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Zhodnocení vlivu finanční krize na akciové trhy

Evaluation of the Impact of Financial Crisis on Stock Market

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Bibliography
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List of Annexes
Annexes

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The Declaration

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

Ostrava dated 21. 04. 2018

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Content

1 Introduction

In 2007, the US financial crisis which triggered by the subprime mortgage crisis, eventually influenced the global financial market. This global financial crisis influenced all over the world, not only in the US; but also in European and Asia. The US economy was heavily hit by the financial crisis, which leaded to a recession as a consequence. The global financial market shrank at the same time.

Thus, the aim of this thesis is to evaluate the impact of the 2007-08 financial crisis on the stock market. Due to the fact that this global financial crisis started in the US, our attention will be focused on the US stock market. One of the most common used stock index S&P 500's closing price will be chosen as our target, and it is the dependent variable in our models. Five factors will be evaluated how the financial crisis affected the stock market, including unemployment rate, inflation rate, interest rate, volume that traded in the stock market, and money supply. And those five factors are the independent variables in our models. These above data are all chosen from 2000 to 2016. And we divided the data into three periods, before, during and after crisis, in order to see how financial crisis influenced the stock market.

This thesis consists of five main chapters. The first chapter is the introduction of the thesis, noting the reason why this topic is chosen and the aim of the thesis.

The second chapter is the overview of the stock market behavior and characteristics. The basic information of stock market including the definition, role and functions, regulations will be introduced as the first part. The main stock exchanges in the US, London, Japan and China will be briefly described as the second part. The third subchapter is about the factors that would influence the stock market, and some of the mentioned factors will be analyzed in the fourth chapter. The fourth subchapter will give us a clearer picture of how bull and bear stock market work. The financial crisis will be introduced in the fifth subchapter, including some historical financial crisis and the global financial crisis.

The third chapter is the theoretical part, noting the method we will analyze and

evaluate the impact of the financial crisis on the stock market. In this thesis, we will choose to set up econometrics models to evaluate. The econometrics method will be briefly introduced and divided into four parts, which are the estimation of models, statistical verification, econometrics verification and economic verification.

The forth chapter is the most essential part which is using the real data to set up three econometrics models to evaluate the impact of financial crisis on the stock market. The first part is to introduce all variables in the econometrics models, and how we choose the time periods. The second part is to create estimated models and test those estimated models whether they are significant or not using T-test and F-test. After the adjustment, we will deduct three adjusted models if they have autocorrelation, heteroscedasticity or multicollinearity, according to the assumption of linear regression. The last but one part includes the model specification and normality of residuals. The last part is the summary of all above analysis.

The last chapter is the conclusion of the thesis. The final calculation verdicts will be presented and interpreted.

2 Overview of Stock Market Behavior

In this thesis, we focus on the stock market behavior, before we introduce the US stock market and the financial crisis, we will introduce the stock market overall, including the definition, major participants, role and function, and regulations. In addition, the factors of stock market will be introduced in detail. The bull and bear stock market will be emphasized. In the last part, the financial crisis will be described, including the historical financial crisis in different regions and the global financial crisis.

2.1Introduction of Stock Market

In this part, we will briefly introduce the stock market. First, the definition of stock market will be introduced, and we divide the market participants as six major parties. Then the role and function of stock market will be introduced as an individual part. In the end of this part, the regulation of stock market will be described as well.

2.1.1 Market Participants

The stock market refers to the collection of markets and exchanges where the issuing and trading of equities (stocks of publicly held companies), bonds and other sorts of securities takes place, either through formal exchanges or over-the-counter (OTC) markets.

It also known as the equity market, the stock market is one of the most vital components of a free-market economy, as it provides companies with access to capital in exchange for giving investors a slice of ownership. The secondary markets for corporate stocks are the most closely watched and reported of all financial security markets. This is because stock markets movements are seen as predictors of economic activity (Fabozzi et al., 2014).

There are many participants in the stock market, in this thesis, only the major participants of the stock market will be introduced, which is consist of stock investor,

stock trader, market maker, floor trader, floor broker and broker-dealer.

First one is the stock investor, which refers to an individual or a party that commits money to investment products with the expectation of financial return, Generally, the primary concern of an investor is to minimize the risk while maximizing the return, as opposed to a speculator, who is willing to accept a higher level of risk in the hopes of collecting higher-than-average profits. Stock investors are usually firms or individuals who purchase stocks with the intention of holding them for an extended period of time, usually several months to years. They rely primarily on fundamental analysis for their investment decisions and fully recognize stock shares as part-ownership in the company. Many investors believe in the buy and hold strategy, which as the name suggests, implies that the investors will hold stocks for the very long term, generally measured in years (Fabozzi et al., 2014).

Second participants are the stock traders, which are the people who usually try to make profit from the short-term price volatility with trades lasting anywhere from several seconds to several weeks. The main difference between the stock investor and stock trader is the time period, the first kind is seeking for the long-term profit, while the latter one is seeking the short-term profit (Fabozzi et al., 2014).

The third one is market maker, which means a broker-dealer firm that accepts the risk of holding a certain number of shares of a particular security in order to facilitate trading in that security. Each market maker competes for customer order flow by displaying buy and sell quotations for a guaranteed number of shares. Once an order is received, the market maker immediately sells from its own inventory or seeks an offsetting order. This process takes place in mere seconds. Most stock exchanges operate on a “matched bargain” or “order driven” basis. In such a system there are no designated or official market makers, but market makers nevertheless exist. When a buyer’s bid meets a seller’s offer or vice versa, the stock exchange’s matching system will decide that a deal has been executed (Fabozzi et al., 2014).

The fourth is floor trader, which is a member of a stock or commodities exchange who trades on the floor of that exchange for his or her own account. The floor trader

must abide by trading rules similar to those of the exchange specialists who trade on behalf of others. These are the guys in the pit waving their arms frantically to make trades. However, these men and women who still operate in an "open outcry" system are increasingly being replaced by automated trading systems and computers that function without human interaction and are specifically designed to match buyers and sellers (Fabozzi et al., 2014).

The last but one is the floor broker, which refers to an employee of a member firm who executes trades on the exchange floor on behalf of the firm's clients. Basically, floor brokers receive orders from their firms, which have been placed by the firms' clients, and executes these orders at the best possible prices. Floor brokers should not be confused with floor traders who execute orders for their own accounts.

The last major participant of the stock market is the broker-dealer, which means a company or other organization that trades securities for its own account or on behalf of its customers. When executing trade orders on behalf of a customer, the institution is said to be acting as a 'broker'. When executing trades for its own account, the institution is said to be acting as a "dealer." Securities bought from clients or other firms in the capacity of dealer may be sold to clients or other firms acting again in the capacity of dealer, or they may become a part of the firm's holdings. Although many broker-dealers are "independent" firms solely involved in broker-dealer services, many others are business units or subsidiaries of commercial banks, investment banks or investment companies (Fabozzi et al., 2014).

2.1.2 Role and Function of Stock Market

The first function of the stock market is raising funds. The corporations pool the unused funds and capitals in the stock market, by issuing stocks in the stock markets. And those funds and capitals can be used for a very long period of time to support production or large-scale operations of corporations. The scale and speed of financing that can be achieved in the stock market cannot be matched by companies relying on their own accumulation and bank loans.

Another function is optimizing resources. The optimized resource allocation function of the stock market is achieved through the financing of the primary market and the flow of stocks in the secondary market. Investors choose to invest in stocks with good growth potential and high profit potential by discontinuing all kinds of timely disclosure information, and discard performance. The stocks with poor returns have gradually allowed funds to flow to companies with good returns and good prospects for long term development, and promote their share prices to gradually increase, providing the company with a great operating environment for capital expansion using the stock market. Poor performance corporate stock price will decline, and it is difficult to continue to raise funds, resulting in gradual decline, demise or merger acquisition, which is good for the whole market (Haan et al., 2015).

Spreading the risk is also a basic function of the stock market. While the stock market provides investors and financiers with investment and financing channels, it also provides a way for the company to spread risks. From the perspective of fund demanders, funds were raised through the issuance of stocks, and at the same time, their operating risks were partially transferred and dispersed to investors, thus realizing the socialization of risks.

From an investor's point of view, risk can be transferred and distributed through the purchase and sale of stocks and the establishment of investment portfolios based on the degree of personal risk preference. Investors can buy stocks for investment when they have excess funds and convert consumer funds into production funds. When shortages of funds are made, they can sell the stocks and turn them into cash to meet the demand for immediate payments. The high liquidity of the stock market enables people to invest surplus funds in the stock market with confidence, thereby transforming idle funds into production funds. This not only allows society to make maximum use of scattered idle funds, but also promotes the preservation and appreciation of personal wealth (Haan et al., 2015).

2.1.3 Regulation

Since the financial system stability refers to a state in which the financial system functions properly and participants, such as firms and individuals, have confidence to a system.

Due to the fact that this thesis is focus on the US stock market, we will introduce briefly how it regulated as follow. It started at 1933, which refers to the Securities Act, and this regulation required disclosure of information for newly issued publicly traded securities. Securities Exchange Act of 1934, created the Securities and Exchange Commission (SEC) to administer provisions of 1933 Act which is mentioned before. And it also required that the publicly traded security must file registration statement and preliminary prospectus disclosing information about issue. In addition, it included periodic disclosure of relevant financial information for firms trading in secondary market. At the same time, it prohibited insiders from trading on private information not previously disclosed to public. The corporate officers and the major stockholders must report all their transactions of their own firm's stock (Grant and Wilson, 2012).

The Glass-Steagall Act in 1933, prohibited the combination of banking, insurance, and securities activities within a single financial institution. But after six years, there existed Gramm-Leach-Bliley Act of 1999, which was strongly agreed by the Clinton. This new Act of 1999 repealed the previous one, Glass-Steagall Act, because many people believed the Act would increase competition within the financial services industry (Grant and Wilson, 2012).

When it comes to the regulation of the stock market, the Dodd-Frank Wall Street Reform and Consumer Protection Act must be mentioned. This act was signed into US federal law by the president Obama on July 21, 2010. This was a huge move of the regulation of the stock market, since it brought the most significant changes to the financial regulation in the US.

The Dodd-Frank Reform focus on expanding the power of regulatory organizations. It allows the separation of troubled so-called "too big to fail" financial institutions and prohibits the use of taxpayer funds to rescue the market, and it may

limit the compensation of financial executives. Second, it established a new consumer financial protection bureau, giving it beyond the power of regulatory agencies, and fully protects the legitimate rights and interests of consumers. Third, the adoption of the so-called "Volcker Rule", which restricts speculative trading of large financial institutions, and in particular strengthens the supervision of financial derivatives to prevent financial risks (Grant and Wilson, 2012).

In addition, it was also considered to be a response to the financial crisis. Because the financial crisis will be introduced in the chapter 2.5 as an individual chapter, we choose to discuss more detail in the chapter 2.5.

2.2 Main Stock Exchanges in the World

There are three main financial centers in the global, which are US, Europe and Asia. In the above financial centers, we can list following cities which are famous for their financial function: New York, Chicago, Toronto, London, Zurych, Geneva, Amsterdam, Luxemburg, Brusel, Paris, Frankurt.

Since this thesis is focused on the US stock market, we will introduce the US stock exchange in detail in chapter 2.2.2. The rest well-known stock exchanges in European and Asia will be introduced together as an individual subchapter.

2.2.1 European and Asia Stock Exchanges

The first group we will introduce is the European stock exchanges. The most famous one is London stock exchange which can be traced to 17th century, and that is main reason why it is one of the oldest stock exchanges in the world. London Stock Exchange Group was created in October 2007 when London Stock Exchange merged with Milan Stock Exchange, Borsa Italiana. In March 2016, the company announced it had reached an agreement with Deutsche Börse to merger, which means the London Stock Exchange Group and Deutsche Börse have finalized a merger agreement after more than a decade of deal talk. And it became the world's most international market place (Saunders and Cornett, 2012).

And the well-known index of London Stock Exchange is FTSE indexes, which are similar to the S&P's indexes in the US. The FTSE 100, is a typical index of blue-chip stocks on the London Stock Exchange.

The second group we will introduce is the Asia stock exchanges. The Tokyo Stock Exchange in Japan was created in 1878, and 75% of market trading is situated in it. There are two major indexes in Tokyo Stock Exchange, Nikkei 225 and Topix. The first one is a price-weighted index, the latter one is a market value-weighted index.

Another typical example is Asia stock exchanges is the Shanghai Stock Exchange (SSE), which was founded on November 1990. The SSE index series consists of 75 indexes, including 69 equity indexes, 5 bond indexes and 1 fund index, and it covers several series such as market size, sector, style, strategy and thematic series (Baike, 2016).

2.2.2 US Stock Exchange and Indexes

As we mention above in the chapter 2.2.2, since this thesis is mainly focus on the US stock market, we will introduce the US stock exchange here individually. The well-known US stock exchange is New York Stock Exchange (NYSE), which can be traced its origins to 1792, when twenty-four New York stockbrokers and merchants signed the Buttonwood Agreement.

In the beginning there were just five securities that traded in the New York city with the first listed company on the NYSE being the Bank of New York.

The big movement of NYSE was the creation of the NYSE Euronext, which refers to the holding company created by the combination of NYSE Group and Euronext, was launched on April 4, 2007. It has operated the world's largest and most liquid exchange group and offers the most diverse array of financial products and services. Moreover, the historic combination of NYSE Group and Euronext in 2007 marked a milestone for the global financial markets. And it brought together the major marketplaces across Europe and the US whose histories stretch back more than four centuries. Another similar combination which is needed to mention is, the Deutsche Börse and the NYSE

Group and Euronext, it failed in 2001 since it was prohibited by the regulation authorities (Saunders and Cornett, 2012).

Since the stock market is a part of financial markets, an index is an imaginary portfolio of securities which represent a particular market or a portion of it. In general, each index has its own calculation methodology and is usually expressed in terms of a change from a base value. Hence, the percentage change is more important than the actual number.

There are several most well-known US stock indexes, including Dow Jones Industrial Average (DJIA), S&P 500, NYSE Composite, NASDAQ and so on. The DJIA is a price-weighted average of 30 important stocks which traded on the NYSE and Nasdaq. The DJIA was invented by Charles Dow back in 1896. It is the oldest and single most watched index in the world. The DJIA includes companies like General Electric (GE), Disney and Microsoft.

Another well-known US stock index is S&P 500, which refers to the index of 500 stocks chosen for market size, liquidity and industry grouping among other factors. It is designed to be a leading indicator of US equities and is meant to reflect the risk and return characteristics of the large cap universe. The S&P 500 is a market value-weighted index, in other words, each stock's weight is proportionate to its market value. And the companies included in the index are selected by the S&P Index Committee, a team of analysts and economists at Standard & Poor's. Due to the fact that S&P 500 is consist of 500 companies while the DJIA only includes 30 companies, for most people, they agree that the S&P 500 is a better representation of the US market (Saunders and Cornett, 2012).

The third US stock index we mentioned above is NYSE Composite, which is designed to measure the performance of all common stocks listed on the NYSE. The calculation method of NYSE Composite is weighted using free-float market capitalization and calculated on both price and total return. This stock index represents 66% of the global stock market capitalization.

The last US stock index we mentioned is NASDAQ, which is short for the National

Association of Securities Dealers Automated Quotations system, was owned and operated by National Association of Securities Dealers. It was created in 1971, since the Nasdaq was the world's first electronic stock market, thanks to the advanced technology. And it was the largest OTC market in the market. It is famous for it is basically home to many high-tech stocks, for instance, Microsoft, Apple, Google, Yahoo!, Intel, Oracle Corporation, Facebook, etc. (Saunders and Cornett, 2012).

2.3 Factors of Stock Market Behavior

In this part, we will introduce the factors of stock market behavior. We divide this chapter into three parts, including the macroeconomics factors, industry factors and the business factor. The above three factors will affect the stock market and stock price, that is main reason why we need to understand what kind of relationship between them and stock market.

2.3.1 Macroeconomics Factors

Macroeconomics factors means the factors in the macroeconomy which will also influence the stock market. When it comes to the macroeconomic factors, we usually refer to the factors that can influence current economic environment and its effect on the industry and company.

In general, macroeconomic factors include gross domestic product (GDP), interest rate, inflation rate, taxes, price level, unemployment rate as the tools to predict the direction of the whole economy within a country.

We take several macroeconomic factors as our example, to show how they affect the stock market as follow.

(1) GDP

GDP, also known as gross domestic product, measures the economy's total output of goods and services. Precisely, the definition of GDP is the total amount of value of all final good and services in a year within a country. Nominal GDP estimates are commonly used to determine the economic performance of whole country or region,

and to make international comparisons. However, the nominal GDP does not reflect differences in the cost of living and the inflation rates of the countries. GDP usually includes all private and public consumption, government outlays, investments, private inventories, paid-in construction costs and the foreign balance of trade, including exports and imports. In other words, GDP is a measurement of a nation's overall economic activity.

GDP is commonly used as an indicator of the economic health of a country. An important statistic that indicates whether an economy is expanding or contracting, GDP can be tracked over long spans of time and used in measuring nation's economic growth or decline, as well as in determining whether an economy is in recession.

Referring to the economic cycles, there are four stages, including expansion, peak, recession and through. After the through, the expansionary phase can start again. The peak means the highest point between the end of an economic expansion and the start of contraction in the business cycle. Generally, it is at this point that real GDP spending in economy is its highest level. The recession is a significant decline in activity across the economy, usually lasting longer than a few months. It generally lasts from six to eighteen months. After the recession, there is a recovery and expansion phase, which indicates the economy moves from a trough to a peak. It usually lasts about three to four years (Saunders and Cornett, 2012).

The relationship between GDP and economic cycles is clear. When the GDP is increasing, which usually indicates there is a growth of economic in this country. On the contrary, when the GDP is declining, which usually indicates there is a recession.

The relationship between GDP and stock prices is different in long term period of time and medium-term period of time. Since the whole economy connects every single part of economy, those growth or recession will clearly influence the stock market. On the basis of research of global economies is possible to say that during long term period (30 years) prices of stocks copy the economic cycles. For instance, when there is a recession, the stock price will decline as well. During medium-term period of time was proved that development of stock prices anticipates several months development of

economic cycle. Most economists believe that stock price trends precede business cycle stages (Saunders and Cornett, 2012).

(2) Interest rate

Interest rate is the amount charged, expressed as a percentage pf principal, by a lender to a borrower for the use of assets. It is typically noted on an annual basis, known as the annual percentage rate.

In general, increase of interest rates will cause decrease of stock prices, hence, the relationship between interest rate and stock price is inverse. Due to the fact that increase of interest rates leads to increase of required interest rates for calculation of net present value, which will decrease of net present value for stockholder, thus, the stock prices will fall as a result. In other words, the increase of bond trading leads to decrease of stock price, since the investors will shift their money from stock markets to the bond markets, then there exists the fall of stock prices (Saunders and Cornett, 2012).

(3) Inflation

Inflation is the rate at which the general level of prices for goods and services is rising and, consequently, the purchasing power of currency is falling. Central banks attempt to limit inflation, and avoid deflation, in order to keep the economy running smoothly.

It measures the general level of prices or the rate at which prices rise. Inflation is primarily measured in two ways, through the consumer price index (CPI) and the GDP deflator. The CPI gives the current price of a selected basket of goods and services that is updated periodically. The GDP deflator is the ratio of nominal GDP to real GDP, and if nominal GDP is higher than real GDP, we can assume that the prices of goods and services have been rising.

The relationship between inflation and stock price can be described as follow. According to the study, the increase of inflation, generally, will lead to the value of stock prices fall but minimally in the reality. But there is also exception, during strong and unexpectable inflation can lose stock prices more because of the instability of the market (Saunders and Cornett, 2012).

(4) Monetary policy

Monetary policy consists of the actions of a central bank, currency board or other regulatory committee that determine the size and rate of growth of the money supply, which in turn affects interest rates. Monetary policy is maintained through actions such as modifying the interest rate, buying or selling government bonds, and changing the amount of money banks are required to keep in the vault (bank reserves).

Since we have already mentioned the relationship between interest rate and stock prices is inverse, and monetary policy will directly influence the interest rate. One of typical tools of monetary policy is open-market-operations (OMO), which indicates the central bank will purchase government bonds to achieve monetary expansion. These securities allow the central bank to inject the economy with an immediate supply of cash. In turn, interest rates, the cost to borrow money, will be reduced because the demand for the bonds will increase their price and push the interest rate down. The verdict is increase of stock prices when there is an expansionary monetary policy. On the contrary, when there is a contracting monetary policy, the stock price will fall.

(5) Fiscal policy

Fiscal policy refers to the use of government spending and tax policies to influence macroeconomic conditions, including aggregate demand, employment, inflation and economic growth.

The common used way is the tax. When the government decreases taxes or increases the spending to achieve a fiscal expansion, the result will be growth in real output because the government will stir demand with increased spending, in the meantime, a consumer with more disposable income due to the less tax liability will purchase more goods and services. The final verdict is increase of stock prices, when there is expansion fiscal policy. On the other hand, when there is contraction fiscal policy, the stock price will fall (Saunders and Cornett, 2012).

(6) Unemployment

The unemployment rate is the share of the labor force that is jobless, expressed as a percentage. Sometimes, when the economy is in poor shape and jobs are scarce, the

unemployment rate can be expected to rise. When the economy is growing at a healthy rate and jobs are relatively plentiful, it can be expected to fall. As such, stocks generally rise or fall with good or bad employment reports, as investors digest the potential changes in these areas (Saunders and Cornett, 2012).

To conclude, the macroeconomics factors can explain the behavior of the economy as a whole, which gives us the basic rule of how stock market will be influenced by the whole macroeconomy.

2.3.2 Industry Factors

Industry factors, also known as sector factors, which refer to the factors in particular industries that can influence the stock market. Industry factors usually involves the interaction of the economic cycles and industry development, including how the industry operates. For instance, the oil or gas sector is an example of an economic sector or industry. Usually individual companies are generally classified into sectors based on their largest sources of revenue.

The term sector is used to refer to a group of related industries. Take the health care sector as an example, the pharmaceutical, bio-technology, medical device, medical supply, hospital are all connected with the health care.

In different analysis, economists use different breakdowns of sectors, but there is also a typical sector list, which can be divided into following: consumer staples, consumer services, energy, financials, health care, industrials, technology, transportation and utilities (Saunders and Cornett, 2012).

Clearly, in this thesis, the stock market that we focused on belong to the financial sector. Since knowing the company's environment and identifying active equity investment opportunities are both essential to the company, industry factors are important to our target. Knowing more about how the whole industry or sector works will give investors a deeper and better understanding of a company's financial health.

There are four typical industries, including cyclical industry, neutral industry, defensive industry and growth industry. The first one, cyclical industry, refers to the

industry copying or imitating of economic cycles. If the target company belongs to cyclical industry, then its stock price will fall when there is recession in the economic cycles. The neutral industry means the impact of economic cycles is really small. For example, the production of essential goods, purchase is not unlikely to leave for later. The defensive industry, as its name shows, is the industry having the negative relationship with the economic cycles. Unlike the cyclical industry, the stock price may increase during the recessions (Saunders and Cornett, 2012).

Typical examples for these four industries as follow. The car, building, electrotechnical, steel industries are from cyclical industry. The food, public transport, medical, pharmaceutical, necessities industries are the neutral industries. As for defensive industry, lottery, entertainment, TV, repairmen, pawn can be the examples.

In our thesis, we cannot say the stock market is any kind of industry which mentioned above, since it should depend on which company we are targeting with.

2.3.3 Business Factors

Business factors, can be also called as company factors, which help the investor to evaluates the company's strengths and weaknesses. Business factors is focused on the company's financial health condition. Usually we need to see the important data of the financial statement of company. Then the determination of the intrinsic value is depended by the special financial model, such as the dividend discount model, cash-flow model and so on. Since the investor can make a comparison of this intrinsic value with the stock's current price, the investor will decide whether buy the stock, sell it or hold it.

We can divide the business factors into mainly two parts, quantitative and qualitative. The quantitative part is linked to the financial analysis, hence, the factors should be the typical ratios in the financial statement, such as profitability ratios, leverage ratios, turnover ratios and liquidity ratios. The profitability ratios measure the profitability of a company, the leverage ratio measure the degree of protection of suppliers of long-term funds and can also aid in judging a firm's ability to raise

additional debt and its capacity to pay its liabilities on time. Turnover ratios refer to the ratios showing the efficiency of company, and liquidity ratios measure a firm's ability to meet its current or short-term liabilities (Saunders and Cornett, 2012).

Moreover, we can use the SWOT analysis to help investor see through its strengths, weaknesses, opportunities and threats, this can also be the recommendation for our investors.

However, the aim of this thesis is to evaluate the impact of financial crisis on the stock market, instead of any specified company, hence, we will not explain the business or company factors in detail.

2.4 Bull and Bear Market

When referring to the stock market, bull and bear market will be described in this part. These two term represents two typical forms of stock markets. In this part, we will divide into three subchapters, first the bull market and bear market will be described, then the chart instruments for stock market will be introduced in order.

2.4.1 Bull Market

Before we introduce the detail of bull market, we will first introduce how and why it was founded in the history. Since Charles Dow is considered to be the founder of DJIA, and wrote editorials about the stock price movements. He pointed that the price movements are believed to follow trends. This suggests that after a trend has been established, the future price movement is more likely to be in the same direction as the trend than to be against it.

The Dow theory notes that there are three concomitant trends in the stock market: the primary trend, the secondary trend and the minor trend. The primary trend is the overall direction of the market and is the longest lasting trend. It usually lasts for years, also it moves up and down with the economic cycles. That is why it is considered to be the most predictable trend. The secondary trend, which is a price movement in the opposite direction of the primary trend. It usually lasts for shorter period. The minor

trend is referring to the daily or weekly fluctuation that movement from the imbalance of supply and demand over very short periods of time (Kirkpatrick, 2016).

The bull market is a financial market of a group of securities in which prices are rising or are expected to rise. The term “bull market” is most often used to refer to the stock market but it can also be applied to anything that is traded, such as bonds, currencies and commodities. Bull markets are characterized by optimism, investor confidence and expectations that strong results should continue, usually for months or years. Economists pointed that, in general, a bull market happens when the stock prices rise by 20%, usually after a drop of 20% and before a 20% decline. Since they are hard to predict, bull markets can typically only be recognized once they have happened.

The relationship between bull market and the whole economy can be predict according to the economists. Bull market generally take place when the economy is already strong, for instance, it happens in line with strong GDP and a drop of unemployment and will often coincide with a rise in corporate profits (Kirkpatrick, 2016).

In this period, investor’s confidence will also be on the rise. The overall demand for stocks will be positive, along with the overall tone of the market. Moreover, there will be a general increase in the amount of IPO activity during bull markets.

In bull market, supply will be weak while demand will be strong. This leads to the verdict that the demand is more than supply; hence, the stock price will increase in the end. When the volume is increasing on higher prices and declining on declining prices, this is a confirmation of the uptrend which is bull market.

2.4.2 Bear Market

On the other hand, the bear market is opposite of bull market. This term is characterized by falling prices and typically shrouded in pessimism. The reason why we used “bull” and “bear” is because the way the animals attack their opponents, the bull horns up into the air while the bear paws down to the ground.

The relationship between bear market and the whole economy can also be predict

according to the economists. Since the causes of the bear market often vary, however, in general, a weak or slowing or sluggish economy will bring with it a bear market. The signs of a weak or slowing economy are typically low employment, low disposable income and a drop of business profits. Moreover, any intervention by the government in the economy can also trigger a bear market. Another reason that can cause the bear market is investors are lacking confidence of stock market (Kirkpatrick, 2016).

In this period, the selling stocks increases in the market. It is generally accepted that a bear market is characterized by a drop of 20% or more over a two-month period. When the volume is increasing on declining prices and declining on increasing prices, this is a confirmation of the downtrend which is bear market.

2.5 Financial Crisis

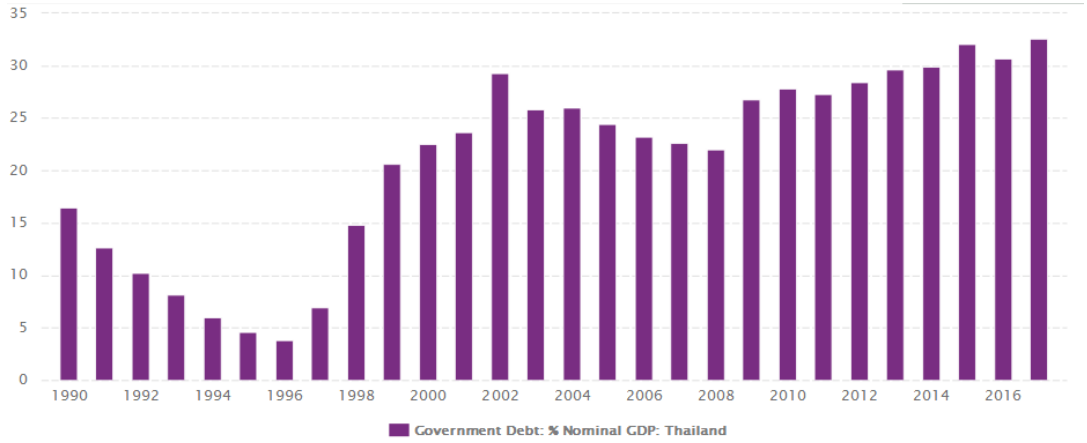
Financial crisis refers to any of a broad variety of situations in which some financial assets suddenly lose a large part of their nominal value. Many financial crises occurred in the 19th and early 20th centuries, and most of them were connected with banking panics, and eventually leaded to the recessions. The financial crisis also includes stock market crashes and the bursting of other financial bubbles, currency crises and sovereign defaults.

2.5.1 Historical Financial Crisis

When we look back to the history, there are many financial crises occurred in different countries or regions. In this part, we choose two well-known financial crises which will be introduced in detail, including the Asia crisis (1997-1998), and Dotcom bubble (1999-2000).

The Asia crisis started in July 1997, Thailand's currency (baht), suddenly collapsed when the government was forced into floating it on the open market. Since Thailand owed a huge amount of foreign debt that it could not pay even before the currency plummeted. Then the crisis spread across the region, with South Korea, Indonesia, Laos, Malaysia and Hong Kong all affected.

Graph 2.1 Thailand's government debt to GDP ratio

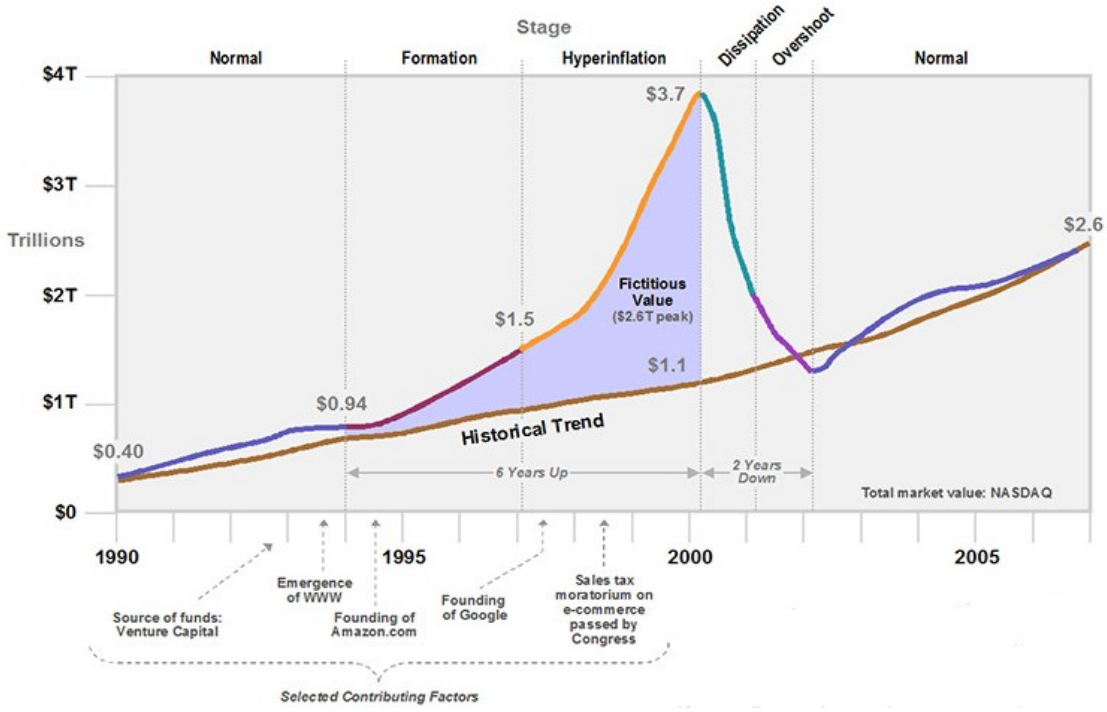


Source: CEIC

As can be seen in graph 2.1, the Thailand's government debt to GDP ratio rose from 4% to 20.5% in 1996-1998 due to the financial crisis. According to the study of Asia Development Bank, the foreign debt to GDP ratio rose from 100% to 167% in the four large Association of Southeast Asian Nations (ASEAN) economies in 1993-1996, then shot up beyond 180% during the worst of the crisis. And in the end of crisis, the International Monetary Fund (IMF) stepped in to initiate a 40 dollars program to stabilize the economies which were hard hit by this crisis.

Another example is the Dotcom bubble, which occurred in 1999-2000. As in most crises, it was preceded by a bull rush into one sector. In this case, it was technology and internet-related stocks. Individuals became millionaires overnight through companies such as eBay and Amazon. The Nasdaq Composite stock market index, which includes technology and internet-based companies, peaked in value on March 10, 2000 before crashing. By 2000, the economy had slowed and interest rate hikes had diluted the easy money that was propping up these companies. When the bubble burst, some companies, like Pets.com, failed completely and shut down. Others, like Cisco, whose stock declined by 86%, and some companies, like Amazon, declined in value but recovered quickly.

Graph 2.2 Total market value of NASDAQ during the Dotcom bubble



Source: Flat World Business

In graph 2.2, we can see clearly that during 1999-2000, the total market value of NASDAQ was skyrocketed due to the excessive speculation that occurred roughly from 1997 to 2001, a period of extreme growth in the usage and adaptation of the internet. Some economists commented, the dotcom crash was simply a case of a feeding frenzy that went out of control, and was a symptom, of the market's underlying irrationality. Back then, the hysteria reached such a pitch that the inconvenient fact that few of these companies made any money scarcely mattered. And that is part of causes why it burst in the end.

2.5.2 Global Financial Crisis

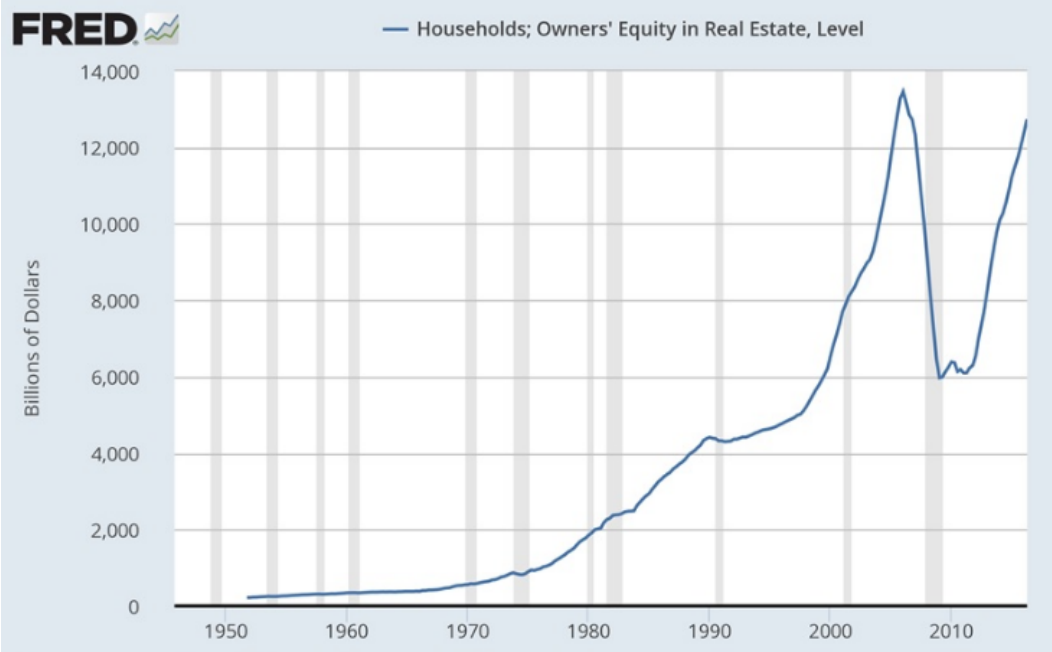
In 2007, the US financial crisis which triggered by the subprime mortgage crisis, eventually affected the global financial market. This was a huge financial crisis and the impact was unprecedented. This global financial crisis influenced to all regions of the world and to all countries. And that is main reason why our thesis is focused on this topic.

Since our thesis is focused on the relationship between 2007-08 financial crisis and stock market, in this chapter, the main causes and impacts this financial crisis will be introduced. And due to the fact that this thesis is concentrated on the US market, the US market will be described as a major part in this chapter.

2.5.2.1 Main Reasons

There are many causes leading to the financial crisis, since it caused by a combination of several factors, all highly interrelated. In this thesis, we will introduce the most commonly accepted drivers, and discuss them one by one in detail as follow. According to the research, we considered that the US housing bubble is the trigger of the financial crisis.

Graph 2.8 US housing bubble



Source: Board of Governors of the Federal Reserve System (2015).

As can be seen in the graph 2.8, the household level of real estate in US, increased rapidly from 1990's to 2007, and it had a peak in the year 2007. But it had a huge drop to the level before 2000 during the crisis, which was the same time when the housing bubble collapsed. And that is one of typically prove for the US housing bubble. In addition, at the same time, nearly the trend existed in the US housing price.

Here are the main causes why housing prices sky-rocketed back then.

(1) Growth of subprime mortgages

In late 1990s, there existed a push for "affordable housing" got stronger. Through Fannie Mae and Freddie Mac, the government sponsored enterprises (GSE), these two corporation are private corporation, but the government's implicit insurance of them. They were purchasing and securitizing mortgages, and devoting a percentage of their lending to support affordable housing.

The background of this is related to the political reason, since the Iraq war started from 2003 to 2009, the military budget was increasing. And military budget is always a huge proportion of US government spending, so the government debt increased, which leaded to the deficits increased. US government wanted to focus their eyes on the US real estate industry, hence, they chose to call on public to buy houses (Bernanke, 2013).

Problem was that, subprime mortgages was low-quality, which not even required good borrower's credit history or high income. At first, the clients were who have the good credit history or high income, but with time passed by, they found out that this kind of clients were less and less. In order to save the declining business, the commercial banks decided to let those who did not have good credit history or high income buy houses using the subprime mortgages. As a result of this, the subprime mortgages increased sharply.

(2) The abuse of financial derivatives

After the commercial banks let poor people or the people who did not have good credit buy houses via subprime mortgages, they sold those loans to the investment banks as form of Mortgages Backed Security (MBS). Since the commercial banks did not want to bear too much risk, commercial banks decided to transfer the risk to the investment banks.

Investment banks first set up many financial derivatives, which turned those risky loans to Collateralized Debt Obligation (CDO), and sold those loans to the whole world. Due to the fact that the investment banks also did not want to bear the risk themselves, they set up new products, which called Credit Default Swap (CDS), in order to let the

insurance company to bear part of risk (Bernanke, 2013).

Above products which are mentioned are the financial derivatives, and those financial derivatives were being abused before the financial crisis. It, in fact, is furtherance of short-term speculative trading.

(3) Excessively loose monetary policy

It is not only the fault of the abuse of financial derivatives, but also the fault of excessively loose monetary policy. From 2001 January to 2003 June, the US Fed decreased the interests rate thirteen times, from 6.5% to 1%. This move is for encouraging the public to use their money to invest not save in the commercial banks. US Fed hope that the real estate industry would push the whole economy to keep booming and growing (Bernanke, 2013).

At the same period, the commercial banks started offering excess loans, including the subprime mortgages, which is mentioned in the first reason. But what they did not expect is the swell of the housing bubble was persistent.

(4) Excessive optimism

Excessive optimism is also considered to be one of the reasons. Since the investors were too optimistic, they expected the housing price would be increasing continually. And the whole market underestimated the risk of the bubble, which drove the crisis to even worse situation.

In the end, the demand of housing market decreased with lots of supply, the housing prices started to drop, and that was the time the burst of the housing bubble (Bernanke, 2013).

(5) Lack of regulation and transparency

Lack of regulation and transparency was another reason why the 2007-08 crisis spread all over the country. Since US lifted its control over financial institutions, more and more financial institutions were attracted to engage in speculative business.

The U.S. government has always believed that the market economy should develop freely. They thought that it could adjust itself through economic cycles. This led to the proliferation of subprime mortgages and financial derivatives without

restrictions. It can thus be seen that the lack of government supervision of financial markets is the main reason for the outbreak of the economic crisis (Bernanke, 2013).

In the United States, most people think that because the Fed has repeatedly raised interest rates again and again, the real estate market finally collapsed and bonds fell sharply. However, although the two mortgage loan institutions of Fannie Mae and Freddie Mac have been taken over by the government, they have not relieved the crisis. On the contrary, the situation was worse than expected.

2.5.2.2 Impacts

In 2007, the US financial crisis which triggered by the subprime mortgage crisis, eventually evolved into a tsunami that affected the global financial market. This was a huge financial crisis that has not been encountered for a hundred years. The impact and destruction of this financial crisis was unprecedented. This global financial crisis has brought about a certain degree of influence to all regions of the world and to all countries. Moreover, it has also caused a certain change in the overall pattern of the world economy (Grant and Wilson, 2012).

Since it started in the US, the global financial crisis has the greatest impact on the US for sure. After the crisis broke out, the US economy suffered a severe decline. Generally, the stock market fell sharply, and the fiscal deficits increased a lot, also, the US real estate collapsed. In short, the financial crisis had brought a huge loss to both the US financial economy and the real economy. It has had a major impact on the US investment and consumption area as well. We will discuss the impacts to US as follow in detail.

(1) Huge damage to the US government

The financial crisis caused huge asset losses to the US government. In 2009, the US fiscal deficit was as high as 1.2 trillion US dollars. Combined with the use of funds in the rescue plan that year, the fiscal deficit totaled 1.75 trillion US dollars. For this reason, the United States has set a four-year plan to reduce its fiscal deficit by half, but everyone knows that this task is hard to achieve, and the US has a large number of

treasury bonds (Grant and Wilson, 2012).

According to statistics, till February 2009, the US outstanding treasury bonds have exceeded 10 trillion US dollars and reached 10.8 trillion US dollars, and the United States still plans to issue 2-3 trillion US dollars of treasury bonds in the next two years. More than 90% of these new government bonds require foreign purchases, creating a huge burden for the U.S. government.

(2) Impact on the US financial economy

In this financial crisis, US financial institutions lost a total of 2.2 trillion US dollars of bad assets. The huge losses caused the investment banking system to eventually collapse. Citigroup, the largest financial group in the United States, showed a huge loss of trading. The original value of the $33 per share fell to $1 after the crisis broke out; the US's largest insurance group, AIG, lost about $100 billion in 2008 and was on the verge of collapse. The Dow and the S&P 500 index fell by half in the same period of last year in 2008. As of the fourth quarter of 2008, 98% of the stocks of the index suffered an average loss of $20.7 per share, representing a total net loss of $180 billion. This was the first time since 1935, a large-scale loss occurred for the entire quarter (Grant and Wilson, 2012).

In September 2008, the retail industry's sales in the United States fell sharply. By September, the US stock market suffered an unprecedented black Wednesday, with the Dow plunging 7.87%. Since the financial crisis broke out, more than 100 large-scale financial institutions have gone bankrupt or merged.

(3) Impact on the US real economy

The global financial crisis also caused the United States to have a hard hit in the real economy. The first thing that occurred was the bursting of the real estate bubble, the real estate market economy fell sharply, and then other industries such as automobiles and steel manufacturing industries were also in trouble (Eigffinger and Masciandaro, 2011).

In 2008, General Motors announced that they had filed for bankruptcy protection and the steel industry had started at less than half of its production capacity. In October

2009, sales in the US automobile market fell by 32% compared to the same period in 2007, which was the worst level of sales in the US automotive market since 1991.

In addition, the investment dropped and unemployment rose as a consequence; at the same time, the consumption decreased sharply, and the exchange rate became volatile hugely. As a consequence of all these, the output of US fell dramatically.

Basically, we could say that the US economy has obviously declined. After the outbreak of this crisis, the U.S. economic community has also agreed to the reality that the economy has fallen into recession.

(4) Impact on the European countries and China

This financial crisis affected not only the US, but also all over the world. For instance, it hit the European economy first, the GDP of most European countries decreased after the crisis broke out, and the real estate industry in those countries fell. Moreover, the unemployment rate increased rapidly, and the whole economy fell into recession (Grant and Wilson, 2012)

As for China, the crisis had a hard hit on the Chinese export. And obviously, this crisis caused the US dollar devaluation. Since China's foreign exchange reserves have exceeded $2 trillion, making it the world's largest foreign exchange reserve country including a large number of US Treasure bonds.

Since this thesis is concentrated on the US market, we will not describe the detail of impact on the European countries and China, and the major impacts to US have already been introduced in the above paragraphs.

3 Description of Methodology

In this thesis, the relationship between the financial crisis and stock market will be analyzed, using the statistical econometric method. In this chapter, the methods will be explained in detail. This chapter will be distinguished into five parts which are estimation of econometrics model, statistical verification, econometric verification and model specification and normality of residual. The knowledge of this part is based on Gujarati (2011).

3.1 Estimation of Econometric Model

The theory of estimation of econometric model will be introduced in this part. Since econometric model is part of linear regression model, the general linear regression model will be introduced.

The linear regression is a method of the relationship between several variables by fitting a linear equation to observed data. One variable is considered to be a dependent variable, and the rest are considered to be independent variables. A valuable numerical measure of association between two variables is the correlation coefficient, which is a value between -1 and 1 indicating the strength of the association of the observed+ data for the two variables (Gujarati, 2011). In general, the basic equation of the linear regression model is shown below:

$$Y = \beta_0 + \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + \cdots + \beta_i \cdot X_i + \mu_i \tag{3.1}$$

X is the independent variable which can also called random variable, and the numerical value is determined by the chance. It is a quantification of outcome of random phenomenon. Y is the dependent variable which will be affected by the independent variables. Where β_0, β_1 and β_i are the parameters of the model, such as the intercept β_0 and slop coefficient (β_1, β_2, … β_i), μ_i is error term.

If $\beta_i > 0$, means the variables X and Y are positively correlated. If $\beta_i = 0$, means the variables X and Y are independent. If $\beta_i < 0$, means the variables X and Y are

negatively correlated or inversely related.

In our thesis, the Ordinary Least Squares (OLS) method will be used in the calculation. Ordinary Least Squares method is a typically method to find the fitting regression line by minimizing the sum of vertical distance between the regression lion and the observed points (Gujarati, 2011). The formula of Ordinary Least Squares is shown as follow:

$$\mu_i = Y_i - (\beta_0 + \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + \cdots + \beta_i \cdot X_i) \tag{3.2}$$

In this method, the error term is the difference between the actual Y value and the Y value calculated from the regression model. In order to find the estimates of the β coefficient, we need the sum of the error term as small as possible, if it is zero, then this regression model is ideal model. For the practical reason, the method of OLS will not minimize the sum of error, but the sum of squared error term as shown following:

$$\sum \mu_i^2 = \sum (Y_i - (\beta_0 + \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + \cdots + \beta_i \cdot X_i))^2 \tag{3.3}$$

According to the formula 3.3, we have the sample value of Y and X, but we do not know the values of the β coefficient. Thus, we have to find out the values of the β coefficient to make ESS as small as possible, and clearly, the ESS is a new function of the β coefficient (Gujarati, 2011).

Econometric model is an estimable formulation of a theoretical relation. In this thesis, we selected data from different periods. We use the Log-linear model to estimate our model according to the theory part, because Log-linear model is focus on the percent growth in the dependent variables for a unit change in the independent variables (Gujarati, 2011). The model of this thesis is shown as follow:

$$\log Y = \beta_0 + \beta_1 \cdot \log X_1 + \beta_2 \cdot \log X_2 + \cdots + \beta_i \cdot \log X_i + \mu_i \tag{3.4}$$

In this thesis, we mainly use STATA software to estimate the regression model. STATA is a statistical software package created in 1985 by Stata Corporation. Most of its users work in research, especially in the fields of economics, sociology, political science, biomedicine. Stata's capabilities include data management, statistical analysis, graphics, simulations, regression, and custom programming. The figure 3.1 shows a

simple sample of equation output in STATA. We will introduce the most important variables in the following figure.

Figure 3.1 The sample of equation output in STATA

```
. regress SP500 inflation i SP500volume Ms
```

Source	SS	df	MS	Number of obs	=	91
				F(4, 86)	=	95.51
Model	2356690.71	4	589172.678	Prob > F	=	0.0000
Residual	530502.111	86	6168.6292	R-squared	=	0.8163
				Adj R-squared	=	0.8077
Total	2887192.82	90	32079.9203	Root MSE	=	78.541

SP500	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
inflation	-33.55753	12.98077	-2.59	0.011	-59.36244	-7.752621
i	99.04441	7.129009	13.89	0.000	84.8724	113.2164
SP500volume	-4.05e-09	1.77e-09	-2.29	0.025	-7.58e-09	-5.27e-10
Ms	8.712601	2.418835	3.60	0.001	3.904116	13.52109
_cons	480.2843	120.0239	4.00	0.000	241.6847	718.8839

Source: STATA

Coefficient: For the simple linear regression, the coefficient measures the marginal contribution of the independent variable to the dependent variable, holding all other variables fixed. When we included “Coef.” in our list of repressors, the corresponding coefficient is the constant or intercept in the regression, and it is the base level of the prediction when all of the other independent variables are zero.

Std. Error: This column reports the estimated standard errors of the coefficient estimates. And it can measure the statistical reliability of the coefficient estimates, and the larger the standard errors, the more statistical noise in the estimates.

Probability: This probability is also known as the p-value or the marginal significance level. The p-value, we can decide if we reject or accept the hypothesis that the true coefficient is zero against a two-sided alternative that it differs from zero.

R-Squared: It measures the success of the regression in predicting the values of the dependent variable within the sample. R-Squared (R^2) is limits $0 \leqslant R^2 \leqslant 1$, it is a perfect fit when R^2 equal to 1. There is no relationship between the regress and the regress or when R^2 equal to 0.

Based on this table in the STATA, we can get the estimated models for our thesis.

3.2 Statistical Verification

The theory of testing the significance of each parameters and the whole model will be introduced in this part. We divided this statistical verification into two parts, first T-test, and then F-test will be introduced.

3.2.1 T-test

T-test is to test hypotheses about individual regression slope coefficients. In other words, the t-test is appropriate to use when the stochastic error term is normally distributed and when the variance of that distribution must be estimated. The t-test accounts for differences in the units of measurement of the variables (Gujarati, 2011).

The most common test performed in regression is:

H0: $\beta_i = 0$ (The parameter β_i is not statistically significant.)

H1: $\beta_i \neq 0$ (The parameter β_i is statistically significant.)

With the t-statistic:

$$Tcal = \frac{\hat{\beta}_i - \beta_i}{\sigma\hat{\beta}_i} \sim \quad) \tag{3.5}$$

k : the number of unknown parameters in the model

n : the number of observations

α : significant level

$\hat{\beta}_i$: Estimated parameter i

β_i : Our hypothesis about parameter i

$\sigma\hat{\beta}_i$: Standard deviation of parameter β_i

Decision rules:

If |Tcal| > T_α(n-k), then we should reject H0 and accept H1, which means we can say the parameter is statistically significant.

If |Tcal| < T_α(n-k), then we should reject H1 and accept H0, which means we

cannot say the parameter is statistically significant.

We will use the excel function to calculate the $T_{\alpha}(n-k)$ by function T.INV. If the p-value is less than the significance level our testing, we should reject the null hypothesis (H0) that this parameter is equal to zero. If the p-value is higher than the significance level our testing, we should accept the null hypothesis (H0) that this parameter is equal to zero (Gujarati, 2011).

3.2.2 F-test

F-test is how we define the notion of the overall significance of a regression, in other words, it shows how multiple hypotheses are test in a regression model. The most common test performed in regression is:

H0: $\beta_1 = \cdots = \beta_k = 0$ (The model is not statistically significant.)

H1: $\beta_1 \neq \cdots \neq \beta_k \neq 0$ (The model is statistically significant.)

With the f-statistic:

$$Fcal = \frac{\frac{ESS}{k-1}}{\frac{RSS}{n-k}} \sim F_{\alpha}(k-1, n-k) \tag{3.6}$$

ESS: Explained sum of squares

RSS: Residual sum of squares

k: the number of unknown parameters in the model

n: the number of observations

α: significant level

Decision rules:

If $|Fcal| > F_{\alpha}(k-1, n-k)$, then we should reject H0 and accept H1, which means we can say the whole model is statistically significant.

If $|Fcal| < F_{\alpha}(k-1, n-k)$, then we should reject H1 and accept H0, which means we cannot say the whole model is statistically significant.

We will use the excel function to calculate the $F_{\alpha}(k-1, n-k)$ by function F.INV. If the p-value is less than the significance level our testing, we should reject the null

hypothesis (H0) that this parameter is equal to zero. If the p-value is higher than the significance level our testing, we should accept the null hypothesis (H0) that this parameter is equal to zero (Gujarati, 2011).

3.3 Econometric verification

In the econometric verification part, the assumption of the error term and the explanatory variables for the classical regression models will be introduced as following:

1. The regression model is linear in the coefficients, is correctly specified, and has an additive error term;
2. The error term has a zero population mean;
3. The error term has a constant variance;
4. Observations of the error term are uncorrelated with each other;
5. All explanatory variables are uncorrelated with the error term;
6. No explanatory variable is a perfect linear function of any other explanatory variables;
7. The error term is normally distributed (Gujarati, 2011).

Those above classical assumptions of OLS are essential for the calculation, due to that under those assumptions, OLS is the best estimator available for regression models. And that is the main reason why we need to test our estimated models based on above assumptions.

We have introduced the testing of statistical significant of parameters and whole model. In this part, we will mainly focus on the analysis of the theory of autocorrelation, heteroscedasticity and multicollinearity.

3.3.1 Autocorrelation

Autocorrelation is the correlation between member of series of observations ordered in time as in time series data, or space as in cross-sectional data.

There are two ways to test the autocorrelation, we divide into graphical methods

and formal methods. Graphical method is to see the time sequence plot of residuals or standardized residuals, which means simply the residuals divided by the standard error of the regression. If there is no autocorrelation, the time sequence plot of residuals should exhibit a pattern, and it should be randomly distributed between -1.96 and 1.96. If it is out of the range from -1.96 to 1.96, then there is autocorrelation in our model (Gujarati, 2011).

In this thesis, we use the formal method called as Durbin-Watson (DW) test.

The hypothesis is shown as below:

H0: $\rho = 0$ (There is no autocorrelation in our model.)

H1: $\rho \neq 0$ (There is autocorrelation in our model.)

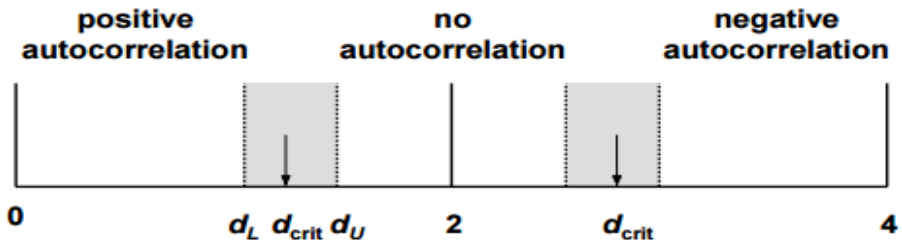
If H0 hold them:

$$d = \frac{\sum_{t=1}^{n}(\hat{u}_t - \hat{u}_{t-1})^2}{\sum_{t=1}^{n}(\hat{u}_t)^2} \tag{3.7}$$

Decision rules:

If this value is near to 0, means there is severe positive autocorrelation. If it is near to 4, means there is severe negative autocorrelation. But if it is near to 2, means there is no autocorrelation.

Graph 3.1 Durbin-Watson (DW) test for autocorrelation



Source: Investopedia. Durbin-Watson.

As shown in the graph 4.1, Durbin-Watson method also suggests that the upper and lower bounds (dU and dL) should be noticed. Since if d is less than dL, it must also be less than the critical value of d for positive autocorrelation, and so we would reject the null hypothesis (H0) and conclude that there is positive autocorrelation. If d is above than dU, it must also be above the critical value of d for negative autocorrelation, and

so we would not reject the null hypothesis (H0). If d lies between dL and dU, we cannot tell whether it is above or below the critical value and so the test is indeterminate. And the exact number for critical values of DW test can be found on the official Stanford education website (Gujarati, 2011).

3.3.2 Heteroscedasticity

Heteroscedasticity is the variance of disturbances term, conditional on the chose values of the explanatory variables, is some constant number. And "homo" means equal, while "scedasticity" means spread.

Homoscedasticity: variance (μ_i) =constant for all i=1, 2…n. That means, the variance of estimated μ_i is the same for all observations in the sample, and thus the variance of Yi is the same for all observations in the sample. The uncertainty in Yi is the same amount when Xi is small as when Xi is a large. When you have heteroscedasticity, the spread of the dependent variable Y could depend on the value of X, for example. Some observations are inherently less influenced by unmeasured factors (Gujarati, 2011).

There are two ways to test the heteroscedasticity, we divide into graphical methods and formal methods. Graphical method is to see if the standard, residual squared exhibit any system pattern. Formula methods include Goldfield-Quandt methods, part test, and white test. In our thesis, we use the white test. White test is a statistical test that establishes whether the variance of the errors in a regression model is constant: that is for homoscedasticity (Gujarati, 2011).

The hypothesis is shown as below:

H0: $\lambda_1 = \lambda_2 = \cdots = \lambda_i = 0$ (There is no heteroscedasticity in our model.)

H1: $\lambda_1 \neq 0$ or $\lambda_2 \neq 0$ or … or $\lambda_i \neq 0$ (There is heteroscedasticity in our model.)

If H0 hold them:

$$X^2 cal = n \cdot R^2 \sim X^2(\mathrm{df}) = X^2(\mathrm{k}-1) \tag{3.8}$$

X^2: the test value

R^2: R-squared in the white test

k: the number of unknown parameters in the model

n: the number of observations

α: significant level

Decision rules:

If $X^2 > n \cdot R^2$, then we should reject H0 and accept H1, which means we can say there is no heteroscedasticity in our model. If $X^2 < n \cdot R^2$, then we should reject H1 and accept H0, which means we cannot say the there is no heteroscedasticity in our model. If the p-value is less than the significance level our testing, we should reject the null hypothesis (H0) that there is no heteroscedasticity in our model. If the p-value is higher than the significance level our testing, we should accept the null hypothesis (H0) that There is no heteroscedasticity in our model (Gujarati, 2011).

3.3.3 Multicollinearity

Multicollinearity means that the does existence of a "perfect" linear relationship among some or all explanatory variables of regression model. But according to the assumption of classical regression model is that among the regressors included in the regression model is no multicollinearity, which means there should not exist a "perfect" linear relationship among some or all explanatory variables of regression model.

The detection of multicollinearity is testing pair-wise correlation among regressors. Suppose we have a model, which has two independent variables, then we should calculate the correlation between these two independent variables (Gujarati, 2011).

$$Fcal = \frac{r^2_{x_i,x_j} / (k-1)}{(1-r^2_{x_i,x_j}) / (n-k)} \sim F(\mathrm{k}-1, \mathrm{n}-\mathrm{k}) \qquad (3.9)$$

$r^2_{x_i,x_j}$: the square of correlation of independent variables

k: the number of unknown parameters in the model

n: the number of observations

α: significant level

Decision rules:

If the correlation is less than 0.8, then we can assume that there is no multicollinearity in our model. If the correlation is higher than 0.8, then we can assume that there is multicollinearity in our model. And this value should between -1 and 1, when -1 means there is a perfect negative correlation between two variables and 1 means there is a perfect positive relationship between two variables (Gujarati, 2011).

In this thesis, we need the correlation coefficient between independent variables as low as possible, on the contrary, we need the correlation coefficient between the independent and dependent variables as high as possible.

If we detect that there is multicollinearity in our model, there are several ways to remove the multicollinearity as follow:

1. Dropping a variable from the model and specification bias;
2. Transformation of variables;
3. Additional or new data;
4. Reducing collinearity in in polynomial regressions;
5. Other methods of remedying multicollinearity (Gujarati, 2011).

3.4 Model Specification

After we did the test of econometrics verification, we will discuss the model specification which consists of choosing:

1. correct independent variables;
2. correct functional form;
3. correct form of the stochastic error term.

However, if one of these choices is wrong, a specification error occurs. And there are three ways to detect the model specified:

1. Examination of residuals;
2. Durbin-Watson statistic;
3. Ramsey's RESET test.

In this thesis, we use the Ramsey's RESET test for all models. Ramsey Regression Specification Error Test (RESET). RESET allows to detect possible misspecification.

And if the equation is correctly specified, nothing is missing (Gujarati, 2011).

Model specification:

H0: The regression model is correctly specified.

H1: The regression model is not correctly specified.

If H0 hold them:

$$Fcal = \frac{(R^2_{new} - R^2_{old}) / df_1}{(1 - R^2_{new}) / df_2} \sim F_\alpha(df_1, df_2) \qquad (3.10)$$

df1: number of new regressors in the new model

df2: number of parameters of new model

R^2_{new}: R-squared of new model

R^2_{old}: R-squared of old model

k: the number of unknown parameters in the model

n: the number of observations

α: significant level

Decision rules:

If Fcal > Fcrit, then we should reject H0 and accept H1, which means we cannot say regression model is correctly specified. If Fcal < Fcrit, then we should reject H1 and accept H0, which means we can say the regression model is correctly specified. Fcrit can be calculated by the excel function F.INV.

3.5 Normality of Residual

Since we have already mentioned the assumptions of linear regression model which include the error term has a normal distribution. The normal distribution of residuals should be symmetric, and has a bell-shape.

There are several methods to test the normality of residual, graphic method and formal method. In this thesis, we use Jarque-Bera test (Gujarati, 2011).

Jarque-Bera test:

H0: The residuals have normal distribution.

H1: The residuals have not normal distribution.

If H0 hold them:

$$JB = n \cdot \left[\frac{S^2}{6} + \frac{(\mathrm{K}-3)^2}{24} \right] \sim \mathrm{X}^2(\mathrm{df}) \qquad (3.11)$$

S: skewness

K: kurtosis

n: the number of observations

Decision rules:

If p-value is less than 0.05, then we should reject H0 and accept H1, which means we cannot say the residuals have normal distribution. If p-value is higher than 0.05, then we should reject H1 and accept H0, which means we can say the residuals have normal distribution (Gujarati, 2011).

In this chapter, the methods of econometric have been introduced in detail. The following chapter will present the output and result of our models.

4 Evaluation of the Impact of Financial Crisis on Selected Stock Market

Due to our aim of this thesis is to analyze the impact of financial crisis on selected stock market, in this thesis we will choose the US stock market, since it was the place that started the 2007-08 financial crisis. We assume that the financial crisis hit the US's economy and it affected the stock market through different economic variables. In this thesis, we will analyze which economic variables influenced US stock market using the econometrics model. We will focus on one of the most important stock index, S&P500 as our target, and pick five essential economic variables which related to the stock market and financial crisis to help us set up econometrics models. We will distinguish our econometrics models into three periods, which are the model before (2000 January – 2007 July), during (2007 August – 2009 July) and after the crisis (2009 August – 2016 December). The reason why we divided the time period like this will be explained in chapter 4.1.

In this chapter, we will first introduce our data which include the independent variables analysis and dependent variables analysis. The second step is the estimation of our three econometric models. The third part is the statistical verification of the parameters and the whole models which will use T-test and F-test. The fourth part is econometric verification of models which will deduct the autocorrelation, heteroscedasticity and multicollinearity of our three models. The fifth part is the economic verification which consist of model specification and normality of residuals. The last part is the summary of above analysis which will also include interpretation of our three models. In this thesis, we mainly use statistical software (STATA) to calculate the results and solve problems.

4.1 Data Analysis

In this part, we will introduce first independent variables and dependent variables

in our cases. In this thesis, we have five independent variables and one dependent variable. And we will distinguish the data into three time-periods. The independent variables are the variables link to the stock market in US, and the dependent variable is chosen to be the one of the most important stock index, S&P500.

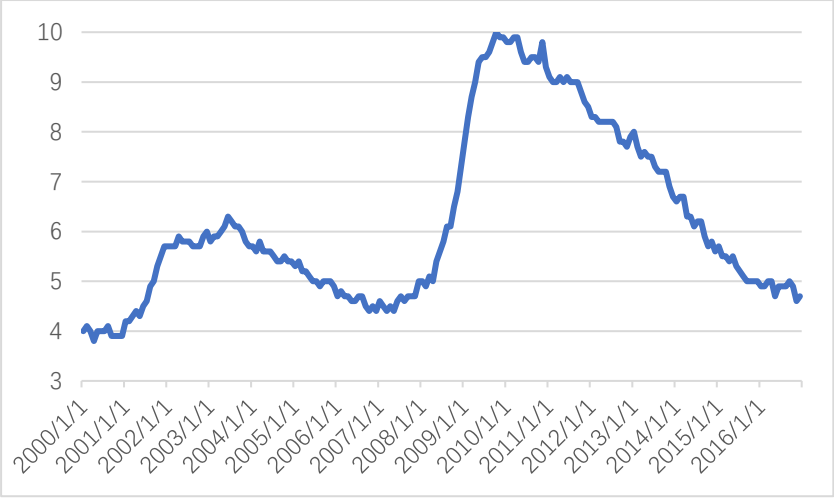
4.1.1 Independent Variables Analysis

As for the independent variables, we chose five independent variables, which include: unemployment rate (u), inflation rate (inflation), interest rate (i), the S&P500 volume that traded in the market (volume) and money supply (Ms). The reason why we chose these variables is explained in detail in following paragraphs. And we will describe those independent variables using graphs.

(1) Unemployment rate

Unemployment rate is the ratio of unemployed people and labor force, it is usually as a percentage form. Basically, the unemployed people are those who have no job. Usually, when the unemployment rate is high, this is the sign of recession of the economy in the economy cycle; and when it is low, which means the economy is growing in the economy cycle.

Graph 4.1 Unemployment rate in the selected period



Source: OECD.org. official website; Author

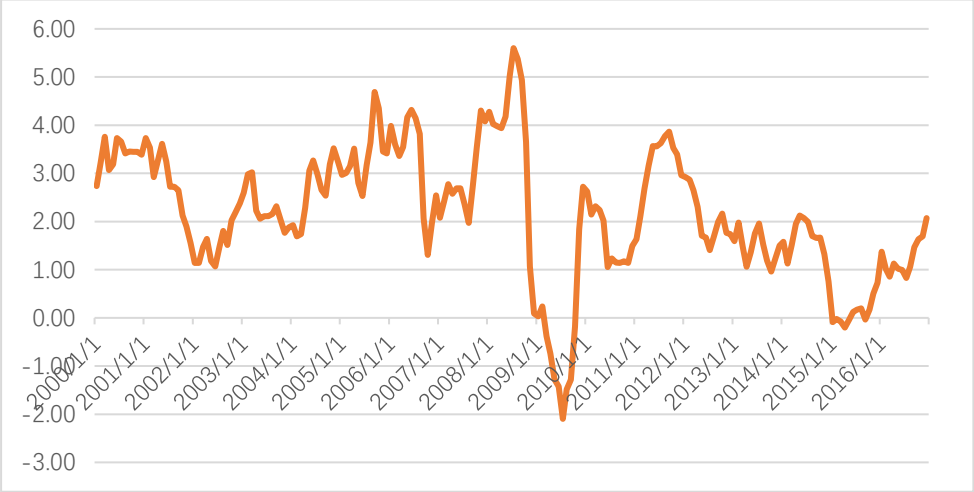
As we can see in the graph 4.1, the unemployment rate raised sharply during 2008 to 2010, which is the verdict of the financial crisis. This suggests that when there

is a financial crisis, the economy will slow down its speed, and the people will lose their jobs when there is an economy recession. Clearly, the labor market suffered in the period of financial crisis in the US market, and that is why we chose this variable in the economy.

(2) Inflation rate

The inflation rate measures the change of the prices. In other words, inflation is the rate at which the general level of prices for goods and services is rising, and this will naturally lead to the purchasing power of currency to fall as a consequence. Usually when there is a booming economy, the inflation rate will rise; and when the inflation falls, there is a sign of recession of economy.

Graph 4.2 Inflation rate in the selected period



Source: OECD.org. official website; Author

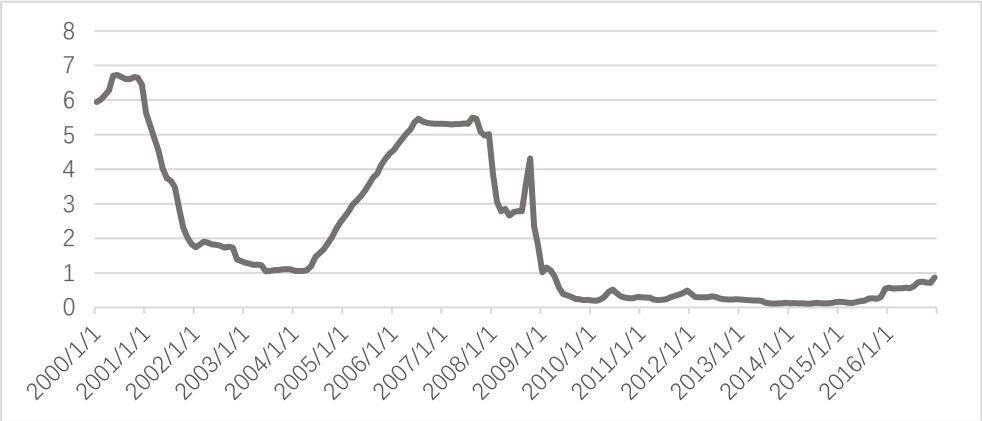
As we can see in the graph 4.2, the inflation rate had a huge drop in the period of 2008 to 2010, which is linked to the financial crisis. Generally, the financial crisis will hit the economy hardly, and the economy will suffer which also showed in the aspect of inflation. Since the inflation will go up, when the economy is over-heated. This huge drop reminds us the relationship between the inflation rate and economy's health condition.

(3) Interest rate

Generally, interest rate is the amount charged, expressed as a percentage of principal, by a lender to a borrower for the use of assets. For example, we have a deposit in the bank, and the interest rate is the amount of money the bank will give us when we

withdraw this deposit, although the rate can be fluctuating.

Graph 4.3 Interest rate in the selected period



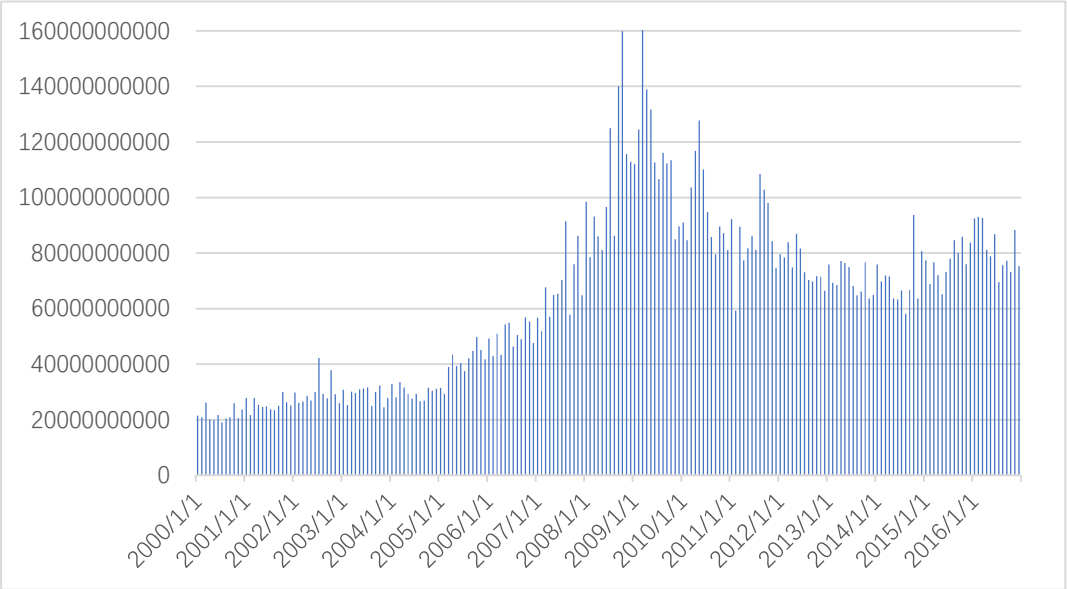
Source: OECD.org. official website; Author

As we can see in the graph 4.3, the interest rate dropped hardly from 2001 to 2004 and from 2008 to 2010. Since this thesis is only focus on the financial crisis in 2007-08, we consider that the drop from 2008 to 2010, is related to the financial crisis. Due to the fact that, for instance, if the bank has high interest rate on its deposit, people will invest their money in the bank account, rather than the stock market. Hence, the stock market will be affected by the increasing interest rate.

(4) Volume

Simply explaining, volume is the number of shares or contracts traded in a security or an entire market during a given period of time. We chose the S&P500 as our dependent variable, and we chose its volume that traded in the market to help us analyze stock market's movement.

Graph 4.4 Volume in the selected period



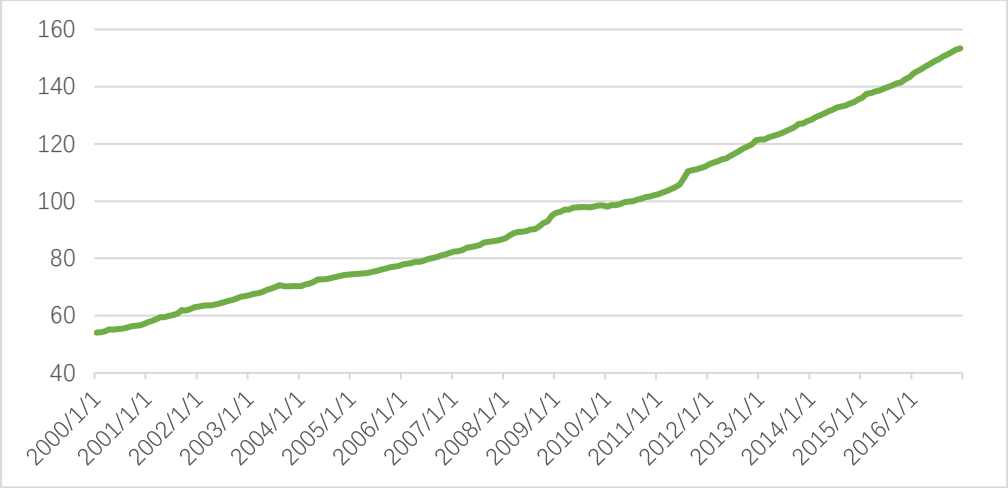
Source: OECD.org. official website; Author

As we can see in the graph 4.4, we notice that during the same period of above graph, from 2007 to 2010, the volume increased quickly, which shows the movement is relative more than the other periods, and it shows in this period, people wanted to trade more than in other periods. And it will also have impact on the stock price, which would be the reason why we chose this variable as an independent variable.

(5) Money supply

Money supply is the entire stock of currency and other liquid instruments circulating in a country's economy as of a particular time. It has several definitions, which are M0, M1, M2 and M3. In this thesis, we chose M3 as our independent variable according to our data from the official website of OECD. According to the OECD's explaining, M3 also can be called as "Broad money", which includes currency, deposits with an agreed maturity of up to two years, deposits redeemable at notice of up to three months and repurchase agreements, money market fund shares/units and debt securities up to two years. In addition, it is controlled by the central bank.

Graph 4.5 Money supply in the selected period



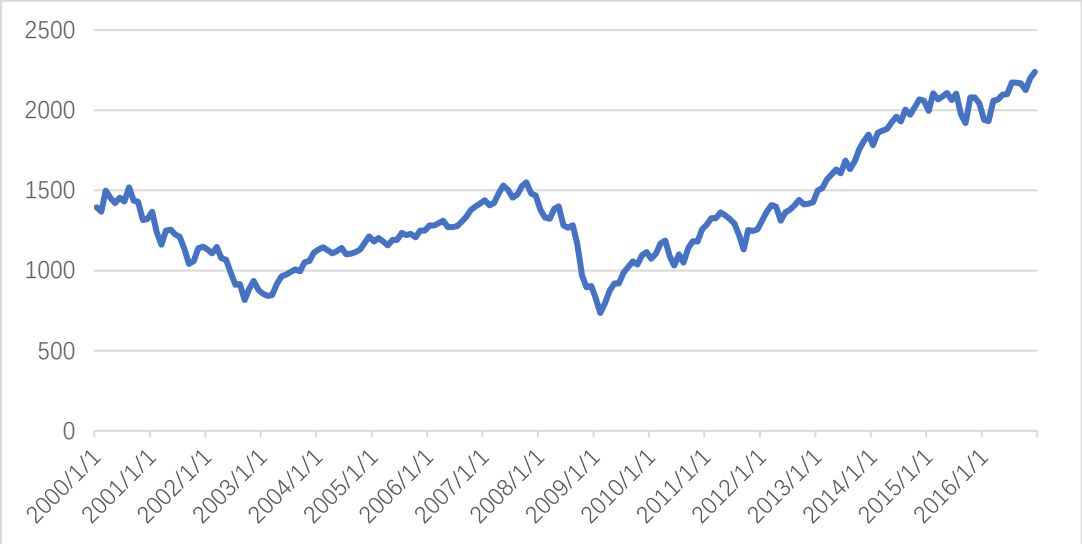
Source: OECD.org. official website; Author

As we can see in the graph 4.5, the US Fed's money supply has been increased in the last 16 years. It seems that the money supply grew smoothly. But in the following subchapter of estimation of the models, we will test if money supply has any effect on the stock market.

4.1.2 Dependent variable analysis

In this thesis, we want to evaluate the impact of financial crisis on the US stock market, so we focus on the stock market index, which will represent the US stock market. In this part, we chose the closing price of S&P500 monthly data (S&P) as the dependent variable. Since the S&P500 is one of the most well-known US stock market index, and it is based on the market capitalizations of 500 large companies which have common stock listed on both the NYSE or NASDAQ. Compared to the Dow Jones Industrial Average (DJIA), which is based on 50 large companies, or compared to the NASDAQ Composite, which is mainly focused on the technology companies, S&P500 has larger scope. Hence, we chose this index as representation of the US stock market.

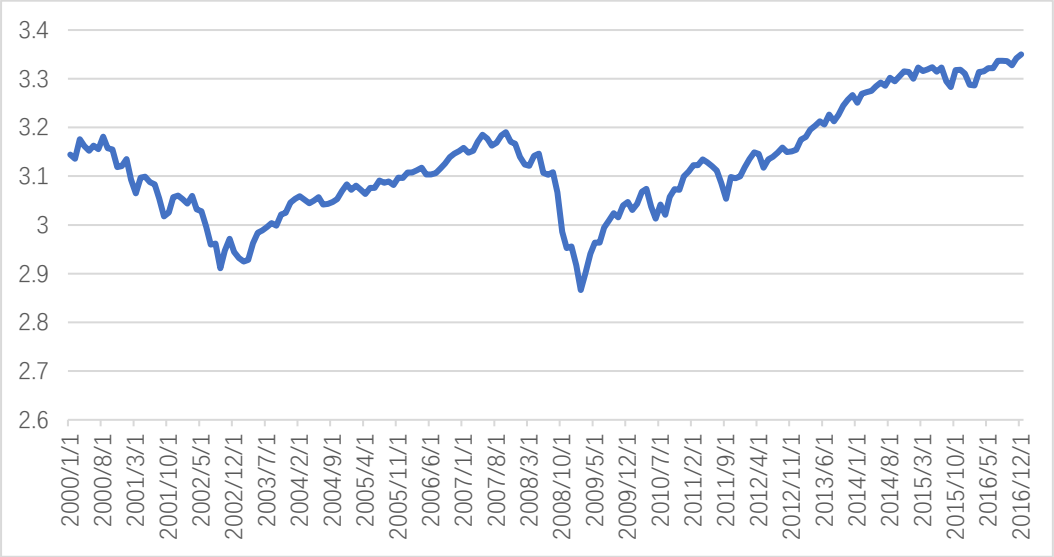
Graph 4.6 S&P500's closing price in the selected period



Source: Yahoo Finance, official website; Author

In the graph 4.6, we can notice the obvious drop from the end of 2007 to 2009. Generally, the stock market shows the health of the whole economy. Since there was a big shock of the US economy when it had financial crisis, the stock market suffered as a verdict, and the drop in the graph 4.6 has proved that.

Graph 4.7 Logarithmic S&P500's closing price in the selected period



Source: Yahoo Finance, official website; Author

Comparing the graph 4.6 and 4.7, we find out the ordinates value are much smaller in the graph 4.6. Since the logarithmic transformation can make the ordinates value smaller, which meet the requirement of linear regression, and it is focused on the percent growth in the dependent variables for a unit change in the independent variables.

In addition, the reason why we divided our time period into three different periods is explained as following. According to The Wall Street Journal report and study of University of Pennsylvania Wharton school, August 9, 2007, was the date marked the beginning of most far-reaching economic disruption since second World War. At that date, the events that Thursday made clear that subprime-lending excesses would not be contained, as Ben Bernanke, then Federal Reserve chairman, had predicted just months earlier. And it pointed the crisis lasted approximately two years which is most commonly accepted. That is main reason why we distinguished our data into three periods, before crisis (2000 January - 2007 July), during (2007 August – 2009 July) and after crisis (2009 August – 2016 December).

4.2 Estimation of Econometric Model

After we introduced our five independent variables and one dependent variable, we will introduce the basic models of this thesis. Since we have three time-periods, we

will first analyze the model before the financial crisis, and then we will analyze the model during the financial crisis. And last, we will analyze the model after the financial crisis. From this subchapter, we start to use STATA to help us set up the econometrics models.

4.2.1 Estimation of Model Before the Crisis

We use STATA to get the basic regression model before the crisis, the results are shown in the graph.

Table 4.1 Regression model before the crisis

Parameters	Variables	Coefficient
constant	-	9.03
β1	u	-1.08
β2	inflation	-0.08
β3	i	0.02
β4	volume	-0.12
β5	Ms	0.67

Source: STATA; Author

As we can see in the table 4.1, the basic regression model can be written as:

$$\log(\text{S\&P1}) = 9.03 - 1.08 \cdot \log(\text{u}) - 0.08 \cdot \log(\text{inflation}) + 0.02 \cdot \log(i) - 0.12 \cdot \log(\text{volume}) + 0.67 \cdot \log(Ms) \quad (4.1)$$

From the formula 4.1, we can know interest rate (i) and money supply (Ms) have positive relationship with our dependent variable, S&P's closing price; while unemployment rate (u), inflation rate (inflation), and S&P volume that traded in the market (volume) have negative relationship with S&P's closing price. According to the slope coefficient, for instance, we can know that the S&P's price will decrease 1.08% units if the unemployment rate increases 1%. Also, we can note that the unemployment rate and money supply, which have 1.08 and 0.67 coefficients, have strong effect on the S&P's price, when unemployment rate has strong negative effect and the money supply

has strong positive effect.

4.2.2 Estimation of Model During the Crisis

After the estimation of model before crisis, we use STATA to get the basic regression model during the crisis, the results are shown in the graph.

Table 4.2 Regression model during the crisis

Parameters	Variables	Coefficient
constant	-	19.51
β1	u	0.62
β2	inflation	0.03
β3	i	-0.04
β4	volume	-0.12
β5	Ms	1.86

Source: STATA; Author

As we can see in the table 4.2, the basic regression model can be written as:

$$\log(\text{S\& P}\,2) = 19.51 - 0.62 \cdot \log(\text{u}) + 0.03 \cdot \log(\text{inflation}) - 0.04 \cdot \log(\text{i}) - 0.12 \cdot \log(volme) - 1.86 \cdot \log(Ms) \quad (4.2)$$

From the formula 4.2, we can know that only inflation rate (inflation) has positive relationship with our dependent variable, and other variables have negative relationship with S&P's closing price. According to the slope coefficient, for instance, we can know that the S&P's price will decrease 0.62% units if the unemployment rate increases 1%. Also, we can note that the unemployment rate and money supply, which have 0.62 and 1.86 coefficients, have strong negative effects on the S&P's price.

4.2.3 Estimation of Model After the Crisis

In the process of last step of estimation, we use STATA to get the basic regression model after the crisis, the results are shown in the graph.

Table 4.3 Regression model after the crisis

Parameters	Variables	Coefficient
constant	-	9.27
β1	u	-0.73
β2	inflation	0.02
β3	i	-0.08
β4	volume	-0.10
β5	Ms	0.41

Source: STATA; Author

As we can see in the table 4.3, the basic regression model can be written as:

$$\log(\text{S\& P}3) = 9.27 - 0.73 \cdot \log(\text{u}) + 0.02 \cdot \log(\text{inflation}) - 0.08 \cdot \log(\text{i}) - 0.10 \cdot \log(\text{volume}) + 0.41 \cdot \log(Ms) \quad (4.3)$$

From the formula 4.3, we can know that inflation rate (inflation) and money supply (Ms) have positive relationship with our dependent variable, and other variables have negative relationship with S&P's closing price. According to the slope coefficient, for instance, we can know that the S&P's price will decrease 0.73% units if the unemployment rate increases 1%. Also, we can note that the unemployment rate and money supply, which have 0.73 and 0.41 coefficients, have strong negative effects on the S&P's price.

Based on the previous analysis, we can easily see that the unemployment rate and money supply, always have strong effects on the S&P's price at three time-periods. While the unemployment rate has the strong negative effect on the S&P's price, the money supply has strong positive effect in the period before crisis, and it has strong negative effect in the periods both during and after crisis. Similar situation happens in the effect of interest rate on the S&P's price, and opposite situation occurs in the effect of inflation rate.

In this sub-chapter, we have three basic models based on the five independent variables and one dependent variable. Next, we will test the statistical significant of the parameters and the whole model to see if the models are statistically significant.

4.3 Statistical Verification

In this part, we will test the statistical significant of our parameters and our whole model using T-test and F-test. Our first step is to test our parameters in our models, and we will test our models in different time periods.

4.3.1 T-test

Simply explaining, in the T-test, we will test the statistical significant of the parameters. We assume that there is 5% significance level, which means the p-value should be less than 0.05 in the test when we reject the null hypothesis (Ho). If there are some p-values which are higher than 0.05, then we should remove those variables based on the T-test. After T-test, we will get an adjusted new model. And in case that, we find out that the number of significant parameter is lower than 2, we will reject this model, according to the theoretical part in chapter 3.

And here are the hypotheses of the T-test:

H0: $\beta_i = 0$ (The parameter β_i is not statistically significant.)

H1: $\beta_i \neq 0$ (The parameter β_i is statistically significant.)

a) Basic model before the crisis

Based on the chapter 4.2.1, we know that there five independent variables in this model, and we have already known the t-statistic results of each independent variables from the annex 1. Hence, we made a table showing the results of T-test as below:

Table 4.4 T-test results of basic model before crisis

Parameters	Variables	|Tcal|	Tcrit	Result	Conclusion	Significant
β1	u	5.83	1.99	Tcal>Tcrit	Reject H0, accept H1	Yes
β2	inflation	2.76	1.99	Tcal>Tcrit	Reject H0, accept H1	Yes
β3	i	0.59	1.99	Tcal<Tcrit	Reject H1, accept H0	No
β4	volume	2.06	1.99	Tcal>Tcrit	Reject H0, accept H1	Yes
β5	Ms	4.53	1.99	Tcal>Tcrit	Reject H0, accept H1	Yes

Source: STATA; Author

In the table 4.4, the results of Tcal are the absolute value of t-statistic value of each independent variable, according to the formula 3.5. And the result of Tcrit is calculated by the excel function while the observation is 91, the number of β is 6 and the significance level is 5%. According to the table, we can see that there is only one variable β3 (i) which is not statistically significant at level 5%, and the rest variables are statistically significant. Hence, we will remove the unsuitable variable β3 (i) in this model based on the verdicts. And we have a new adjusted model shows as below:

Table 4.5 Adjusted regression model before crisis

Parameters	Variables	Coefficient	P-value
constant	-	8.90	0.00
β1	u	-1.18	0.01
β2	inflation	0.07	0.04
β4	volume	-0.11	0.00
β5	Ms	0.65	0.00

Source: STATA; Author

As we can see that all the p-value are lower than the significance level at 5%, which means we should reject the null hypothesis (H0). Hence, based on the new adjusted model, we can say that all the parameters in the new adjusted model are statistically significant at the level of 5%.

b) Basic model during the crisis

Similarly, based on the chapter 4.2.2, we know that there five independent variables in this model, and we have already known the t-statistic results of each independent variables from the annex 1. And we made a table showing the results of T-test as below:

Table 4.6 T-test results of basic model during crisis

Parameters	Variables	|Tcal|	Tcrit	Result	Conclusion	Significant
β1	u	1.56	2.16	Tcal<Tcrit	Reject H1, accept H0	No
β2	inflation	2.03	2.16	Tcal<Tcrit	Reject H1, accept H0	No
β3	i	0.58	2.16	Tcal<Tcrit	Reject H1, accept H0	No
β4	volume	1.20	2.16	Tcal<Tcrit	Reject H1, accept H0	No
β5	Ms	0.75	2.16	Tcal<Tcrit	Reject H1, accept H0	No

Source: STATA; Author

In the table 4.6, the results of Tcal, which are based on the formula 3.5, are the absolute value of t-statistic value of each independent variable, and the result of Tcrit is calculated by the excel function while the observation is 19, the number of β is 6 and the significance level is 5%. According to the table, we can see that there is none parameters which is statistically significant at level of 5%, so we reject this model which has none significant variables. This suggests that we cannot find a strong relationship between the S&P500's close price and all those variables during the crisis.

Since we noticed that because of there are five inflation rates are lower than 0 at this time period, and that will lead to the fact that the number of our observation is too small (19). We try to use the original model without logarithmic transformation, and the results are shown as below:

Table 4.7 Adjusted regression model during crisis

Parameters	Variables	Coefficient	P-value
constant	-	10428.70	0.00
β1	u	145.93	0.01
β2	inflation	18.89	0.21
β3	i	-33.22	0.30
β4	volume	-1.74e-09	0.12
β5	Ms	-109.10	0.00

Source: STATA; Author

As shown in the table 4.7, there are some p-values more than 0.05, hence, we will do the T-test in the following.

Table 4.8 T-test results of adjusted model during crisis

Parameters	Variables	|Tcal|	Tcrit	Result	Conclusion	Significant
β1	u	2.86	2.16	Tcal>Tcrit	Reject H0, accept H1	Yes
β2	inflation	1.31	2.16	Tcal<Tcrit	Reject H1, accept H0	No
β3	i	1.07	2.16	Tcal<Tcrit	Reject H1, accept H0	No
β4	volume	1.60	2.16	Tcal<Tcrit	Reject H1, accept H0	No
β5	Ms	3.99	2.16	Tcal>Tcrit	Reject H0, accept H1	Yes

Source: STATA; Author

As we can see, in the table 4.8, the results of Tcal are the absolute value of t-statistic value of each independent variable, and the result of Tcrit is calculated by the excel function while the observation is 24, the number of β is 6 and the significance level is 5%. According to the table, we can see that there are two variable which are statistically significant at level 5%, and the rest variables are not statistically significant. Hence, we will remove the three unsuitable variables in this model based on the verdicts. And we have a new adjusted model shows as below:

Table 4.9 New adjusted regression model during crisis

Parameters	Variables	Coefficient	P-value
constant	-	9749.13	0.00
β1	u	115.40	0.03
β5	Ms	-102.03	0.00

Source: STATA; Author

As shown in table 4.9, all the p-value are lower than the significance level at 5%, which means we should reject the null hypothesis (H0). Hence, based on the new adjusted model, we can say that all the parameters in the new adjusted model are statistically significant at the level of 5%.

c) Basic model after the crisis

The methodology of these three models are the same. Hence, based on the chapter 4.2.3, we know that there 5 independent variables in this model, and we have already known the t-statistic results of each independent variables from the annex 1. In the annex 1, the results of Tcal are the absolute value of t-statistic value of each independent variable, and the result of Tcrit is calculated by the excel function while the observation is 80, the number of β is 6 and the significance level is 5%. According to the formula 3.5, we made a table showing the results of T-test as below:

Table 4.10 T-test results of adjusted model after crisis

Parameters	Variables	|Tcal|	Tcrit	Result	Conclusion	Significant
β1	u	7.00	1.99	Tcal>Tcrit	Reject H0, accept H1	Yes
β2	inflation	1.91	1.99	Tcal<Tcrit	Reject H1, accept H0	No
β3	i	7.57	1.99	Tcal>Tcrit	Reject H0, accept H1	Yes
β4	volume	2.54	1.99	Tcal>Tcrit	Reject H0, accept H1	Yes
β5	Ms	2.26	1.99	Tcal>Tcrit	Reject H0, accept H1	Yes

Source: STATA; Author

According to the table 4.10, we can see that there is only one variable β2 (inflation) which is not statistically significant at level 5%, and the rest variables are statistically

significant. Hence, we will remove the unsuitable variable β2 (inflation) in this model based on the verdicts. And we have a new adjusted model shows as below:

Table 4.11Adjusted model after crisis

Parameters	Variables	Coefficient	P-value
constant	-	8.70	0.00
β1	u	-0.58	0.00
β3	i	-0.07	0.00
β4	volume	-0.13	0.00
β5	Ms	-0.63	0.00

Source: STATA; Author

As can be seen that all the p-value are lower than the significance level at 5%, which means we should reject the null hypothesis (H0). Hence, based on the new adjusted model, we can say that all the parameters in the new adjusted model are statistically significant at the level of 5%.

In this part, we tested the significant of parameters, and we have three new adjusted models. After we removed some unsuitable variables or adjusted the whole model without logarithmic transformation, we can say these three models' parameters are all statistically significant at the level of 5%. According to the process, we get three different models which have different variables in the equations. Next, we will test the F-test of all three models in the following subchapter.

4.3.2 F-test

In this part, we will test the statistical significant of the whole model. We assume that the statistic is follow the F-distribution under the null hypothesis (Ho), the sums of squares should be statistically independent, and each should follow the scaled chi-squared distribution.

And here are the hypotheses of the F-test:

H0: $\beta_1 = \cdots = \beta_k = 0$ (The model is not statistically significant.)

H1: $\beta_1 \neq \cdots \neq \beta_k \neq 0$ (The model is statistically significant.)

a) Model before the crisis

Based on the chapter 4.3.1, we know that there four independent variables in this adjusted model, and we have already tested the T-test. Now we know that our significance level is still 5%, number of observations is still 91, and the number of variables (k) is 5.

And we use the data in the annex 2 to calculate the results using the formula 3.6:

$$Fcal=130.87$$

$$Fcrit=F_{0.05}(4;86) =2.48$$

According to the results, we notice that the Fcal>Fcrit, which means we should reject H0, and accept H1. Hence, we could say that this model is statistically significant at the level of 5%.

b) Model during the crisis

Similarly, based on the chapter 4.3.1, we know that there two independent variables in this adjusted model, and we have already tested the T-test. Now we know that our significance level is still 5%, number of observations changed to 24, and the number of variables (k) is 3.

And we use the data in the annex 2 to calculate the results using the formula 3.6:

$$Fcal=104.00$$

$$Fcrit=F_{0.05}(2;21) =3.47$$

Based on the results, we notice that the Fcal>Fcrit, which means we should reject H0, and accept H1. Hence, we could say that this model is statistically significant at the level of 5%.

c) Model after the crisis

In the model after the crisis, we know that there 4 independent variables in this adjusted model, and we have already tested the T-test. We know that our significance level is still 5%, number of observations changed to 89, and the number of variables (k) is 5.

And we use the data in the annex 2 to calculate the results using the formula 3.6:

Fcal=789.00

Fcrit=$F_{0.05}(4,84)$ =2.48

According to the results, we notice that the Fcal>Fcrit, which means we should reject H0, and accept H1. Hence, we could say that this model is statistically significant at the level of 5%.

In this part, we tested the significant of parameters and whole models. We did some adjustment during the T-test, and we have three new adjusted models. And we did the F-test according to these three new adjusted models. The results show that all parameters and all models are statistically significant at the level of 5% after the adjustment. Next part we will test the econometric verification of the parameters and models.

4.4 Econometric Verification

In this part we will test the econometric verification of the parameters and models. According to the theoretical part in the chapter 3, we will check if our models have autocorrelation, heteroscedasticity and multicollinearity. And if the verdict shows that the model has any of above characteristic, we will remove it; if the verdict shows that the model has none above characteristic, then we assume it is a good model.

We will first deduct the autocorrelation of each model, and then deduct the heteroscedasticity and last multicollinearity in the following subchapter.

4.4.1 Autocorrelation

According to the theoretical part, the autocorrelation of residual parts means the serial dependence time series residues and residues time delayed series. And we will use Durbin-Watson test (DW test) to deduct the autocorrelation.

The hypotheses are shown as below:

H0: $\rho = 0$ (There is no autocorrelation in our model.)

H1: $\rho \neq 0$ (There is autocorrelation in our model.)

a) Model before the crisis

According to the statistically verification in chapter 4.3, we have an adjusted model which has four independent variables, including unemployment rate (u), inflation rate (inflation), volume and money supply (Ms).

According to formula 3.7, we use DW test, and the result is:

Dcrit=0.71

Since this number is lower than the lower confidential interval dL (1.75), which means it has autocorrelation. In order to eliminate the autocorrelation in our model, we choose the Prais-Winsten method to remove it.

Table 4.12 Results after removing autocorrelation in model before crisis

DW original	0.71
DW transformed	1.94

Source: STATA; Author

In table 4.12, we get DW statistic transformed number is 1.94, which is higher than the upper confidential interval dU (1.75). Since if the DW calculated value is in the middle of dU and (4- dU), we conclude that we accept H0, and reject H1, which means there is no autocorrelation in our model. After we remove the autocorrelation of this model, this model has no autocorrelation which meets the assumption of regression model.

b) Model during the crisis

Similarly, according to the statistically verification in chapter 4.3, we have an adjusted model which has 4 independent variables, including unemployment rate (u), inflation rate (inflation), interest rate (i), volume and money supply (Ms).

We use DW test based on the formula 3.7, and the result is:

Dcal=0.82

Since this number is lower than the lower confidential interval dL (1.19), which means it has autocorrelation. In order to eliminate the autocorrelation in our model, we choose the Prais-Winsten method to remove it.

Table 4.13 Results after removing autocorrelation in model during crisis

DW original	0.82
DW transformed	1.53

Source: STATA; Author

In table 4.13, we get DW statistic transformed number is 1.53, which is higher than the upper confidential interval dU (1.45). Since if the DW calculated value is in the middle of dU and (4- dU), we conclude that we accept H0, and reject H1, which means there is no autocorrelation in our model. After we remove the autocorrelation of this model, this model has no autocorrelation which meets the assumption of regression model.

c) Model after the crisis

Using the same method, according to the statistically verification in chapter 4.3, we have an adjusted model which has 4 independent variables, including unemployment rate (u), interest rate (i), volume and money supply (Ms).

Based on the formula 3.7, we use DW test, and the result is:

$$Dcal=0.87$$

Since this number is lower than the lower confidential interval dL (1.56), which means it has autocorrelation. In order to eliminate the autocorrelation in our model, we choose the Prais-Winsten method to remove it.

Table 4.14 Results after removing autocorrelation in model after crisis

DW original	0.87
DW transformed	1.94

Source: STATA; Author

In the table 4.14, we get DW statistic transformed number is 1.94, which is higher than the upper confidential interval dU (1.75). Since if the DW calculated value is in the middle of dU and (4- dU), we conclude that we accept H0, and reject H1, which means there is no autocorrelation in our model. After we remove the autocorrelation of this model, this model has no autocorrelation which meets the assumption of regression

model.

4.4.2 Heteroscedasticity

In this part, we will deduct if our models have heteroscedasticity in three different periods. Since there is an assumption of the linear regression model is the variance of the error term should be constant. This also means the variance of each error should be equal to each other, otherwise we consider it has heteroscedasticity in the model.

The hypothesis is shown as below:

H0: $\lambda_1 = \lambda_2 = \cdots = \lambda_i = 0$ (There is no heteroscedasticity in our model.)

H1: $\lambda_1 \neq 0$ or $\lambda_2 \neq 0$ or … or $\lambda_i \neq 0$ (There is heteroscedasticity in our model.)

a) Model before the crisis

Based on the results of chapter 4.4.1, we know our model is good after removing the autocorrelation. And we need to use white test to deduct if this model has heteroscedasticity. And the results are shown in below.

P-value=0.26

We notice that the p value is 0.26 which is more than 0.05, which means we accept H0, and reject H1. And our null hypothesis (H0) is there is no heteroscedasticity in the model, which means our model does not have heteroscedasticity.

b) Model during the crisis

Similarly, based on the results of chapter 4.4.1, we know our model is good after removing the autocorrelation. Now we need to use white test to deduct if this model has heteroscedasticity. And the results are shown in below.

P-value=0.53

Since p value is 0.53 which is more than 0.05, which means we accept H0, and reject H1. And our null hypothesis (H0) is there is no heteroscedasticity in the model, which means our model does not have heteroscedasticity.

c) Model after the crisis

Since the methods of these three models are the same, based on the results of chapter 4.4.1, we know our model is good after removing the autocorrelation. Now we

need to use white test to deduct if this model has heteroscedasticity. And the results are shown in below.

P-value=0.12

Similarly, p value is bigger than 0.05, which means we accept H0, and reject H1. And our null hypothesis (H0) is there is no heteroscedasticity in the model, which means our model does not have heteroscedasticity.

4.4.3 Multicollinearity

In this part, we will test if the models have multicollinearity. The regression model should not have multicollinearity which is an assumption of linear regression model. In other words, the multicollinearity is the existence of a linear relationship between the observations of the explanatory variables. Hence, we will test if some variables of our regression model have linear relationship, and we will test multicollinearity by calculating the correlation between each independent variable.

a) Model before the crisis

According to the results of chapter 4.4.2, we know our model is without the autocorrelation and heteroscedasticity. Next, we need to use correlation matrix to deduct if this model has multicollinearity. According to the formula 3.9, and the results are shown in below:

Table 4.15 Correlation matrix of model before crisis

	Log u	Log inflation	Log volume	Log Ms
Log u	1	-	-	-
Log inflation	-0.55	1	-	-
Log volume	-0.01	0.06	1	-
Log Ms	0.26	0.03	0.87	1

Source: STATA; Author

The correlation between two independent variables should be lower than 0.8, otherwise, it shows there is a strong relationship between these two independent variables. We noticed that the correlation between volume and money supply (Ms) is

0.87, which is higher than 0.8. Hence, we should remove one of these two independent variables.

We chose to remove the volume in our model, and we calculated the variance inflation factor (VIF).

VIF=1.41

Since variance inflation factor (VIF) shows the degree of multicollinearity, when VIF is higher than 10, we could say the model has strong multicollinearity. And we can see that our VIF is 1.41, which is lower than 10, so we assume our model has no multicollinearity after removing one independent variable.

b) Model during the crisis

Due to the fact that results show that the correlation between unemployment rate (u) and money supply (Ms) is less than 0.8, which means two independent variables have no strong correlation, and our model has no multicollinearity.

c) Model after the crisis

Nearly same to the model before the crisis, according to the results of chapter 4.4.2, we know our model is also without autocorrelation and heteroscedasticity. Using the same process, we need to use correlation matrix to deduct if this model has multicollinearity based on the formula 3.9. And the results are shown in below.

Table 4.16 Correlation matrix of model after crisis

	Log u	Log i	Log volume	Log Ms
Log u	1	-	-	-
Log i	-0.13	1	-	-
Log volume	-0.38	0.43	1	-
Log Ms	-0.98	0.09	-0.47	1

Source: STATA; Author

As mentioned before, the correlation between 2 independent variables should be lower than 0.8. We noticed that the correlation between unemployment rate (u) and money supply (Ms) is 0.98, which is higher than 0.8. Hence, we should remove one of these 2 independent variables.

We chose to remove the money supply in our model, and we calculated the

variance inflation factor (VIF).

VIF= 1.44

Since the VIF is 1.44, which is lower than 10, so we suppose our model has no multicollinearity after removing one independent variable.

4.5 Economic Verification

After we did the deduction of the statistically verification, including autocorrelation, heteroscedasticity and multicollinearity of each model, in this subchapter, we will test if our models meet the requirement of model specification and normality of residuals. Hence, there are mainly 2 parts, and first we will test if our model is correctly specified, then we will test the distribution of our models' residuals to see if they are normal distribution.

4.5.1 Model Specification

In this part, we will test if our model is correctly specified. In other words, we will deduct if all important variables are in the model, and linear dependence is the good one for the model or not. In this subchapter, we need to work with the predicted values and residuals. And we chose to use Ramsey Regression Specification Error Test (RESET) to help us to analyze the unstandardized predicted values.

And here is the hypothesis of model specification:

H0: The regression model is correctly specified.

H1: The regression model is not correctly specified.

a) Model before the crisis

Based on the previous analysis, we get the adjusted model before the crisis which has 3 independent variables: unemployment rate (u), inflation rate and money supply (Ms). And we know that our old model has 91 observations (n), and number of parameters (k) are 4, also our model is under significance level of 5%. Now we suppose the number of new variables is 2 (df1), so the difference between the observations (n) and the total number of all variables in the new model is 85 (df2). And the old R-squared

is 0.81, while the new R-squared is 0.82.

According to the above information and formula 3.10, we calculated the results:

$$Fcal=1.50$$

$$Fcrit=F0.05(2,85) =3.10$$

As we noticed that the Fcal<Fcrit, which means we should accept H0, and reject H1. Hence, we could say that this model is correctly specified.

b) Model during the crisis

Similarly, according to the previous analysis, we get the adjusted model during the crisis which has 2 independent variables: unemployment rate (u) and money supply (Ms). We know that our old model has 24 observations (n), and number of parameters (k) are 3, also our model is under significance level of 5%.

We did the similar process of model using the method when we calculated the model before the crisis, which is that we suppose the number of new variables is 2 (df1), so the difference between the observations (n) and the total number of all variables in the new model is 19 (df2). And the old R-squared is 0.91, while the new R-squared is 0.93.

According to the formula 3.10, we calculated the results:

$$Fcal=3.39$$

$$Fcrit=F_{0.05}(2,19) =3.52$$

Since Fcal<Fcrit, which means we should accept H0, and reject H1. Hence, we could say that this model is correctly specified.

c) Model after the crisis

Using the similar process, based on the previous analysis, we get the adjusted model after the crisis which has 3 independent variables: unemployment rate (u), interest rate (i), and volume. We know that our old model has 89 observations (n), and number of parameters (k) are 4, also our model is under significance level of 5%.

Similarly, we did the same process of model than shown in the above samples, which is that we suppose the number of new variables is 2 (df1), so the difference between the observations (n) and the total number of all variables in the new model is

83 (df2). And the old R-squared is 0.970, while the new R-squared is 0.972.

According to the above information and formula 3.10, we calculated the results:

$$Fcal=3.07$$

$$Fcrit=F_{0.05}(2,83) =3.11$$

From this result, the Fcal<Fcrit, which means we should accept H0, and reject H1. Hence, we could say that this model is correctly specified.

Based on the Ramsey's RESET, we did the model specification to test if our models are correctly specified, and verdicts have shown that our models are correctly specified.

4.5.2 Normality Test of Residuals

In this part, we will test the distribution of our models' residuals to see if they are normal distribution. Since there are some assumptions of linear regression model using the least squares method which mentioned in the theoretical part in chapter 3, for instance:

- medium value of random component u is zero;
- variance of random component u is constant.

From these two prerequisites, we can assume that the residual component should be normal distribution.

And here are the hypotheses of model specification:

H0: The residuals have normal distribution.

H1: The residuals have not normal distribution.

a) Model before the crisis

We use Jarque-Bera test which mentioned in the chapter 3.5, to test the normality of residuals, according to the formula 3.11. And the result is shown below:

$$X^2=0.34$$

Since the result is higher than 0.05, which means we should accept H0 and reject H1, so we suppose that residuals have not normal distribution.

b) Model during the crisis

Similarly, we use JB test and formula 3.11 for the model during crisis as well. And the result is shown as below:

$$X^2=0.17$$

Also, this value is more than 0.05, which means we should accept H0 and reject H1, so we suppose that residuals have not normal distribution.

c) Model after the crisis

We use the same method that we used above. Based on the formula 3.11, the result is shown as below:

$$X^2=0.44$$

Based on this result, since it is bigger than 0.05, which means we should accept H0 and reject H1, so we suppose that residuals have not normal distribution.

4.6 Summary

In this part, we made a summary of all above analysis. At first, we introduced all five independent variables and dependent variable in our models. Then we did a series of tests or deductions of our models. Before we did the tests, we set up three basic models which suggests the relationship between the stock market and some selected economy variables in three periods (before, during and after crisis).

In the first step of our deduction, we did the statistical verification of our models, which included T-test and F-test. According to the T-test, we deducted if each parameter is statistically significant under the level of 5%, and the result showed that we should remove interest rate (i) in the model before the crisis, and remove inflation rate in the model after the crisis. Since we found out the logarithmic transformation is not suitable for the model during the crisis, we decided to use the model without logarithmic transformation, and the model during the crisis would suit the requirement of linear regression model after we removed the inflation rate, interest rate (i) and volume. According to the F-test, we noticed that all three adjusted models are statistically significant under the level of 5%.

In econometric verification, we tested the autocorrelation, heteroscedasticity and

multicollinearity of each models in order. For the autocorrelation deduction, we used the Durbin-Waston (DW) method to test each model, and it turned out all three models have autocorrelation. Thus, we use the Prais-Winsten method to remove the autocorrelation in each model. For the heteroscedasticity deduction, we used the White test to deduct, and all three models are without heteroscedasticity. For multicollinearity deduction, we used the correlation matrix to see the relationship between each independent variable, and used Variance Inflation Factor (VIF) to help us analyze. And it turned out that we should remove volume in the first model, and remove money supply (Ms) in the last model.

And last step, we did the model specification and tested the normality of residual component by using the Ramsey RESET, and Jarque-Bera test. The result is that all three models are correctly specified and their residuals are normal distribution which meets the assumptions of the linear regression model.

In the end, we get three new adjusted models for three periods.

$$\log(\mathrm{S\&P1}) = 7.25 - 1.09 \cdot \log(\mathrm{u}) - 0.06 \cdot \log(\mathrm{inflation}) + 0.39 \cdot \log(Ms) \qquad (4.4)$$

In the model before the crisis, we have three independent variables which include unemployment rate, inflation rate and money supply in the period before financial crisis, and these three variables used the logarithmic transformation in this model. Because the log-linear model is suitable to find the percent growth in the dependent variables for a unit change in the independent variables, which mentioned in the chapter 3.1. Hence, the unemployment rate and inflation rate have negative effect on the stock index S&P500's price, while the money supply has positive effect. According to the coefficient, we noticed that, for instance, when the unemployment rate rises 1% unit, the price of S&P500 will decrease 1.09% unit. Since the independent variable unemployment rate has the largest coefficient in this model, we can say that it has the strongest effect on the S&P500's price.

$$\mathrm{S\&P2} = 9739.13 + 115.40 \cdot (\mathrm{u}) - 102.03 \cdot (Ms) \qquad (4.5)$$

In the model during the crisis, we have only two independent variables which include unemployment rate and money supply in the period of the financial crisis, and

these variables are the original form, since we rejected the logarithmic transformation form of this model in the statistical verification in chapter 4.3. The unemployment rate has positive effect while the money supply has negative effect on the stock index. According to the coefficient, we noticed that, the coefficient of unemployment rate is bigger than the coefficient of money supply, we can say that unemployment rate has larger effect on the S&P500's price.

$$\log(S\&P3) = 14.16 - 0.91 \cdot \log(u) - 0.06 \cdot \log(i) - 0.20 \cdot \log(volume) \qquad (4.6)$$

In the model after the crisis, we have three independent variables: unemployment rate, interest rate and volume in the period after financial crisis, and these variables used the logarithmic transformation in this model. As mentioned in the above paragraphs, the log-linear model is to find the percent change. Thus, all three independent variables have negative effects on the stock index S&P500's price. According to the coefficient, we can say that, for instance, when the interest rate rises 1% unit, the price of S&P500 will decrease 0.06% unit. Since unemployment rate has the largest coefficient in this model, we can note that it has the strongest effect on the S&P500's price.

To conclude our above interpretations, from statistical econometrics method, we can say that the in each model, we have independent variable unemployment rate (u), but the effects in the three periods are different. In the model before and after crisis, we found out that the unemployment rate has negative effect on the stock price, while it has positive effect in the model during the crisis. For this result, we suppose that before and after crisis are the period which the US economy worked as normal, so that the stock index's price decreased when the unemployment rate increased; but since financial crisis was a huge shock to the US economy, and it made the whole economy behave abnormally, which leaded to this verdict. Also, for other independent variables, we can see that they have different effect on the stock index's price. In the period of financial crisis, the stock market is unstable, risky and hard to predict, and the whole economy will be hit by the crisis, thus, we suggest, from view of investors, they should be aware of the financial crisis' impacts on the stock market.

5 Conclusion

Financial crisis refers to the sharp, transient and cyclical deterioration of all or most of the financial indicators of a country or several countries and regions. One of the most common impacts is the sharp decrease of stock market. In 2007-08, the well-known global financial crisis influenced first US market, then the whole global financial market, by a hard hit. This is what investors afraid of, and even leading to the shrink of investment.

Thereby, based on our aim, this thesis was concentrated on evaluation of the impact of 2007-08 financial crisis on US stock market. Since we wanted to know which particular factors in the economy had influences before, during and after crisis, we distinguished our data into three periods from 2000 to 2016. We chose the one of the most important stock index, S&P 500 as the representative of the US stock market's movement, and five essential economic variables which related to the stock market and financial crisis to help us set up econometrics models, including unemployment rate, inflation rate, interest rate, volume that traded in the stock market, and money supply.

In this thesis, we first estimated three basic models for three different time periods. In the process of T-test and F-test, we deducted interest rate in the model before crisis, and inflation rate in the model after crisis. Since we found out the model during crisis have been rejected, we did some adjustment and tested it again. There are two independent variables left in the model during crisis, including the unemployment rate and the money supply. In the process of detecting autocorrelation, heteroscedasticity and multicollinearity, we removed volume in the model before crisis, and the money supply in the model after crisis. Then after model specification and normality test of the residuals, we had three adjusted models in three different time periods which met the assumptions of linear regression.

As for the model before crisis, we found out the unemployment rate had the strongest effects on the S&P 500's closing price according to our analysis. The unemployment rate and inflation rate had negative influences on the stock price. As for

the model during crisis, we noticed the unemployment rate had a positive relationship between the stock price based on our data and model. As for the model after crisis, we could note the unemployment rate, interest rate and volume that traded all had negative affects to the stock price.

To conclude our models, from statistical econometrics' point of view, the unemployment rate always has huge effect on the stock market. It has negative effect on the stock market when in the model before and after crisis, however, it has positive relationship with the stock price when in the model during crisis. For this verdict, we suppose since the financial crisis had a hard hit on the US economy, the whole economy behaved abnormally.

Based on the above conclusion, we could note the stock market is unstable, risky and hard to predict, when there is a financial crisis, since the most of economy indicators would behave abnormally. Therefore, we suggest, from investor's point of view, they should diversify investment and be aware of the financial crisis' impacts on stock market.

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List of Abbreviations

US	United State
S&P	S&P500
DJIA	Dow Jones Industrial Average
Ms	Money supply
U	Unemployment rate
I	Interest rate
OECD	Organization for Economic Co-operation and Development
DW	Durbin-Watson test
JB	Jarque-Bera test
VIF	Variance Inflation Factor
RESET	Ramsey Regression Specification Error Test

Declaration of Utilisation of Results from the Diploma Thesis

Herewith I declare that

- I am informed that Act No. 121/2000 Coll. – the Copyright Act, in particular, Section 35 – Utilisation of the Work as a Part of Civil and Religious Ceremonies, as a Part of School Performances and the Utilisation of a School Work – and Section 60 – School Work, fully applies to my diploma thesis;
- I take account of the VSB – Technical University of Ostrava (hereinafter as VSB-TUO) having the right to utilize the diploma thesis (under Section 35(3)) unprofitably and for own use;
- I agree that the diploma thesis shall be archived in the electronic form in VSB-TUO's Central Library and one copy shall be kept by the supervisor of the diploma thesis. I agree that the bibliographic information about the diploma thesis shall be published in VSB-TUO's information system;
- It was agreed that, in case of VSB-TUO's interest, I shall enter into a license agreement with VSB-TUO, granting the authorization to utilize the work in the scope of Section 12(4) of the Copyright Act;
- It was agreed that I may utilize my work, the diploma (bachelor) thesis or provide a license to utilize it only with the consent of VSB-TUO, which is entitled, in such a case, to claim an adequate contribution from me to cover the cost expended by VSB-TUO for producing the work (up to its real amount).

Ostrava dated 21.04.2018

Weizhi SUN 孙惟治

Student's name and surname

List of annexes

Annex 1: Data of all variables

time	S&P 500	u	inflation	i	volume	Ms	Log(S&P)
2000/1/1	1394.46	4	2.74	5.95	21494400000	54.05785	3.144406
2000/2/1	1366.42	4.1	3.22	6.01	20912000000	54.21226	3.135584
2000/3/1	1498.58	4	3.76	6.14	26156200000	54.56984	3.17568
2000/4/1	1452.43	3.8	3.07	6.28	20106460000	55.21765	3.162095
2000/5/1	1420.6	4	3.19	6.71	19898300000	55.07253	3.152472
2000/6/1	1454.6	4	3.73	6.73	21738300000	55.27918	3.162744
2000/7/1	1430.83	4	3.66	6.67	19089100000	55.48351	3.155588
2000/8/1	1517.68	4.1	3.41	6.61	20363700000	55.80974	3.18118
2000/9/1	1436.51	3.9	3.45	6.6	20838300000	56.22305	3.157309
2000/10/1	1429.4	3.9	3.45	6.67	25951400000	56.4088	3.155154
2000/11/1	1314.95	3.9	3.45	6.65	20532300000	56.53418	3.118909
2000/12/1	1320.28	3.9	3.39	6.45	23610800000	57.05429	3.120666
2001/1/1	1366.01	4.2	3.73	5.62	27829800000	57.64174	3.135454
2001/2/1	1239.94	4.2	3.53	5.26	21644400000	58.08523	3.093401
2001/3/1	1160.33	4.3	2.92	4.89	27806610000	58.75742	3.064582
2001/4/1	1249.46	4.4	3.27	4.53	25409990000	59.49928	3.096722
2001/5/1	1255.82	4.3	3.62	4.02	24525900000	59.46213	3.098927
2001/6/1	1224.38	4.5	3.25	3.74	24748030000	59.92999	3.087916
2001/7/1	1211.23	4.6	2.72	3.66	23793710000	60.27712	3.083227
2001/8/1	1133.58	4.9	2.72	3.48	23359200000	60.67069	3.054452
2001/9/1	1040.94	5	2.65	2.87	25025290000	61.95471	3.017426
2001/10/1	1059.78	5.3	2.13	2.31	29951280000	61.79798	3.025216
2001/11/1	1139.45	5.5	1.90	2.03	26330000000	62.303	3.056695
2001/12/1	1148.08	5.7	1.55	1.83	25128570000	62.91947	3.059972
2002/1/1	1130.2	5.7	1.14	1.74	29746200000	63.15747	3.053155
2002/2/1	1106.73	5.7	1.14	1.82	26047600000	63.49995	3.044042
2002/3/1	1147.39	5.7	1.48	1.91	26563200000	63.6381	3.059711
2002/4/1	1076.92	5.9	1.64	1.87	28568900000	63.63927	3.032183
2002/5/1	1067.14	5.8	1.18	1.82	26905500000	63.93647	3.028221
2002/6/1	989.82	5.8	1.07	1.81	29981510000	64.22672	2.995556
2002/7/1	911.62	5.8	1.46	1.79	42228720000	64.72244	2.959814
2002/8/1	916.07	5.7	1.80	1.73	29298400000	65.21469	2.961929
2002/9/1	815.28	5.7	1.51	1.76	27723710000	65.49796	2.911307
2002/10/1	885.76	5.7	2.03	1.73	37856310000	66.01575	2.947316
2002/11/1	936.31	5.9	2.20	1.39	29200960000	66.59508	2.97142
2002/12/1	879.82	6	2.38	1.34	25993640000	66.84236	2.944394
2003/1/1	855.7	5.8	2.60	1.29	30749580000	67.22431	2.932322
2003/2/1	841.15	5.9	2.98	1.27	25235300000	67.64574	2.924873

2003/3/1	848.18	5.9	3.02	1.23	30080030000	67.8849	2.928488
2003/4/1	916.92	6	2.22	1.24	29669610000	68.32143	2.962331
2003/5/1	963.59	6.1	2.06	1.22	30952100000	69.02032	2.983892
2003/6/1	974.5	6.3	2.11	1.04	31219400000	69.44524	2.988782
2003/7/1	990.31	6.2	2.11	1.05	31553200000	69.9874	2.995771
2003/8/1	1008.01	6.1	2.16	1.08	24881470000	70.66192	3.003465
2003/9/1	995.97	6.1	2.32	1.08	29940110000	70.33453	2.998246
2003/10/1	1050.71	6	2.04	1.1	32298500000	70.23121	3.021483
2003/11/1	1058.2	5.8	1.77	1.11	24463220000	70.29041	3.024568
2003/12/1	1111.92	5.7	1.88	1.1	27839130000	70.26836	3.046074
2004/1/1	1131.13	5.7	1.93	1.06	32820000000	70.36703	3.053513
2004/2/1	1144.94	5.6	1.69	1.05	27985600000	70.82098	3.058783
2004/3/1	1126.21	5.8	1.74	1.05	33597900000	71.23776	3.051619
2004/4/1	1107.3	5.6	2.29	1.08	31611900000	71.71375	3.044265
2004/5/1	1120.68	5.6	3.05	1.2	29326400000	72.60653	3.049482
2004/6/1	1140.84	5.6	3.27	1.46	27529500000	72.63323	3.057225
2004/7/1	1101.72	5.5	2.99	1.57	29285600000	72.79229	3.042071
2004/8/1	1104.24	5.4	2.65	1.68	26586800000	73.09762	3.043063
2004/9/1	1114.58	5.4	2.54	1.86	26829870000	73.50047	3.047111
2004/10/1	1130.2	5.5	3.19	2.04	31511000000	73.82671	3.053155
2004/11/1	1173.82	5.4	3.52	2.26	30460280000	74.13552	3.069601
2004/12/1	1211.92	5.4	3.26	2.45	31102500000	74.35146	3.083474
2005/1/1	1181.27	5.3	2.97	2.61	31498800000	74.4246	3.072349
2005/2/1	1203.6	5.4	3.01	2.77	29297410000	74.52212	3.080482
2005/3/1	1180.59	5.2	3.15	2.97	39014150000	74.62544	3.072099
2005/4/1	1156.85	5.2	3.51	3.09	43424270000	74.78914	3.063277
2005/5/1	1191.5	5.1	2.80	3.22	39321990000	74.98882	3.076094
2005/6/1	1191.33	5	2.53	3.38	40334040000	75.36497	3.076032
2005/7/1	1234.18	5	3.17	3.57	37464670000	75.73184	3.091379
2005/8/1	1220.33	4.9	3.64	3.77	42030090000	76.11263	3.086477
2005/9/1	1228.81	5	4.69	3.87	44777510000	76.50504	3.089485
2005/10/1	1207.01	5	4.35	4.13	49793790000	76.90441	3.081711
2005/11/1	1249.48	5	3.46	4.31	45102870000	77.09597	3.096729
2005/12/1	1248.29	4.9	3.42	4.45	41756130000	77.40594	3.096316
2006/1/1	1280.08	4.7	3.99	4.56	49211650000	77.89935	3.107237
2006/2/1	1280.66	4.8	3.60	4.72	42859940000	78.18147	3.107434
2006/3/1	1294.87	4.7	3.36	4.88	50905040000	78.34749	3.112226
2006/4/1	1310.61	4.7	3.55	5.03	43308430000	78.77821	3.117473
2006/5/1	1270.09	4.6	4.17	5.15	54312830000	78.85599	3.103834
2006/6/1	1270.2	4.6	4.32	5.35	54873260000	79.29599	3.103872
2006/7/1	1276.66	4.7	4.15	5.46	46348220000	79.77663	3.106075
2006/8/1	1303.82	4.7	3.82	5.38	50485620000	80.13305	3.115218

2006/9/1	1335.85	4.5	2.06	5.34	49001440000	80.44767	3.125758
2006/10/1	1377.94	4.4	1.31	5.33	56793620000	81.02235	3.13923
2006/11/1	1400.63	4.5	1.97	5.32	55343930000	81.42519	3.146323
2006/12/1	1418.3	4.4	2.54	5.32	47578780000	81.92673	3.151768
2007/1/1	1438.24	4.6	2.08	5.32	56686200000	82.36906	3.157831
2007/2/1	1406.82	4.5	2.42	5.31	51844990000	82.55133	3.148239
2007/3/1	1420.86	4.4	2.78	5.3	67622250000	82.94373	3.152551
2007/4/1	1482.37	4.5	2.57	5.31	57032470000	83.77962	3.170957
2007/5/1	1530.62	4.4	2.69	5.31	64958050000	83.93867	3.184867
2007/6/1	1503.35	4.6	2.69	5.33	65322800000	84.32296	3.17706
2007/7/1	1455.27	4.7	2.36	5.32	70337430000	84.67473	3.162944
2007/8/1	1473.99	4.6	1.97	5.49	91381760000	85.56287	3.168495
2007/9/1	1526.75	4.7	2.76	5.46	57809700000	85.77184	3.183768
2007/10/1	1549.38	4.7	3.54	5.08	76022580000	85.93785	3.190158
2007/11/1	1481.14	4.7	4.31	4.97	86246950000	86.22577	3.170596
2007/12/1	1468.36	5	4.08	5.02	64821670000	86.57755	3.166833
2008/1/1	1378.55	5	4.28	3.84	98475340000	86.96995	3.139423
2008/2/1	1330.63	4.9	4.03	3.06	78536130000	87.95096	3.124057
2008/3/1	1322.7	5.1	3.98	2.79	93189170000	88.71719	3.121461
2008/4/1	1385.59	5	3.94	2.85	85978630000	89.21525	3.141635
2008/5/1	1400.38	5.4	4.18	2.66	80990480000	89.35224	3.146246
2008/6/1	1280	5.6	5.02	2.76	96614040000	89.55541	3.10721
2008/7/1	1267.38	5.8	5.60	2.79	124980570000	90.09409	3.102907
2008/8/1	1282.83	6.1	5.37	2.79	86266010000	90.2694	3.108169
2008/9/1	1166.36	6.1	4.94	3.59	140007320000	91.08208	3.066833
2008/10/1	968.75	6.5	3.66	4.32	159823030000	92.34404	2.986212
2008/11/1	896.24	6.8	1.07	2.36	115660210000	92.93149	2.952424
2008/12/1	903.25	7.3	0.09	1.77	112884470000	94.98174	2.955808
2009/1/1	825.88	7.8	0.03	1.02	112090640000	95.92561	2.916917
2009/2/1	735.09	8.3	0.24	1.16	124492210000	96.26344	2.866341
2009/3/1	797.87	8.7	-0.38	1.07	161843640000	97.02968	2.901932
2009/4/1	872.81	9	-0.74	0.89	138855320000	97.06335	2.94092
2009/5/1	919.14	9.4	-1.28	0.57	131614940000	97.72858	2.963382
2009/6/1	919.32	9.5	-1.43	0.39	112653150000	97.84003	2.963467
2009/7/1	987.48	9.5	-2.10	0.35	106635790000	97.89576	2.994528
2009/8/1	1020.62	9.6	-1.48	0.3	116059270000	97.89227	3.008864
2009/9/1	1057.08	9.8	-1.29	0.25	112295490000	97.88066	3.024108
2009/10/1	1036.19	10	-0.18	0.24	113410990000	98.19877	3.015439
2009/11/1	1095.63	9.9	1.84	0.21	84981530000	98.54822	3.039664
2009/12/1	1115.1	9.9	2.72	0.22	89515330000	98.49249	3.047314
2010/1/1	1073.87	9.8	2.63	0.2	90947580000	98.05481	3.030952
2010/2/1	1104.49	9.8	2.14	0.19	84561340000	98.62949	3.043162

2010/3/1	1169.43	9.9	2.31	0.23	103683550000	98.58769	3.067974
2010/4/1	1186.69	9.9	2.24	0.3	116741910000	98.93946	3.074337
2010/5/1	1089.41	9.6	2.02	0.45	127662780000	99.57683	3.037191
2010/6/1	1030.71	9.4	1.05	0.52	110106750000	99.79974	3.013136
2010/7/1	1101.6	9.4	1.24	0.41	94778110000	99.91583	3.042024
2010/8/1	1049.33	9.5	1.15	0.32	85738250000	100.4975	3.020912
2010/9/1	1141.2	9.5	1.14	0.28	79589450000	100.8585	3.057362
2010/10/1	1183.26	9.4	1.17	0.27	89536270000	101.4286	3.07308
2010/11/1	1180.55	9.8	1.14	0.27	87151070000	101.6712	3.072084
2010/12/1	1257.64	9.3	1.50	0.3	80984530000	102.0404	3.099556
2011/1/1	1286.12	9.1	1.63	0.29	92164940000	102.4699	3.109281
2011/2/1	1327.22	9	2.11	0.28	59223660000	102.9947	3.122943
2011/3/1	1325.83	9	2.68	0.28	89507640000	103.4997	3.122488
2011/4/1	1363.61	9.1	3.16	0.23	77364810000	104.223	3.13469
2011/5/1	1345.2	9	3.57	0.21	81708980000	104.8197	3.128787
2011/6/1	1320.64	9.1	3.56	0.22	86122730000	105.7996	3.120784
2011/7/1	1292.28	9	3.63	0.24	81102170000	107.9868	3.111357
2011/8/1	1218.89	9	3.77	0.29	108419170000	110.4655	3.085965
2011/9/1	1131.42	9	3.87	0.33	102786820000	110.7511	3.053624
2011/10/1	1253.3	8.8	3.53	0.37	98063670000	111.1145	3.098055
2011/11/1	1246.96	8.6	3.39	0.41	84275050000	111.5963	3.095853
2011/12/1	1257.6	8.5	2.96	0.49	74742430000	112.0456	3.099543
2012/1/1	1312.41	8.3	2.93	0.4	79567560000	112.9732	3.11807
2012/2/1	1365.68	8.3	2.87	0.3	78385710000	113.4608	3.135349
2012/3/1	1408.47	8.2	2.65	0.29	83899660000	113.9728	3.148748
2012/4/1	1397.91	8.2	2.30	0.29	74761710000	114.6055	3.145479
2012/5/1	1310.33	8.2	1.70	0.29	86920490000	114.9735	3.117381
2012/6/1	1362.16	8.2	1.66	0.32	81582440000	115.7885	3.134228
2012/7/1	1379.32	8.2	1.41	0.3	73103810000	116.643	3.139665
2012/8/1	1406.58	8.1	1.69	0.26	70283810000	117.4638	3.148164
2012/9/1	1440.67	7.8	1.99	0.24	69784280000	118.4192	3.158565
2012/10/1	1412.16	7.8	2.16	0.23	71752320000	119.1251	3.149884
2012/11/1	1416.18	7.7	1.76	0.23	71489310000	119.8136	3.151118
2012/12/1	1426.19	7.9	1.74	0.24	66388180000	121.2729	3.154177
2013/1/1	1498.11	8	1.59	0.23	75848510000	121.5782	3.175544
2013/2/1	1514.68	7.7	1.98	0.22	69273480000	121.5271	3.180321
2013/3/1	1569.19	7.5	1.47	0.21	68527110000	122.3549	3.195676
2013/4/1	1597.57	7.6	1.06	0.2	77098000000	122.767	3.20346
2013/5/1	1630.74	7.5	1.36	0.2	76447250000	123.1896	3.212385
2013/6/1	1606.28	7.5	1.75	0.19	74946790000	123.8282	3.205821
2013/7/1	1685.73	7.3	1.96	0.14	68106820000	124.4829	3.226788
2013/8/1	1632.97	7.2	1.52	0.12	64802810000	125.1575	3.212978

2013/9/1	1681.55	7.2	1.18	0.11	66174410000	125.7623	3.22571
2013/10/1	1756.54	7.2	0.96	0.12	76647400000	127.0614	3.244658
2013/11/1	1805.81	6.9	1.24	0.12	63628190000	127.1624	3.256672
2013/12/1	1848.36	6.7	1.50	0.14	64958820000	127.8869	3.266787
2014/1/1	1782.59	6.6	1.58	0.12	75871910000	128.4755	3.251051
2014/2/1	1859.45	6.7	1.13	0.13	69725590000	129.4159	3.269384
2014/3/1	1872.34	6.7	1.51	0.12	71885030000	129.8965	3.272385
2014/4/1	1883.95	6.3	1.95	0.12	71595810000	130.5594	3.275069
2014/5/1	1923.57	6.3	2.13	0.11	63623630000	131.3535	3.284108
2014/6/1	1960.23	6.1	2.07	0.11	63283380000	131.9746	3.292307
2014/7/1	1930.67	6.2	1.99	0.13	66524690000	132.6851	3.285708
2014/8/1	2003.37	6.2	1.70	0.13	58131140000	133.023	3.301761
2014/9/1	1972.29	5.9	1.66	0.12	66706000000	133.4189	3.294971
2014/10/1	2018.05	5.7	1.66	0.12	93714040000	134.1027	3.304932
2014/11/1	2067.56	5.8	1.32	0.13	63600190000	134.581	3.315458
2014/12/1	2058.9	5.6	0.76	0.15	80743820000	135.4935	3.313635
2015/1/1	1994.99	5.7	-0.09	0.16	77330040000	136.2063	3.299941
2015/2/1	2104.5	5.5	-0.03	0.15	68775560000	137.567	3.323149
2015/3/1	2067.89	5.5	-0.07	0.14	76675850000	137.769	3.315527
2015/4/1	2085.51	5.4	-0.20	0.13	72060940000	138.317	3.319212
2015/5/1	2107.39	5.5	-0.04	0.15	65187730000	138.7082	3.323745
2015/6/1	2063.11	5.3	0.12	0.18	73213980000	139.2747	3.314522
2015/7/1	2103.84	5.2	0.17	0.19	77920590000	139.8692	3.323013
2015/8/1	1972.18	5.1	0.20	0.26	84626790000	140.474	3.294947
2015/9/1	1920.03	5	-0.04	0.27	79989370000	141.1044	3.283308
2015/10/1	2079.36	5	0.17	0.25	85844900000	141.4562	3.31793
2015/11/1	2080.41	5	0.50	0.3	75943590000	142.5405	3.318149
2015/12/1	2043.94	5	0.73	0.54	83649260000	143.2313	3.310468
2016/1/1	1940.24	4.9	1.37	0.57	92409770000	144.6442	3.287855
2016/2/1	1932.23	4.9	1.02	0.54	93049560000	145.4557	3.286059
2016/3/1	2059.74	5	0.85	0.55	92639420000	146.215	3.313812
2016/4/1	2065.3	5	1.13	0.55	81124990000	147.2436	3.314983
2016/5/1	2096.95	4.7	1.02	0.57	78883600000	148.0702	3.321588
2016/6/1	2098.86	4.9	1.00	0.55	86852700000	148.9467	3.321983
2016/7/1	2173.6	4.9	0.83	0.62	69530250000	149.6328	3.33718
2016/8/1	2170.95	4.9	1.06	0.73	75610310000	150.6638	3.33665
2016/9/1	2168.27	5	1.46	0.75	77270240000	151.3441	3.336113
2016/10/1	2126.15	4.9	1.64	0.72	73196630000	152.1115	3.327594
2016/11/1	2198.81	4.6	1.69	0.71	88299760000	152.9671	3.342188
2016/12/1	2238.83	4.7	2.07	0.87	75251240000	153.3688	3.350021

Annex 2: Estimated model

2-1: model before crisis

```
. regress LnSP500 Lnu Lninflation Lni Lnvolume LnMs
```

Source	SS	df	MS	Number of obs	=	91
				F(5, 85)	=	76.87
Model	1.7593999	5	.35187998	Prob > F	=	0.0000
Residual	.389083833	85	.004577457	R-squared	=	0.8189
				Adj R-squared	=	0.8083
Total	2.14848373	90	.023872041	Root MSE	=	.06766

LnSP500	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lnu	-1.082087	.1855182	-5.83	0.000	-1.450947	-.713227
Lninflation	-.0754678	.0273873	-2.76	0.007	-.129921	-.0210146
Lni	.0249552	.0420879	0.59	0.555	-.0587269	.1086373
Lnvolume	-.1233268	.059944	-2.06	0.043	-.2425116	-.004142
LnMs	.6673976	.1474661	4.53	0.000	.3741954	.9605998
_cons	9.026837	.8868331	10.18	0.000	7.263576	10.7901

2-2: model during crisis

```
. regress LnSP Lnu Lninflation Lni Lnvolume LnMs
```

Source	SS	df	MS	Number of obs	=	19
				F(5, 13)	=	52.44
Model	.890839781	5	.178167956	Prob > F	=	0.0000
Residual	.044170636	13	.003397741	R-squared	=	0.9528
				Adj R-squared	=	0.9346
Total	.935010417	18	.051945023	Root MSE	=	.05829

LnSP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lnu	-.6217866	.3996499	-1.56	0.144	-1.485178	.2416044
Lninflation	.0314991	.0154799	2.03	0.063	-.0019431	.0649412
Lni	-.0443178	.0765069	-0.58	0.572	-.2096008	.1209652
Lnvolume	-.1155554	.095996	-1.20	0.250	-.3229421	.0918313
LnMs	-1.863525	2.486479	-0.75	0.467	-7.235237	3.508187
_cons	19.51068	9.662078	2.02	0.065	-1.362973	40.38433

2-3: model after crisis

```
. regress LnSP Lnu Lninflation Lni Lnvolume LnMs
```

Source	SS	df	MS	Number of obs	=	80
				F(5, 74)	=	552.61
Model	4.33566205	5	.86713241	Prob > F	=	0.0000
Residual	.116118167	74	.001569164	R-squared	=	0.9739
				Adj R-squared	=	0.9722
Total	4.45178022	79	.056351648	Root MSE	=	.03961

LnSP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lnu	-.7332714	.1047203	-7.00	0.000	-.9419312	-.5246117
Lninflation	.0168899	.0088658	1.91	0.061	-.0007756	.0345554
Lni	-.0773476	.0102129	-7.57	0.000	-.0976972	-.0569979
Lnvolume	-.1021641	.0401492	-2.54	0.013	-.1821631	-.022165
LnMs	.4131835	.1830311	2.26	0.027	.048486	.777881
_cons	9.269223	1.730379	5.36	0.000	5.821367	12.71708

Annex 3: Adjusted model

3-1: model before crisis

```
. regress LnSP500 Lnu Lninflation Lnvolume LnMs
```

Source	SS	df	MS	Number of obs	=	91
				F(4, 86)	=	96.73
Model	1.75779063	4	.439447657	Prob > F	=	0.0000
Residual	.390693107	86	.004542943	R-squared	=	0.8182
				Adj R-squared	=	0.8097
Total	2.14848373	90	.023872041	Root MSE	=	.0674

LnSP500	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lnu	-1.181963	.0774433	-15.26	0.000	-1.335916	-1.028011
Lninflation	-.0729696	.026959	-2.71	0.008	-.1265624	-.0193769
Lnvolume	-.1083489	.0541562	-2.00	0.049	-.216008	-.0006899
LnMs	.6543622	.1452674	4.50	0.000	.3655802	.9431442
_cons	8.904364	.859185	10.36	0.000	7.19636	10.61237

3-2: model during crisis

```
. regress  SP500 u inflation i SP500volume Ms
```

Source	SS	df	MS	Number of obs	=	24
				F(5, 18)	=	58.18
Model	1559346.63	5	311869.327	Prob > F	=	0.0000
Residual	96487.8699	18	5360.43721	R-squared	=	0.9417
				Adj R-squared	=	0.9255
Total	1655834.5	23	71992.8046	Root MSE	=	73.215

SP500	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
u	145.9317	51.06574	2.86	0.010	38.64652	253.2168
inflation	18.89235	14.4601	1.31	0.208	-11.4872	49.2719
i	-33.22227	30.94792	-1.07	0.297	-98.24145	31.7969
SP500volume	-1.74e-09	1.09e-09	-1.60	0.127	-4.03e-09	5.45e-10
Ms	-109.0939	27.33118	-3.99	0.001	-166.5146	-51.67319
_cons	10428.7	2264.663	4.60	0.000	5670.821	15186.58

```
. regress SP500 u Ms
```

Source	SS	df	MS	Number of obs	=	24
				F(2, 21)	=	104.00
Model	1503985.54	2	751992.769	Prob > F	=	0.0000
Residual	151848.967	21	7230.9032	R-squared	=	0.9083
				Adj R-squared	=	0.8996
Total	1655834.5	23	71992.8046	Root MSE	=	85.035

SP500	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
u	115.3981	48.88949	2.36	0.028	13.7268	217.0693
Ms	-102.0312	19.41667	-5.25	0.000	-142.4104	-61.65203
_cons	9749.129	1466.1	6.65	0.000	6700.207	12798.05

Annex 3: Adjusted model (continued)

3-3: model after crisis

```
. regress LnSP Lnu Lni Lnvolume LnMs
```

Source	SS	df	MS	Number of obs	=	89
				F(4, 84)	=	791.98
Model	5.25535494	4	1.31383873	Prob > F	=	0.0000
Residual	.139350867	84	.001658939	R-squared	=	0.9742
				Adj R-squared	=	0.9729
Total	5.3947058	88	.061303475	Root MSE	=	.04073

LnSP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lnu	-.5792583	.0908348	-6.38	0.000	-.7598933	-.3986234
Lni	-.0680069	.0096267	-7.06	0.000	-.0871507	-.0488631
Lnvolume	-.1328955	.0387773	-3.43	0.001	-.2100084	-.0557826
LnMs	.6329919	.1713859	3.69	0.000	.2921723	.9738115
_cons	8.699099	1.698416	5.12	0.000	5.321612	12.07659

Annex 4: DW test results

4-1: model before crisis

```
Durbin-Watson statistic (original)    0.705224
Durbin-Watson statistic (transformed) 1.938236
```

4-2: model during crisis

```
Durbin-Watson statistic (original)    0.819875
Durbin-Watson statistic (transformed) 1.533202
```

4-3 model after crisis

```
Durbin-Watson statistic (original)    0.871768
Durbin-Watson statistic (transformed) 1.940596
```

Annex 5: White's test results

5-1: model before crisis

```
. estat imtest, white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(14)      =     16.99
         Prob > chi2   =    0.2566

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	16.99	14	0.2566
Skewness	6.49	4	0.1654
Kurtosis	0.82	1	0.3642
Total	24.31	19	0.1847

5-2: model during crisis

```
. estat imtest, white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(5)       =      4.17
         Prob > chi2   =    0.5255

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	4.17	5	0.5255
Skewness	2.57	2	0.2767
Kurtosis	0.04	1	0.8457
Total	6.78	8	0.5611

Annex 5: White's test results (continued)

5-3: model after crisis

```
. estat imtest, white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(14)      =     20.33
         Prob > chi2   =    0.1202

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	20.33	14	0.1202
Skewness	8.92	4	0.0632
Kurtosis	0.02	1	0.8820
Total	29.27	19	0.0619

```
.
```

Annex 6: Correlation matrix

6-1 model before crisis

```
. pwcorr Lnu Lninflation Lnvolume LnMs,sig
```

	Lnu	Lninfl~n	Lnvolume	LnMs
Lnu	1.0000			
Lninflation	-0.5487	1.0000		
	0.0000			
Lnvolume	-0.0113	0.0654	1.0000	
	0.9153	0.5378		
LnMs	0.2602	0.0284	0.8738	1.0000
	0.0128	0.7892	0.0000	

6-2 model after crisis

```
. pwcorr Lnu Lni Lnvolume LnMs,sig
```

	Lnu	Lni	Lnvolume	LnMs
Lnu	1.0000			
Lni	-0.1278	1.0000		
	0.2326			
Lnvolume	0.3752	0.4292	1.0000	
	0.0003	0.0000		
LnMs	-0.9778	0.0878	-0.4655	1.0000
	0.0000	0.4132	0.0000	

Annex 7: VIF results

7-1: model before crisis

```
. vif
```

Variable	VIF	1/VIF
Lnu	1.61	0.622777
Lninflation	1.50	0.667448
LnMs	1.12	0.890391
Mean VIF	1.41	

7-2: model after crisis

```
. vif
```

Variable	VIF	1/VIF
Lnvolume	1.59	0.627806
Lni	1.39	0.718705
Lnu	1.32	0.756996
Mean VIF	1.44	

Annex 8: Jarque-Bera test results

8-1: model before crisis

```
. sktest u_t

                    Skewness/Kurtosis tests for Normality
                                                              ------ joint ------
    Variable |        Obs  Pr(Skewness)  Pr(Kurtosis) adj chi2(2)    Prob>chi2
-------------+-----------------------------------------------------------------
         u_t |         89       0.5135        0.9554        0.44         0.8041
```

8-2: model during crisis

```
. sktest u_t

                    Skewness/Kurtosis tests for Normality
                                                              ------ joint ------
    Variable |        Obs  Pr(Skewness)  Pr(Kurtosis) adj chi2(2)    Prob>chi2
-------------+-----------------------------------------------------------------
         u_t |         24       0.9041        0.6964        0.17         0.9200
```

8-3: model after crisis

```
. sktest u_t

                    Skewness/Kurtosis tests for Normality
                                                              ------ joint ------
    Variable |        Obs  Pr(Skewness)  Pr(Kurtosis) adj chi2(2)    Prob>chi2
-------------+-----------------------------------------------------------------
         u_t |         89       0.5135        0.9554        0.44         0.8041
```