COST OF HOME OWNERSHIP:

EVIDENCE FROM GREAT VANCOUVER

by

Xiao Liu

BA, Ocean University of China, 2012

and

Xiaoxi Chen

BE, Zhongnan University of Economics and Laws, 2012

BM, Zhongnan University of Economics and Laws, 2012

PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN FINANCE

In the Master of Science in Finance Program
of the
Faculty
of
Business Administration

SIMON FRASER UNIVERSITY

Fall 2013

Approval

Name: **Xiao Liu and Xiaoxi Chen**

Degree: **Master of Science in Finance**

Title of Project: **Cost of homeownership to price and rent**

Supervisory Committee:

_____

Andrey Pavlov
Senior Supervisor
Professor, Finance

_____

Derek Yee
Second Reader
Adjunct Professor, Finance

Date Approved: _____

Abstract

From 1991 to 2012, there was a substantial rise in real house prices in Greater Vancouver. Much research has been done to examine house market by assessing the growth of house prices and price-to-rent ratio. However, house prices are not the only expense that people make when buying houses. In this paper, we use user cost of housing to assess house market. The user cost of housing depends not only on house prices, but also on the opportunity cost, property tax, annual depreciation and risk premium. We then estimate the user cost of owner-occupied housing using Greater Vancouver data and Calgary data. We also build up two models to explain user cost of different ways to buy houses. Based on our tests, we found renting, compared to owning, is a better choice for people living in Greater Vancouver for most of the time, while in Calgary people should buy from 2007 and ever after.

Key word: user cost, price-to-rent ratio, tenure choice

Acknowledgements

We would like to express our sincerest gratitude to our supervisor, Dr. Andrey Pavlov, who has provided invaluable oversight and assistance for our thesis. We greatly appreciate his time, patience, insights and continual guidance to have our work completed.

Our appreciation goes also to our second reader, Dr. Derek Yee. He provided exceptional guidance and support every step of the way, from the time we asked him to be our reader to the time of completion of this dissertation.

Table of Contents

Section I: Introduction

During the period between mid-90s and 2013, we witnessed a substantial rise in real house prices and significant increases in price-to-rent ratio in Greater Vancouver.

The Bank of Canada, among others, has recently expressed concerns over the dramatic rise in domestic housing prices. A good deal of concern has also been shown in recent years about the increasing cost of living in Vancouver, as in many other cities in Canada. For a family, the cost to enter the housing market for the first time, particularly, is also rising rapidly. Although the housing component of the Consumer Price Index is one of the major components that are increasing rapidly, its rate of increase does not seem to be as great as that in the cost. We can see from the Appendix that interest rate is negative in the last three years. This is because real interest rates are not keeping up with inflation. When the inflation is high and nominal interests keeps stable, we will get negative real interest rate.

In our paper, we build two equilibrium models in which the price is equal for the same quantity of housing services in renting and owner-occupation. Our assumption is, firstly, all the people are first home buyers and the house is owner-occupied. Secondly, they only have two ways to buy house, one is pay at one time and another one is finance. Finally, if buyers decide to use mortgage, the amortization period is 20 years and the mortgage rate is 5 year fixed rate.

There are two different models to calculate cost of ownership in two scenarios. One is a scenario that house buyers want to pay all the money at one time, the other one is for scenario that house buyers want to pay periodically with mortgage. For the first scenario the model has five components which are opportunity cost, property tax, annual depreciation, house price growth and risk premium. In the second scenario the model also has the five components which resemble the first model but the first component is different. After we get the cost of ownership, we need to discuss the best choice for people, owning or renting? For those who pay at one time there are two ways to help them make decisions. The first method is the inverse of cost of ownership per dollar 1/u. When 1/u is smaller than real price-to-rent ratio, it means owning a house is a better choice. The second method is comparing the cost of ownership with the rent. If the cost of ownership is smaller than rent, owning house would be a better choice. For those who pay periodically with mortgage we only have one way to help them, which is comparing the total cost of

ownership with the total cost of rent. If total cost of ownership is smaller, owning a house would be a better choice.

Scenario	With Mortgage	Without Mortgage
Number of Tools	2	1
Description	1、 Compare Pt/Rt to 1/u 2、 Compare cost of ownership to rent	Compare total cost of ownership to total rent
Decision	1、 If Pt/Rt < 1/u, buy, otherwise rent 2、 If cost < rent, buy, otherwise rent	If total cost < total rent, buy, otherwise rent

Section II: Literature Review

Many researchers are exploring frameworks that can explain the observed behaviour of house market and the user cost of home ownership. Our paper builds on a growing literature examining tenure choice.

Many of them present the factors that drive up house prices. Davis and Heathcote (2007) find economic fundamentals such as interest rates and personal income per capita have impacts on house prices. They also point out that an inelastic housing supply plays an crucial role in driving up house prices. Favara and Imbs (2010) conduct an empirical study in a large sample of counties across the US to explain why house prices increase. They found branching deregulations are significant reasons for the expansion of credit supply between 1994 and 2005, which contributes to the rise in house prices.

Poterba (1984) uses an asset-market model of the housing market and shows accelerating inflation in 1970s not only reduced user cost of owning a house, but accounted for as much as a 30 percent increase in real house price. Poterba (1991) builds a framework that homeowners, as investors, earn the same return on housing investments as on other assets and finds out three factors that account for the rise in house price during the 1970s. The first factor is shocks on construction costs. Another factor relies on a favourable and unexpected demand shock caused by the interaction of the tax system and inflation. The third explanation is that demand for housing increases substantially between the ages of 20 and 34 which is the major fraction of the population.

Other authors also point out the importance of psychological factors as explanations of the upsurge in real house prices. Case and Shiller (2003) and Shiller (2007) argue that the public hold an expectation that the house price will increase, which causes prices elevate temporarily.

Turning to the dynamics of the price-rent ratio, Sommer, Sullivan and Verbrugge (2011) build a dynamic equilibrium stochastic life cycle model of housing tenure choice with a market for rent and homeownership. In this model, house prices and rents are endogenous and mortgages are available, but home-payers must pay a minimum down-payment. They find lower interest rates, relaxed lending standards and higher incomes are three important determinants of the increase in the US house price-to-rent ratio during the housing market boom between 1995 and 2005. Hattapoglu (2009) conducts an empirical analysis of cross section data within the Houston metropolitan area and links prices and rents of similar houses to determine whether price or rent appreciation can account for the rent-to-price ratio. He shows that price appreciation has an impact on people's appreciation expectations, which provides evidence for instability of price.

Additionally, there are approaches provided to estimate for the average effective user cost of owner-occupied housing. To truly understand the cost of housing, Haffner and Heylen (2010) explain that the cost of using is based on the purchase price, the value to change house and other cost spent to manage the house and is about the opportunity cost of investing in alternative things. They also point out the difference between the expenses to finance the access to the dwelling and the costs of using. Expenses only consider debt financing, while costs of using take interest costs of equity financing into account as well.

Himmelberg, Mayer and Sinai (2005) present that the conventional metrics, such as growth rate of house price and price-to-rent ratio, fail to take the time series pattern of real long-term interest rates into account which is a key determinant of house prices in recent years. To solve this problem, they calculate the annual cost of single-family housing in the US over the 25 years and compare it to price and income to judge whether the housing prices are too high. They conclude that, from 1995 to 2004, although the cost of owning increased for some reason, it does not mean houses are overvalued. Díaz and Luengo-Prado (2007) also construct a measure for evaluating the owner-occupied housing service by constructing a model which is a miniature of US economy. Compared to Himmelberg, Mayer and Sinai (2005)'s way to calculate user cost calculation, they take two more key factors into consideration. One is transaction costs, the other is the difference between the cost of a dollar from own wealth and that of a borrowed dollar. They find that rental equivalence approach tends to overestimate the value of housing services substantially.

Poterba and Sinai (2008) construct an equilibrium model in which each household's imputed rental income per unit of housing capital divided by the house price equals the user cost. As a result, they show mortgage interest deduction will raise the average user cost, especially for the high-income, young homeowners. Property tax deduction is another element that can account for the increase of user cost.

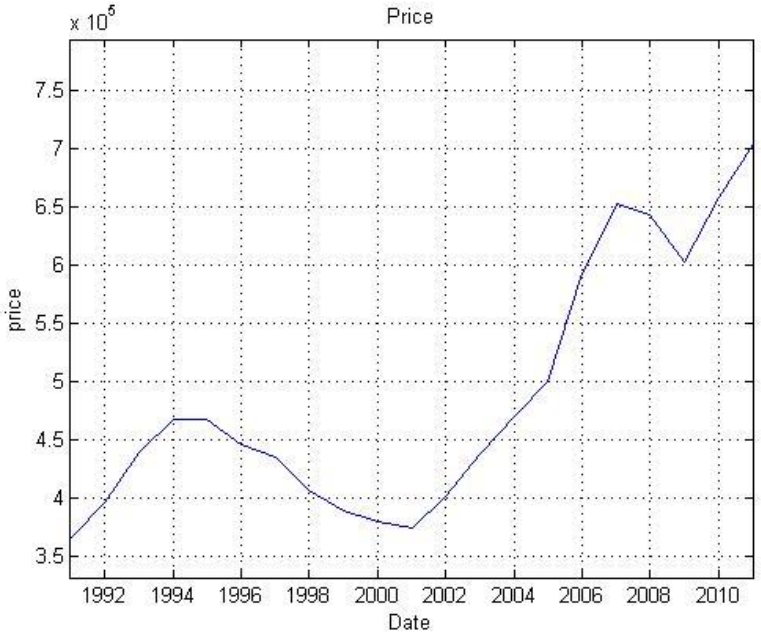
Rayna Brown, Rob Brown, O'connor, Schwann and Scott (2011) find user cost of housing for owner-occupier without debt is always lower than that for corresponding property investor, while cost of housing for owner-occupier with debt tends to be higher than that for the corresponding investor.

Section III: The Real Estate Market in Vancouver

In this paper, we will explain how to assess the effect that the change of house price and rent make on the cost of housing. We first look at the ways in which the house market may be measured. In doing so, we need to correct a conventional view that the price of a house is the same as the cost of home ownership. When the house price is rising, the cost of owning does not necessarily follow the change.

There are two conventional ways to assess house market. The first one is to look at house price growth rate. The data of house price we use are from the Centre for Urban Economics & Real Estate of University of British Columbia, from which we can find current and historic data on Canadian real estate market. It provides quarterly data of real house price which are converted to annual data in the following assessment. As can be seen in the Figure 1, between 1990 and 2012, the real house price in Vancouver grew 97.62%, from $364,000 to $721,000.

Figure 1



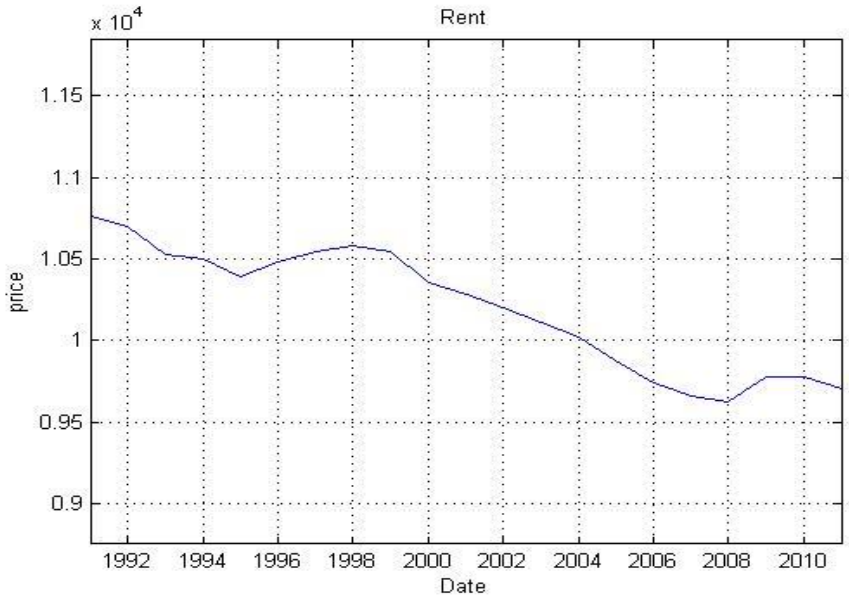
It is common to see real house prices fluctuating over the 13 years. In Greater Vancouver, the average real house price grew by 28.2 percent from 1990 to 1994 and subsequently declined 19.9 percent between 1995 and 2001. The period between 2001 and 2007 experienced a dramatic growth in the average real house price, with the price increasing 62.8 percent. Real house price in the following two years decreased

6.3 percent. From 2009 onwards, real house price showed an increasing trend and by 2012, it increased 9.6 percent. About one-third of the growth in real house price since 2001 reflects the return of house price to if previous real peak of 1994. House price in 2012 had risen 54.1 percent over the 1994 peak. Although the above descriptions, to some extent, account for the change in the house market of Greater Vancouver, they are not enough to reveal the fundamental factors and whether there is a price bubble exists.

Another conventionally used method to assess housing valuations is the house price-to-rent ratio because it compares the relative cost of owning with the cost of renting, which impact both owner-occupied and rental housing. Price-to-rent ratio, at its core, is a measure of how favourable an investment in housing is at current valuations. A higher price-to-rent ratio generally indicates a less favourable investment and a lower price-rent ratio indicates a more favourable investment. However, when the ratio is too high, people tend to choose to rent instead of buying houses. The reason why there is a situation where the ratio stays high without change is that a "bubble" exists and some "unrealistic expectations of future price gains" drive up the price.

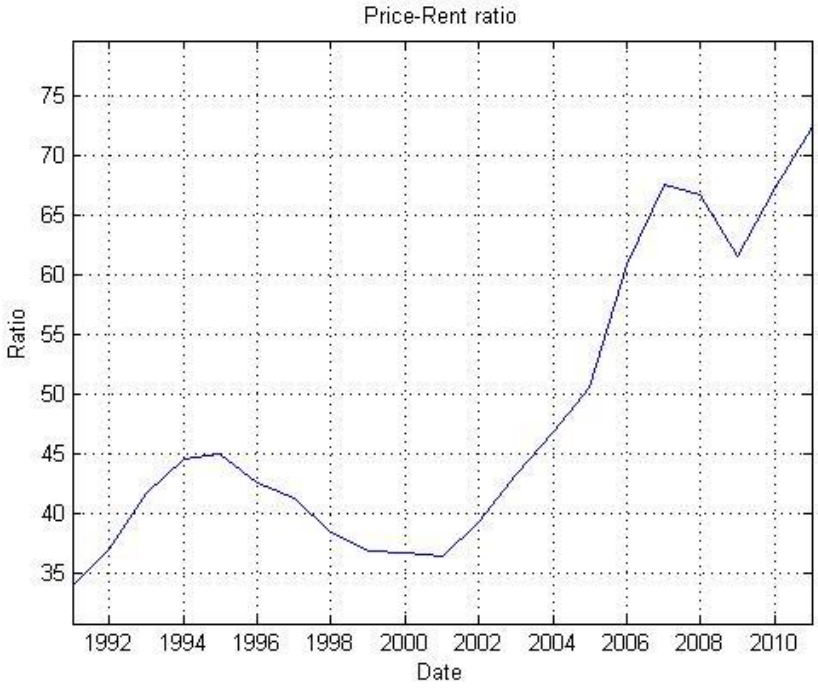
Rents are more difficult to measure, mostly because the sources of the data are not collated anywhere save through CPI measures and some other surveys that have been performed over the years. We obtained rent data from Canada Mortgage & Housing Corporation, the CMHC, which not only attempts to measure rents through broad-reaching surveys and other datasets with some success, but surveys rents from a pool of purpose-built rental units as well. We chose annual average rents for three-bedroom apartments in Greater Vancouver between 1991 and 2011, constructed the ratio of real annual hour prices relative to real annual rents and observe the movements in this ratio over time.

Figure 2



Compared to house price dynamic, rents stayed relatively stable over 22 years. According to Figure 2, rents decreased slightly 3.5 percent from 1991 to 1995 and increased slowly 0.9 percent between 1996 and 1998. After that, rents experienced an consistent decline until 2012, about 7.8 percent.

Figure 3



As shown in Figure 3, the price-to-rent ratio experienced a similar trend with the price movement. More specifically, in 1991, price-to-rent ratio stood at 33.9012. Then it rose by 32.79 percent until 1995 and subsequently fell by 14.52 percent from 1996, bottoming out at 36.4134 in 2001. After that, the price-to-rent ratio ascended substantially over the period between 2002 and 2007, peaking at 67.5487, which was 50.05 percent above its previous peak (in 1995). In the following two years, the price-to-rent ratio declined 7.81 percent and afterwards, it increased 7.57 percent to 72.4235. The real price-to-rent ratio, during 21-year period, showed an upward trend and increased 113.63 percent.

This measure shows the impact of rents on the ratio and how elevated the ratio is compared to its value through the 21-year period. The price-to-rent ratio is often view as an indicator of house market. However, there are limitations that are inherent in this measure. Several broad factors can and do influence price-to-rent ratios being higher and lower, such as market expectations of future rent appreciation, market expectations of future mortgage rates and speculation and other non-cash-flow-supporting returns. The illustration of price-to-rent ratio above is by no means a definitive measure of valuation. It is a measure with imprecise factors and should be used as part of a larger suite of measures to form an argument for the sustainability of current housing valuations.

Section IV: The User Cost of Housing

The conventional ways to measure housing market ignore the fact that the purchase price of a house is not the same as the annual cost of owning. House prices alone are not a good proxy for the cost of home ownership. When it comes to using $1 million to buy a house, the annual cost of living in this house is not $1 million. There are other costs but also benefits associated with owning a house, which cannot be ignored. On the benefit side, people avoid subjecting themselves to annual fluctuations in rent by purchasing a house that delivers a guaranteed stream of housing services for a known up-front price. Moreover, houses provide access to collateralized credit. On the cost side, homeowners are faced with not only maintenance expenses and asset price risk, but also the loss of potential gain from other alternative investment other than a house—the "opportunity cost of capital."

This section presents a measure to assess the annual cost of home owning that is grounded in economic theory and applies it to 22 years of history in the house market of Greater Vancouver. This evaluation enables us to present how the cost changes through time. In what follows, we focus on understanding the user cost measure and assess whether the recent spree on house prices can be explained by fundamentals.

We will use the most common procedure to calculate the true annual cost of owning a house in Greater Vancouver and compare it to the cost of rent to estimate whether the cost of owning is out of line with the cost of renting and whether Greater Vancouver house market is overheated.

Now there are two different scenarios for households who want to become homeowners. First, the owner is wealthy enough to pay house price at first year, there is no mortgage debt. Second, the owner has liquidity constrains and has to take mortgage.

1. First scenario, owner pays house price at one time

There are five components in the formula for the annual cost of homeownership. The first component is the opportunity cost which is the homeowner could earn if he did not buy the house. To make it normal, we just assume the opportunity cost as risk-free interest, rf that homeowner could earn from bank. This opportunity cost is calculated as house price times the risk-free rate after tax, which is P*rf*(1-0.4). Actually, tax rate is not constant, but it changes relatively little over the long-run. 40% marginal tax rate is the lowest rate in Canada for combined federal and provincial rates. The second component is the property tax. This is calculated as house price times property tax w, which is P*w. The third component is the annual depreciation of the building. Assume that a horizon of a house is 25 years, as a result, the depreciate rate is 0.04 every year. This term is therefore 0.04*P every year. The fourth component is perhaps an offset of cost of ownership. The house price increase in the next year will offset the cost of ownership in this year. We will calculate this part as P*g where g is the increase rate of long-run real annual average price. Here, we will use two different rates, one is historical average rate 3.5% and another is the expected future rate 2% in Great Vancouver. Finally, the last component is the risk premium of homeowners versus renting. According to the explanation, the total annual cost of homeownership is:

$$C = P_t * rf(1-0.4) + P_t * w + 0.04P_t - P_t g \ + P_t rp$$

It is understandable that a rational person would buy a house only when the annual cost of ownership is smaller or equal to the annual cost of renting. This means E[Annual cost of rent]=E[annual cost of ownership].

When annual cost of rent is smaller than annual cost of ownership, more people would choose to rent and the cost of rent, as a result, would increase because of the increase demand and vice versa. “No arbitrage”

states that E[Annual cost of rent]=E[annual cost of ownership] is the equilibrium. We can summarize this logic by equating annual cost of rent with annual cost of ownership.

$$R_t = P_t u_t$$

Where u is the cost of homeownership per dollar of house price:

$$u_t = rf(1-0.4) + w + 0.04 - g \ + rp$$

u is very useful because if we rearrange the equation $R_t = P_t u_t$ we can get $P_t/R_t=1/u$. It tells us that the price-to-rent ratio should equal to the inverse of the annual cost per dollar of house price. Thus, if we know u, we can get the calculated P_t/R_t ratio and compare it with the real P_t/R_t ratio we get from market. If the calculated ratio is smaller than real ratio it means there are bubbles in real estate market. The bigger the ratio gap, the larger the bubble is.

For example, Figure 4 shows the cost of ownership per dollar in year 1991 is 5.26%, that is, for one dollar of price, the owner pays 5.26 cents. This means people should be willing to pay up to 19 times (1/0.0526) the market rent to purchase a house. For example, a three-bedroom apartment that rents for $10697 should sell for up to $203,243. This price-to-rent ratio provides a standard for us to judge whether the price level is “too high” or “too low”. Let’s back on the example, the real house price in year 1991 is $395,570. This is far higher than $203,243. So as a rational buyer, one should wait. Figure 4 below shows the 1/u in different years which is calculated P_t/R_t ratio. We can see the 1/u is always smaller than Real Price-Rent ratio near 2011 which means we should rent a house instead of buying in this period. Here, we can see red line has a drastic increase in the last three years, which means u decrease a lot. From the Appendix, we can see risk-free rates turn to negative in the last three years. These negative rates would heavily decrease u. That is the reason why 1/u raises quickly.

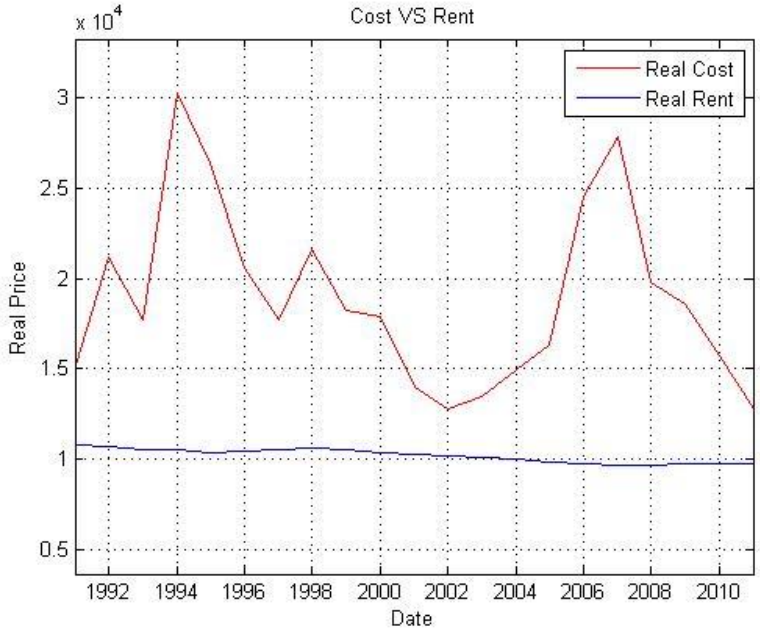
Figure 4(Historical price growth 3.5%)

Figure 5(Expected price growth 2%)

While if we use the expected price growth 2%, the figure above shows that buying a house would not be a good choice in anytime.

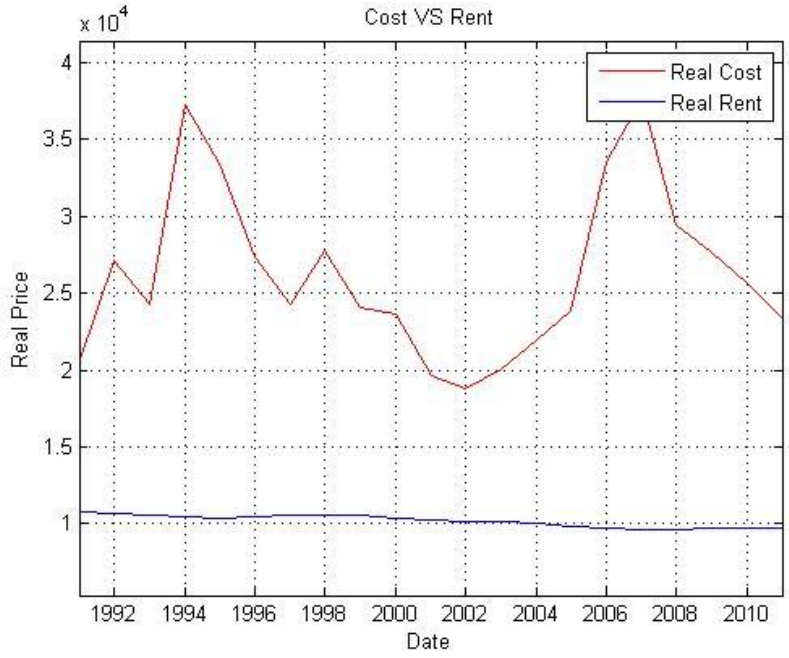
Then we change another method to make a decision on whether buying or renting: Compare the cost of ownership with the rent.

Figure 6(Historical price growth 3.5%)



We can see the rent keeps smaller than cost of ownership, which means it is cheaper to rent.

Figure 7(Expected price growth 2%)

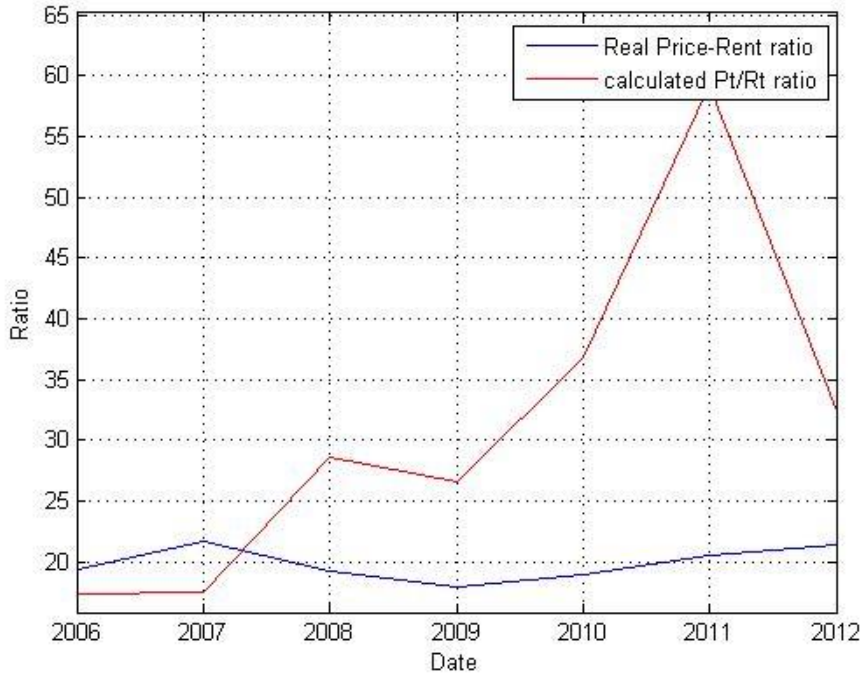


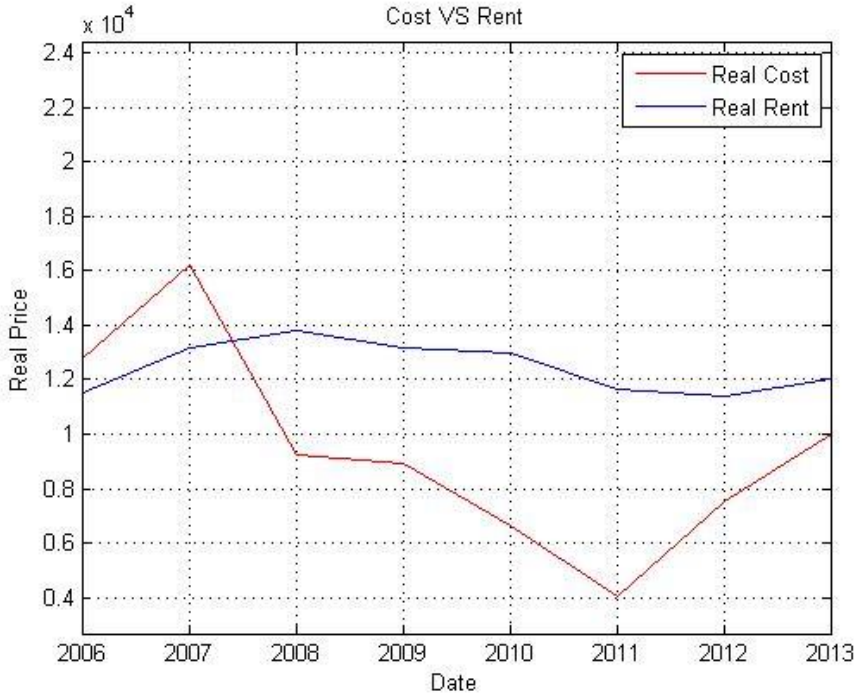
While if we use the expected price growth 2%, the figure above shows that buying a house would not be a good choice in anytime.

The two methods give us the same conclusion so we can use either one in reality analysis. However, if we use different price growth rate, the final results would be very different. Find an exact growth is very important.

The Figure 8 below shows the situation in Calgary.

Figure 8





The situation in Calgary is much different. From the first figure, we can see the 1/u exceeds Real Price-Rent ratio near 2007 which means we should buy a house instead of renting.

So, in Vancouver we should rent rather than buy until 2011 while in Calgary we should buy from 2007 and ever after. And the second figure gives us the same answer.

1.1 Cost of homeownership to changes of different components:

First, the real interest rate is an important determinant of the cost of ownership. A lower real interest rate reduces the cost of ownership. This is obviously,

$$u_t = rf + w + 0.04 - g + rp$$

When rf is smaller, the u would be smaller. This is because the lower real interest rate gives buyer a lower cost on financing. This also means the opportunity cost is smaller. In practice, people tend to buy house because mortgage interest is low and alternative investments do not yield much. Similarly, lower property tax w and lower risk premium rp would also decrease cost of ownership.

Conversely, a higher or fast average house price growth will reduce cost of ownership.

1.2 Sensitivity of cost of homeownership to real interest rates

Table 1

1-year riskfree rate 5%	**1-year riskfree rate 6%**	**% change in cost of ownership**
0.0736	0.0835	13.45
1-year riskfree rate 6%	**1-year riskfree rate 7%**	**% change in cost of ownership**
0.0835	0.0936	12.1

Table 1 above shows the percentage increase of the cost of ownership if risk-free rate changed one percentage. The numbers in table are cost of ownership. In my example, increasing the real interest rate from 5% and 6% to 6% and 7%, respectively, would lead to the increase of 13.45% and 12.1% in the cost of ownership, respectively.

It is apparent from these calculations that the lower the already interest, the higher the sensitivity of cost to changes of interest. Besides, the price-to-rent ratio equals the inverse of the cost. Increasing cost means decreasing price-to-rent ratio.

Therefore, we assume the real rent in Greater Vancouver is constant and the current risk-free rate is low. A given increase in risk-free rate will induce a larger potential percentage decrease in house price than the same increase in risk-free rate would cause starting from a high risk-free rate. Of course, the reverse is true.

Now we should focus on another important factor—the expected growth rate of housing prices. Because the expected growth has negative correlation with cost, a higher expected growth would lower the cost of homeownership.

Change in real interest rate will induce a larger potential percentage change in high appreciation area than in low appreciation area.

Table 2

Appreciation rate 4% with riskfree rate 5%	**Appreciation rate 4% with riskfree rate 6%**	**% change in cost of ownership**
0.0687	0.0786	14.41
Appreciation rate 5% with risk-free rate 5%	**Appreciation rate 5% with risk-free rate 6%**	**% change in cost of ownership**
0.0587	0.0686	16.87

According to Table 2, we assume the expected appreciation on house price is 4% and 6%, respectively. Then in each situation, the risk-free rate increase one percentage from 5% to 6%. As can be seen in the table, one percentage increase in risk-free rate could raise cost of ownership much larger in a higher appreciation rate condition.

2. Second scenario, owner pays house price with mortgage

In this scenario, owner does not pay house price at one time, instead, he will use mortgage to pay several years.

There are five components in the formula for the annual cost of homeownership. The first component is the opportunity cost which is the homeowner could earn if he did not buy the house. To make it normal, we just assume the opportunity cost as risk-free interest, r*f, that homeowner could earn from bank. This opportunity cost is calculated as Mortgage payment every year plus down payment times the risk-free rate,

which is (MortgagePayment+DownPayment)*rf. Here, I use software to calculate mortgage payment every year according to different mortgage rate. The down payment assumed here is 20% in all years. Because for down payments of less than 20%, home buyers are required to purchase mortgage default insurance. To make model simple and easy to understand, I assume it 20% so no insurance is required. If insurance have to be taken into consideration, the various insurance rate would complicate the model. The second component is the property tax. This is calculated as house price times property tax w, which is P*w. The third component is the annual depreciation of the building. According to Canada rule, this depreciate rate is 0.04 every year. This term is therefore 0.04*P every year. The fourth component is perhaps an offset of cost of ownership. The house price increase in the next year will offset the cost of ownership in this year. We will calculate this part as P*g where g is the average increase rate of house price in the next year. Owner has no idea what the next year growth would be. So we use a long-term average. Finally, the last component is the risk premium of homeowners versus renting. According to the explanation, the total annual cost of homeownership is:

$$C_i = (i * Mrtg + P_t * 0.2) * rf\,(1-0.4) + P_t * w + 0.04P_t - P_t g \; + P_t rp$$

Where C_i is the ith year cost of ownership, 1<= i <=20. We assume a 20- year-mortgage.

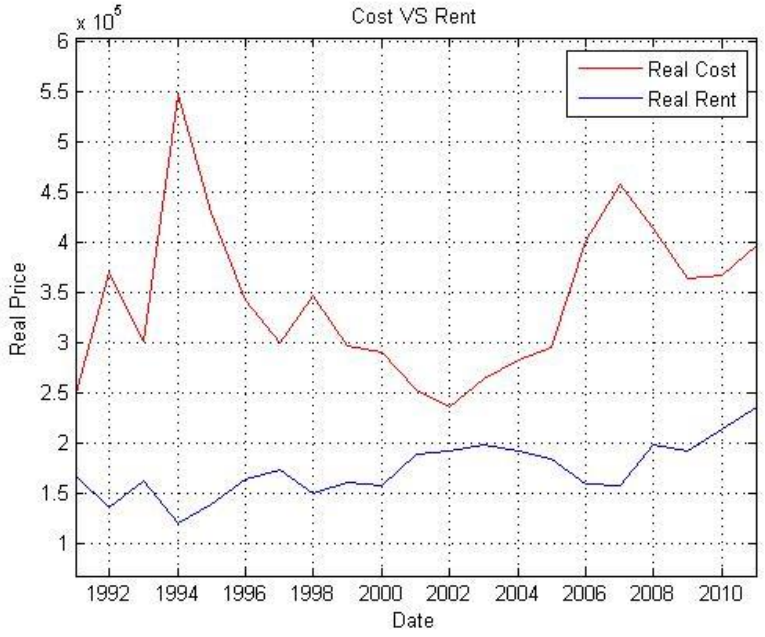
As we talked about in scenario one that a rational person would buy a house only when the annual cost of ownership is smaller or equal to the annual cost of renting. This means E[Annual cost of rent]=E[annual cost of ownership].

Here comes a big difference with the first scenario, the cost of ownership is no longer the same in every year. The differences in every year are because the total mortgage paid increase every year. And as we know, the opportunity cost comprise of two parts. One is down payment times risk-free rate, this part is same in every year. The other part is the total mortgage already paid times the risk-free rate, this part increase with time. Overall, the cost of ownership rise with time going by. So we change the equilibrium to E[Total cost of rent]=E[Total cost of ownership].

Therefore, we can no longer make a decision on buying or renting just according to the first year cost of ownership. We should use other method to help us make a decision.

Now we should sum all the cost of ownership every year and compare it with the total rent we pay during this period. We assume all the other factors in cost of ownership stay constant. Figure 9 below shows the total cost of ownership VS total renting.

Figure 9(Historical price growth 3.5%)



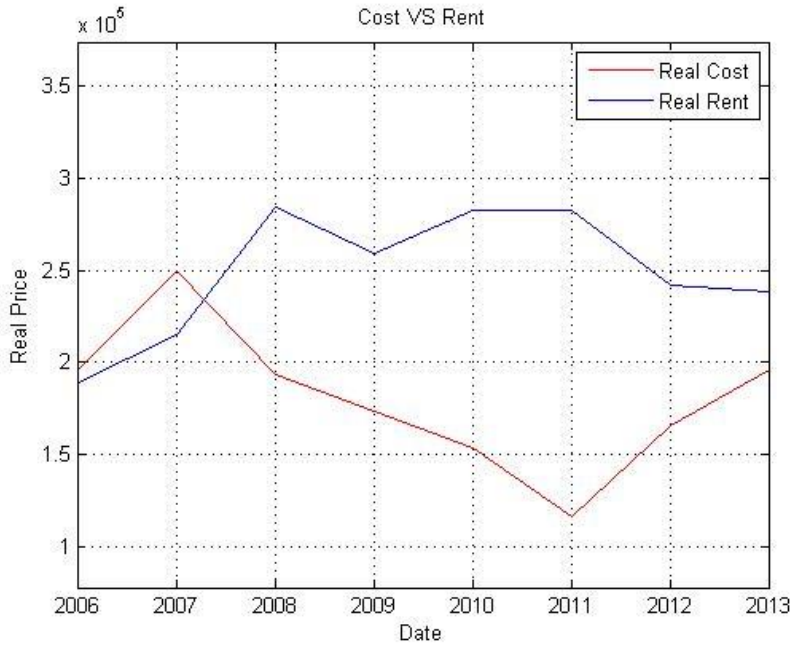
We can see the cost of ownership is always larger than renting. This suggests that if we decide to take a mortgage, it would not be a good idea. The best choice in Vancouver is renting.

Figure 10(Expected price growth 2%)

The cost of ownership is also larger than renting in this whole period. This suggests that it would not be a good idea to own a house. The best choice in Vancouver is renting.

Figure 11 below shows the situation in Calgary

Figure 11



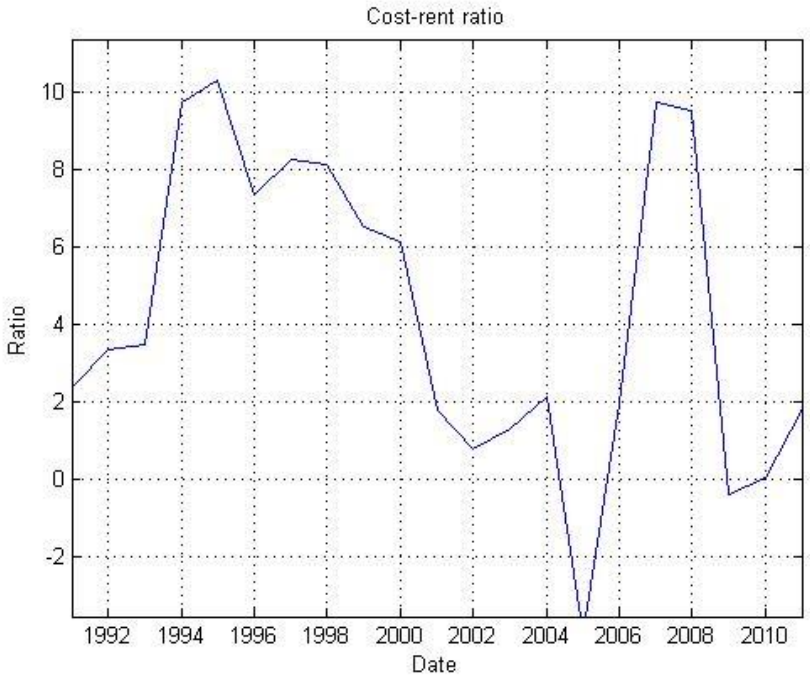
We can see the different situation in Calgary, the Real Cost fall below Real Rent near 2007. This means we should buy a house using mortgage from 2007 and ever after.

Section V: Are current house prices too high?

1. Cost-to-Rent ratio

One way to see whether the prices are too high is to compute the rent by using our formula in page 5 and compare it to real rent got from the market. We create a compute-to-real rent ratio by dividing the computed rent by the real rent. This ratio shows us the changes of cost of owning a house relative to renting the same one in Greater Vancouver from 1991 to 2012.

Figure 12



As shown in Figure 12, we can clearly see the changes of computed cost-to-rent ratio. However, we cannot come to a simple conclusion about the price level. The ratio is not a good judgment of whether the price is "too high" and it only gives us a way to measure the changes but not a way to make a conclusion.

2. Tenure choice in two scenarios

We know there are two ways to buy a house. One is paying it at one time and the other one is paying periodically by mortgage. What about the cost of ownership between two scenarios? Which way should we use when we decide to buy a house? Now we put the total cost of ownership of two scenarios in one figure. Figure 13, 14 and 15 below show the different situations in Vancouver and Calgary.

Figure 13(Historical price growth 3.5%)

Figure 14(Historical price growth 2%)

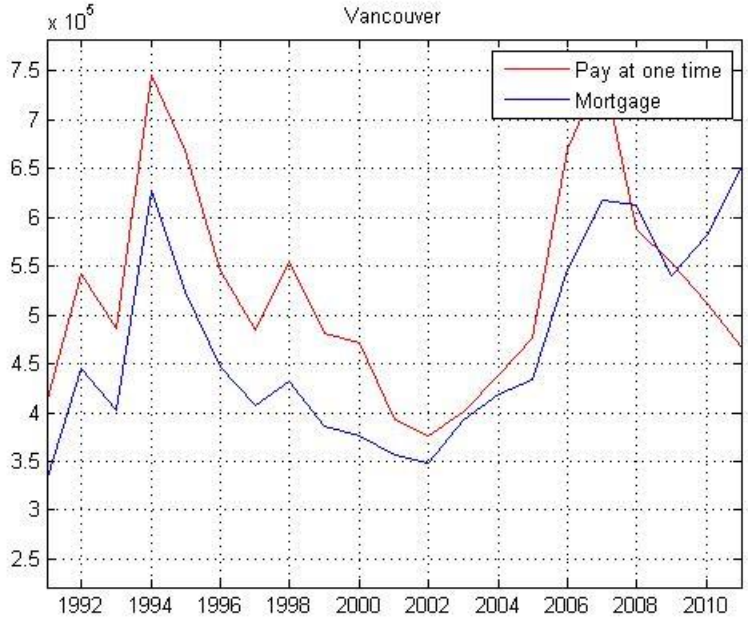
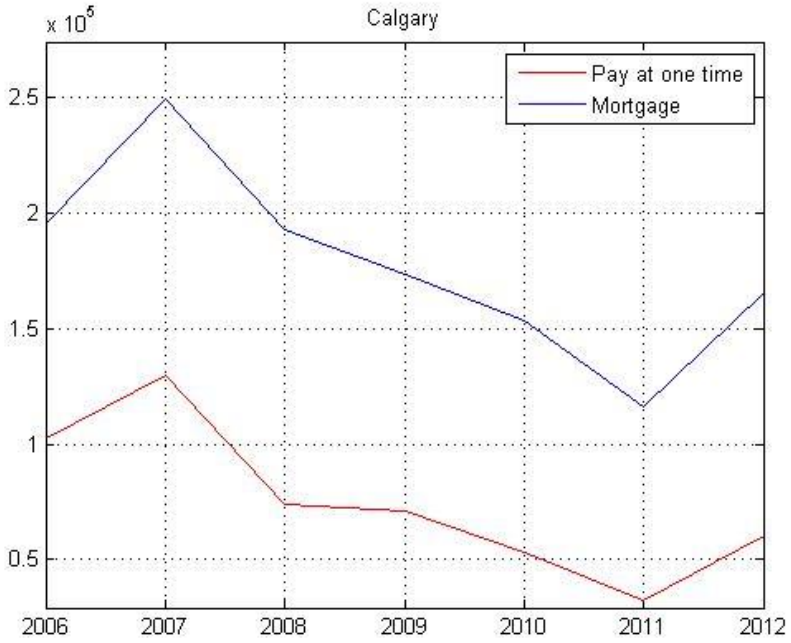


Figure 15



We can see that mortgage cost is always smaller from 1991 to 2008 in Vancouver no matter what the price growth are, while the situation is totally different in Calgary. The mortgage method would never be a good choice to buy a house in Calgary because the cost of mortgage is always larger.

Therefore, it tells us that different cities have different situations, when we decide to buy a house we should choose the best way, which means the lowest cost of total ownership.

Section VI: What might be missing in these calculations?

To begin with, the rent data comes from three-bedroom apartment in Greater Vancouver while the house price data comes from the single-family house. They are two different kinds of residential. This mismatch would have negative impacts on our results. The problem with average existing rent is that rent growth is limited in Vancouver by the apartment owner association. It is usually flat 3% nominal. So true market rents are represented only by newly constructed units that are not restricted. This data can only represent the returns to an existing owner, but do not fully capture the true market conditions. The ideal data should

be come from the same type residential. However, we met a trouble to get the excellent data source, so we have to use the data that we can find.

Alternative issue is the down payment. In our model, we did not consider about the down payment influence on the cost of ownership. Generally, every house buyer is required to pay a down payment, from 20% to 50%. Down payment certainly has impact on buyer's liquidity and therefore impacts the cost of ownership.

Third, in my model we only consider the owner-occupied house, not the second or investment purpose houses. This is because the second or investment purpose houses are not tax deductible. The fifth factor of formula in page 2 should be removed in this condition.

Next issue is the depreciation rate we use in the formula. Actually, only the residential part depreciates with time, the land does not depreciate. House price includes the price of residential part and land, if we depreciate the total house price it means we use a too high depreciate rate. That means 0.04 is too high here.

Another potential shortcoming is that we assume that no cost between owning and renting. In reality, broker commissions and moving cost make the cost of switch between owning and renting more expensive than our computed cost of ownership. These transaction costs may make the real market cost of owning a house bigger than my computed cost.

Section VII: Conclusion

This essay mainly focus on how to calculate the annual cost of owner-occupied house roughly and how to measure the price by comparing this cost to annual rent. However, one cannot draw a conclusion whether the house price is "too high or too low" just based on cost of ownership. There are no standard rules to judge the price level. We need to combine many other factors such as politics, consumption level and so on. Unexpected changes in the future could make huge price fluctuate even though the price seems moderate now. For example, an unexpected risk-free rate rise would raise cost of ownership. Or weak economy would reduce growth of price in the future and thus may reduce the house price. However, this fact cannot prove that houses today are mispriced. We have another way to judge the price level using cost of ownership, which is the reverse of cost of ownership per dollar, 1/u. As what we discussed before, 1/u means how much more people are willing to pay for purchasing a house rather than renting. Assume

1/u is 20 and the annual rent is 12,000, people would be willing to pay 12000*20=240,000 to buy a house. If the market price is much higher than $240,000, we could say there is bubble in price.

Reference

Brown, R., Brown, R., O'connor, I., Schwann, G. and Scott, C. (2011) The Other Side of Housing Affordability: The User Cost of Housing in Australia. Economic Record

Case, K. E., Shiller, R. J. (2003) Is there a bubble in the housing market? Brookings Papers on Economic Activity 34(2): 299-362

Chambers, M., Garriga, C. and Schlagenhauf, D. E. (2009) Accounting for Changes in the homeownership Rate. International Economic Review 50(3): 677-726

Davidoff, T. (2003) Labour Income, Housing Prices, and Homeownership. Mimeo, UC Berkeley.

Díaz, A., Luengo-Prado, M. J. (2008) On the User Cost and Homeownership. Review of Economic Dynamics 11(3): 584-613

Favara, G., Imbs, J. (2010) Credit Supply and the Price of Housing.

Girouard, N., Kennedy, M., van den Noord, P. and Andr, C.(2006) Recent House Price Developments: The Role of Fundamentals. OECD Economics Department Working Papers 475

Haffner, M., Heylen, K. (2011) User costs and Housing Expenses. Towards a more Comprehensive Approach to Affordability. Housing Studies 26(4): 593-614

Harding, J.P., Rosenthal, S.S., Sirmans, C. (2007) Depreciation of Housing Capital, Maintenance, and House Price Inflation: Estimates from a Repeat Sales Model. Journal of Urban Economics 61(2): 193-217

Hattapoglu, M. (2009) The Dependency of Rent-to-price Ratio on Appreciation Expectations: Theory and Evidence.

Hattapoglu, M., Hoxha, I. (2013) The Dependency of Rent-to-price Ratio on Appreciation Expectations: An Empirical Approach. The Journal of Real Estate Finance and Economics.

Henderson, J. V. and Ioannides, Y.M. (1983) A Model of Housing Tenure Choice. American Economic Review 73(1): 98-113

Himmelberg, C., Mayer, C. and Sinai, T. (2005) Assessing High House Price: Bubbles, Fundamentals and Misperceptions. Journal of Economic Perspectives 19(4): 67-92

Ortalo-Magné, F., Rady, S. (2002) Tenure Choice and the Riskiness of Non-housing Consumption. Journal of Housing Economics 11(3): 266-279

Paciorek, A. (2013) Supply Constrains and Housing Market Dynamics. Journal of Urban Economics.

Pavlov, A., Wachter, S. (2011) Subprime Lending and Real Estate Prices. Real Estate Economics 39(1): 1-17

Poterba, J. M. (1991) House Price Dynamics: The Role of Tax Policy and Demography. Brookings Papers on Economic Activity 2: 83-143

Poterba, J. M. (1984) Tax Subsidies to Owner-occupied Housing: An Asset Market Approach. Quarterly Journal of Economics. 99(4): 52-729

Poterba, J. M., Sinai, T. (2008) Tax Expenditures for Owner-occupied Housing: Deductions for Property Taxes and Mortgage Interest and the Exclusion of Imputed Rental Income. American Economic Revies 98(2): 84-89

Shiller, R. J. (2007) Understanding Recent Trends in House Prices and Homeownership. Proceedings, 89-123

Sinai, T., Souleles, N. S. (2005) Owner-occupied Housing as a Hedge Against Rent Risk. Quarterly Journal of Economics. 120(2): 789-763

Skinner, J. (1996) The Dynamic Efficiency Cost of not Taxing Housing. Journal of Public Economics 59(3): 397-417

Sommer, K., Sullivan, P. and Verbrugge, R. (2010) Run-ups in the House Price-rent Ratio: How Much Can be Explained by Fundamentals.

Appendix

Great Vancouver without mortgage data

Year	Price	Rent	Risk-Free rate	Property tax	Risk Premium
1991	364913	10764	0.028	0.00745	0.0121
1992	395568	10697	0.0535	0.00759	0.0089
1993	438825	10527	0.02925	0.0069	0.0109
1994	467943	10504	0.06625	0.00647	0.0134
1995	467615	10387	0.0465	0.00605	0.0175
1996	446318	10477	0.02775	0.00592	0.0186
1997	435200	10545	0.02125	0.00602	0.017
1998	406735	10578	0.0395	0.00584	0.0187
1999	389545	10543	0.03075	0.00606	0.0172
2000	380105	10353	0.03	0.00628	0.0178
2001	374580	10287	0.00925	0.0064	0.0204
2002	400678	10201	0.00675	0.00662	0.0162
2003	437398	10108	0.00175	0.00661	0.0182
2004	470475	10019	0.00425	0.00634	0.0178
2005	499308	9876	0.008	0.00599	0.0169
2006	592770	9743	0.02175	0.00564	0.0178
2007	652438	9659	0.022	0.00495	0.0195
2008	642763	9627	-0.00325	0.00431	0.0234
2009	601960	9780	0.002	0.00423	0.0205
2010	658038	9774	-0.009	0.00421	0.0201
2011	703060	9708	-0.01975	0.00418	0.0208
2012	721143	9718	-0.006	0.00405	0.0206

Great Vancouver with mortgage data

Year	Mortgage Payment	Risk-Free rate	Property tax	Risk Premium
1991	23496	0.028	0.00745	0.0121
1992	31452	0.0535	0.00759	0.0089
1993	31632	0.02925	0.0069	0.0109
1994	40728	0.06625	0.00647	0.0134
1995	34140	0.0465	0.00605	0.0175
1996	30708	0.02775	0.00592	0.0186
1997	28428	0.02125	0.00602	0.017
1998	27804	0.0395	0.00584	0.0187
1999	26064	0.03075	0.00606	0.0172
2000	24768	0.03	0.00628	0.0178
2001	22728	0.00925	0.0064	0.0204
2002	24108	0.00675	0.00662	0.0162
2003	23832	0.00175	0.00661	0.0182
2004	26892	0.00425	0.00634	0.0178
2005	27252	0.008	0.00599	0.0169
2006	34476	0.02175	0.00564	0.0178
2007	39156	0.022	0.00495	0.0195
2008	36744	-0.00325	0.00431	0.0234
2009	37200	0.002	0.00423	0.0205
2010	35136	-0.009	0.00421	0.0201
2011	33108	-0.01975	0.00418	0.0208
2012	36972	-0.006	0.00405	0.0206