January 2017

Can Money Illusion Effect Explain Hong Kong Housing Market?

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CAN MONEY ILLUSION EFFECT EXPLAIN HONG KONG HOUSING MARKET?

by

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A Thesis

Submitted to the Graduate Faculty

of the

University of North Dakota

In partial fulfillment of the requirements

for the degree of

Masters of Science in Applied Economics

Grand Forks, North Dakota

May 2017

This thesis, submitted by Kuen Kuen Ho in partial fulfillment of the requirements for the Degree of Master of Science in Applied Economics from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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PERMISSION

Title: Can Money Illusion Effect Explain Hong Kong Housing Market?

Department: Applied Economics

Degree: Master of Science in Applied Economics

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Kuen Kuen Ho

April 26, 2017

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ACKNOWLEDGEMENTS

I wish to express my sincere appreciation to the members of my advisory committee for their guidance and support during my time in the master's program at the University of North Dakota. I would like to especially thank Dr. Xiao Wang who provided valuable insight and direction during my research process.

ABSTRACT

This paper studies if the Hong Kong housing market from 1993:Q1 to 2016:Q2 can be explained by money illusion. When people suffer from money illusion, a drop in inflation can lead to a high increase in housing prices since they mistakenly believe that inflation lowers the real interest rate, and the future fixed nominal mortgage payments in the real cost are underestimated. Unlike the supportive evidence of money illusion on the UK housing market found by Brunnermeier and Julliard (2007), no empirical link was found between inflation and the estimated mispricing term (implied irrational component) of the price-rent ratio in the Hong Kong housing market. Money illusion may not be universal and more efforts are required to explain the housing market in each country.

CHAPTER I

INTRODUCTION

Residential property is the largest asset to general households and property prices have an influential effect on a country's economic growth. Most households have to pay mortgages for 20 to 30 years with a substantial portion of their monthly income[1]. Stability in the housing market values plays a vital role to the financial well-being of households. Moreover, from the examples of the housing crisis in Hong Kong during 1997 and in the US during 2006, the economies in both countries were negatively affected shortly after the collapse of the housing market.

Figure 1 shows the property price index and the unemployment rate in Hong Kong before and after the housing crisis in 1997. The unemployment rate increases abruptly at almost the same time as the housing prices drop. A similar phenomenon is observed in the US market in 2006 as illustrated in figure 2.

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[1] The typical mortgage term in Hong Kong is 20 to 30 years, and a minimum of 10% and 30% down payment is commonly required for the new construction and the secondary market respectively. The mortgage-backed securitization market in Hong Kong is governed by the Hong Kong Mortgage Corporation Limited (HKMC), incepted in 1997. Compared to the US securitization market, the level of securitization activities is relatively low and the market is less liquid and matured (http://www.hkmc.com.hk).
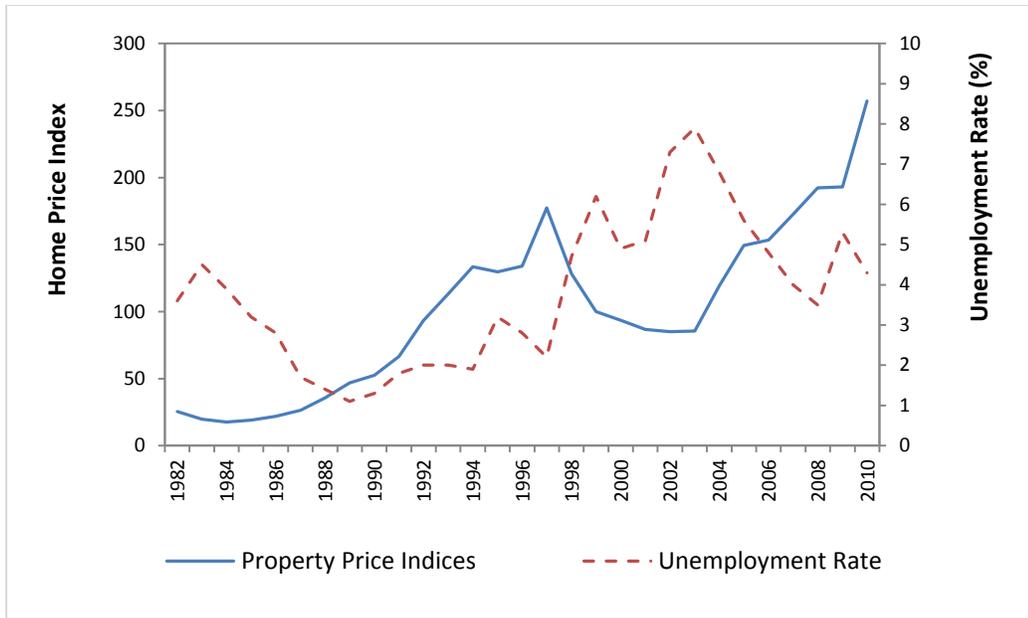
Figure 1: Hong Kong Home Price Index and Unemployment Rate
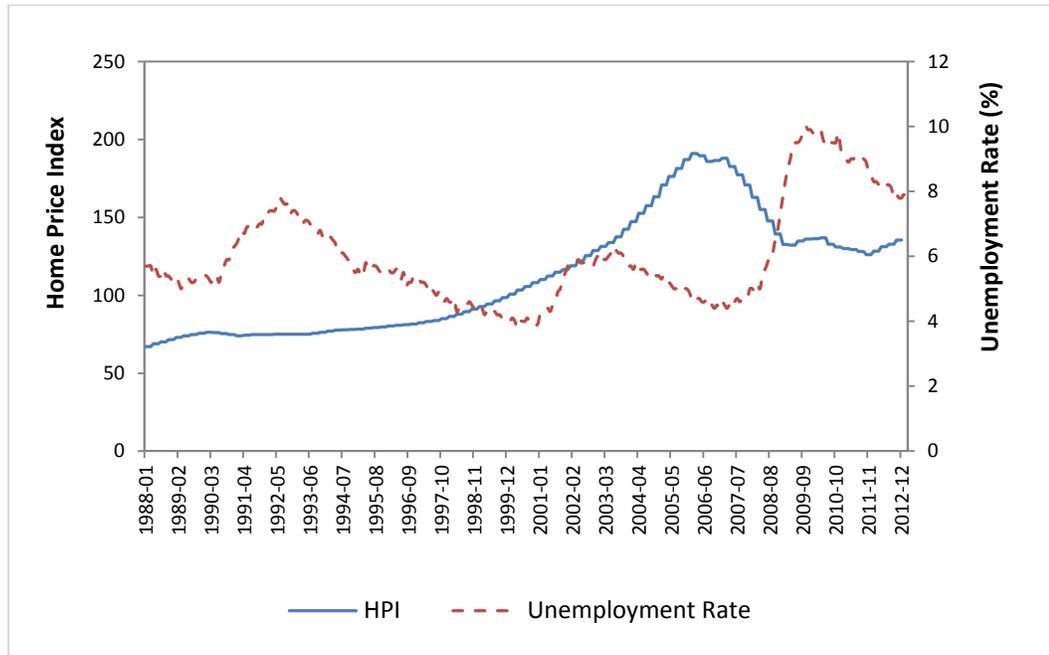(Source: Hong Kong Ratings and Valuations Department)

Figure 2: U.S. Case-Shiller Home Price Index and Unemployment Rate
(Source: Standard and Poor's and U.S. Department of Labor - Bureau of Labor Statistics)

The housing prices in Hong Kong have reached extraordinarily high levels in the past 15 years[2]. To provide some perspectives, using the Hong Kong housing data in 2015, the average price of an 800-square foot apartment in Hong Kong was USD 1.34 million (Hong Kong Ratings and Valuations Department 2015). Since 2011, Hong Kong has been rated as the most unaffordable housing market in the world according to the annual Demographia International Housing Affordability Survey of January 2016. In 2015, the average apartment price in Hong Kong was 19 times the median gross annual income, the highest measure ever in the past 11 years (Li 2016). In addition, to qualify for a mortgage, 30% down payment of the property is usually required in the secondary market. Therefore, it is a non-trivial undertaking for a family to own property in Hong Kong. The biggest complaint among all other social issues such as education, healthcare, etc. from the general public in Hong Kong is housing affordability.
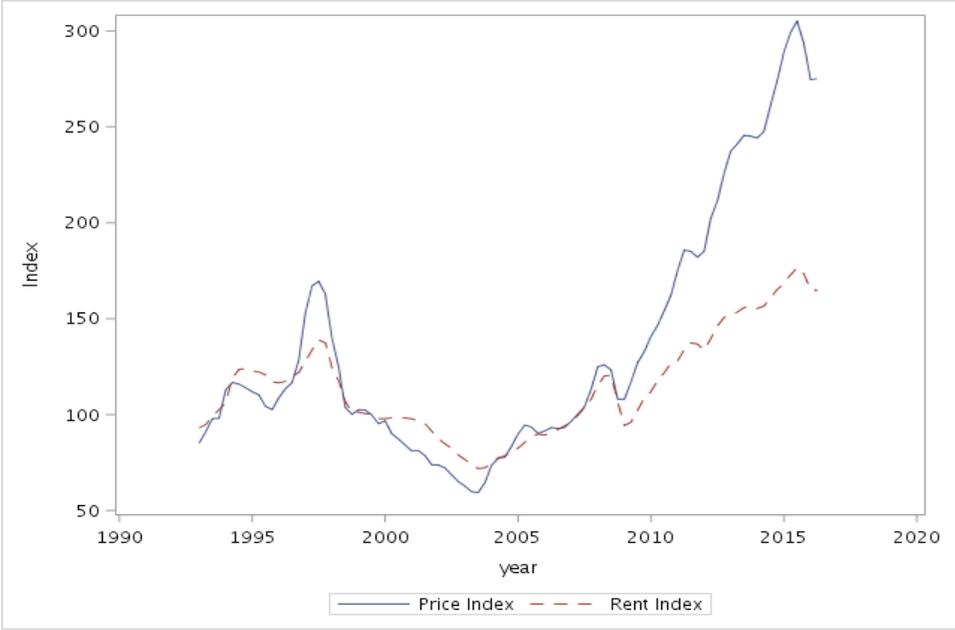
Figure 3: Hong Kong Housing Price and Rent Index from 1993 to Second Quarter of 2016 (Source: Hong Kong Ratings and Valuations Department)

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[2] The Hong Kong government has imposed multiple curbs to the housing market such as introduction of a stamp duty and increase in property taxes as they believe that the market has been over heated since 2010. Together with the economy slowdown in China and anticipated rising interest rate, the housing prices declined slightly in 2016.

Why can residential prices be and stay so high for such a long time? Some possible reasons are: (1) the demand of houses in Hong Kong is high with a population over 7.3 million (Hong Kong Census and Statistics Department 2016). (2) Hong Kong is a very small island with a total land area of 1,106 square kilometers and the government limits the supply of land for housing development. (3) Mortgage interest rates have been persistently low. (4) Large amounts of investment capital from mainland China to the housing market have pushed prices, especially for luxury property, to a very high level.

In addition to these commonly known/speculated reasons, economists have also studied the topic of the Hong Kong housing market. A number of studies specifically discussed the existence of the Hong Kong housing bubbles. Hui, Ng, and Lau (2011) confirmed that there were speculative bubbles in the overall housing market before 2003 and in the luxury properties market around 2008 in Hong Kong. Hui and Yue (2006) compared the Hong Kong housing bubble during 1997 with the potential housing bubble in the Shanghai and Beijing housing markets, and concluded that a housing bubble existed in the Shanghai market, similar to the Hong Kong market, but not in the Beijing market.

Xiao and Liu (2010) studied if the residential market in Hong Kong experienced a rational or irrational price level.   A similar study was conducted by Chan and Lee (2001) to understand if the Hong Kong housing market was at a mispricing level. Both studies focused on using the fundamental model defining market fundamental price as sum of the expected present value of rental income, discounted at a constant rate of return. These studies showed that the Hong Kong housing market could not be fully explained by the fundamentals nor the rational component, and there was also an irrational, unobservable misspecification component.

Based on the literature review, there is an unexplained irrational component in the price level of the Hong Kong housing market, and the objective of this paper is to study if the money illusion effect can explain the irrational component of the Hong Kong housing market using data from 1993:Q1 to 2016:Q2. It is reasonable to believe that money illusion matters in the Hong Kong housing market. First, Brunnermeier and Julliard (2007) found an empirical link between money illusion and the irrational component (implied mispricing) of the UK housing market and there are several similarities between the Hong Kong and the UK housing markets.

Hong Kong was ceded to and ruled by Britain for over 100 years, from 1841 to 1997. Some fundamental policies in the economic environment, credit and housing market in Hong Kong are still rooted from the policies of the British government. The two countries' economies are still connected very closely with a strong presence of British owned banks and corporations in Hong Kong. In addition, the housing prices in Hong Kong have been unusually high in recent years, similar to the UK housing market when Brunnermeir and Julliard (2007) conducted their study.

Secondly, according to Case and Shiller (1989, 1990), due to inefficiency in the housing market, housing price changes are predictable, and money illusion is one of several reasons of market inefficiency in the housing market. As pointed out by Brunnermeier and Julliard (2007), since possible mispricing in the housing prices cannot be arbitraged away easily by professional investors due to market frictions, money illusion is a good candidate for explaining the housing market.

Moreover, Fehr and Tyran (2001) also concluded that the combined direct and indirect effects of money illusion could generate a very large increase in prices. The direct effects of money illusion referred to individuals who directly suffered from money illusion and made

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decision mistakes. The indirect effects of money illusion referred to other agents' behavioral change because of the expectation of others who were prone to money illusion.

This study follows closely with the methodology in Brunnermeier and Julliard (2007) who studied the money illusion hypothesis on the UK housing data from 1966:Q2 to 2005:Q1. They decomposed the UK housing price-rent ratio into the rational component and the implied mispricing component, and found that the mispricing could be largely explained by inflation in a negative relationship. Their study showed an empirical evidence of the money illusion effect on the UK housing market and was not caused by the tilt effect[3].

When the housing market suffers from money illusion, housing prices can increase substantially when inflation drops. People make their decision to buy or rent a house by comparing the monthly rent and monthly payment of mortgage with a fixed nominal interest rate. With money illusion, they assume that real and nominal rates move in the same direction. When inflation is low, they mistakenly believe that the real interest rate is also low and underestimate the real cost of future fixed nominal mortgage payments. In other words, the future mortgage payments are larger in real terms. If a decline in inflations leads people to expect lower mortgage payments, this creates upward pressure to the housing prices as the demand of houses (mortgages) increases according to Brunnermeier and Julliard (2007, p. 3).

In order to isolate the rational component of price changes due to movements in fundamentals, Brunnermeier and Julliard (2007) focused on the use of price-rent ratio. Although renting and buying a house were not perfect substitutes, the price-rent ratio implicitly controlled for the movements of fundamentals that affected prices and rents symmetrically (e.g.

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[3] Inflation can shift the real financial costs towards the earlier years of the mortgage and this can cause an increase in housing demand and prices under nominal fixed interest payment mortgages in a low inflation environment.

demographics, land cost, etc.). The price-rent ratio was then decomposed into the rational component (the expected return on housing and the expected rent growth rate) and the mispricing component.

Since there was no prior study of money illusion conducted for the Hong Kong market based on the literature review, this paper studies if inflation can explain the Hong Kong housing market by decomposing the rational and irrational component (implied mispricing) of the Hong Kong housing price-rent ratio from 1993:Q1 to 2016:Q2. Unlike the money illusion effect found in the UK housing market by Brunnermeier and Julliard (2007), based on the empirical results in this study, money illusion does not appear to be able to explain the skyrocketing prices in the Hong Kong housing market during 1993:Q1 and 2016:Q2. The fitted series, using inflation as the only regressor to predict the estimated mispricing term, does not track very closely with the target variable. The signs of inflation as the explanatory factor are positive in all three regressions which is contradictory to the money illusion hypothesis, i.e. the housing prices increase when inflation drops.

Nevertheless, the key conclusion in this study is that money illusion may not be universal across all housing markets, with the Hong Kong market as an example. Each country's housing market can be uniquely affected by its own set of factors and surrounding environment. In order to explain the housing market in Hong Kong in the last 20 years, more efforts need to be made to test the possible contributions from other market inefficiencies.

CHAPTER II

DATA AND METHODOLOGY

Data Used

All Hong Kong data used in this study are sourced directly from the three major Hong Kong government agency websites: Hong Kong Rating and Valuation Department (RVD), Hong Kong Monetary Authority (HKMA), and Hong Kong Census and Statistics Department (CSD). They are reputable government agencies in Hong Kong who maintain relatively comprehensive and organized databases related to the Hong Kong housing market (RVD), economy (HKMA), and society (CSD) so the data used in this study are of good quality.

Some data series are available for longer history than others, but for consistency I conduct this empirical analysis using data from the first quarter of 1993 to the second quarter of 2016. In the event the data series is available monthly instead of quarterly, monthly data series is converted to quarterly data series by taking a three-month average. Table 1 summarizes the raw data series collected, brief descriptions of the series, and their sources.

Table 1: Data Descriptions and Sources

Data Series	Description	Data Source
Composite Consumer Price Index (CPI)	Consumer Price Indices (CPIs) are compiled to reflect the impact of consumer price changes on households in different expenditure ranges. Based on the results of the Household Expenditure Survey (HES), the expenditure weights of CPIs are updated regularly. The CPIs refer to 2009/10-based index series.	Census and Statistics Department

Table 1 Cont.

Data Series	Description	Data Source
Inflation	Calculated from CPI: $\frac{(CPI_t - CPI_{t-1})}{CPI_{t-1}}$	
Nominal Interest Rate	One month time and saving deposits rates on deposits of less than HK$ 100,000 (% per annum) based on the interest rates quoted by major licensed banks.	Hong Kong Monetary Authority
10-year Government Bond	Yields on 10-year government bond	Hong Kong Monetary Authority
Property Price Index	Private retail property price index (base year 1999)	Hong Kong Rating and Valuation Department
Property Rent Index	Private retail property rent index (base year 1999)	Hong Kong Rating and Valuation Department

Table 2 is the summary statistics for the data collected from 1993:Q1 to 2016:Q2. As inflation is calculated using the previous quarter Consumer Price Index (CPI), the number of observations for inflation is one less than all the others.

Table 2: Summary Statistics

Data	Obs.	Mean	Std. Dev.	Min	Max
Inflation	93	0.0059	0.0135	-0.0225	0.0368
Nominal Interest Rate	94	0.0203	0.0230	0.0000	0.0765
Government Bond Rate	94	0.0441	0.0160	0.0164	0.0784
Price Index	94	135.86	65.49	59.28	305.16
Rent Index	94	114.55	27.18	71.87	176.56
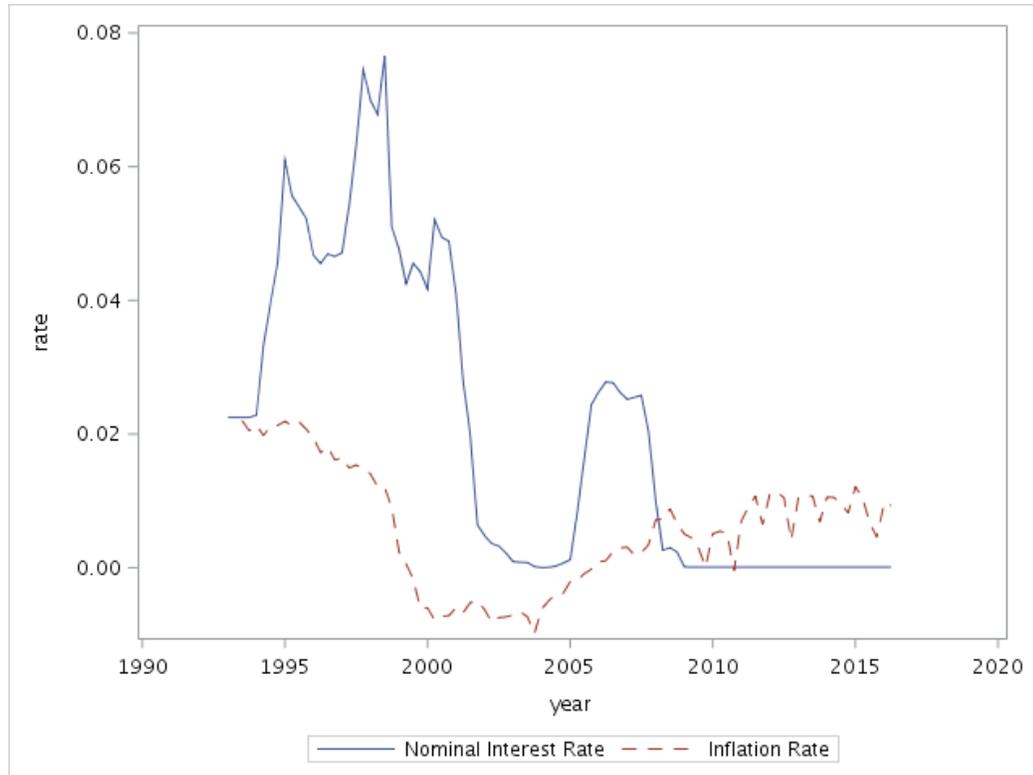
Figure 4: Nominal Interest Rate and Exponentially Smoothed Moving Average of Inflation Rate

Methodology

The methodology from Brunnermeier and Julliard (2007) is used to study the link between inflation and the housing price-rent ratio in Hong Kong. Brunnermeier and Julliard (2007) referenced Campbell and Shiller's (1988) methodology and allowed a subjective probability measure that was potentially different from the rational probability measure. The focus of this study is to provide an empirical test on the relationship between the implied mispricing component and inflation to determine if money illusion affects the Hong Kong housing market.

For constructing the mispricing term, the process of Brunnermeier and Julliard (2007, p.17) is followed. Three mispricing terms are estimated to ensure the robustness of this study.

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The first step of the mispricing estimation is to obtain the empirical counterpart of the objective expectations of excess return on housing $\widehat{E}_t[r_{h,t+\tau}^e]$ based on the estimated objective expectations of rent grown rate $\widehat{E}_t[\Delta l_{h,t+\tau}^e]$.

The objective expectations of rent growth rates are estimated using the Vector Autoregression (VAR) approach. The chosen VAR is based upon the Akaike information criterion (AIC), and is estimated using quarterly data from 1993:Q1 to 2016:Q2 with one lag. Four variables, as modelled by Brunnermeier and Julliard (2007), are included in the VAR and they are: (1) the log excess rent growth rate Δl_t^e, (2) the log excess return on housing $r_{h,t}^e$, (3) the log price-rent ratio $p_t - l_t$, and (4) the exponentially smoothed moving average of inflation π_t. The empirical counterpart of the objective excess return on housing is then obtained by subtracting the estimated expected rent growth rates from the log price-rent ratio using equation (6) of Brunnermeier and Julliard (2007, p.16), i.e. equation (1).

$$p_t - l_t = \sum_{\tau=1}^{\infty} p^{\tau-1}\widehat{E}_t[\Delta l_{h,t+\tau}^e] - \sum_{\tau=1}^{\infty} p^{\tau-1}\widehat{E}_t[r_{h,t+\tau}^e]$$

(1)

Secondly, since the mispricing component is the difference between the subjective and the objective expectations of excess return on housing, a proxy for the unobserved term (subjective expectations) is required. Following Campbell and Vuolteenaho (2004), it is assumed that the unobserved term is governed by a risk proxy of the conditional volatility of an investment on the ten-year government bond, represented by h. The mispricing component $\widehat{\psi}_t$ is the OLS residual of the linear regression in equation (13) of Brunnermeier and Julliard (2007, p.18), i.e. equation (2).

$$\sum_{\tau=1}^{\infty} \rho^{\tau-1} \widehat{E_t[r^e_{h,t+\tau}]} = \hat{\alpha} + \sum_{\tau=0}^{2} \widehat{b_\tau h_{t-\tau}} - \widehat{\psi_t}$$

<div align="right">(2)</div>

The first mispricing term $\hat{\psi}_t$ is the OLS residual of regressing the estimated objective expectations of excess return on housing, $\widehat{E}_t[r^e_{h,t+\tau}]$, with the two lagged ARCH(1) - estimates of the conditional volatility and a lagged VAR forecast of $\widehat{E}_t[r^e_{h,t+\tau}]$ where $p^{\tau-1}\widehat{E}_t[r^e_{h,t+\tau}] :=$ $(p_t - l_t) - p^{\tau-1}\widehat{E}_t[\Delta l^e_{h,t+\tau}]$.

The second mispricing term $\hat{\hat{\psi}}_t$ is the OLS residual of regressing the estimated objective expectations of excess return on housing, $\widehat{E}_t[r^e_{h,t+\tau}]$, with the two lagged ARCH(1) - estimates of the conditional volatility only.

Table 3: Regressions on First and Second Mispricing Term (t-statistics in brackets)

Mispricing Term	Dependent Variable	Constant	2 Lagged Volatility	Lagged $\widehat{E_t[r^e_{h,t+\tau}]}$	R^2
$\hat{\psi}_t$	$\widehat{E}_t[r^e_{h,t+\tau}]$	0.0103	-97.71	0.9999	0.97
		(1.60)	(-0.86)	(50.53)	
$\hat{\hat{\psi}}_t$	$\widehat{E}_t[r^e_{h,t+\tau}]$	0.1480	-931.14		0.03
		(4.62)	(-1.54)		

In addition to the two mispricing terms estimated, using equation (15) of Brunnermeier and Julliard (2007, p.19), i.e. equation (3), the third mispricing term $\hat{\varepsilon}_t$ is derived by decomposing the log price-rent ratio $p_t - l_t$ into the discounted future rent growth $p^{\tau-1}\widehat{E}_t[\Delta l^e_{h,t+\tau}]$, the discounted expected future returns on housing $p^{\tau-1}\widehat{E}_t[r^e_{h,t+\tau}]$, and the implied pricing error (mispricing) $\hat{\varepsilon}_t$. This approach constructs the mispricing term without the need of specifying any exogenous risk proxy which could be subjective and arbitrary. E_t is the τ-step ahead estimated VAR based upon the data observed up to time t.

$$p_t - l_t = \sum_{\tau=1}^{\infty} p^{\tau-1} \widehat{E}_t [\Delta l^e_{h,t+\tau}] - \sum_{\tau=1}^{\infty} p^{\tau-1} \widehat{E}_t [r^e_{h,t+\tau}] + \widehat{\varepsilon}_t$$

(3)

CHATPER III

RESULTS

The Modigliani and Cohn (1979) hypothesis of money illusion was that inflation caused a negative mispricing so when a positive mispricing is observed in the Hong Kong housing market similar to the UK housing market, a negative correlation with inflation and the nominal interest rate, and a positive correlation with the reciprocal of the nominal interest rate should be observed.
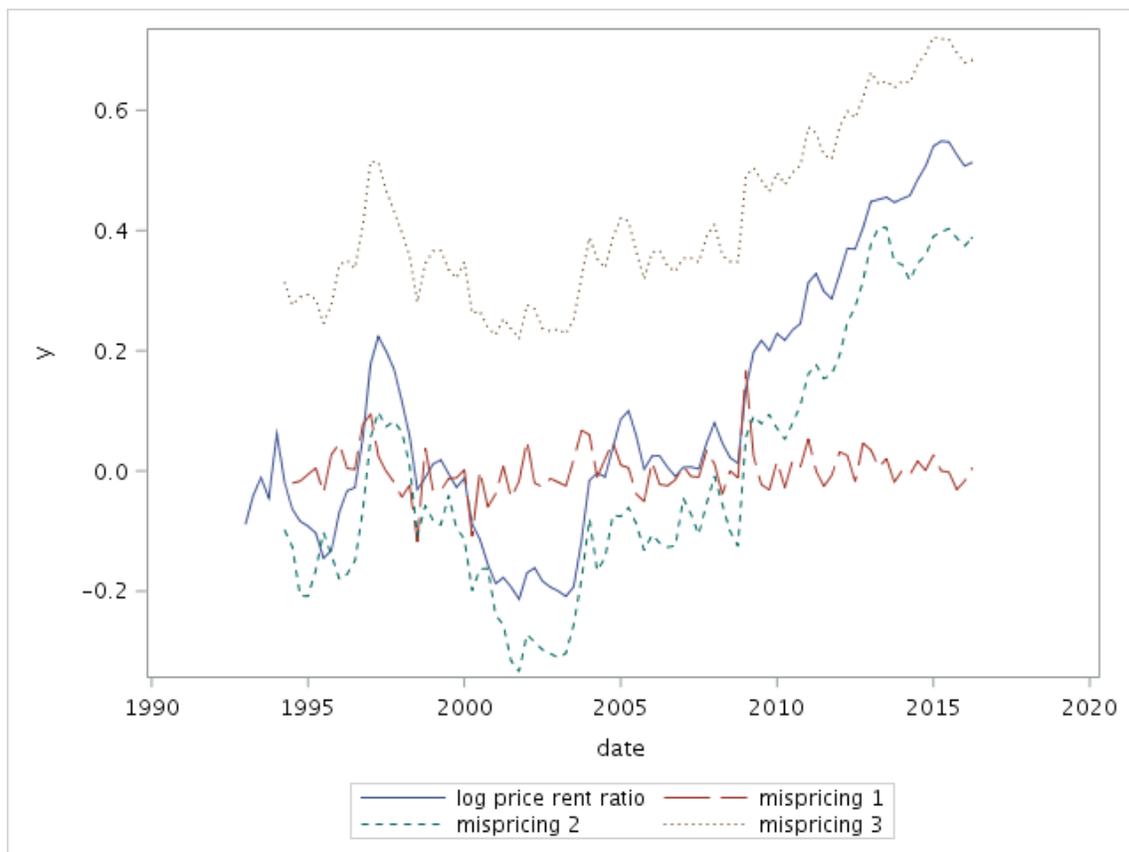

Figure 5: Log Price-Rent Ratio and Mispricing Measures on Hong Kong Data

Therefore, in order to examine the money illusion theory effect on the Hong Kong housing market, bivariate regressions are conducted for the three estimated mispricing terms with the three regressors: the exponentially smoothed moving average of inflation π_t, the nominal interest rate i_t, and $\log(1/i_t)$ as described in the Modigliani and Cohn (1979) hypothesis of money illusion. Their results are summarized in table 4.

Table 4: Bivariate Regressions on Inflation, Nominal Interest Rate, and Illusion Proxy (t-statistics in brackets)

Mispricing Term	π_t	R^2	i_t	R^2	$\log(1/i_t)$	R^2
$\hat{\psi}_t$	0.4204 (1.03)	0.0121	-0.2480 (-1.91)	0.0403	0.0007 (1.07)	0.0130
$\hat{\psi}_t$	6.8789 (3.28)	0.1090	-1.9507 (-2.79)	0.0812	0.0086 (2.61)	0.0718
$\hat{\varepsilon}_t$	25.38 (6.66)	0.3353	7.1536 (5.37)	0.466	0.0646 (29.86)	0.9102

Each row in table 4 reports the bivariate regression result of each mispricing component estimated with the three regressors tested. Unlike the money illusion hypothesis found in the UK housing market by Brunnermeier and Julliard (2007), the empirical evidence in the Hong Kong housing market is contrary to the money illusion hypothesis suggested by Modigliani and Cohn (1979). The correlations between inflation and all three mispricing terms are positive in all three regressions.

The signs for the nominal interest rate and its log reciprocal however are consistent with the Modigliani and Cohn (1979) hypothesis of money illusion in the first and second mispricing term tests, i.e. negative correlation with the nominal interest rate and positive correlation with its log reciprocal, although their r-squares are relatively low. On the other hand, the r-squares for the third mispricing term tests with all three regressors are relatively high but the signs for

inflation and the nominal interest rate are both not as expected under the money illusion hypothesis.

Figure 5 shows the time series of the estimated mispricing term (the second of the three mispricing terms estimated in this study) on the price-rent ratio in the Hong Kong housing market and its fitted values obtained using inflation as the only explanatory variable.

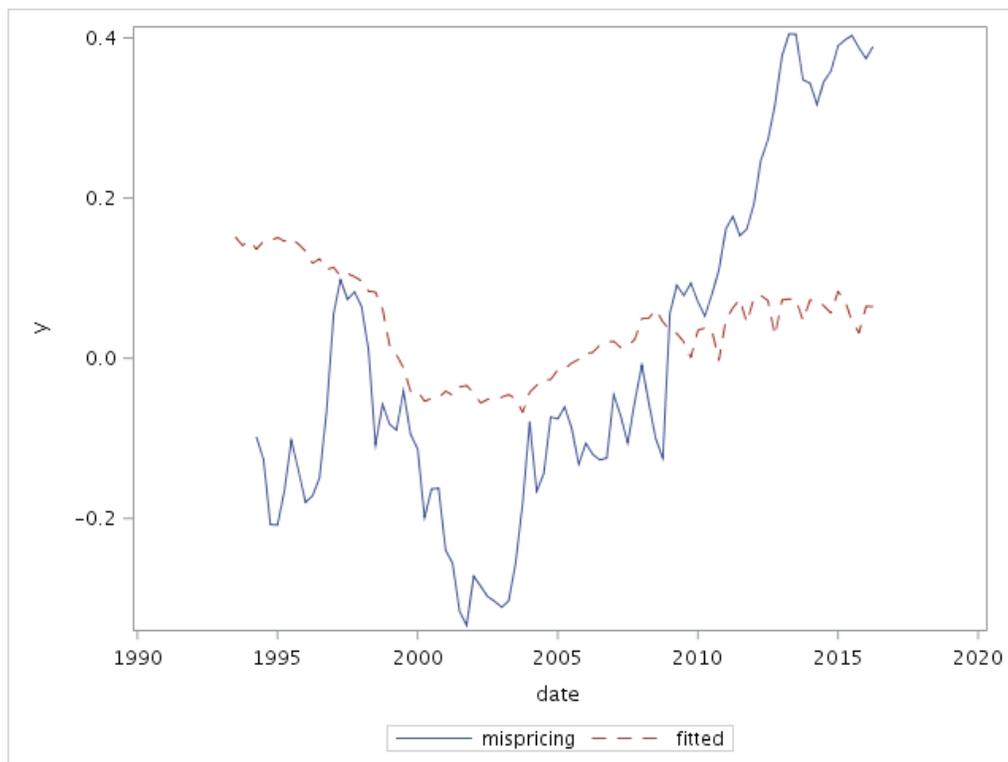Figure 6: Mispricing and Fitted Series based on Hong Kong Inflation

Robustness Check

For robustness check, Brunnermeier and Julliard (2007) used the real interest rate implied by the yields on inflation protected ten-year government bonds (called "ibond" in Hong Kong) instead of using the nominal interest rate minus inflation. Unfortunately, this data was not available until after 2014 in Hong Kong.

Following is the robustness checks performed in this study: (1) Instead of using the smoothed inflation, I use the calculated inflation from the Consumer Price Index, and the result is consistent with the previous results. The sign of inflation as the only regressor to mispricing is still positive with a further reduction in r-square measure. (2) Lagged inflation is also tested to predict the three estimated mispricing components. This also does not change the relationship between inflation and the mispricing terms.

Tilt Effect

The Tilt effect could generate a negative relationship between inflation and housing prices so the tilt effect of inflation to the Hong Kong housing market is also tested in this study. Lessard and Modigliani (1975) and Tucker (1975) showed that under nominal fixed payment and fixed interest rate mortgages, inflation could shift the real financial costs toward the earlier years of the mortgage. In this case, the mortgage payment-to-income ratio was high in the earlier years of the mortgage and this could cause a decrease in housing demand and prices because people were subject to higher liquidity constraints (Brunnermeier and Julliard, 2007, p.27).

To test the tilt effect on the Hong Kong housing market, three mispricing measures are regressed jointly on inflation π_t and the nominal interest rate i_t as well as the log of nominal interest rate $\log(i_t)$, as modelled by Brunnermeier and Julliard (2007, p.28). Since inflation affected the nominal interest rate, if the tilt effect drove the increase in the housing prices, a negative correlation between the mispricing term and both inflation and the nominal interest rate should be observed. Furthermore, after controlling the nominal interest rate by regressing jointly on both π_t and $i_t/\log(i_t)$, inflation should not play any role if the tilt effect was the driver (Brunnermeier and Julliard, 2007, p.28). Similar to the previous results, no negative correlation is found between inflation with any of the mispricing terms. The rest of the estimated signs and

r-square results are consistent with the tests on money illusion. Therefore, no empirical evidence

of money illusion nor tilt effect on the Hong Kong housing market is found.

Table 5: Regression Coefficients for Tilt Effect Test (t-statistics in brackets)

Mispricing Term	π_t	i_t	$\log(i_t)$	R^2
$\hat{\psi}_t$	0.9883	-0.4335		0.0817
	(0.0447)	(-2.71)		
$\hat{\psi}_t$	0.0727		-0.0007	0.0141
	(0.16)		(-0.94)	
$\hat{\psi}_t$	14.0862	-4.6032		0.4125
	(7.05)	(-6.83)		
$\hat{\psi}_t$	5.0326		-0.0052	0.1226
	(2.26)		(-1.48)	
$\hat{\varepsilon}_t$	18.7041	3.6907		0.3813
	(4.31)	(2.52)		
$\hat{\varepsilon}_t$	9.2543		-0.0586	0.9475
	(8.02)		(-32.01)	

CHAPTER IV

CONCLUSION

This paper studies the empirical relationship between inflation and housing prices to identify if money illusion affects the Hong Kong housing market over the sample period of 1993:Q1 to 2016:Q2. The methodology in Brunnermeier and Julliard (2007) is closely followed as they found supportive evidence of money illusion on the UK housing market over the sample period of 1966:Q2 to 2005:Q5 – inflation explained a large share of the time movement of the mispricing.

Following the literature of Brunnermeier and Julliard (2007), the time series of price-rent ratio is first decomposed into a rational component and an implied mispricing component – an empirical proxy of the risk premium demanded. There are three mispricing terms estimated in this study. Each estimated mispricing term is then regressed independently using inflation as the only regressor.

All three mispricing terms persistently increase throughout the sample period; however, the estimated signs for inflation in all three regressions are positive and this is contrary to the money illusion hypothesis. With money illusion, reduction of inflation could cause a large increase in housing prices and vice versa and this was what observed in the UK housing market by Brunnermeier and Julliard (2007). Therefore, no empirical evidence of the money illusion effect on the Hong Kong housing market over the period of 1993:Q1 to 2016:Q2 is found.

As discussed previously, it is reasonable to believe that the money illusion effect can explain the Hong Kong housing market due to its similar background with the UK market. However, there are also possible differences between the Hong Kong market and the UK market, and these may be the reasons for money illusion to be found in the UK but not in Hong Kong. For example, the Hong Kong housing market has been increasingly influenced by the Chinese government and its investment and economy in recent years. There are more professional speculative investors influencing the Hong Kong housing market than the general households suffered from money illusion.

Nevertheless, there are two key contributions of this paper. Based on the literature review, there were no prior empirical studies on the money illusion effect on the Hong Kong housing market, and the results presented in this study show that money illusion is not observed in the Hong Kong housing market using data from 1993:Q1 to 2016:Q2. Furthermore, although Brunnermeier and Julliard (2007) found empirical evidence of money illusion in the UK housing market, this study demonstrates that this may not be universal for all housing markets around the world. In order to find an empirical explanation to each country's housing market, more efforts need to be made.

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