DETERMINANTS OF HOUSING PRICE IN SINGAPORE

LAU XUE KEI
LAW JIN YAO
LEE WEI YING
LIEW WEI XIANG
TAN BOON SUAN

BACHELOR OF BUSINESS ADMINISTRATION
(HONS) BANKING AND FINANCE

UNIVERSITI TUNKU ABDUL RAHMAN

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BY

LAU XUE KEI
LAW JIN YAO
LEE WEI YING
LIEW WEI XIANG
TAN BOON SUAN

A final year project submitted in partial fulfilment of the requirement for the degree of

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DECLARATION

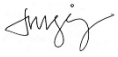
We hereby declare that:

(1) This undergraduate FYP is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this FYP has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) Equal contribution has been made by each group member in completing the FYP.

(4) The word count of this research report is 25842.

Name of Student:	Student ID:	Signature:
1. LAU XUE KEI	18ABB02982	
2. LAW JIN YAO	18ABB02870	
3. LEE WEI YING	19ABB02727	
4. LIEW WEI XIANG	18ABB02043	
5. TAN BOON SUAN	18ABB01173	

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
ARCH	Autoregressive Conditional Heteroscedasticity
ARDL	Autoregressive Distributed Lag
BPG	Breusch-Pagan-Godfrey
CCR	Core Central Region
CLRM	Classical Linear Regression Model
CPF	Central Provident Fund
CPI	Consumer Price Index
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum of Square
DOS	Department of Statistics
DW	Durbin Watson
ECM	Error Correction Model
EDF	Empirical Distribution Function
EX	Exchange Rate
GDP	Gross Domestic Product
GMM	Generalised Method of Moments

HDB	Housing and Development Board
HPI	Housing Price Index
HQC	Hannan-Quinn Criterion
IMF	International Monetary Fund
JB	Jarque-Bera
LM	Lagrange Multiplier
LTV	Loan-To-Value
MAS	Monetary Authority of Singapore
MOM	Ministry of Manpower
MS	Money Supply
OCR	Outside Central Region
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Square
OMO	Open Market Operations
RCR	Rest of Central Region
REER	Real Effective Exchange Rate
RESET	Regression specification error test
SARS	Severe Acute Respiratory Syndrome
SBC	Schwarz Bayesian Criterion
SGD	Singapore Dollar
UNE	Unemployment Rate
VAR	Vector Autoregression

VECM	Vector Error Correction Model

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PREFACE

The property market has played an important role in the economy of Singapore. The housing price in Singapore fluctuates over the years with an overall upward trend due to land scarcity and causes a growing number of Singapore citizen facing difficulties to own a house. Thus, this study mainly examines the macroeconomic variables that affect the housing price in Singapore which include Gross Domestic Product (GDP), inflation rate (CPI), unemployment rate (UNE), money supply (MS) and exchange rate (EX).

This research is conducted depends on guidelines that include 3 main sections:

The **first section** is preliminary pages including copyright pages, a declaration form, acknowledgement, table of content, list of tables, list of figures, list of abbreviation, list of appendixes, preface and abstract.

The **second section** is the content of the study which consists of:
Chapter 1: Research Overview
Chapter 2: Review of Literature
Chapter 3: Methodology
Chapter 4: Analysis of Data
Chapter 5: Discussions, Conclusion and Implications

The **third Section** is the end materials that consists of references and appendixes
The above 3 major criteria will be accomplished in order to carry out this research study. This study provides various types of information about the property industry of Singapore that will be useful for future researchers.

ABSTRACT

The main purpose of this study is to examine the determinants of housing price in Singapore. The increasing housing price level in Singapore over the years has become one of the alarming issues discussed nowadays. Therefore, this study attempts to investigate the relationship between housing price and macroeconomic determinants which include gross domestic product, inflation rate, unemployment rate, money supply, and foreign exchange rate in Singapore from 2005 quarter 1 to 2020 quarter 4. The ARDL bounds testing to cointegration, and Granger Causality test procedures are employed in the empirical part of this study. In general, the empirical results show that unemployment rate and foreign exchange rate possess a significant positive relationship towards Singapore's housing price, whereas money supply possesses a significant negative relationship towards Singapore's housing price. On the other hand, it is discovered that gross domestic product and inflation rate have no significant impact on Singapore's housing price. Based on the results, it is concluded that money supply possesses the greatest influence on Singapore's housing price among the five determinants.

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

The purpose of this research study is to examine the influence of macroeconomic factors on housing prices in Singapore from 2005 Q1 to 2020 Q4. A total of five macroeconomic factors including gross domestic product, inflation rate, unemployment rate, money supply and foreign exchange rate will be employed in this study. This chapter will begin with the research background which illustrates the worldwide and Singapore housing market. Next, the relevant problems will be illustrated and discussed. Subsequently, the research objectives and questions will be stated, followed by the significance of this study, chapter layout, and conclusion.

1.1 Background of Housing Price across the Globe

The house is a basic necessity of life which provides human beings with a place to live, eat, wash, relax and rest. It also delivers a sense of security and wellbeing that determines one's living standard. According to the Theory of Maslow's Hierarchy of Needs, owning a house is connected with all of the five categories of needs, including physiological needs, safety, love and belongingness, esteem and self-actualization (Mulligan, 2019). People not only look for a basic shelter that is safe and comfortable to live and stay with family, but also increasingly strive for a shelter that can be maintained internally and externally, as well as can be upgraded in order to maximize its comfortability and quality. In fact, home ownership is one of the most common signs of wealth and success as it considers a significant portion of a household's net wealth and serves as a source of long-term investment, particularly in the form of rental and property sales (Kogid & Pinjaman, 2020). Housing typically plays a critical role in driving the economic standing of the nation as it is closely connected with various markets. As people can purchase a house through applying for mortgages or using their own funds; the housing market is believed to have a strong connection with the financial sector (Doungmanee, n.d.).

Therefore, the fluctuation in housing prices is considered as a critical issue as it can significantly affect the residential investment and households' net wealth, thus influencing their purchasing power. Consequently, changes in housing wealth can significantly influence economic growth. According to Mavrodiy (2005), housing prices and housing market activities were found to be linked with the economic development of a nation. Apart from that, several studies like Mavrodiy (2005), Himmelberg, Mayer, and Sinai (2005), as well as Lin and Chen (2011) revealed that housing price can vary greatly across different countries as well as cities, for which bigger cities are observed to have costly housing price.

1.1.1 The Global Real Housing Price Index

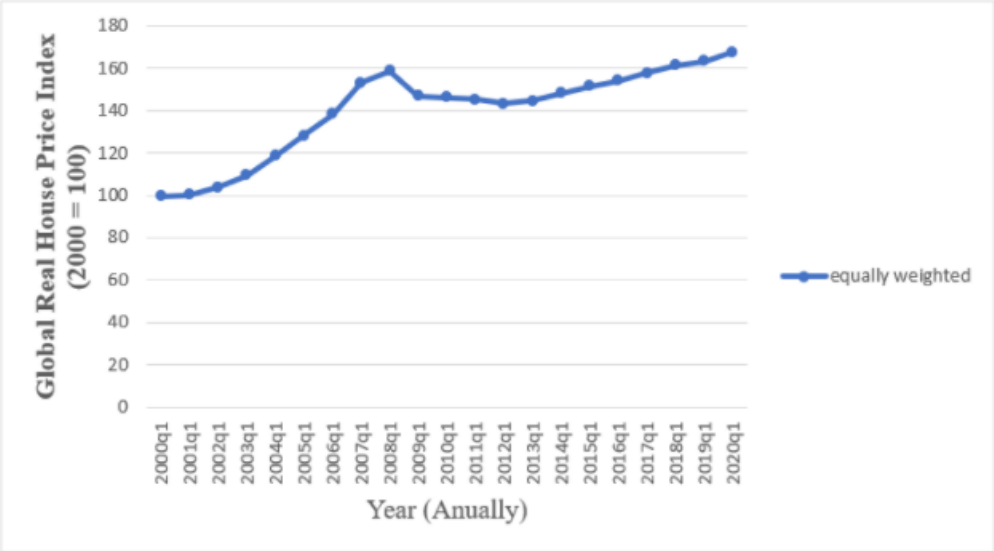


Figure 1.1.1. Global Real House Price Index

Source: International Monetary Fund

Globally, housing prices are booming in the wake of strong demand that embarks on the strained supply in the market. During the period from Q4 2019 to Q4 2020, a considerably 6.7% growth in real house price can be seen in the 37 rich countries that are owned by the Organization for Economic Cooperation and Development (OECD), which considered as the fastest year-on-year growth in the past twenty years (Ziady, 2021). Based

on Figure 1.1.1, the global real price indexes have shown an overall upward trend since the first quarter of 2000, standing at 99.4 points. It rose dramatically and reached 158.5 points in the first quarter of 2008; however, a remarkable drop to 144.9 points can be seen in the second quarter of 2009. Then, it remained stable at around 144 points to 146 points until 2013. After that, it started to grow continuously and reach a peak at 169.8 points in the third quarter of 2020. The dramatic decline in 2009 was particularly caused by the surge in risky loans and mortgages to borrowers who is less than qualified; thus, foreclosures and defaults not only hit the housing market, but also led to a series of negative effects on global markets, including drop in the personal consumption expenditure, lower consumer confidence, plus a tight credit and poor unemployment rate (Global Property Guide, 2009). To note, the expansion of subprime mortgages was mainly due to lax lending standards offered by mortgage lenders, which have also resulted in turmoil in the financial markets. The housing market slowly recovered from the crisis in the light of numerous economic stimulus measures plus new lending policies, particularly with tighter credit standards for higher credit risk borrowers (Duca, 2013). During the year to the first quarter of 2021, the housing prices were growing at a fast pace in many countries, including Europe, Asia-Pacific, the United States and Canada (Montagu-Pollock, 2021). This was primarily caused by increasing housing needs owing to the global COVID-19 pandemic, along with the support of huge monetary and fiscal policy; hence leading to strong housing demand in the market (Sarkar, 2021).

1.1.2 The Housing Market for the Rich Countries

Figure 1.1.2. Real House Prices in Selected Advanced Countries
Source: Bicester

According to Figure 1.1.2, the real house prices of several rich countries, including Canada, Australia, France, Britain, the United States, and Ireland have shown a similar upward trend between 2000 and 2006; while the housing market for Germany saw a far less price movements during the same period, which is mainly due to the supply overhang for the sake of robust building activity in the 1990s (Hoffmaister, Banerji, Shi, & Hilbers, 2008). The housing market across these countries were significantly hit by the recession from 2007 to 2009, for which the U.S and Ireland housing market saw the most notable slump compared to other countries, particularly due to the housing crisis that depressed the home sales (Congressional Research Service, 2021). After recovering from the housing crisis, the housing markets continued to grow rapidly and experienced a housing boom in 2020 amidst the impact of the pandemic that gave rise to ongoing housing-supply issues as well as extremely low interest rate. Despite the most fluctuated real house price movements in the U.S. and Ireland, Germany's housing market saw a relatively steady growth during the whole period. Besides, Germany housing market was found to be one of the few that escaped from a collapse during the global financial crash from 2008 to 2009 and the recent COVID-19 pandemic owing to low interest rates,

construction supply that remained weak in major cities, and growing demand from over one million refugees (Delmendo, 2021).

Recently, American housing prices recorded an 11% growth over the previous year, which was the fastest pace since the past two decades. In Britain and Germany, the growths were recorded at 8% and 9% respectively in the last year (Bicester, 2021). The same pattern can be seen in many rich countries, as shown in Figure 1.1.2. The surge in demand for houses can be explained by the changes in consumers' buying behavior as an increasing number of workers are working from home, along with years of low interest rates even prior to the pandemic (Cherney, 2021). However, there has been a concern regarding whether or not housing prices are fairly valued in the rich world. In this case, affordability of homeownership which is measured by using a price-to-income ratio, particularly by comparing housing prices relative to income, can be used to indicate the valuation issue of housing prices. To note, housing prices are viewed as overvalued when the price-to-income or rent ratio is shifting more than their long-term average (OECD, 2021).

In Australia, France and Canada, housing prices appeared to be overvalued by more than 40% based on the measurement on the average of relationship between prices and disposable incomes, as well as relationship between prices and rents. While in Britain, the housing prices were 40% overpriced relative to rents; but it saw better-valued as compared with income, suggesting whether rents or prices need to fall or to moderate respectively. In the U.S, recent housing prices were found to be fairly valued after a 25% decline from the peak during the period 2007 to 2012 (Fransham, 2020). Housing prices in Ireland also appeared to be fairly valued, where prices have been observed to grow again recently. On the other hand, housing prices in Germany appeared to be undervalued but it seems to have risen due to higher household disposable income along with favorable financing conditions (OECD, 2017).

1.1.3 The Real House Prices Across the Emerging Countries

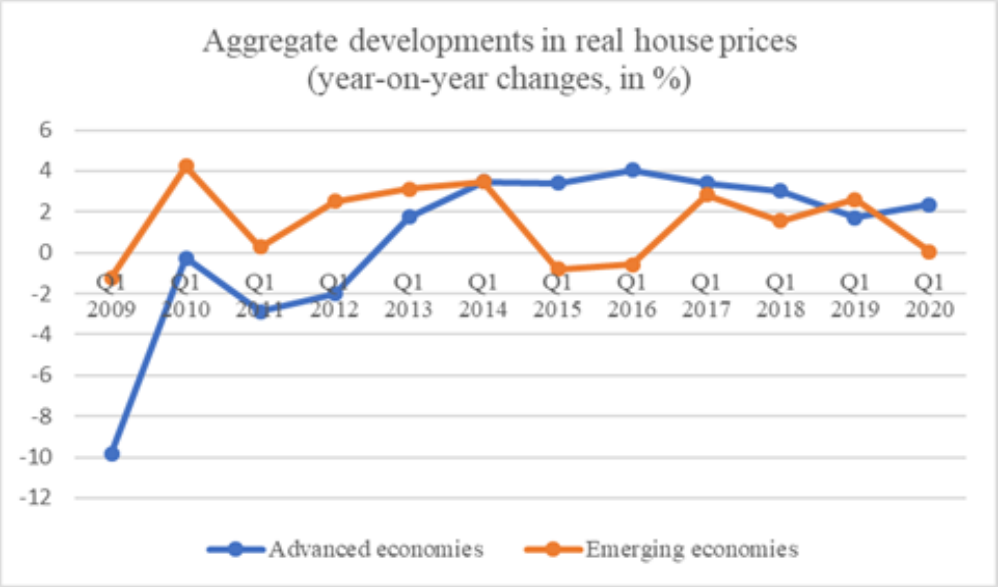


Figure 1.1.3. Real House Prices Across Advanced and Emerging Economies in Based on Quarterly Average Data

Source: BIS Data Bank

In emerging economies, housing prices saw a more rapid growth, more fluctuated, less synchronized, as well as less consistent across countries compared to advanced economies, as shown in Figure 1.1.3. Over the past ten years, real estate markets in emerging economies have found to be progressing towards those in advanced economies, by growing at about 15% to 20% of average annual price which is adjusted for inflation. Besides, the increased housing prices prior to the 2008 financial crisis can be explained by the unpredictable accumulation of credit from the private sector (Ciarlone, 2012). On the other hand, housing prices have risen at a rate of 2.8% and 1.6% annually in advanced economies and emerging economies respectively during the period of 1990 to 2012. The volatility of the housing market in emerging economies is more than double as compared with advanced economies, which accounted for approximately 5% per quarter (Cesa-Bianchi, Cespedes, & Rebucci, 2015). As rapid growing housing prices in the emerging economies could potentially attract buy-to-let and

expatriate investors, this can contribute to higher volatility in the housing market.

After experiencing a significant fluctuation between 2009 and 2011, the housing market in advanced economies remained stable from 2014 to 2017 and achieved its peak in 2016; then, it declined gradually until 2019 and started to rise again recently. However, the housing market in emerging economies have experienced a great fluctuation throughout the years, for which only the period from 2012 to 2014 and 2015 to 2016 observed a relatively steady price growth. Given the severe impact of the pandemic along with extensive fiscal and monetary stimulus, the average real house prices in advanced economies have expanded by 4.4% year-on-year in the third quarter of 2020, which is the fastest pace observed since 2016. Notable growth in real property prices can be seen in Canada (9%), the United States and the euro region (both 5%), Australia (4%), and the United Kingdom (2%); while the growth of real property prices in emerging economies rose only marginally at 0.9% year on year in the same quarter owing to a remarkable drop in India (5%), despite growing in Thailand and Korea at 5% and 4% respectively (BIS, 2021).

1.1.4 The Housing Market Strengthened Across Asian Regions

Table 1.1.4

The Changes in House Prices (Inflation Adjusted) Across Asian Countries as of Q1 2021

Changes in House Prices (Inflation Adjusted)				
Country	**y-o-y (%)**			**q-o-q (%)**
	Q1 2020	**△**	**Q1 2021**	**Q1 2021**

China (Beijing)	-4.82	↑	9.48	2.47
Pakistan	-6.74	↑	5.21	2.15
Japan (Tokyo)	-0.23	↑	9.30	1.88
Indonesia	-1.20	↗	-0.26	-0.54
Vietnam (HCMC)	15.29	↓	-0.54	-1.58
Turkey	2.85	↑	13.59	3.02
Philippines (Makati CBD)	-1.65	↓	-23.59	-3.75
South Korea	0.70	↑	9.44	2.42
Sri Lanka	-1.44	↑	15.93	2.02
Taiwan	2.70	↑	9.43	3.98
Hong Kong	-2.32	↑	2.07	1.12
Macau	-2.26	↑	-0.06	-3.26
Singapore	2.40	↑	5.31	2.60
Israel	5.84	↓	1.80	1.08

Note:

↑= > one percentage point rise in house price change

↗= < one percentage point rise in house price change

↓= > one percentage point fall in house price change

Source: Montagu-Pollock

As of Q1 2021, eleven out of fourteen housing markets in Asian regions have reflected a strengthened growth over the past year, with remarkable spikes in several countries, including Sri Lanka, China, and South Korea. To note, Sri Lanka is one of the strongest performing markets during the year to the first quarter of 2021, recording a surge of 15.93% in the nationwide house prices. As the impact of the pandemic has shifted buyer's preference on housing areas from the city centre to rural areas, the housing prices in the largest city of Sri Lanka, Colombo, have faced modest growth (Montagu-Pollock, 2021). On the other hand, China's housing prices saw a 9.48% growth during the same observed period. As China's economic conditions have recovered from the pandemic shocks, its housing market in February saw a slight expansion with housing prices soaring by 0.4 % in 70 large- and medium-sized cities. The major cities that lead the price growth were Beijing, Shanghai, as well as Guangzhou. As such, the housing market of smaller and less desirable cities in China is expected to plummet owing to government policies that imposed limits on property loans (Focus Economics, 2021). While in South Korea, the housing prices saw a stronger growth even though the government has implemented new policies to stabilize the housing market. There was an increasing number of foreign investors and multi-homeowners purchasing houses in South Korea with a purpose of investment (Yoon, 2021). During the year to Q1 2021, the housing prices in South Korea have surged by 9.44%, a notable improvement compared to 0.7% growth in the previous year. As well, more modest housing prices growth can be seen in other countries across Asian regions during the same observed period, for which Taiwan at 9.43%, Japan at 9.3%, Singapore at 5.31%, Pakistan at 5.21%, Thailand at 2.1%, and Hong Kong at 2.07%.

1.2 Background of Singapore Housing Market

In 1959, after Singapore obtained self-governance from British, Singapore was facing a critical housing crisis which referred to the growing population resulting

in a housing supply shortage (Phang, 2015). The insufficient accommodation caused the rise in citizen homelessness. This severe problem drove the establishment of Housing and Development Board (HDB) in Singapore one year later under the leadership of the first Prime Minister Lee Kuan Yew with the purpose to build affordable housing units and rent to the low-income group.

By 1965, HDB Singapore had built over 51 thousand apartments and reduced the homelessness by managing to accommodate 400,000 people. Not only building the apartments, HDB also came out with a retirement plan called Central Provident Fund (CPF) for the purpose of securing citizen's retirement. This is because the employees will contribute up to 20% of their monthly salary while the employers will also contribute a maximum 17% of the wages to the CPF (Ng, 2017). CPF also acts as a housing pension fund system to allow citizens to use the contributions from the fund to purchase houses which in turn increased home ownership in the country (Phang, & Helble, 2016).

Until today, HDB had built over one million apartments over the country to cope with the shortage of housing supply and it resulted in a sharp rise in the percentage of resident population in public housing which grew from 9% in 1960 to 82% in 2016. Following the economic development in Singapore, the homeownership marked at a high level of 90% which is ahead from many other economies.

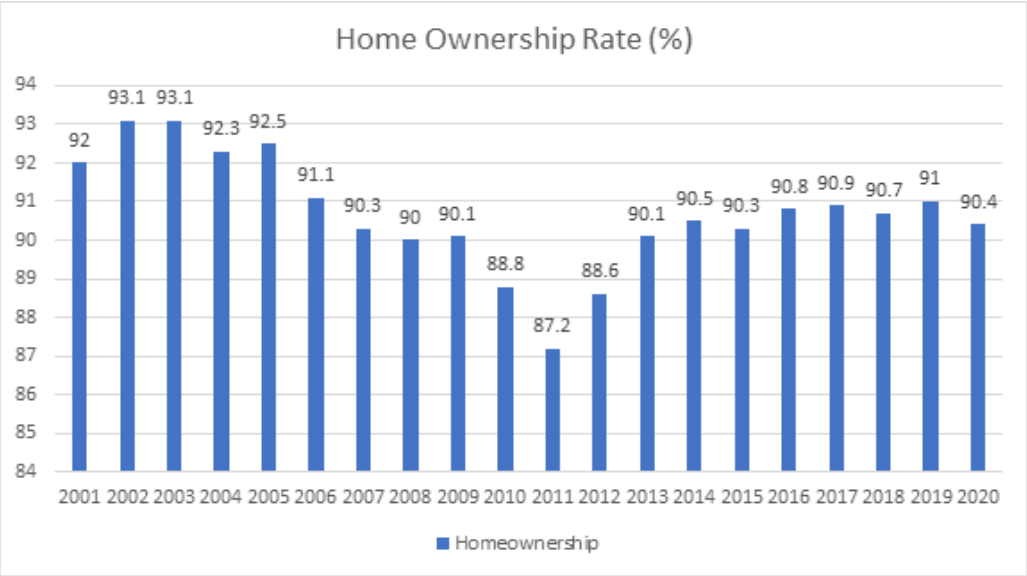


Figure 1.2a. Singapore Home Ownership Rate (%).
Sources: Statistics Singapore

From Figure 1.2a, it showed that the average home ownership in Singapore maintained at the level around 90% for the past 20 years. It recorded the highest rate of 93.1% in 2002 and 2003 while the lowest rate was recorded as 87.2% in 2011. The lowest home ownership rate recorded in 2011 was due to growing in population following a shortage in housing supply. Hence, the government has kept increasing construction activity to increase the housing supply, especially the flats, since 2011. As a result, the home ownership rate in Singapore started to increase back to 90.4% in 2020. The high ownership rate was due to the effective and successful housing policies and strategies in Singapore.

The reasons where the government introduced different strategies and policies in Singapore are mainly due to the rising price in property assets coupled with the growth in population. According to Delmendo (2021), the strong demand for housing while having a low construction activity in Singapore was also one of the main contributions to the rising housing price in the country.

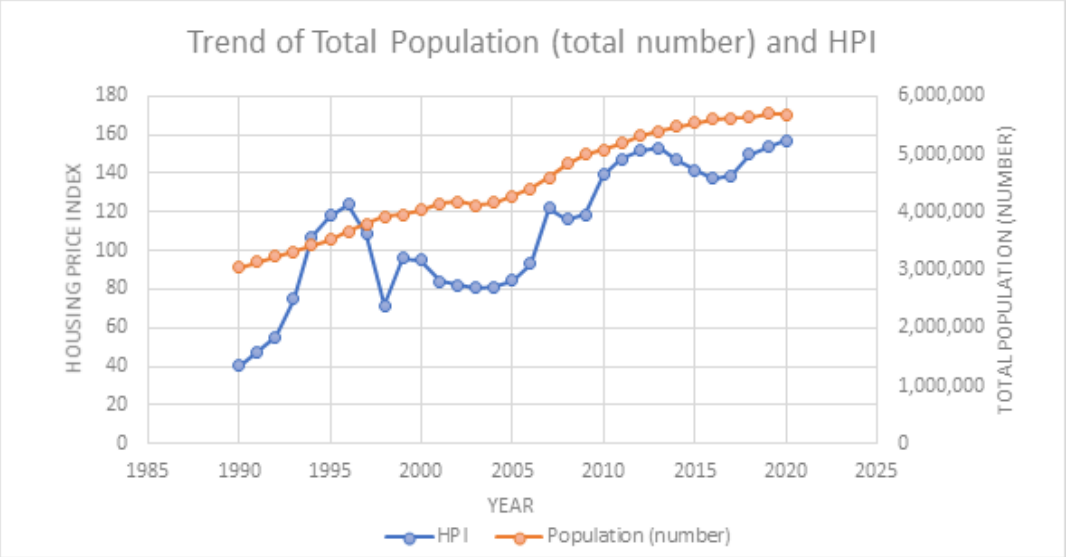


Figure 1.2b. Trend of Total Population (in number) and Housing Price Index in Singapore from 1990 to 2020.

Source: HPI data adapted from Data.gov.sg and total population number extracted from World Bank Data

Based on the illustration from Figure 1.2b, the Housing Price Index (HPI) in Singapore has an upward trend followed by the continuous growth in population for the past 30 years from 1990 to 2020. Singapore's population is made up of citizens, permanent residents, and foreigners. The rapid growth of foreigners was mainly arising from the immigration and foreign worker policies which attract foreigners into the Singapore labor market according to Phang (2015) research report. Another research report from Phang (2013) also pointed out that Singapore housing stock experienced short supply due to the rapid growth in the population. The growth in population is critical for Singapore since Singapore's land area is small. According to Jaganmohan (2021), Singapore's land area is only 728.3 square kilometers today. Sawe (2017) article ranked Singapore as the second smallest country in Asia behind Maldives.

For the housing price movement, the HPI of Singapore showed an upward trend from the past until now according to Figure 1.2b. The major reason for a sharp rise in 1990 until 1996 was due to the strong demand resulting from the growing population. After that the HPI dropped dramatically starting from 1996 until 1998. This was due to the financial crisis in 1997 which negatively affected the economy. The HPI started to recover after 1998 as market confidence increased. In 2003, the HPI Singapore slightly dropped due to the outbreak of severe acute respiratory syndrome (SARS) which in turn affected the economy as well. One year later the HPI kept rising until 2007 where another global financial crisis occurred which in turn caused a drop in HPI. In 2009, the HPI rose year by year before decreasing in 2014 until 2017. The dropping HPI from 2013 to 2017 was due to the cooling measures introduced by the Singapore government from 2012 in order to cool down the heated housing market where the prices of properties keep increasing. According to Delmendo (2021), the Singapore government has tightened the mortgage term to 35 years and lowered the loan-to-value (LTV) ratio for the mortgage loans exceeding 30 years at the end of 2012. Other than that, the government also introduced a 16% seller's stamp duty for selling the properties within one year as well as imposed a higher additional buyer's stamp duty which

stands at 7% for purchasing properties (Delmendo, 2021). Despite these measures, the government increased the down payment required for purchasing property. As well, the immigration rules in Singapore also tightened for the purpose to reduce the immigration of foreigners into Singapore since there was a high portion (38%) of foreigners in Singapore's population which contributed to the increasing housing demand. As a result, the housing market started to respond to the different measures from 2014 to 2017 where the HPI reduced due to the lower demand for properties.

In a more detailed context, Singapore is separated into three regions: Core Central Region (CCR), Rest of Central Region (RCR), and Outside Central Region (OCR). Figure 1.2c below showed the regions in Singapore and Figure 1.2d below showed the private property price index in the three regions.

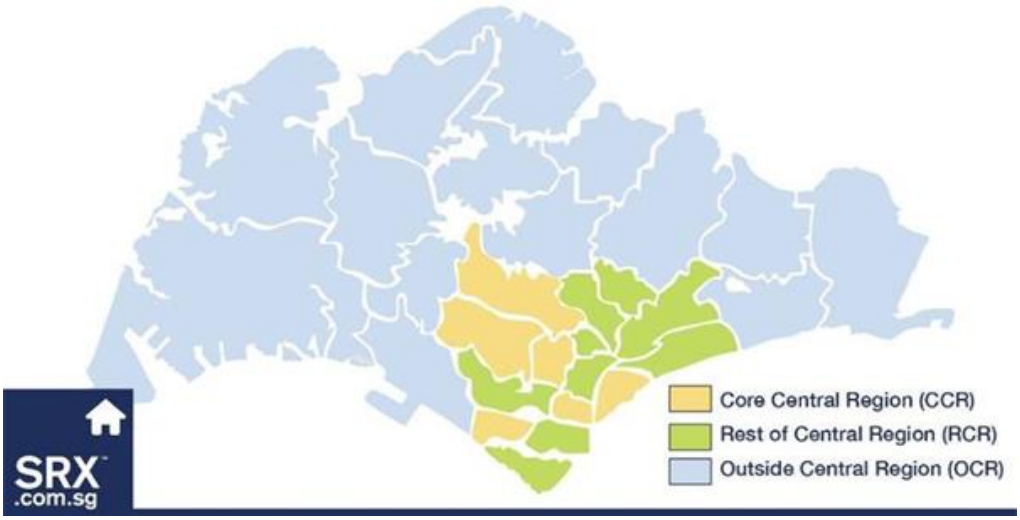


Figure 1.2c. Singapore District and Region Map
Source: SRX Singapore

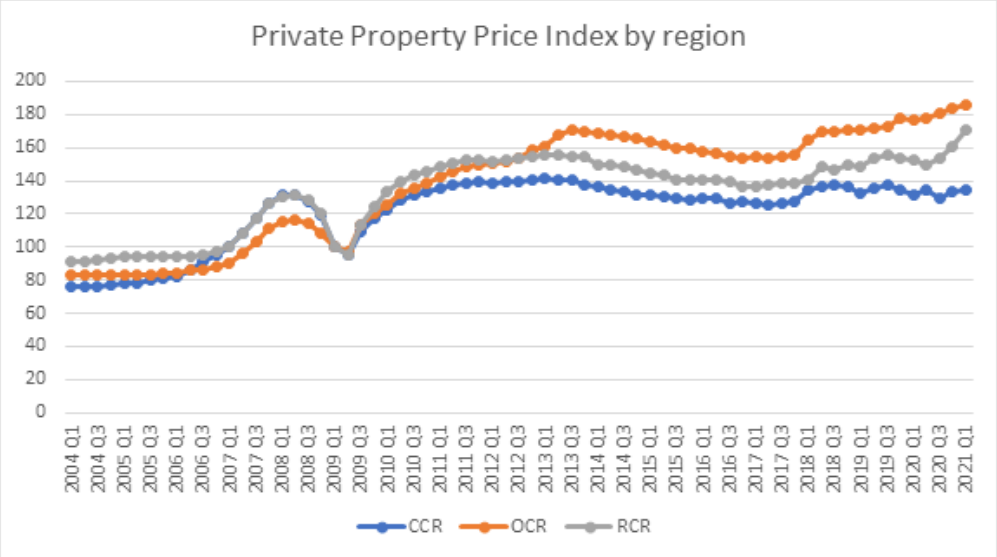


Figure 1.2d. Singapore Private Property Price Index by Regions from 2004 to 2021. Source: Data.gov.sg

From Figure 1.2d, the price index for Singapore in different regions has the same movements across the years. The OCR property price index has surpassed the CCR and RCR since 2012 Q4. According to Delmendo's (2021) data updated in 2021, the CCR residential units' prices are range from SGD 2,500 to SGD 3,100; the RCR residential units' prices are range from SGD 1300 to SGD 2300; the OCR residential units' prices are range from SGD 1,300 to SGD 2,100. It showed that the OCR property prices index increased and surpassed CCR and RCR mainly due to the lower price in OCR as well as due to the supply shortage in the CCR and RCR that are near to the central part of Singapore.

To conclude, the small land area in Singapore and the acceleration in population are causing the demand for accommodation, whether renting or buying a shelter increase which in turn will result in a housing price expansion. An increase in the population is compulsory for almost all countries. Other than that, there are some other potential factors, mainly the macroeconomic factors like unemployment rate, inflation rate, money supply, exchange rate and economic growth may also impact the housing prices.

1.2.1 Singapore Economic Growth (Annual Growth Rate of Gross Domestic Product) and Housing Price Index from 1990 to 2020

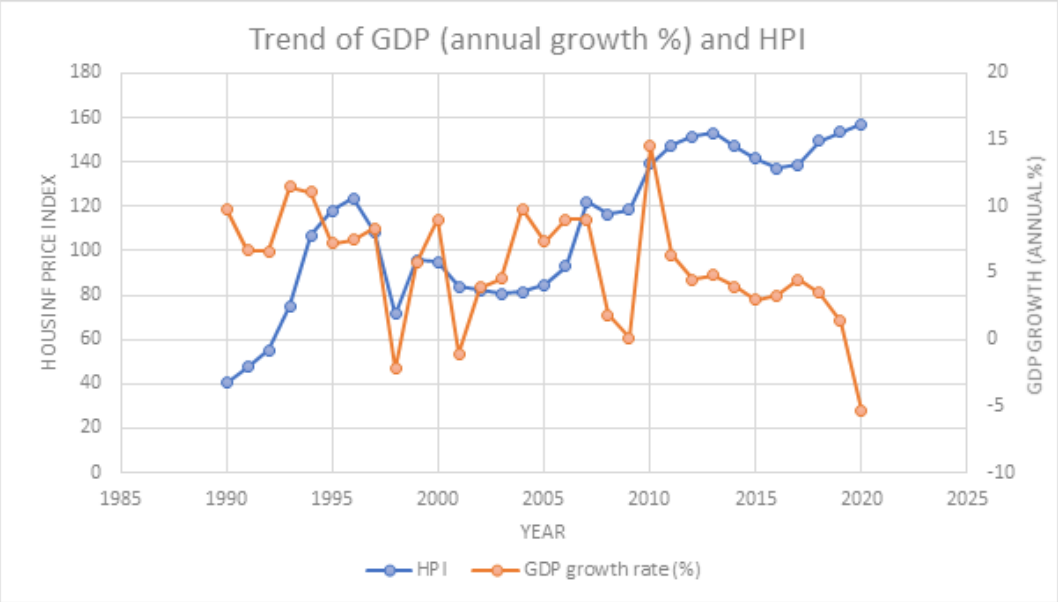


Figure 1.2.1. Singapore GDP annual growth rate (%) and Housing Price Index from 1990 to 2020.
Source: HPI data adapted from Data.gov.sg and GDP annual growth rate (%) adapted from World Bank Data

GDP is a key indicator that can be used to determine the performance of economic conditions in the country. A rise in GDP means an economic expansion while a drop in GDP means an economic contraction. When GDP increases, the HPI also increases. This is because the growth of GDP is always followed by an improvement in employment, consumer markets, equity market as well as investors and consumers' confidence level (Liberto, 2021). As a result, it increases citizens' purchasing power, attracts local and foreign investors, the economy expands and hence increases the pricing level of goods of that country. It explained the reason behind the overall growth of GDP accompanied by a growth in HPI in Singapore. The growth in HPI most likely negatively affects people's affordability in buying a house. From Figure 1.2.1, during the Asian economic crisis in 1997, we can see

that the HPI dropped immediately to 108.4 in 1997 from 123.7 in 1996; and followed by a further dropping of 30% to 71.5 in the following year 1998. Meanwhile, the GDP also showed a downward movement from 1997 to 1998 where the GDP recorded a -2.20% growth rate in 1998 compared to the growth rate of 8.31% in 1997 before the financial crisis. After that in 1999, the housing price started to recover back when the country slowly recovered the economy and the GDP also recovered back to 5.72% growth in 1999 and 9.04% growth in 2000. After that in 2008, another global financial crisis happened, this incident followed by an acceleration in housing prices during the post-2008 global financial crisis period. The financial crisis resulted in a contraction in the economy as we noticed that the GDP growth rate declined from 9.02% in 2008 to 1.87% in 2009, so that the government expanded the money supply for the purpose to boost the economy. Hence, the accommodative monetary policies of central banks in developed economies resulting in a limited supply, rapid population increase, the low interest rate, and high global liquidity (Phang, & Helble, 2016). The policies drove the property prices in Singapore as the money supply increased and people largely invested in real estate. In 2010, Singapore's growth rate reached the peak at 14.53% due to the economic expansion resulting from the booming in manufacturing and service sectors as well as tourism industry while the HPI also showed an upward trend at that moment. For 2019 and 2020, the GDP dropped significantly due to the outbreak of Covid-19 virus that badly affected the economy and the rising of Singapore's housing price was slowed down for that period. In short, the fluctuations in GDP may have positive or negative impacts to the housing price.

1.2.2 Singapore Inflation (Consumer Price Index) and Housing Price Index from 1990 to 2020

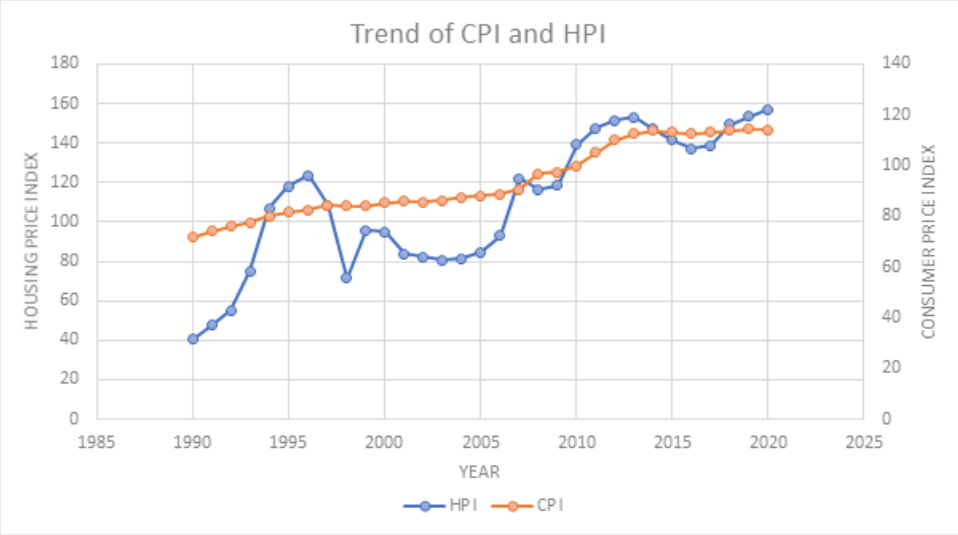


Figure 1.2.2. Singapore Inflation (Consumer Price Index) and Housing Price Index from 1990 to 2020.
Source: HPI data adapted from Data.gov.sg and CPI adapted from World Bank Data

Consumer Price Index (CPI) is an important indicator of the inflation rate of a country which measures the percentage change in consumer goods and services prices. In Singapore, CPI is used as a measurement for inflation by measuring the cost of a fixed basket of goods and services consumed by households according to the Monetary Authority of Singapore (2018). From Figure 1.2.2, the CPI showed an upward trend from past to now and recorded the highest CPI in 2020 at 114.20. We can conclude that consumer goods and services prices keep increasing as the standard of living increases. This may be due to the improvement in employment rate, wages, GDP etc., which in turn increases the demand for goods and services in the country. Rising costs of production will also increase inflation. According to Choy (2016), the inflation in Singapore rose during 2011 to 2012 caused the housing price to rise due to the limited supply. In short, from Figure 1.2.3, the overall trend of HPI and CPI have an upward movement where it indicates that the inflation and housing price are correlated.

1.2.3 Singapore Unemployment Rate (%) and Housing Price Index from 1990 to 2020

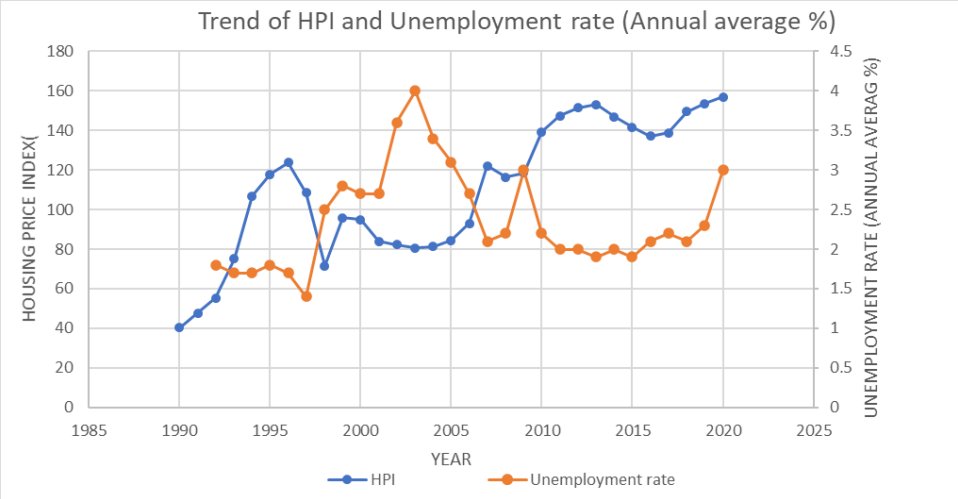


Figure 1.2.3. Singapore Unemployment Rate (Annual average %) and Housing Price Index from 1992 to 2020.
Sources: HPI data adapted from Data.gov.sg and unemployment rate adapted from Ministry of Manpower (MOM) Singapore

From Figure 1.2.3, we can observe that the unemployment rate and housing price index are moving in opposite directions. When the unemployment rate increases, the housing price will decrease as people are now having lower purchasing power. Hence, people will demand less properties causing the prices of properties to decrease. The lowest unemployment was recorded at 1.4% in 1997 and immediately after the financial crisis happened in 1997, the unemployment rate spiked to 2.5% in 1998. While the housing price index dropped from 123.7 in 1996 to 108.4 in 1997; followed by a continuous drop to 71.5 in 1998. After that, in 2003, the highest unemployment rate of Singapore for the past 30 years was recorded at 4%. The reason was mainly the outbreak of a serious respiratory virus ─ SARS during 2003 (Phua, 2020). During the year, we can observe that the housing price index decreased to 80.6 which was the lowest record from 1999 and onwards. Phua (2020) added that another global financial crisis that happened around 2008-2009 resulted in an increase in unemployment rate

again. The rate increased from 2.1% in 2007 to 2.2% in 2008 and continued to reach 3% in 2009 before a drop to 2.2% in the following year 2010 as the economy recovered. From the few crises, the housing price index trend line truly reflected the uncertainties by experiencing a drop in housing prices when the crisis happened as the unemployment rate increased. Until 2020, the unemployment rate once again experienced a 30% increase from 2.3% in 2019 to 3% in 2020. This was arising from the outbreak of Covid-19 pandemic. In short, the increase in unemployment rate will affect a country's price levels of goods and services.

1.2.4 Singapore Money Supply, M2 (S$ Million) and Housing Price Index from 1990 to 2020

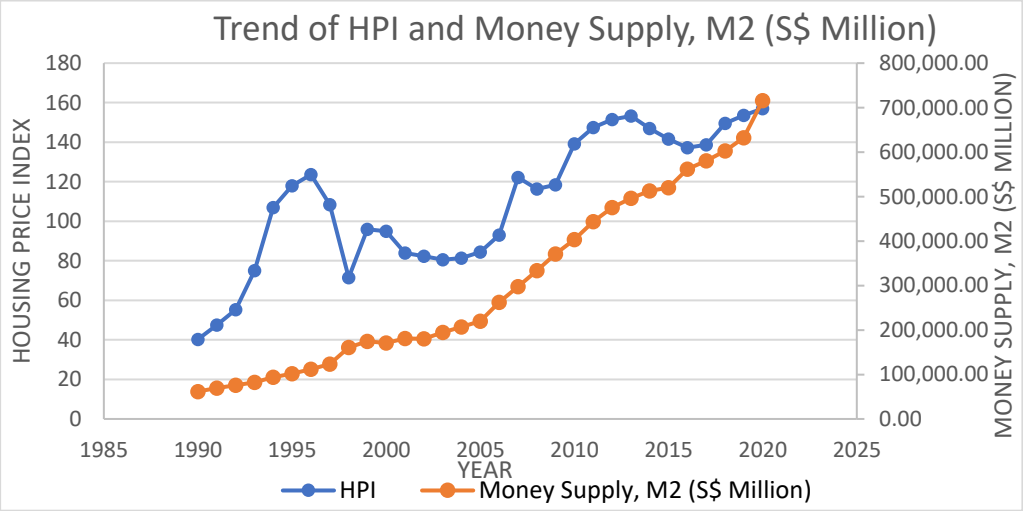


Figure 1.2.4. Singapore Money Supply, M2 (S$ Million) and Housing Price Index from 1990 to 2020.
Sources: HPI data adapted from Data.gov.sg and Money Supply, M2 (S$ Million) adapted from Monetary Authority of Singapore

Based on Figure 1.2.5, we can notice that the trend of HPI and MS has been moving in a similar direction for the past 30 years. When the money supply in the country increases, the housing price increases as well. This was because the investment in property and demand of housing accelerates when

people hold more money which then results in an increase in housing prices as well. Most of the countries control the money supply by changing the interest rate and conducting Open Market Operations (OMO) through monetary policy. By looking into more detail figure, Singapore money supply increased steadily year by year while the housing price was more fluctuate compared to the money supply movement. It meant that the housing in Singapore is less likely to be affected by the money supply which will then affect the demand for housing.

1.2.5 Singapore Exchange Rate Index and Housing Price Index from 1990 to 2020

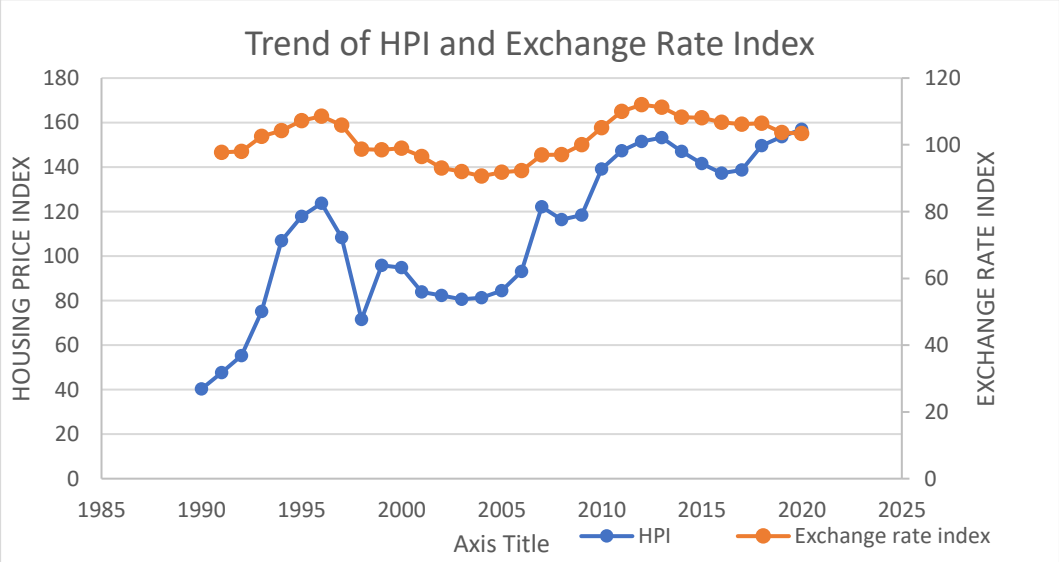


Figure 1.2.5. Singapore Exchange Rate Index and Housing Price Index from 1990 to 2020.

Sources: HPI data adapted from Data.gov.sg and Exchange Rate Index adapted from International Monetary Fund.

Based on Figure 1.2.5, we can notice that the overall trend of HPI and Exchange Rate Index were similar over the years. The rising of Exchange Rate Index means that the exchange rate of Singapore Dollar (SGD) strengthens. It indicated that when SGD appreciate, the Singapore citizen is

having more purchasing power because the currency in their hand became more valuable; hence, they might demand for housing. From the graph, we can observe that when the housing price dropped from 1996 to 2005, the currency also depreciated (Exchange Rate Index fell). After that, when the housing price recovered from 2007 to 2013, the exchange rate index also rose accordingly. When the housing price fell again from 2013 to 2016, the currency also showed similar movement. We can say that the exchange rate having certain effect on the housing price in Singapore. This is because the monetary policy applied by Singapore is exchange rate based as Singapore is involving in heavy open trade with other countries. It means that Singapore controls its exchange rate rather than controls its interest rate to control the inflation and good prices (Williams, 2015).

1.3 Problem Statement

Singapore has about 6 million people, but it is a land scarce city, with just 728.3 square kilometers of land in 2020 (Singapore Land Authority, 2021; Phang, 2019). However, the Singapore government's major goal is to promote home ownership since residential property market is one of the main economy activities in Singapore (Gary & Jason, 2017). From 1980 to 2019, Singapore's average rate of home ownership stood at 89.13% (Singapore Home Ownership Rate, n.d.). Furthermore, the growing population of Singapore result in higher demand of residential properties had also pushed up the property prices. This is because it is unable to fulfil market demand due to supply scarcity. In this situation, the inflation rate will increase in Singapore and boost the housing price (Ranasinghe, 2013; Choy, 2016).

According to figure 1.2d, the housing price in Singapore fluctuates over the years with an overall upward trend. One of the factors that give rise to the housing price of Singapore may be GDP. The economy of Singapore is one of the countries that are most stable in the world, with a consistently positive surplus, high government revenue and no foreign debts (Eddie, n.d.). Therefore, most of the investors invest in the real estate of Singapore because it is considered a safe haven for investment.

This contributes to the increasing of GDP of Singapore and leads to a continuous increase in the housing price (Ong, 2018). In addition, the rapid economy growth of Singapore helps to boost the money supply and cause the strong demand for investment in housing. Therefore, this will cause the housing price of Singapore to increase continuously (Chen, Chang, Yang &Hsieh, 2012). It is also shown that money supply is also one of the elements that may give impact to the Singapore's housing price. This is because the government of Singapore decided to tighten the money supply of Singapore which decreases the loan limit in order to constrict spending in an economy. Moreover, the government decided to increase the supply of property in order to meet the market demand. Thus, it can prevent inflation from happening and avoid the housing price of Singapore to increase continuously as well as ensure the house still affordable for locals (Ministry of Finance, 2021).

Additionally, Singapore is an open economy country that depends heavily on trade. Therefore, the Monetary Authority of Singapore applied the exchange rate as its main policy instruments instead of interest rate (Tang, 2021). Then, housing prices may be influenced by the foreign exchange rate. When the government implemented a monetary policy which tighten the money supply, the economy of Singapore grew about 6.5%. This causes the exchange rate of Singapore Dollar appreciated and attracts more foreign investors to invest in the real estate of Singapore. This is due to the increase of investors' confident towards the real estate investment in Singapore and therefore drive up the housing price of Singapore (Lee, 2021; Singapore Property Investment Market Insights, n.d.).

Furthermore, although the housing price in Singapore fluctuates over the years with an overall upward trend, it experienced a sharp decline from 1996 to 1998. This is due to the increasing supply of new HDB and the Asian Financial crisis 1997 which was initiated by the floating of Thai baht in July 1997 (Phang, 2015). The GDP of Singapore had declined about 2.2% and causes the CPI to decrease (Monetary Authority of Singapore, 2018). It is because many companies shut down or downsized during that time, which caused the unemployment rate increase which there are a total of 28,300 employees being retrenched. Therefore, Singaporeans put back their buying decisions and thus caused the demand of residential properties of Singapore to decrease (Chew, n.d.). The private property price index of Singapore

has declined around 40% in only one year (Ngiam, 2000). The property price index during the fourth quarter of 1998 is 45% below its peak in 1996, it has reached its trough.

In short, the housing price in Singapore is increasing continuously over the years besides during the financial crisis. It is generally caused by demand more than supply and leads to several consequences. Thus, the main purpose of this research is to examine the significant determinants of housing price in Singapore in order to obtain an in-depth analysis and have a better understanding on the situation of housing market in Singapore.

1.4 Research Questions

1. What is the relationship between economic growth and Singapore housing price in long run?
2. What is the relationship between inflation rate and Singapore housing price in long run?
3. What is the relationship between unemployment rate and Singapore housing price in long run?
4. What is the relationship between money supply and Singapore housing price in long run?
5. What is the relationship between foreign exchange rate and Singapore housing price in long run?
6. Do economic growth, inflation rate, unemployment rate, money supply and foreign exchange rate have causality relationship with Singapore housing price?

1.5 Research Objectives

The general objective of this study is to examine the macroeconomic determinants of housing price in Singapore.

The specific objectives are:

1. To identify the relationship between economic growth and Singapore housing price in long run.
2. To identify the relationship between inflation rate and Singapore housing price in long run.
3. To identify the relationship between unemployment rate and Singapore housing price in long run.
4. To identify the relationship between money supply and Singapore housing price in long run.
5. To identify the relationship between foreign exchange rate and Singapore housing price in long run.
6. To examine the causality relationship between economic growth, inflation rate, unemployment rate, money supply and foreign exchange rate with Singapore housing price.

1.6 Significance of the Study

Undeniably, the increasing property pricing level in Singapore is an alarming issue, causing low house affordability. Thus, the significance of this study is to deliver a clear understanding on the impacts of selected independent variables which include economic growth (GDP), inflation rate, unemployment rate, money supply as well as foreign exchange rate on the dependent variable, housing price in Singapore. Moreover, this study adopts the latest 16 years quarterly data in order to provide readers the latest information on the chosen macroeconomic variables that give impact on the price level of housing in Singapore.

Firstly, policy makers must be extremely cautious in implementing housing policies as the policies will affect the labor force apart from housing price, and housing supply and demand (Reed & Ume, 2016). Drawing upon its importance, this study enables the policy makers to have a more advance understanding on the determinants of housing price in Singapore. Therefore, they can use this study as a

reference to design appropriate policies and strategies in order to effectively control the housing price movement, and thus stabilize the housing market and economy.

Furthermore, this study contributes to the investors and speculators by providing them a clearer vision on the determinants of housing price in Singapore. This allows the investors and speculators to obtain a more accurate estimation of housing prices, and thus a better and more accurate decision can be obtained. Consequently, they will have a higher probability of outperforming the market. Besides, the study conveys advantages to the housing developers and homebuyers. They can take this study as a reference to better understand the indicators of housing price in Singapore. This allows the housing developers and homebuyers to have a rational expectation on future housing prices before they start a project or own a house.

In addition, students and future researchers who study similar issues can benefit from this study. Adequate information and robust tests in this study can provide valuable data for their study and research purpose.

1.7 Layout of Chapter

Chapter 1 introduces the study and details the research background as well as the problem statement. Next, the chapter discusses the study objectives, questions, significance, layout of the chapter, and concludes with a summary.

Chapter 2 presents a review of literature including the relevant theories and concepts as well as the relevant empirical studies. Subsequently, the gap of study will be discussed, followed by the development of theoretical framework, hypotheses, and conclusion.

Chapter 3 discusses the research methodology that will be applied in this study. For instance, it consists of research design, data collection procedures, proposed data examinations and concludes with a summary of the chapter.

Chapter 4 investigates and interprets the estimation output generated based on the methodology discussed in the previous chapter.

Chapter 5 concludes this study by discussing the key findings, policy implication, limitations of the research study and recommendations for future work.

1.8 Conclusion

In short, Singapore housing price index showed an upward trend throughout the years. Problems such as the real estate bubble, enlarging housing affordability gap, and wealth inequality may arise if the issue of increasing housing price in Singapore persists. Therefore, this research aims to determine the potential macroeconomic elements that determine the price level of housing in Singapore. The connection between the potential macroeconomic indicators and the housing prices in Singapore were established graphically. It is believed that the variables: economic growth, inflation rate, unemployment rate, money supply and foreign exchange rate are the main determinants of the dependent variable, housing price in Singapore. By showing the latest trend on how the chosen macroeconomic factors impact on the housing price in Singapore, this study provides a significant contribution to policy makers, investors, speculators, housing developers, homebuyers, future researchers and students. The following chapter will provide a detailed discussion about the literature review.

CHAPTER 2: REVIEW OF LITERATURE

2.0 Introduction

Chapter 2 will present the relevant concepts and theories of the housing market to further explain the relation of macroeconomic variables and housing prices. Additionally, Chapter 2 will also review the previous empirical studies related to the housing market and summarize the different viewpoints on the relationship between macroeconomic factors towards the housing price. Subsequently, the gap of the study will be discussed, and the study's theoretical framework and hypotheses will be developed. Lastly, a summary of the chapter will be presented at the end of the chapter.

2.1 Relevant Theory

2.1.1 Demand and Supply Theory

The demand and supply theory is a fundamental economic principle that shows the relationship between supply and demand of goods and services. It also shows how the price of those goods or services will be affected by its demand and supply. This theory originated from a British economist, Alfred Marshall. In 1980, he proposed the supply and demand curve in his book titled "Principles of Economics". He suggested that the price of a good is determined by their demand and supply. Besides that, the intersection point of demand and supply curve is the equilibrium point (Henderson, n.d.). Thus, when demand and supply of houses are equal, we will obtain the equilibrium housing price. According to Kogid and Pinjaman (2020), there is a negative relationship between the housing price and the land supply index, which is in line with the supply-side theory. Furthermore, according to a study done

by Haron (2013), he mentioned that the housing demand is the most important factor that causes the increase in housing prices. When there is an increase in housing demand, housing prices will also be rising.

Furthermore, the housing demand will decline when there is a rise in the unemployment rate. This is because people cannot afford to own a house when they are unemployed. Thus, it causes the housing price to decline too. However, according to Haron (2013), due to the stable income and financial assistance provided these days, the demand for houses is not decreasing even though housing prices have increased. Besides that, according to Haron (2013), inflation will lead to a significant increase in housing prices and result in house buyers suffering from a high housing loan or even holding up their decision to own a house. This then results in lower housing demand. In addition, when domestic currency depreciates, foreign investors are more likely to purchase domestic property as it has become cheaper. Thus, when the demand for domestic property increases, it will result in the rising of housing prices (Kiong & Aralas, 2019). However, it also may cause the local property price to increase as well since the citizens may also demand local property as their purchasing power increases when currency appreciates. Also, the money supply of a country will also affect the demand and supply of housing which will then affect the prices. A rise in money supply simply means that the citizens are holding more money in hand and hence, having higher purchasing power. They may be able to demand housing and cause the housing price to increase. This statement was supported by Zhao (2015) study report by saying that housing prices rose when the government loosened the monetary policy. For economic growth, it always led to an improvement in employment, consumer markets, equity markets as well as investors and consumers' confidence level (Liberto, 2021). Hence, it improves citizens' purchasing power, attracts local and foreign investors, and the economy expands. So that the demand for housing will increase and drive up the housing price. As a whole, there are chances in macroeconomic factors at the end will affect the supply and demand for goods and services which will then affect the price.

2.2 Review of Empirical Studies

2.2.1 Economic Growth – Gross Domestic Product (GDP)

Gross Domestic Product is considered one of the most common measures in macroeconomics. According to the Addae-Dapaah and Anh (2014), they used the Vector Error Correction Model (VECM) and Johansen cointegration test to analyze the data about the determinants such as housing loan, housing price, interest rate and GDP with the housing price in Singapore. Then, they found that the GDP has a positive relationship with the housing price. Based on the study of Tan and Razali (2016), they used the Pearson Correlation Analysis and Autoregressive Conditional Heteroscedasticity (ARCH) model to investigate the determinants of the volatility of housing price. They found that GDP and housing prices have a strong positive correlation. This is because income plays a fundamental role in driving the price of a house. The purchasing power of consumers will increase as their income increases. This will raise the demand for houses and significantly line with the income increase.

Based on the research done by Shaari, Mahmood, Affandi, and Baharuddin (2016), they carried out the same result in which GDP and housing price has a significant relationship by using a fixed effect model. The increase of GDP means that the economic growth of a country increases, this will cause the consumer or investors who have excess money to increase the demand for a house in order to own a house or gain high return. Therefore, this will boost the price of houses in the market. Then, similar research conducted by Baharuddin, Isa and Zahari (2019) also showed that GDP has a positive correlation with housing price. Through the cointegration test, they found that housing prices will increase 1516.18% for every 1% increase in GDP.

However, there are some scholars who have different views about the linkage between GDP and housing price. From the research of Trofimov, Aris and Xuan (2018), the relationship between GDP and housing prices is negative. For every 1% increase in GDP will cause the prices of real assets decrease 0.854%. The inverse relationship between two variables is also supported by Pour, Khani, Zamanian and Barghandan (2013). They used Engel Granger cointegration technique and claimed that the supply of houses will increase because of the increase in construction activity when the GDP increases. In this situation, it will cause the housing price to decrease since oversupply of houses occurs in the market.

On the other hand, Wong and Aralas (2019) that studied the relationship of the housing price in Malaysia with macroeconomic factors by using Error Correction Model, Autoregressive Distributed Lag Model and DiPasquale-Wheaton Model found that there is no relationship between GDP and housing price. They pointed out that the income growth of Malaysian does not move together with economic growth which means that an increase slowly in household income relative to the housing price in the market will only cause the households unable to afford the house. The similar study that was carried out by Pillaiyan (2015) also showed that GDP is unable to become a driver of housing price because the housing price growth in Malaysia has exceeded the GDP growth.

2.2.2 Inflation rate – Consumer Price Index (CPI)

Inflation refers to the state for which the purchasing power of a given currency is falling over time. It is often expressed as a percentage, reflecting that an intermediate level of prices for a basket of chosen products is rising in the economy across certain time intervals. That is, a unit of currency is now worth less than it did in the previous time (Fernando, 2021). The rising prices for food, commodities, energy, and other goods and services could pose some significant impacts to the entire economy, ranging from

individual's cost of living and doing business to financing, and thus giving rise to various macroeconomic concerns like decline in exports, mal-investments and many more (Floyd, 2021). According to Rangel and Ng (2017), the empirical study examined the macroeconomic variables that affect the housing prices growth in Singapore using the three-regime Markov-Switching methodology, which was initiated by Nneji, Brooks, and Ward (2013). The results showed that inflation rates significantly and positively affect the movements of Singapore's housing prices, especially in the boom regimes and steady state. Rangel and Ng (2017) further added that lagged inflation rates also found to be positively related to the changes in Singaporean housing prices, along with an expression saying that Singaporean housing prices create potential hedging properties against the inflationary pressures. Besides, there is another research conducted by Kuang and Liu (2015) using a four-sector general equilibrium model involving parties like consumers, firms, developers and the central bank to demonstrate the relationship between inflation and housing price. Meanwhile, such a relationship is determined based on a generalized method of moments (GMM) framework, which revealed that inflation is having positive linkage to the house prices, showing that when CPI growth, as a measure of inflation, increased by one percent, the housing prices increased by 0.84%.

Additionally, there is an empirical study carried out by Tan and Razali (2016) which applied the ARCH model and indicated that the rate of inflation possesses a significant positive effect on the housing prices' volatility. It is noted that if there is any shock found in the inflation rate, it will result in certain dynamic responses in the housing market. This result is consistent with Gholipour, Al-mulali, and Mohammed (2014) which applied panel cointegration techniques to analyze the driving forces of property prices and their relationships in OECD countries. The results of this research paper revealed that, if inflation increases by one percent, housing prices will increase by 0.027 percent. Higher inflation will lead to the growth in prices of various goods and services, particularly the construction costs of new houses; therefore, the higher costs of building a new house will eventually

push the housing prices to a higher level. Other than that, inflation is identified as the primary determinant of housing prices with reference to certain industrialized economies. The plausible explanation is that houses are perceived by the general public as either an investment or a useful hedging strategy as opposed to the pressures of inflation. As such, houses are also attractive as long-term savings, especially when there is a higher level of uncertainty concerning expected returns on investments in bonds and equities which is closely connected with high inflation (Zhu, 2004). Numerous other empirical studies were also found to have the similar conclusions regarding the significant positive connection between inflation and house prices, including Portnov and Akron (2014); Tupenaite, Kanapeckiene, and Naimaviciene (2017); Prabhu Parrikar (2019); Latif, Majeed, Rozzani, and Saleh (2020).

However, in the long run, housing prices and inflation were proposed to possess a strong negative relationship in accordance with Pillaiyan (2015) using a cointegrating VECM. The conclusion was in line with the research conducted by Ahmed (2020) using regression analysis and Granger Causality test. The findings reported that the inflation rate can significantly affect housing prices adversely. As is known, high inflation will reduce individual purchasing power, so as to their capacity to buy or demand a house. Hence, the decline in housing demand is believed to cause the price level of housing to move in the same way. Results were also consistent with empirical studies carried out by Arestis and González (2014). On the other hand, there were few studies that declared that housing price and inflation do not have significant relationship or correlation, including Rosli (2013); Ong (2013); Zandi, Supramaniam, Aslam, and Lai (2015); and Tan (2011). Despite the results obtained from various tests or analysis, there were no specific reasons to explain the insignificant relationships.

2.2.3 Unemployment rate

Unemployment rate is denoted as the percentage or proportion of which the labor force is known as workless or those who are 16 years old or above with the willingness, availability, and ability to work, and who have actively looked for a job within the previous month, in particular, four weeks (Anderson, 2021). Unemployment can give rise to various adverse effects on the individual as well as the economy, such as reducing disposable income of households, diminishing purchasing power, lowering morale of employees, as well as decreasing the output of an economy. As such, unemployment is found to have some influence on the housing market. An empirical study was carried out by Mohan, Hutson, MacDonald, and Chung (2019) which intended to determine whether the major macroeconomic indicators influence the price level of houses over time by using a vector autoregression statistical model. According to the results, the unemployment rate possessed a significant adverse influence on the housing prices, meaning that a higher unemployment rate tends to cause the housing prices to reduce immediately. To put it simply, the rising unemployment rate has discouraged individuals from buying a house; as demand for houses decline, housing prices will also decline. According to Latif et al. (2020), unemployment could create financial constraints for households; as disposable income has reduced, buying a house is considered less affordable to them, thus it can adversely affect the demand in the housing market.

Other than that, a higher unemployment rate can result in a lower expectation of job security, thus leading to a lower willingness of homebuyers to change or buy a new property as there would be a high possibility of losing a job in the coming period (Latif et al., 2020). According to the research conducted by Gathergood (2011) using pooled Probit model, fixed effect model and Tobit model, the effect of income uncertainty arising from unemployment risks had been reported to negatively affect the household decision on pursuing homeownership. The results also suggested that, if the income uncertainty increased by one standard deviation (0.013 against a mean value of 0.009), the likelihood of renters becoming homeowners in the next year decreases by about 65 percent to 118 percent. However, the findings did not investigate the impact

of the unemployment rate on housing prices. Zhu (2010) also proposed the unemployment rate and housing prices possess a negative relationship by using a panel data analysis. The findings showed that house prices will decline by 0.27 percent if the unemployment rate rises by one percent. As the households' decisions on whether to purchase a house is mostly based on permanent rather than current income, unemployment risk that creates uncertainty on permanent income can cause the employed households less willing to apply for mortgages; hence, reduction in demand for houses will lead to lower housing prices. Zhu (2010) further added that high unemployment can be concentrated in certain regions as unemployed people are less able or willing to migrate to other regions; therefore, reducing homeownership could lead to lower house prices in the particular regions. However, this study captured only the indirect effect of unemployment on the house price where their direct relationship had been overlooked. Similar conclusions can be found in several other empirical studies, including Taltavull de La Paz (2003); Shi, Joub, and Tripea (2014); Smet (2016); Lee (2009); and Stratton (2017) which declared that rate of unemployment and real estate prices have a negative relationship, particularly due to financial constraints and income uncertainty.

On the other hand, Rosli (2013) documented that unemployment is insignificant to have an effect on housing prices based on the results derived from linear multiple regression model, T-test, F-test and Pearson Correlation. The plausible explanation is that incomes are varied against ages, meaning that even youngsters are being employed, they are still unaffordable to buy a house. This is in line with the study by Quigley and Raphael (2004) which claimed that almost every young household has an income stage that is much lower than their long-term prospects. Chong, Koo, Lim, Wong, and Wong (2019) also revealed that unemployment rate and real estate prices have no relationship at 5% level of significance. As certain jobs have provided workers with relatively low wages, employees with lesser earnings definitely do not manage to buy a property; even for those with higher income, the possibility of purchasing a house could be very low in case they find a suitable one. The findings were consistent with the

research done by Wang, Koblyakova, Tiwari, and Croucher (2018), using Ordinary Least Square (OLS), the VECM framework.

2.2.4 Money supply

Money supply signifies the circulation of money or currency or other liquid instruments in an economy, commonly includes cash and deposits that can be used by households and businesses to make payments or short-term investment (The Investopedia Team, 2022). Historically, change in money supply is found to have some influences on an economy as increase in money supply will cause the interest rates to reduce; therefore, consumers holding more money in hands will result in higher purchasing capacity as well as spending, housing demand will then increase followed by growing housing prices. Besides, lower interest rates will also give rise to higher borrowing, thereby increasing investment demand for housing and assets, ultimately results in rising housing prices (Liu, 2013). Numerous studies revealed that money supply (M2) is found to have an obvious connection with housing prices. According to Li, Pan, Tang, and Tan (2021), the study using TVP-VAR model reported that money supply (M2) can significantly influence the housing prices in China. They added that money supply in China has increased fivefold in the past decades due to a series of fairly loose monetary policies, thereby causing a persistent surge in the housing prices. Similar result was found by Su, Wang, Tao, and Chang (2019) to determine the correlation between the money supply and housing prices. This study was carried out by using dynamic equilibrium model and the findings reveal that money supply (M2) could have impact on the housing prices through two channels particularly in terms of relative costs of housing finance using mortgage loans as well as assets. Rising money supply could lead to lower user costs as mortgage rates decline more than the rate of return on alternative assets which encourage higher demands for housing. On the other hand, housing prices could increase when the money supply increases as people tend to invest in real estate to preserve their value, thus

resulting in rising investment demand for housing. This is consistent with Yu and Lee (2010) using statistical method, they mentioned that housing prices could increase when money supply increases as a result of surge in housing demand due to lower interest rates and user costs. Yan (2019) illustrated that money supply growth will lead to rising prices of raw materials and labor, thereby pushing up the development costs of houses, ultimately results in growing housing prices.

Moreover, Negro and Otrok (2007) using factor-augmented-VAR also pointed out growth in housing prices has often related to expansionary monetary policies. Another study reported that reducing money supply following a contractionary monetary policy can cause the housing prices to reduce by 3% to 5% when interest rate is increased by one percentage point. Hence, money supply (M2) is concluded to have immediate and strong positive effect on housing prices in terms of credit availability (Bjørnland & Jacobsen, 2010). Chiang & Tsai (2020) also demonstrated money supply as a crucial determinant of housing prices in United Kingdom. If money supply rises to a great extent, capital tends to be invested in the housing market, thereby driving up the housing prices. Barksenius and Rundell (2012) confirmed the short run positive relationship between money supply and housing prices in Swedish by applying Error Correction Model (ECM) based on quarterly data from 1987 to 2011. The results were consistent with Goodhart and Hofmann (2008) who stated that money supply has greater effect on housing prices during the time of deregulated financial markets, especially during a period of rapid growth of housing prices. Another study determining the real effects of money supply shocks on housing markets by applying vector autoregression (VAR) implied that both the housing sales and real housing prices grow in the short run as a consequence of positive money supply shocks. In particular, money supply shocks can influence the housing market through the impact of unexpected movements in interest rates and inflation in the short run (Lastrapes, 2002). Tripathi (2019) also revealed that rising money supply in the economy leads to growth in demand for housing and eventually the housing price. The results showed that real house prices will rise by approximately 0.2% when the money supply

increases by 10%, and this confirmed the findings of Zhang, Hua, and Zhao (2012).

However, several studies argued that money supply and housing prices possess an inverse relationship. As stated in the research conducted by Mathenge (2017) using simple means, standard deviations, regression, and correlation analysis, the results implied that money supply and housing prices possess a negative relationship. The findings revealed that when the level of money supply declined by one unit, the housing prices would increase by 12.5%. By employing a cointegration approach and error correction model, Xu and Tang (2014) also concluded that money supply is adversely correlated with the housing prices based on quarterly data derived from the first quarter of 1971 until the fourth quarter of 2012 in the United Kingdom. Money supply could impact both the demand and supply side of real estate in which the real estate prices tend to reduce if the positive impacts on housing supply are more than that on the housing demand. In other words, if money supply shock causes a surge in housing supply, the level of housing prices will drop in the market. On the other hand, by using VAR model, Chen, Wei, and Huang (2018) indicated that money supply shock has no impact on the housing prices even though the results show a contractionary monetary policy causes a downward slope of housing prices in China. This is because the money supply only exerts an indirect effect on housing prices, particularly in terms of a shock to interest rate, that is changes in short-term interest rates. Hence, the study found no evidence to prove the significant relationship between money supply and housing prices. Lastrapes (2002) revealed that money supply does not exert any influence on the nominal real estate price in the long run, but it affects real estate prices positively in the short run. Therefore, it is reasonable to examine whether the money supply (M2) has a positive, negative or no influence on the housing prices in Singapore.

2.2.5 Foreign Exchange

Foreign exchange, also known as forex, is to convert one of the country's currencies to another currency and it was one of the important indicators in analyzing the housing prices (Nick, 2021). There are different views on the effect of the foreign exchange rate on the housing industry from several research studies that investigated the connection between foreign exchange and property prices. First, Liu and Zhang (2013) that studied the relationship between the RMB exchange rate and the price of real estate by VAR Model found that there is a positive correlation between these two variables which the appreciation of RMB will cause the housing price in China to increase. They provided the explanation that the foreign speculators would like to earn the dual profit from the rising value of RMB and housing prices. Besides that, Prabhu Parrikar (2019) who examined the relationship between macroeconomic factors and housing prices in India by using Correlation and regression analysis, Johansen co-integration, Unit root analysis and Vector Error Correction model detected a strong positive relationship between exchange rate and property price. This result is similar with the empirical studies carried out by Asal (2018) who applied Vector Autoregression model and Cointegration analysis. The similar study conducted by Sabyasachi (2019) who used random-effect models' analysis also showed that the exchange rate has a statistically significant and positive effect on house prices.

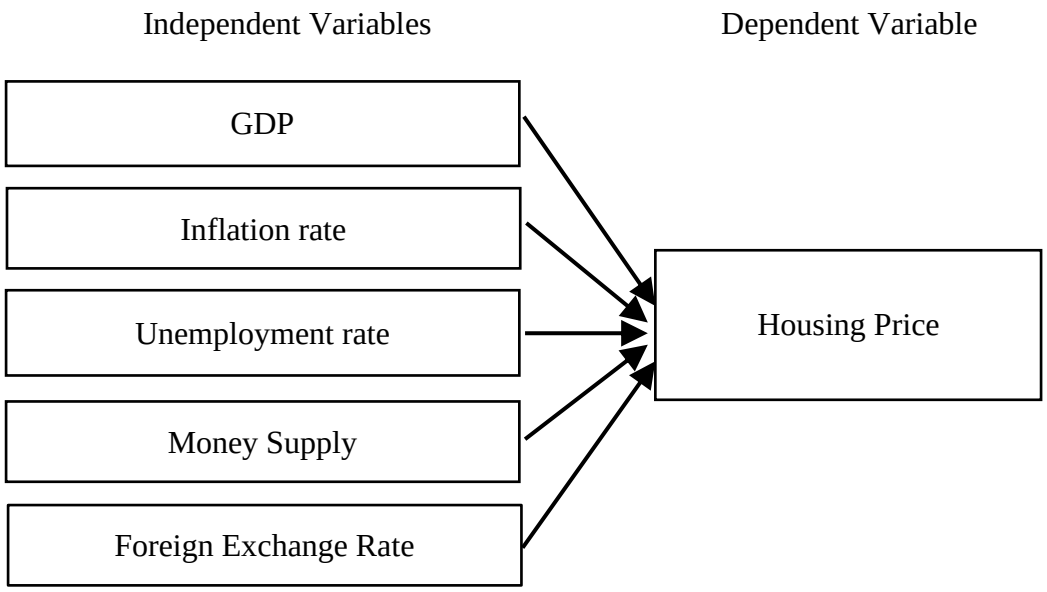
However, Wong and Aralas (2019) who investigated the relationship of property prices in Malaysia with the macroeconomic variables by using Error Correction Model, Autoregressive Distributed Lag Model and DiPasquale-Wheaton Model found that there is an inverse relationship between foreign exchange rate and housing prices. From the result of the research of David (2014), he was also realized of the rate of exchange was having a negative correlation with property price. In his research, he noted that the Kenyan shilling US dollar exchange rate negatively affected housing prices at -0.001. This is because the Kenyan shillings gains strength against other currencies. In this situation, this will discourage foreign investors invest in the Kenyan market and cause the housing price declined.

On the other hand, according to the research from Levent and Beliz (2020), the VAR econometric model was used to inspect the relationship of the price of the property in Turkey with the exchange rate. Then, they realized that exchange rate and property prices have no significant correlation. However, they do not state specific reasons to explain the insignificant relationship.

2.3 Gap of the Study

Based on the review of literature, there are many previous studies discussing the relationship between macroeconomic factors and housing price. However, most of the studies were in China, U.S. and OECD countries whereas there are limited studies on the Singapore housing market individually. Perhaps the results of previous studies on foreign housing markets are not completely suitable and accurate in explaining or describing the current real estate market in Singapore. Therefore, this research report will fill the gap by providing the latest trend on how the macroeconomic factors determine the housing price in Singapore. Additionally, it is noted that the results of the previous studies are not consistent in explaining the relationship between macroeconomic factors and housing prices. Even though there are limited studies on Singapore's case, consistency is not observed. Hence, by examining the connection between the macroeconomic factors and housing prices in Singapore critically, this report can throw light on the resulting inconsistency in the previous studies. Moreover, it is believed that the money supply and foreign exchange rate are the key determining factors of housing prices. However, there is a lack of researchers that included these two as independent variables in their study. Therefore, this study will again fill the gap by examining their relationship with the housing price.

2.4 Hypotheses Development and the Study's Theoretical Framework



H_1: GDP will have a positive relationship with housing prices.

GDP is positively related to housing prices. As one of the key indicators of economic performance, a rise in GDP indicates economic growth. When GDP increases, housing prices will also increase. It is because a rising GDP is always followed by an improvement in employment, consumer and equity market. As a result, citizens' income level and purchasing power will increase, leading to a growing demand for houses, and subsequently a rising house price. This is supported by Income Effect Theory which proposes that the change in demand for goods and services is based on the change in income, and there is a positive association between them (CFI Education Inc., n.d.). Besides, Keynes' Absolute Income Hypothesis proposed by John Maynard Keynes also states that the current income level is the key determinant of consumption. The theory asserts that household consumption will rise as income rises (Guru, n.d.). Furthermore, The Law of Demand and Supply Theory also indicates that the demand for goods and services will change in response to the change in income in which higher income will lead to higher demand (Henderson, n.d.). In short, there are theories suggesting that a rise in GDP (income level) will cause the demand for houses to grow and eventually results in rising housing price.

In addition, the developed hypothesis is supported by numerous previous empirical studies. To begin with, Shaari et al. (2016) stated that an increase in GDP will cause consumers and investors to have excess money to demand for a house, hence

boosting the housing price in the market. In addition, Tan and Razali (2016) stated that GDP and housing price have a strong positive correlation. They discovered that income increment is the fundamental role in driving housing price since housing demand is income elastic. Furthermore, a study on Singapore housing market showed that GDP is positively related to the housing price (Addae-Dapaah & Anh, 2014). The result is consistent with a study by Baharuddin et al. (2019) on Malaysia's case stating that housing price will increase 1516.18% for every 1% increase in GDP. Moreover, in Shanghai's case, Guo and Wu (2013) discovered that GDP was positively related to property price. It is because an increase in GDP indicates that people have higher consumption ability which enables them to demand for houses. Additionally, Dietz (2015) stated that economic growth will create more jobs in the economy which will subsequently increase household formation rate as well as housing demand. This will result in housing price improvement. Besides, earlier research from researchers like Panagiotidis and Printzis (2016), Adams and Füss (2010), Duja and Supriyanto (2019), and Chan and Woo (2013) also detected a positive connection between economic growth and housing prices.

H_2: CPI will have a positive relationship with housing prices.

Inflation is positively related to housing prices. Undeniably, the construction cost of houses will increase when the inflation rate is higher. This can be explained by the cost-push inflation in which the housing price increases due to the higher cost of wages and raw materials. Therefore, and undoubtedly, higher inflation leads to higher housing prices. The developed hypothesis can be proved by an empirical study by Kuang and Liu (2015), stating that the housing price will grow by 0.84% for every 1% increase in CPI, as a measure of inflation. Additionally, Gholipour et al. (2014) discovered that rate of inflation has positively correlated with property prices in OECD countries in which the house prices will increase by 0.027% for every 1% increase in inflation. Furthermore, Rangel and Ng (2017) discovered a significant positive linkage between inflation and the housing prices movements in Singapore. A consistent result is also found in a study by Tan and Razali (2016). Moreover, Zhu and Tsatsaronis (2004) found that houses are perceived by the general public in industrialized economies as a good investment tool and hedging

strategy to hedge the pressures of inflation rate. Hence, the demand for houses will increase when there is higher inflation. Besides that, Prabhu Parrikar (2019) also concluded that housing prices and inflation are having a strong positive correlation in her research study regarding the housing price in India. Furthermore, according to White (2015), housing prices have been proven to increase with an increase in inflation in United Kingdom. In addition, Tripathi (2019) conducted a research study regarding the macroeconomic determinants of housing prices at a cross-country level and discovered that inflation rate was positively related to property prices. This result is also in line with the results obtained by Andrew (2010), Duja and Supriyanto (2019), Panagiotidis and Printzis (2016), and Apergis and Rezitis (2003) in which they discovered that housing prices increased with the inflation rate.

H_3: Unemployment rate will have a negative relationship with housing prices.

The unemployment rate is negatively related to housing prices. A higher unemployment rate indicates a weaker purchasing power, thus creating a financial constraint for households to buy or own a house. Consequently, the demand for houses will decrease, followed by a decrease in housing prices. In other words, the unemployment rate and property prices are inversely correlated. This conclusion aligns with the Pigou Effect Theory that indicates the unemployment rate, people's purchasing power and goods' prices are correlated. Specifically, unemployment will reduce people's purchasing power and their demand for houses and hence lower the housing price (Gordon, 2021). Moreover, the Keynesian Economics theory mentions that the economy spending, and unemployment rate are related and suggests that the government should intervene in the market to improve employment in order to boost the demand and spending during the economic recession (Keynesian Economics, 2020). Interventions like lowering interest rates, controlling labor supply, and increasing money supply through Open Market Operations can be taken. Besides, the Economic Theory also indicates that the demand and supply of goods and services will be influenced by different economic variables and unemployment rate is either of them that will negatively affect the demand for houses and will then in turn affect the housing price (Henderson, n.d.).

There is multiple empirical evidence supporting the developed hypothesis of unemployment rate and housing price having a negative relationship. For instance, Mohan et al. (2019) found that the unemployment rate has a significant negative impact on housing prices. Besides, both Latif et al. (2020) and Zhu (2010) discovered an inverse effect between the unemployment rate and property price. Latif et al. (2020) stated that a higher unemployment rate will reduce the willingness of homeowners to change or buy a new house due to a lower expectation of job security. On the other hand, Zhu (2010) demonstrated a higher unemployment rate will cause a higher uncertainty on permanent income, and thus reducing the willingness of households to purchase a house. Zhu (2010) further added that the house price will decline by 0.27 percent, in response to one percent increase in the unemployment rate. Next, Gathergood (2011) also mentioned that the unemployment rate was negatively affecting the homeownership of the households as unemployment caused households' purchasing power to be reduced. Moreover, researchers like Taltavull de La Paz (2003); Stratton (2017); Shi, Joub, and Tripea (2014); Smet (2016); and Lee (2009) also concluded that the unemployment rate caused the contraction in the housing market due to the reduction in income. In the context of a high unemployment rate, the increased job insecurity kept the households away from entering into the housing market and reduced their affordability to own a house. (Gan & Zhang, 2013).

H_4: Money supply will have a positive relationship with housing prices.

Money supply is positively correlated with housing prices. Specifically, when the money supply increases, consumers will be holding more money in their hands since there is more money circulates in the economy. This will result in consumers now possessing greater purchasing power. According to the theory of consumption, it is very likely for consumers to spend more or drive up their consumption in the economy when they have higher purchasing capacity (Hill, 2021). Hence, the consumers will have a higher demand for housing, and eventually results in a rising housing price. Besides, The Wealth Effect also suggested that consumers will feel more confident in spending when they perceive a rise in their asset value. In other words, consumers are more willing to spend when they perceive that they are richer (Pettinger, 2018). Therefore, with an increase in money supply, consumers with

more money in their hands are confident and willing to spend more. Consequently, housing demand will increase and be followed by the housing price. In addition, The Liquidity Effect stated that consumers will spend more with an increase in the availability of money (Dontigney, 2017). Therefore, a rising money supply that increases the availability of money will result in the growth of both housing demand and housing prices.

Furthermore, there are multiple empirical evidence that support the developed hypothesis. For instance, Yan (2019) discovered that housing prices increase with money supply. It is because a rising money supply will push up the development costs such as raw materials and labor. Besides, a same result is gained by Bjørnland and Jacobsen (2010) stated that decrease in money supply due to a contractionary monetary policy can cause the housing prices to fall. In addition, Chiang and Tsai (2020) also discovered that the housing prices in United Kingdom will be driven up by a significant increase in money supply. On top of that, Zhang, Hua and Zhao (2012) found that the real housing prices will rise by approximately 0.2% with a 10% increase in money supply. Additionally, a study by Tsai (2019) stated that a remarkable rise in money supply will result in the overvaluation of housing in US. Moreover, the result is consistent with the results obtained by Su, Wang, Tao and Chang (2019), Yu and Lee (2010), Negro and Otrok (2007), Tripathi (2019) and Lastrapes (2002).

H_5: Exchange rates will have a positive relationship with housing price.

Exchange rates and housing prices are expected to possess a positive relationship. The stated positive relationship indicates that when the exchange rate rises (appreciates), housing prices will also rise. This is because an appreciation in SGD will increase the expected return on SGD denominated assets. Therefore, it will attract the flow of foreign funds or capital into Singapore to earn the excess return. Simultaneously, real estate investment which offers high return and consistent capital growth has become the first choice of international capital. Eventually, the appreciation in the exchange rate will cause the increase in both housing demand and housing price. As empirical evidence to support the developed hypothesis, Asal (2019) has discovered that real effective exchange rate is an important indicator of

housing price in Sweden. His findings showed that when Swedish Krona depreciated by 1%, the real housing price fell by 1.7%. In addition, Liu and Zhang (2013) also discovered that housing price in China will increase with the appreciation of RMB. It is because the foreign speculators wish to gain from the continuous appreciation of RMB and the rapid rising housing prices in China housing market. A similar result is obtained by Liu and Hu (2012). They stated that the continuous revaluation of RMB and the booming housing market in China had attracted the flow of international capital, to earn the dual profit. They further added that the appreciation of RMB can increase the disposable income and wealth of the public in China as the locals can purchase the imported goods at lower costs. As a result, the public wealth will grow and the growing wealth will lead to a higher demand for housing, and thus increases the housing price. Moreover, Miller, Sklarz and Ordway (1988) found that a 10% appreciation of Yen against USD resulted in a 27% increase in Waialae-Kahala housing prices. Furthermore, a similar result was obtained by Benson, Hansen, Schwartz, and Smersh (1999) in the US. Their findings showed that the housing price in Bellingham climbed 7.7% when the exchange rate raised by 10%. The result is also in line with the results obtained by Prabhu Parrikar (2019), Sabyasachi (2019), Ohno and Shimizu (2015), and Kogid and Pinjaman (2020).

2.5 Conclusion

To summarize, the connection between the various independent variables and housing price has been supported by different past studies and several theories. Subsequently, the theoretical framework and the hypotheses of this research study are developed and clearly justified by the relevant theories and the previous empirical studies. From the literature review, it is discovered that there are extremely limited previous empirical studies examining the relationship between money supply and foreign exchange rate with housing price in Singapore. Hence, this study serves a purpose to fill the gap of study by including money supply and foreign exchange rate as the manipulated variables in this research. The following

chapter will detail the data and methodology acquired to estimate the relationship between independent variables and dependent variables.

CHAPTER 3: METHODOLOGY

3.0 Introduction

This section illustrates numerous econometric techniques that are utilized for examining the linkage between the housing prices and several macroeconomic indicators in Singapore over the period from 2005 Q1 to 2020 Q4. The macroeconomic variables include economic growth (GDP), inflation rate (CPI), unemployment rate, money supply (M2) and foreign exchange rate. Moreover, secondary data is used and collected from several sources that are trustworthy and valid, such as official websites of Singapore Ministry of Manpower (MOM), Data.gov.sg., Monetary Authority of Singapore (MAS), Singapore Department of Statistics (DOS), and International Monetary Fund (IMF).

To begin with, the Augmented Dickey-Fuller unit root test is used in this research to identify the stationarity of the time series data. Furthermore, the co-integration concept which is proposed by Pesaran and Shin (1995) and Pesaran, Smith, and Shin (1996) highlighted the long run relationship found in between the property prices and the proposed macroeconomic factors. In this case, Autoregressive Distributed Lag (ARDL) approach to cointegration is used for analyzing relationship between housing prices and macroeconomic variables in Singapore in long run. In addition, the application of Granger Causality test is to detect the causal relationship between the explained variable and manipulated variables.

In the time series modeling process, diagnostic checking is an important step to ensure the regression adequately expresses the observed time series, by testing a calibrated model using various statistical tests. In other words, the application of diagnostic checking is to make sure the absent of error found from the regression and to indicate the significance of each independent variables to explain the house price in Singapore. In the research, ARCH is going to be applied in discovering the potential heteroscedasticity problem; Breusch-Godfrey Serial Correlation LM Test

is conducted to identify possible autocorrelation issue; while Jarque-Bera (JB) test is executed to examine whether the error terms are normally distributed.

3.1 Research Design

In the study, quantitative research methods are adopted to examine the developed hypotheses. Quantitative research method is suitable for the study since it enables the expression of relationships into statistical mathematics such as correlations (Sekaran & Bougie, 2010). This study aims to investigate the relationship between the chosen independent variables and housing price in Singapore based on time series analysis from 2005 Q1 to 2020 Q4. Hence, quarterly data of Singapore for housing price index, gross domestic product, consumer price index, unemployment rate, money supply (M2), and exchange rate from 2005 to 2020 will be used for analysis in this research.

3.2 Data Collection Method

Data collection is a process of gathering data for the targeted variables in an organized manner. The process should be well organized to avoid inaccuracy and invalid results. In this study, secondary data is collected for further analysis.

3.2.1 Secondary Data

Secondary data refer to the data that have been collected previously by someone and they can be easily accessed and obtained through sources such as journals, articles, historical data, statistics and others. There are several advantages for a study to adopt a secondary data collection method. For instance, it is time savings and cost effective since the secondary data have been provided in an organized manner and they can be easily acquired.

Furthermore, secondary data enable researchers to better understand and compare the explanatory and response variables (Juneja, n.d.).

In this study, secondary data are adopted to investigate the relationship between housing price and the selected macroeconomic factors in Singapore. All secondary data are directly derived from numerous reliable sources including Singapore MOM, Data.gov.sg., MAS, Singapore DOS, and IMF. Furthermore, the data are collected from the year 2005 to 2020 on a quarterly basis with 64 observations in order to perform time series analysis. The study period, 2005 to 2020 is selected in order to generate an output that provides the latest trend on the macroeconomic determinants of housing price in Singapore. Table 3.2.1 below shows the summary of data sources for the variables and their unit measurements.

Table 3.2.1

Summary of Data Source for the Factors and Their Unit Measurements

Factors	**Proxy**	**Unit Measurement**	**Source**
Housing Price	HPI	Index (2009 = 100)	Data.gov.sg
Gross Domestic Product	GDP	Growth percentage, %	Singapore Department of Statistics (DOS)
Inflation	CPI	Index (2019 = 100)	Monetary Authority of Singapore (MAS)
Unemployment Rate	UNE	Growth percentage, %	Singapore Ministry of Manpower (MOM)
Money Supply, M2	MS	Growth percentage, %	Monetary Authority of Singapore (MAS)
Exchange Rate	EX	Index (2010 = 100)	International Monetary Fund (IMF)

3.3 Description of Variables

3.3.1 Housing Price Index (HPI)

Housing price is usually measured by HPI that reflects the price movements of housing over time. Generally, HPI serves a function of providing the prevailing trend of housing price for estimation purpose. The data of Singapore HPI is acquired from Data.gov.sg from 2005 to 2020 with the frequency of quarterly basis. Majority of the researchers such as Baharuddin et al. (2019), Trofimov et al. (2018), Pour et al. (2013), Wong and Aralas (2019), and Ong (2013) used HPI as an indicator to determine the housing price variations over time.

3.3.2 Gross Domestic Product (GDP)

Gross domestic product is a crucial indicator of economic growth. It can be defined as the total market value of the final goods and services produced in a country during a specific period. It is normally expressed as a percentage rate which represents the growth rate of GDP at market price. In this study, the growth rate of GDP from 2005 Q1 to 2020 Q4 is obtained from the Singapore DOS. Many researchers such as Addae-Dapaah and Anh (2014), Tan and Razali (2016), Shaari et al. (2016), Baharuddin et al. (2019), Trofimov et al. (2018), and Pour (2013) had been using GDP as a key determinant of housing price.

3.3.3 Inflation Rate (CPI)

Inflation can be defined as the reduction of purchasing power due to the increasing price of goods and services over time. It is measured by CPI which represents the percentage change over time in the price paid by

consumers for a basket of goods and services. In this study, the Consumer Price Index of Singapore from 2005 to 2020 based on quarterly basis is collected from MAS. Numerous past studies by Rangel and Ng (2017), Kuang and Liu (2015), Pillaiyan (2015), Ahmed (2020), Portnov and Akron (2014), and Tupenaite et al. (2017) had taken inflation as a vital indicator to determine the housing price.

3.3.4 Unemployment Rate (UNE)

The unemployment rate is expressed as a percentage which refers to the proportion of unemployed workers in the total labor force. High unemployment rate in the economy will result in reducing disposable income of household and diminishing purchasing power. In this study, the unemployment rate is obtained from Singapore MOM, covering from 2005 Q1 to 2020 Q4. Multiple researchers such as Mohan et al. (2019), Latif et al. (2020), Lee (2009), Zhu (2010), Stratton (2017), and Smet (2016) had taken unemployment rate as a crucial determining factor of housing price.

3.3.5 Money Supply (MS)

Money Supply (M2) not only includes all the components in M1 (circulated coins and currency, travelers' checks, checkable deposits), but also money market funds, savings deposit, and time deposits. M2 is selected in this study to indicate money supply as it includes all the most highly liquid assets as well as the easily-convertible near money. Additionally, M2 is closely watched as an indicator of money supply, and the target of central bank monetary policy. In this study, the Singapore money supply data (M2), covering from 2005 Q1 to 2020 Q4, is acquired from MAS and measured in percentage growth. Many researchers such as Su, Wang, Tao and Chang (2019), Yu and Lee (2010), Mathenge (2017), Xu and Tang (2014) and Yan (2019) had proven that money supply is a key determinant of housing price.

3.3.6 Exchange Rate (EX)

Exchange rate can be defined as the value of a currency against another. In this study, the Singapore Real Effective Exchange Rate (REER) Index from 2005 Q1 to 2020 Q4 is collected from IMF. REER index is suitable in this study to describe the strength of SGD in relation to a basket of other major currencies. Numerous researchers including Liu and Zhang (2013), Benson, Hansen, Schwartz, and Smersh (1999), Sabyasachi (2019), Ohno and Shimizu (2015), and Wong and Aralas (2019) had certified that the exchange rate is a determining factor of housing price.

3.4 Empirical Model

Functional model:
Housing Price: F (Gross Domestic Product, Consumer Price Index, Unemployment rate, Money supply, Exchange Rate Index)

Economic model:

$$HPI_t = \beta_0 + \beta_1 GDP_t + \beta_2 CPI_t - \beta_3 UNE_t + \beta_4 MS_t + \beta_5 EX_t + \mu_t$$

Where,

HPI_t = Housing Price Index
GDP_t = Gross Domestic Product
CPI_t = Consumer Price Index
UNE_t = Unemployment Rate
MS_t = Money Supply
EX_t = Exchange Rate Index
μ_t = Error Term

3.5 Econometric Techniques

In this chapter, various econometric tests are employed in this study to examine the relationship between the macroeconomic determinants and housing prices in Singapore. By applying the unit root test, it helps to verify the stationarity of the time series data. Besides, ARDL approach to cointegration is used for determining whether there is any linkage between housing prices and the proposed macroeconomic factors in Singapore in the long run. Moreover, the Granger Causality test is employed in our research to stipulate whether there exists a causal relationship between the manipulated variables and explained variable.

3.5.1 Unit Root Test

In econometrics, the use of unit root test is applied to determine the stationarity of a time series variable and the presence of unit roots which can give rise to non-stationarity. A time series is considered stationary if the mean and variance are found to be constant over time; as well, the auto-covariance depends only on the time lag, instead of the actual time. On the other hand, time series is non-stationary if there is a varying of mean. In fact, unit root tests shall be conducted on the variables and residuals before carrying out the test on cointegration. This is due to the fact that two variables are said to be cointegrated as long as the variables are integrated at the same order, with the residuals of the two variables obtained from regression are stationary (Ooi, 2012).

In general, Augmented Dickey-Fuller (ADF) test is a popular approach applied in unit root test. It is the modified version of Dickey-Fuller test which had been improved to solve the autocorrelation problem in the basic Dickey-Fuller test, commonly employed by researchers to analyze whether a time series variable is stationary. As compared to Dickey-Fuller test, ADF can handle a more complex or higher order regressive process in the model; therefore, ADF is used widely in the research field. The null hypothesis for

ADF is: There is a unit root (α = 1). In order to reject the null hypothesis, the p-value obtained should be lower than the level of significance (commonly 0.01 or 0.05). As a result, the series is said to be stationary (Chaudhary, 2020). On the other hand, the alternate hypothesis varies slightly according to which equation has been used, but the basic alternate hypothesis is often the time series is stationary, or trend- stationary.

The test equation used in ADF test is shown as equation (1): (Prabhakaran, 2019).

$$\Delta y_t = c + \beta_t + \alpha y_{t-1} + \delta_1 \Delta Y_{t-1} + \delta_2 \Delta Y_{t-2} + \cdots + \delta_p \Delta Y_{t-p} + e_t$$

(Equation 1)

Where,

- t is the time index,
- c is an intercept constant,
- β is the coefficient on a time trend,
- α is the coefficient presenting process root (the focus of the test),
- y_{t-1} is the lag one of time series,
- $\delta_1 \Delta Y_{t-1}$ is the first difference of the series at time (t - 1),
- p is the lag order of the first-difference autoregressive process,
- e_t is an independent identically distributed residual term.

Fundamentally, the focus of ADF test is to examine whether the coefficient of y_{t-1} (α) is zero, inferring the stationarity of the time series by rejecting the null hypothesis. In contrast, if α is found to be one, the conclusion will be: there is existence of a unit root. To make it simple, ADF unit root test can be conducted using the Eviews software. The t-statistic is generated and used to compare with the respective critical value to determine the significance of the coefficient. So, the null hypothesis will be rejected if the t-statistic is lower than the critical value, thereby confirming the stationarity of the series.

3.5.2 Co-integration Regression Framework

A co-integration test is employed by researchers to indicate whether long run correlation is presented between several time series. The concept was first established in 1987 by Nobel laureates Robert Engle and Clive Granger. It indicates scenarios in which two or more non-stationary time series are integrated in the same order in the sense that they cannot alter from long run equilibrium (CFI Education Inc., n.d.). In this study, co-integration test is applied to determine whether or not the non-stationary variables are co-integrated. The use of cointegration test can avoid spurious regression, thereby detecting the existence of stable long-run relationships between sets of variables. In this case, the autoregressive distributed lag approach is often used in estimating cointegration.

3.5.2.1 Autoregressive Distributed Lag (ARDL) Approach

ARDL approach is introduced by Pesaran & Shin (1995) and Pesaran, Smith, and Shin (1996), which is to estimate the cointegration or bound procedure for a long run relationship. The ARDL approach is employed with regardless of whether or not the fundamental variables are I(1), I(0) or a combination of both. Then, the use of ARDL approach to cointegration will provide estimates that are both realistic and efficient. By using ARDL approach to cointegration, researchers can identify the cointegrating vectors. To put it simply, every fundamental variables represents a single long run relationship equation for which the ARDL model of the cointegrating vector is going to be re-parameterized into ECM if any one cointegrating vector (say the underlying equation) is recognized. Then, the results obtained from the re-parameterized model will show dynamics in short run and long run relationship of a single model's variables. It is possible for re-parameterization as the ARDL is a single model equation that is dynamic along with the same structure as ECM. To put it simply, the distributed lag

model refers to a regression function that includes the unrestricted lag of the regressors (Nkoro, & Uko, 2016). Typically, this cointegration test helps researchers to identify the existence of cointegration in the underlying variables in the model with known endogenous variables.

According to Nkoro and Uko (2016), the general ARDL model is written as:

$$\Phi(\mathrm{L,p})y_t = \sum_{i=1}^{k} \beta_i (L, q_i)x_{it} + \delta w_t + \mu_t \qquad \text{(Equation 2)}$$

Where,

$\Phi(\mathrm{L,p}) = 1 - \Phi_1 L - \Phi_2 L^2 - \cdots - \Phi_p L^p$

$\beta_i(L, q) = 1 - \beta_1 L - \beta_2 L^2 - \cdots - \beta_q L^q$

for i = 1, 2, 3, …, k; u_t ~ iid (0; δ^2)

- L is a lag operator in the form of $L^o y_t = X_t$, $L^1 y_t = y_{t-1}$,
- w_t is a random vector of deterministic variable, for example: the time trends, intercept term, seasonal dummies, or exogenous variables with the fixed lags,
- p = 0, 1, 2, …, m; q= 0, 1, 2, …, m; i= 1, 2, …, m
- k is a sum of $(\mathrm{m} + 1)^{k+1}$ different ARDL models,
- m is the maximum lag order,
- t is the sample period, t = m+1, m+2, …, n.

In this study, the ARDL model is specified as equation (3) to test the cointegration relationship between the variables:

$$\Delta \ln HPI_t = \alpha + \beta_1 \ln HPI_{t-1} + \beta_2 \ln GDP_{t-1} + \beta_3 \ln CPI_{t-1} + \beta_4 \ln UNE_{t-1} + \beta_5 \ln MS_{t-1} + \beta_6 \ln EX_{t-1} + \sum_{i=1}^{p} \phi_i \Delta \ln HPI_{t-i} + \sum_{j=0}^{q1} \varphi_j \Delta \ln GDP_{t-j} + \sum_{k=0}^{q2} \varphi_k \Delta \ln CPI_{t-k} + \sum_{l=0}^{q3} \varphi_l \Delta \ln UNE_{t-l} + \sum_{m=0}^{q4} \varphi_m \Delta \ln MS_{t-m} + \sum_{n=0}^{q5} \varphi_n \Delta \ln EX_{t-n} + \varepsilon_t$$

(Equation 3)

where β_i are the long run multipliers, α is the intercept and ε_t refer to white noise errors.

The testing procedures for ARDL approach is:

Firstly, equation (3) is estimated to use OLS to indicate the existence of long run relationship among the variables. So, the F-test is conducted to examine the joint significance of the lagged levels of the variables' coefficients, for which:

$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$ (There is no long run relationship.)
$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$ (There is long run relationship.)
We will reject H_0 if the critical value (F-Statistic) is higher than the upper bound critical value, or else H_0 will not be rejected; the result is inconclusive if the F-statistic falls between the lower and upper critical values (Pesaran, Smith, & Shin, 2001).

Next, if the result shows that the underlying variables have long run relationship between themselves, at the same time, no long-run relation is found between variables in the other equations, then researchers can apply ARDL approach to cointegration. The optimum lag length (k) needs to be selected based on proper model order selection criteria, for example: Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQC) or Schwarz Bayesian Criterion (SBC). To make it simple, Eviews software can be used to present the results, in which the smallest result is often chosen to avoid autocorrelation issue existing between the error terms.

Lastly, ARDL model is re-parameterized into Error Correction Model to observe both long run and short run relationships between the variables. Therefore, equation (3) can be modified to equation (4):

$$\Delta \ln HPI_t = \alpha + \sum_{i=1}^{p} \phi_i \Delta \ln HPI_{t-i} + \sum_{j=0}^{q1} \varphi_j \Delta \ln GDP_{t-j} + \sum_{k=0}^{q2} \varphi_k \Delta \ln CPI_{t-k} + \sum_{l=0}^{q3} \varphi_l \Delta \ln UNE_{t-l} + \sum_{m=0}^{q4} \varphi_m \Delta \ln MS_{t-m} + \sum_{n=0}^{q5} \varphi_n \Delta \ln EX_{t-n} + \lambda (ECM)_{t-1} + \varepsilon_t$$

(Equation 4)

Hence, the variables are said to be important if they are determined to have an explainable relationship with the housing price index (HPI).

3.5.3 Granger Causality Test

Granger Causality test is a statistical hypothesis test that was first proposed by Professor Clive Granger in the 1960s, and it is widely used for analyzing the causal relationship between two variables in a time series (Seth, 2007). The test of Granger causality is unable to provide insight into the true causal relationship among two variables since it only provides information about the ability of forecasting. By conducting the test, the researcher can determine the causality relationship among the variables whether they are bidirectional, unidirectional and or even no causality relationship (Dhuria, Chetty & Choudhury, 2018). The simple equations are as follows:

$$Y_t = \propto_1 + \sum \beta_1 X_{t-1} + \sum \gamma_1 Y_{t-1} + \mu_{1t}$$

(Equation 5)

$$X_t = \lambda_1 + \sum \delta_1 Y_{t-1} + \sum \rho_1 X_{t-1} + \mu_{2t}$$

(Equation 6)

From the equation above, Y_t and X_t are a time series of variables that can be any pairs of housing prices and a macroeconomic variable that researchers want to examine. For equation 5, it is used to analyze whether independent variable has granger cause the dependent variable or not; while for equation 6 is used when researchers want to examine dependent variable has granger cause the independent variables. Then Y_{t-1} and X_{t-1} are the lagged terms of

Y_t and X_t respectively. From this research, we examine the causal relationship between the dependent variable, housing price and some independent variables where GDP, unemployment rate, inflation rate, money supply as well as foreign exchange in Singapore during 1991 to 2020.

Hypothesis statement:
H_0: X not Granger causes the housing price.
H_1: X Granger causes the housing price.

Then, F test is used in order to show the hypothesis testing in this test, the formula is as follows:

$$F = \frac{(RSS_R - RSS_{UR})/q}{RSS_{UR}/(n-k)}$$

Based on the formula given above, RSS_R represents R^2 from restricted model; RSS_{UR} indicates R^2 from unrestricted model; n is the number of observations; k refers to the number of explanatory variables in the unrestricted regression.

Then, H_0 should be rejected when the critical value is larger than F statistic at 10%, 5% or 1% significance level that is used in the test. Otherwise, do not reject H_0. In this situation, we should conclude whether X and Y have a relationship or not.

3.6 Diagnostic Checking

3.6.1 Heteroscedasticity

The Classical Linear Regression Model (CLRM) assumes that the variance of the error term is constant. This is known as homoscedasticity. However,

when the variance of the error term is not constant and relies on the independent variables' value, there is heteroscedasticity problem (Williams, 2020).

There are several methods to detect the heteroscedasticity problem, which includes White Test, Park Test, Breusch-Pagan-Godfrey (BPG) test, Glejser Test, Spearman's Rank Correlation test, Golfeld-Quandt Test and other. Besides, there is another test called ARCH test for time series model. It was proposed by economist Robert F. Engle III in the 1980s (Kenton, 2021). The hypothesis statement and decision rule are as follows:

Statement of Hypothesis:
H_0: There is no heteroscedasticity problem.
H_1: There is a heteroscedasticity problem.
Decision rule: Reject H_0 if p-value is below the significance level. Otherwise, do not reject H_0.

3.6.2 Autocorrelation

The problem of autocorrelation occurs when the error terms or disturbances in the models are dependent on one another from one period to another in the time series research designs. (Huitema, & Laraway, 2006). In other words, it measures how the variable's current value, and its past value is related. When the error terms are autocorrelated or dependent to the error terms of another period across the same time series, the results obtained from the analysis are more likely to be misleading or inaccurate. The estimated variances of regression coefficients will also become biased and inconsistent, which in turn lead to an invalid hypothesis testing since the test statistic tend to be higher that increase the chance to reject the null hypothesis. Also, the R^2 will be overestimated.

Autocorrelation is crucial because it can affect the validity of the conclusion drawn from the hypotheses testing given the confidence level. Also, autocorrelation test can used to improve the prediction made form the regression equations (Huitema, & Laraway, 2006). For instance, researchers can use autocorrelation diagnostic checking to test whether the models' disturbances are correlated, if autocorrelation exists, corrective actions can be taken to improve the result.

Autocorrelation can arise from the measurement error, omitting in variables, and model misspecification. There are several tests that can be used to identify the issue of autocorrelation in the models including Breusch-Godfrey LM and Durbin Watson (DW) Statistic. Breusch-Godfrey LM test is applied to discover the existence of autocorrelation issue. The statement of hypothesis and decision rule are as follows:

Statement of Hypothesis:
H_0: There is no autocorrelation problem.
H_1: There is an autocorrelation problem.
Decision rule: Reject H_0 if test statistic is above the critical value or p-value is less than the significance level. Otherwise, do not reject H_0.

3.6.3 Normality

Normality test is for detecting whether the error terms are normally distributed or not. When the normality does not achieve, the following t-test and F-test results may be inaccurate, and in turn the hypothesis testing is not valid as well. The tests involve in normality testing including Empirical Distribution Function (EDF) Tests, Kolmogorov-Smirnov Test, Shapiro-Wilk test, Anderson-Darling Test etc. According to Das and Imon (2016), JB Test is the most widely used test in testing the normality of the models in economics and businesses. The formula to compute the JB test statistic is as below:

$$JB = n\left[\frac{S^2}{6} + \frac{(k+3)^2}{24}\right]$$

Where n = sample size

S = skewness

k = kurtosis

Other than the formula, the JB test statistic can also be obtained from the Eviews output. The hypothesis statement and decision rule are as below:

Statement of Hypothesis:

H_0: The error term meets the normality assumption.

H_1: The error term does not meet the normality assumption.

Decision rule: Reject H_0 if p-value is less than the significance level. Otherwise, do not reject H_0.

3.6.4 Model Specification

Model specification errors basically occurred due to the errors of omission or errors of inclusion. There are different forms of specification errors. It includes the omitting of relevant variables, including unnecessary variables, adopting incorrect functional form and measurement errors. For determining the presence of model specification bias, we can perform Durbin-Watson d test, Lagrange Multiplier (LM) Test or Ramsey's regression specification error test (RESET) (Gujarati & Porter, 2009). In this study, we are applying the Ramsey's RESET test to detect the model specification. The hypothesis statement and decision rule are as follows:

Hypothesis Testing:

H_0: The is no model specification bias.

H_1: There is model specification bias.

Decision rule: Reject H_0 if p-value is less than the significance level. Otherwise, do not reject H_0.

3.6.5 Coefficients Stability Tests

Cumulative sum (CUSUM) of the recursive residuals and cumulative sum of squares (CUSUMSQ) of the recursive residuals tests was first proposed by Brown, Durbin and Evans (1975). There are both used to test the constancy of coefficients in a model. The CUSUSM test is to determine whether there are systematic changes in the regression coefficients while the CUSUMSQ test it to determine whether there is a sudden change from the constancy of the regression coefficients (Ravinthirakumaran, Selvanathan, & Selvanathan, 2015). Coefficients of the model are stable when the test statistic falls within the corridor with the significance level of 5% (Galpin & Hawkins, 1984). However, if it crosses into the critical region, it indicates that there is structural change in the model over time (Dao, 2021).

3.7 Conclusion

To conclude, this chapter highlights the econometric tests that will employ in this research work to determine the relationship between housing prices and the macroeconomic indicators in Singapore. Before that, data collection method is clearly discussed in which the type of data used in this study is secondary data, which applied time series data from 2005 to 2020 based on quarterly basis. Hence, 64 observations for each dependent variable and independent variables are acquired from several reliable sources including Singapore MOM, Data.gov.sg., MAS, Singapore DOS, and IMF. Subsequently, this chapter also detailed the diagnostic tests adopted in this study to discover economic problems that may exist in the model. In the next chapter, all the proposed tests will be conducted, and the outputs will be presented and discussed.

CHAPTER 4: ANALYSIS OF DATA

4.0 Introduction

In this division, the correlation between the housing price and the five macroeconomic factors including gross domestic product, inflation rate, unemployment rate, money supply and foreign exchange rate will be examined and presented. First, we conducted the Unit Root Test, ADF test. Then followed by the ARDL Bound Test for Cointegration to investigate the long run relationship of the determinants in housing price. Next, we also performed the Granger Causality Test to determine the causal relationship between the housing price and the five macroeconomic factors. Lastly, we carried out the diagnostic checking.

4.1 Result of Unit Root Test

Table 4.1

Augmented Dickey-Fuller (ADF) Unit Root Test Results for Independent and Dependent Variables (in p-value)

Variables	Level Form		First Difference	
	Intercept	Trend and intercept	Intercept	Trend and intercept
HPI	0.2464	0.4782	0.0001***	0.0007***
CPI	0.0436 **	0.5860	0.0000***	0.0002***
EX	0.3936	0.9933	0.0000***	0.0000***
GDP	0.0050***	0.0012***	0.0000***	0.0000***
MS	0.0000***	0.0000***	0.0000***	0.0000***
UNE	0.0000***	0.0000***	0.0000***	0.0000***

Note: *, ** and *** signified that the null hypothesis of non-stationary is rejected at 10%, 5% and 1% significance level respectively.

Based on Table 4.1, it shows the findings of the unit root test for the six determinants, namely rate of inflation, exchange rate, GDP, money supply as well as unemployment rate, along with those of the dependent variable, housing prices. With the selection of intercept as well as trend and intercept, the results demonstrate that the data series of variables achieved stationarity at level form, first difference level form or a combination of both. The data series of variables which are stationary at level form are found to be following the integrated of order zero, I(0); whereas those that achieved stationarity at first difference level form are found to be following the integrated of order one, I(1). According to the results, the data series of GDP, money supply and unemployment rate achieved stationarity at the level form and first difference level form when intercept as well as trend and intercept are included. As for the inflation rate, it is stationary at level form when including only the intercept; it also achieved stationarity at the first difference level form when two selection is included. Lastly, it is found that the data series of housing prices and exchange rate achieved stationarity at only first difference level form.

4.2 Bound Test for Co-integration

Unit root test in 4.1 does confirm that the selected variables are stationary at I(1), I(0) or a combination of both. To examine whether there exits a long run relationship in the time series variables, we apply ARDL bound test for cointegration. By applying this test, long-run relationships will be presented in the time series variables if the F-statistic is higher than the upper critical value. On the other hand, if the F-statistic is below the lower critical value, it implies no presence of long run relationship. However, if the F-statistic falls within the lower and upper bound critical value, the result is considered inconclusive or no conclusion can be drawn at this point (Pesaran, Smith, & Shin, 2001). According to Table 4.2, it illustrates that the lower bound critical value which follows I(0) is 3.06 and 4.15 for

upper bound critical value which follows I(1) at significance level of 1%. At 5% significance level, the lower bound critical value which follows I(0) and the upper bound critical value which follows I(1) are 2.39 and 3.38 respectively. As for 10% level of significance, it presents that the lower bound critical value which follows I(0) is 2.08 whereby the upper bound critical value which follows I(1) is 3. Based on the outcomes presented in the table, the F-statistic generated in ARDL bound test was found to be 5.2648, well above the upper bound critical value of 4.15, 3.38, and 3 at 1%, 5%, 10% level of significance respectively. Therefore, our conclusion is: there presents a long run relationship in the time series variables.

Table 4.2

Outcomes of ARDL Bound Test for Co-integration Results (Housing Price)

Variables	(HPI/INF, EX, GDP, MS, UNE)	
F-statistic	5.2648***	
	Critical Value	
Significance Level	**I(0)**	**I(1)**
1%	3.06	4.15
5%	2.39	3.38
10%	2.08	3
Conclusion	Co-integration	

Note: *, ** and *** signified that the null hypothesis of no long run relationship is rejected at 10%, 5% and 1% level of significance respectively.

4.3 Effect of Determinants on Housing Prices in the Long Run

Table 4.3

Long Run Results Using ARDL Bound Test

Variables	Coefficient	Standard Error	t-Statistic	P-value
GDP	0.159220	0.913291	0.174336	0.8625
CPI	-1.672131	1.183308	-1.413098	0.1658
UNE	3.848409	1.849521	2.080760	0.0442**
MS	-5.466189	2.777642	-1.967924	0.0564*
EX	4.177995	1.005361	4.155715	0.0002***

Note: *, ** and *** denoted that the null hypothesis is rejected at 10%, 5% and 1% significance level respectively.

4.3.1 Economic Growth and Housing Price

By referring to the results from Table 4.3, it showed an insignificant correlation found between the housing prices and economy growth, as measured by GDP in Singapore context. The relationship between HPI and GDP is insignificant as the p-value of 0.8625 is higher than the levels of significance of 1%, 5%, and 10%. When there the economic growth increase by 1%, there is no effect on the housing price in Singapore. Hence, a conclusion can be drawn from the results, which is economic growth and housing price is not related in long run for Singapore.

By comparing to the previous studies, the result is against most of the studies. Research done by Shaari et al. (2016) and Baharuddin et al. (2019) showed that GDP was having a significant and yet positive connection with housing prices. In their research, they concluded that the economic expansion meant that the unemployment rate is low, salary improves, and investment increases. Hence, property prices increase accordingly as purchasing power improves. In contrast, research done by Trofimov et al. (2018) and Wong et al. (2019) showed a negative relationship between the GDP and housing prices. This condition was mainly due to the expansion in construction activity during the economic expansion which led to a fall in property prices.

However, there were also researchers who got similar results of no relationship between economic growth and housing prices. According to the research report done by Pillaiyan (2015), the relationship between economic growth and housing prices in the long run was not detected under the study report. With this result, Pillaiyan (2015) concluded that housing prices may be deviated from the economic fundamentals that are affected by GDP growth. The dynamic of property prices can be driven by other factors including the rate of urbanization, construction activity, and demographic changes. Besides that, our study result is also similar to another study report that was conducted by Gaspareniene, Remeikiene, and Skuka (2017). They did not find any meaningful relationship between the economic growth (as measured by GDP) and price level of housing in their study on the impacts of macroeconomic factors that may affect the housing price level. They suggested that other variables like social, psychological, and political factors can be taken into consideration for future research rather than the major macroeconomic factor like GDP.

Some researchers also get the same results, and they explained this insignificant condition from another perspective, that is the income effect. According to Kiong and Aralas (2019), they also found a non-significant relationship between GDP and housing price. This can be explained by the fact that the GDP is not a significant factor that affects people's demand power on housing, so that it did not affect the country's housing price. They added that the reason behind may be due to the income effect. In particular, normally labor's salary will improve during economic expansion, but it is not compulsory all the time for every country. It is highly possible that economic growth was not followed by salary growth of the citizen. Hence, citizens are not necessarily able to afford housing when the economy improves since it does not mean people's salary will also growth in accordance with economic growth. In this case, economic growth of a country does not show an obvious effect on driving the housing price in the country. Another research done by Hii, AbdLatif, and Nasir (1999) also found that the GDP was not affecting housing prices all the time for the buildings. They also supported that GDP does not have much effect on

people's income. In detail, no matter how much a decrease or increase is in a country's GDP, it does not affect people's purchasing decision and their purchasing power. They explained the reason behind by saying that the fluctuation in GDP has a larger impact on the supply side rather than the demand side. According to Leong (2022), she reported that the housing price growth rate of Singapore was 7.9% in 2018. While the salary increment rate was only 4.6% in the same year (Writer, 2019). It showed that the salary increment rate does not increase in accordance with the GDP. Therefore, economic growth will not have a significant effect on people's purchasing decisions and hence no effect on housing prices.

4.3.2 Inflation and Housing Price

The findings obtained in Table 4.3 indicated that housing price and inflation rate, as measured by CPI, are having insignificant connection. The coefficient (-1.67) is insignificant because the probability of 0.1658 is higher than the levels of significance of 1%, 5%, and 10%. This means that, when the CPI grows by one index, there is no effect on the Singapore housing price in the long run. Hence, it clearly demonstrates that there is no significant relationship between inflation and housing price in Singapore in the long run.

In comparison, the result of the no significant relationship between inflation and housing prices is against most of the researchers' findings that suggested a significant positive relationship between the variables. For instance, Kuang and Liu (2015), Gholipour et al. (2014), Rangel and Ng (2017), Tan and Razali (2016), Zhu and Tsatsaronis (2004), Andrew (2010), and White (2015) discovered that inflation rate was positively related to property prices. They believe that construction costs will be driven up due to higher inflation which in turn causes higher housing prices.

Nevertheless, the result is supported by several researchers. For instance, Ong (2013) concluded the absence of possible correlation between inflation and real estate price in Malaysia based on monthly data derived from 2001 to 2010. In addition, a similar study by Tan (2011) also discovered an insignificant relationship between consumer price index and housing price in Malaysia. The study further added that the insignificant relationship indicates a low sensitivity of home buyers towards the consumer price index changes (price changes) and/or the CPI fluctuation is too narrow to draw their attention.

Moreover, Rosli (2013) who studied the determinants of housing price in Malaysia concluded that inflation does not provide significant impacts on Malaysia housing price. Additionally, study by Zandi, Supramaniam, Aslam, and Lai (2015) in Malaysia also showed that there is no significant correlation between inflation and housing price. Besides, Nneji, Brooks, and Ward (2012) discovered that inflation rate is an insignificant determining factor of house prices in US housing market based on monthly data derived from 1960 to 2011.

Additionally, the insignificant relationship was found between inflation rate and housing price in Ahlgrim and D'Arcy (2012) study. They mentioned that the value of housing reflects two components which are the consumption portion and investment portion. However, CPI only takes the price of renting a house (consumption portion) into measurement and pays no attention to the appreciation of selling price of a house (investment portion). Furthermore, the rental rates do not necessarily follow the housing prices closely as the rental market is relatively thin. Hence, it means that the rental prices of housing do not utterly reflect housing prices. As such, this has explained the insignificant effect of inflation (CPI) on housing prices.

On the other hand, Arestis and González (2014), and Pillaiyan (2015) revealed that the inflation rate can significantly affect housing prices in Saudi Arabia and OECD countries adversely. It is because high inflation will reduce individual purchasing power which in turn causes the decline in

both housing demand and housing prices. On the contrary, our result showed that inflation has no significant impact on housing prices in Singapore. To explain, Singapore, as one of the smallest countries in the world, has extremely limited land resources as compared to other larger countries. Hence, the housing demand of the citizens in Singapore might be insensitive or irresponsive to the changes in goods' prices (inflation).

4.3.3 Unemployment Rate and Housing Price

The relationship between the unemployment rate and housing prices in Singapore is illustrated in Table 4.3. The findings illustrate that, at significance level of 5% and 10%, there exists a significant long run relationship between unemployment rate and housing price in Singapore. The coefficient of unemployment rate (3.85) is significant with p-value equals to 0.0442, that is well below the level of significance of 5% and 10%. This means that, on average, when unemployment rate grows by 1%, Singapore's housing prices will rise by 3.85 index in the long run. Thus, it clearly demonstrates that the unemployment rate and housing prices possess a significant long-term relationship.

According to the computed results, it is shown that the findings of unemployment rate and housing prices having a positive connection were inconsistent with the theory as well as the results obtained from previous researchers mentioned above, such as Mohan, Hutson, MacDonald, and Chung (2019); Gathergood (2011); Smet (2016); and Stratton (2017). These studies claimed that unemployment rate and housing prices are negatively related as high unemployment will translate into lower purchasing power, financial constraints, and income uncertainty, thus resulting in lower willingness and affordability for buying a house, and subsequently reducing the demand for homeownership, followed by a decline in housing prices.

Historically, it is not often that a rising unemployment rate will cause housing prices to decline. In fact, it is possible for the unemployment rate to be positively related to housing prices. This finding is supported by Ni, Huang, and Wen (2011), who declared that unemployment rate has a long run stable relationship with the housing market index in a positive direction. Based on their results, one unit change in the unemployment rate will cause the housing market index to rise by 11.7. The relationship between unemployment rate and property prices is highly influenced by the deviations of the economic conditions from its potential output in the long term. In other words, their relationship is resulted from an 'indirect' effect, which is simply an indication of the economy (Zhu, 2010). To illustrate, the unemployment rate and housing prices in Australia in the past two decades have been moderately, positively correlated at approximately 0.5 (Ashley & Prka, 2020). This means that Australian housing prices have declined when the unemployment rate has declined, vice versa.

The condition may seem illogical; however, it is possible for certain housing markets to be well-performing during the time of surge in unemployment rate. This is because rising unemployment rate is likely to weaken the national economy as the gross domestic product is unable to be produced to its full potential (Blanchflower & Oswald, 2013); the monetary system will then respond to reduce the cash rate. With this, individuals who still afford to buy can obtain borrowings at cheaper costs as the repayment of loan principal is reduced, which is favorable to homebuyers. This could attract households and investors to buy a house for residential use or as an investment, thereby resulting in growing demand in the housing market, and eventually raising the average housing prices (Owen, 2020). Therefore, it is shown that real estate prices are positively affected by the movements in the unemployment rate through the effect of the interest rate. Based on Xu and Tang (2014) study, UK housing market also confirms that higher unemployment rate can bring growth in the housing prices in the long run. As housing market regulate is considered as one of the effective means for a nation's macro-control (Bai & Zhao, 2020), this causes the housing prices to be stimulated by the external factor, which is the state intervention,

instead of adhering to the common marketing rules. Indeed, policy intervention, particularly during the liquidity crisis, has impacted the UK's market of housing during the 2008 crisis. Hence, possible policy implications for a weakened economy that is associated with a high unemployment rate can be a reduction in interest rate to boost the economy, which will lead to rising housing demand, and thus growth in housing prices.

As Singapore is an interest rate taker, Singapore does not control the interest rate movement in which Singapore's interest rate will follow the global interest rate (Chow, & Wilson, 2011). When the global economy is underperforming, Singapore will also be having an economic slowdown along with growth in the unemployment rate as Singapore's economy is highly relying on international imports and exports. Therefore, Singapore's interest rate will fall in accordance with the falling global interest rate to boost the economic condition. Hence, the computed result of unemployment rate and housing prices having a positive relationship here could be explained reasonably through the effect of the global interest rate.

From other perspective, according to Xu and Tang (2014) study, they mentioned that high unemployment in a country indicates that there is less labor force in the country. Therefore, the property constructors may outsource the labor forces from other countries which leads to a rise in construction costs. Eventually, the property will be priced at a higher level to cover the cost. On the other hand, according to the Ministry of Manpower Singapore (2018) report, he mentioned that increase in unemployment was likely to drive the housing price. This was because rising unemployment could happen when the economy was performing well. Singapore MOM indicated that there was a large inflow of labor forces during economic expansion and not all labor forces could be employed immediately, so it will translate into a high unemployment rate. Thus, the inflow of labor forces will increase the housing prices as more foreign workers demand for housing, regardless of buying or renting as they need a place to live when working there.

4.3.4 Money Supply and Housing Price

The relationship between money supply and housing prices in Singapore is illustrated in Table 4.3. Based on the findings, it shows that money supply possesses a significant relationship with housing prices in Singapore in the long run at 10% significance level. The coefficient of money supply (-5.47) is significant with p-value of 0.0564, that is below 10% significance level. This indicates that, on average, when money supply increases by 1%, the housing prices in Singapore will decrease by 5.47 in indexes in the long run. Thus, it clearly demonstrates that the money supply and housing prices possess a significant and inverse relationship in the long run.

In comparison, the negative relationship found between money supply and housing prices is against the majority of previous researchers' results that suggested a positive relationship between the variables. For instance, the findings by Liu (2013), Su et al. (2019), Yu et al. (2010), Yan (2019), Negro et al. (2007), and Tripathi (2019) indicate a positive relationship between money supply and housing prices. They explained that an increase in money supply is always accompanied by a reduction in the interest rate, which will decrease the cost of mortgage loans and increase housing demand and subsequently housing prices. Additionally, money supply growth will also lead to rising prices of raw materials and labor, thereby causing higher development costs and eventually higher housing prices.

However, there could be a negative relationship between money supply and housing prices. Mathenge (2017) declared a significant negative relationship between money supply level and housing prices where the housing prices in Nairobi would increase by 12.5% for one unit of decline in money supply level. Besides, Xu and Tang (2014) also concluded that money supply is adversely correlated with the housing prices in United Kingdom based on the data derived from 1971 to 2012. They further explained that money supply could have an effect on both demand and supply of housing. Hence, when the positive effects on housing supply are

more than that on the housing demand, the price level in the housing market will drop.

The explanation given by Xu and Tang (2014), stating that money supply could influence both demand and supply of housing, can further justify the negative relationship between money supply and housing prices in Singapore. As one of the smallest countries in the world, Singapore's land is a prized commodity due to its scarcity. The stable growth rate of housing prices in Singapore has attracted the housing developers to earn the substantial return. Hence, people tend to invest their excess money in housing developments during the implementation of expansionary monetary policy. Consequently, the greater positive impact on housing supply than housing demand causes the contraction of housing price. As an illustration, Chiu, Taghizadeh-Hesary and Yoshino (2019) stated that a substantial increase in money supply will cause the supply of new housing to surge and eventually lead to a rapid decline in housing prices.

Furthermore, the negative relationship is supported by Ryczkowski (2019) who studied the relationship between money supply and housing prices in 12 developed countries. He explained that the implementation of expansionary monetary policy in an environment of high uncertainty could create a large number of bad credits which puts a downward pressure on the housing price. Simultaneously, risk-averse investors might still put their housing investment on hold, thereby placing housing prices in a downward pressure. As such, it explained the adverse correlation between money supply and housing prices.

4.3.5 Exchange Rate and Housing Price

By referring to the results obtained from Table 4.3, it indicates that a significant relationship was detected between the exchange rate and housing price in Singapore context. The relationship between HPI and EX is

significant as the p-value (probability) stands at 0.0002. The value is below the respective 1%, 5%, and 10% of significant level. By referring to the variable coefficient, we can interpret that the housing price will boost by 4.18 in indexes, for every index increase in the exchange rate index, on average. Therefore, a conclusion can be drawn from the results, that is exchange rate is positively affecting the housing prices in Singapore.

The positive connection between the exchange rate and property price was also pointed out in some other studies before. It can be explained by that when the currency appreciates, it simply means that the citizen is having more purchasing power as their currency in hand became more valuable; hence, they might also demand for domestic housing or upgrading their housing other than investing in foreign market. In addition, according to Liu and Zhang (2013) study results, they mentioned that exchange rate was having positive relationship with housing price in China. In their explanation, they concluded that the improvement of exchange rate encouraged speculation activity where the investors increased their investment in property assets when they believed the country's currency stayed in strong force without depreciation. Another paper from Chong, Koo, Lim, Wong, and Wong (2019) also expected the exchange rate to positively affect the property prices. They believed that the favorable exchange rate was expected to improve the confidence of investors in the real estate market. Besides, based on the study contributed by Glindro, Subhanji, Szeto, and Zhu (2011), they also get the same outcome where the exchange rate and housing prices were having a positive connection. They further explained that the underlying reason was due to the increase in investment in the real estate market as investors see a positive sign when the currency appreciates. It means that they can obtain a favorable return on the real estate investment when the currency continues to appreciate. This condition occurs particularly in the countries that highly depend on foreign investment (Glindro et al., 2011). This explanation can be used to explain Singapore condition as well. This is because Singapore is also one of the major economies that rely heavily on foreign investment in its economy (Cuc, 2021).

Moreover, a strong currency also indicates that the country is growing stably and hence people will have a positive projection on the country performance (Sümer, & Özorhon, 2020). Thus, people are likely to invest in the country with growing potential so that the country's assets will boom including real estate. Besides, when investors believe that the country's currency will continue to appreciate, they tend to invest in the country's assets especially the property assets as it is considered as a 'safe haven' asset for investors. An appreciation in the currency will increase the expected return on the currency denominated assets. Therefore, it will attract the flow of foreign funds into Singapore to earn the excess return. This is because property is classified as a 'safe-haven' asset for storing value and gaining returns. This statement was supported in Sabyasachi (2019) study report on macroeconomics determinants of housing price. Eventually, a strengthened exchange rate will give rise to a rise in housing prices as well.

On the other hand, another reason behind that drive up the housing price in Singapore is the strong and stable currency in Singapore. According to Corporate Finance Institution (n.d.), SGD is one of the strongest and safest currencies due to its country's strong economy. The characteristics of SGD successfully attracted investors to invest in Singapore. Unlike other countries, Singapore is utilizing the exchange rate-based monetary policy which means that Singapore is emphasize on using the exchange rate as the instrument of monetary policy rather than using interest rate. According to Monetary Authority of Singapore (2001), Singapore takes exchange rate as the most useful monetary policy instrument to maintain financial stability due to its small and open traded economy. Hence, we can say that SGD is stable and strong since it is under the control of Singapore government. Also, when the country's currency is stably under control, it means that the risk is low. Hence, it encourages speculation and investment activity in that country.

4.4 Granger Causality Test

Granger causality test is a test of the statistical hypothesis that can examine whether the dependent variable and independent variable has any causality relationship. The Table 4.4 shows that GDP and inflation rate have significant granger cause the housing prices index at level of significance of 5% and 10%. In the meantime, housing price index is significant granger causes inflation rate, GDP and unemployment rate at 1% and 5% significant level. In this situation, it is shown that the rate of inflation and GDP have bidirectional relationship with the home prices. Instead, the exchange rate, money supply and unemployment rate do not causality relationship with the housing price index.

Table 4.4

Granger Causality Test

y \ x	HPI	CPI	EX	GDP	MS	UNE
HPI	-	0.0756*	0.1597	0.0370**	0.6069	0.2189
CPI	0.0420**	-	0.1589	0.6971	0.0000***	0.1523
EX	0.1062	0.0232**	-	0.6174	0.1506	0.8675
GDP	0.0156**	0.1952	0.4745	-	0.0808*	0.0006***
MS	0.4593	0.7874	0.4048	0.9023	-	0.2428
UNE	0.0011***	0.4831	0.5095	0.0434**	0.9797	-

Note: *, ** and *** indicated that the null hypothesis is rejected at significance level of 10%, 5% and 1% respectively.

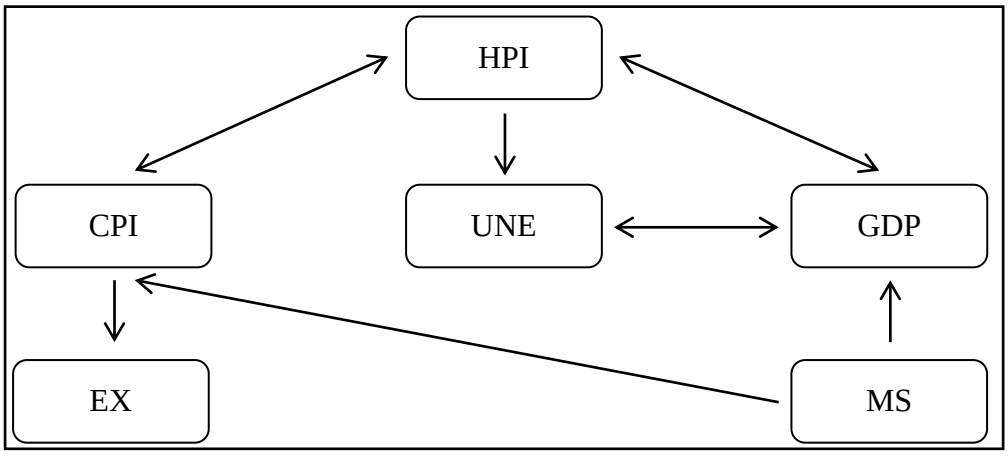


Figure 4.4. Granger Causality Effect among the Variables

Note: ⟶ One-way causality relationship

⟷ Two-way causality relationship

Inflation rate

H_0: Inflation rate does not granger causes the housing price.

H_1: Inflation rate does granger causes the housing price.

From the table and diagram above, they show that the rate of inflation has a bidirectional relationship with home prices, where we should reject the null hypotheses since the p-value of 0.0756 is smaller than 0.10. Therefore, the inflation rate does granger causes the housing price at a 10% significant level. Besides that, housing price does also granger causes the inflation rate at a 5% level of significance since 0.0420 for the p-value is smaller than 0.05. In this case, we should reject the null hypotheses. Then, we can use the past changes of the inflation rate to predict the happening of the event of housing price or the housing price changes in the past can be applied to foresee the inflation.

Exchange rate

H_0: Exchange rate does not granger causes the housing price.

H_1: Exchange rate does granger causes the housing price.

From the table and figure above, exchange rate and the price of property are shown to have no causality relationship. We cannot reject null hypothesis because 0.1597 for the p-value is larger than 0.1. This means that the exchange rate does not granger causes the housing price at 10% significant level. This indicates that the past changes of exchange rate cannot be used to anticipate the housing prices.

Gross Domestic Product

H_0: GDP does not granger causes the housing price.
H_1: GDP does granger causes the housing price.

From the table and figure above, it is shown that GDP and property price has a bidirectional relationship. GDP has a granger causes the housing price at 5% significant level since the p-value of 0.0370 is smaller than 0.05. Therefore, we need to reject the null hypothesis. Furthermore, the p-value of 0.0156 which is smaller than 0.05 indicates that the housing price has granger causes the GDP at 5% significant level. Therefore, we can apply the changes of the past data of GDP to predict the occurrence of the event of housing price. On the other hand, we can also use the changes of the past data of housing prices to expect the occurrence of the event of GDP.

Money supply

H_0: Money supply does not granger causes the housing price.
H_1: Money supply does granger causes the housing price.

From the table and figure above, they show that there is no causality relationship between money supply and housing price. This is because the p-value of 0.6069 is greater than 0.1. Thus, we should not reject the null hypotheses which mean that money supply does not have granger causes the price of house at 10% level of significant. In this situation, the money supply that changes in the past cannot be used to predict the housing prices.

Unemployment rate

H_0: Unemployment rate does not granger causes the housing price.
H_1: Unemployment rate does granger causes the housing price.

From the table and diagram above, they show that unemployment rate and housing price has a unidirectional relationship, where housing price does granger cause the housing price at the 1% level of significance. As 0.0011 for p-value is smaller than 0.01, so we should reject the H_0. However, the data above shows that the unemployment rate does not granger causes the housing price which we cannot reject the null hypothesis, H_0. This is because 0.2189 for the p-value is larger than 0.1 significance level. In this situation, this indicated that we could use the past data of housing price to predict the occurrence of the event of unemployment; however, we are unable to use the past data of unemployment rate to anticipate the occurrence of the event of housing price.

4.5 Result of Diagnostic Checking

Table 4.5

Outcomes of Diagnostic Checking

Diagnostic Checking	F-statistic/ Jarque-Bera	P-value	Conclusion
Heteroscedasticity (ARCH Test)	0.388762	0.8157	Heteroscedasticity problem not detected.
Autocorrelation (LM test)	0.898022	0.4759	Autocorrelation problem not detected.
Normality Test (JB Test)	1.027796	0.598159	The error term meets the normality assumption.
Model Specification (Ramsey Reset Test)	0.141836	0.7086	Model specification bias was absent.

Heteroscedasticity

H_0: There is no heteroscedasticity issue.

H_1: There is a heteroscedasticity issue.

We conducted the ARCH test to observe whether heteroscedasticity problem was found in the model. According to Table 4.5, the E-views result stated that the p-value (0.8157) stands above the levels of significance of 1%, 5% and 10%. So, we do not reject the null hypothesis and we can conclude that no heteroscedasticity issue is found.

Autocorrelation

H_0: There is no autocorrelation issue.
H_1: There is an autocorrelation issue.

Besides, Breusch-Godfrey LM Test was also conducted to discover the existence of autocorrelation issue in the model. According to Table 4.5, the E-views result stated that the p-value of 0.4759 is larger than the 1%, 5% and 10% of significance level respectively. So, we do not reject the null hypothesis and we can conclude that no autocorrelation issue is found.

Normality Test

H_0: The error term meets the normality assumption.
H_1: The error term does not meet the normality assumption.

JB test was applied to examine if the error terms meet the normality assumption. According to the result table, the p-value of 0.598159 is well above the 1%, 5% and 10% of significance level respectively. Thus, we do not reject the null hypothesis. Therefore, we can conclude that the error term is normally distributed.

Model Specification

H_0: There is no model specification bias.

H_1: There is model specification bias.

Furthermore, Ramsey Reset Test was performed to detect the existence of model specification bias. According to Table 4.5, the E-views result stated that the p-value (0.7086) is larger than the significance level of 1%, 5% and 10%. Thus, we do not reject the null hypothesis. Therefore, we can conclude that no model specification bias in the model.

Coefficients Stability Tests

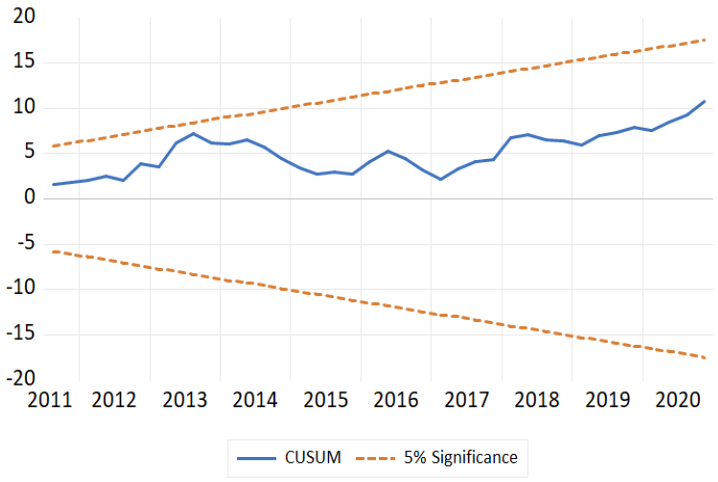


Figure 4.6a. Cumulative Sum Test

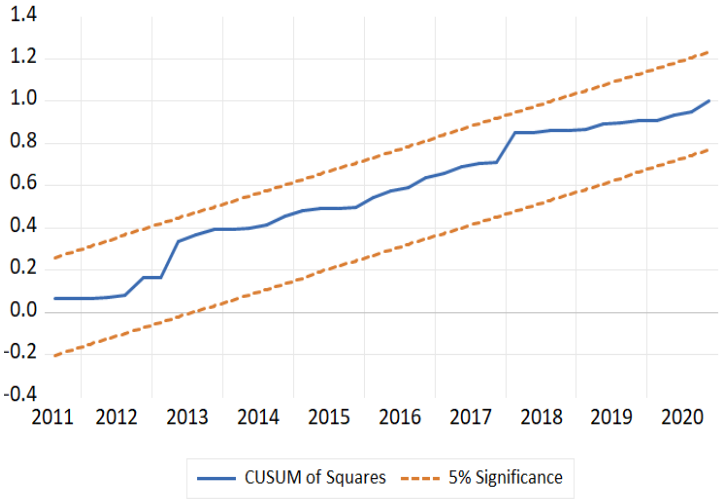


Figure 4.6b. Cumulative Sum of Square Test

Both Figure 4.5a and 4.5b above illustrate the Eviews result of the CUSUM test and CUSUMSQ test. Based on the figures above, we can clearly see that the dot of CUSUM and CUSUMSQ fall within the red lines at the significance level of 5%. Therefore, it indicates that the parameters are stable across the years.

4.6 Conclusion

Through the ADF test carried out, all the variables are stationary at first difference. From the ARDL Bound Test's results, the variables are co-integrated as long run relationship was found between the variables. Among the variables, unemployment rate, money supply, and exchange rate are having significant relationship with housing price in Singapore. MS and EX are positively correlated to housing prices while UNE is negatively correlated with housing prices. The detailed discussions of the findings are also presented in this part. For the Granger causality relationship between the variables, CPI and GDP are having bidirectional relationship with HPI while HPI is having a unidirectional relationship with UNE. Instead, UNE, MS, and EX do not granger case the HPI. After that, diagnostic checking was conducted to identify any potential econometric problems presence in the model. The results showed that heteroscedasticity and autocorrelation problems are not detected, as well, the error terms meet the normality assumption. Lastly, model specification bias was not found, and the coefficients are stable.

CHAPTER 5: CONCLUSION, LIMITATIONS, IMPLICATIONS

5.0 Introduction

The overall outline of the study will be presented in this section. Then followed by the suggestions on policy implications for future research. Lastly, the limitations of the study and the suggestions for future research will also be pointed out here.

5.1 Summary

According to the results we have obtained, exchange rate and unemployment rate possess a significant positive relationship towards Singapore's housing prices whereas money supply possess a significant negative relationship towards Singapore's housing prices. To illustrate, higher(lower) unemployment rate will result in rising(declining) housing prices in Singapore. In response to the high unemployment rate which indicates a weakened economy, the monetary system would lower the cash rate, thereby increasing the affordability of citizens towards buying a house due to low costs of borrowing. As well, a rising unemployment rate can happen when there are large labor force flows into Singapore during economy expansion. Simultaneously, housing demand will grow and eventually give rise to housing prices expansion.

In addition, when exchange rate is improving(shrinking), the housing prices will also increase(decrease) in Singapore. As Singapore's currency, SGD is relatively strong and stable as it is under Singapore's government control, it gives signals of positive anticipation on the country's performance and low risk of investment. So, not only the local investors, but also the foreigners are attracted to invest in Singapore, especially the real estate investment. This is because an appreciation in the currency will strengthen the expected return on the currency denominated assets.

Hence, growing demand for housing when exchange rate is improving is believed to drive up the Singapore's housing prices

Historically, movements in housing prices can bring serious impacts on the economic performance of a country, particularly because it will influence residential investment, which is a critical component for measuring economic growth. In Singapore, the housing prices is moving at an upward trend as demand for accommodation, regardless of renting or buying a house is rising, mainly due to its small land resources. Housing price expansion has resulted in growing number of Singapore citizen facing difficulties in owning a house. By considering the impacts of housing price on the citizens as well as the economy of Singapore, our study focused on determining the relationship between the selected macroeconomic variables and housing prices in Singapore based on time series analysis from 2005 Q1 to 2020 Q4.

The selected independent variables are GDP, inflation rate, unemployment rate, money supply (M2), and exchange rate. To make our research more reliable and accurate, we have conducted a series of tests, including unit root test, ARDL, Granger Causality test as well as several diagnostics checks; the results obtained have been presented in Chapter 4. The unit root test has shown that the data series of GDP, inflation rate, money supply, and unemployment rate achieved stationarity at level form and first difference level form while exchange rate is stationary at only first difference level form. The bound test's result has also clearly suggested that there exists co-integration between the manipulated variables and explained variable. For ARDL approach, we have found that unemployment rate, money supply, and exchange rate are significantly influencing the housing prices in Singapore in the long run. Other than that, inflation rate and GDP are significantly granger causing the Singapore's housing prices. There also exists a bidirectional relationship between inflation rate and housing prices; GDP and housing prices; as well as unemployment and GDP.

According to the results we have obtained, exchange rate and unemployment rate possess a significant positive relationship towards Singapore's housing prices whereas money supply possess a significant negative relationship towards

Singapore's housing prices. To illustrate, higher(lower) unemployment rate will result in rising(declining) housing prices in Singapore. In response to the high unemployment rate which indicates a weakened economy, the monetary system would lower the cash rate, thereby reducing the mortgage costs to citizens who still afford to buy a house. Thus, it puts upward pressure on the average housing prices. For Singapore, rising unemployment rate can happen when there are large labor forces flows into Singapore during economy expansion. This is because not all labor forces could be employed immediately which will give rise to a high unemployment rate. Simultaneously, housing demand will grow as more foreign workers demand accommodation, thereby leading to housing prices expansion.

In addition, when exchange rate is improving(shrinking), the housing prices will also increase(decrease) in Singapore. As Singapore's currency, SGD is relatively strong and stable as it is under Singapore's government control, it gives signals of positive anticipation on the country's performance and low risk of investment. So, not only the local investors, but also the foreigners are attracted to invest in Singapore, especially the real estate investment. This is because an appreciation in the currency will strengthen the expected return on the currency denominated assets. Hence, growing demand for housing when exchange rate is improving is believed to drive up the Singapore's housing prices.

On the other hand, when money supply increases(decreases), the housing prices in Singapore is believed to fall(rise), ceteris paribus. Singapore's housing prices are growing steadily due to its scarce land area, so it has increasingly become attractive to the housing developers for earning a substantial return. Thus, during the implementation of expansionary monetary policy, people are more likely to shift their excess money for investment in housing developments. As a result, rising housing supply causes the housing prices to drop. To put it simply, aTo put it simply, substantial increase in money supply will lead to a surge in new housing supply, thereby causing a rapid fall in housing prices. Hence, when in the event that money supply increases possesesincrease possesses a greater positive impact on the housing supply than housing demand, the housing prices tend to fall. However, we found that GDP and inflation rate possess an insignificant relationship with Singapore's housing prices in the long run.

By referring to the results and facts presented in Chapter 4, we are strongly believed that the movements of housing prices in Singapore is affected by the three macroeconomic variables, namely unemployment rate, exchange rate and money supply. Money supply does possess a greater influence on the housing prices over unemployment rate and exchange rate due to its highest coefficients among the variables, particularly because of its greater positive impact on housing supply than housing demand in the market.

5.2 Policy Implications

From the study, we found that the housing price in Singapore showing a continuous upward trend. Hence, we conducted research to investigate the macroeconomic factors that may contribute to the rising housing price in Singapore. With the results, several policy implementations are suggested to improve the housing market in Singapore.

Firstly, Singapore government can further enhance its exchange rate monetary policy. This is because the results obtained showing that exchange rate having impact on Singapore housing price. When the currency appreciates, the housing price of Singapore also increase according to the results obtained. It is mainly due to the strong and stable SGD that attract investment in the country's property market as Singapore property market is considered as safe-haven investment. Singapore focusses on controlling the exchange rate rather than adjusting its interest rate. In other words, Singapore is the only country that applied exchange rate monetary policy unlike other countries that mostly applied interest rate monetary policy. Singapore is on its right direction this is because Singaporean is interest rate inelastic. It means that the change in interest rate will not largely affect the buying decision of property among the citizens. Hence, Singapore needs to emphasize on controlling the exchange rate through different ways. Adjusting the slope, width and center of trading band to manage the exchange rate like lower the upward slope

of the band can limit the further appreciation of the country currencies (Williams, 2015).

Also, Singapore can limit the foreign direct investment on the country's real estate market. This is because the results showed that the exchange rate is positively correlated with the property price in the country. It indicates that Singapore housing prices increase during SGD appreciation, and this was largely due to the investors around the world are likely to invest in Singapore real estate market. They take it as a tool to store value and real estate investment in Singapore is safe haven investment because Singapore currency is stable and the economic also always performing well. Hence, Singapore government can impose higher taxes for foreigners who buy or invest in Singapore real estate market. As we know, Singapore is open for foreign investors or corporations to start their business in Singapore without restrictions for the purpose to boost the economic (Lam, 2019). Singapore also having a low tax environment that encourage the foreign businesses to start their businesses in Singapore. For instance, Singapore does not have capital gain tax and with a low seller's stamp duty for business partners (Lam, 2019). When more foreign business partners flow into Singapore, they not only demand for commercial property but also demand for residential housing. It led to a rising demand for the property which will then increase the overall real estate prices including the residential property prices. Even though Singapore does impose higher tax like the increased 10% of Additional Buyers' Stamp Duty for foreigners to own private property, it does not seem to limit the demand for private housing especially for the rich (Kok, & Sim, 2021). Hence, Singapore can consider to further rising the stamp duty for foreigners or impose some other taxes on their investment in the property market.

Moreover, although the results showed that inflation does not have significant impact on housing prices, the Singapore government must be cautious in fighting the inflation. It is because the primary policy to control inflation, which is monetary policy, will have a significant impact on housing prices. Based on the findings, an increase in money supply will result in a decrease in housing prices. Hence, it indicates that the implementation of expansionary or contractionary monetary policy to control the inflation rate will provide significant impact on the Singapore

housing prices. Simultaneously, the intervention of Singapore government in foreign exchange markets could also help to control the inflation rate. It is because when the exchange rate strengthens, the domestic and foreign demands for domestic goods tend to be reduced, and vice versa. However, the movements of exchange rates will affect the housing prices in Singapore as the result showed that exchange rate and housing prices in Singapore are positively linked together. Accordingly, Singapore government must be considerate in selecting the 'tools' to fight inflation.

As shown by the result, money supply possesses a greater influence on the Singapore housing price over unemployment rate and exchange rate. Hence, implementation of monetary policy could help to control the Singapore housing price effectively. According to the findings, an implementation of expansionary monetary policy (increasing money supply) will lead to the contraction of housing price in Singapore, thus cooling down the overheated housing market. This is because Singapore citizens tend to invest their excess money in housing developments to earn the substantial return, which eventually causes a surge in housing supply. The raise of money supply can be accomplished by the government through several ways including the open market purchases of government bonds, reduction in the reserve requirement, or decrease in the discount rate. However, it should be noted that the increase in money supply could bring another significant impact to the economy in the long run, which is inflation.

Besides, Singapore policy makers can also consider limiting foreign labor forces. This is because the results obtained show that the rising unemployment rate is positively affecting housing prices. The reason behind may be due to the inflow of labor forces which causes the unemployment rate to increase as not all labor forces will get employed immediately. Therefore, Singapore policy makers may try to limit the labor force when there is large labor force enter to the country.

5.3 Limitations

Without exception to previous studies, in the process of producing this research study, several limitations are found and expected to be improved for a finer research study in future. First of all, there are some constraints on the sample size. Initially, this research attempts to study the factors affecting housing price in Singapore from 1991 to 2020 by using its annual data. However, the data for the unemployment rate is only available starting from 1992. Besides that, the results obtained by using the annual data which has fewer observations are invalid. Therefore, this study uses the quarterly data from 2005 to 2020 as the finalise observations.

Moreover, there are only five macroeconomic indicators including economic growth, inflation rate, unemployment rate, money supply and foreign exchange rate selected to conduct this research. However, there are many other variables including interest rate, foreign direct investment, population and personal income that are not taken into consideration in this study. It is difficult to include each and every variable that affects the housing price in this study. In addition, geographical factors might also affect the housing price which was not adopted in this study.

Furthermore, this research study investigates the determinants of housing prices only in one particular country which is Singapore. Thus, it is only useful for Singapore's policy makers, economists and investors. Singapore is a developed country, therefore, the result obtained in this study may not be applicable to other developing countries such as Thailand, India, Indonesia and Philippines. Additionally, the cultural background, government policy and regulations as well as economic performance are different across countries.

Moreover, there is a base year issue where the base year of the indexes are not the starting year of the data. It may not result in a serious problem or provide unreliable results, but it can be improved for more highly accurate findings and results. Lastly, this research was conducted mainly by collecting secondary data. There is no data regarding the opinion from the residents in Singapore or investors was collected. These primary data might provide more useful information to the study.

5.4 Recommendation for Future Research

Throughout the research, there have been some problems and limitations that arose and need to improve in future studies. By enhancing the studies to become better in the future, the research recommendation part is important as we can avoid mistakes repeated and provide outcomes accurately in future studies. Therefore, there are some recommendations suggested for researchers in order to enhance their future studies.

First, future researchers can expand the observation period and use monthly data to get more sample sizes. If possible, researchers may try to use the base year that is the same as the data starting year if there is index data. Also, researchers could apply other data categories including cross-sectional data and panel data instead of using time-series data that have been applied in our research. Therefore, they can get more divergent feasible outcomes for this study. In addition, future researchers can collect more data from different secondary resources such as Yahoo Finance, International House Price Database, OECD Economic Outlook Online Database and others before they run the test through E-views. In this situation, it can ensure that the outcome is valid as well as can prevent econometric problems from happening.

Furthermore, future researchers could consider other factors of macroeconomic that would affect the home prices in their research like population, lending rate, foreign direct investment, personal income, geographical factors and others. For example, the population increase will cause the demand for property to increase and affect housing prices. Next, a low-interest rate will cause citizens to have high purchasing power over houses since the cost of borrowing decreases. In this situation, this will cause the demand for houses to increase and boost housing prices continuously.

Besides that, the housing industry is highly geographical which the housing prices in urban areas are higher than in rural areas. This is because some factors are interrelated such as monthly salary, living costs, convenience and others. Future researchers also suggested expanding their study scope because housing prices in different countries will have a different relationship with macroeconomic factors.

Consequently, their study result can become more accurate to make estimation or intimation of the housing industry in the particular geographical areas if they take these factors into consideration. Also, researchers may try to conduct more research in Singapore context to get a more reliable results because there are very few studies on determinants of housing prices done in Singapore context.

In addition, future researchers could try to apply another type of research method in collecting data such as primary research. Primary research assured that the data and information collected is up-to-date, specific and directly relevant to our study. We can collect the data and receive some opinions of Singapore residents toward our research directly. Thus, it will enable accurate trends to be revealed. Primary research is constituted of information about interviews, observations, surveys and others. It can be used to collect more information from many respondents as a greater sample size may obtain a more favourable outcome.

5.5 Conclusion

To sum it up, this section provides a summary of the findings and with policy implementations. It may be helpful for policy makers in Singapore to address the rising property price in the country. Investors and scholars also can have a clearer view on Singapore housing market through our study that provide reliable results. Besides, the limitations of this research paper are also pointed out and some recommendations are also discussed here. Hopefully future researchers can be aware of them and avoid them for improving the outcomes of their relevant research in future.

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APPENDICES

Appendix 1: Unit Root Results

Level Form: Intercept

Housing prices (HPI)

Null Hypothesis: HPI has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.097442	0.2464
Test critical values:	1% level	-3.542097	
	5% level	-2.910019	
	10% level	-2.592645	

*MacKinnon (1996) one-sided p-values.

Gross Domestic Product (GDP)

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.785444	0.0050
Test critical values:	1% level	-3.544063	
	5% level	-2.910860	
	10% level	-2.593090	

*MacKinnon (1996) one-sided p-values.

Consumer Price Index (CPI)

Null Hypothesis: CPI has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.972573	0.0436
Test critical values:	1% level	-3.550396	
	5% level	-2.913549	
	10% level	-2.594521	

*MacKinnon (1996) one-sided p-values.

Unemployment Rate (UNE)

Null Hypothesis: UNE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.295289	0.0000
Test critical values:	1% level	-3.538362	
	5% level	-2.908420	
	10% level	-2.591799	

*MacKinnon (1996) one-sided p-values.

Money Supply (MS)

Null Hypothesis: MS has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.656449	0.0000
Test critical values:	1% level	-3.538362	
	5% level	-2.908420	
	10% level	-2.591799	

*MacKinnon (1996) one-sided p-values.

Exchange Rate (EX)

Null Hypothesis: EX has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.766273	0.3936
Test critical values:	1% level	-3.538362	
	5% level	-2.908420	
	10% level	-2.591799	

*MacKinnon (1996) one-sided p-values.

Level Form: Trend & Intercept

Housing Price (HPI)

Null Hypothesis: HPI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.205112	0.4782
Test critical values:	1% level	-4.115684	
	5% level	-3.485218	
	10% level	-3.170793	

*MacKinnon (1996) one-sided p-values.

Gross Domestic Product (GDP)

Null Hypothesis: GDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.832644	0.0012
Test critical values:	1% level	-4.118444	
	5% level	-3.486509	
	10% level	-3.171541	

*MacKinnon (1996) one-sided p-values.

Consumer Price Index (CPI)

Null Hypothesis: CPI has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.006919	0.5860
Test critical values:	1% level	-4.113017	
	5% level	-3.483970	
	10% level	-3.170071	

*MacKinnon (1996) one-sided p-values.

Unemployment Rate (UNE)

Null Hypothesis: UNE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.439809	0.0000
Test critical values:	1% level	-4.110440	
	5% level	-3.482763	
	10% level	-3.169372	

*MacKinnon (1996) one-sided p-values.

Money Supply (MS)

Null Hypothesis: MS has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.212372	0.0000
Test critical values:	1% level	-4.110440	
	5% level	-3.482763	
	10% level	-3.169372	

*MacKinnon (1996) one-sided p-values.

Exchange Rate (EX)

Null Hypothesis: EX has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.127699	0.9933
Test critical values:	1% level	-4.110440	
	5% level	-3.482763	
	10% level	-3.169372	

*MacKinnon (1996) one-sided p-values.

First Difference: Intercept

Housing prices (HPI)

Null Hypothesis: D(HPI) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.931284	0.0001
Test critical values:	1% level	-3.542097	
	5% level	-2.910019	
	10% level	-2.592645	

*MacKinnon (1996) one-sided p-values.

Gross Domestic Product (GDP)

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.919451	0.0000
Test critical values:	1% level	-3.540198	
	5% level	-2.909206	
	10% level	-2.592215	

*MacKinnon (1996) one-sided p-values.

Consumer Price Index (CPI)

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.440876	0.0000
Test critical values:	1% level	-3.540198	
	5% level	-2.909206	
	10% level	-2.592215	

*MacKinnon (1996) one-sided p-values.

Unemployment Rate (UNE)

Null Hypothesis: D(UNE) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.02691	0.0000
Test critical values:	1% level	-3.540198	
	5% level	-2.909206	
	10% level	-2.592215	

*MacKinnon (1996) one-sided p-values.

Money Supply (MS)

Null Hypothesis: D(MS) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.518858	0.0000
Test critical values:	1% level	-3.544063	
	5% level	-2.910860	
	10% level	-2.593090	

*MacKinnon (1996) one-sided p-values.

Exchange Rate (EX)

Null Hypothesis: D(EX) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.783301	0.0000
Test critical values:	1% level	-3.540198	
	5% level	-2.909206	
	10% level	-2.592215	

*MacKinnon (1996) one-sided p-values.

First Difference: Trend & Intercept

Housing prices (HPI)

Null Hypothesis: D(HPI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.021164	0.0007
Test critical values:	1% level	-4.115684	
	5% level	-3.485218	
	10% level	-3.170793	

*MacKinnon (1996) one-sided p-values.

Gross Domestic Product (GDP)

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.866846	0.0000
Test critical values:	1% level	-4.113017	
	5% level	-3.483970	
	10% level	-3.170071	

*MacKinnon (1996) one-sided p-values.

Consumer Price Index (CPI)

Null Hypothesis: D(CPI) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.502430	0.0002
Test critical values:	1% level	-4.127338	
	5% level	-3.490662	
	10% level	-3.173943	

*MacKinnon (1996) one-sided p-values.

Unemployment Rate (UNE)

Null Hypothesis: D(UNE) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.92301	0.0000
Test critical values:	1% level	-4.113017	
	5% level	-3.483970	
	10% level	-3.170071	

*MacKinnon (1996) one-sided p-values.

Money Supply (MS)

Null Hypothesis: D(MS) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.443632	0.0000
Test critical values:	1% level	-4.118444	
	5% level	-3.486509	
	10% level	-3.171541	

*MacKinnon (1996) one-sided p-values.

Exchange Rate (EX)

Null Hypothesis: D(EX) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.343278	0.0000
Test critical values:	1% level	-4.113017	
	5% level	-3.483970	
	10% level	-3.170071	

*MacKinnon (1996) one-sided p-values.

Appendix 2: Bound Test for Co-integration

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP	0.159220	0.913291	0.174336	0.8625
EX	4.177995	1.005361	4.155715	0.0002
CPI	-1.672131	1.183308	-1.413098	0.1658
MS	-5.466189	2.777642	-1.967924	0.0564
UNE	3.848409	1.849521	2.080760	0.0442
C	-145.9510	49.88935	-2.925494	0.0058

EC = HPI - (0.1592*GDP + 4.1780*EX -1.6721*CPI -5.4662*MS + 3.8484 *UNE - 145.9510)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	5.264754	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15
Actual Sample Size	60	Finite Sample: n=60		
		10%	2.204	3.21
		5%	2.589	3.683
		1%	3.451	4.764

Appendix 3: Granger Causality Test

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 02/25/22 Time: 17:28
Sample: 2005Q1 2020Q4
Included observations: 61

Dependent variable: D(HPI)

Excluded	Chi-sq	df	Prob.
D(GDP)	6.591437	2	0.0370
D(EX)	3.669477	2	0.1597
D(CPI)	5.165868	2	0.0756
D(MS)	0.998873	2	0.6069
D(UNE)	3.038477	2	0.2189
All	23.04705	10	0.0106

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(HPI)	8.323335	2	0.0156
D(EX)	1.490899	2	0.4745
D(CPI)	3.267028	2	0.1952
D(MS)	5.031585	2	0.0808
D(UNE)	14.73120	2	0.0006
All	32.62772	10	0.0003

Dependent variable: D(EX)

Excluded	Chi-sq	df	Prob.
D(HPI)	4.485010	2	0.1062
D(GDP)	0.964621	2	0.6174
D(CPI)	7.525363	2	0.0232
D(MS)	3.786675	2	0.1506
D(UNE)	0.284390	2	0.8675
All	13.77706	10	0.1834

Dependent variable: D(CPI)

Excluded	Chi-sq	df	Prob.
D(HPI)	6.340913	2	0.0420
D(GDP)	0.721704	2	0.6971
D(EX)	3.678678	2	0.1589
D(MS)	19.83403	2	0.0000
D(UNE)	3.764213	2	0.1523
All	43.99290	10	0.0000

Dependent variable: D(MS)

Excluded	Chi-sq	df	Prob.
D(HPI)	1.555951	2	0.4593
D(GDP)	0.205514	2	0.9023
D(EX)	1.808941	2	0.4048
D(CPI)	0.478054	2	0.7874
D(UNE)	2.830814	2	0.2428
All	10.70920	10	0.3806

Dependent variable: D(UNE)

Excluded	Chi-sq	df	Prob.
D(HPI)	13.61446	2	0.0011
D(GDP)	6.274934	2	0.0434
D(EX)	1.348579	2	0.5095
D(CPI)	1.454994	2	0.4831
D(MS)	0.041080	2	0.9797
All	31.11310	10	0.0006

Appendix 4: Diagnostic Checking Results

Heteroscedasticity Test: ARCH Test

Heteroskedasticity Test: ARCH

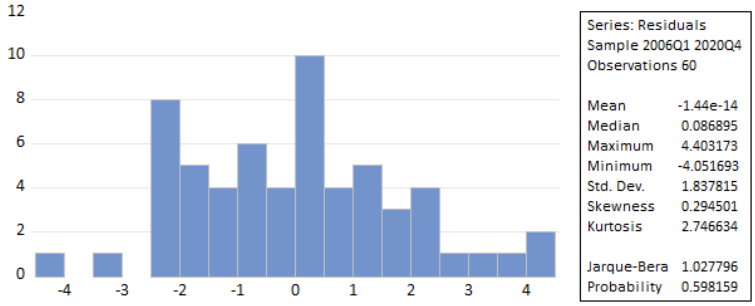
F-statistic	0.388762	Prob. F(4,51)	0.8157
Obs*R-squared	1.656980	Prob. Chi-Square(4)	0.7985

Autocorrelation Test: LM Test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 4 lags

F-statistic	0.898022	Prob. F(4,34)	0.4759
Obs*R-squared	5.733261	Prob. Chi-Square(4)	0.2200

Normality Test: Jarque-Bera Test



Model Specification: Ramsey's RESET Test

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: HPI HPI(-1) HPI(-2) HPI(-3) GDP GDP(-1) GDP(-2) GDP(-3) EX EX(-1) EX(-2) EX(-3) CPI CPI(-1) CPI(-2) MS MS(-1) UNE UNE(-1) UNE(-2) UNE(-3) UNE(-4) C

	Value	df	Probability
t-statistic	0.376611	37	0.7086
F-statistic	0.141836	(1, 37)	0.7086
Likelihood ratio	0.229565	1	0.6318

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.760990	1	0.760990
Restricted SSR	199.2763	38	5.244112
Unrestricted SSR	198.5153	37	5.365278

LR test summary:

	Value
Restricted LogL	-121.1467
Unrestricted LogL	-121.0320