler and Weisman, 2009). The sub-prime financial crisis which originated in the U.S. subprime mortgage greatly affected the real estate market in the world. New Zealand, one of the most open economies in the world, was affected by it. In fact, changes in the price of self-occupied housing have multiple impacts on dwelling owners. These changes affect many households' wealth, since home equity constitutes a relatively large percentage of household wealth. Furthermore, variations in residential property prices also affect the risk level of a homeowners' portfolio (Bourassa et al., 2009). Therefore, knowing the date of housing price turning point in times of poor economy may provide some useful insights when the next financial crisis comes. In this paper, we will discuss the causes and consequences of the

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[1] Email: ritarec1@yahoo.com.hk

subprime lending in the US and how it affects the New Zealand real estate market.

CAUSES OF THE FINANCIAL CRISIS

After the stock market reached the peak in 2000, the Federal Reserve reduced its target federal funds rate gradually to 1% in 2003. In view of low interest rates, investors looked for high yield investments. The perfect vehicle in collateralized debt obligations (CDOs) backed by subprime mortgages sounded good to these investors. No matter it is prime or subprime mortgages, they appeared to be safe investments as a borrower in distress could refinance or sell the property out to repay the mortgage. As house prices leveled off in 2006 and interest rate went up, rate of defaults rose. Some firms had trouble financing their positions. As a decade passed, the underwriting standards for subprime mortgages lowered. Mortgage brokers lent to households without adequate assets or income to service the mortgages (Poole, 2010). Furthermore, many investors took the triple‑A ratings at face value and loaded their portfolios with the CDOs. To hold CDOs, Some of the companies include Citigroup formed structured investment vehicles (SIVs) as off‑balance‑sheet entities. Because mortgages return principal gradually over years, the abovementioned CDOs became long‑term assets for the SIVs. When the financial crisis broke in August 2007, investors demanded to receive cash and the financial market contracted (Poole, 2010).

NEW ZEALAND ECONOMY

New Zealand was a highly protected domestic economy with a strong support from the agricultural sector. She faced keen competition from international competitor. The reforms included an extensive program of asset sales; the abolition of wage and price controls; the deregulation of financial markets; the corporatization of government departments; and the dismantling of import quotas and export subsidies. As a consequence of the reforms, the agricultural sectors and traditional manufacturing industries being most adversely affected, there was a significant increase in unemployment from 4.2 to 10.1%. in 1986 and 1991 respectively (Murphy and Cloher, 1995).

In recent decade, New Zealand's economy benefits much from the global economic growth. Besides, China's fast expansion has led to significant increase in commodity price. Exports were pushed up and lowered those of its manufactured imports. New Zealand recorded a significant increase in income and output over the past 14 years. Even during the 1997 Asian crisis, its real GDP rises by 3.5 per cent per annum on

average (Table 1). The long period expansion was underpinned by five important factors:

1. High net immigration led to a rapid working-age population growth and a substantial increase in labour income, employment rate and salary growth;

2. The booming commodity export prices such as dairy products and the presence of cheap manufactures from China result in a strong terms of trade gains;

3. Fiscal consolidation and structural reforms successfully boosted per capita potential growth;

4. A housing boom due to easy credit and increase immigration and an ample supply of global savings which provide ready access to credit at a not so high domestic interest rates;

5. Rapid expansion of export markets in China (OECD, 2009).

Table 1 New Zealand Macroeconomy from 2005 to 2010 (OECD, 2009)

	2005	2006	2007	2008	2009	2010
	Percentage changes, volume (1995/96 prices)					
Private consumption	92.0	2.6	4.0	0.1	–0.6	0.0
Government consumption	28.0	4.6	3.9	4.0	4.5	4.5
Gross fixed capital formation	37.4	–0.4	5.0	–5.7	–19.2	–1.4
Final domestic demand	157.4	2.2	4.2	–0.5	–3.7	0.7
Stockbuilding1	1.3	–0.8	0.3	0.2	–1.1	0.0
Total domestic demand	158.7	1.4	4.5	–0.3	–4.8	0.7
Exports of goods and services	43.4	1.8	3.8	–1.8	–11.9	0.2
Imports of goods and services	46.7	–2.6	8.6	2.5	–17.0	0.7
Net exports1	–3.2	1.3	–1.5	–1.2	1.9	–0.2
GDP at market prices	155.4	2.6	3.0	–1.6	–2.9	0.5
GDP deflator	…	2.2	4.2	4.7	1.8	2.6
Memorandum items:						
GDP (production)	…	2.0	3.1	0.2	–2.8	0.5
Consumer price index	…	3.4	2.4	4.0	2.1	1.7
Private consumption deflator	…	2.8	1.6	3.4	2.1	1.0
Unemployment rate	…	3.8	3.6	4.1	6.8	7.9
General government financial balance2	…	5.9	5.0	2.8	–2.1	–4.9
Current account balance2	…	–8.7	–8.2	–8.9	–7.6	–6.3

Nevertheless, New Zealand was affected by the reversal of this supportive atmosphere severely during the global subprime financial crisis. This was mainly due to the sudden drop in commodity prices and the shrunk in export. Moreover, the supply of foreign credit was tightened and the external deficit was very large by international standards (OECD, 2009). Therefore the New Zealand government has implemented fiscal policies to mitigate the economic problems, such as personal tax cuts and accelerate the public investments.

NEW ZEALAND HOUSING MARKET

Since the 19th century, New Zealand emphasized on the subsidy for the purchase of private housing and home construction (Murphy and Cloher, 1995). In the 30s, the First Labour Government initiated the development of 'state housing' to solve the long term housing problems. This type of housing was usually built at a relatively high standard and became an icon. It was also the country's early and innovative welfare given to their citizens. In the 1970s, New Zealand became the largest mortgage funds owner in the country and a lender of last resort. The Housing Corporation was established in 1974 to manage the state's rental stock of houses and provide mortgage finance to low income households. It also became the major tool for government intervention in the residential market. By the mid-80s, even though state housing accounted for only 5% of dwellings in New Zealand, its home ownership rate reached 74% (Murphy, 2004). Starting from 1984, New Zealand began to initiate some policies which shifted the country away from state owned enterprises, regulation of foreign exchange rate controls, business investment, interest and price controls, public provision of services, The currency was allowed to float and their centralized labor agreements were replaced by voluntary unions and bargaining at the individual and enterprise and levels, monetary policy was focused on maintaining low inflation (Fraser et al., 2008). In a country like New Zealand with very low population densities even in the urban areas, the recent growth of the inner-city apartment market appear to be weird. The largest New Zealand cities, have been experiencing urban sprawl from 1980s to 1990s which stood sharp contrast to the continuing relative decay of many US inner cities (Morrison and McMurray, 1999). Yet, many New Zealand citizens started to blame the high unemployment rate of 24 % was due to the homeownership (Murphy and Cloher, 1995). In December 2006, New Zealand's home ownership rate remained high at 67% with 1.5million owner occupied dwellings, over 8,000 houses were transacted and the monthly value of residential changing hands was $3.4 million. Assuming trading volumes of 96,000 annually and there was a building stock of 1.5 million dwellings, it implied that one out of every fifteen

houses were sold in 2006 (Fortes and McCarthy, 2010). Partly because of high ownership rates, housing assets as a percentage of total assets are also high (Table 2). To minimize the potential of overproduction due to speculative activity in downturn, New Zealand is strongly aligned with the market dominance of single detached dwellings located on the pieces of land. (Murphy, 2011).

Table 2 Household wealth (New Zealand Billion at the end of the year) (OECD, 2009).

	1,985	1,990	1,995	2,000	2,005	2,006	2,007
Housing assets	73	127	182	231	506	559	614
Financial assets	49	68	99	126	165	188	200
Total assets	122	195	281	357	671	747	814
Financial liabilities	14	28	47	74	135	152	170
Net wealth	108	167	233	279	528	586	634
Memorandum item:							
Housing assets as a percentage of total assets	59.8	65.1	64.8	64.7	75.4	74.8	75.4

HOUSING PRICE DETERMINANTS

Factors which led to housing price rise and fall varies. Previous research shows that a higher unemployment rate discourages individuals from purchasing home (Garcia and Hernandez, 2004). Meen (2008) concurs that sustainable homeownership rates depend mainly on the expansion of housing supply rather than demand. Other research also shows that existence of bubbles may be due to the exchange rate volatility (Cho, 1996). The mortgage interest rate significantly affects an individual's decision to purchase a residential unit. A rise in the mortgage rate or mortgage payment (including both the principal and interest) discourages people from home purchase and hence decreases its demand. Significant impact of the interest rate on consumer spending are also expected when houses serve as collateral (Dua, 2008). Therefore, decrease in interest rate leads to an increase in housing prices (Mellish and Rhoden, 2009). For example, the negative real interest rates caused sharp fluctuations in house prices in Hong Kong in the early 90s (Chen et al., 2004). It is also found that there is a positive relationship between Australian Real Estate and Stock Market prices (Okunev et al., 2002). In Taipei, it was evidenced that the first housing price boom in the early 70s was caused by the sudden increase in oil price which led to an increase in construction costs. An increase in urban housing demand and price was triggered primarily by Japan's highest population growth about 40 years ago in Tokyo in 1947 (Chen et al., 2004). Movements in per capita real GDP as well as the total housing

stock are found to have correlations with real housing prices in the long run (Tu, 2004). With the help of US data, Kiyotaki et al. (2011) find that housing prices react more to an exogenous change in expected productivity (one of the objective measures is GDP) or the world interest rate. Finally, since homeowners usually have high reservation prices or resist selling their housing units below a certain price level during recessions Residential housing prices exhibit strong downward price stickiness. Hence, home prices tend to decrease through inflation rather than decrease in nominal price (Adams and Füss, 2010).

CHOW TEST

When there is no special events occur over time, the graph which shows the relationship between time and housing price may be represented by a continuous line graph (

Figure 1). Yet, time series of data can often contain a structural break, due to a change in policy, e.g. housing supply policy or sudden shock to the economy, e.g. 1987 stock market crash. In order to test for a structural break, we often use the Chow test. This is Chow' first test (the second test relates to predictions). The model uses an F-test to determine whether a single regression is more efficient than two separate regressions which splits the data into two sub-samples. The latter one occurs as shown in case 2 where we have a structural break at time "T1" (Morley, 2006) (Figure 2).

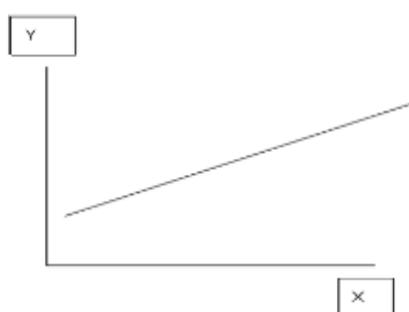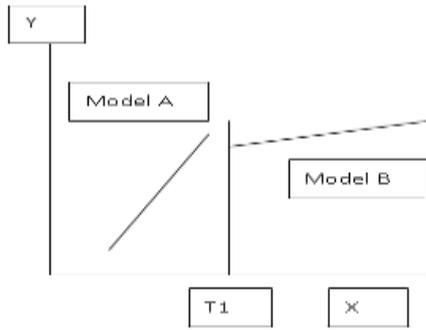Figure 1 Diagrams shows equation without structural break (Morley, 2006).

Figure 2 Diagrams shows equation without structural break (Morley, 2006).

In the first case we can use a single regression line to fit all the data points which can be expressed as:

$$y_t = \alpha_0 + \alpha_1 x_t + u_t$$

In case 2, where there is a structural break and we have two separate models, it can be expressed as:

$$y_t = \beta_1 + \beta_2 x_t + u_{1t}$$
$$y_t = \delta_1 + \delta_2 x_t + u_{2t}$$

The classical test for structural change is attributed Chow (1960). It is a famous econometric test which split the sample into two sub-periods, estimates the parameters for each of the sub-periods and then tests if the two sub periods are equal with the help of F-statistics (Hansen, 2001). The above two sets of equation proposes that model 1 applies before the structure break at time "T", model 2 applies after the structural break. If all the parameters in the above models are the same, i.e. $\beta_1 = \delta_1, \beta_2 = \delta_2$, models 1 and 2 can be expressed as a single model as in case 1, where there is a single regression line. The Chow test basically tests whether the single regression line or the two separate regression lines fit the data best (Morley, 2006).

DATA USED IN CHOW TEST

To test if there was any structural change in housing prices in New Zealand during the global financial crisis, quarterly data from 1988 to 2010 is collected which includes 1) Housing Price Index and building permit (Department of Building and Housing, 2011) (Figure 3 and Figure 7), 2) Gross Domestic Product (Statistics New Zealand, 2010) (

Figure 4) and 3) unemployment rate (Department of Building and Housing, 2011) (Figure 5), 4) currency exchange rate (Zealand, 2011) (

Figure 6), 5) building permit in New Zealand which provides information on housing supply (Department of Building and Housing, 2011) (Figure 7). Gross Domestic Product From 1997 to 2007, house price in New Zealand increased by twice while the gross domestic product increased by near 2 times. In 2007, the House Price Index reached the peak of 1519 and the Gross Domestic Product reached the peak of NZD 46004 million (Department of Building and Housing 2010, Statistics New Zealand 2010). In 2007, sub-prime financial crisis occurred. The fall in house price in US causing a loss of confidence to financial system, then made credit unavailable and lead to a liquidity shortfall in financial system (IMF, 2009). The lack of liquidity results in a contraction of economy and slows down of international trade. US real output level reduced by over 10% while the unemployment rate increased to 10% (BEA, 2010).

Figure 3 Housing Price Index from 1988 to 2010 (Department of Building and Housing, 2011).
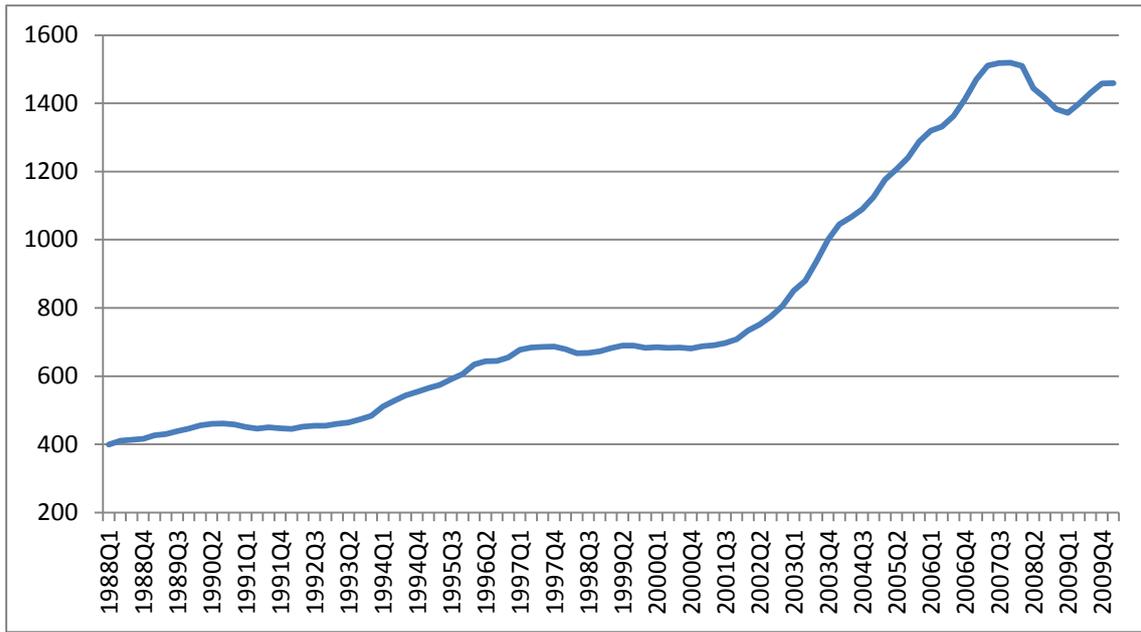
Figure 4 Gross Domestic Product in New Zealand from 1988 to 2010 (Statistics New Zealand, 2010).
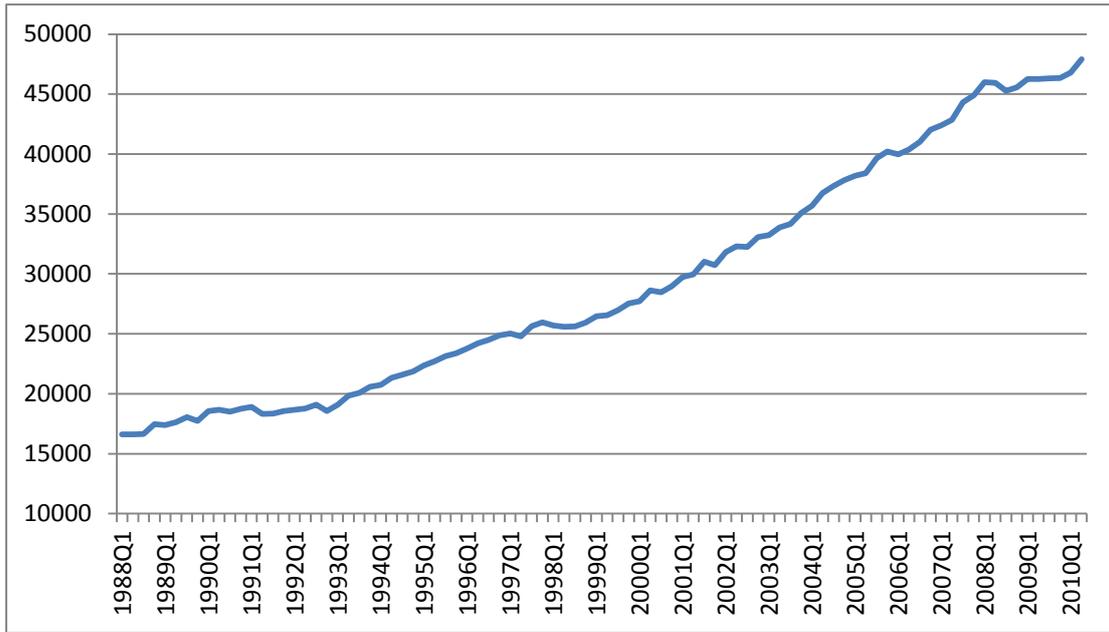
Figure 5 Unemployment rate in New Zealand from 1988 to 2010 Statistics New Zealand (2010)
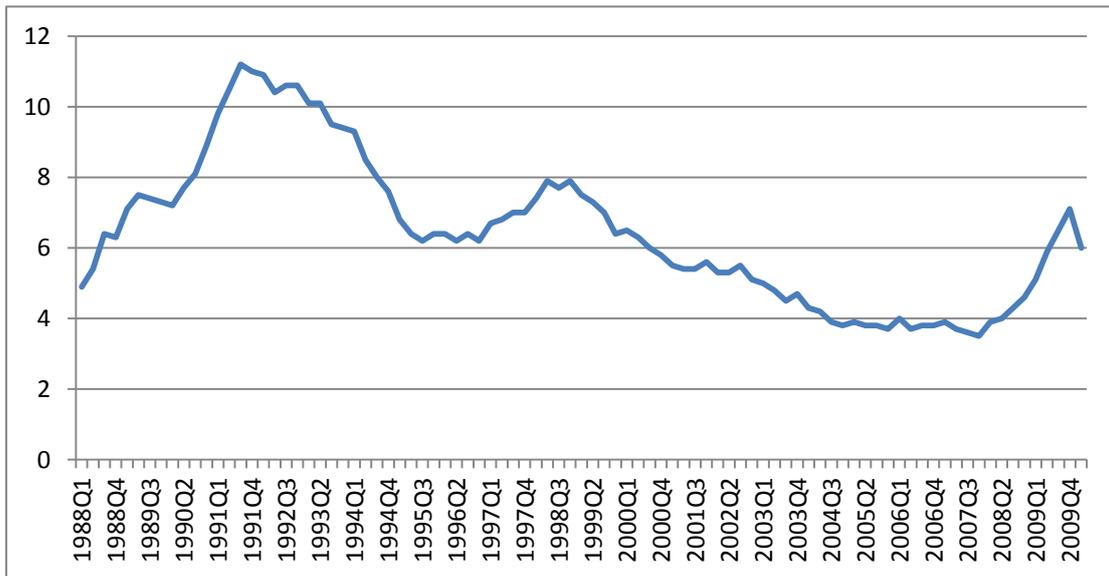

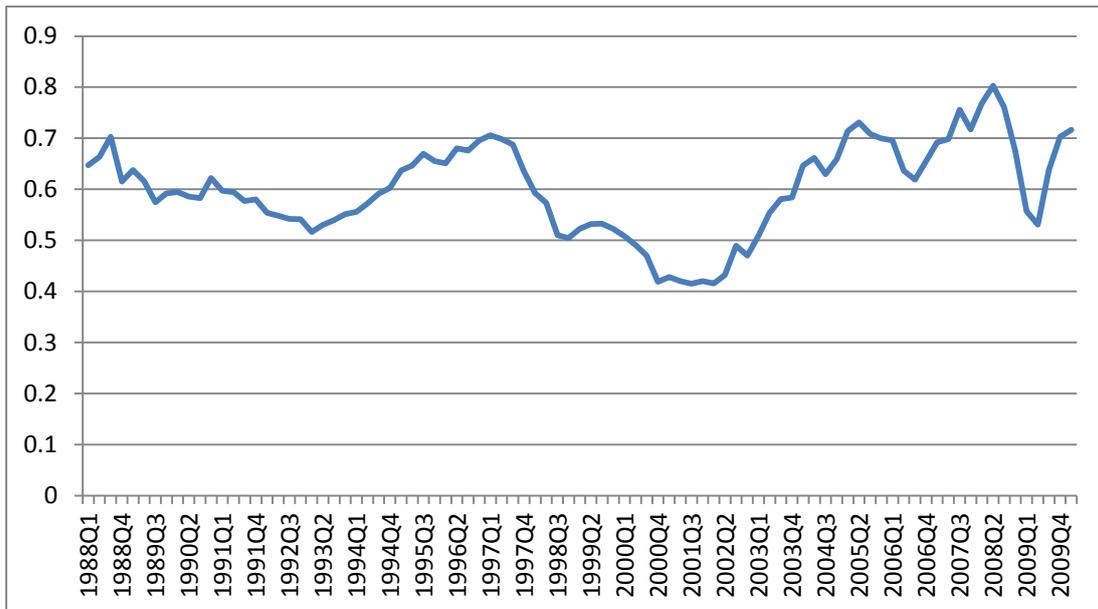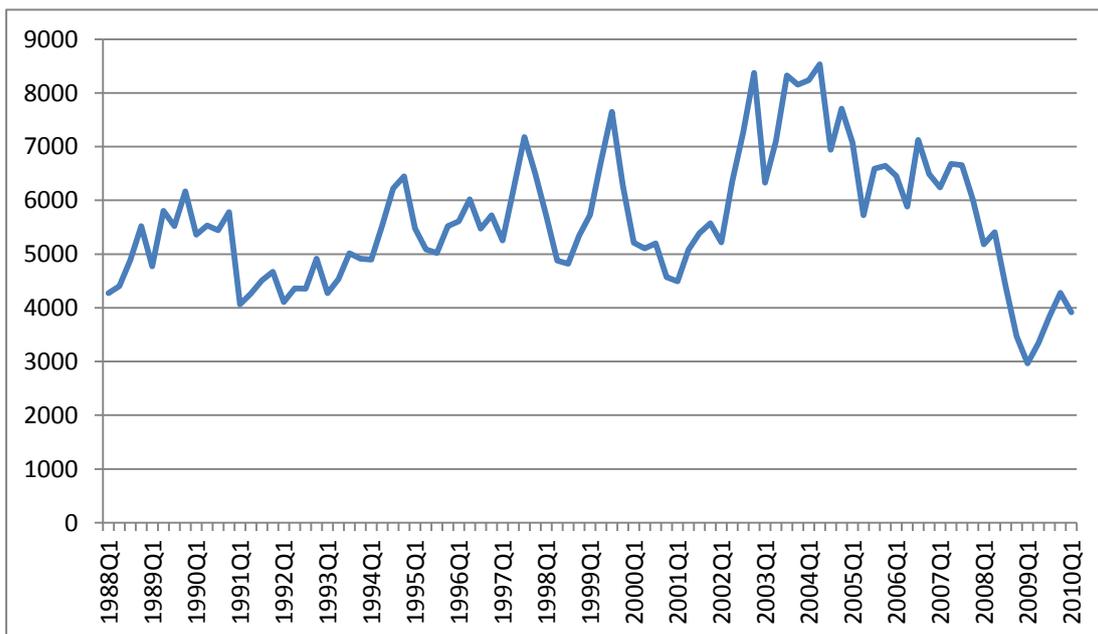Figure 6 Exchange rate from 1988 to 2010 (Zealand, 2011).

Figure 7 Building permit in New Zealand 1988 to 2010 (Department of Building and Housing, 2011).

RESULTS FOR CHOW TEST

The following Tables show the results of chow test. The results suggest that the structural break point occurred at first quarter of 2008. The first set of the equations, i.e. equation before first quarter of 2008 show that RGDP, unemployment rate, exchange rate are positively related to Housing Price Index in the list of independent variables of this regression model before using it to explore the structural pattern of the dependent variable (i.e. the Housing price Index). Building permit number, which

represent the supply of housing, displays a negative relationship with the housing price. All these coincide the previous literature. Nevertheless, all the above mentioned relationship between price and other factors are refuted when we study the second half of the equations. New Zealand exchange rate is negative significant related to the housing price index which is just opposite to the equation before first quarter 2008.

Table 3 EViews results of the Chow Test

Augmented regression for Chow test

OLS, using observations 1988:1-2010:1 (T = 89)

Dependent variable: HP

	coefficient	std. error	t-ratio	p-value	
const	-1771.73	118.490	-14.95	9.52e-025	***
RGDP__m	0.0735124	0.00261919	28.07	7.61e-043	***
Unemployment	26.3878	5.76903	4.574	1.75e-05	***
exchange_rate_N	1013.85	78.0206	12.99	2.62e-021	***
Building_permit	-0.0281776	0.00781428	-3.606	0.0005	***
splitdum	-1116.79	4761.33	-0.2346	0.8152	
sd_RGDP__m	0.0533698	0.149295	0.3575	0.7217	
sd_Unemployment	-26.7369	26.5346	-1.008	0.3167	
sd_exchange_rat	-1384.33	635.603	-2.178	0.0324	**
sd_Building_per	0.0819792	0.0530332	1.546	0.1261	

Mean dependent var	805.8315	S.D. dependent var	366.3105
Sum squared resid	245728.5	S.E. of regression	55.77174
R-squared	0.979190	Adjusted R-squared	0.976819
F(9, 79)	413.0260	P-value(F)	1.40e-62
Log-likelihood	-478.8744	Akaike criterion	977.7489
Schwarz criterion	1002.635	Hannan-Quinn	987.7798
rho	0.757992	Durbin-Watson	0.481888

Chow test for structural break at observation 2008:1

$F(5, 79) = 1.92074$ with p-value 0.1001

Table 2 Chow test results

LIMITATION AND CONCLUSION

The global subprime crisis happened in the United States 2007-2009 had seriously affected many countries' economy. The author speculates that whilst the United States is not a close trading partner of New Zealand and geographically far away from each other, the financial tsunami affects her trading partners. It therefore indirectly affects her economy and real estate prices. Unemployment rate climbed up and housing

supply dropped (as indicated in the decrease in building permit). The Chow Test shows that the structural break occurred in the first quarter of 2008 in New Zealand housing price. While the correlation between various macro economic factors such as real GDP and building supply as represented by the number of building permits strongly correlates with housing prices, many of these were insignificantly correlated with them. In the near future, the interest rate (cost of borrowing in home purchase), economic factor in Australia (in view of the close relation between Australia and New Zealand economy) and some other related variables will be used in the chow test model. In terms of geographical location, this study limits on New Zealand only, it would be better if more countries' data can be used in the study.

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