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# TABLE OF CONTENTS

ABSTRACT ......................................................................................................................... iii

LIST OF TABLES .................................................................................................................. iv

LIST OF FIGURES .............................................................................................................. v

1. INTRODUCTION .............................................................................................................. 1

2. LITERATURE ................................................................................................................... 5
   2.1 Theory of the Inflation ............................................................................................... 7
       2.1.1 The Relationship between Stock Price and Inflation ........................................ 10
       2.1.2 Previous Empirical Studies on the Relationship between Inflation and Stock Price .......................................................... 15

3. HYPOTHESIS .................................................................................................................. 20

4. RESEARCH DESIGN ....................................................................................................... 22
   4.1 Data .......................................................................................................................... 22
       4.1.1 Correlation Analysis ....................................................................................... 24
   4.2 Methodology ............................................................................................................ 25
       4.2.1 Vector Auto-regression Model ........................................................................ 26
       4.2.2 Impulse Response Function ............................................................................. 27

5. RESULTS ....................................................................................................................... 28
   5.1 Primary Results ....................................................................................................... 28

6. CONCLUSION ................................................................................................................ 35

REFERENCES ..................................................................................................................... 37
ABSTRACT

Identifying the causes of inflation has become more popular with investors and policy makers because after the financial crisis it has become more frequent and fluctuating. Many economic variables impact inflation, such as interest rate, unemployment rate and M2. In addition to the above variables, we will introduce stock price as a representation of financial asset prices, into the analysis.

This thesis investigates to what extent important results on relations among CPI, stock returns and other macroeconomic factors by utilizing the multivariate vector autoregressive (VAR) model on American and Chinese data. The thesis tests the hypothesis that stock prices impact the inflation rate. We find that stock price has a positive impact on inflation rate, though in a subtle, complex way.
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manual Adjusted Data (U.S.)</td>
<td>22</td>
</tr>
<tr>
<td>2. Automatically Adjusted Data (U.S.)</td>
<td>23</td>
</tr>
<tr>
<td>3. Automatically Adjusted Data (China)</td>
<td>23</td>
</tr>
<tr>
<td>4. Correlation of Automatically Adjusted Data (U.S.)</td>
<td>24</td>
</tr>
<tr>
<td>5. Correlation of Manual Adjusted Data (U.S.)</td>
<td>24</td>
</tr>
<tr>
<td>6. Correlation of Adjusted Data (China)</td>
<td>25</td>
</tr>
<tr>
<td>7. Regression Results of Inflation in two different countries</td>
<td>28</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Phillips Curve of the “New classic-comprehensive school”</td>
<td>9</td>
</tr>
<tr>
<td>2. Transmission mechanism of stock price changes</td>
<td>14</td>
</tr>
<tr>
<td>3. Impulse Response Function(U.S.)</td>
<td>30</td>
</tr>
<tr>
<td>4. Impulse Response Function(China)</td>
<td>32</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

Whether for the entire world or individual countries, inflation has always been one of the most important economic factors. Economists from various countries have proven the importance of price stability for the steady growth of a country’s economy through both theoretical and empirical study. Along with the development of technology and globalization, stock markets have undergone unprecedented development. High volatility of stock prices plays an increasingly important role in the price stability of a country.

In many countries, especially among developed countries with mature financial markets, the policy objectives of monetary authorities have changed from “economic growth, price stability, full employment and the international balance of trades” (Keynes, 1936) to focus more on stabilizing prices and the macro-financial system. Especially since the U.S. subprime mortgage crisis swept the globe in 2007, stability of financial markets and risk control by central banks has become increasingly important. Meanwhile, the relationship between stock prices and the level of inflation has become more complex. Focusing on the outbreak of the financial crisis 2008, governments have implemented similar bailout plans to inject large quantities of liquid assets into the market to prevent economic decline. Correspondingly, the central banks of most countries implemented expansionary monetary policy. They lowered interest rates to stimulate the economy and recover from the recession. Supervision of financial market was strengthened to prevent high volatility risk at the same time. However, liquidity injection comes with the added risk of inflation. China has recovered from the financial crisis very quickly. For example, the year industrial added value increased from 8.7% in 2009 to 10.7% in 2011. However, due to the four trillion RMB of infrastructure investment, excessive liquidity flowed into the market. According to the data of November 2010, the M2 growth rate is still maintained at a relatively
high 19.5%. The Marshall K value (M₂/Nominal GDP) of China has already increased to levels above the U.S. and other developed countries. This situation started a new round of inflation in China from the second half of 2010. Of course, this is just one of many predisposing factors. Since July 2010, China’s CPI growth crossed the 3% warning line and even reached 6.5% (July 2011). Into 2012, the indicator for China has dropped slightly, but the geopolitical situation is leading to price increases for international oil. For countries like China who have a high dependence on imported oil, the rise in oil and other commodity prices may cause a new round of cost-push inflation. Hence, the inflation will be a constraint of China’s economic development for a long time. After the financial crisis, the emerging financial markets of China have also undergone tremendous changes. The Shanghai composite Index fell from 6124 points in 2007 to a low of 1667 points in 2008, a 70% decline. In the following years, the shockwaves of the stock market repeated over and over. The volatility of financial market, especially the stock market, is evident.

Since 2011, the global economic recovery has been threatened by the intensification of euro-zone debt crisis, as well as the vulnerability of other emerging markets and developing countries. Deteriorated global financial conditions and poor prospects for economic growth increase the risk of a second recession. Accordingly, the International Monetary Fund (IMF) adjusted their expectation of 2012 annual output growth from 3.25% to 2.5%. In response to the risk of sovereign debt crisis in Europe, the European Central Bank is likely to loosen fiscal and monetary policies. They will continually provide liquidity to the market while,
purchasing the very securities they issued in order to maintain market confidence in the Euro zone.

The sustained injection of liquidity will inevitably increase the risk of global inflation, especially in China. The world’s hot money will flow into this huge market due to the appreciation of Chinese currency, the Renminbi (RMB). The pressure of imported inflation may increase in the near future. I will explore how financial assets such as stocks are affected by inflation in the marketplace. According to the Fisher Effect, stock prices would rise under inflationary conditions, and I aim to test the validity of this theory in relation to the real world. I will also explore policy implications of these findings.

Although there are many studies and much research on the relationship between inflation and stock price, there is no unified result for this relationship, neither are there clear theoretical explanations. The data used in this article is selected from the two most representative countries: U.S. which has the world’s most developed financial market and China, which represents the emerging markets. Whether for theoretical analysis or practical application, the relationship between inflation and stock prices is worthy of research, as this could be beneficial to governments and central banks when establishing their policies. From empirical test, the positive correlation can be found between stock price and inflation. However, it is very weak. The inflation itself from last period has the strongest influence to this period.

This paper is structured into six major chapters: In the second chapter, the theory of inflation is investigated. First, from the microeconomic point of view, the definition of inflation, classification, measurement methods, impact on the economy and the mature contemporary theory regarding the causes of inflation are explained. Most importantly, through the analysis of
the wealth effect, as well as Tobin’s Q Theory, the theoretical connection between stock prices and inflation is explored. After the extensive literature review, it was found that the effect between stock prices and inflation is not clear. Whether stock prices should be attributed as an early warning indicator of inflation is still not settled between different scholars. Chapter III presents the model. Then in chapter IV, the relevant data from the U.S. and Chinese markets is explained, followed by a descriptive statistical analysis. Chapter V presents the results based on the VAR model. Chapter VI presents the final conclusions from the perspective of economic theory. On this basis, the relevant policy recommendations and the further research are given.
2. LITERATURE

There is no single conclusion regarding the relationship between stock prices and inflation, though the findings observed in the present literature will be presented in the literature review section. When analyzing the stock price, inflation must be taken into account. Under moderate inflation, price increases are likely to cause the company’s profit to increase. People will reduce their liquidity preference and invest in the stock market to hedge against inflation. However, if hyperinflation happens, investors will take the money out of the stock market and invest in real estate or precious metal markets to hedge against inflation. Stock markets have little to no ability to hedge against inflation, which leads to herd behavior. Investors will scramble to sell their stocks, causing stock prices to fall sharply. Therefore, in theory, inflation is one of the important factors affecting stock prices.

Inflation means all products’ prices should rise. Single or localized commodity price increases cannot be labeled as inflation, since they could be caused by seasonal fluctuations. Inflation does not only mean direct price increases, but possibly reflects other factors, such as reducing the quality of goods. These hidden price increases tend to be ignored, but this is another form of inflation. Inflation is a pathological continuing rise in consumer prices that are not attributed to normal price increase, and such price increases must be sustained. Therefore, general inflation is defined as: When the price of most goods and services continually increase in an economy for a period of time, the economy is experiencing macroeconomic inflation.

The causes of inflation can be divided into demand-pull inflation, cost-push inflation and structural inflation. Demand-pull inflation is the commodities’ price continual increase when aggregate demand exceeds aggregate supply. In other words, under the full employment, the
production still cannot meet people’s needs, and then it is reflected in commodity price.

Cost-push inflation is the inflation caused by rising production costs, which can be divided into three sub-categories: The first one is the wage-push inflation. Due to the strong power of labor unions in western countries, wages of workers are no longer in equilibrium wages under a perfectly competitive labor market. This rise in wages will lead to a rise in the cost of doing business, and ultimately be reflected on commodity prices. This rise in wages and the increase in commodity prices have a mutually causal relationship, which signifies that they promote each other. The second sub-category is profit-push inflation, which occurs when monopoly and oligopoly firms continue to raise product prices in pursuit of high profits. This is quite similar to the wage-push inflation, because both of them occur in imperfect competition market. The third is the exchange rate cost-push inflation, which occurs when excessive volatility in exchange rates causes domestic product prices to increase. Structural inflation continual price increases in the absence of demand-pull or cost-push inflation. This is due to the economic structure, which is also why it is referred to as structural inflation. Consider an example in which two different sectors of one country have different productive efficiencies. Sector A has a higher efficiency, open policies and rapid development, while Sector B has low productivity, protective policies and declining growth. Depending on the productivity level, employees in Sector A should get higher wages than Sector B. However, in order equalize wages Sector B raises its wage growth rate. Ultimately, this inefficiency passes on to consumers as an increase in the commodity price level. This type of inflation is referred to as structural inflation.

The basic characteristics of inflation allow for it to be measured by calculating average price increases, which can act as an indicator of inflation. The result of inflation which is the
price increase can be used as inflation indicators. Composite Consumer Price can be used to reflect the level of price increases. It includes the Consumer Price Index, Product Price Index, Wholesale Price Index, GDP Deflator, Commodity Price Index, Cost of Living Index and Personal Consumption Expenditures Price Index. A consumer price index (CPI) measures changes in the price level of consumer goods and services purchased by households. This indicator is generally used to measure the level of inflation, which is main indicator I will use to measure inflation in this article.

2.1 Theory of the Inflation

Research on the causes of inflation started from the early 16th century. Bodin, who is representative of the French mercantilist school, attributed the increase in prices to an excess of hard currency, such as gold and silver. Until today, the causes of inflation are still controversial, and have no one unified theory. Early inflation theory includes the three different theories. The first is the quantity theory of money such as “Exchange equation” and “Cambridge equation”. The second is Marx’s theory of inflation and the third is the Keynesian inflation theory. After the great depression of 1930 and the world stagflation of 1970, there were many developments in inflation theory in an attempt to adapt theory to the reality of the economic situation. These developments emerged under new schools and theories, including Paul Samuelsson as the representative of the “New classic-comprehensive school”, Kaldor and Robinson as the representative of the “New Cambridge school”, Hicks as the representative of the structural inflation theory, Friedman as the representative of the modern monetarist inflation theory and the inflation theory of the rational expectation school.
Under early quantity theory of money, the Fisher exchange equation \((MV=PT)\) and Cambridge equation from Marshall \((M=KPY)\) explained the reason of inflation from the perspective of the quantity of money. They agreed that the other variables in the equation do not change during a given period, so the price depends only on the number of currency issued. Marx also pointed out the law of notes in circulation in his book. He wrote that when notes were issued excessively; there would be paper money devaluation and commodity price increases. This is because the banknotes are only representative of the metal currency in circulation, and have no inherent value. Keynesian inflation theory is developed based on the quantity theory of money. He thought that prices being merely dependent on the quantity of money in circulation and its velocity were unreasonable. He expounded his main idea which took into account key variable, interest rates. He asserts that changes in the quantity of money and prices are connected through interest rates. He believes that, in the case of non-full employment, increasing the money supply will bring the total social output to a higher level, while prices remain unchanged. This is known as half inflation. When manufacturers hire more workers to achieve full employment, total social output stops increasing. Simple issuance of the currency cannot play a role in increasing production and employment, as the commodity price will follow the issuance of currency. John Maynard Keynes calls this type of price increases real inflation.

Paul Samuelsson established his own theoretical framework as the representative of the New classic-comprehensive school. According to his Phillips curve in Figure 1, there is negative correlation not only between the wage changing rate and unemployment, but inflation and
unemployment. Hence, he suggests that under the macro environment, it is very important to select a reasonable combination of inflation and unemployment to achieve the minimum loss of social welfare.

![Figure 1. Phillips Curve of the “New classic-comprehensive school”](image)

“New Cambridge school”, which is represented by Kaldor and Robinson, believe they are the authentic Keynesian heritage, rather than the “New classic-comprehensive school”. They used the agricultural and mineral commodities price changes and economic uncertainty to observe their impact on inflation. “Stagflation” sweeping the world in 1970s proves that the bankruptcy of the “New classic-comprehensive school”, then they think the monopoly power of the various sectors of the economy on prices is the real cause of inflation.

Hicks’ structural inflation theory is developed on the basis of Marshall and Walras’ general equilibrium theory, and Keynesian macro-economic theory. He believes that there is a stark difference between the labor market and the general commodity market. The rigidity of wages, caused by the existence of strong labor unions, ensures that wages can only be increased. Employees in sectors that are about to be eliminated due to low productivity demand the same
wage level as those of new and high productivity sectors, which results in a rising spiral of wages and prices. These ideas are the basic theory of structural inflation.

Friedman’s new quantity theory of money is built on the early quantity theory of money. Based on the original Cambridge equation, he developed a more complex money demand function. Through quantitative analysis, he believes that inflation is only a monetary phenomenon, which only because the increase of money supply is faster than the increase of social total output. Hence, as long as the government controls the issuing speed of currency, inflation problems can be solved fundamentally.

The rational expectations school started in the 1960s, the antithesis of the Keynesian school. The inflation theory in the rational expectations school is built on the basis of the natural unemployment rate as well as Say’s Law. They think the government’s macro-economic policy should primarily focus on maintaining certain (price?) stability rather than reducing the unemployment rate, and only then will the public have a reasonable expectation of inflation. They think that due to the presence of a natural unemployment rate, unemployment will always exist, and so the government should pay close attention to preventing inflation and make relevant, stable policies, such as a fixed, long-term money supply growth rate.

2.1.1 The Relationship between Stock Price and Inflation

The stock market and its price volatility will affect a country’s inflation level. Overall, the rise of stock price will cause public consumption to increase, enterprises productions to expand and the employment rate rise. Finally, the inflation level will be promoted by the increase of the
commodities and financial assets prices. If stock price falls, the company value will decline, and in turn reduce the scale of production. The employment rate and public consumption will decline, making the inflation level fall. Changes in the stock market and stock price can influence the investment and consumption decisions of companies and individuals, leading to change in aggregate demand and thus affect output and price level.

However, the volatility of stock prices does not directly affect the macro-economy, but influences it through other credit systems. Under targeted inflation, the stock price affects consumption and investment decisions which then pass influence to the price level. Theoretically, the increase in stock price will stimulate consumption and investment, however, on the other hand, the excessive rise in stock prices will also contribute to short-term price increases, resulting in inflationary pressures.

From an economic view, investment and consumption affect the general price level. The allocation of resources that are used in current investment and consumption also affect the future social welfare level. There are two very important theories of price transmission in today’s academic research: one is Tobin’s Q theory from investment aspect, another is wealth effect from consumption aspect.

- Tobias Q Effect

In 1969, James Tobin proposed a very famous theory, which is Tobin’s Q effect. Tobin’s q is the ratio between the market value and replacement value of the same physical asset, which remains between 0.5 and 0.6 in western developed countries.

Q ratio=the market value/capital replacement cost

Although this ratio formula is very simple, it is one of the theories which combines the real
economy with virtual economy effectively. It measures the value of the enterprises from two different markets. When the q value is greater than 1, purchasing new equipment to enlarge production is more favorable, because it will increase the demand for investment. If the q value is less than 1, purchasing the company needed to expand production from the stock market will lead to more cost savings. Therefore, the conduction mechanism in simple terms follows that when the central bank increases the money supply, stock prices will rise, along with Tobin’s Q value, which will cause investment expansion and increase final social output.

➢ Wealth Effect

The wealth effect was developed by C. Haberler(1939) after conducting research on the non-full employment equilibrium. He believes that the implementation of monetary policy will cause fluctuations in the amount of money in circulation, which will affect household wealth. For example, if prices begin to decline, the actual value of the currency will rise, so currency holders would be willing to spend more, which will result in increase in aggregate demand and production expansion. Finally, the employment rate will rise and the total social output will increase.

When using the wealth effect to analyze the stock market, if the stock price goes up, shareholders will view the change as in increase in disposable wealth. Increases in total nominal assets, or future income expectations, will increase people’s consumption preferences and ultimately cause an increase in total output. However, this wealth effect causes aggregate demand to exceed aggregate supply. This will lead to increases in all commodity and service prices, ultimately resulting in inflation. Of course, this wealth effect doesn’t necessarily lead to inflation, but at least it shows that the central bank’s monetary policy is effective and has a deep
influence on the macro-economy. From a consumption perspective, the wealth effect is mainly shown from the following three aspects:

(1) Through affecting people’s income expectations, thereby enhancing confidence of the stock market and raising the marginal consumption tendency, thus expanding consumption. This theory was proposed by Romer(1999) when he did the research about how U.S. stock market affected consumption from 1929 to 1932. He believes that ongoing bull markets indicate a good macro-economic environment, which is beneficial to the development of most enterprises. This increases individual and enterprise confidence to expand consumption and investment.

(2) Through affecting investors’ real income to increase their consumption. In a bull market, compared to dividends, capital gains will result in higher income. Hence, summing up the two parts will be very impressive, which will lead to increase consumption.

(3) Through affecting financing conditions of enterprises to impact consumption indirectly. This point should be combined with Tobin’s Q theory. In short, in a bull market, the listed companies’ financing cost will be lower. They are then willing to expand their investment which indirectly promotes consumption.
Figure 2 represents when the money supply goes up, it will encourage stock prices to rise quickly. In this case, Tobin’s Q and households’ wealth rise together, which will increase enterprises’ investment and social consumption. Finally, the total output will increase which may be one of the reasons for inflation.
2.1.2 Previous Empirical Studies on the Relationship between Inflation and Stock Price

Irving Fisher (1911) is one of the earliest economists who began studying the relationship between inflation expectations and asset prices. The famous Fisher effect proposed by him illustrates that bank notes begin to depreciate when inflation occurs. Residents will find relatively safe assets in which to invest to ensure that their purchasing power is not affected, while stocks are reasonable hedging tools.

Goodhart (1993) also points out that the price index used by the central bank should not only include the price of consumption and production, but also the price of goods and services in the future. Only this index can reflect economic development, and on this basis the effective monetary and fiscal policy questions will be raised.

Fama (1981), Danthine & Donaldson (1986) and Gallagher & Taylor (2002) find results contrary to Fisher. Their findings suggest a significant negative correlation between the rate of inflation and stock returns.

Smets (1997) discovers one reason for asset price volatility to affect inflation. One impact of changes in asset prices is that they will influence the household wealth and consumption. By affecting corporate investment and financing capabilities, the total needs of the community as a whole will be influenced, whereby the potential for demand-pull inflation will arise. The second reason is that even if asset prices have little effect on aggregate demand, the information in and of itself will be able to change people’s inflation expectations, eventually affecting the central bank’s monetary policy. For example, if the stock market is strong and efficient, the stock price itself already contains the past, present and future information (You could mention the Efficient Markets Hypothesis here). Hence, it can affect people’s expectations, which then affect household investment decisions.
On this basis, Lowe and Kent(1997) point out that compared with the fall of asset prices, the rise of asset prices will have a stronger impact on output and inflation. Furthermore, they illustrate that the effects of asset price volatility on output and inflation are quite different.

Shiratsuka’s(1999) empirical study examine whether or not the volatility of asset prices can affect inflation expectations. The study finds that at the 5% significance level, the price index of total assets is the Granger cause of the GDP deflator, but the GDP deflator index is not the Granger cause of the price index of total assets.

Jaeuk Khil, Bong-Soo Lee(2000) use 11 countries and regions’ data to investigate the relationship between inflation and returns to stock equity from 1970 to 1997. The sample includes the United States, Australia and Southeast Asia. Except for Malaysia and the United States, all other nine countries and regions have shown a negative correlation between these two figures.

Empirical Analysis from Goodhart and Hofmalm(2000, 2001) identifies some factors that may cause inflation, including output, broad money growth(M2) and short-term interest rates, etc. Through further investigation, they find that if the volatility of stock prices and real estate price index were added to the original regression and the variables were lagged two periods, the coefficient of determination is significantly improved. On this basis, they derive the financial Condition Index (FCI) through the coefficient estimates of the economic model and the VAR pulse response function. The index is set up by the weighted average of short-term interest rates, the effective real exchange rate, the actual real estate prices and the real stock prices. The real estate and stock prices have a high proportion of the weight. This weighted index helps significantly in predicting inflation levels.
Different scholars have different descriptions on whether the volatility of asset prices should attract the attention of central banks and monetary authorities. Filardo(2001) asserts that the relationship between asset prices and inflation can’t be drawn by using simple empirical methods. Because prices in the stock market and real estate market are not necessarily the reflection of their true value, their impacts on inflation expectation are very complex. Hence, the central banks should not change their inflation expectation and adjust the appropriate monetary policy due solely to changes in asset prices. At the same time, other scholars such as Goodhart(2001), Kontnonikas and Montagnoli(2002, 2004) adhere to a completely different point of view. The empirical analysis shows that the correlation of stock prices and inflation is not very strong, but that there is a significant correlation between changes in real estate prices and inflation. Therefore, the changes in the asset prices should arouse the attention of monetary authorities.

Ceechetti, Genberg, Lipsky and Wadhawani(2000) propose the use of their CGLW model structure which proposes that changes in asset prices are one of the most important indicators of inflation expectation. Without the disturbance factors, the relationship between the asset price and inflation would be stable. This endogenous disturbance factor explains the unstable relationship between asset price movements and inflation, and is worthy of further research. In relation, Stock and Watson (2001) use many economic indicators, including various types of asset prices, to predict the level of inflation in the United States in the following years. However, the results appear insignificant, raising doubt about the CGLW model. They don’t believe that the changes in asset prices should be the basis on which to forecast future inflation.

Svesson (2003) raises — target system for the inflation problem, which minimizes the overall utility loss of the utility loss function to find out that interest rate. This model can
estimate an inflation and output level by forecasting changes in asset prices and asset price bubbles. However, finding a trustworthy estimate of the asset price bubble is difficult and the key problem in this estimation. How to screen the level of asset price bubble and a reasonable degree of the bubble is the key problem to this system.

Hess & Lee (1999) find that inflation and stock returns would show a different relationship under different circumstances by studying the impact of the real economy. Hence, both of them think that the relationship between these two variables is unstable. Antonio Diaz and Francisco Jareno (2009) also consider that the relationship between the two cannot be determined.

In conclusion of an extensive literature review including research on the relationship between total asset prices and inflation, as well as the relationship between stock price and inflation, the two main paradigms are as follows: One party believes that the changes of stock price and inflation level have a significant relationship. At first, most scholars found they should have a positive relationship from a theoretical aspect. However, after much empirical analysis, a negative correlation between them arose. Overall, this group agreed that the central banks and monetary authorities should consider the changes of stock prices when they figure into inflation factors.

The other party’s view is that the relationship between inflation and changes in stock price is neither significant nor certain. Because there are too many factors that can affect inflation and the stock price change is difficult to estimate, the relationship between the two is very complex and difficult to measure. Especially when there is a bubble in the stock market, the prices of stocks include a miscalculation, which makes it more difficult to measure the relationship between these two figures. They believe that there is no need to consider stock price changes
when the central banks and monetary authorities solve the inflation problem through making appropriate policies. Furthermore, the estimation of stock prices changes is a difficult task, let alone taking delayed effects into account.
3. HYPOTHESIS

My primary research question centers on the effect of stock price on inflation. Traditional models normally just built on stock returns and CPI. There are restrictions to this kind of model. We do not know how to find a general representative stock return, every researcher could use different index. Another problem regards a variable’s quantity. We know that not only stock price could influence inflation, but many other economic factors could influence inflation. Hence, when we build the model, we should consider these requirements.

Prime studies found a very innovative index – Financial Conditions Index, which includes short-term interest rate, real exchange rate, real estate price and real stock price. (See Goodhart and Hofmalm, 2000, 2001) This is a very comprehensive index for predicting inflation. However, in this index, real estate prices are heavily weighed, so it is difficult to distinguish the effect of stock prices. Furthermore, this index doesn’t represent the financial assets price, because there are still some doubts as to whether or not real estate belongs in financial assets.

Another famous prior study of this topic built up the CGLW structural model. They used the model to test whether changes in asset prices was one of the most important variables for predicting inflation. Here, assets are not only financial assets, but includes many other different assets. However, under their model, it is too difficult to distinguish destabilizing factors.

I predict that inflation will have some effects on stock prices, though it is difficult to estimate the size of this effect and the length of the persistence. Comparing the differing markets of U.S. and China will pose difficult due to different market mechanisms. Different
goals of government intervention may cause the relationship between inflation and stock market to differ between the two countries. Coupled with other factors, such as the unemployment rate and the market interest rates, the relationship between the two will become even more complex.

I also predict that, due to the complex interaction between inflation and stock market, it is improbable that investors want to take advantage of the inflation rate to predict stock price movements. The government will be reluctant to use the stock market as a predictor of future inflation for the same reason. Same difficulties that the government wants to use the performance of the stock market to predict future inflation. Only though the additions of many other factors will this kind of prediction be possible and accurate.
4. RESEARCH DESIGN

4.1 Data

For both U.S. and China, I chose four variables to represent inflation, stock price, unemployment rate and interest rate. All data are monthly observations, starting in January 2002 and going through December 2011.

For the U.S., CPI and unemployment rates are both from United States Department of Labor Bureau of Labor Statistics (http://stats.bls.gov). Standard & Poor’s 500 index is chosen here to represent the stock returns of the whole market. It is adjusted closing data from Yahoo Finance. The 10-year U.S. treasury security yield is chosen here to be the most representative data of interest rate of the U.S., and it is from the Fed’s FRED II website.

However, due to the two types of CPI, we have two sets of data here for the U.S. which has quite different results when they are used for analysis in the next chapter. One is already adjusted once downloaded from United States Department of Labor website, while the other is adjusted by Eviews Census X12 method.

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<th>Table 1. Manual Adjusted Data (U.S.)</th>
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<td>CPI&lt;sub&gt;MA&lt;/sub&gt;</td>
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<td>Std. Dev.</td>
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<td>Skewness</td>
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<td>Kurtosis</td>
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In Table 1, CPI<sub>MA</sub> represents the adjusted U.S. CPI, and is taken directly from the United States Department of Labor website. SP<sub>A</sub> represents the percentage changes of adjusted S&P 500 index, UR<sub>U</sub> represents unemployment rate and TY<sub>U</sub> represents the 10-year U.S. treasury...
Simple descriptive statistics from Table 1 indicate that the average monthly CPI percentage change in the U.S. during the sample period is 0.20%, which is not very volatile. The average monthly S&P index percentage change is 0.12% and the average unemployment rate is 6.5275%.

Table 2. Automatically Adjusted Data (U.S.)

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<td>0.285000</td>
<td>5.750000</td>
<td>4.125000</td>
</tr>
<tr>
<td>Maximum</td>
<td>1.400000</td>
<td>5.090000</td>
<td>10.00000</td>
<td>5.230000</td>
</tr>
<tr>
<td>Minimum</td>
<td>-1.800000</td>
<td>-7.440000</td>
<td>4.400000</td>
<td>2.010000</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.352836</td>
<td>2.448686</td>
<td>1.904217</td>
<td>0.710611</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.624172</td>
<td>-0.670808</td>
<td>0.706423</td>
<td>-0.509389</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>12.45899</td>
<td>3.865480</td>
<td>1.855743</td>
<td>2.699872</td>
</tr>
</tbody>
</table>

Similar to table 1, in table 2 SP_A represents the percentage changes of adjusted S&P 500 index, UR_U represents unemployment rate, and TY_U represents the 10-year U.S. treasury yield. The only difference is CPIAA which represents U.S. CPI as seasonally adjusted by Eviews 5.0.

For China, monthly CPI is from China Economic Information Network (http://db.cei.gov.cn/). I chose the adjusted closing data from Yahoo Finance for the Shanghai Stock Exchange Composite Index (SSEC) as the stock market price. Unemployment rate is also from CEI Network, but there are only quarterly observations. The 7-Day repurchase moving average interest rate is selected as the representative interest rate, and comes from the China Foreign Exchange Trade System (CFETS).
Table 3. Automatically Adjusted Data (China)

<table>
<thead>
<tr>
<th></th>
<th>CPIc</th>
<th>SSECI</th>
<th>URc</th>
<th>RMAIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.189583</td>
<td>0.348667</td>
<td>4.111583</td>
<td>2.297167</td>
</tr>
<tr>
<td>Median</td>
<td>0.135000</td>
<td>-0.165000</td>
<td>4.145000</td>
<td>2.175000</td>
</tr>
<tr>
<td>Maximum</td>
<td>0.770000</td>
<td>13.91000</td>
<td>4.340000</td>
<td>4.260000</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.350000</td>
<td>-9.330000</td>
<td>3.590000</td>
<td>0.980000</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.252422</td>
<td>5.001290</td>
<td>0.163815</td>
<td>0.807668</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.185769</td>
<td>0.363048</td>
<td>-1.505431</td>
<td>0.795721</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>2.753064</td>
<td>2.877553</td>
<td>5.485983</td>
<td>3.247357</td>
</tr>
</tbody>
</table>

In Table 3, CPIc represents monthly CPI of China, SSECI represents the percentage change of Shanghai Stock Exchange Composite Index, URc represents the unemployment rate, and RMAIR represents 7-Day repurchase moving average interest rate in China.

Table 3 shows that the average CPI change in China during the sample period is 0.18% which is controlled very well by government. The average monthly Shanghai Stock Exchange Composite Index percentage change is 0.34% and the average unemployment rate is 4.112%.

4.1.1. Correlation Analysis

Table 4. Correlation of Automatically Adjusted Data (U.S.)

<table>
<thead>
<tr>
<th></th>
<th>CPIt</th>
<th>S&amp;P500t</th>
<th>URt</th>
<th>IRt</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPIt</td>
<td>1.000000</td>
<td>0.240421</td>
<td>-0.106337</td>
<td>0.142542</td>
</tr>
<tr>
<td>S&amp;P500t</td>
<td>0.240421</td>
<td>1.000000</td>
<td>0.169265</td>
<td>0.002976</td>
</tr>
<tr>
<td>URt</td>
<td>-0.106337</td>
<td>0.169265</td>
<td>1.000000</td>
<td>-0.804241</td>
</tr>
<tr>
<td>IRt</td>
<td>0.142542</td>
<td>0.002976</td>
<td>-0.804241</td>
<td>1.000000</td>
</tr>
</tbody>
</table>

Compared with the other two variables, stock price has the strongest positive correlation with CPI, at 0.24. Following is the 10-year treasury yield at 0.14. The unemployment rate has a negative correlation with CPI, which is consistent with the Phillips Curve.
Table 5. Correlation of Manual Adjusted Data (U.S.)

<table>
<thead>
<tr>
<th></th>
<th>CPI&lt;sub&gt;t&lt;/sub&gt;</th>
<th>S&amp;P500&lt;sub&gt;t&lt;/sub&gt;</th>
<th>UR&lt;sub&gt;t&lt;/sub&gt;</th>
<th>IR&lt;sub&gt;t&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI&lt;sub&gt;t&lt;/sub&gt;</td>
<td>1.000000</td>
<td>0.369155</td>
<td>-0.307999</td>
<td>0.292367</td>
</tr>
<tr>
<td>S&amp;P500&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.369155</td>
<td>1.000000</td>
<td>0.169265</td>
<td>0.002976</td>
</tr>
<tr>
<td>UR&lt;sub&gt;t&lt;/sub&gt;</td>
<td>-0.307999</td>
<td>0.169265</td>
<td>1.000000</td>
<td>-0.804241</td>
</tr>
<tr>
<td>IR&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.292367</td>
<td>0.002976</td>
<td>-0.804241</td>
<td>1.000000</td>
</tr>
</tbody>
</table>

As shown above, stock price has a stronger positive correlation with CPI, at 0.37. Following is the 10-year treasury yield, at 0.29. However, unemployment rate has a negative correlation with CPI, which is also consistent with Phillips Curve. The results are almost the same with the automatically adjusted data, the main difference being that the relationships seem to be slightly stronger than in the previous.

Table 6. Correlation of Adjusted Data (China)

<table>
<thead>
<tr>
<th></th>
<th>CPI&lt;sub&gt;t&lt;/sub&gt;</th>
<th>SSECI&lt;sub&gt;t&lt;/sub&gt;</th>
<th>UR&lt;sub&gt;t&lt;/sub&gt;</th>
<th>IR&lt;sub&gt;t&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPI&lt;sub&gt;t&lt;/sub&gt;</td>
<td>1.000000</td>
<td>0.190773</td>
<td>0.211714</td>
<td>0.430247</td>
</tr>
<tr>
<td>SSECI&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.190773</td>
<td>1.000000</td>
<td>0.197800</td>
<td>-0.350137</td>
</tr>
<tr>
<td>UR&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.211714</td>
<td>0.197800</td>
<td>1.000000</td>
<td>-0.258066</td>
</tr>
<tr>
<td>IR&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.430247</td>
<td>-0.350137</td>
<td>-0.258066</td>
<td>1.000000</td>
</tr>
</tbody>
</table>

As table 6 showed, according to the data of China, CPI has positive relationship with all three x variables. Interest rate has the strongest influence on CPI, then the employment rate, and least is the SSEC Index. This result is quite different than those of the U.S. This may be caused by many different factors, such as different CPI structure or the authenticity of the data.
4.2 Methodology

My model specifies that inflation will be a function of itself, stock price, unemployment rate and interest rate. I specify the demand function in structural form as:

\[ \text{CPI}_t = \beta_1 \text{CPI}_{t-1} + \beta_2 \text{STOCK}_t + \beta_3 \text{UR}_t + \beta_4 I_t + \varepsilon_t \]

CPI\(_t\) represents inflation now, and CPI\(_{t-1}\) represents the last period’s inflation level. Stock\(_t\) represents the stock price which here is stock price index. UR\(_t\) represents the unemployment rate. I\(_t\) represents the interest rate.

To study the relationship between inflation and stock market, there are some other important variables introduced in this model. Unemployment rate, which has a negative relationship with inflation according to Phillips curve, and interest rate, which also has a strong influence on inflation, are both used here to make my model more complete. In the meanwhile, the previous CPI also used in the model because it has a strong impact to this period’s CPI.

4.2.1 Vector Auto-regression Model

Vector auto-regressive model (VAR) is an unstructured multi-equation model applied to the variables of time-series data generation process. It extends the single variable autoregressive model to multi-variables time series regression model. Sims (1980) introduced the VAR model into economics analysis and it greatly promoted the development of dynamic economics.

The mathematical expression of VAR model:

\[ y_t = \varphi_1 y_{t-1} + \cdots + \varphi_p y_{t-p} + Hx_t + \varepsilon_t \quad t=1,2,\ldots,T \]

Where, \( y_t \) is a column vector of endogenous variables, \( x_t \) is a column vector of
exogenous variables, and \( p \) is the number of lags. In my VAR model, \( Y \) represents CPI, \( X_1 \) represents stock price, \( X_2 \) represents unemployment rate and \( X_3 \) represents interest rate.

Normally, the VAR model requires that each variable is stationary. However, with the development of co-integration theory, the VAR model can be used even with non-stationary time-series data.

The four variables which are \( CPI_t, Stock_t, UR_t \) and \( I_t \) are used here to build up the VAR model. It is showed as followed:

\[
CPI_t = a_0 + a_1 \sum_{i=1}^{p} CPI_{t-i} + a_2 \sum_{i=1}^{p} STOCK_{t-i} + a_3 \sum_{i=1}^{p} UR_{t-i} + a_4 \sum_{i=1}^{p} I_{t-i} + e
\]

\[
STOCK_t = a_0 + a_1 \sum_{i=1}^{p} STOCK_{t-i} + a_2 \sum_{i=1}^{p} CPI_{t-i} + a_3 \sum_{i=1}^{p} UR_{t-i} + a_4 \sum_{i=1}^{p} I_{t-i} + e
\]

\[
UR_t = a_0 + a_1 \sum_{i=1}^{p} UR_{t-i} + a_2 \sum_{i=1}^{p} CPI_{t-i} + a_3 \sum_{i=1}^{p} STOCK_{t-i} + a_4 \sum_{i=1}^{p} I_{t-i} + e
\]

\[
I_t = a_0 + a_1 \sum_{i=1}^{p} I_{t-i} + a_2 \sum_{i=1}^{p} CPI_{t-i} + a_3 \sum_{i=1}^{p} STOCK_{t-i} + a_4 \sum_{i=1}^{p} UR_{t-i} + e
\]

All VAR model’s lags used in my paper are 6.

4.2.2. Impulse Response Function

The impulse response function is used to measure the influence of random disturbance term on the current and future endogenous variables. Through the inspection, it can measure the dynamic changes of the economic variables, as well as how the disturbance impacts various variables. In the variable impulse response function, changes the order of the sequence of pulses will produce different images. This is a very useful method to analyze VAR model. From the impulse response, it can clearly identify the significant influencers.
In this paper, CPI has been chosen to be the response variable. In the meanwhile, stock price, unemployment rate and interest rate have been selected as impulse variables. They will be analyzed separately.
5. RESULTS

5.1 Primary Results

Basically, as the previous analyses, there are two different results for U.S. due to the different adjustment method, and there is one result for China.

Table 7. Regression Results of Inflation in two different countries

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.154923**</td>
<td>-0.024042***</td>
<td>0.183504*</td>
</tr>
<tr>
<td></td>
<td>(-0.362017)</td>
<td>(-0.48819)</td>
<td>(2.200719)</td>
</tr>
<tr>
<td>CPI_{t-1}</td>
<td>0.420383***</td>
<td>0.924691**</td>
<td>1.004265***</td>
</tr>
<tr>
<td></td>
<td>(5.082926)</td>
<td>(42.92068)</td>
<td>(68.59062)</td>
</tr>
<tr>
<td>Stock{t}</td>
<td>0.026393***</td>
<td>0.010182**</td>
<td>0.006364***</td>
</tr>
<tr>
<td></td>
<td>(2.139279)</td>
<td>(7.105017)</td>
<td>(10.16531)</td>
</tr>
<tr>
<td>UR{t}</td>
<td>-0.013099*</td>
<td>0.00098***</td>
<td>-0.034565**</td>
</tr>
<tr>
<td></td>
<td>(-0.497559)</td>
<td>(0.319718)</td>
<td>(-1.78875)</td>
</tr>
<tr>
<td>It</td>
<td>0.011966*</td>
<td>0.008127**</td>
<td>-0.018605***</td>
</tr>
<tr>
<td></td>
<td>(0.172029)</td>
<td>(1.045504)</td>
<td>(-3.773129)</td>
</tr>
<tr>
<td>F-statistic</td>
<td>9.573184</td>
<td>649.2448</td>
<td>1992.017</td>
</tr>
<tr>
<td>AD R^2</td>
<td>0.223708</td>
<td>0.956121</td>
<td>0.985278</td>
</tr>
</tbody>
</table>

Model 1 is the OLS regression for automatical data of U.S., model 2 is the regression for manual data of U.S., and the model 3 is automatical data of China.

Hence, our model for automatical data of U.S. should be:

\[ CPI_t = 0.420383 CPI_{t-1} + 0.026393 STOCK_t - 0.013099 UR_t + 0.011966 I_t + \epsilon_t \]

R^2=0.249801, it is not big enough but still OK. According to the equation above, it showed CPI itself has strong autoregressive tendencies. Using the stock price coefficient of 0.026393, we estimate that a 100% increase in stock is associated with approximately a 2.6% increase in CPI, and is economically significant at the 5% level.
Our model for manual data of U.S. should be:

\[ CPI_t = 0.924691CPI_{t-1} + 0.010182STOCK_t - 0.00098UR_t + 0.008127I_t + \varepsilon_t \]

\[ R^2 = 0.957596, \] it is big enough to prove that the model passes the test.

Next, the outputs of the impulse response function for U.S. manual adjusted data is as follows:
According to Figure 3, CPI of U.S. has a positive response to S&P 500, and it achieves largest amount of two years when it is around 1 year, then it nearly disappears after two years. It has a negative response to the unemployment rate. It also almost disappears in two years. The response of CPI to interest rate is quite different; it changes from negative to positive.
response after 8 months. And then it lasts for two years too.

The Chinese model (model 3) based should be:

\[ CPI_t = 1.004265CPI_{t-1} + 0.006364STOCK_t - 0.034565UR_t - 0.018605I_t + \epsilon_t \]

\( R^2 = 0.985773 \), it is big enough to prove that the model passed the test.
Response to Cholesky One S.D. Innovations ± 2 S.E.

Response of CPI$_c$ to SSECI

Response of CPI$_c$ to UR$_c$

Response of CPI$_c$ to RMAIR

Figure 4 Impulse Response Function (China)
According to Figure 4, CPI of China has a positive response to SSEC Index, and it achieves largest amount when it is around 1 year, then it becomes negative after 20 months. It has a negative response to the unemployment rate at the beginning, but after 17 months the response becomes positive. The response of CPI to interest rate remains negative and shrinks gradually. Compared with the U.S. impulse response function, all X variables impulse to Y seems quite different. It also followed our regression results.

Compared to the American data, we can see there are many differences between the two countries. There are mainly three reasons caused this difference. Firstly, although we tried to use the same index to represent the same variables, the construction of the indices is somewhat different, such as CPI. In the U.S. market, CPI includes the price of real estate but this is excluded from the CPI of China. Secondly, the data now we used is not original. For some purposes, the government smoothed the index, such as the unemployment rate. Third, after all the data are collected, different ways of processing data also leads to different results, for example there are two ways to do the seasonal adjustment in for the U.S.

As the results we got from OLS model and VAR model, it is clearly showed that inflation and stock price has a positive correlation either in U.S. market or in Chinese market. These results allow me to accept my initial hypotheses. Compared with the prior literature, it follows Irving Fisher’s Fisher Effect (1911) and Goodhart (1993). Due to the different market and different data which is chosen in different articles, the results should be different from one to the other. However, it seems somehow the two variables have some relationship which is unstable.
According to the results from this paper, the investors in stock market should be aware of inflation level, which maybe is the positive signal for stock price rising at the beginning stage. However, if the stock price goes up, the policy makers should notice the inflation rate which shortly can stimulate economy, but hurts the economy in a long-term way. The government can make some policies to prevent the inflation level going too high.
4. CONCLUSION

This thesis examines the relationship between the stock market and inflation in U.S. and China. Although these are two different types of countries, the VAR multiple regression models show significance that stock prices have a significant impact on inflation. The positive beta coefficient values indicate that if the stock price is rising, inflation will be too, which can be seen by the positive relationship. Meanwhile, according to the regression output, inflation has an inverse relationship with unemployment rate, as the beta coefficient values are both negative. However, compared with other variables, CPI, has the strongest correlation with the previous CPI, which may cause autocorrelation problems.

There are also some slight differences between the two countries’ results. U.S. stock prices reflect the true level of enterprises and social economic strength. Price conduction is also smoother. Chinese stock market relies much more on information. Hence, it is not so significant when it reflects on CPI. Rather, CPI is even more dependent on the last period CPI in the Chinese market. Overall, this analysis helps show that when predicting inflation levels, stock prices likely are not the main factor. Although, there is positive relationship between one another, it is not sufficient to use stock price to predict inflation.

Therefore, this paper agrees with the point of view from Irving Fisher(1911) and Goodhart(1993), who think inflation should include the effect of financial asset prices. However, due to the data chosen here, there are only two countries data for 10 years, this result is not for sure. Further studies and more complete analysis are needed to test this relationship between inflation and stock price. More variables, longer period and more different forms of economies can be joined in this analysis. The different methods should be
test in this type of analysis instead of just using VAR model. Then, the more accurate results between stock price and inflation will be showed up.
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