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Performance Evaluation of Real Estate Equity Investments in China

Zhodnocení výkonnosti nemovitostních akcií v Číně

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Annexes

References:

CHAMBERS, Donald R. et al. *Alternative investments: CAIA level I.* 3rd ed. Hoboken: Wiley, 2015. ISBN 978-1-119-00336-6.
ELLIOTT, Robert J. *Mathematics of financial markets.* 2nd ed. New York: Springer, 2005. ISBN 0-387-21292-2.
SAUNDERS, Anthony and Marcia, M. CORNETT. *Financial markets and institutions.* 5th ed. New York: McGraw-Hill, 2012. ISBN 978-0-07-108674-5.

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The declaration

"Herewith I declare that I elaborated the entire thesis, including all annexes independently."

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Contents:

1 Introduction

This thesis is focused on real estate investment in China. After reform and opening up, the government has taken growth of GDP as an important aim. When the natural growth rate of the economy is lower than the declared target growth rate, the huge political inertia will force the government to intervene in the market, at the expense of resource mismatch to push GDP to achieve the goal. Especially in the thirty years after the marketization of real estate, the real estate industry in China has greatly improved the housing, consumption and urban landscapes of the huge population in China. It brought up about 60 industrial developed and have a significant impact on the Chinese economy and caused the high growth speed of houses' price. With the competition is becoming more fierce, it is necessary to evaluate the current condition of real estate equity investment in China and if the property bubble will break in the future.

The objective of the work is examining the changes in real estate equity investment performance across fifty selected real estate companies in China over the period 2000-2017. This thesis attempts to investigate how stocks of companies in real estate performed before financial crisis (2000-2008) and after crisis (2008-2017).

This thesis is divided into five chapters. The first chapter is introduction and the last chapter is conclusion. The second chapter is description of real estate in China. In this chapter, firstly, it will focus on investing in alternative assets, types of alternative investment, advantage and disadvantage of it. Next is types of real estate and forms of investment in real estate. And then, it is the overview of real estate investment in China. This part will introduce the history of real estate in China and how the government regulates this industry. In the last part, it is about the comparison between China and America in terms of real estate industry.

The third chapter is methodology, which is used to examine the changes in stock returns and indicators across fifty selected real estate companies. This part is mainly focused on hypothesis test which could deal with testing the difference between means of stock return before and after financial crisis. The first part is some basic terms in hypothesis test. Then is measurements for

testing under the different condition. At last, the regression analysis will be used for modelling the selected data and analyzing the trend of real estate equity investment.

The fourth chapter is comparison and interpretation of the result of hypothesis test. The first part is the description of data: real residential property prices for Beijing and stock prices of fifty real estate companies which are listed in Shanghai Stock Exchange. Next, it will assess if the performance of real estate equity investment is different before and after financial crisis by using the methods which have mentioned in chapter three. And finally, it is summarizes of the results in previous parts. This part is about discussion of the findings and some recommendations which will be given to investors.

2 Characteristics of Real Estate Investment

In this chapter, attention is paid to the description of real estate investment. First part is characteristics of alternative investment. It includes types, advantages and disadvantage of alternative investments. Real estate investment is one type of alternative investments. Second part focuses on real estate investment. The types of real estate and the forms how investors can invest in real estate will be introduced. In third part, it is constituted of history and development of real estate investment in China. In addition, some risks also exist in Chinese real estate industry. Investor ought to act cautiously. So some improvement and recommendations will be put forward for real estate investment in China. At last, it is the comparison between China and the United State in real estate investment.

2.1 Investing in Alternative Assets

This part begins with an introduction of alternative investments. It includes what is alternative investment and types of it. The real estate investment is one of alternative investments. Then, the advantages and disadvantages of investing in alternative investment will be introduced.

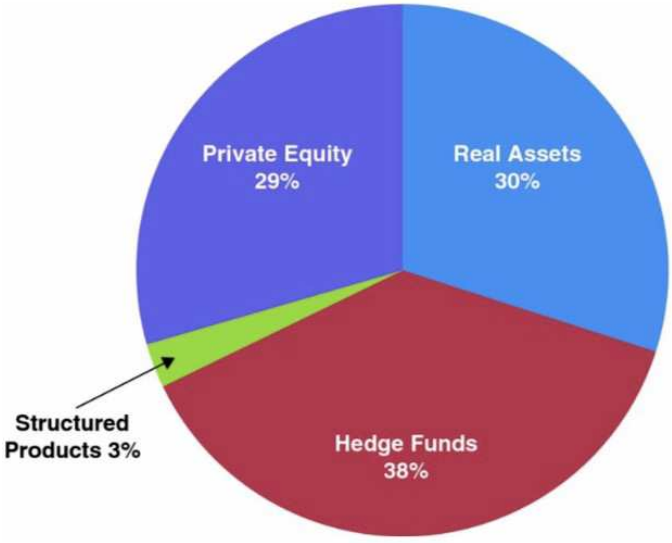
2.1.1 Types of Alternative Investment

Actually, what constitutes the alternative investment haven't defined, due to it is a new filed and also a rapidly change field. Generally, the alternative investment is defined as the asset that is not one of the conventional investment types, such as stocks, bonds and cash. Comparing to most conventional investments, many alternative investments have higher minimum investments and fee. And alternative investments is always complicated and the regulations are limited. Therefore, most alternative investments are held by institutional investments or some high-wealth individuals.

Alternative investments includes tangible assets such as precious metals, art, coins or stamps and some financial assets like private equity, hedge funds, real estate, commodities and financial derivatives. In this part, alternative investments are classified as four types: real assets, hedge funds,

private equity and structured products. And according to *Global Alternatives Survey(2014)*, the proportion of each categories are shown in Figure 2.1.

Figure 2.1 Major Alternative Assets Categories.



Source: Global Alternatives Survey(2014)

Hedge fund is a fund that collects capital from accredited individuals or institutions investors and invests in several different assets. Different from mutual funds, the usage of leverage of hedge funds is not restricted by regulations. Comparing to private equity funds, most of hedge funds are invested in relatively liquid assets. There are some characteristics of hedge funds. First is accredited investors. The investors should meet the requirements of their income or wealth. Second is large personal stake. Thirdly, hedge funds have high minimum of capital for each investors. Then is first year lock-in and infrequent redemption. It is to prevent investors from withdrawing funds at will. In the first year, investors can't withdraw capital. After the first year, investors can withdraw capital only in the specified date in one year. Sixth, hedge funds have variety of investments. It not only can invest in real assets, financial derivatives, but also invest in traditional financial assets. Expect capital from accredited investors, the sponsor can borrow money from institution, which is called as leverage (Christory et al, 2006 p. 71).

Real assets are investments that the underlying assets involve direct ownership of non-financial assets. It includes natural resources and land, commodities, operationally intensive real assets,

liquid and fixed-income real estate and real estate equity investments. Natural resources are resources that create value for consumption to people. Most natural resources related to facilitating energy such as oil, water, natural gas. Other sectors of natural resources have precious metals and other minerals. These resources are highly regulated by the government. Commodities are always homogenous goods available in large quantities. Investors hold them and wait what will happen. Commodities includes energy products such as oil, coal and electricity, agricultural products such as wheat or rice, metals like gold and silver. The forms of investing in commodities have forward contracts, future contracts, commodity-linked notes, exchange-traded funds and so on. Operationally intensive real assets includes real estate, land, infrastructure and intellectual property. Real estate focuses on the land and the buildings on it. The investing in real estate is the topic of my thesis. It is an essential asset class. Land has a variety of forms such as undeveloped land, timberland and farmland. Infrastructure investments refer the investments on airport, high-way, regulated utilities, which are traditionally held and controlled by the public sector. Intellectual property means the intangible creations of human intellect such as patents, copyrights , trademark and other types of rights such as moral rights, trade secrets and so on (Christory et al, 2006 p. 82).

Private equity means the investment funds organized as limited partnership that aren't publicly traded. The investors are typically large institutional investors. In Europe, private equity almost equal to venture capital. Private equity investment is generally made by private equity firm, venture capital firm or angel investors. The aim of private equity investment is to provide working capital and expand new produce or restructure the company's operation, management or ownership. The resources of private equity have a wide range such as individuals which have high wealth, venture funds, leveraged buyout funds, strategic investors, pension funds and insurance companies. The investment object is the non-listed companies that have great developed potential. The sole criterion for the project choice is the ability to generate high return on investment. In addition, the investors of private equity have right to vote for decision-marking of investment object firms. And liquidity of private equity is not good. The period of investment is around three to five years or

even more longer. Private equity can be classified as venture capital, development capital, buyout capital, mezzanine capital and private investment in public equity. Venture capital refers to support technological innovation projects and technology-based start-ups. Because start-up companies have many uncertainty on operation, finance and technology, it is high-risk but have high return. Buyout capital focuses on merging and acquiring target companies. According to acquire the target companies, obtains the right of control and reorganizes them to improve the companies' value. A substantial proportion of buyout capital is invested in relatively mature businesses. Mezzanine debt is a kind of investment that combines the dual nature of debt investment and equity investment. The essence of mezzanine debt is a long-term unsecured debt with right and interest. The object is the enterprises that have completed initial equity financing. Mezzanine debt always includes convertible debt, warrants. The profitability and risk of mezzanine debt is between stock investment and preferred stock. PIPE is the investment that invests in listed companies, which investors buy stocks with the discount price to expand the companies' capital investment (Christory et al., 2006 p. 89).

Structured products are instruments which are created for some particular return and risk. It always bases on a fixed return products and adds derivatives with one or more indicators. The derivatives could be related with stocks, bonds, interest, exchange rate, commodities and funds. Structured products include capital protection products, yield enhancement products, certificate products and leverage products. Capital protection products have limited risk and unlimited return. The loss has limited in premium. On the contrary, yield enhancement products have unlimited risk of loss and limited return. Certificate products can reflect the changes in assets directly. Products with the delta equals to 1 have no leverage effect. It has unlimited loss risk (but limited to the investment principal) and unlimited return. For leverage products, the increase of return could be a multiple of the investment principal. It has unlimited loss of risk, such as sell option or buy option (Christory et al., 2006 p. 95).

2.1.2 Advantages and Disadvantage of Investment in Alternative Assets

Alternative investment is rapidly developing because of its high return. Too much money in the market chases investors to seek alternative opportunities for investment. As an investment instruction, alternative investment has its own advantages and disadvantages.

For benefit, alternative investments can be used to reduce investment risk through diversification due to some characteristics of them. First of all, alternative investments have low correlation with the standard asset classes. This makes them suitable for diversification. Many large institutional funds begin to allocate a portion of their portfolio for alternative investment. Alternative investments also can mitigate market volatility. When the market become sour, it rarely can influence alternative investment. And alternative investments will bring lower transaction costs. Short-term investments always need a high turn, which will create a high transaction costs. In spite of the high initial upfront investment fees, the lower turnover still make transaction fees of alternative investment are lower than traditional investment. And the period of alternative investments is always longer than 12 months. It may result tax benefits. Influenced by long-term capital gains tax, which is lower than the taxes incurred from short-term investment, long-term investments have lower taxes.

On the other hand, alternative investment also have some disadvantages. Firstly, the current market value of alternative assets is difficult to forecast. For example, in real assets such as art or gold, nobody could ensure it will appreciate or depreciate in the future. Secondly, because the term of alternative is always longer than one year, it is illiquid. It means alternative investment can't convers into cash quickly for investors if they need money now. unfortunately, if the market become sour, investors will get more loss because they can withdraw the money immediately. And the initial upfront investment fee of alternative investment is high. The high minimum of capital implies the cost of purchase and sale may be relative high. Only investors with high wealth and institutional investors can invest it. And the special of alternative investment decides the historical risk and return data is limited. It increases the risk for investment.

2.2 Real Estate Investment

In modern economic, the extensive and active financing activities of the real estate industry must be carried out through market relations. Real estate investment refers to transactions sum of all types of real estate funds through the usage of financial instruments of both sides of the real estate capital supply and demand. It can be traded in a fixed place or an invisible way. The way of transaction also could be direct or indirect.

2.2.1 Types of Real Estate

According to China Data Online (2017), with the increasingly developed and innovative credit tools, the scope of real estate business is expanding. It includes all kinds of housing savings deposits, housing loans, real estate mortgage loans, real estate trusts, real estate securities, real estate insurance, real estate pawn and so on. A wide variety of real estate financial activities not only adds vitality of the real estate financial market, but also makes the financial industry and the real estate industry closely. It is facilitate to use of the relevant financial mechanism to macro-control the development of China 's real estate industry.

As an important part of the financial market, the real estate financial market can be classified by a variety of criteria, such as level of market, repayment period, transaction methods and service object. I will introduce several important categories in the following.

According to **service object**, real estate market can be classified as residential market and land market. Real estate Financial market refers to the market where banks or other financial institutions finance the reproduction of houses. Among them, the residential financial market occupies a very important position in the real estate financial market. According to the different modes of the financial system, residential financial markets can generally be divided into free residential financial markets and state-guided residential financial markets.

In western countries, the free residential financial market is based on residential mortgages and dominated by private financial institutions. The both sides of mortgage loan have a double

relationship. The borrower is both debtor and grantor. The lender is both the creditor and mortgagee. Borrowers and lenders are connected by the contract. In order to increase the liquidity of residential mortgage funds, the re-trading of residential mortgage instruments or the issuance of residential mortgage bonds between financial institutions, which constitutes operating activities in the secondary market.

The state-guided residential financial market means the market which controlled by government and the credit qualification is more stable and loose than free residential market. In general, the market guided by the government is less affected by fluctuations in market. And the term of loans is longer and interest rate is lower. Central banks lend capital through intermediaries such as housing credit cooperatives and housing companies, while raising residential investment and credit funds through saving and issuing bonds. In the state-guided residential financial market, the control of the government infiltrates into all levels and links in the financial market, with a high degree of concentration and unity. It can make full use of credit levers to regulate the supply and demand of funds so as to obey the overall development of government dwelling houses Planning and overall benefits.

The land financial market refers to the sum of trading activities in which the land is mortgaged and the financial institutions obtain funds and credit. Land financial market includes agricultural land finance and business land finance. Its main business is to make land as collateral to raise financing facilities in order to achieve the purpose of land development and utilization. Generally, land finance is carried out by the way of bond business, with the characteristics of reliable creditor's rights, low interest rates, long repayment period and safe operation, which are the businesses that banks are more willing to engage in. Land financial market and residential financial market is not completely separate. The two are closely linked. They interact with each other to form a complete real estate financial markets (Eldrer, 2009. P. 189).

According to **seasoning of claim**, real estate market can be classified as primary market and

secondary market. Primary market is the initial trading market and the basic part of real estate market. It includes various types of credit business of financial institutions for those who need real estate funds. It also includes issuance of new real estate securities and financial businesses which is affiliated to securities issuance, such as government agencies, trusts and insurance agencies in the credit. The range of real estate credit business is wide. From the different developed aspects, it can be divided into land development loans, construction loans, residential loans and so on. Object of real estate credit is very complex. It includes different levels of government, real estate corporations, business corporations and individual. The usage of real estate credit funds are mainly loans, commissioned loans, the purchase of bonds, deposit reserve and taxes. In order to reduce the credit risk, the primary market generally adopts the mortgage as the common credit method. In addition, the issuance of real estate securities is also a common credit instrument for the government. The mortgage bonds issued by financial institutions mainly includes three kinds. First is bonds that require the specified immovable property as collateral. The second one is bond that requires a large number of immovable property being mortgaged and issue different denominations for investors purchasing. The third is several institutions jointly run real estate mortgages and issue bonds together. In the primary market, insurance agencies and government's institutions provide real estate credit insurance for guarantee and as a guarantor and insurer to repay the loan. The trust is responsible for the custody of the collateral.

The secondary market is the market for re-trading and re-circulation of real estate credit, which is the core part of the real estate financial market. The secondary market is generated to adapt to the liquidity of real estate credit funds and balance the deposit and loan structures of financial institutions. It is a regional market and the main object is real estate security. In the primary market, financial institutions lend large sums of money. In order to meet the requirements of new capital demanders, financial institutions will re-trade their existing real estate credits. They sell originally mortgages or bonds to obtain funds, then provide loans to others. For real estate bond investors,

the secondary market is where they sell bonds to meet their needs of liquidity. In the secondary market, most of the transactions are between banks.

According to **ways to transaction**, real estate financial market can be classified into credit market and open market. Credit market is the market that suppliers and demanders transact directly according to the principle of voluntary. The price is negotiated by the parties in the loan agreement. According to different financial instruments or trading objects, the credit market can be divided into many kinds, such as housing special saving market, housing special loan market, real estate mortgage market and so on.

Open market can be divided into the money market and capital market according to the repayment period. Money market refers to the market that maturity is lower than one year. The main function is providing loan for corporations which lack of money. And it connects all banks so that banks can effectively pool deposits in the national credit market. More importantly, money market can adjust temporary surpluses and deficits of most enterprises, families and government. Capital market also known as long-term markets, refers to the market which maturity is longer than one year. It includes long-term credit market and securities market (Eldrer, 2009. P. 210).

2.2.2 Forms of Investment in Real Estate

When people think about real estate investment, the first thing that comes to their mind is buying a house. But there are many ways to invest in real estate. In this part, the forms of investment in real estate will be introduced according to (Eldrer, 2009. P. 311).

The first is **rental properties**. It is the basic way to invest in real estate. People will buy a property and rent it to others. The owner of house is responsible for paying for the house, taxes and the maintenance of the property. The profit is from the rent. With the appreciation of the property, the owner may get more value.

The second is **real estate trading**. Investors will buy and hold properties, waiting for the appreciation of them. It can be long-term and short-term. For short-term investment, real estate

traders always hold properties no more than three or four months and then sell them for a profit. It always happened in a very hot area. For long-term, the investors buy cheap properties and adding value by renovating them.

The third is **real estate investment groups**. It is similar to small mutual funds for rental properties. Real estate investment group is suitable for investors who want to own a rental property but don't want to be landlord. For this method, a company buy or build a set of buildings. Investors can buy one or multiple units of them through the company and joining the group. The company is responsibility for operating the group, maintenance of the building and seeking tenants. And the company will take a percentage of the rent for return of management.

The forth is **real estate limited partnerships**. It is similar to the real estate investment groups. A company purchases and hold one or a portfolio of properties. The company will choose an experienced property manager or a firm to be the partner. The investors provide financing for real estate project to exchange a share of ownership. Investors will gain dividends as a share of ownership of the company and get a sizeable profit when the properties are sold. The same as real estate investment group, investors needn't to join the management of the company.

The sixth is **real estate investment trust (REIT).** It is the way to securitize real estate and pool capital from investors, and doesn't need the investors have a large amount of money. It is a kind of mutual fund, but the investment object is real estate. REITs are bought and sold in exchange like stocks. The main income of REITs is from rent so the return is kindly stable. The 90% of its profit must be paid for investors in the form of dividends, which makes REITs avoid paying corporate income tax. The risk and return of REITs is between stocks and bonds. And the liquidity of REITs is higher than other types of real estate investment.

The last is **real estate mutual fund**. It invests in REITs and real estate companies. The mutual fund can provide higher diversification because of its strategies and diversified targets. Different from REITs, real estate mutual fund provide more chooses for investors but not only buying one

REITs stocks. The same as REITs, real estate mutual fund has high liquid. And the diversified investment strategies make it more flexible.

2.3 Real Estate Industry in China

In the thirty years after the marketization of real estate, the real estate industry in China has greatly improved the housing, consumption and urban landscapes of the huge population in China. It brought up about 60 industrial developed and have a significant impact on the Chinese economy. In the future, China's real estate industry will continue to play a pivotal role in the development of China under the influence of development policies.

2.3.1 History of Real Estate in China

The development of China's real estate industry has gone through three major stages. Before 1978s, real estate has not yet become an industry because of highly centralized planned economy. During this period, government was responsibility for building houses and distributed for citizen.

1) 1978-1998, Chinese real estate industry formed and developed rapidly.

With the reform of the housing and land system in 1978, housing and land are both products and resources. And with the deeper understanding of goods and assets, real estate's value gradually revealed. The real estate market was initially formed. From 1992 to 1993, there had a sudden boom of real estate in many cities like Shenzhen, Shanghai, Guangzhou and so on. But after 1993, the government implemented the system of housing fund and housing bond. Under the overheating economy, the first round of real estate bubble happened.

2) 1998-2003, renew real estate development period.

1998 is a key year for Chinese real estate industry. Under the impact of the Southeast Asian financial crisis, GDP of China dropped off a lot. In order to curb the decline of GDP, government

decided to find some new points for economic growth. Real estate is the most effective industry to achieve the goal of economic growth. Government implemented a series of policies to stimulate development of real estate. The most representative one is the cancellation of welfare housing distribution. And government implemented mortgage loan policies to solve the problems like the lack of housing consumption through market credit and personal credit. These policies made demand erupted in a short time and increased sharply and rapidly.

3) 2004-2013, macro-control.

Because of the reform of policies about real estate, the real estate industry had a unprecedented growth in the following 10 years. Huge demand of investment and consumption, abolition of price control makes the real estate industry developed so rapidly. Since 2004, Chinese real estate investment maintained a continuous year-on-year growth rate as 20%. And the price increase 200%. The completed area had reached 5 million square meters, which is 1.5 times the sum of area before 1998. In the ten years developed period, real estate, export and government investment are the mainly parts of "Chinese growth". Real estate industry is 25% of GDP since 2010 and the income is more than 70% of government finance. Real estate industry became the pillar industry in China.

4) Since 2013, to make direction, structure and reform.

The rapid development of real estate also brought many problems. Many families bear high debt because of houses. Some people who have large wealth purchase several houses, but people who live in rural area can't afford even one small apartment. In order to solve these conflicts, the government change the direction of real estate development. Government implemented new policies to ensure real estate industry turned from investment-oriented into consumption-oriented. The population is another reason for development of Chinese real estate industry. Under the reform and adjustment of structure, Chinese real estate industry will improve and get better in the future.

2.3.2 Trend of Real Estate Industry

1) Real estate financial market competition is becoming more fierce.

In recent years, due to the rapid development of the domestic real estate industry and considerable benefit in real estate financial business, all the commercial banks increased their investment in this industry. The amount of real estate development loans and individual housing loans steadily increased year after year. Nowadays, China Construction Bank and Industrial and Commercial Bank of China are the leading banks in real estate financial market.

2) Individual housing loan business has become the focus of contention.

The quality and efficiency of individual housing loan business is better than other credit products. It also has lower nonperforming loan rate and higher return than other loans. Simultaneously, the increasing of proportion of individual housing loan in bank's loan can improve credit structure and quality of assets. Thus, the domestic banking industry has increased investment in individual housing loan business.

3) Various forms of banking services improves the ability of buyers to pay.

Commercial banks are trying their best to innovate products and services according to the development trend and potential demand of market. In 2002s, CCB and ICBC securitization of mortgage-back loans progressed steadily. In addition, due to the maturity of individual housing loans is long, many commercial banks also provide customers with integrated account services, assets management or other financial services through customers' repayment accounts. In recent years, many new policies have been issued like portfolios about individual housing loan and auto loan. Some banks also provide various forms of mortgage products through cooperation with guarantee agencies and insurance companies to enhance the affordability of home-buyers (Li and Wenjun, 2009. p. 31).

2.3.3 Regulation of Real Estate Industry

In this part, it will talk about the regulation of real estate in China and why real estate market need regulation. There are three main reasons for regulation of real estate: the real estate market failure, the particularity and problems of Chinese real estate industry.

The failure of the real estate market determines the need for government regulation

The market failure is an significant reason for government regulation in economy. Monopoly, external effect and public goods and information asymmetry are the main reason of real estate failure.

First, the real estate market is monopolistic. It is determined by its own characteristics. Once the location of houses has been conformed, the elements like floor, toward causes the differential of each house, which lead monopoly of price. And because of the large capital input and long repay period, only a little number of enterprises are able to have this business. In addition, the limitation of land supply and requirements for development scale results regional monopoly. Thus, in order to protect customers' benefit and maintain stability of price, real estate market must be regulated.

External effect of real estate market refers the influences that activities of real estate bring to other economic subjects. The development of real estate can cause good external effect, it also can result bad external effect. Sometimes, it can drive the growth of economy. But if activities of real estate cause the overcrowding of land and reduce the public green space, the value of land will reduce. In order to avoid bad influence, the real estate market should be regulated.

The real estate market not only have private good, like individual house, but also have public good, like unban infrastructure, flood control project and public facilities. Due to the large amount of capital input and long repay period, capital is hard to provide by enterprises and only can be provided by government. However, it is not necessary to be produced by the government. Government can entrust or contract it to enterprises for production and only responsible for rising capital and management.

The particularity of China's real estate industry determines the necessity of supervision

Because of the special development of Chinese real estate industry, the market mechanism is not perfect and the necessary information function, incentive function are not fully displayed. And due to the large amount of population in China, the potential of real estate is huge. The healthy development of real estate market plays an important role in the whole economy in China. So, the real estate market needs government's regulation.

China's real estate market problems that determine the need for regulation

The financing of real estate in China mainly depends on banks' loan. The bank bears the most of financial risks. In developed countries, the financing of real estate is more diversification. Apart from bank loans, it also includes real estate investment funds and trusts. But in China, expect for the self-financing capital, all the rest of the capital comes from banks. Obviously, there is a problem that the real estate enterprises depend too much on banks. Once the real estate market fluctuates, the operating risk of real estate enterprises will be transformed into the financial risk of banks. In the meantime, some listed companies into the field of real estate. In the public auction of land, listed companies buy the land in a high price because they have strong financial strength. This behavior raises the market price of land and influence the price of houses and increases investment risk. If don't regulate and correct these problems, it will influence the stability of economic growth.

2.3.4 Risk of Investing in Real Estate

Though investing in real estate can bring great return, the risk investors will meet is also high. There are many kind of risk when investing, such as competition risk, purchase power risk, liquidity risk, management risk, financial risk, society risk and so on. In Chinese real estate market, there still exists many problem.

Firstly, real estate credit has bias. Housing public accumulation fund support wrong object. Provident fund should support low-income families to improve their ability to purchase a house.

But in currently, only high-income families can easily meet the bank's requirements for pay in advance. In addition, banks are more willing to lend to projects about commercial and entertainment, because these projects can bring more profit for banks. The risk of this type of loan is relatively higher. The sustained increase of price can only happen in a short time. When investors find price stop rising, bank will not be able to get loan back.

And transaction cost of housing credit is high. Cost of transaction can be divided into two types. One is identify and filter cost. This cost is for banks. Bank examines the qualification of borrowers and excludes clients who have possibility of default. Banks often spend large amount of resources in order to accurately obtain the borrower's credit profile. For the purpose of minimizing cost, banks have to set higher requirements for borrowers. The higher the payment in advance, the fewer people will be eligible to apply for loan, and the less banks will face a default risk. Another cost is for borrowers. Borrowers should prepare documents and materials required by banks. In a well-established market, this cost is generally not expensive. But domestic intermediaries don't charge fees standardly. Some government department are inefficient, causing borrowers spending a lot of time and money.

Next, price of house rise too fast especially in decades. And the number of idle house continued to grow. In many large and medium-size cities, the prices of house have risen too fast. This also led the rise of price of second-hand housing, so that the vacancy of commercial housing continued to increase. The number of idle houses is clearly more than normal condition. At present, in many cities, price of normal houses is between 8 000 and 15 000 yuan per square meters, price of superior quality houses is between 15 000 and 30 000 yuan per square meters. In Shanghai, Beijing, the price has even reached 60 000 to 80 000 yuan per square meters.

And the individual housing loan exists default risk. At present, the non-performing loan ratio of individual housing loan is less than 0.5%, of individual housing provident fund is only 0.24%. it is important to improve the banks' asset quality. Therefore, commercial bank consider individual housing loan as excellent assets and expand this kind of business. In fact, according to practice, the

risk exposure period of personal loan is usually three to eight years. But the personal credit system is not completely established. Future fluctuations in house price and the changes in interest rate also increase the risk of default. In addition, malpractices such as “false mortgage” are also existing. All of these indicate the commercial banks will face risk of default if risk exposures or debt chain interrupts.

Because commercial bank consider individual housing loan as excellent assets and expand this kind of business, they tend to have a quick success in this business, which will cause some problems like irrational, unscientific and unstandardized business behavior. Some commercial banks reduce the requirements of customers’ qualification rating, simplify the examination procedure and so on. In the process of providing loans, some commercial banks blindly optimistic about the government guarantees projects and ignore the risk of these projects. And many real estate trusts are referred as the provision of banks’ loan. However the trust companies may not have the same ability to monitor and manage the loan (Ebrahim, 2010 (34). P. 150).

2.3.5 The Improvement Measures of Real Estate Market

The development of real estate financial market not only causes the increasing of GDP, but also brings many problems. In order to solve these problems , there are many policies have been implemented to change the condition of real estate market. For this part, there are some example for reference. In the Britain, the England Bank increased interest rate, which led the cost of mortgage loan also increased. For the United States, the Federal Reserve increased Federal Fund rate and mortgage rate. For Japan, government invest in construction for public supporting projects to restore the vitality of real estate. And it also relaxed many restrictions on the financial industry to help investors to establish real estate investment trusts.

Chinese government solve these problems according to its own condition and goal. Firstly, strengthen financial risk education and rational consumption is the basic measure. Under the environment of market economy, regulators should predict and control the real estate market risk

and guide consumers don't over value the return on real estate. The investors should avoid the temptation of the rising real estate market and borrow high-rate loan to invest.

Government should let the market rules play a better role in economy. Let the market determines the supply structure and price level of commodity housing. Secondly, government should cultivate a diversified financing system to defuse systematic risk. The way of financing should turn indirect financing into diversified financing. Thirdly, the scale of real estate credit will be controlled. Some enterprises' main business is not real estate, but they use a large amount of credit funds for real estate development. This phenomenon should be strictly controlled. The fourth is the implementation of differentiated real estate financial services. According to the income and credit rating of families, government should give some discount and subsidies for first house purchase.

Next is improvement of regulation. First, government should strengthen the decision-making management and monitor the dynamic data of land supply, housing construction and market transaction to provide basis for decision-making. By the way, the combination of the macroeconomic indicators, urban plan, regional population situation, social development planning and data of real estate can judge the health of the real estate's prices, structure and market order (Glindro et al., 2008).

2.4 Comparison with the United States

The United States is the most developed country in the world. It is also the strongest in economy. Every U.S citizen enjoys welfare, which promotes the consumption of American citizen. The development of the U.S. real estate market before the crisis was unbalance. Indeed, from 2003 to 2004, the housing price of the whole country increased by 13%, but it includes Michigan whose price increased by 13% and Arizona whose price increased by 35%. And the coast of California is always the largest market for high price. During this period, the income of California was lower than other states and the population had decreased by 8%. The general opinion can't explain this

phenomenon. Some economists found in this period, government of California began to implement laws to limit usage of land strictly. Under these constraints, land resources were artificially created a scarce state. Thus, it drove up the price of land.

On the other hand, the innovation of financial products also resulted the crisis. According to Allen et al. (2007), in fact, the innovated financial products are instructions to reduce the bargain threshold and made low income people or who are unable to buy houses can purchase houses. These products have zero-pay in advance loan, variable interest rate loans, home equity loans and so on. From 2002 to 2005, the 30-year mortgage rate in the United States dropped from 7.07% to 5.58%, the average annual growth rate of prices reached 12%, which is significantly higher than growth rate of disposable income in the same period. In the second half of 2005, nevertheless the growth rate of disposable income increased over 5%, the annual growth rate of houses price reached 18%. At the same time, the Federal Reserve started to raise interest rates to curb inflation. The 30-year mortgage loan rate rose from 5.58% to 6.66%. Under the double pressure, the monthly mortgage payment to income rate increased from 24 to 37%. Some even increased over 40% and led the real estate bubble eventually burst.

Although the reasons of burst of the United States real estate bubble is related with its particular national conditions, in comparison with today's China, it is similar in some aspects. As the matter of fact, the administrative intervention led the price distortion. On the other hand, houses price is hard to fall because the demand of house buyers. Financial intermediaries also have the impulse to innovate financial tools to facilitate the transaction between buyers and sellers. In this way, we can find that some problems in Chinese real estate market also occurred in the United States before the crisis. We ought to learn from the crisis in the United States and try avoid make the same mistakes, reduce the uncertainty which the government intervention bring to the real estate market and balance the market and government.

3 Description of Methodology

In this chapter, the methodologies which will be used to solve the statistical problem of real estate equity investment will be introduced. It is not strict but need some basic steps to come to the conclusion. First, the problem must be defined carefully. Then is the selection of a representative sample and gathering appropriate data. And we use inferential statistic to test hypothesis parameters of given population. The last part is focused on regression analysis. Regression analysis is used to analyze relationship between variables. Covariance is another characteristic can show relationship between variables as well as. And in this part, linear regression model and multiple regression model will be introduced.

3.1 Basic Terms

In this part, some basic terms that will be used in the following will be introduced. Firstly, data are facts which is collected, analyzed and summarized for interpretation. All the data that collected for a special study are referred to as data set. A parameter is a descriptive measure computed from an entire population. We always use Greek letters to represent population numerical descriptive measures and Roman letters along with other symbols to represent sample. Descriptive statistics always describe a large set of data. And one or more single number such as average can be set from the data. Inferential statistics is used to conclude a large group which is called as population by collecting a portion of it (a sample). A population is all of the outcomes. And a sample is an observed subset of population values. The sample size is denoted by n. Population size is always so large that the collection of all information could be expensive. The ample must be representative of the population. The sample of the thesis is the stock prices of fifty real estate companies from 2000 to 2017.

Moore (2000, p. 123), who has published widely on the subject of statistical education, points out that it “is influenced by a movement to reform the teaching of mathematical science in general.” The most common measure of central tendency is the arithmetic mean. It is also called as mean or

average. The mean of data is the sum of the data values divided by the number of sample. The sample mean $\bar{x}$ is :

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}, or\ \bar{x} = \frac{\sum_{i=1}^{k} x_i \cdot f_i}{n}, \tag{3.1}$$

where n is a sample size, and k is number of categories.

The sample variance (s^2) is the sum of the squared differences between each observation and the sample mean divided by the sample size minus 1.

$$s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}, or\ s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2 \cdot f_i}{n-1}, \tag{3.2}$$

where s^2 is the unbiased estimator of the population variance. If the number of measurements in the sample is larger, the sample variance is more difficult to calculate. But there exists shortcut formulas for calculating variance:

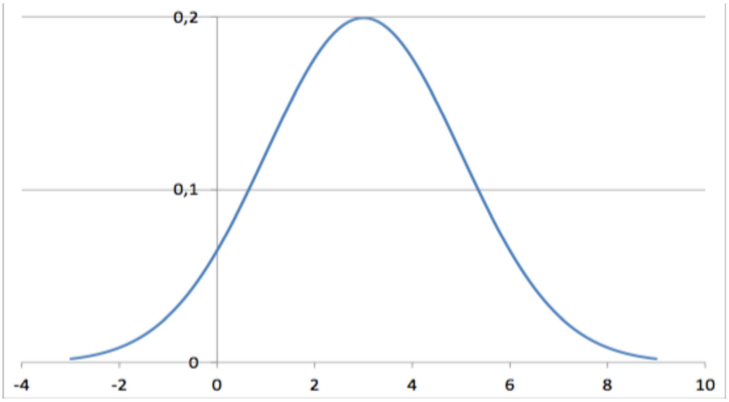
$$s^2 = \frac{\sum_{i=1}^{n} {x_i}^2 - \frac{(\sum_{i=1}^{n} x_i)^2}{n}}{n-1} = \frac{\sum_{i=1}^{n} {x_i}^2 - n \cdot \bar{x}^2}{n-1}. \tag{3.3}$$

In order to compute the variance, the distances should be squared. Then, it changes the unit of measurement to square units. The standard deviation is the square root of variance:

$$s = \sqrt{s^2}. \tag{3.4}$$

The last term is standard normal distribution. Let Z be a normal random variable with mean is 0 and variance is 1. It can be expressed like: Z ~ N(0,1). We can say that Z follows the standard normal distribution. There is an example for standard normal distribution in Fig. 3.1.

Figure 3.1. X ~ N(3,4)



Source: Anderson et al.(2005)

The corresponding cumulative distribution function is denoted as $\phi(z)$. Then for any a < b it can be get $P(a < Z < b) = P(a \leq Z < b) = P(a < Z \leq b) = P(a \leq Z \leq b) = \phi(b) - \phi(a)$. $\phi(z)$ is the nonnegative values of z. z_α can be expressed as the real number such as $P(Z > z_\alpha)$. For negative values we use the formula $\phi(z_\alpha) = 1 - \alpha$. The quantity α is called as significance level. The quantity $(1 - \alpha)$ is called as confidence level.

z_α shows the value in standard normal distribution that cuts off a right tail area of α. z_α is also referred as z-score. The Table 3.1 shows selected z-scores from the Standard Normal Distribution Table (Anderson et al.,2005).

Table 3.1 Standard Normal Distribution Table.

α	0.1	0.05	0.025	0.01	0.005
z_α	1.282	1.645	1.960	2.326	2.576

And it also can be calculated by using Excel.

$$\phi(z) = NORM.S.DIST(z, 1) \; and \; z_\alpha = NORM.S.INV(1 - \alpha) \tag{3.5}$$

3.2 Hypothesis Test

Using inferential statistic we can test hypothesis involving one, two, or more parameters of given population. In this part, parametric testing will be introduced. At first, two claims should be set. They are referred to as null hypothesis H_0 and alternative hypothesis H_1.

H_0 is the hypothesis that will be accepted unless the data convinces it is false. H_1 is the hypothesis which will be accepted if the data convinces it is true. If we fail to reject the null hypothesis, we will reject the alternative hypothesis. If we reject the null hypothesis in favor of the alternative, we will accept the alternative hypothesis.

When we fail to reject the null hypothesis, either the hypothesis is true or the test procedure is not enough strong to reject. So we have committed an error. We can refer α as the significance level, which is the probability of rejecting a null hypothesis that is true. Such probability is called as type I error. And 1-β is referred as a power of the test, which is the probability of rejecting a

null hypothesis that is false. And β is called as type II error, that is the acceptance of a false null hypothesis(Anderson et al.,2005).

Decision on H_0	H_0 is true	H_0 is false
Fail to reject probability:	Correct decision 1- α	Type II error β
Reject probability:	Type I error α	Correct decision 1- β

The concentration can be paid in either minimization of type I error or type II error. But we cannot minimalize both of them at the same time. So we should choose one of them. We will focus on type I error in the following according to Lehmann (2006. P. 132).

The test can be divided into six steps:

1) Identify the null hypothesis H_0 and alternative hypothesis H_1.
2) Choose α (usually 1%, 5% or 10%).
3) Identify the test statistic that can be used to assess H_0.
4) Compute the observed value of the test statistic.
5) Determine appropriate critical region W.
6) Make the decision:
    a) If the numerical value of the test statistic falls in W, we reject H_0 and conclude H_1 is true.
    b) If the numerical value of the test statistic doesn't fall in W, we fall to reject H_0 and accept H_1.

In order to determine sample size for confidence interval for mean when the population variance is unknown, firstly, we should gather data for sample. We can determine sample size n, critical value $t_{\frac{\alpha}{2}}(n-1)$, and sample standard deviation s.

1) Test for difference between population means: σ_i^2 unknown, large samples

When the two independent samples of $n_1 \geq 30$ and $n_2 \geq 30$ observations, they are large samples. Usually, we do not know population variance, but the sample means of $\bar{x}_1$ and $\bar{x}_2$,

sample variance s_1^2 and s_2^2 which is coming from normal distribution $X_1 \sim N(\mu_1; \sigma_1^2)$, and $X_2 \sim N(\mu_2; \sigma_2^2)$ can be calculated.

Version 1 (arbitrary d_0):

Hypothesis:

$$H_0: \mu_1 - \mu_2 = d_0 \qquad H_1: \mu_1 - \mu_2 \neq d_0$$

Test Statistic:

$$Z = \frac{\bar{x}_1 - \bar{x}_2 - d_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \sim N(0,1) \tag{3.6}$$

Critical Region:

$$W = (-\infty; -z_{\frac{\alpha}{2}}) \cup (z_{\frac{\alpha}{2}}; +\infty)$$

For one-tailed alternatives:

$$H_0: \mu_1 = \mu_2 (or\ \mu_1 \leq \mu_2), H_1: \mu_1 > \mu_2 \Rightarrow W = (z_\alpha; +\infty)$$

$$H_0: \mu_1 = \mu_2 (or\ \mu_1 \geq \mu_2), H_1: \mu_1 < \mu_2 \Rightarrow W = (-\infty; -z_\alpha)$$

Version 2 ($d_0 = 0$):

Hypothesis:

$$H_0: \mu_1 = \mu_2 \qquad H_1: \mu_1 \neq \mu_2$$

Test Statistic:

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \sim N(0,1) \tag{3.7}$$

Critical Region:

$$W = (-\infty; -z_{\frac{\alpha}{2}}) \cup (z_{\frac{\alpha}{2}}; +\infty)$$

For one-tailed alternatives:

$$H_0: \mu_1 = \mu_2 (or\ \mu_1 \leq \mu_2), H_1: \mu_1 > \mu_2 \Rightarrow W = (z_\alpha; +\infty)$$

$$H_0: \mu_1 = \mu_2 (or\ \mu_1 \geq \mu_2), H_1: \mu_1 < \mu_2 \Rightarrow W = (-\infty; -z_\alpha)$$

2) Test for equality of variances

Let s_1^2 and s_2^2 be observed sample variances from independent random sample of size n_1 and n_1 from normally distributed populations with variances σ_1^2 and σ_2^2. The test statistic follows F-distribution (Lehmann, 2006. P. 144):

$$F = \frac{\frac{s_1^2}{\sigma_1^2}}{\frac{s_2^2}{\sigma_2^2}} \sim F(n_1 - 1; n_2 - 1). \tag{3.8}$$

It can be used for tests different between σ_1^2 and σ_2^2 in terms of proportion of these two. Generally the population variance $\sigma_1^2 = \sigma_2^2$ and $\frac{s_1^2/\sigma_1^2}{s_2^2/\sigma_2^2} = \frac{s_1^2}{s_2^2}$.

Hypothesis:

$$H_0: \sigma_1^2 = \sigma_2^2 \qquad H_1: \sigma_1^2 \neq \sigma_2^2$$

Test Statistic:

$$F = \frac{s_1^2}{s_2^2} \sim F(n_1 - 1; n_2 - 1) \tag{3.9}$$

Critical Region:

$$W = (0; -F_{1-\frac{\alpha}{2}}(n_1 - 1; n_2 - 1)) \cup (F_{\frac{\alpha}{2}}(n_1 - 1; n_2 - 1); +\infty)$$

For one-tailed alternatives:

$$H_0: \sigma_1^2 = \sigma_2^2 \ (or\ \sigma_1^2 \leq \sigma_2^2), H_1: \sigma_1^2 > \sigma_2^2 \Rightarrow W = (F_\alpha(n_1 - 1; n_2 - 1); +\infty)$$

$$H_0: \sigma_1^2 = \sigma_2^2 \ (or\ \sigma_1^2 \geq \sigma_2^2), H_1: \sigma_1^2 < \sigma_2^2 \Rightarrow W = (0; -F_{1-\alpha}(n_1 - 1; n_2 - 1))$$

3) Test for difference between population means, if $\boldsymbol{\sigma_1^2 = \sigma_2^2}$

In addition, if one of the sample size is less than 30 it is not allowed to use the test above. We know the sample means of $\bar{x}_1$ and $\bar{x}_2$, sample variance s_1^2 and s_2^2 which is coming from normal distribution $X_1 \sim N(\mu_1; \sigma_1^2)$, and $X_2 \sim N(\mu_2; \sigma_2^2)$. Then we do the same notation as previous test.

Hypothesis:

$$H_0: \mu_1 = \mu_2 \qquad H_1: \mu_1 \neq \mu_2$$

Test Statistic:

$$T = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{(n_1-1)\cdot s_1^2 + ((n_2-1)\cdot s_2^2}} \cdot \sqrt{\frac{n_1 \cdot n_2 \cdot (n_1+n_2-2)}{n_1+n_2}} \sim t(n_1+n_2-2) \quad (3.10)$$

Critical Region:

$$W = (-\infty; -t_{\frac{\alpha}{2}}(n_1+n_2-2)) \cup (t_{\frac{\alpha}{2}}(n_1+n_2-2); +\infty)$$

For one-tailed alternatives:

$$H_0: \mu_1 = \mu_2 (or\ \mu_1 \leq \mu_2), H_1: \mu_1 > \mu_2 \Rightarrow W = (t_{\frac{\alpha}{2}}(n_1+n_2-2); +\infty)$$

$$H_0: \mu_1 = \mu_2 (or\ \mu_1 \geq \mu_2), H_1: \mu_1 < \mu_2 \Rightarrow W = (-\infty; -t_{\frac{\alpha}{2}}(n_1+n_2-2))$$

4) Test for difference between population means, if $\sigma_1^2 \neq \sigma_2^2$

For another condition, when the two independent samples of observations that $n_1 < 30$ and $n_2 < 30$, if you do not know population variance, you can't assume the unknown variances to be equal to the following procedure. The sample means of $\bar{x}_1$ and $\bar{x}_2$ and sample variance s_1^2 and s_2^2 which is coming from normal distribution $X_1 \sim N(\mu_1; \sigma_1^2)$, and $X_2 \sim N(\mu_2; \sigma_2^2)$ can be calculated.

Hypothesis:

$$H_0: \mu_1 = \mu_2 \qquad H_1: \mu_1 \neq \mu_2$$

Test Statistic:

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \sim t(df) \quad (3.11)$$

where

$$df = \frac{(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2})^2}{\frac{1}{n_1-1}\cdot\left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{n_2-1}\cdot(\frac{s_2^2}{n_2})^2} \quad (3.12)$$

Critical Region:

$$W = (-\infty; -t_{\frac{\alpha}{2}}(df)) \cup (t_{\frac{\alpha}{2}}(df); +\infty)$$

For one-tailed alternatives:

$$H_0: \mu_1 = \mu_2 (or\ \mu_1 \leq \mu_2), H_1: \mu_1 > \mu_2 \Rightarrow W = (t_\alpha(df); +\infty)$$

$$H_0: \mu_1 = \mu_2 (or\ \mu_1 \geq \mu_2), H_1: \mu_1 < \mu_2 \Rightarrow W = (-\infty; -t_\alpha(df))$$

5) Test for difference between population means: matched pairs

In this measure, we assume that we get a random sample of n matched pairs of observation from populations, whose means are defined as μ_x and μ_y. Then, $\bar{d}$ is denoted as the observed sample mean and s_D is standard deviation for the n difference $(x_i - y_i)$. And we can test as following when the population distribution of the difference is a normal distribution(Lehmann, 2006. P. 153).

Hypothesis:

$$H_0: \mu_x = \mu_y \qquad H_1: \mu_x \neq \mu_y$$

Test Statistic:

$$T = \frac{\bar{d}}{s_D} \cdot \sqrt{n} \sim t(n-1) \tag{3.13}$$

Critical Region:

$$W = (-\infty; -t_{\frac{\alpha}{2}}(n-1)) \cup (t_{\frac{\alpha}{2}}(n-1); +\infty)$$

For one-tailed alternatives:

$$H_0: \mu_x = \mu_y \left(or\ \mu_x \leq \mu_y\right), H_1: \mu_x > \mu_y \Rightarrow W = (t_{\frac{\alpha}{2}}(n-1); +\infty)$$

$$H_0: \mu_x = \mu_y \left(or\ \mu_x \geq \mu_y\right), H_1: \mu_x < \mu_y \Rightarrow W = (-\infty; -t_{\frac{\alpha}{2}}(n-1))$$

3.3 Regression Analysis

In this part, the relationship between quantitative variables will be introduced. The analysis of economy and businesses makes extensive use of relationships between variables. It can be express as following:

$$Y = f(X),$$

where X is referred as independent variable, which is used in a relationship to explain or to predict changes of Y, which is referred as dependent variable. The function can be linear and nonlinear

forms. The aim of regression is to estimate the unknown function. And scatter plots provide a picture of the two variables by displaying data points on two-dimensional graph, where axis x is the independent variable and axis y is for dependent variable. In scatter plots, it is obvious to find the range of each variable, the possible relationship between these two variables and the indication of outliers. The most familiar methods like linear regression and ordinary least squares regression are parametric. Parametric regression function is defined in terms of a finite number of unknown parameters which are estimated from data. Nonparametric regression allows the function to lie in a specified set of functions (Berenson, 2006.p.367).

3.3.1 Covariance and Correlation Coefficient

For each particular dataset we can determine mean, variance, skewness, kurtosis and so on. Covariance is another characteristic which can show relationship between variables. The sample covariance is measure of the linear relationship between two variables.

$$Cov(x,y) = S_{xy} = \frac{\sum_{i-1}^{n}(x_i-\bar{x})\cdot(y_i-\bar{y})}{n-1} = \frac{\sum x_i\cdot y_i - n\cdot\bar{x}\cdot\bar{y}}{n-1}, \tag{3.14}$$

where x_i, y_i are observed values and $\bar{x}, \bar{y}$ are means of sample, n is the sample size.

And if the result is higher than 0, it implies a positive linear relationship and increasing of independent variable will cause the rise of dependent variables. On the contrary, if the result is negative, it means a decreasing linear relationship. If we want to use this characteristic as a measure, it is needed to standardized it in the following way.

The correlation coefficient is standardized measure of the linear relationship between two variables.

$$r_{xy} = \frac{cov(x,y)}{s_x\cdot s_y} = \frac{\sum\sum x_i\cdot y_i - n\cdot\bar{x}\cdot\bar{y}}{\sqrt{(\sum x_i^2 - n\cdot\bar{x}^2)(\sum y_i^2 - n\cdot\bar{y}^2)}}, \tag{3.15}$$

where s_x, s_y are the sample standard deviations.

This measurement is more representative as a descriptive measure of the strength of linear association in a sample. The corresponding population parameter is denoted as ρ. The range of the result is between -1 and 1. If r_{xy} equals to 1, it indicates the perfect positive linear relationship.

When r_{xy} equals to 0, it means there is no linear relationship between x and y. If r_{xy} equals to -1, it indicates the perfect negative linear relationship. But it is still hardly to say the relationship is strongly or weakly. For example, if the coefficient is greater than 0.7, it is significantly high. The minimum size of r_{xy} that is required to conclude that a relationship exists is:

$$|r_{xy}| \geq \frac{2}{\sqrt{n}}$$

It is better to apply test for zero population correlation for some conclusions, like the following test:

Hypothesis:

$$H_0: \rho = 0 \qquad H_1: \rho \neq 0$$

Test Statistic:

$$T = \frac{R_{xy}}{\sqrt{1-R_{xy}^2}} \cdot \sqrt{n-2} \sim t(n-2) \tag{3.16}$$

Critical Region:

$$W = (-\infty; -t_{\frac{\alpha}{2}}) \cup (t_{\frac{\alpha}{2}}; +\infty)$$

For one-tailed alternatives:

$$H_0: \mu = \mu_0 (or\ \mu \leq \mu_0), H_1: \mu > \mu_0 \Rightarrow W = (t_\alpha; +\infty)$$

$$H_0: \mu = \mu_0 (or\ \mu \geq \mu_0), H_1: \mu < \mu_0 \Rightarrow W = (-\infty; -t_\alpha)$$

We can use the correlation to test the hypothesis that there is no linear association in the population between a pair of random variables. Rejecting the null hypothesis, we cannot conclude that one variable led to the other, but only that they are related in some way (Berenson, 2006.p.454).

3.3.2 Linear Regression Model

Considering the population model as a linear relationship:

$$Y = \beta_0 + \beta_1 \cdot X. \tag{3.17}$$

where Y is the function of variable X. Y is dependent variable and X is independent.

$$E(Y|X = x) = \beta_0 + \beta_1 \cdot x.$$

So for given x_i, y_i, we can get

$$y_i = \beta_0 + \beta_1 \cdot x_i + \epsilon_i.$$

Where β_0, β_1 are coefficients of unknown parameters, β_0 is the intercept of the function and β_1 is the slope of the regression line. It means the change of Y for every unit change of X. ϵ_i is random error, $\epsilon_i \sim N(o, \sigma^2)$. X is dependent of ϵ_i, and they are not correlated.

For least squares procedure, we define β_0, β_1 as $\hat{\beta}_0 = b_0, \hat{\beta}_1 = b_1$. It is used to estimate value of Y.

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 \cdot x_i = b_0 + b_1 \cdot x_i$$

Least Squares Procedure minimizes sum of the square residents e_i:

$$e_i = y_i - \hat{y}_i$$

In the following way

$$SSE = \sum e_i^2 = \sum (\hat{y}_i - y_i)^2 = \sum (b_0 + b_1 \cdot x_i - y_i)^2 \tag{3.18}$$

SSE is a component due to unexplained error. SSR is a component by the regression and SST is the total variability in a regression analysis.

Sum of square total:

$$SSE = \sum_{i=1}^{n} (\hat{y}_i - y_i)^2 \tag{3.19}$$

$$SSR = \sum_{i=1}^{n} (\bar{y}_i - \hat{y}_i)^2 \tag{3.20}$$

Sum of squares total:

$$SST = \sum_{i=1}^{n} (\bar{y}_i - y_i)^2 \tag{3.21}$$

Coefficient of Determination:

$$R^2 = \frac{SSR}{SST} = \frac{\sum (\bar{y}_i - \hat{y}_i)^2}{\sum (\bar{y}_i - y_i)^2} = 1 - \frac{\sum (\hat{y}_i - y_i)^2}{\sum (\bar{y}_i - y_i)^2} = \frac{s_{\hat{y}}^2}{s_{\hat{y}}^2} \tag{3.22}$$

The coefficient of determination varies from 0 to 1. The higher the value is, the regression is better. Regression equation is always used to explain the variability if dependent variable (Berenson, 2006.P. 511).

3.3.3 Test for the Population Regression Slope

T-test is used to test hypothesis about individual regression coefficients. And we do not need to test the constant β_1. Assume the normal distribution of residual component at the level of significance $\alpha \Rightarrow u_t \approx N(0, \sigma^2)$ and α=5%.

Hypothesis:

$$H_0: \beta_i=0 \quad H_1: \beta_i \neq 0$$

Test Statistic

$$t_{cal} = \frac{\beta_i^{\wedge}}{\sigma_{\beta_i^{\wedge}}} \sim t(n-k) \tag{3.23}$$

where n is number of observation, k is number of β_i.

Critical Region:

$$W = (-\infty; -t_\alpha(n-k)) \cup (t_\alpha(n-k); +\infty)$$

F-test is used to test more than one coefficient at a time. We also assume normal distribution of residual component at the level of significance $\alpha \Rightarrow u_t \approx N(0, \sigma^2)$ and α=5%.

Hypothesis:

$$H_0: \beta_2 = \beta_3 = \cdots = \beta_i=0 \quad H_1: \beta_2 \neq 0 \vee \beta_3 \neq 0 \vee \cdots \beta_i \neq 0$$

Test Statistic:

$$F = \frac{\frac{ESS}{df1}}{\frac{RSS}{df2}} = \frac{\frac{ESS}{k-1}}{\frac{RSS}{n-k}} \sim F(k-1, n-k) \tag{3.24}$$

Critical Region:

$$W = (-\infty; -F_\alpha(k-1, n-k)) \cup (F_\alpha(k-1, n-k); +\infty)$$

3.3.4 Multiple Regression Analysis

This part is the development of the simple linear model. Multiple regression analysis can use more general form for various models. For example, for a given model: $Y = \beta_0 + \frac{\beta_1}{x}$, we can denote $X' = \frac{1}{x}$, thus we get a linear model: $Y = \beta_0 + \beta_1 \cdot X'$. The multiple regression analysis is

used to find how a dependent variable Y is related to two or more independent variables by fitting a linear equation to observed data. Then

$$Y = \beta_0 + \beta_1 \cdot X_1 + \cdots + \beta_i \cdot X_i + \epsilon \tag{3.25}$$

is called as linear multiple regression model, where $\beta_0, \beta_1, \cdots, \beta_i$ are unknown parameters, and ϵ is a random variable in a linear model with appropriate assumption. The Least Square Method(LSM) is used to develop the estimate multiple regression equation. In the LSM, the best fitting line fro observed data is calculation for the minimum the sum of the squares of the vertical deviations from each data point to the line. And the reason that squares the vertical deviations from data point to line is there no cancellations between positive and negative.

$$minSSE = min \sum e_i^2 = min \sum (\hat{y}_i - y_i)^2 \tag{3.26}$$

where y_i are observed values of the dependent variable, $\hat{y}_i$ are estimated value of the dependent variable calculated from Estimated multiple regression equation:

$$\hat{y}_i = b_0 + b_1 \cdot x_i + \cdots + b_1 \cdot x_i \tag{3.27}$$

4 Performance Evaluation of Real Estate Equity Investments in China

In this chapter, we will evaluate the performance of real estate equity in China by using the methodologies which are described in the chapter three. This chapter is divided into four parts. The first part is the description of data: real residential property prices for Beijing and stock prices of fifty real estate companies which are listed in Shanghai stock exchange. Next, the hypothesis tests will be conducted and used to judge if the performance of real estate equity investment is different before and after financial crisis. Then is the evaluation for performance of real estate equity investment in China. Finally, summary of the results and performance will be listed.

4.1 Data Description

In this part is the description of data. It includes real residential property prices for Beijing and stock prices of fifty real estate companies which are listed in Shanghai Stock Exchange. The reason to choose the real residential property prices in Beijing is because Beijing is the capital of China. The price for Beijing is relatively representative. The real residential property prices for Beijing set mean price of 2010 as the benchmark. It is quarterly data from 2000 Q4 to 2017 Q2. The data is shown in Table 4.1.

Because we want to evaluate the performance of real estate equity investment in China, we select the stock price of fifty real estate companies, which lists in Shanghai Stock Exchange. The monthly data of stock prices of fifty real estate companies in China is from October, 2000 to June, 2017 (Annex 1). The difference between stock price in two period is the monthly return. And then we can calculate the stock monthly return and average stock monthly return of all companies (Annex 2).

Tab 4.1 Real residential property prices for Beijing (Index 2010=100, not seasonally adjusted)

2000Q4	83.31	2005Q1	87.77	2009Q2	95.85	2013Q3	100.98
2001Q1	82.83	2005Q2	89.33	2009Q3	97.35	2013Q4	100.79
2001Q2	82.35	2005Q3	89.88	2009Q4	98.49	2014Q1	100.33
2001Q3	80.86	2005Q4	88.60	2010Q1	100.87	2014Q2	98.75
2001Q4	81.38	2006Q1	90.79	2010Q2	100.70	2014Q3	96.05
2002Q1	82.89	2006Q2	92.55	2010Q3	99.94	2014Q4	93.95
2002Q2	84.41	2006Q3	92.50	2010Q4	99.26	2015Q1	94.05
2002Q3	84.93	2006Q4	90.81	2011Q1	99.48	2015Q2	94.04
2002Q4	85.44	2007Q1	92.78	2011Q2	98.64	2015Q3	94.39
2003Q1	83.96	2007Q2	93.31	2011Q3	97.74	2015Q4	93.96
2003Q2	83.38	2007Q3	94.51	2011Q4	95.79	2016Q1	96.96
2003Q3	84.95	2007Q4	91.96	2012Q1	95.62	2016Q2	99.91
2003Q4	86.51	2008Q1	92.86	2012Q2	95.66	2016Q3	102.48
2004Q1	88.07	2008Q2	93.53	2012Q3	95.26	2016Q4	102.60
2004Q2	87.63	2008Q3	93.84	2012Q4	95.26	2017Q1	104.97
2004Q3	87.19	2008Q4	92.35	2013Q1	98.31	2017Q2	105.87
2004Q4	87.75	2009Q1	93.86	2013Q2	100.04		

Source: Federal Reserve Bank of ST. Louis: Real Residual Property Prices for Beijing, China (2017)

4.2 Comparison and Interpretation of Hypothesis Test

In this part, it is usage of methodologies described in chapter 3. The goal is to judge if the performance of real estate equity investment is different before and after financial crisis. The financial crisis originated from the subprime mortgage crisis. The convergence of highly market-oriented financial systems creates a special risk transmission path. The rapid development of securitization and derivative instruments in mortgage loans has increased the impact of the risk that prices of financial assets related to subprime mortgages. The deepening international integration of financial markets has accelerated financial turmoil from one country to others. With the liquidity crunch in the credit market, the subprime mortgage crisis eventually evolved into a global financial crisis. It slowed Chinese export grows and increased the risk of overseas investment. And the turmoil in the domestic financial market had intensified. So the one period before financial crisis

is from 2000 to 2007, another period after financial crisis is from 2008 to 2017. The data from 2000 to 2007 is referred to as sample 1, with the data from 2008 to 2017 is sample 2. The hypothesis test in the following is based on this.

4.2.1 Hypothesis Test for Price Index

For the real residential property prices index for Beijing has been shown in Table 4.1. In the last part, the data has been divided into two samples. Sample 1 is data from 2000 Q4 to 2007 Q4. Sample 2 is data from 2008 Q1 to 2017 Q2.

Firstly, we have to identify the problem that will be solved. The question is if the financial crisis impacted the real residential property prices index for Beijing. The financial crisis originated from the subprime mortgage crisis. And it caused the global financial crisis in 2008. Most of countries were influenced by it. As a result of global financial crisis, many enterprises had gone bankrupt. The collapse of some international enterprises influenced many countries, which caused the changes in price level. So the hypothesis will be identified as:

$H_0: \mu_1 = \mu_2$ (the price index has no difference before and after financial crisis)

$H_1: \mu_1 \neq \mu_2$(the price index has difference before and after financial crisis)

Where significance level α=5%, n_1 (size of sample 1)=29, n_2 (size of sample 2) = 38. We can know that if one of the sample size is less than 30, it is necessary to test for the equality of variances of the population. The test statistic follows F-distribution.

Test for equality of variance:

Hypothesis:

$H_0: \sigma_1^2 = \sigma_2^2$ (variances are equal)

$H_1: \sigma_1^2 \neq \sigma_2^2$ (variance are not equal)

Where significance level α=5%, $\bar{x}_1$ = 87.33, $\bar{x}_2$ = 97.68, s_1^2 = 15.68, s_2^2= 11.85.

So, we can calculate by using formula (3.9):

$$F_{cal} = \frac{s_1^2}{s_2^2} = \frac{15.68}{11.85} = 1.323,$$

$$F_{crit1} = \text{FINV}(0.05/2,28,37) = 1.993,$$

$$F_{crit2} = \text{FINV}(1\text{-}0.05/2,28,37) = 0.485.$$

Critical Region:

$$W = (0, 0.485) \cup (1.993, +\infty)$$

It is clear that the result of test statistic $F_{cal} = 1.323$ is not included in the critical region. So we should fail to reject H_0 at the level of significance α=5%. It means we can assume that variance are equal $\sigma_1^2 = \sigma_2^2$. So next step is test if the financial crisis will impact the real residential property prices index for Beijing.

Test for difference between population means, if $\boldsymbol{\sigma_1^2 = \sigma_2^2}$

Hypothesis:

$H_0: \mu_1 = \mu_2$ (the price index has no difference before and after financial crisis)

$H_1: \mu_1 \neq \mu_2$(the price index has difference before and after financial crisis)

So, we can calculate by using formula (3.10):

$$t_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{(n_1 - 1) \cdot s_1^2 + ((n_2 - 1) \cdot s_2^2}} \cdot \sqrt{\frac{n_1 \cdot n_2 \cdot (n_1 + n_2 - 2)}{n_1 + n_2}} = -11.42.$$

$$t_{crit} = \text{TINV}(0.05/2,46\text{-}3) = 2.29.$$

Critical Region:

$$W = (-\infty;\ -2.29) \cup (2.29;\ +\infty)$$

When $|t_{cal}| > t_{crit}$, we should reject H_0 at the level of significance α=5%. It means we can assume that the price index has difference before and after financial crisis.

4.2.2 Hypothesis Test for Stock Return

The monthly data of stock prices of fifty real estate companies in China is from October, 2000 to June, 2017 (see Annex 1). And then is calculation the stock monthly return and average stock monthly return of all companies (see Annex 2). In the last part, the data has been divided into two samples. Sample 1 is data from October, 2000 to December,2007. Sample 2 is data from January,

2008 to June, 2017. First, it is necessary to test difference between population means for each company, and then it is test for the average stock return. The sample size of each company is the same. We can get significance level α=5%, n_1 (size of sample 1)=87, n_2 (size of sample 2) = 114. The two samples have more than 30 observations.

The first company is China VANKE CO, LTD. It is the leader and largest real estate company in China.

Test for difference between population means: σ_i^2 unknown, large samples

Hypothesis:

$H_0: \mu_1 = \mu_2$ (the monthly stock return of VANKE has no difference before and after financial crisis)

$H_1: \mu_1 \neq \mu_2$ (the monthly stock return of VANKE has difference before and after financial crisis)

Where significance level α=5%, $\bar{x}_1$ = 1.06, $\bar{x}_2$ = 2.98, s_1^2 = 0.15, s_2^2= 0.08.

So, we can calculate by using formula (3.6):

$$t_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = 0.34$$

t_{crit} = NORM.S.INV(0.05/2)=1.96

Critical Region:

$$W = (-\infty;\ -1.96) \cup (1.96;\ +\infty)$$

When $|t_{cal}| < t_{crit}$, we should fail to reject H_0 at the level of significance α=5%. It means we can assume that the monthly stock return of VANKE has no difference before and after financial crisis.

Next, we will do the same procedures for the rest 49 companies. The result is shown in Table 4.2.

Table 4.2 Test Statistic for Monthly Stock Return of Fifty Real Estate Companies.

Company	μ_1	μ_2	s_1^2	s_2^2	t_{cal}	Company	μ_1	μ_2	s_1^2	s_2^2	t_{cal}
1	1.06	2.98	0.15	0.08	**0.34**	26	0.44	2.18	0.08	0.06	**0.14**
2	0.42	2.93	0.11	0.14	**-0.13**	27	1.19	3.89	0.16	-0.01	**0.78**
3	1.61	2.92	0.12	-0.01	**0.59**	28	2.01	2.01	0.15	-0.05	**0.98**
4	0.44	2.60	0.08	-0.01	**0.50**	29	0.02	0.59	-0.04	0.03	**-1.00**
5	0.44	2.13	0.02	0.00	**0.09**	30	0.53	1.61	0.06	-0.02	**0.59**
6	0.03	0.94	0.04	0.01	**0.36**	31	0.25	3.39	-0.06	0.12	**-0.99**
7	0.62	1.09	0.09	-0.01	**0.78**	32	0.38	0.55	0.07	-0.04	**1.12**
8	0.72	1.49	0.08	0.00	**0.55**	33	0.17	0.36	0.03	0.00	**0.51**
9	0.07	3.60	0.01	0.03	**-0.09**	34	0.32	1.56	-0.14	0.05	**-1.40**
10	0.21	0.76	0.03	0.02	**0.04**	35	0.29	0.70	0.01	0.00	**0.08**
11	0.81	1.44	0.03	0.03	**0.00**	36	0.40	0.80	0.10	0.02	**0.70**
12	0.27	0.65	0.10	0.00	**1.00**	37	0.00	2.82	0.00	0.05	**-0.29**
13	0.10	1.11	0.02	0.05	**-0.22**	38	0.18	1.77	-0.03	-0.01	**-0.19**
14	0.16	0.38	0.03	-0.02	**0.74**	39	0.10	0.81	0.00	0.00	**-0.05**
15	0.08	0.89	0.07	0.06	**0.09**	40	1.26	3.62	0.15	0.00	**0.65**
16	0.53	0.97	0.09	0.03	**0.45**	41	5.52	9.36	0.22	-0.04	**0.68**
17	0.08	0.37	0.00	0.02	**-0.32**	42	0.02	3.74	0.01	0.03	**-0.13**
18	0.55	1.09	0.12	0.01	**0.86**	43	0.50	2.17	0.05	0.07	**-0.08**
19	0.36	0.86	0.06	-0.02	**0.76**	44	0.43	12.95	0.03	0.18	**-0.41**
20	0.36	0.69	0.07	-0.01	**0.82**	45	0.71	3.04	0.02	0.08	**-0.30**
21	0.17	1.45	-0.02	0.03	**-0.45**	46	0.24	0.46	0.01	0.00	**0.07**
22	0.39	1.20	0.00	-0.03	**0.27**	47	0.08	0.22	0.04	0.01	**0.56**
23	0.52	9.25	0.06	0.12	**-0.18**	48	0.24	2.21	0.01	0.05	**-0.23**
24	0.54	5.17	0.01	0.00	**0.07**	49	0.30	3.87	0.00	0.03	**-0.17**
25	0.11	0.19	0.05	-0.02	**1.30**	50	0.16	2.73	0.01	0.02	**-0.06**

The critical region W = $(-\infty;\ -1.96) \cup (1.96;\ +\infty)$. From the Table 4.2, we can see that the t_{cal} of all companies are not in the critical region. When $|t_{cal}| < t_{crit}$, we should fail to reject H_0 at the level of significance α=5%. It means we can assume that the monthly stock return of the selected fifty companies has no difference before and after financial crisis.

The last test is if there exists difference of the average monthly stock return of fifty selected real estate companies.

Hypothesis:

$H_0: \mu_1 = \mu_2$ (the average monthly stock return of fifty selected real estate companies has no difference before and after financial crisis)

$H_1: \mu_1 \neq \mu_2$ (the monthly stock return of fifty selected real estate companies has difference before and after financial crisis)

where significance level α=5%, $\bar{x}_1$ = 0.047, $\bar{x}_2$ = 0.022, s_1^2 = 0.16, s_2^2= 0.643.

So, we can calculate by using formula (3.6):

$$t_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = 0.283$$

t_{crit} = NORM.S.INV(0.05/2)=1.96

Critical Region:

$$W = (-\infty;\ -1.96) \cup (1.96;\ +\infty)$$

When $|t_{cal}| < t_{crit}$, we should fail to reject H_0 at the level of significance α=5%. It means we can assume that the average monthly stock return of fifty selected real estate companies has no difference before and after financial crisis.

4.3 Evaluation for Real Estate Equity Investment in China

In this part, the evaluation of real estate equity investment in China will be measured. It will use regression method to analyze and deduce the function of the quarterly average stock return and the real residential property price for Beijing from 2000 Q4 to 2017 Q2. In order to make the model more reasonable, Shanghai Stock Exchange Composite Index (SSECI) will be added in. The Shanghai Stock Exchange divides the listed companies into five major categories according to their respective industries: industrial, commercial, real estate, public utility, and general industry. The sample stock of the industry index is all listed stocks in the industry, including A shares and B-shares reflect the conditions of different industries and the overall changes in their share prices.

4.3.1 Regression Analysis

Tab 4.3 Data of stock return and real residential property price.

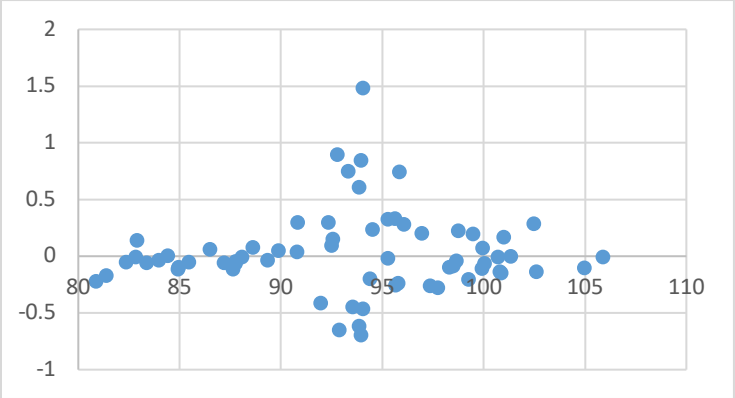
T	stock return	price	SSECI	$\Delta SSECI$	T	stock return	price	SSECI	$\Delta SSECI$
2000Q4	0.0895	83.31	2069.90	-	2009Q1	0.6100	93.86	1894.21	-245.77
2001Q1	-0.0046	82.83	2063.71	-6.19	2009Q2	0.7424	95.85	2311.21	417.00
2001Q2	-0.0533	82.35	2117.53	53.82	2009Q3	-0.2572	97.35	3001.45	690.24
2001Q3	-0.2226	80.86	1762.72	-354.81	2009Q4	-0.0873	98.49	2814.34	-187.11
2001Q4	-0.1705	81.38	1628.54	-134.18	2010Q1	-0.1455	100.87	3153.91	339.57
2002Q1	0.1383	82.89	1598.79	-29.76	2010Q2	-0.0084	100.70	3010.55	-143.36
2002Q2	0.0055	84.41	1633.36	34.58	2010Q3	0.0741	99.94	2542.67	-467.88
2002Q3	-0.1109	84.93	1585.24	-48.12	2010Q4	-0.2022	99.26	2757.76	215.09
2002Q4	-0.0539	85.44	1430.55	-154.70	2011Q1	0.1995	99.48	2806.32	48.55
2003Q1	-0.0362	83.96	1514.65	84.10	2011Q2	-0.0394	98.64	2914.89	108.57
2003Q2	-0.0551	83.38	1513.01	-1.64	2011Q3	-0.2742	97.74	2735.76	-179.13
2003Q3	-0.0961	84.95	1379.15	-133.86	2011Q4	-0.2351	95.79	2464.94	-270.82
2003Q4	0.0616	86.51	1495.00	115.85	2012Q1	0.3314	95.62	2275.15	-189.79
2004Q1	-0.0060	88.07	1670.76	175.76	2012Q2	-0.2556	95.66	2362.53	87.38
2004Q2	-0.1128	87.63	1447.09	-223.67	2012Q3	-0.0169	95.26	2233.77	-128.76
2004Q3	-0.0551	87.19	1353.10	-93.99	2012Q4	0.3246	95.26	2067.52	-166.24
2004Q4	-0.0476	87.75	1266.36	-86.74	2013Q1	-0.0972	98.31	2211.56	144.03
2005Q1	-0.0599	87.77	1215.46	-50.90	2013Q2	-0.0599	100.04	2260.04	48.49
2005Q2	-0.0321	89.33	1074.90	-140.56	2013Q3	0.1699	100.98	2091.20	-168.84
2005Q3	0.0504	89.88	1137.08	62.17	2013Q4	-0.1344	100.79	2138.22	47.02
2005Q4	0.0777	88.60	1172.79	35.71	2014Q1	-0.0012	101.33	2123.19	-15.03
2006Q1	0.0412	90.79	1345.85	173.06	2014Q2	0.2259	98.75	2038.66	-84.53
2006Q2	0.1497	92.55	1642.08	296.23	2014Q3	0.2805	96.05	2096.37	57.71
2006Q3	0.0932	92.50	1749.68	107.60	2014Q4	0.8487	93.95	2333.75	237.38
2006Q4	0.3003	90.81	2520.37	770.68	2015Q1	1.4843	94.05	3042.65	708.90
2007Q1	0.8949	92.78	3302.11	781.74	2015Q2	-0.4635	94.04	3833.29	790.63
2007Q2	0.7502	93.31	4133.80	831.69	2015Q3	-0.1983	94.39	4184.23	350.95
2007Q3	0.2383	94.51	5575.30	1441.50	2015Q4	-0.6951	93.96	3213.78	-970.46
2007Q4	-0.4139	91.96	4838.91	-736.39	2016Q1	0.2053	96.96	3240.73	26.95
2008Q1	-0.6491	92.86	3838.12	-1000.79	2016Q2	-0.1054	99.91	2876.74	-363.99
2008Q2	-0.4450	93.53	2981.72	-856.40	2016Q3	0.2853	102.48	2941.85	65.11
2008Q3	-0.6170	93.84	2139.98	-841.75	2016Q4	-0.1359	102.60	3063.56	121.71
2008Q4	0.2973	92.35	2069.90	14.33	2017Q1	-0.1025	104.97	3170.95	107.38

Regression analysis is used to analyze the relationship between quantitative variables**.** Because stock return is the variable which we want to evaluate, it is appointed as dependent variable Y. The independent variables are real residential property price (X_1) and growth of SSECI (X_2). Thus, we can get the function as following:

$$Y = \beta_0 + \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + \epsilon.$$

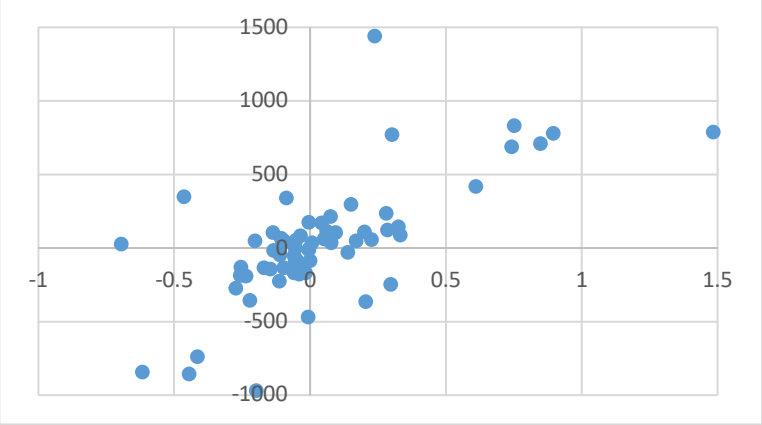
Table 4.3 shows stock return, real residual property price index in Beijing, SSECI and $\Delta SSECI$ from 2000Q4 to 2017Q1. Then we use scatter plots to provide a picture of stock return and real residual property price index in Beijing, stock return and $\Delta SSECI$ in Figure 4.1and Figure 4.2.

Figure 4.1 The relationship between Y and X_1.



From figure 4.1, we can see the relationship between stock return (Y) and price index is positive. So, we can predict the parameter $\beta_1 > 0$.

Figure 4.2 The relationship between Y and X_2.



From figure 4.2, we can see the relationship between stock return and $\Delta SSECI$ positive. So, we can predict the parameter $\beta_2 > 0$.

Using Excel we can get the coefficients of variables (see Annex3). The selected data is listing in following Table 4.4.

Table 4.4 Selected data of regression analysis.

R Square	SSR	SST	Coefficient of price	Coefficient of $\Delta SSECI$	Standard Error of price	Standard Error of $\Delta SSECI$
0.484	4.0805	8.4309	0.0012	0.0006	0.0052	7.84E-05

We can see the P-value of the constant and the three variables are lower than the significant level which is 0.05. so, the model is acceptable. According to formula (3.21), R^2 can be computed as following:

$$R^2 = \frac{SSR}{SST} = \frac{4.0805}{8.4309} = 0.4840$$

So, we can get the model:

$$stock\ return = -0.089 + 0.0012 \cdot price + 0.0006 \cdot \Delta SSECI + \epsilon$$

We can see that β_1=0.0012 >0, the real residential property price in Beijing is positive to the stock return. If real residential property price index increase by 1 unit, stock return will increase by 0.0012 unit one quarter. $\beta_2 = 0.0006 > 0$ means the $\Delta SSECI$ is positive to the stock return. When $\Delta SSECI$ increase by 1 unit, stock return will increase by 0.0006 unit.

4.3.2 T-test

T-test is used to test hypothesis about individual regression coefficients. And we do not need to test the constant β_1. Assume the normal distribution of residual component at the level of significance $\alpha \Rightarrow u_t \approx N(0, \sigma^2)$ and α=5%.

T-test for β_1

H_0: β_1=0 (β_1- coefficient is not statistically significant)

H_1: $\beta_1 \neq 0$ (β_1- coefficient is statistically significant)

where significance level α=5%, n (number of observation)=66, k (number of β_i) = 3, coefficient is 0.0012, Std.Err is 0.0052.

So, we can calculate by using Excel:

$$t_{cal} = \frac{\beta_2^{\wedge}}{\sigma_{\beta_2^{\wedge}}} = 0.0012/0.0052 = 0.2279,$$

$$t_{crit} = \text{TINV}(0.05,66-3) = 1.998.$$

When $|t_{cal}| > t_{crit}$, we should reject H_0 at the level of significance α=5%. But the result of test statistic is 0.2279, is not included in critical region. It means we can assume that β_1 is not statistically significant.

T-test for $\boldsymbol{\beta_2}$

H_0: β_2=0 (β_2- coefficient is not statistically significant)

H_1: $\beta_2 \neq 0$ (β_2- coefficient is statistically significant)

Where significance level α=5%, n (number of observation)=66, k (number of β_i) = 3, coefficient is 0.0006, Std.Err is 0.000078.

So, we can calculate by using Excel:

$$t_{cal} = \frac{\beta_3^{\wedge}}{\sigma_{\beta_3^{\wedge}}} = 0.0006/0.000078 = 7.6656$$

$$t_{crit} = \text{TINV}(0.05,66-3) = 1.998$$

When $|t_{cal}| > t_{crit}$, we should reject H_0 at the level of significance α=5%. It means we can assume that β_2 is statistically significant.

Because β_1 is not statistically significant, we ought to remove real residential property price index in Beijing. The new model is:

$$stock\ return = \beta_0 + \beta_1 \cdot \Delta SSECI + \epsilon$$

Using Excel we can get the new coefficients of variables (see in Annex4).

$$R^2 = \frac{SSR}{SST} = \frac{4.0769}{8.4309} = 0.4836$$

So, we can get the model:

$$stock\ return = -0.022 + 0.0006 \cdot \Delta SSECI + \epsilon$$

We can see that β_1=0.0006 >0, the $\Delta SSECI$ is positive to the stock return. When $\Delta SSECI$ increase by 1 unit, stock return will increase by 0.0006 unit.

4.3.3 F-test

F-test is used to test more than one coefficient at a time. We also assume normal distribution of residual component at the level of significance $\alpha \Rightarrow u_t \approx N(0, \sigma^2)$ and α=5%.

H_0: $\beta_1 = \beta_2$=0 (whole model is not statistically significant)

H_1: $\beta_1 \neq 0 \vee \beta_2 \neq$0 (whole model is statistically significant)

where at least one β_i is not 0, significance level α=5%, n (number of observation) =66, k (number of β_i) = 2, model Sum of Square =4.0769, Residual Sum of Square = 4.3539.

So, we can calculate by formula (3.23):

$$F_{cal} = \frac{\frac{ESS}{df1}}{\frac{RSS}{df2}} = \frac{\frac{ESS}{k-1}}{\frac{RSS}{n-k}} = (4.0769/1) / (4.3539/64) = 59.928$$

$$F_{crit} = \text{FINV}(0.05,1,64) = 3.9909$$

When $|F_{cal}| > F_{crit}$, we should reject H_0 at the level of significance α=5%. It means the whole model is good.

After T test and F test, the final model is $stock\ return = -0.022 + 0.0006 \cdot \Delta SSECI + \epsilon$, the coefficient of real residual property price index in Beijing is not statistically significant. Thus, we remove the variable real residual property price index. The difference of SSECI is positive to the stock return.

4.4 Summary

In this part, the performance of the real estate equity investment in China was evaluated by using several econometrics methodology.

First is the description of basic data: real residential property prices for Beijing and stock prices of fifty real estate companies which are listed in Shanghai stock exchange. They are essential for the following test.

Then is the application of hypothesis test. In order to judge if the financial crisis influenced the performance of real estate equity investment in China, so we choose the one period before financial crisis is from 2000 to 2007, another period after financial crisis is from 2008 to 2017. At the beginning, this thesis tests the real residential property prices index for Beijing in two period (2000 Q4 to 2007 Q4 and 2008 Q1 to 2017 Q2). The result showed $|t_{cal}| > t_{crit}$, we should reject H_0 at the level of significance α=5%. It means we could assume that the price index has difference before and after financial crisis. It proves that the choice of two sample is accepted. And it can be used in the following test for stock return.

For hypothesis test of stock return, it is necessary to test difference between population means for each company, and then it is test for the average stock return. The sample size of each company is the same. From the Table 4.2, we can see that the t_{cal} of all companies are not in the critical region. When $|t_{cal}| < t_{crit}$, we should fail to reject H_0 at the level of significance α=5%. It means we can assume that the monthly stock return of the selected fifty companies and average stock return has no difference before and after financial crisis. So the financial crisis didn't have much influence in Chinese real estate equity investment.

Next part was the evaluation of real estate equity investment. It used regression method to analyze and deduce the function of the quarterly average stock return and the real residential property price for Beijing from 2000 Q4 to 2017 Q2. We defined the independent variables and dependent variables and got the function by using Excel: $stock\ return = -0.089 + 0.0012 \cdot price + 0.0006 \cdot \Delta SSECI + \epsilon$ We can see that β_1=0.0012 >0, the real residential property price index in Beijing is positive to the stock return. If real residential property price index increase by 1unit, stock return will increase by 0.0012 unit one quarter. $\beta_2 = 0.0006 > 0$ means the

$\Delta SSECI$ is positive to the stock return. When $\Delta SSECI$ increase by 1 unit, stock return will increase 0.0006 unit.

At last, It tested if the coefficient is statistically significant. T-test is used for test each coefficient and F test is used for the whole model. The result shows β_1 is not statistically significant. It is necessary to remove the variable real residential property price index in Beijing. Then we got a new model: $stock\ return = -0.022 + 0.0006 \cdot \Delta SSECI + \epsilon$. We can see that β_1=0.0006 >0, the $\Delta SSECI$ is positive to the stock return. When $\Delta SSECI$ increase by 1 unit, stock return will increase by 0.0006 unit.

5 Conclusion

This thesis paid attention to real estate investment in China. After reform and opening up, the government has taken growth of GDP as an important aim. When the natural growth rate of the economy is lower than the declared target growth rate, the huge political inertia will force the government to intervene in the market, at the expense of resource mismatch to push GDP to achieve the goal. It causes the high growth speed of houses' price. It is necessary to estimate the current condition of real estate investment in China and if the property bubble will break in the future.

The aim of this thesis was to examine the changes in stock performance across fifty selected real estate companies in China over the period 2000-2017. This objective of this work was to investigate how companies in real estate performed before financial crisis (2000-2008) and after crisis (2008-2017).

This thesis is divided into five chapters. The second chapter is paid attention to the overview of real estate investment. First is the characteristics of alternative investment. In this part, alternative investments are classified as four types: real assets, hedge funds, private equity and structured products according to *Global Alternatives Survey*. And alternative investments can be used to reduce investment risk through diversification due to some characteristics of them. On the other hand, the current market value of alternative assets is difficult to forecast and it is illiquid. Real estate investment is one of alternative investments. Second part conducted the types and forms of investment. According to service object, real estate market could be classified as residential market and land market. According to seasoning of claim, real estate market could be classified as primary market and secondary market. The forms of real estate investment have rental properties, real estate investment groups, REITs and so on.

The third chapter is methodology, and mainly focuses on hypothesis test which could deal with testing the difference between means of stock return before and after financial crisis. The first part is some basic terms in hypothesis test. Then is measurements for testing under the different condition. At last is the linear regression model and multiple regression model. It is necessary to

use the correlation to test the hypothesis that there is no linear association in the population between a pair of random variables.

The fourth chapter was evaluation of the performance in the real estate equity investment in China by using econometrics methodologies. It was divided into three parts. The first part was the description of basic data: real residential property prices for Beijing and stock prices of fifty real estate companies which are listed in Shanghai stock exchange. Then was the application of hypothesis test. We chose the one period before financial crisis is from 2000 to 2007, another period after financial crisis is from 2008 to 2017. It tested the real residential property prices index for Beijing in two period. The result showed the price index has difference before and after financial crisis. For hypothesis test of stock return, the result showed that the monthly stock return of the selected fifty companies and average stock return has no difference before and after financial crisis. In addition, we found the relationship between real estate equity investment and the whole equity investment. We get the function by using Excel. The slope is not high, which means the relationship between real estate stock return and $\Delta SSECI$ is mitigative. When $\Delta SSECI$ increase by 1 unit, stock return will increase by 0.0006 unit. Even though the financial crisis brought unrest for the whole world and attacked the global financial market, the real estate stock market in China was still stable. Investors can use real estate equity investment in portfolio for hedge or diversification.

Bibliography

[1] CHAMBERS, Donald R., Mark Jonathan Paul ANSON, Keith H. BLACK and Hossein KAZEMI. *Alternative investments: CAIA level I*. Third edition. Hoboken: Wiley, 2015. ISBN 978-1-119-00336-6.

[2] ELLIOTT, Robert J. *Mathematics of financial markets*. 2nd ed. New York: Springer, 2005. ISBN 0-387-21292-2.

[3] SAUNDERS, Anthony and Marcia, M. CORNETT. *Financial markets and institutions*. 5th ed. New York: McGraw-Hill, 2012. ISBN 978-0-07-108674-5.

[4] EDWARDS, Robert Davis, John MAGEE and W. H. C. BASSETTI. *Technical analysis of stock trends*. 9th ed. Boca Raton: CRC Press ; New York, c2007. ISBN 978-0-8493-3772-7.

[5] LUCEY, Terence. *Quantitative techniques*. 3th ed. London: DP Publications, 1989. ISBN 1-870941-97-7.

[6] ELDRED, Gary W. *Investing in real estate*. 6th ed. Hoboken: Wiley, c2009. ISBN 978-0-470-49926-9.

[7] Ebrahim, M. S.,Hussain S. *Financial development and asset valuation: The special case of real estate [J]*. Journal of Banking & Finance, 2010. ISBN 978-1-32-64795-10.

[8] JAFFE, Austin J. and C. F. SIRMANS. *Fundamentals of real estate investment*. 3rd ed. Mason: South-Western/Thomson Learning, c2001. ISBN 0-324-13992-6.

[9] BRUEGGEMAN, William B. and Jeffrey. D. FISHER. *Real estate finance and investments*. 13th ed. New York: McGraw-Hill, 2008. ISBN 978-0-07-125919-4.

[10] BONNINI, Stefano. *Nonparametric hypothesis testing: rank and permutation methods with applications in R*. Chichester: Wiley, 2014. ISBN 978-1-119-95237-4.

[11] MADURA, Jeff. *Financial markets and institutions*. 8th ed. Mason: South-Western Cengage Learning, c2008. ISBN 978-0-324-56821-9.

[12] ANDERSON, D. R., D. J. Sweeney, T. A. WILLIAMS. *Statistics for Business and Economics*. 9th ed. Thomson South-Western, Mason, OH. 2005. ISBN 978-8-131-50288-4.

[13] BERENSON, M. L., D. M. Levine, T. C. KREHBIEL. *Basic Business Statistics: Concepts and Applications*. 10th ed. Prentice Hall, Upper Saddle River, NJ. 2006. ISBN 978-0-132-16838-0.

[14] LEHMANN, E.L., Romano. J.P. *Testing Statistical Hypotheses*. 3rd ed. New York: Springer, 2005b. ISBN 978-0-387-27605-2.

[15] ELLIOTT, Robert J. *Mathematics of financial markets*. 2nd ed. New York: Springer, 2005. ISBN 0-387-21292-2.

[16] SAUNDERS, Anthony and Marcia, M. CORNETT. *Financial markets and institutions*. 5th ed. New York: McGraw-Hill, 2012. ISBN 978-0-07-108674-5.

Electronic bibliography

[17] Federal Reserve Bank of ST. Louis: Real Residual Property Prices for Beijing, China [online]. [4.12.2017]. Available on: https://fred.stlouisfed.org/series/QCNR628BIS

[18] Yahoo Finance: stock price of VANKE CO, LTD. [online]. [4.12.2017]. Available on: https://finance.yahoo.com

[19] China Data Online, various years. [online]. [4.12.2017]. Available on: http://chinadataonline.org/

[20] China Statistical Yearbooks, various years. [online]. [4.12.2017]. Available on: http://www.stats.gov.cn/english/statisticaldata/yearlydata/cnbc.com

[21] Low-income Housing Key to Curb Rising Home Prices." *China Daily Website - Connecting China Connecting the World*. [online]. [4.12.2017]. Available on: http://www2.chinadaily.com.cn/business/2010-10/04/content_11376996.htm

List of Abbreviations

GDP Gross Domestic Product

REIT Real Estate Investment Trust

SSECI Shanghai Stock Exchange Composite Index

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List of Annexes

Annex1: Monthly data of stock prices of fifty real estate companies in China.
Annex2: Stock monthly return and average stock monthly return of all companies.
Annex3:Excel summary output of original regression model.
Annex4: Excel summary output of final regression model.

Annexes

Annex1: Monthly data of stock prices of fifty real estate companies in China.

Date	China VANKE	China Overseas Land	BUCID	SHANGHAI chengtou	great town	DIMA	Ocean wide holding	HBFX	gree real estate	Bright real estate	HNA infrastructure	shenzhen overseas	BJHY	HUA YUAN PROPERTY	XIEMEN c&d INC	Gemdale corporation	jinke property group	financial street holding	MTL	Citychamp dartong	sichuan languang	lushang property	LJZ	Greenland Holdings	MYHOI	NJGK	golden	beijing capital	SFHY	SUning Universal	tahoe group	HKHC	xinhu zhongbao	macrolink cultyraltain	cinda real eatate	young	yango group
2000/10/31	**0.80**	**0.64**	**4.65**	**4.22**	**6.61**	**1.42**	**1.65**	**6.34**	**3.12**	**2.61**	**6.56**	**0.69**	**2.29**	**3.06**	**0.70**	0.99	**3.54**	**0.78**	**3.72**	**2.11**	**7.39**	**9.05**	**4.93**	**7.52**	**0.41**	**3.21**	**6.49**	**3.77**	**3.60**	**2.30**	**9.56**	**2.25**	**2.57**	**14.04**	**6.08**	**0.19**	**0.29**
2000/11/30	0.85	0.70	4.58	4.50	6.74	1.34	1.72	6.44	3.01	2.40	6.84	0.72	2.29	3.15	0.69	0.72	3.18	0.78	3.65	2.02	6.94	8.97	5.19	7.25	0.42	3.11	7.44	3.70	3.50	2.40	9.34	2.21	2.47	13.63	5.85	0.19	0.29
2000/12/31	0.79	0.72	4.42	4.64	6.12	1.31	1.63	5.89	2.79	2.30	6.97	0.75	2.16	2.50	0.64	0.98	3.23	0.75	3.29	1.91	6.85	8.86	4.82	5.87	0.36	2.90	6.49	3.29	3.01	2.24	8.45	2.03	2.25	13.25	4.65	0.18	0.26
2001/1/31	0.87	0.57	4.83	4.73	6.66	1.33	1.69	6.31	2.83	2.68	6.65	0.82	2.25	2.86	0.68	1.13	3.33	0.81	3.87	1.98	7.33	9.26	4.92	6.26	0.38	2.98	6.95	3.30	3.10	2.40	9.37	2.27	2.36	13.62	5.09	0.19	0.29
2001/2/28	0.83	0.66	4.71	4.48	6.58	1.34	1.60	6.41	2.81	2.97	6.94	0.80	2.19	3.17	0.63	1.02	3.61	0.84	3.79	2.09	7.79	8.94	5.00	6.29	0.39	2.89	6.81	3.43	3.18	2.39	10.26	2.18	2.32	13.42	5.25	0.35	0.31
2001/3/31	0.81	0.90	4.95	4.44	6.92	1.45	1.62	6.46	2.81	3.20	7.01	0.79	2.32	3.40	0.64	0.97	4.46	0.97	4.13	2.36	8.32	8.88	5.10	6.54	0.47	2.83	6.81	3.59	3.21	2.49	10.62	2.57	2.55	13.07	5.27	0.41	0.33
2001/4/30	0.85	0.91	5.80	4.44	7.44	1.54	1.68	7.04	2.87	3.22	7.42	0.77	2.42	3.27	0.65	1.00	4.24	1.04	3.97	2.30	8.31	9.35	5.21	6.46	0.47	2.94	6.78	3.58	3.14	2.55	10.52	2.44	2.57	13.44	5.06	0.41	0.34
2001/5/31	0.79	0.85	5.54	3.96	6.76	1.43	1.73	5.86	2.33	2.61	7.79	0.72	2.23	2.91	0.72	0.84	3.91	0.99	3.47	2.04	6.97	8.45	5.94	5.49	0.40	2.52	6.47	3.80	2.58	2.30	9.06	1.81	2.09	12.92	4.43	0.36	0.32
2001/6/30	0.83	0.81	4.80	3.84	6.27	1.36	1.75	5.87	2.12	2.54	7.03	0.79	2.04	3.00	0.57	0.77	3.77	0.86	3.48	2.12	7.02	7.57	5.37	5.58	0.39	2.35	6.63	2.81	2.60	2.04	9.24	1.80	2.18	12.91	4.21	0.37	0.31
2001/7/31	0.97	0.47	4.59	3.86	5.51	1.25	1.43	4.93	2.20	2.59	6.76	0.77	1.99	2.37	0.57	0.78	2.70	0.84	3.29	2.22	6.72	7.71	5.32	5.50	0.44	2.34	6.39	2.39	2.41	1.75	8.42	1.73	2.14	10.97	4.08	0.37	0.29
2001/8/31	0.88	0.58	4.09	3.82	5.11	1.23	1.38	4.60	2.10	2.31	6.24	0.71	1.88	2.16	0.50	0.77	2.83	0.84	3.02	1.76	6.31	6.98	5.01	5.18	0.35	1.99	5.69	2.12	1.96	1.70	6.94	1.54	1.89	10.21	3.52	0.33	0.27
2001/9/30	0.89	0.65	4.62	4.09	5.52	1.33	1.43	4.25	2.15	2.34	6.02	0.75	1.89	2.41	0.49	0.83	2.62	0.86	3.10	1.89	6.33	7.50	4.95	5.26	0.38	2.32	5.83	2.37	2.22	1.78	7.37	1.70	1.99	9.52	4.20	0.33	0.28
2001/10/31	0.88	0.68	4.22	3.84	4.97	1.28	1.21	4.19	1.95	2.20	6.30	0.70	1.76	1.75	0.50	0.85	1.90	0.84	2.91	1.77	5.92	7.28	4.68	4.71	0.31	2.03	5.40	2.39	1.82	1.60	6.11	1.50	1.90	9.85	3.55	0.33	0.24
2001/11/30	0.82	0.66	3.94	3.75	4.16	1.19	1.02	3.16	1.65	1.84	5.92	0.70	1.40	0.92	0.50	0.72	1.98	0.82	2.71	1.62	5.33	6.60	4.03	4.20	0.25	1.78	4.62	2.10	1.66	1.25	5.05	1.17	1.48	7.15	3.56	0.31	0.20
2001/12/31	0.83	0.63	4.24	3.76	4.16	1.20	1.10	3.96	1.71	1.90	5.21	0.71	1.46	1.33	0.46	0.71	1.90	0.81	2.82	1.78	5.66	6.64	4.08	4.80	0.26	1.84	5.28	2.18	1.74	1.48	5.48	1.23	1.54	7.58	3.60	0.32	0.21
2002/1/31	0.84	0.61	4.35	3.84	4.44	1.22	1.25	4.27	1.76	2.09	5.48	0.73	1.53	1.29	0.50	0.86	2.37	0.89	3.20	1.96	5.75	7.04	4.54	5.44	0.33	1.96	5.57	2.64	2.01	1.73	6.31	1.32	1.80	9.18	3.68	0.33	0.22
2002/2/28	0.82	0.63	4.77	3.98	5.00	1.29	1.29	3.94	1.79	2.32	5.74	0.73	1.57	1.54	0.51	0.85	2.31	0.94	3.24	2.01	5.77	7.21	4.63	4.55	0.36	2.06	6.15	2.85	2.15	1.75	7.12	1.46	1.89	8.37	3.70	0.33	0.26
2002/3/31	0.75	0.63	4.04	3.97	4.81	1.21	1.11	4.08	1.68	2.12	5.97	0.68	1.38	1.54	0.46	0.77	1.94	0.86	3.18	1.92	5.24	6.31	4.22	4.29	0.30	1.83	5.39	2.32	1.98	1.57	6.32	1.52	1.66	6.51	3.55	0.30	0.24
2002/4/30	0.87	0.60	4.74	4.74	5.02	1.34	1.37	4.20	1.81	2.38	5.61	0.71	1.55	1.54	0.51	0.89	2.19	0.99	3.64	2.03	5.75	7.24	5.03	4.73	0.36	2.08	6.89	2.58	2.16	1.77	6.89	1.84	1.73	7.01	4.02	0.40	0.26
2002/5/31	0.79	0.52	4.70	4.46	4.70	1.25	1.27	4.02	1.73	2.65	6.23	0.89	1.48	1.54	0.53	0.91	2.21	0.96	3.53	2.29	5.58	7.12	5.23	4.52	0.33	1.97	6.67	2.39	1.99	1.73	6.57	1.71	1.64	7.23	3.62	0.37	0.26
2002/6/30	0.78	0.54	4.70	4.34	4.91	1.23	1.27	3.84	1.72	2.67	5.95	0.89	1.55	1.54	0.52	0.92	2.14	0.91	3.70	2.32	5.63	6.96	5.28	4.32	0.33	1.94	6.93	2.51	2.02	1.65	6.31	1.71	1.63	6.73	3.67	0.39	0.26
2002/7/31	0.75	0.53	4.56	4.11	4.46	1.18	1.24	3.55	1.60	2.51	6.02	0.88	1.41	1.66	0.51	0.91	2.10	1.07	3.85	2.17	5.26	5.98	5.25	3.85	0.31	1.83	6.49	2.33	1.91	1.60	6.02	1.50	1.53	5.60	3.40	0.38	0.24
2002/8/31	0.73	0.53	4.28	3.92	4.37	1.03	1.16	3.49	1.52	2.35	5.33	0.90	1.25	1.59	0.49	0.83	2.10	0.82	3.36	2.16	4.98	5.61	5.20	3.93	0.30	1.75	6.26	2.11	1.78	1.54	5.82	1.59	1.35	5.50	3.32	0.37	0.22
2002/9/30	0.67	0.54	3.91	3.62	3.81	0.95	1.02	2.90	1.38	2.19	4.91	0.89	1.26	1.26	0.46	0.76	2.10	0.81	3.05	2.18	4.58	5.19	4.67	3.48	0.27	1.57	5.77	1.71	1.69	1.37	5.25	1.31	1.25	4.32	2.95	0.35	0.20
2002/10/31	0.64	0.51	3.56	3.41	3.57	0.86	0.94	3.08	1.26	2.09	4.24	0.92	1.21	1.10	0.41	0.73	2.10	0.85	2.75	2.14	4.15	4.67	4.28	3.13	0.26	1.47	5.30	1.68	1.51	1.25	4.90	1.28	1.23	3.99	2.64	0.33	0.19
2002/11/30	0.66	0.52	3.92	3.76	3.89	0.92	1.05	3.31	1.41	2.20	4.73	0.97	1.28	1.43	0.44	0.78	2.10	0.93	2.98	2.25	4.68	5.23	4.54	3.86	0.28	1.61	5.91	2.00	1.74	1.38	5.50	1.41	1.38	4.72	3.07	0.34	0.21
2002/12/31	0.68	0.52	4.14	3.74	4.00	0.99	1.17	3.37	1.40	2.30	5.04	1.01	1.33	1.41	0.44	0.71	2.23	0.99	3.16	2.32	4.69	5.36	4.57	3.81	0.30	1.61	5.88	2.13	1.74	1.43	5.74	1.51	1.43	5.01	3.03	0.35	0.21
2003/1/31	0.78	0.42	3.82	3.85	3.76	0.95	1.21	3.37	1.33	2.33	4.53	1.07	1.27	1.31	0.44	0.69	2.20	1.05	3.07	2.46	4.47	4.94	4.30	3.57	0.28	1.52	5.61	2.16	1.70	1.30	5.31	1.41	1.36	4.79	2.82	0.35	0.19
2003/2/28	0.85	0.44	3.58	3.81	3.74	0.81	1.26	3.31	1.21	2.00	4.62	0.97	1.01	1.17	0.45	0.64	2.24	1.10	2.89	2.24	4.57	5.37	4.44	3.23	0.26	1.51	5.53	2.16	1.60	1.26	5.57	1.34	1.11	3.68	2.93	0.36	0.17
2003/3/31	0.94	0.55	3.97	3.95	4.41	0.83	1.21	3.67	1.31	1.93	4.86	1.15	1.03	1.17	0.44	0.64	2.38	1.13	3.04	2.15	4.95	5.69	4.79	3.33	0.26	1.66	5.87	2.20	1.82	1.15	5.71	1.37	1.15	3.97	3.33	0.37	0.17
2003/4/30	0.83	0.60	3.51	3.82	4.15	0.76	0.98	3.38	1.19	1.96	4.39	1.13	0.95	1.17	0.40	0.67	2.11	1.08	2.87	2.15	4.32	4.77	4.24	3.08	0.23	1.48	5.32	1.98	1.66	1.13	5.04	1.29	1.09	3.76	3.04	0.42	0.16
2003/5/31	0.91	0.61	3.37	3.82	3.82	0.88	0.93	3.13	1.11	2.19	4.23	1.07	0.95	1.17	0.54	0.65	2.04	1.04	2.46	2.43	3.79	4.76	4.06	2.85	0.24	1.44	4.87	1.88	1.58	1.12	4.55	1.39	1.03	3.63	3.02	0.43	0.16
2003/6/30	0.92	0.66	3.33	3.60	3.61	0.85	0.96	3.03	1.12	2.16	3.88	1.08	0.89	1.17	0.52	0.58	1.90	1.01	2.33	2.39	3.55	4.44	4.00	2.97	0.28	1.33	4.60	2.06	1.59	1.07	4.61	1.34	1.02	3.81	2.92	0.41	0.15
2003/7/31	0.84	0.81	3.62	3.44	3.33	0.86	0.83	2.62	1.01	2.27	3.61	1.08	0.89	1.22	0.51	0.55	2.04	0.96	2.21	2.45	3.42	4.50	3.80	2.98	0.26	1.31	4.55	2.02	1.57	1.01	4.62	1.24	1.12	3.54	2.45	0.38	0.15

Annex2: Stock monthly return and average stock monthly return of all companies.

Date	Average	China VANKE	China Overseas Land &	BUCID	SHANGHAI chengtou	great town	DIMA	Oceanwide holding	HBFX	gree real estate	Bright real estate	HNA infrastructure	shenzhen overseas	BJHY	HUA YUAN PROPERTY	XIEMEN c&d INC	Gemdale corporation	jinke property group	financial street holdings	MTL	Citychamp dartong	sichuan languang Develop	lushang property	LJZ	Greenland Holdings Corpora	MYHOME	NJGK	golden b	beijing capital development
2000/10/31	-0.001	0.102	0.117	-0.319	0.096	0.043	0.057	0.168	0.067	0.093	0.317	0.037	-0.034	-0.288	0.029	0.029	-0.057	-0.053	-0.257	0.034	-0.152	0.499	0.132	0.402	0.000	0.123	-0.067	0.050	-0.267
2000/11/30	0.054	0.057	-0.066	0.275	0.129	-0.072	0.073	0.094	-0.102	-0.209	0.280	0.032	0.001	0.090	-0.010	-0.274	-0.362	0.004	-0.073	-0.088	-0.442	-0.083	0.263	-0.272	0.005	-0.104	0.951	-0.071	-0.100
2000/12/31	-0.066	0.019	-0.161	0.142	-0.624	-0.039	-0.096	-0.547	-0.226	-0.101	0.132	0.031	-0.129	-0.643	-0.054	0.262	0.057	-0.036	-0.361	-0.114	-0.089	-0.104	-0.372	-1.380	-0.060	-0.208	-0.956	-0.407	-0.485
2001/1/31	0.078	-0.146	0.412	0.093	0.540	0.025	0.060	0.422	0.044	0.373	-0.313	0.062	0.087	0.357	0.037	0.145	0.100	0.059	0.587	0.074	0.479	0.395	0.099	0.388	0.024	0.088	0.466	0.009	0.088
2001/2/28	-0.031	0.089	-0.117	-0.250	-0.079	0.008	-0.086	0.098	-0.023	0.294	0.283	-0.012	-0.062	0.306	-0.045	-0.113	0.278	0.034	-0.080	0.108	0.453	-0.312	0.087	0.036	0.003	-0.095	-0.139	0.127	0.085
2001/3/31	-0.022	0.235	0.236	-0.039	0.337	0.113	0.019	0.055	-0.003	0.228	0.074	-0.016	0.133	0.231	0.007	-0.048	0.851	0.125	0.337	0.273	0.532	-0.062	0.093	0.250	0.085	-0.055	0.000	0.164	0.023
2001/4/30	0.035	0.010	0.847	0.000	0.523	0.087	0.062	0.578	0.059	0.021	0.404	-0.017	0.097	-0.132	0.007	0.033	-0.223	0.072	-0.160	-0.066	-0.011	0.465	0.112	-0.087	0.002	0.108	-0.034	-0.005	-0.069
2001/5/31	-0.056	-0.052	-0.253	-0.481	-0.681	-0.113	0.053	-1.179	-0.531	-0.611	0.375	-0.056	-0.185	-0.354	0.078	-0.160	-0.329	-0.048	-0.497	-0.258	-1.341	-0.893	0.734	-0.964	-0.079	-0.422	-0.307	0.213	-0.562
2001/6/30	0.044	-0.045	-0.742	-0.123	-0.495	-0.067	0.014	0.008	-0.216	-0.066	-0.760	0.071	-0.190	0.084	-0.156	-0.072	-0.142	-0.125	0.003	0.083	0.056	-0.885	-0.571	0.087	-0.006	-0.174	0.154	-0.988	0.022
2001/7/31	0.140	-0.337	-0.213	0.016	-0.753	-0.111	-0.320	-0.937	0.080	0.046	-0.269	-0.016	-0.059	-0.625	0.004	0.016	-1.068	-0.020	-0.188	0.102	-0.300	0.136	-0.057	-0.080	0.046	-0.007	-0.240	-0.421	-0.188
2001/8/31	-0.090	0.104	-0.496	-0.041	-0.399	-0.016	-0.052	-0.328	-0.102	-0.279	-0.523	-0.059	-0.106	-0.210	-0.075	-0.013	0.130	-0.004	-0.274	-0.467	-0.412	-0.728	-0.302	-0.324	-0.089	-0.346	-0.696	-0.269	-0.453
2001/9/30	0.006	0.070	0.529	0.273	0.405	0.101	0.057	-0.351	0.054	0.037	-0.223	0.037	0.006	0.249	-0.002	0.059	-0.208	0.016	0.087	0.133	0.019	0.521	-0.058	0.081	0.029	0.327	0.144	0.250	0.267
2001/10/31	-0.010	0.033	-0.404	-0.253	-0.547	-0.055	-0.223	-0.059	-0.199	-0.149	0.278	-0.052	-0.128	-0.661	0.003	0.024	-0.715	-0.016	-0.188	-0.124	-0.412	-0.214	-0.279	-0.545	-0.068	-0.293	-0.432	0.018	-0.406
2001/11/30	-0.064	-0.020	-0.275	-0.091	-0.815	-0.091	-0.191	-1.035	-0.301	-0.358	-0.373	-0.001	-0.356	-0.835	0.000	-0.135	0.072	-0.019	-0.205	-0.149	-0.584	-0.685	-0.643	-0.512	-0.053	-0.245	-0.778	-0.285	-0.154
2001/12/31	0.017	-0.027	0.297	0.015	0.006	0.015	0.080	0.797	0.056	0.058	-0.708	0.018	0.054	0.411	-0.032	-0.008	-0.078	-0.010	0.115	0.164	0.326	0.036	0.052	0.600	0.009	0.060	0.653	0.078	0.077
2002/1/31	0.003	-0.020	0.106	0.081	0.274	0.020	0.149	0.316	0.054	0.190	0.265	0.018	0.074	-0.042	0.035	0.145	0.474	0.076	0.375	0.178	0.090	0.407	0.455	0.644	0.063	0.113	0.293	0.454	0.270
2002/2/28	-0.017	0.013	0.422	0.142	0.564	0.064	0.043	-0.328	0.034	0.236	0.263	0.002	0.038	0.258	0.005	-0.004	-0.057	0.051	0.045	0.055	0.022	0.171	0.088	-0.898	0.032	0.106	0.576	0.214	0.144
2002/3/31	-0.074	0.000	-0.734	-0.015	-0.188	-0.073	-0.177	0.137	-0.115	-0.199	0.225	-0.057	-0.193	0.000	-0.045	-0.085	-0.371	-0.073	-0.063	-0.093	-0.528	-0.906	-0.406	-0.254	-0.059	-0.232	-0.759	-0.529	-0.173
2002/4/30	0.126	-0.027	0.701	0.775	0.205	0.130	0.252	0.115	0.134	0.257	-0.357	0.037	0.172	0.000	0.052	0.120	0.244	0.124	0.455	0.111	0.502	0.935	0.812	0.438	0.062	0.254	1.500	0.255	0.181
2002/5/31	-0.077	-0.082	-0.040	-0.289	-0.314	-0.096	-0.099	-0.172	-0.084	0.269	0.619	0.179	-0.063	0.000	0.021	0.025	0.024	-0.028	-0.111	0.259	-0.170	-0.121	0.201	-0.206	-0.034	-0.117	-0.217	-0.181	-0.173
2002/6/30	-0.012	0.020	0.000	-0.116	0.203	-0.019	0.004	-0.184	-0.013	0.019	-0.279	0.001	0.063	0.000	-0.011	0.003	-0.069	-0.050	0.177	0.030	0.053	-0.164	0.042	-0.208	-0.003	-0.026	0.254	0.112	0.030
2002/7/31	-0.029	-0.007	-0.140	-0.226	-0.449	-0.047	-0.034	-0.284	-0.112	-0.155	0.070	-0.019	-0.135	0.117	-0.014	-0.007	-0.039	0.162	0.146	-0.151	-0.370	-0.977	-0.026	-0.461	-0.011	-0.115	-0.433	-0.181	-0.111
2002/8/31	-0.029	0.000	-0.281	-0.194	-0.092	-0.149	-0.082	-0.068	-0.088	-0.163	-0.693	0.020	-0.159	-0.069	-0.019	-0.079	0.000	-0.247	-0.486	-0.008	-0.282	-0.371	-0.049	0.077	-0.019	-0.077	-0.232	-0.219	-0.124
2002/9/30	-0.057	0.008	-0.371	-0.296	-0.559	-0.079	-0.138	-0.588	-0.139	-0.155	-0.419	-0.001	0.004	-0.336	-0.029	-0.070	0.000	-0.010	-0.316	0.013	-0.397	-0.421	-0.536	-0.447	-0.029	-0.177	-0.486	-0.393	-0.097
2002/10/31	-0.032	-0.028	-0.349	-0.209	-0.236	-0.095	-0.079	0.180	-0.116	-0.103	-0.671	0.023	-0.049	-0.159	-0.048	-0.028	0.000	0.036	-0.292	-0.035	-0.427	-0.521	-0.383	-0.358	-0.005	-0.106	-0.470	-0.030	-0.176
2002/11/30	0.028	0.014	0.360	0.342	0.322	0.060	0.110	0.232	0.150	0.105	0.491	0.050	0.075	0.336	0.025	0.045	0.000	0.079	0.226	0.111	0.526	0.564	0.260	0.737	0.019	0.143	0.602	0.314	0.233
2002/12/31	0.017	-0.007	0.229	-0.015	0.104	0.072	0.123	0.056	-0.015	0.103	0.311	0.043	0.044	-0.027	0.002	-0.070	0.130	0.063	0.181	0.066	0.015	0.128	0.029	-0.055	0.021	0.004	-0.021	0.134	-0.002
2003/1/31	0.098	-0.098	-0.326	0.112	-0.236	-0.043	0.042	0.000	-0.064	0.030	-0.513	0.063	-0.057	-0.099	0.004	-0.022	-0.033	0.055	-0.094	0.144	-0.225	-0.414	-0.266	-0.243	-0.020	-0.091	-0.275	0.032	-0.042
2003/2/28	0.068	0.021	-0.240	-0.046	-0.023	-0.138	0.047	-0.056	-0.125	-0.331	0.095	-0.105	-0.263	-0.132	0.012	-0.050	0.039	0.053	-0.181	-0.217	0.103	0.421	0.140	-0.332	-0.018	-0.011	-0.079	-0.008	-0.094
2003/3/31	0.094	0.112	0.394	0.148	0.668	0.021	-0.051	0.360	0.100	-0.069	0.243	0.181	0.026	0.000	-0.017	0.002	0.136	0.034	0.156	-0.097	0.374	0.328	0.344	0.094	-0.005	0.146	0.338	0.048	0.210
2003/4/30	-0.108	0.044	-0.465	-0.133	-0.253	-0.071	-0.225	-0.288	-0.118	0.034	-0.473	-0.016	-0.085	0.000	-0.037	0.036	-0.263	-0.059	-0.177	0.000	-0.629	-0.920	-0.549	-0.251	-0.027	-0.172	-0.549	-0.222	-0.151
2003/5/31	0.079	0.014	-0.135	0.000	-0.334	0.117	-0.058	-0.252	-0.082	0.226	-0.161	-0.058	-0.003	0.000	0.139	-0.025	-0.072	-0.033	-0.403	0.278	-0.529	-0.013	-0.175	-0.221	0.008	-0.048	-0.454	-0.097	-0.079
2003/6/30	0.013	0.050	-0.045	-0.225	-0.207	-0.022	0.037	-0.100	0.015	-0.030	-0.350	0.001	-0.051	0.000	-0.014	-0.072	-0.136	-0.034	-0.132	-0.040	-0.237	-0.317	-0.064	0.115	0.040	-0.112	-0.269	0.175	0.002
2003/7/31	-0.086	0.149	0.295	-0.160	-0.282	0.010	-0.135	-0.412	-0.118	0.107	-0.264	0.005	-0.001	0.048	-0.010	-0.030	0.139	-0.049	-0.125	0.068	-0.132	0.054	-0.203	0.009	-0.025	-0.013	-0.042	-0.039	-0.022

Annex3:Excel summary output of original regression model.

Regression Statistics								
Multiple R	0.69569745							
R Square	0.48399495							
Adjusted R S	0.46761383							
Standard Err	0.26278109							
Observations	66							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	2	4.08052126	2.04026063	29.5459137	8.8838E-10			
Residual	63	4.35039583	0.0690539					
Total	65	8.4309171						
	Coefficients	*tandard Erro*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.0892418	0.48832675	-0.1827502	0.85558086	-1.065085	0.88660134	-1.065085	0.88660134
X Variable 1	0.00118996	0.00522029	0.22794989	0.82042341	-0.0092419	0.01162187	-0.0092419	0.01162187
X Variable 2	0.0006014	7.8455E-05	7.66562405	1.3724E-10	0.00044462	0.00075818	0.00044462	0.00075818

Annex4: Excel summary output of final regression model.

Regression Statistics								
Multiple R	0.69539151							
R Square	0.48356936							
Adjusted R S	0.47550013							
Standard Err	0.26082753							
Observations	66							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	4.076933144	4.07693314	59.9275799	9.2159E-11			
Residual	64	4.353983954	0.068031					
Total	65	8.430917097						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.02182734	0.032132987	0.67928133	0.49940901	-0.0423657	0.08602036	-0.0423657	0.08602036
X Variable 1	0.00060221	7.7792E-05	7.74129058	9.2159E-11	0.0004468	0.00075762	0.0004468	0.00075762