

Paradox of Inflation:

The Study on Correlation between Money Supply and Inflation in New Era

by

Tong Cao

**A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Business Administration**

**Approved April 2015 by the
Graduate Supervisory Committee:**

**Edward C. Prescott, Co-Chair
Jun Liu, Co-Chair
Chang Chun**

**ARIZONA STATE UNIVERSITY
May 2015**

ABSTRACT

Before 1990s, the relationship between money supply and inflation was positively correlated, however, from 1990 onwards, the US and other major developed countries entered into a new financial era with a typical belief that hyper money supply coexisted with lower inflation. This phenomenon is called “the paradox of inflation”. Traditional theories cannot provide reasonable explanations of this new phenomenon.

In my study, I have taken the linear filtering techniques which Lucas developed in 1980, and the recursive estimation method, as well as the chow test and F-test, and choose the data of the US, Britain, Japan, Germany, Euro area, BRICKs and some members of ASEAN, from 1960 to 2012, to study the relationship between annual rate of M2 growth and CPI inflation. The results show that in most sample developed and developing countries the positive correlation relationship between money supply and inflation began to weaken since the 1990s, and “the paradox of inflation” is now a common phenomenon.

In my paper, I attempt to provide a new explanation of “the paradox of inflation”. I conjecture that, in the past two decades, some advanced countries were becoming a “relatively wealthy society”, which means that commodity supply as well as money supply is abundant. I state that the US is a “relatively wealthy society” and try to determine what features could mark a “relatively wealthy society”.

I choose the credit growth rate of nonfinancial sectors and the ratio of dividends to investment to represent the production inclination of the business sector, and choose the income per capita and the GINI index to represent the consumption inclination of the resident sector. Then, through a semi parametric varying-coefficient regression model, I found that, in the US, when the credit growth of the business sector is under 5%, the ratio of dividends to investment is over 0.20, the per capita income is more than

\$30,000, and the GINI index is over 0.45, the country becomes a “relatively wealthy society”.

Base on this new explanation, I can conclude “in the relatively wealthy society, inflation is no longer a monetary phenomenon; it is a wealth allocation phenomenon”.

TABLE OF CONTENTS

	Page
LIST OF FIGURES	v
CHAPTER	
I BACKGROUND AND ARTICLES REVIEW.....	1
A. General Background	1
B. Traditional Phenomenon: All Inflation Is a Monetary Phenomenon	1
C. Traditional Theoretical Explanation.....	1
D. New Phenomenon: Inflation and Money Supply Have a Weak Correlation..	4
E. Former Studies Showed the Old and New Phenomenon	5
F. There Are Some Explanations for the New Phenomenon, but either Stay on the Surface or Are Invalid.....	8
II TYPICAL FACTS AND REGULAR PHENOMENON	10
A. Data Selection and Data Sources.....	10
B. Empirical Methods	10
C. Empirical Results of the US.....	11
D. Empirical Results of other Sample Countries	15
III THE NEW HYPOTHESIS ABOUT THE PARADOX OF INFLATION.....	16
A. Money Creation Process and the Impact on the CPI.....	16
B. Derivation of the Key Equations.....	17
C. The New Hypothesis about the Paradox of Inflation	18
D. The Hypothesis Model.....	20
E. Some Data Which Support the New Hypothesis	22
IV ECONOMETRIC MODEL AND TEST.....	25
A. The Econometric Model	25

CHAPTER	Page
B. The Estimation of the Econometric Model.....	25
C. The Test of the Econometric Model.....	26
D. The Explanation for One Question.....	31
V. CONCLUSIONS AND POLICY SUGGESTIONS.....	33
REFERENCES	34
APPENDIX	
A EMPIRICAL STUDY RESULTS OF THE OTHER SAMPLE COUNTRIES.....	38
B ARTICLES REVIEW	72

LIST OF FIGURES

Figure	Page
1 Recursive Coefficient between Annual Rate of M2 Growth and CPI Inflation in the US	12
2 Linear Regression for M2 and CPI of the US Based Data from 1962 to 1980.....	13
3 Linear Regression for M2 and CPI of the US Based Data from 1981 to 1990	14
4 Linear Regression for M2 and CPI of the US Based Data from 1991 to 2010	14
5 Money Creation Process and the Impact on the CPI.....	17
6 The Growth of Nonfinancial Sector in the US.....	22
7 The Ratio of Investment to Dividend in the US.....	23
8 The Ratio of Household Average Annual Expenditure to Income before Tax.....	23
9 The Ratio of Official U.S. Dollars Reserve to US M2.....	24
10 The Function Graph of $\widehat{\beta}_1(x_1)$	27
11 The Function Graph of $\widehat{\beta}_2(x_2)$	28
12 The Function Graph of $\widehat{\beta}_3(x_3)$	29
13 The Function Graph of $\widehat{\beta}_4(x_4)$	30
14 Import/ Household Consumption Expenditure.....	31
15 The Imports from China/Imports.....	32

CHAPTER I

BACKGROUND AND ARTICLES REVIEW

A. General Background

Since the 1990s, The US and other major developed countries entered into a new financial era with a typical belief that hyper money supply coexisted with lower inflation. We call this phenomenon “the paradox of inflation”. It is significant to find a reasonable explanation of the new phenomenon for both developed and developing countries. Especially for China, just targeting Consumer Price Index (CPI) and monitoring money supply (M2) can make China’s monetary policy effective and adapt it to the rapidly changing economy. The reviewed published articles and thesis studies do not provide a reasonable explanation for the “paradox of inflation”.

B. Traditional Phenomenon: All Inflation Is a Monetary Phenomenon.

Before the Bretton Woods System established in 1944, under the gold (and other metal) standard, the money supply and inflation had a positive correlation. Before the US left the Bretton Woods System (President Nixon closed the gold exchange window in 1971), under the gold exchange standard, the money supply and inflation also had a positive correlation (1944—1971).

In the 1970s and 1980s, no anchored currency creation entered into an acceleration period. The advanced world entered into a period of stagflation, where the positive correlation between money supply and inflation was obvious.

C. Traditional Theoretical Explanation

About the relationship between money supply and inflation, the traditional theories give some explanations:

1. Karl Marx’s theory

According to Marx's theory of money demand, $M = PQ / V$

Where:

M= necessary currency amount in circulation

P= commodity price

Q= commodity supply volume

V= velocity of money

The above formula reflects the transaction that is demand for money becomes a circulation function. Karl Marx also emphasizes that the commodity price is decided by its value, and the velocity of money is stable in the short term, so the necessary currency amount in circulation is determined by the aggregate value of social commodities.

2. Classicism theory (The traditional quantity theory of money)

The classicism theory includes the Fisher equation of exchange and the Cambridge cash balance equation. The main point is that, the monetary amount determines the monetary value and commodity price, monetary value and quantity changes are inversely proportional, and commodity price and monetary quantity changes are proportional.

(1) Fisher equation of exchange

$$MV=PT$$

Whereas M= Currency amount in circulation; V= velocity of money; P= commodity price; T= Commodity trading volume.

Fisher states that T is limited by non-monetary factors such as labor and natural resources, so T is stable in the short term, V is limited by institutional factors such as payment custom and social conventions, and therefore V is also stable in the short term. The change of P is determined by M.

(2) Cambridge cash balance equation

$$M=kPY$$

Where:

M= Aggregate demand for money

k= the proportion of cash wealth in total wealth

P= the price level

Y= real income

The Cambridge cash balance equation considered the trading currency demand and storage requirements at the same time. It assumed that Y is a constant under the condition of full employment, therefore M is determined by k and P. Pigou assumed k is a constant, because terms of payment are stable in a certain period, therefore the change of P is decided by M.

3. Keynes' Liquidity preference theory

Keynes divided the money demand motive into a trading motive, a precautionary motive and a speculative motive. $M=M_1+M_2=L_1(y) +L_2(i)$. M1 is money demand caused by the transaction motive and the precautionary motive, and is an increasing function of income (y); M2 is money demand caused by the speculative motive, and is a decreasing function of interest rate (i).

Baumol, Whalen and Tobin improved Keynes' liquidity preference theory from the transaction demand, precautionary demand and speculative demand for money aspects respectively; their studies proved that interest rate also affected transaction demand and the speculative demand for money.

4. Modern quantity theory of money

Friedman inherited Keynes' viewpoint which consider that monetary demand is for assets, but he expanded the form of wealth to a wider range including stocks, bonds, and real assets.

Friedman's monetary demand function, $Md/P=f(Y_p, w; r_m, r_b, r_e, 1/p \cdot dP/dt; u)$.
 Md/p = the real money demand; Y_p = permanent income; w = the ratio of assets and income; r_m = expected nominal return rate of currency; r_b = expected nominal return rate of bond; r_e =expected nominal return rate of stock; $1/p \cdot dP/dt$ = expected price changing rate; u = other non-income variables influenced the utility of the currency.

Friedman's research shows that, despite the fact that the demand for money is a function of a variety of complex variables. However, due to the variables which play a decisive role, subject to the limit of the social productivity levels and the system factors which will not cause big changes in the long run, some variable factors such as interest rate, the rate of price changes on the function of money demand is very limited. Therefore, from an overall point of view, the monetary demand function is stable, and the amount of money needed is predictable. The crux of the problem lies in the fact that monetary authorities can evaluate the monetary demand for money, and can provide a stable growth of the money supply.

Although the monetarism school and Keynesian school had great differences on the determinants of inflation in the middle of the 20th century, mainstream economists believe that higher money supply growth leads to higher inflation, they believe that the money supply plays an important role in determining the level of inflation.

D. New Phenomenon: Inflation and Money Supply Have a Weak Correlation

After the 1980's stagflation was brought under control, inflation in the developed countries started to moderate and the linkage with the money supply was lost. "Missing money" (money supply increased fast, but did not lead to inflation) in the US since the 1990's increased. This type of phenomenon has not been observed among developing countries when that occurred. In recent years, a similar phenomenon seems to appear in some developing countries such as China from 2009 to 2013, with moderate inflation

rate accompanied by hyper monetary supply and time delay, which became increasing obviously.

E. Former Studies Demonstrate the Old and New Phenomenon

Some researchers have found and demonstrated the old and new phenomenon in their papers.

1. Studies support the old phenomenon

Lucas (1980) examined the relationship between the annual rate of CPI inflation and M1 growth during 1955 to 1975 in the US, and proved that the relationship was positive.

Analysis of Osakwe (1983) showed that the relationship between money supply and inflation was positive during 1970-1980 in Nigeria. Increases in the money wage rate and money supply (with a lag in effect) were identified as the two most important factors that influenced the movement of prices during the period. The relationship between money supply and inflation in Nigeria also has been empirically examined by several authors like Malina (1980), Chibber and Nemat (1990), Adeyeye and Fakiyesi (1980), Osakwe (1983), Ogunmuyiwa (2004), Omokeet (2010) and Bakare (2011).

Manser and McDonald (1988), Asogu (1991), Fakiyesi (1996) also found the positive relationship between money supply and inflation while considering a host of other factors.

McCandless and Weber (1995) analyzed data of 110 countries from 1960 to 1990, including 21 OECD nations and 14 Latam countries, and found that the relationship between money growth and inflation has a high positive correlation.

L. H. Cheng and P. Laura (1997) showed that high inflation has appeared in the Turkish economy since the 1970s. They found that monetary variables especially money supply and exchange rate play a main role in the Turkish inflation process.

Dwyer and Hafer (1999) analyzed the data of USA, UK, Brazil, Chile and Japan from 1900 to 2000. They found that price level and money growth rate have a positive correlation in the short term or long term. This positive relationship is weak in low inflation countries, and is significant in high inflation countries.

Altimari (2001) demonstrated that the relationship between money supply (both M1, M2 and M3) and inflation is positive by examining the data of Euro Area for 1980-1997.

Graude and Polan (2005) examined the link between money supply and inflation in 160 countries using 30 years of data although they accepted that inflation is a monetary phenomenon, they claimed that the link between inflation and money supply is much stronger only in the countries with high inflation rates. They further noted that in countries with a relatively low inflation rate the long run linkage cannot be easily identified. Thornton (2008) found evidence to support the Graude and Polan (2005) claim, after employing a panel and cross section analysis to empirically estimate the applicability of QTM on 36 countries in Africa. He concluded that, money strongly determines inflation in countries with more than 10 percent inflation and money growth rates.

Morana & Bagliano (2007) investigated the long-run link between inflation and money growth in the United States over the 1960 to 2003 period. They proved that monetary aggregates can still provide valuable information to monetary policymakers.

Aikaeli (2007) examined the money supply and inflation relationship by employing a GARCH model while M2 and M3 monetary aggregates were used as proxies for money supply. The analysis was made basing on monthly data ranging from 1994 to 2006. The study identified that it requires a period of 7 months for any fluctuations in money supply to have an impact on inflation rates in Tanzania.

Hossain and Islam (2013) examined the determinants of inflation using the data from 1990 to 2010. The empirical results showed that the money supply and the one year lagged value of interest rates positively and significantly affect inflation. Results also indicated that the one year lagged value of money supply and one year lagged value of fiscal deficit significantly and negatively influence the rate of inflation. This study suggests that money supply must be controlled to reduce inflation.

2. Studies support the new phenomenon

Haldane (1997) found that high money growth rate and low inflation coexist in developed and developing countries.

Cheng and Tan (2002) examined the long run equilibrium relationship and the causality between inflation and its determinants (i.e. money supply, output, interest rate, exchange rate and trade balance) in Malaysia. They found that there is no evidence of direct causal effect of money supply on inflation in Malaysia.

In the same vein, Tang and Lean (2007) found that the effect of money supply (M1) on inflation in Malaysia is negative and statistically significant at a 1 percent level.

Vuslat Us (2004) detected a zero correlation between money and inflation in Turkey at a time of high inflation rates. According to Vuslat Us (2004), for more than 30 years Turkey has been facing a high and increasing rate of inflation. The empirical findings suggest that the higher rate of inflation is mainly a result of the depreciating of the country's currency and increases in prices in the public sector.

Roffia and Zaghini (2008) analyzed the data of 15 industrialized countries and found that there is no positive correlation between money growth rate and price index in at least 50% of the cases.

Bigyan Shrestha analyzed the data of Nepal for 1980-2009, and found that price levels are not affected by money supply, but rather money supply is caused by price levels.

Sargent and Surico (2010) analyzed the annual rate of money growth and inflation in the US from 1900 to 2005, and found that the correlation was weakening during 1984 to 2005 compared with the prior period.

Ndanshau (2010) examined the role of money in explaining inflation dynamics based on quarterly data ranging from 1967 to 2005 in Tanzania, the study couldn't identify any relationship between money and inflation.

F. There Are Some Explanations for the New Phenomenon, that either Stay on the Surface or Are Invalid

1. The velocity of money continues to slow.

Under this condition, it is not clear how to measure monetary velocity. If we measure the velocity of money with GDP/M (M , the money supply), in the case of nominal M increase, velocity of money certainly will be smaller. However, this explanation is far from the truth in most situations. In fact, the velocity of money continues to increase, capital flows are faster, capital markets are more efficient, inventory turnover improves, personal loan balances increase, and electronic means of payment develop.

Even though it is true that the velocity of money is smaller, the theory that the velocity of money slows down is effective in the short term. But it still fails to explain why this phenomenon lasted for more than 20 years. It also does not explain why the velocity of money became slower.

2. Excess money supply did not enter into the real economy, and flowed to capital markets and overseas.

Generally this explanation should be better than the velocity of money explanation, and we need to understand why the money supply not follow the real economy and how we can measure these phenomena are less obvious.

3. Financial innovation has changed the monetary liquidity concept and inner logic.

Ben Bernanke presented another explanation for the paradox of inflation. He thought that financial innovation has changed the monetary liquidity concept and inner logic. So if we just monitor M2 or M3 which are defined by the traditional methods, they will be less useful when we are faced with a new financial world-wide crisis. We believe that no matter how the world of finance innovated in the new era, it could not change the scope of the monetary supply, and could not change the role which money plays on the determination of price levels.

CHAPTER II

TYPICAL FACTS AND REGULAR PHENOMENON

Although some researchers have found a new phenomenon that hyper money supply coexisted with lower inflation in their papers, previous researchers showed that it appeared in some countries against a wide range of region. And most studies focused on prior to 2000, and there have been fewer researchers in the last decade. Therefore, it is not clear whether the paradox of inflation is continuous or changing. In order to test whether the new phenomenon in the last decade is universal and the level of significance, this paper analyzes data from more sample countries and time series Over a long period of time.

A. Data Selection and Data Sources

In this paper, we choose the annual rate of M2 growth and CPI inflation data of the US, Britain, Japan, Germany, Euro area, BRICKs and some members of ASEAN countries, from 1960 to 2012. (All data came from CEIC database, and some countries' data failed to date back to 1960 due to the database).

We choose CPI as price definition in this paper. Money supply is more effective when calculated using consumption prices, and other price indices, such as PPI, and we will convert to CPI at a future time.

We choose M2 as a money supply liquidity scope. Because CPI has a strong link with M2 compared to M3, which has stronger links with capital markets.

B. Empirical Methods

In this paper, we take the linear filtering techniques which Lucas adopted in 1980 to analyze the relationship between the annual rate of M2 growth and CPI inflation of the sample countries. The data processing method adopted by Lucas is as follows:

$$X_t(\beta) = \alpha \sum_{k=-2}^2 \beta^{|k|} X_{t+k} \quad (1)$$

$$\alpha = \frac{1 - \beta}{1 + \beta}, \quad k \in (-2, -1, 0, 1, 2), 0 \leq \beta \leq 1.$$

Consistent with Lucas (1980), in this paper, we set $\beta=0.95$.

In addition, in order to observe how the relationship between the annual rate of M2 growth and CPI inflation changes over time, we introduce the recursive estimation method, obtained recursive coefficients between annual rate of M2 growth and CPI inflation. The recursive estimation formula is as follows:

$$\text{CPI} = a + b_t \text{M2} + \varepsilon \quad (2)$$

b_t , the regression coefficient. At the given time t , we take the sample data of CPI and M2 from the beginning period to period t to perform a regression estimation, and the result was b_t .

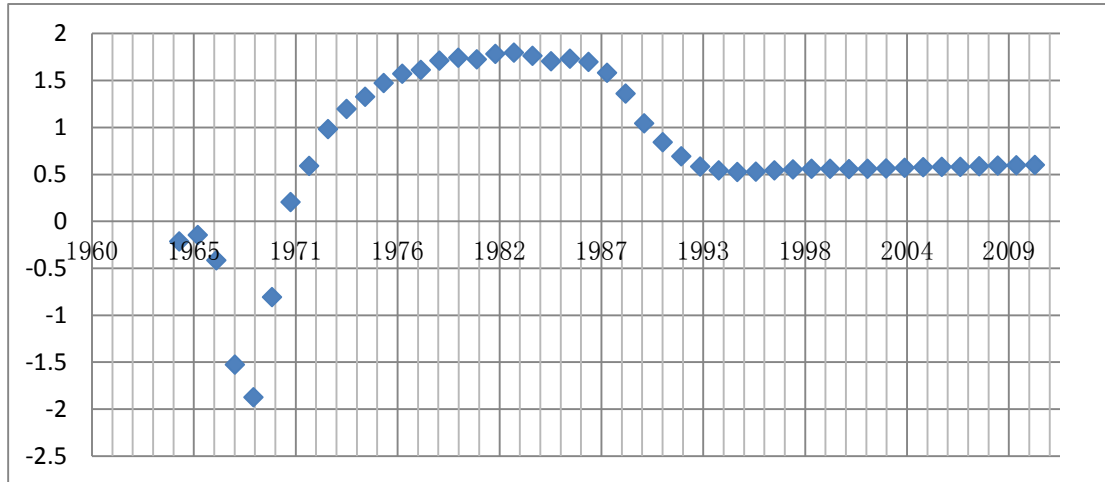
To compare the fluctuation of the recursive coefficient in different periods, we compare the variances before and after the 1990's.

C. Empirical Results of the US

From figure 1, we can find that the regression coefficient between the annual rate of M2 growth and CPI inflation reached its highest level in 1982, and then began to decline, and was basically stable after 1991.

Figure 1

The Recursive Coefficient Between the Annual Rate of M2 Growth and CPI Inflation in the US



Through the chow test, we find that the relationship between the annual rate of M2 growth and CPI inflation changes before, and after 1991.

Breakpoint Chow Test: 1991

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1962 2010

F-statistic	8.545072	Prob. F(2,45)	0.0007
Log likelihood ratio	15.77431	Prob. Chi-Square(2)	0.0004
Wald Statistic	17.09014	Prob. Chi-Square(2)	0.0002

Through an F-test, we find that the variance of the recursive coefficient are markedly different before, and after 1991.

F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	0.89854897	0.5666372
Variance	1.10390901	0.0004921
Observation	28	19
df	27	18
F	2243.34234	
P(F<=f) one-tailed	6.8976E-27	
F one-tailed critical	2.12624323	

Figure 2

Linear Regression for M2 and CPI of the US Based Data from 1962 to 1980

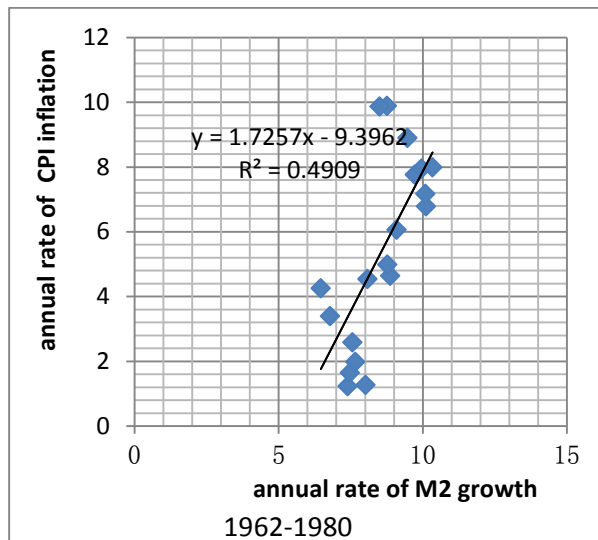


Figure 3

Linear Regression for M2 and CPI of the US Based Data from 1981 to 1990

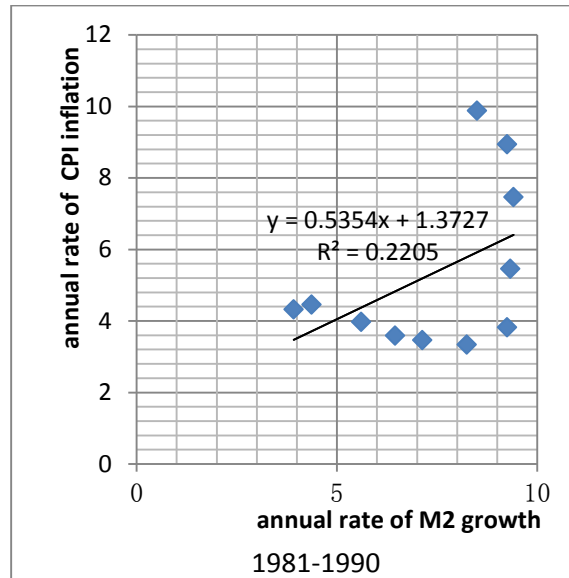
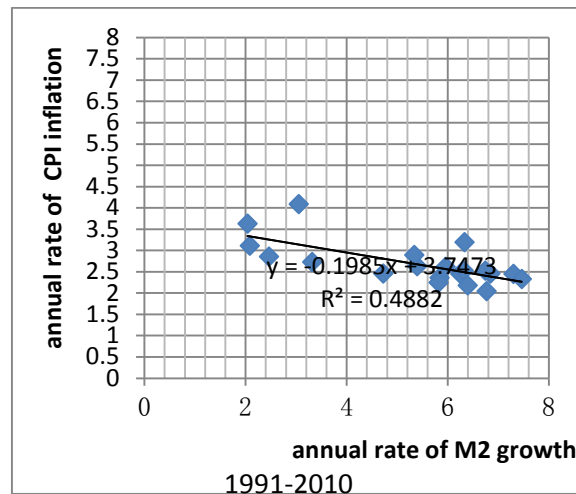


Figure 4

Linear Regression for M2 and CPI of the US Based Data from 1991 to 2010



From figure 2 to 4, we can find that the positive correlation relationship between annual rate of M2 growth and CPI inflation weaken observably after 1980, and even shows a negative relationship after 1990.

D. Empirical Results of other Sample Countries:

Summarizing the empirical results of other sample countries, we can find that:

1. In advanced countries, the empirical results of Britain, Germany, and Euro zone are similar to those in the United States. From 1980 to 1990, the positive correlation relationship between the annual rate of M2 growth and CPI inflation began to weaken, then became gradually stable. In Japan, the result is the first fall against rising, eventually become stable which similar with other advanced samples.

2. In BRICs, the empirical results of India, South Africa, and Brazil are similar. The positive correlation relationship between annual rate of M2 growth and CPI inflation changes from strong to weak. In China and Russia, the results are just the reverse, from weak to strong, but eventually become stable.

3. In ASEAN countries, the empirical results of Singapore, Thailand, and Indonesia are similar. The positive correlation relationship between annual rate of M2 growth and CPI inflation changes from strong to weak, and then become stable after about 2000. In Philippines and Malaysia, the result is from weak to strong, and then become stable after about 2000.

4. The paradox of inflation has been verified among wide range region and long period. It is a common phenomenon among advanced countries since 1990s and starts to appear in developing countries in the latest decade.

Refer to appendix A for details.

CHAPTER III

THE NEW EXPLANATION ABOUT THE PARADOX OF INFLATION

A. Money Creation Process and the Impact on the CPI

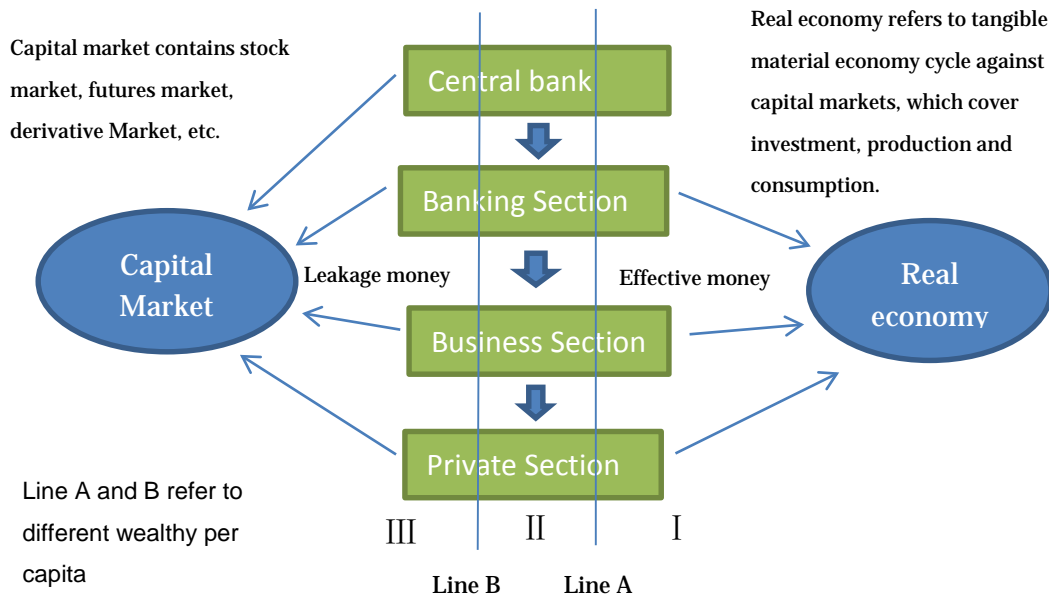
The process of money creation generally falls into two areas. The first area is basic currency provided by the central bank, and second is circulated currency created by commercial banks.

In a closed economy without capital markets, the central bank provides the basic currency and delivers it to commercial banks. The commercial banks provide loans to enterprises, and the enterprises put the loans to work which expands investment or production, which in turn, pushes prices up. By expanding investment, enterprises earn higher profits, pay dividends, and pay more to employees. This increases personal expenditure on consumption, which pushes prices up.

In an economy with capital markets, the central bank can adjust the basic currency supply through both commercial banks and the capital markets. When commercial banks take extra money, they can invest in capital markets, but it may not be to make loans. Enterprises which receive loans also can invest in capital markets, and it may not be for expanding production. Personal income increases can also be used for investment and not necessarily for consumption. When commercial banks, enterprises, and individuals put money into the capital market rather than for consumption, the money supply leaks out, and the influence of money supply on prices will weaken. (As shown in figure 5)

Figure 5

Money Creation Process and the Impact on the CPI



B. Derivation of the Key Equations

In the past 150 years, there have been a number of theories about the correlation between money supply, price, velocity of money, and the quantity of goods consumed. But when we focus on the correlation between M2 and CPI, we think Fisher’s theory is better. Karl Marx’s theory is similar to Fisher’s. Keynes’s and Friedman’s theory are more about the interaction between the real economy and capital markets (against the single real economy), as well as money stock (against transactions). Hence these are not typical enough for us.

So we start from the Fisher Equation:

$$MV = PT \quad (3)$$

M= currency amount in circulation; V= velocity of money; P= commodity price; T= commodity trading volume.

In the gold standard period or earlier, the money supply is relatively insufficient; all the currencies take part in the real economy circulation.

So, $M_E = M$, M_E , “effective money supply”, the part of money supply takes part in the real economy circulation, then

$$M_E V = PT \quad (4)$$

After US withdrew from the Bretton Woods System and capital markets started booming, money supply actually separated into two parts, the “effective money supply” which still remains in and service the real economy, and “leakage money supply”, which flows to capital markets or overseas and does not affect domestic inflation. We call it M_L . If M_{ALL} which represents the money supply, then

$$M_E = M_{ALL} - M_L \quad (5)$$

$$(M_{ALL} - M_L)V = PT \quad (6)$$

After the first order difference, we got

$$\Delta(M_{ALL} - M_L)V = \Delta PT \quad (7)$$

Or

$$\Delta(M_{ALL} - M_L)V / T = \Delta P \quad (8)$$

From equation(8), if the money supply leaked most outside circulation, in other words M_{ALL} is getting equal to M_L , the price changes (ΔP) will approach zero. In this case, V and T play a less decisive role on ΔP .

C. The New Hypothesis about the Paradox of Inflation

Some researchers have proposed that excess money supply does not enter into the real economy, but, instead, flows to capital markets or overseas. And we also deduced that money supply leakage weakens the correlation between money supply and CPI in the previous section. In this section, we give a new hypothesis including some definitions

and assumptions. Meanwhile the new hypothesis provides a further explanation of why the money supply leaks out of the system.

1. The definitions:

Price: we choose CPI as the price definition in this paper, because money supply is more compatible with consumption price, and other price index such as PPI will convert to CPI eventually.

Monetary supply: We choose M2 as money supply liquidity scope, because CPI is much link with M2 against M3, which associate with capital markets more.

“Relatively wealthy society”: There are two components. One is the rich residents, which means that their per capita income is higher than the rest of the society and some social classes have more wealth than they need. The aggregate demand of consumption in the real economy is relatively stable. Another component is the commodity supply which is abundant. This means that enterprises cannot expand production to obtain excess profits.

2. The assumptions:

1) Money supply leakage will not affect the trend of domestic CPI through capital markets or overseas market.

2) The Wealth effect (consumer behavior is affected by value of capital markets) is a separate concern.

3) Total social demand doesn't enter into a new stage. That is to say, Total social demand mainly provides material needs.

3. The hypothesis

1) After the 1990s, some advanced countries entered into a “relatively wealthy society” period, companies did not expand production. When companies and individuals received income, they put the cash into capital markets or overseas (the money supply

leaked), which means that the money supply is beyond the needs of the real economy. In other words the money supply is abundant.

2) In the “relatively wealthy society”, money supply separates into two parts, “effective money supply” and “leakage money supply”, and “leakage money supply” does not affect domestic inflation.

3) In this case, “effective money supply” remained very stable and the marginal money supply leaked out quickly. Therefore nominal money supply, whether high or low, has less incentive to push prices up.

4) In conclusion, when a country becomes a high-income country, per capita income is high and some social classes have more wealth than they need, and the business enterprises do not want to expand production. We say the country has entered into a “relatively wealthy society” position. The positive relationship between the money supply and the CPI becomes weaker, and may even become negative.

D. The Hypothesis Model

From figure 5, the process of money creation includes at least four links, the central bank, banking sector, business sector and the resident sector. The central bank provides basic currency; and the banking sector creates money for circulation by lending it to the business sector and resident sector; the business sector pays salaries to employees, or pays dividends to individual investors; individuals spend money which circulates the funds through either consumption or investment. Through this money creation and circulation cycle, we can determine how the specific behavior of the business sector (dividend or production) and resident sector (investment or consumption) will impact prices, respectively. Generally, if these sectors are more inclined to pay dividends or make investments rather than using the funds for production or consumption, the increase in the money supply will have less effect on

prices, and may even have no effect. If the money is not used for dividends or investment, the opposite will be true.

From the above analysis, we can derive the following equation:

$$P = F(B_p, R_c, M) \quad (9)$$

P , CPI; B_p , the production inclination of business sector; R_c , the consumption inclination of the resident sector; M , M2.

This equation signifies that there is a functional relationship between CPI, the production inclination of the business sector, the consumption inclination of the resident sector and M2.

In order to measure the will of the business sector and resident sector, we chose the credit growth rate of nonfinancial sectors and the ratio of dividends to investment to represent the production inclination of the business sector. When the credit growth rate is high or the ratio of dividends to investment is low, it indicates the production inclination of the business sector is strong. Otherwise, it will be the opposite. We chose income per capita and the GINI index which represents the consumption inclination of the resident sector. When the income per capita is high or the GINI index is high, it indicates that the consumption inclination of the resident sector is weak. Otherwise, it will be the opposite.

Through the above replacement, we get the following equation:

$$P = F(C, D, I, G, M) \quad (10)$$

P , CPI; C , the credit growth rate of nonfinancial sectors; D , the ratio of dividends to investment; I , the income per capita; G , the GINI index; M , M2.

According to the above analysis, when C decline, D increases, I increases or G increases, and the correlation between CPI and M2 weakens.

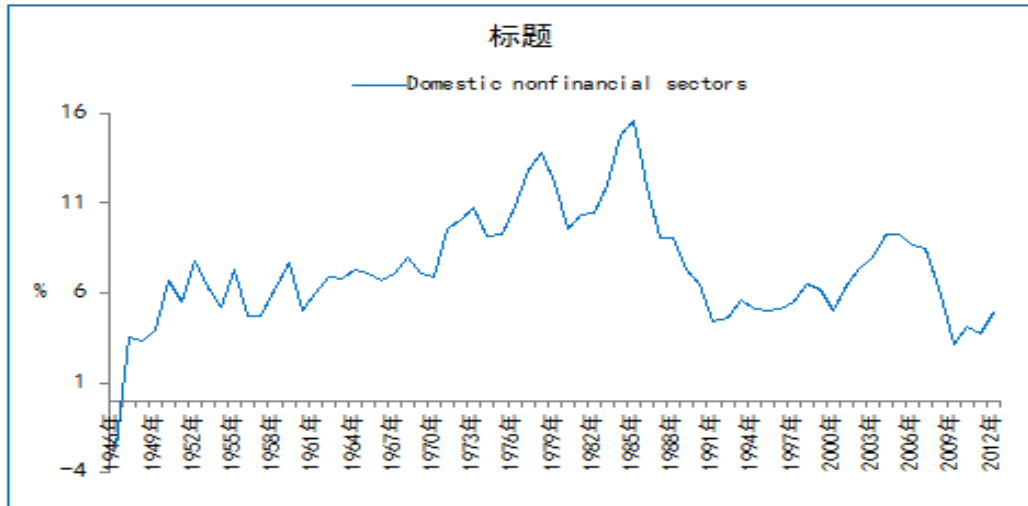
E. Some Data Which Support the New Hypothesis

1. The growth of the nonfinancial sector in the US

From figure 6, we can find that the growth of the nonfinancial sector credit reached 16% at its highest point, and then began falling from the end of the 1980s until the current time, and it has now reached the lowest since 1970. This is consistent with our analysis that when credit growth rate declines, the correlation between CPI and M2 becomes weaker.

Figure 6

The Growth of the Nonfinancial Sector in the US



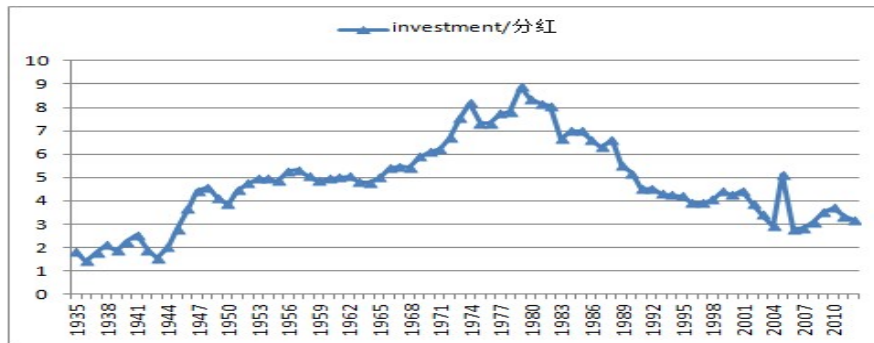
Source: Federal Reserve

2. The ratio of investment to dividend in the US

From figure 7, we find that the ratio of investment to dividends has been declining since the 1980s. This means that the production inclination of business sector has been declining and capital has been leaving the real economy circulation. It is also consistent with our analysis that when the ratio of dividends to investment increases, the correlation between CPI and M2 becomes weaker.

Figure 7

The Ratio of Investment to Dividends in the US



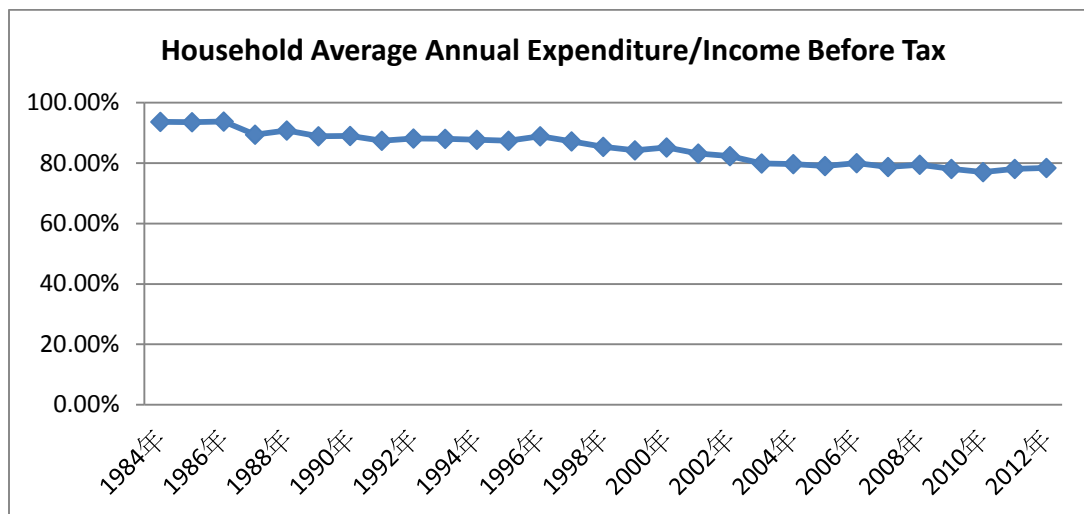
Source: NBER

3. The ratio of household average annual expenditure to income before tax

From figure 8, we find that the ratio of household average annual expenditure to income before tax declined with the increase of income. This means that the proportion that people spend on commodities and service declined, the proportion spent on real estate, stocks, funds, insurance and other financial derivatives increased.

Figure 8

The Ratio of Household Average Annual Expenditure to Income before Tax



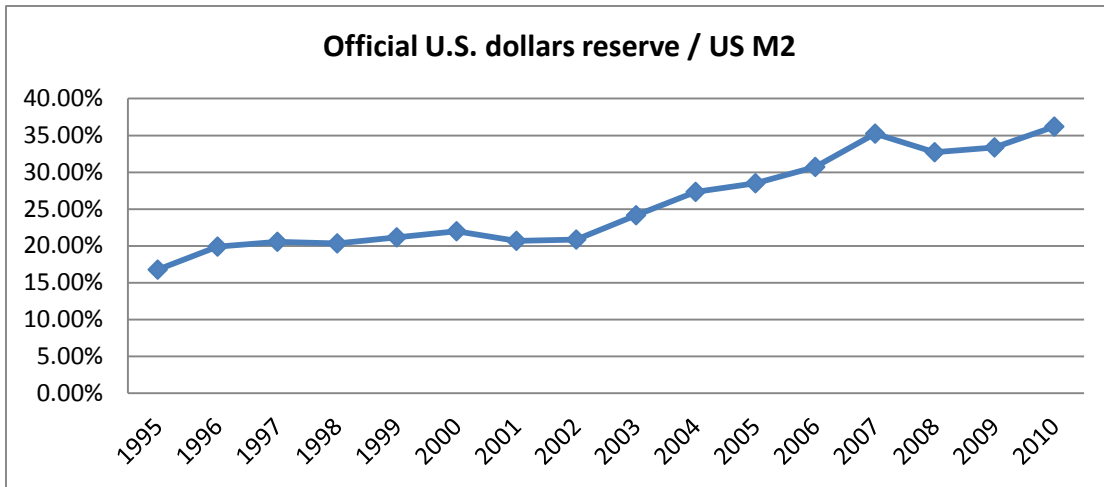
Source: CEIC

4. The ratio of the official U.S. dollars reserve to US M2

From figure 9, we find that the ratio of official U.S. dollars reserve to US M2 continued to rise; it has increased from 16.78% in 1995, to 36.2% in 2010. This means that with the increase of the dollar supply, more and more dollars flow to overseas.

Figure 9

The Ratio of Official U.S. Dollars Reserve to US M2



CHAPTER IV

ECONOMETRIC MODEL AND TEST

A. The Econometric Model

In order to verify our theoretical model further and to discover the signs of how to judge when a country enter into a “relatively wealthy society”, we try to build an econometric model and test it with data of the United States.

For testing the relationship between P, the 4 factors and M2, we describe how the M2 affects the CPI under the influence of variables with semi parametric varying-coefficient regression model, as follows:

$$P = \beta_0 + \beta_1(x_1)M + \varepsilon \quad (11)$$

$$P = \beta_0 + \beta_2(x_2)M + \varepsilon \quad (12)$$

$$P = \beta_0 + \beta_3(x_3)M + \varepsilon \quad (13)$$

$$P = \beta_0 + \beta_4(x_4)M + \varepsilon \quad (14)$$

P , CPI; M , $M2$; x_1 = credit growth of the nonfinancial sectors; x_2 = the ratio of dividends to investment; x_3 = per capita income; x_4 = the GINI index; $\beta_1(x_1)$, $\beta_2(x_2)$, $\beta_3(x_3)$, $\beta_4(x_4)$ respectively are the influence coefficient of M to P under the effect of x_1, x_2, x_3, x_4 .

B. The Estimation of the Econometric Model

This paper takes the equation (11) for an example to illustrate the estimation of semi-parametric varying-coefficient model.

$$p = \beta_0 + \beta_1(x_1)M_2 + \varepsilon \quad (15)$$

The principle of estimation is to expand the non-parametric part $\beta_1(x_1)$ with B-splint and simplify it into a parametric model, which will be easier to estimate.

Assuming $B_1(x_1), B_2(x_1), \dots, B_k(x_1)$ for a group of B-splint basis, and then

$$\beta_1(x_1) \approx \alpha_1 B_1(x_1) + \alpha_2 B_2(x_1) + \dots + \alpha_k B_k(x_1). \quad (16)$$

Therefore the equation (11) can be approximated as

$$p \approx \beta_0 + \alpha_1 B_1(x_1) M 2 + \alpha_2 B_2(x_1) M 2 + \dots + \alpha_k B_k(x_1) M 2 + \varepsilon \quad (17)$$

We can get the estimated value of $\alpha_1, \alpha_2, \dots, \alpha_k$ by the method of least-squares, and mark them as $\hat{\alpha}_1, \hat{\alpha}_2, \dots, \hat{\alpha}_k$. Thus the estimated value of $\beta_1(x_1)$ is

$$\hat{\beta}_1(x_1) \approx \hat{\alpha}_1 B_1(x_1) + \hat{\alpha}_2 B_2(x_1) + \dots + \hat{\alpha}_k B_k(x_1) \quad (18)$$

Determine the threshold value

It will be easy to determine the position of significant change (i.e. threshold value) by making the function image of $\hat{\beta}_1(x_1)$ and observing its varying trend.

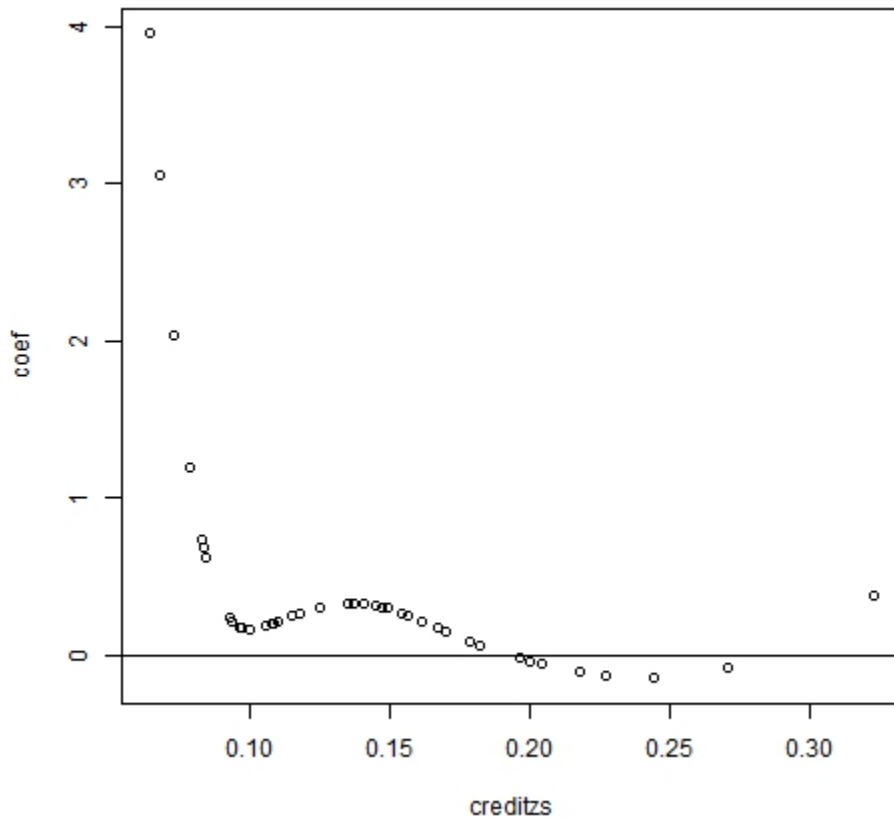
C. The Test of the Econometric Model

1. The critical value of credit growth of the nonfinancial sector

Take the M2, CPI and credit growth of nonfinancial sector data of the United States into semi parametric varying-coefficient regression model, by statistical software eviews7.0, we can draw the function graph of $\hat{\beta}_1(x_1)$:

Figure 10

The Function Graph of $\hat{\beta}_1(x_1)$



Vertical axis: $\hat{\beta}_1(x_1)$; Horizontal axis: $1/x_1$;

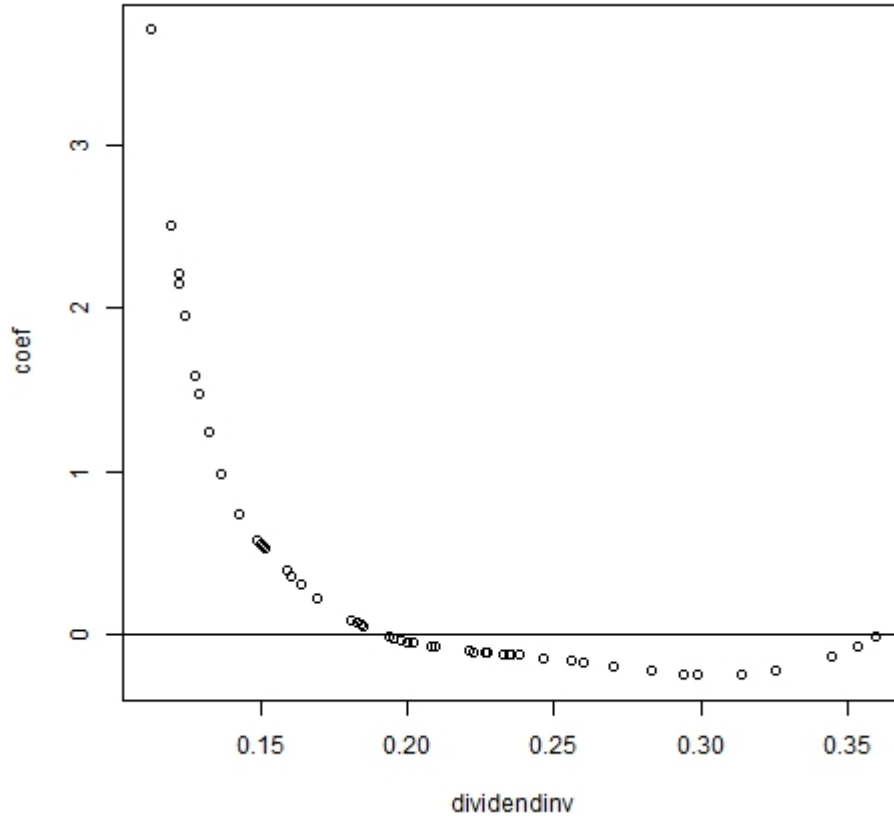
The function graph indicates that when x_1 is less than 10%, the relationship between M2 and CPI has been very weak; when x_1 is under 5%, the relationship between M2 and CPI becomes negative.

2. The critical value of the ratio of dividends to investment

Take the M2, CPI and the ratio of dividends to investment data of the United States into semi parametric varying-coefficient regression model, after a statistical estimate, we can draw the function graph of $\hat{\beta}_2(x_2)$:

Figure 11

The Function Graph of $\hat{\beta}_2(x_2)$



Vertical axis: $\hat{\beta}_2(x_2)$; Horizontal axis: x_2 ;

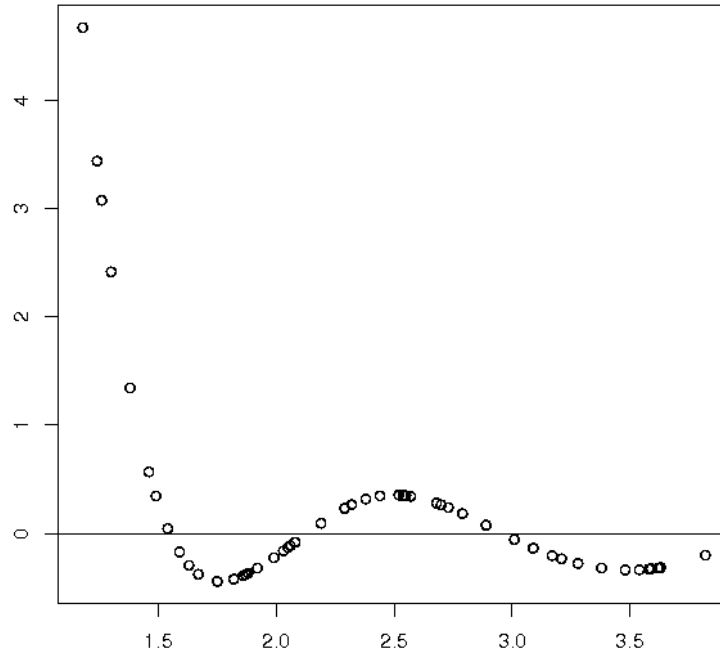
The function graph indicates that when x_2 is over 0.15, the relationship between M2 and CPI has been very weak; When x_2 is over 0.20, the relationship between M2 and CPI becomes negative.

3. The critical value of per capita income

Take the M2, CPI and the per capita income data of the United States into semi parametric varying-coefficient regression model, after a statistical estimate, we can draw the function graph of $\hat{\beta}_3(x_3)$:

Figure 12

The Function Graph of $\widehat{\beta}_3(x_3)$



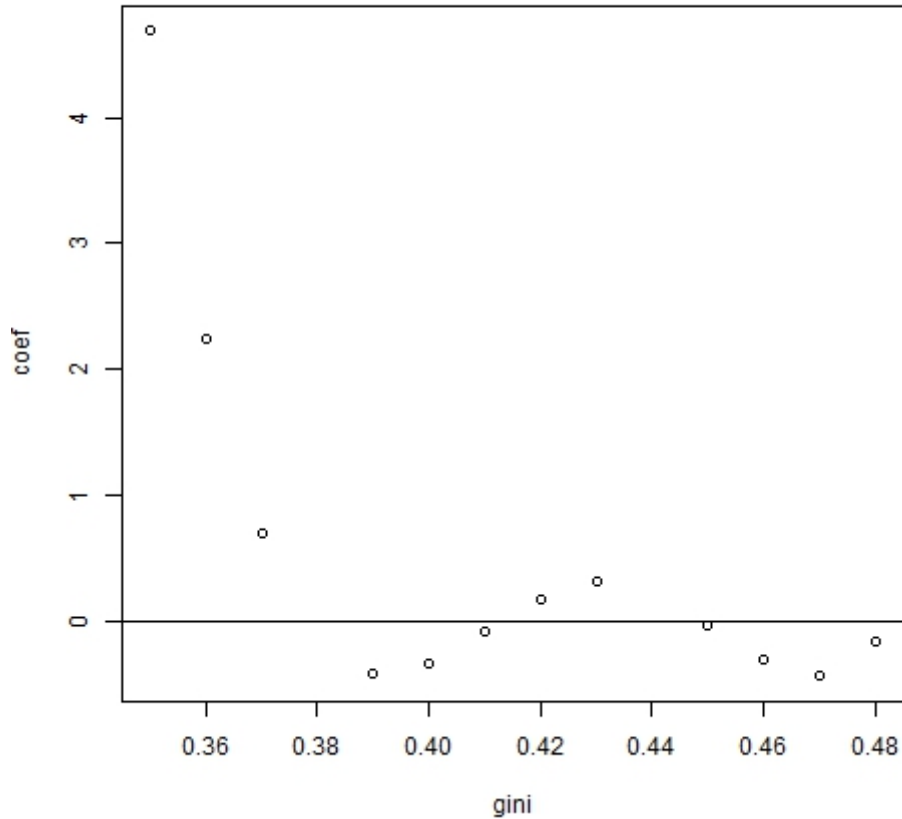
Vertical axis: $\widehat{\beta}_3(x_3)$; Horizontal axis: x_3 ;

The function graph indicates that when x_3 is more than \$15,000, the relationship between M2 and CPI becomes negative. With the increase of x_3 , when x_3 is more than \$22,000, the relationship between M2 and CPI becomes a positive correlation again. But when x_3 is more than 30,000 dollars, the relationship between M2 and CPI changes to be negative again and may last for a relatively long period.

4. Using the M2, CPI and the GINI index data of the United States into semi parametric varying-coefficient regression model, after a statistical estimate, we can draw the function graph of $\widehat{\beta}_4(x_4)$:

Figure 13

The Function Graph of $\hat{\beta}_4(x_4)$



Vertical axis: $\hat{\beta}_4(x_4)$; Horizontal axis: x_4 ;

The function graph indicates that when x_4 is over 0.38, the relationship between M2 and CPI becomes negative. With the increase of x_4 , when x_4 is over 0.41, the relationship between M2 and CPI becomes to be positive. But when x_4 is over 0.45, the relationship between M2 and CPI changes to be negative again.

To summarize the above analysis, we can determine when the credit growth of the business sector is fewer than 5%, the ratio of dividend to investment is over 0.20, the per capita income is more than \$30,000, and the GINI index is over 0.45, then the

United States enters into “relatively wealthy society”. In this case, the paradox of inflation has occurred.

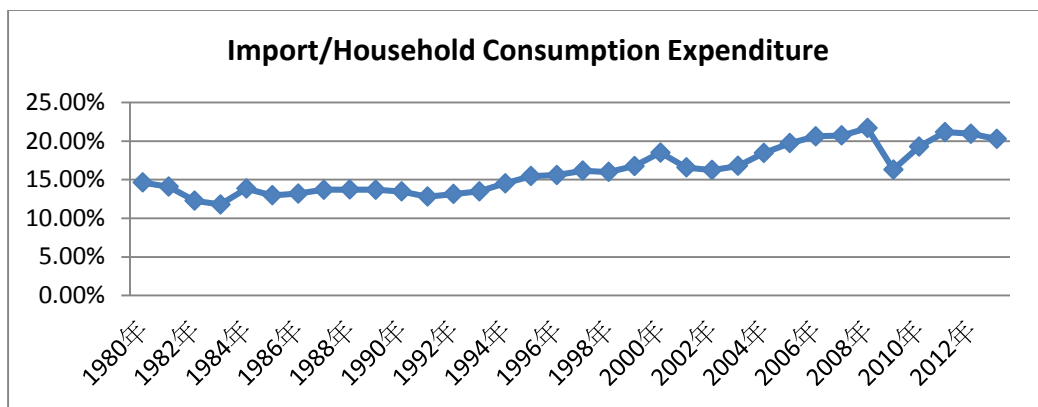
It must be said that the critical values of credit growth of the business sector, the ratio of dividends to investment, per capita income and GINI index are just a reference point. Even though these factors have reached the critical value, the paradox of inflation may not occur, because there are several other factors. The critical values also do not necessarily apply to other countries.

D. The Explanation for One Question

Someone may argue that the CPI of the United States has not risen proportionally with the growth of M2 since the 1990s. The main reason is that the United States imported a substantial amount of low cost consumer goods from developing countries, such as China, which depressed the CPI and caused it to decline rather than keep pace. In fact, this statement is lack of foundation. From figure 13 and figure 14, we can find that the total imports in the United States accounted for only 20% of the household consumption expenditure. In the total imports, only 20% came from China. So the cheap imports from developing countries cannot be enough to explain the stable CPI trend.

Figure 14

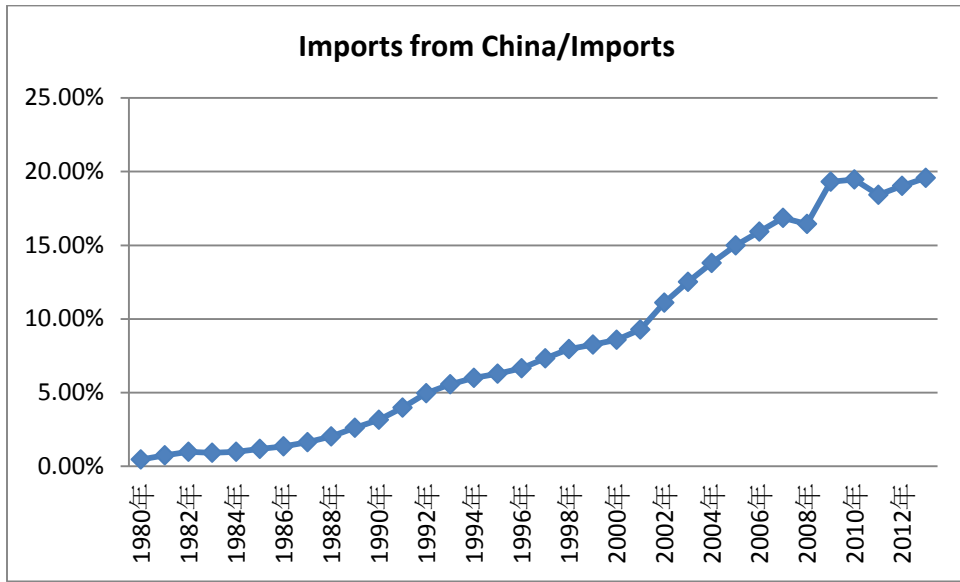
Import/ Household Consumption Expenditure



Source: CEIC

Figure 15

The Imports from China/Imports



Source: CEIC

CHAPTER V

CONCLUSIONS AND POLICY SUGGESTIONS

In this paper, we found that the paradox of inflation has been a common phenomenon among advanced countries since 1990s using the method of Lucas and the recursive estimation method, as well as the chow test and F-test. This phenomenon has been spreading to the developing world in the recent decade.

We provide a new hypothesis to explain the paradox phenomenon. The new hypothesis is based on the money creation process framework and Fisher's monetary Equation derivation.

We found that key factors provide the new explanation. These factors mark the features of a "relatively wealthy society". Through semi parametric varying-coefficient regression model, we test these key factors and determine the specific threshold value of them which can tell us if and when we will enter into a "relatively wealthy society" and face the paradox of inflation phenomenon.

Base on this new hypothesis, we can state that "in the relatively wealthy society, inflation is no longer a monetary phenomenon; it is a wealth allocation phenomenon".

That means that the basic theory of monetary policy must be modified. The decision whether or not to impose loosen monetary policy should not be based solely on the CPI. (In a "relatively wealthy society", the excess money supply will flow to overseas or domestic capital markets. If the money flows overseas, it may cause other countries to fall into inflation. If the money flows to domestic capital markets, it may lead to asset bubbles.) Whether or not to eliminate the Quantitative Easing scheme should not depend on level of the CPI index alone. It is an open question as to whether inflation should be the target of monetary policy.

REFERENCE

- Adeyeye E. A. & Fakiyesi T. O. (1980). *Productivity, Prices and Incomes Board and anti-inflationary Policy in Nigeria: The Nigerian Economy under the Military*. NES, Ibadan.
- Aglietta, M. (1980). *La Dévalorisation du Capital: Etude des Liens entre Accumulation et Inflation*. *Economie Appliquée*, 33(2), 387-423.
- Aikaeli, J. (2007). *Money and inflation dynamics: A lag between change in money supply and the corresponding inflation response in Tanzania*. Working papers series, SSRN-id1021227
- Ajakaiye, O. (2002). *Economic Development in Nigeria: A Review of Experience*. CBN Bullion, 26(1):47- 64.
- Akinbobola, T. O. (2012). *The dynamics of money supply, exchange rate and inflation in Nigeria*. *Journal of Applied Finance & Banking*, vol.2, no.4, 2012, 117-141
- Altimari, S. N. (2001). *Does money lead inflation in euro area?* European central research center, working paper no.63
- Alvarez, F., Lucas, R. E. Jr., & Weber, W. E. (2001). *Sorensen, Interest Rates and Inflation*, Working Paper 609 January 2001. (2).
- Anyanwu, J. C. (1993). *Monetary Economics: Theory, policy and Institutions*, Onitsha. Joance Educational Publishing Ltd.
- Asogu, J. O. (1991). *An Econometric Analysis of the Nature and Causes of Inflation in Nigeria*. CBN Economics and Financial Review. 29 (3):239-253.
- Bernanke, Ben S. (2006), “*Monetary Aggregates and Monetary Policy at the Federal Reserve: A Historical Perspective*”, Speech at the Fourth ECB Central Banking Conference, Frankfurt, Germany Nov 2006.
<http://www.federalreserve.gov/boarddocs/speeches/2006/20061110/default.htm>
- Cheng, L. H. & Laura, P. (1997), “*An Econometric Analysis of the determinant of Inflation in Turkey*”. Working Paper, International Monetary Fund.
- Chhibber, A. & Nemat, S (1990). *Exchange Reform, Parallel Markets, and Inflation in Africa: The Case of Ghana*. World Bank Working Papers, WPS 427, May.
- Clarke, S. (1994). *Marx's Theory of Crisis*. London: Macmillan.

- Darrat, F. A. (1986). *Money, inflation and causality in North Africa countries: An empirical investigation*. Journal of macroeconomics, vol 8, issue 1, 1986, Pages 87- 103
- Diouf, A. M. (2007). *Modeling Inflation for Mali*. IMF Working paper, WP/07/295
- Durevall, D. & Ndung'u, S. N. (2001). *A dynamic model of inflation for Kenya, 1974 – 1996*. Journal of African Economies, Vol 10, number 1, pp 92 – 125
- European Central Bank, 2004, the Monetary Policy of the ECB.
<http://www.ecb.int/pub/pdf/other/monetarypolicy2004en.pdf>
- Fashoyin, T. (1984). *Income and Inflation in Nigeria*. Ikeja: Longman.
- Fatukasi, B. (1988). "Determinants of Inflation in Nigeria: An Empirical Analysis". International Journal of Humanities and social science. Vol.1, No.18Grou, P. (1977). *Monnaie, Crise Economique*. Paris: Masprro.
- Guttman, R. (1994). *How Credit-Money Shapes the Economy: the United States in a Global System*. M. E. Sharpe, Armonk.
- Hossain, T. & Islam, N. (2001). "An Economic Analysis of the Determinants of Inflation in Bangladesh." The International Journal of Social Science 2001, 11(1): 29-36.
- Iyoha, M. A. (1998). *Macroeconomics for Developing World, Benin City*. Miyo Educational Publisher.
- Jones, D. J., & Khilji, M. N. (1998). *Money growth, inflation, and causality (Empirical Evidence for Pakistan, 1973–1985)*. The Pakistan development review, Vol. 27, No. 1 (Spring 1988), pp. 45-58
- Kabundi, A. (2012). *Dynamics of Inflation in Uganda*. Working Paper Series No 152 African Development Bank
- Khanam, R. & Mohammad, R. M. (1995) "The Causative Factors of Inflation in Bangladesh: An Econometric Study". Chittagong University Studies, Social Science, Vol.XVI, No.1, pp.100-116.
- Malina, K. A. (1980). "Inflation in the Tanzania Environment" in Rwegasira K.S.P and L.A Kanneworth (ed) *Inflation in Tanzania (Causes, Effects and Control)*. Institute of Finance Management (IFM), Dar-es-Salam.
- Manser, M. E. & McDonald, R. J. (1988), "An analysis of substitution bias in measuring inflation, 1959-1 985". Econ. 56:909-9301.
- Mattick, P. (1978). *Economics, Politics, and the Age of Inflation*. M. E. Sharpe, White Plains.

- Morana, C., & Bagliano, C. F. (2007). *Inflation and monetary dynamics in the USA: A quantity –theory approach*. *Economics*, 2007, 39, 229–244
- Ndanshau, M. A. (2010). *Money and other determinants of inflation: the case of Tanzania*. *Indian journal of economics and business*, Volume: 9 Source Issue: 3, ISSN: 0972-5784
- Ndanshau, M. A. (2012). *Budget deficits, money supply and inflation in Tanzania: A Multivariate Granger causality test, 1967- 2010*. University of Dar es Salaam working paper No. 04/12
- Nikolic, M. (2000). *Money growth–inflation relationship in post communist Russia*. *Journal of comparative economics* 28, 108–133 (2000)
- Osakwe, J.O. (1983). “*Government expenditures, money supply and prices 1970–1980*”. *CBD Economic and Financial Review*, 21(2): 4–18.
- Oyejide, T.A. (1972). “*Deficit financing, inflation and capital formation: An analysis of the Nigerian experience, 1957–1970*”. *Nigerian Journal of Economic and Social Studies*, 14(1): 27–43.
- Perelman, M. (1996). *The Pathology of the US Economy*. London: Macmillan.
- Pindiriri, C. (2012). *Monetary reforms and inflation dynamics in Zimbabwe*. *International research journal of finance and economics* ISSN 1450-2887 Issue 90 (2012)
- Polan, M., & Grauwe, P. D. (2005). *Is Inflation always and everywhere a monetary phenomenon?* *Scand. J. of Economics* 107(2), 239–259, 2005
- Saini, G. K. (1982). *The monetarist explanation of inflation: The experience of six Asian countries*. *Word development*, Vol.10, No. 10, pp. 871-884, 1982.
- Sellin, P. (2001). “*Monetary Policy and the Stock Market: Theory and Empirical Evidence*”. *Journal of Economic Surveys* 15.4 (2001): 491-541. (1).
- Sims, C. A. (1994), “A Simple Model for Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy,” *Economic Theory* 4, 381-99.
- Simwaka, K., Ligoya, L., Kabango, G., & Chikonda. M. (2012). *Money supply and inflation in Malawi: An econometric investigation*. *The international journal of applied economics and fianace* 6(3): 74-88, 2012
- Thornton, J. (2008). *Money, output and inflation in African economies*. *South African journal of economics* Vol. 76:3 September 2008

Us, V. (2004). *Inflation dynamics and monetary policy strategy: Some aspects for the Turkish economy*. *Journal of Policy Modeling*, 26 (2004) 1003–1013

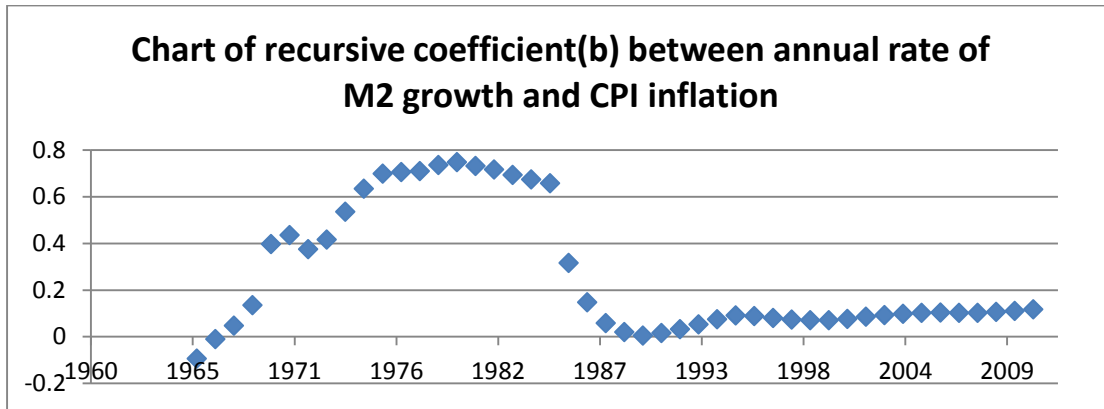
Vroey, M. de. (1984). *Inflation: A Non-Monetarist Monetary Interpretation*. *Cambridge Journal of Economics*, 8, 381-399.

Zhang, C. (2012). *Monetary dynamics of inflation in China*. *The world economy*, DOI: 10.1111/twec.12021

APPENDIX A

EMPIRICAL STUDY RESULTS OF THE OTHER SAMPLE COUNTRIES

1. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Britain



The chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 1992.

Breakpoint Chow Test: 1992

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1963-2010

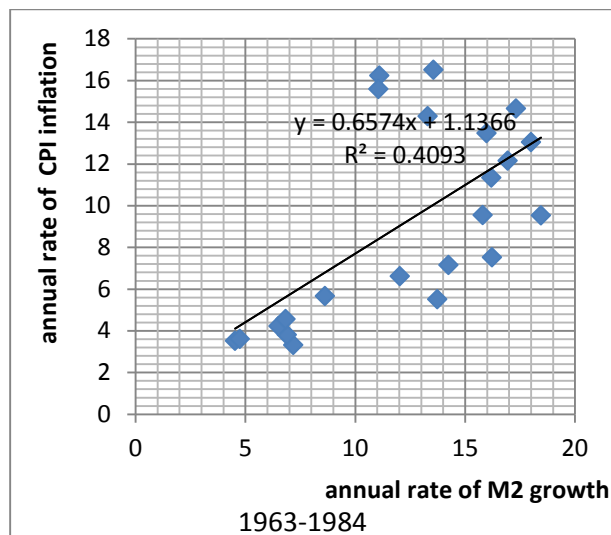
F-statistic	12.24461	Prob. F(2,44)	0.0001
Log likelihood ratio	21.23937	Prob. Chi-Square(2)	0.0000
Wald Statistic	24.48923	Prob. Chi-Square(2)	0.0000

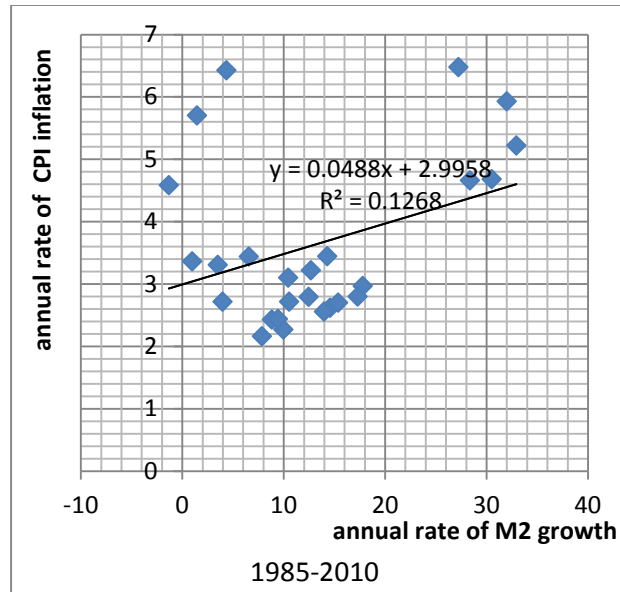
The F-test result: the variances of recursive coefficient are markedly different before, and after 1992.

F-test: variance analysis of two samples

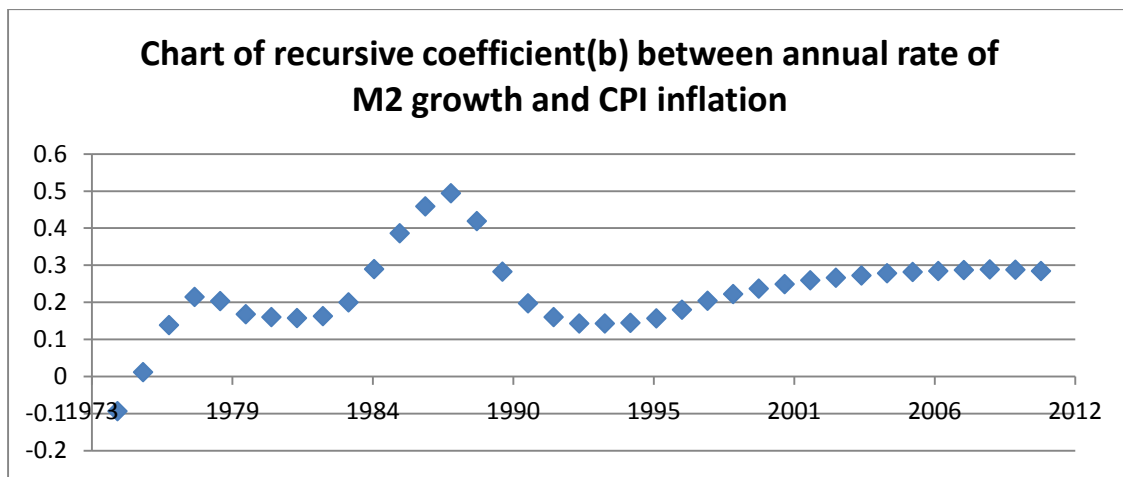
	Variable 1	Variable 2
Mean	0.37797974	0.09125499
Variance	0.09301128	0.00021501
Observation	28	18
df	27	17
F	432.592916	
P(F<=f) one-tailed	1.8694E-19	
F one-tailed critical	2.16659315	

Linear regression for M2 and CPI of Britain during different periods as follows:





2. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Germany



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes obviously before, and after 1990.

Breakpoint Chow Test: 1990

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1972-2010

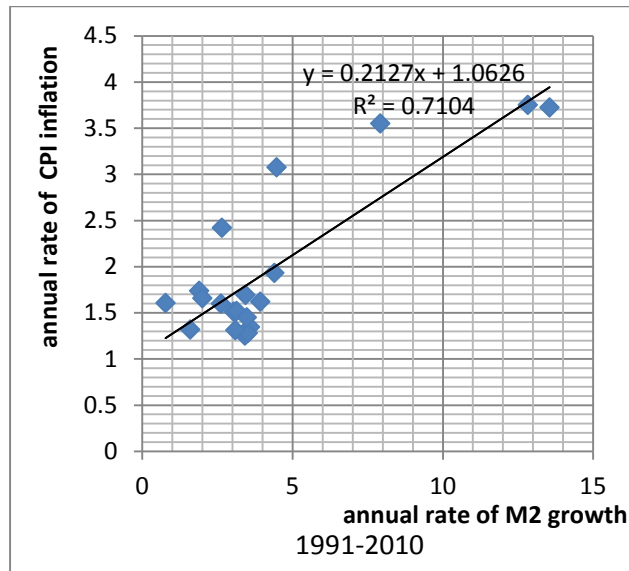
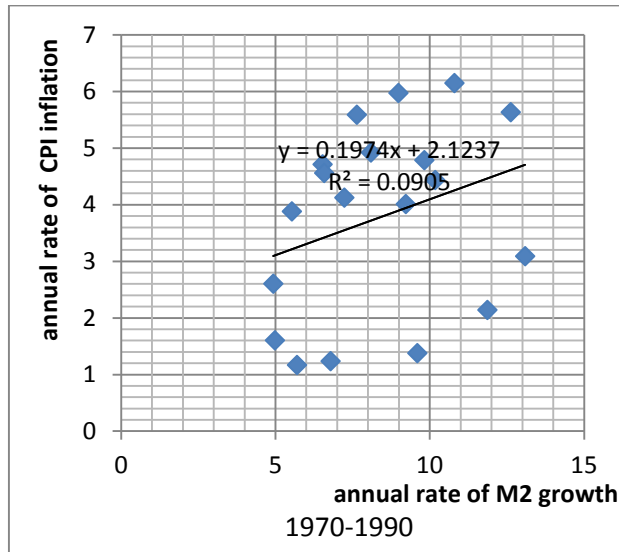
F-statistic	3.377530	Prob. F(2,35)	0.0456
Log likelihood ratio	6.882430	Prob. Chi-Square(2)	0.0320
Wald Statistic	6.755059	Prob. Chi-Square(2)	0.0341

The F-test result: the variances of recursive coefficient are markedly different before, and after 1990.

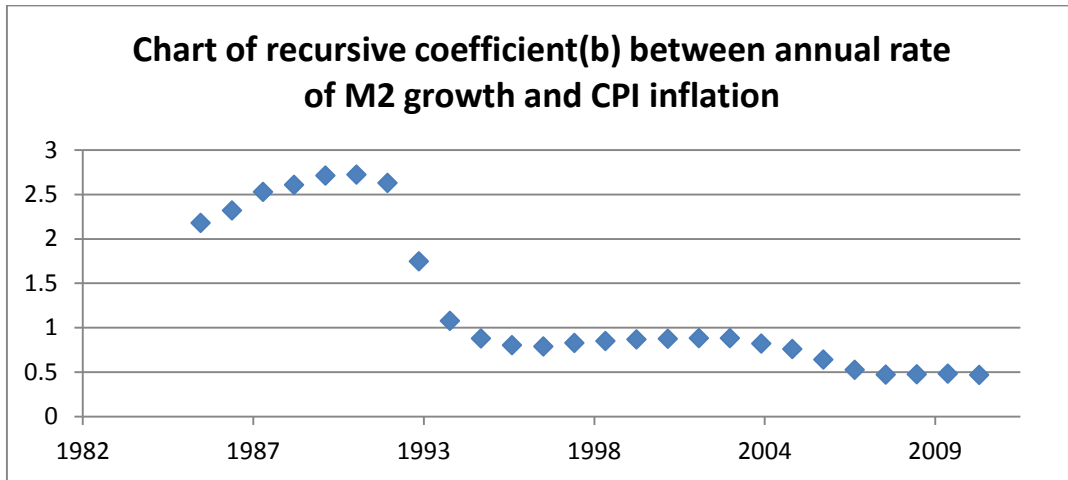
F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	0.2267993	0.231899
Variance	0.02312184	0.003228
Observation	17	20
df	16	19
F	7.16307436	
P(F<=f) one-tailed	5.1498E-05	
F one-tailed critical	2.214895	

Linear regression for M2 and CPI of Germany during different periods as follows:



3. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Euro zone



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 2004.

Breakpoint Chow Test: 2004

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1983 2010

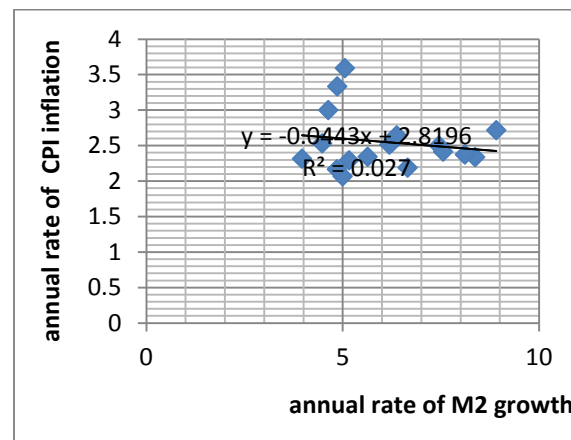
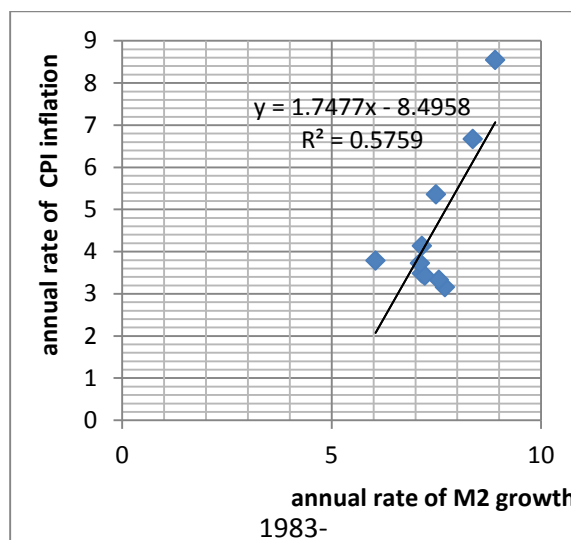
F-statistic	8.183075	Prob. F(2,24)	0.0020
Log likelihood ratio	14.55826	Prob. Chi-Square(2)	0.0007
Wald Statistic	16.36615	Prob. Chi-Square(2)	0.0003

The F-test result: the variances of recursive coefficient are markedly different before, and after 2004.

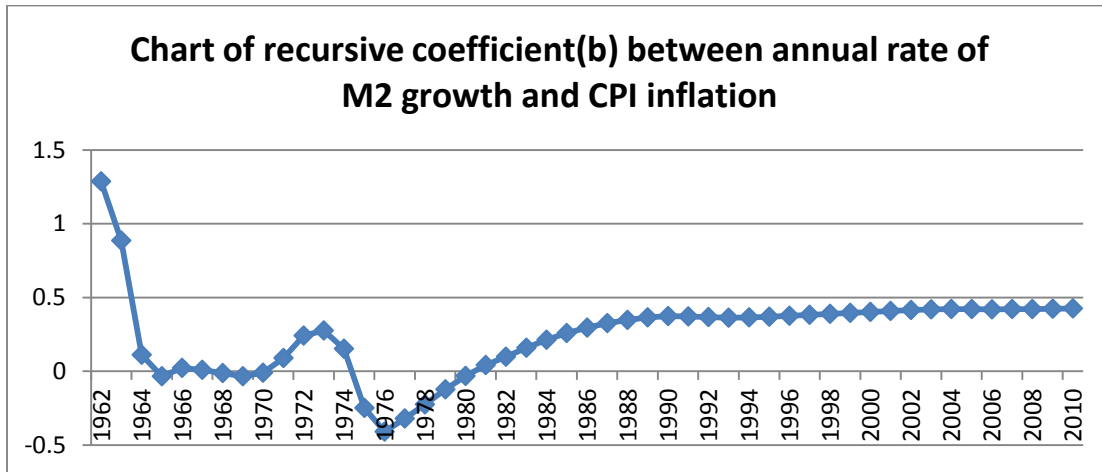
F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	1.48717538	0.5093141
Variance	0.66939577	0.0044834
Observation	20	6
df	19	5
F	149.305144	
P(F<=f) one-tailed	1.2935E-05	
F one-tailed critical	4.56782046	

Linear regression for M2 and CPI of Euro zone during different periods as follows:



4. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Japan



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 1986.

Chow Breakpoint Test: 1986

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1960-2010

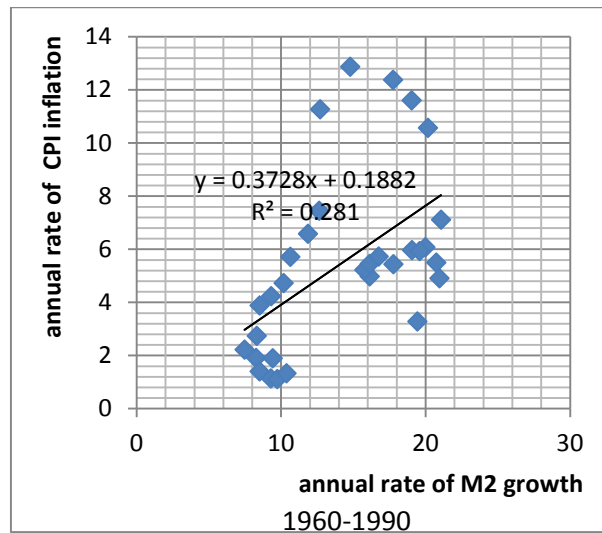
F-statistic	3.830531	Prob. F(2,47)	0.0288
Log likelihood ratio	7.701204	Prob. Chi-Square(2)	0.0213
Wald Statistic	7.661062	Prob. Chi-Square(2)	0.0217

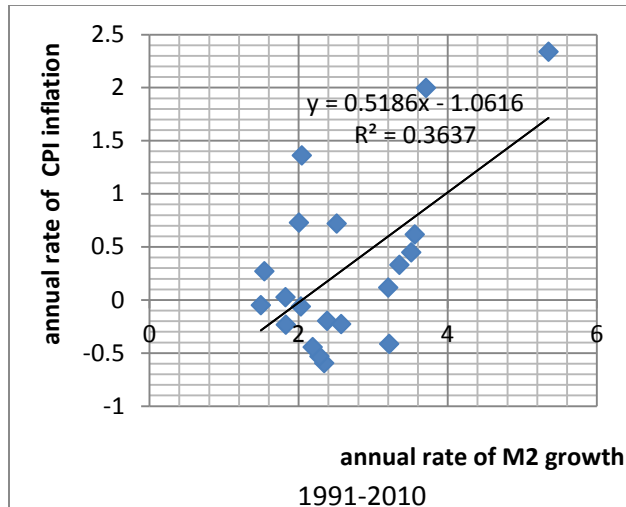
The F-test result: the variances of recursive coefficient are markedly different before, and after 1986.

F-test: variance analysis of two samples

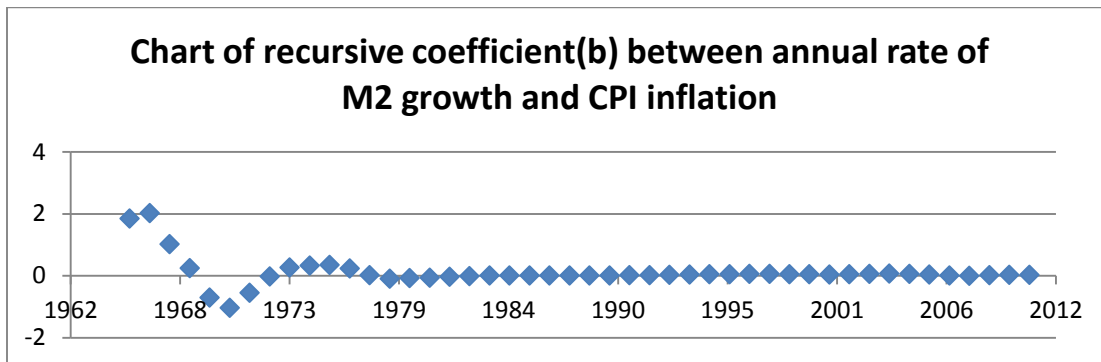
	Variable 1	Variable 2
Mean	0.1078604	0.391353
Variance	0.1236862	0.000825
Observation	25	24
df	24	23
F	149.94377	
P(F<=f) one-tailed	4.97E-20	
F one-tailed critical	2.0050095	

Linear regression for M2 and CPI of Japan during different periods as follows:





5. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in India



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 2000.

Breakpoint Chow Test: 2000

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1963 2010

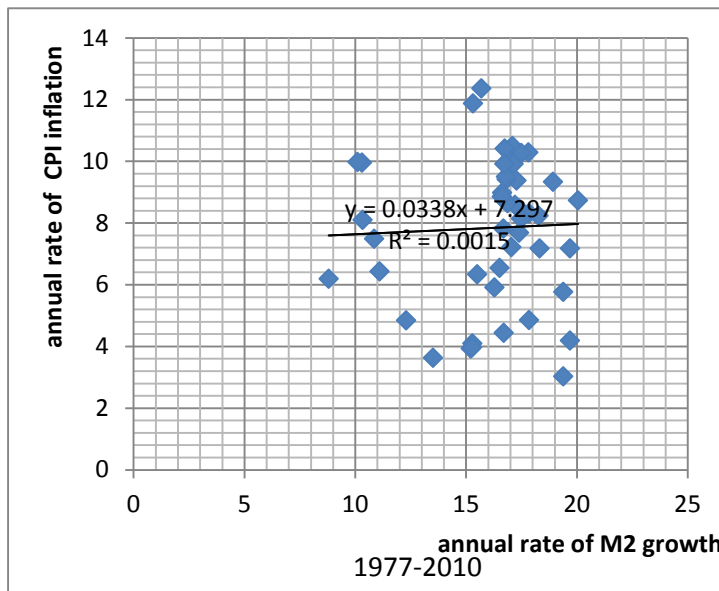
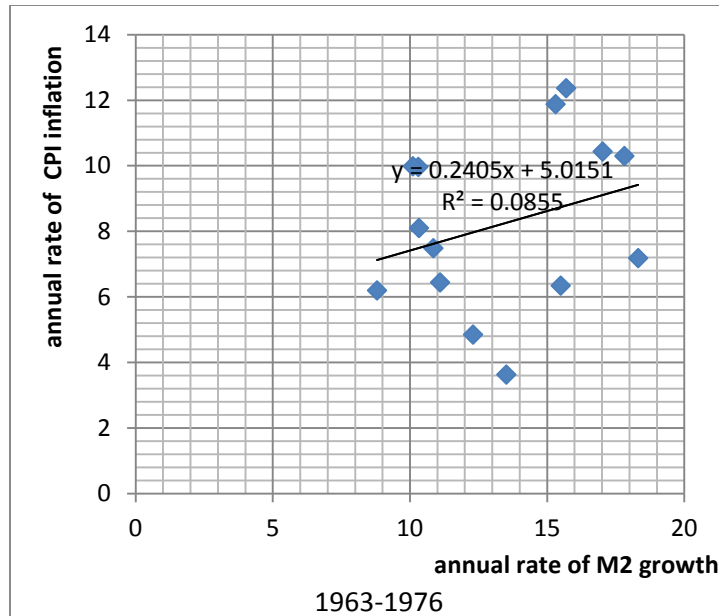
F-statistic	6.475132	Prob. F(2,44)	0.0034
Log likelihood ratio	12.38346	Prob. Chi-Square(2)	0.0020
Wald Statistic	12.95026	Prob. Chi-Square(2)	0.0015

The F-test result: the variances of recursive coefficient are markedly different before, and after 2000.

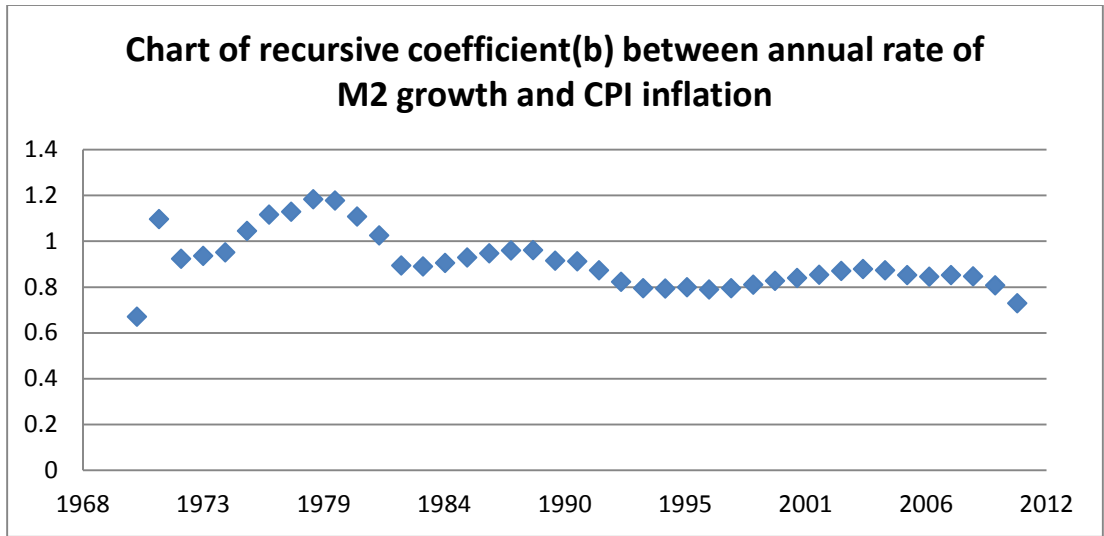
F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	0.12461398	0.03983964
Variance	0.30521316	0.0004635
Observation	35	11
df	34	10
F	658.490045	
P(F<=f) one-tailed	3.588E-13	
F one-tailed critical	2.68147062	

Linear regression for M2 and CPI of India during different periods as follows:



6. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in South Africa



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 2000.

Breakpoint Chow Test: 2000

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1968 2010

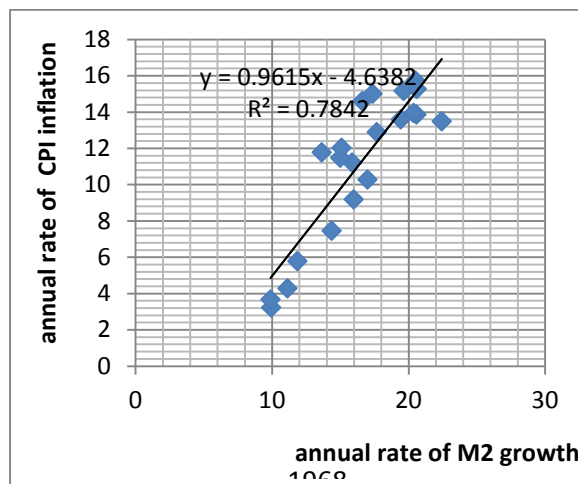
F-statistic	18.61102	Prob. F(2,39)	0.0000
Log likelihood ratio	28.81383	Prob. Chi-Square(2)	0.0000
Wald Statistic	37.22204	Prob. Chi-Square(2)	0.0000

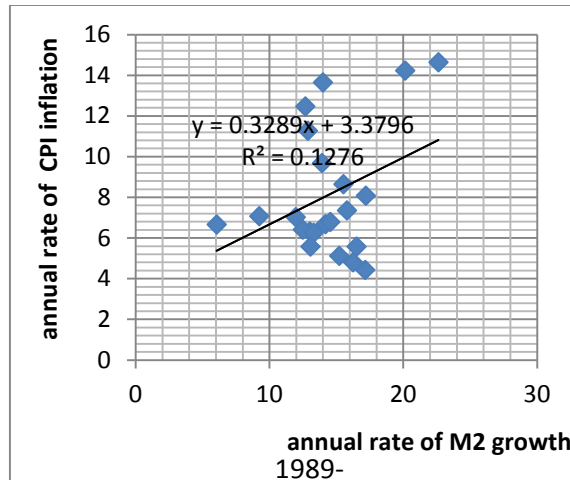
The F-test result: the variances of recursive coefficient are markedly different before, and after 2000.

F-test: variance analysis of two samples

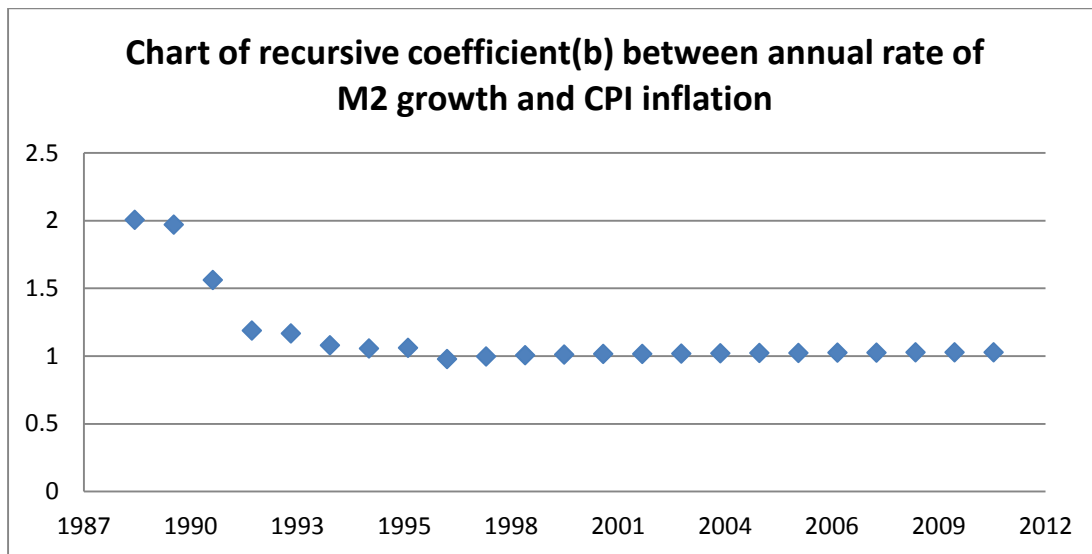
	Variable 1	Variable 2
Mean	0.9328177	0.8409141
Variance	0.0168324	0.0017519
Observation	30	11
df	29	10
F	9.6079376	
P(F<=f) one-tailed	0.000337	
F one-tailed critical	2.7048084	

Linear regression for M2 and CPI of South Africa during different periods as follows:





7. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Brazil



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 1993.

Breakpoint Chow Test: 1993

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1986 2010

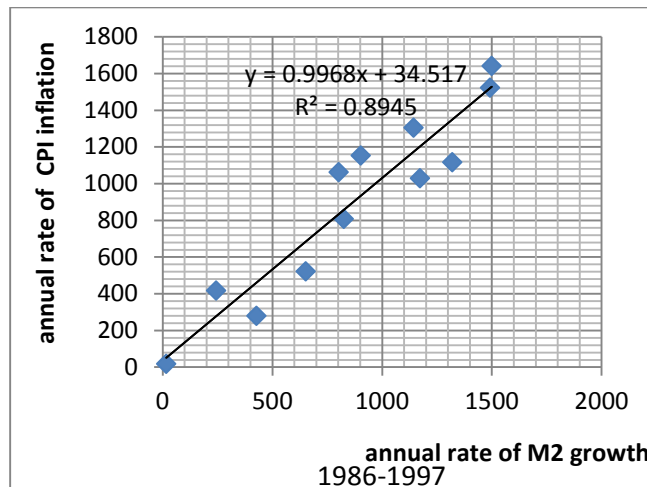
F-statistic	6.135755	Prob. F(2,21)	0.0080
Log likelihood ratio	11.50448	Prob. Chi-Square(2)	0.0032
Wald Statistic	12.27151	Prob. Chi-Square(2)	0.0022

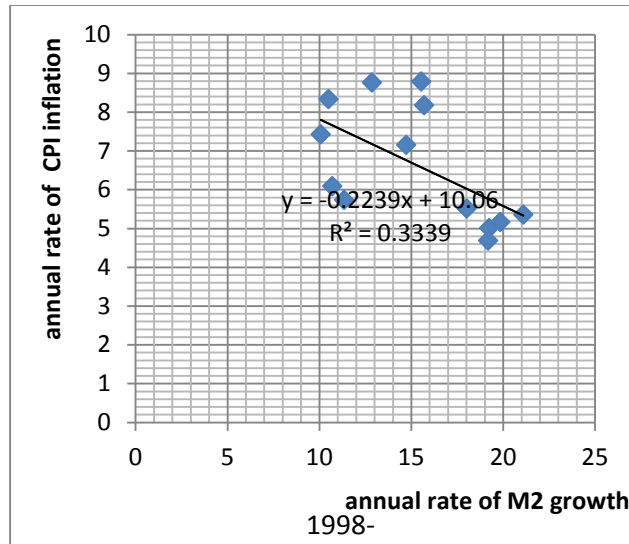
The F-test result: the variances of recursive coefficient are markedly different before, and after 1993.

F-test: variance analysis of two samples

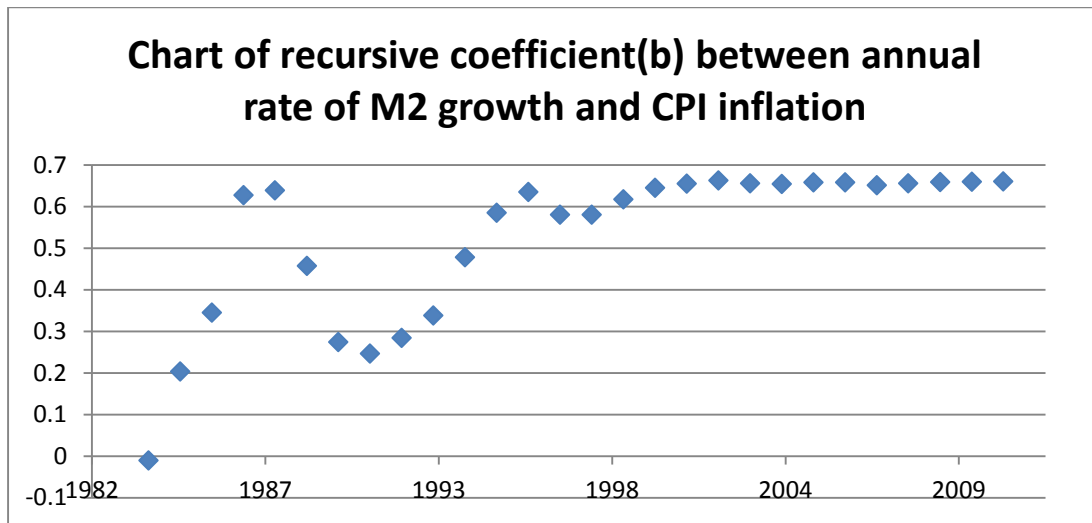
	Variable 1	Variable 2
Mean	1.5793742	1.0249619
Variance	0.1640879	0.0005296
Observation	5	18
df	4	17
F	309.82895	
P(F<=f) one-tailed	1.227E-15	
F one-tailed critical	2.9647081	

Linear regression for M2 and CPI of Brazil during different periods as follows:





8. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in China



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 1988.

Breakpoint Chow Test: 1988

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1981 2010

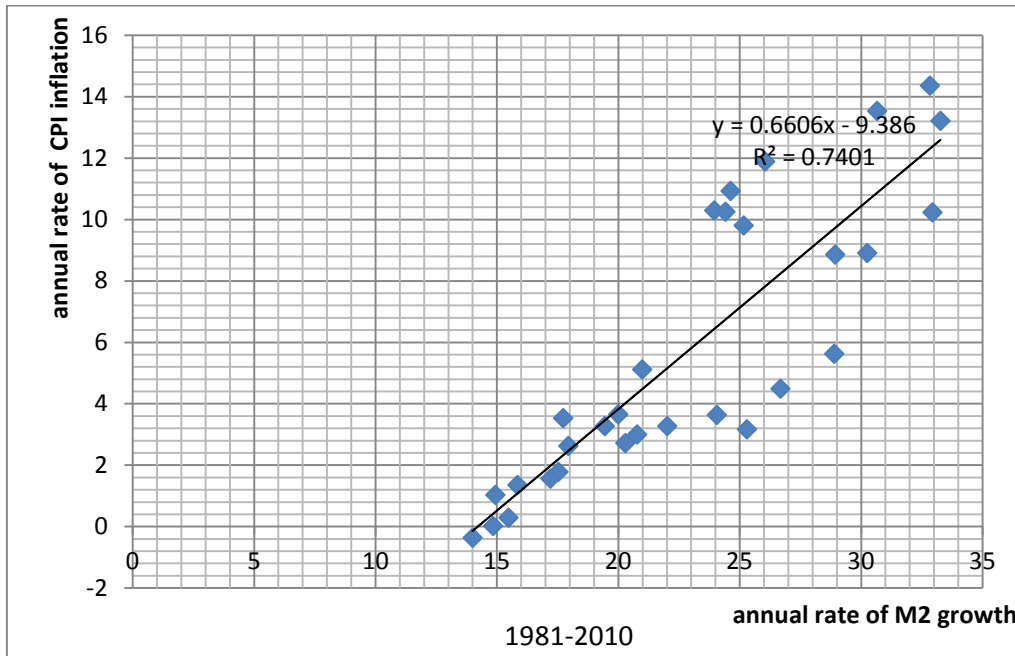
F-statistic	4.199518	Prob. F(2,26)	0.0263
Log likelihood ratio	8.397960	Prob. Chi-Square(2)	0.0150
Wald Statistic	8.399036	Prob. Chi-Square(2)	0.0150

The F-test result: the variances of recursive coefficient are markedly different before, and after 1988.

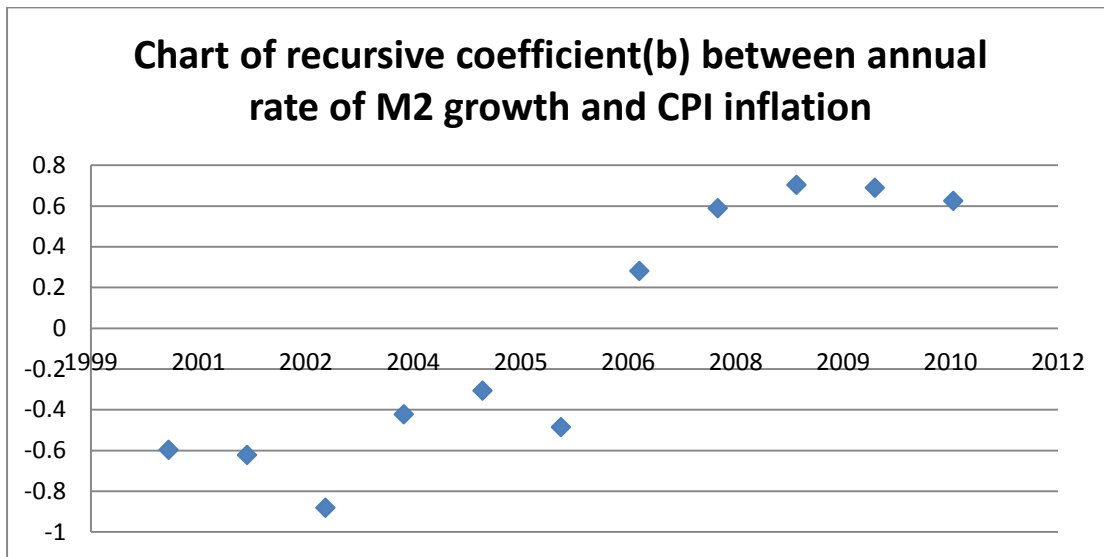
F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	0.377205	0.568326
Variance	0.063833	0.020605
Observation	6	22
df	5	21
F	3.097998	
P(F<=f) one-tailed	0.03003	
F one-tailed critical	2.684781	

Linear regression for M2 and CPI of China as follows:



9. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Russia



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 2004.

Breakpoint Chow Test: 2004

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1998 2010

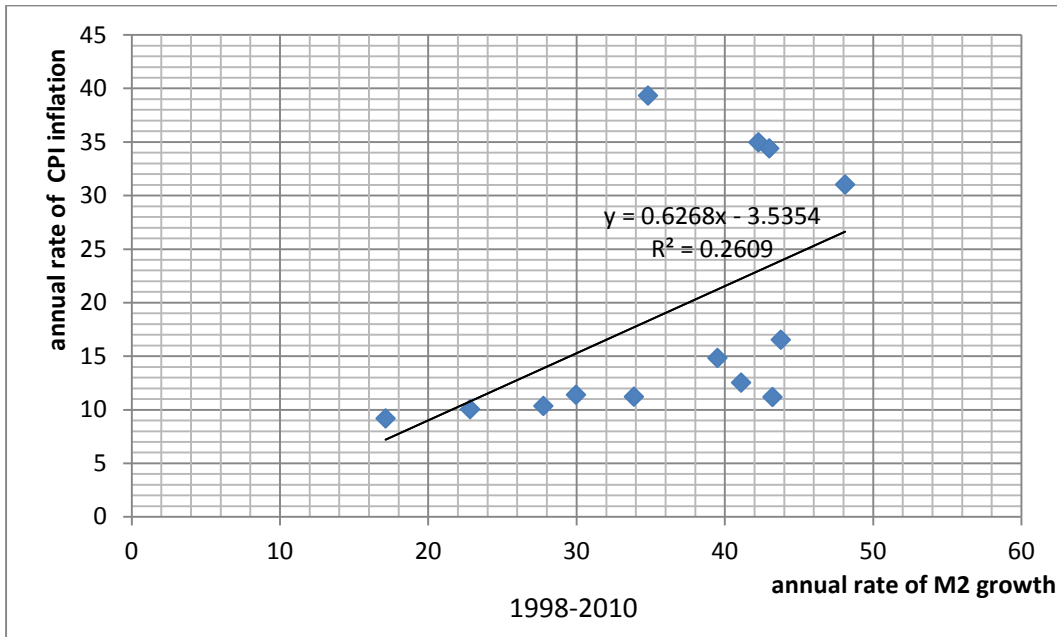
F-statistic	5.494494	Prob. F(2,9)	0.0276
Log likelihood ratio	10.37344	Prob. Chi-Square(2)	0.0056
Wald Statistic	10.98899	Prob. Chi-Square(2)	0.0041

The F-test result: the variances of recursive coefficient are markedly different before, and after 2004.

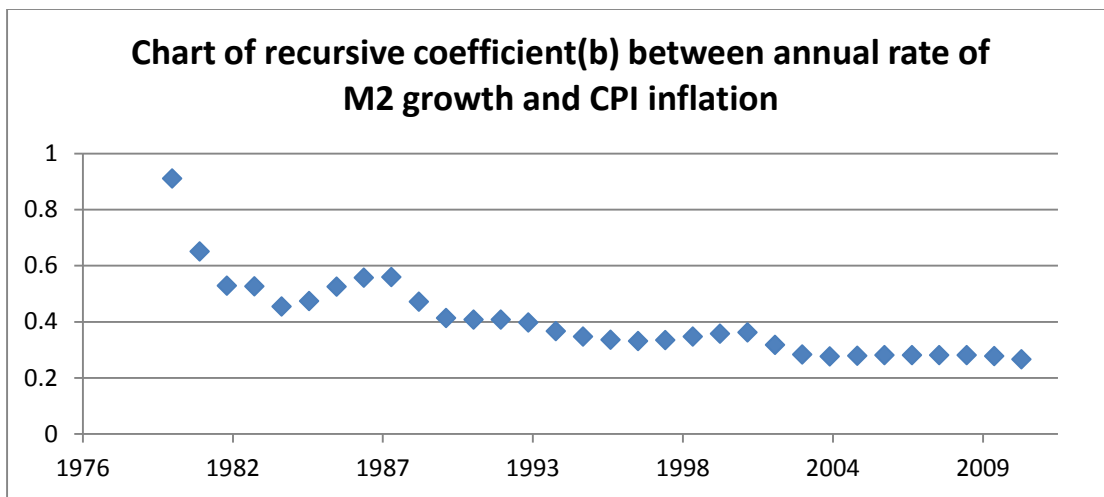
F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	-0.5645901	0.4018415
Variance	0.04784686	0.2121496
Observation	5	6
df	4	5
F	0.22553357	
P(F<=f) one-tailed	0.08704642	
F one-tailed critical	0.1598451	

Linear regression for M2 and CPI of Russia as follows:



10. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Singapore



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 1988.

Breakpoint Chow Test: 1988

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1977 2010

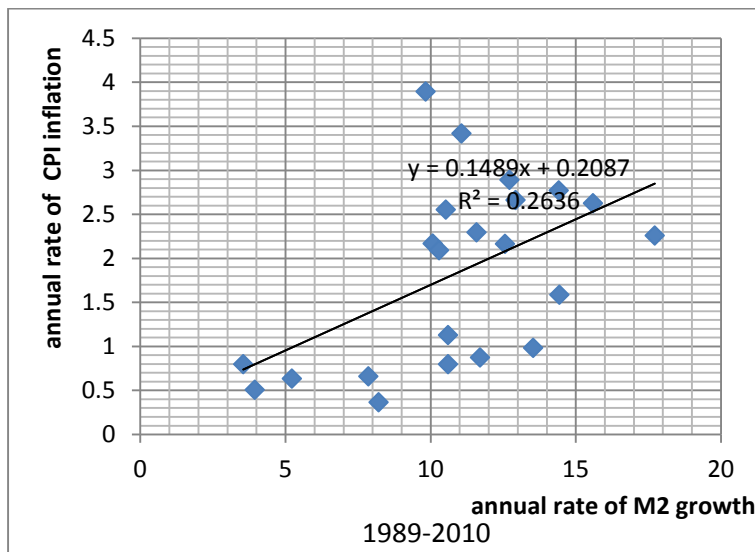
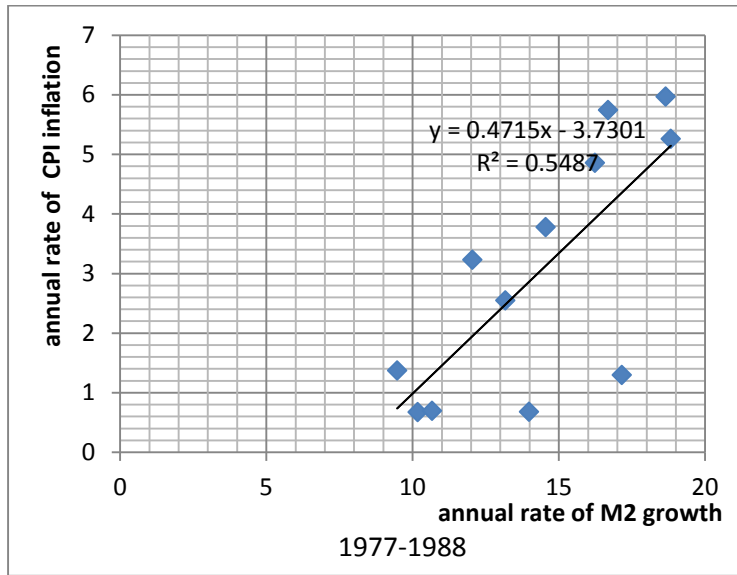
F-statistic	9.618757	Prob. F(2,30)	0.0006
Log likelihood ratio	16.84559	Prob. Chi-Square(2)	0.0002
Wald Statistic	19.23751	Prob. Chi-Square(2)	0.0001

The F-test result: the variances of recursive coefficient are markedly different before, and after 1988.

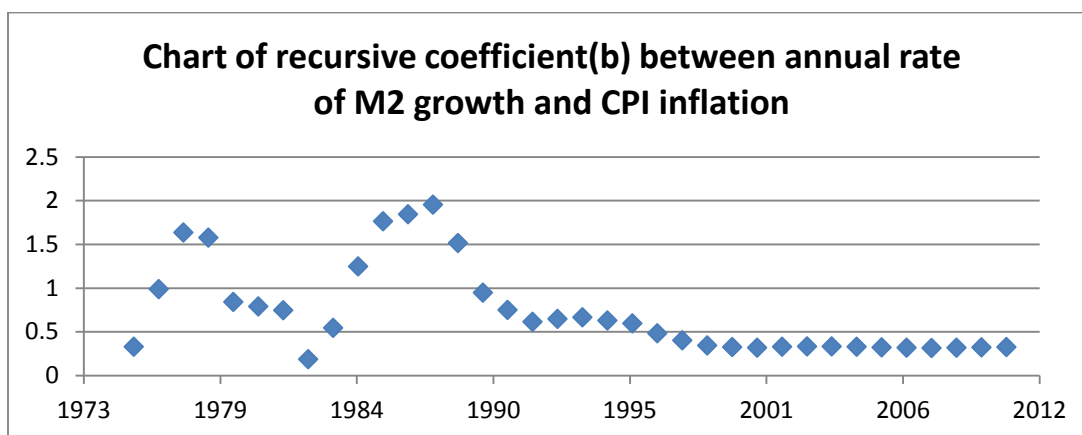
F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	0.5657896	0.3287899
Variance	0.0178848	0.0024532
Observation	10	22
Df	9	21
F	7.2903816	
P(F<=f) one-tailed	9.094E-05	
F one-tailed critical	2.3660482	

Linear regression for M2 and CPI of Singapore during different periods as follows:



11. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Thailand



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 1989.

Breakpoint Chow Test: 1989

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1973 2010

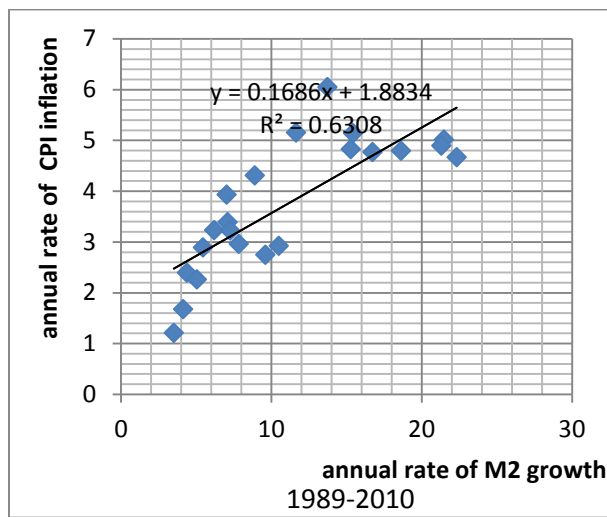
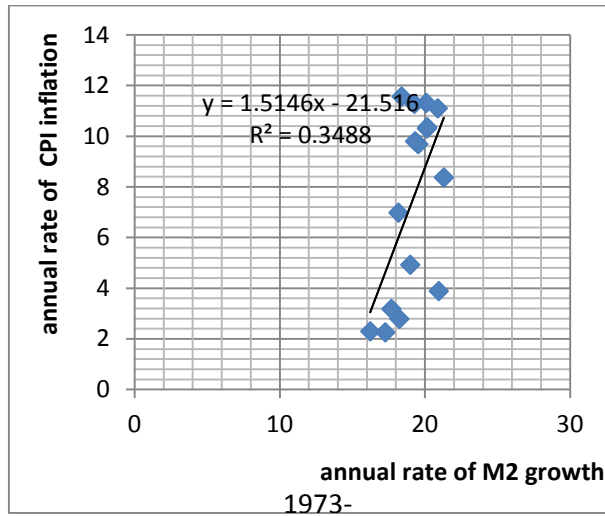
F-statistic	8.741215	Prob. F(2,34)	0.0009
Log likelihood ratio	15.76544	Prob. Chi-Square(2)	0.0004
Wald Statistic	17.48243	Prob. Chi-Square(2)	0.0002

The F-test result: the variances of recursive coefficient are markedly different before, and after 1989.

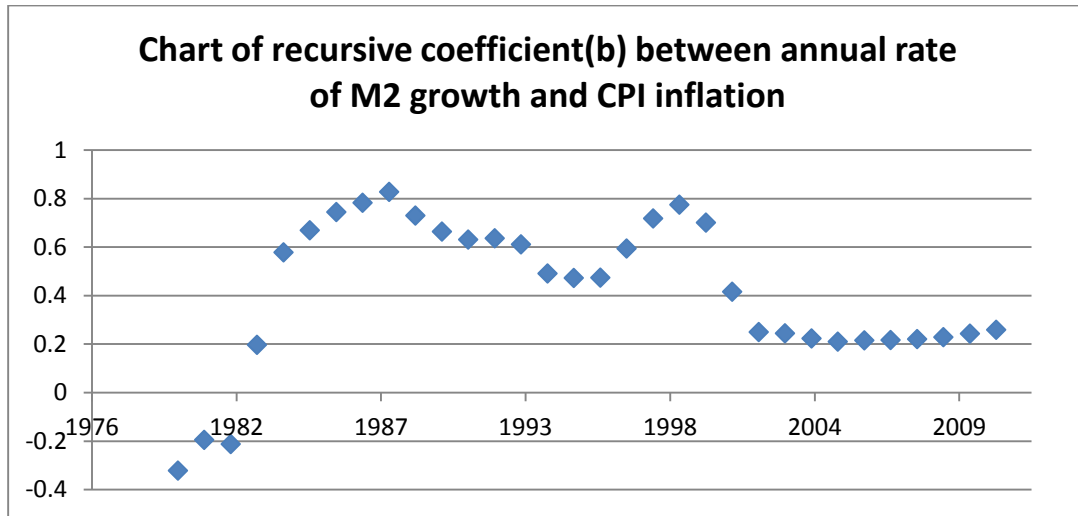
F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	1.127012	0.428378
Variance	0.320285	0.022658
Observation	15	21
df	14	20
F	14.13549	
P(F<=f) one-tailed	2.02E-07	
F one-tailed critical	2.224956	

Linear regression for M2 and CPI of Thailand during different periods as follows:



12. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Indonesia



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 1998.

Breakpoint Chow Test: 1998

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1977 2010

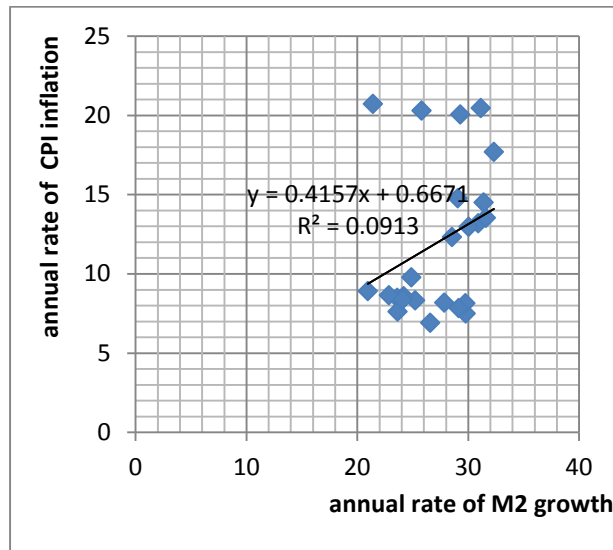
F-statistic	12.59156	Prob. F(2,30)	0.0001
Log likelihood ratio	20.72163	Prob. Chi-Square(2)	0.0000
Wald Statistic	25.18312	Prob. Chi-Square(2)	0.0000

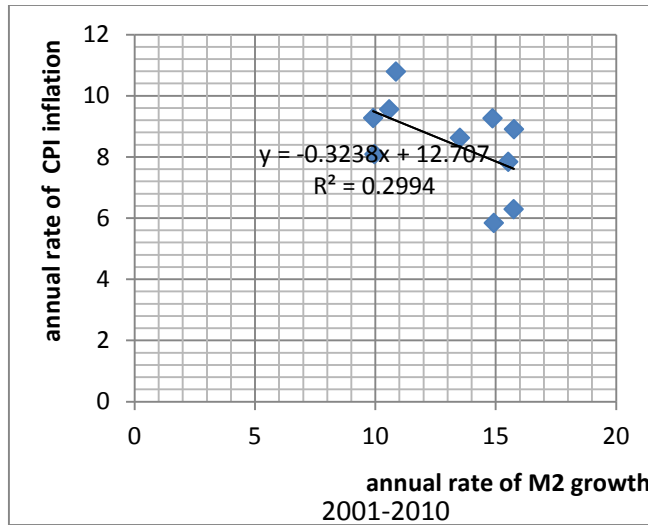
The F-test result: the variances of recursive coefficient are markedly different before, and after 1998.

F-test: variance analysis of two samples

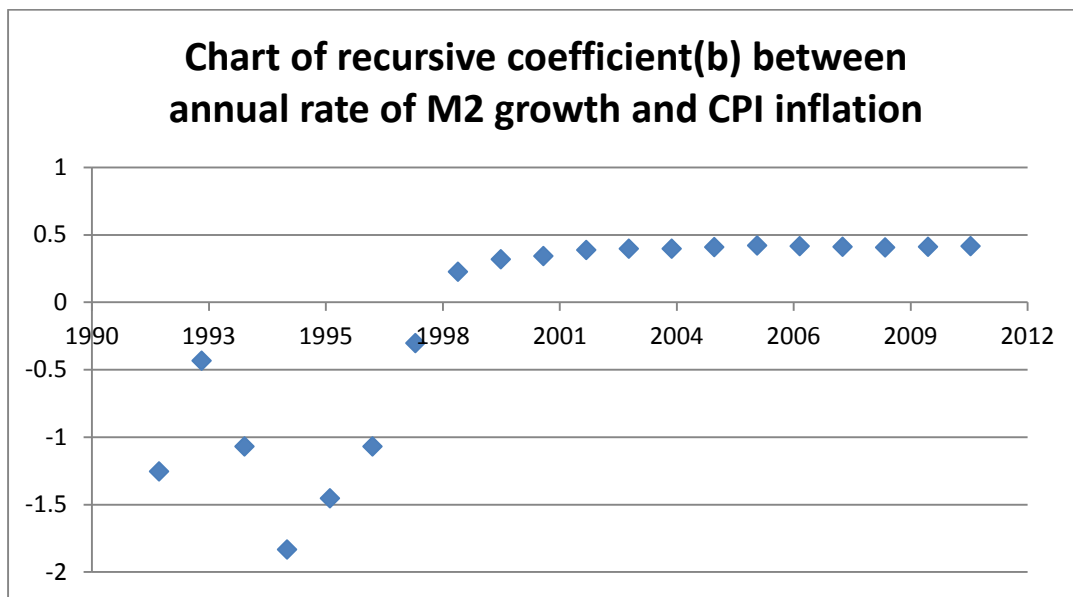
	Variable 1	Variable 2
Mean	0.493128	0.285571
Variance	0.120885	0.0201
Observation	20	12
Df	19	11
F	6.014173	
P(F<=f) one-tailed	0.002048	
F one-tailed critical	2.65808	

Linear regression for M2 and CPI of Indonesia during different periods as follows:





13. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Philippines



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 1997.

Breakpoint Chow Test: 1997

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1989-2010

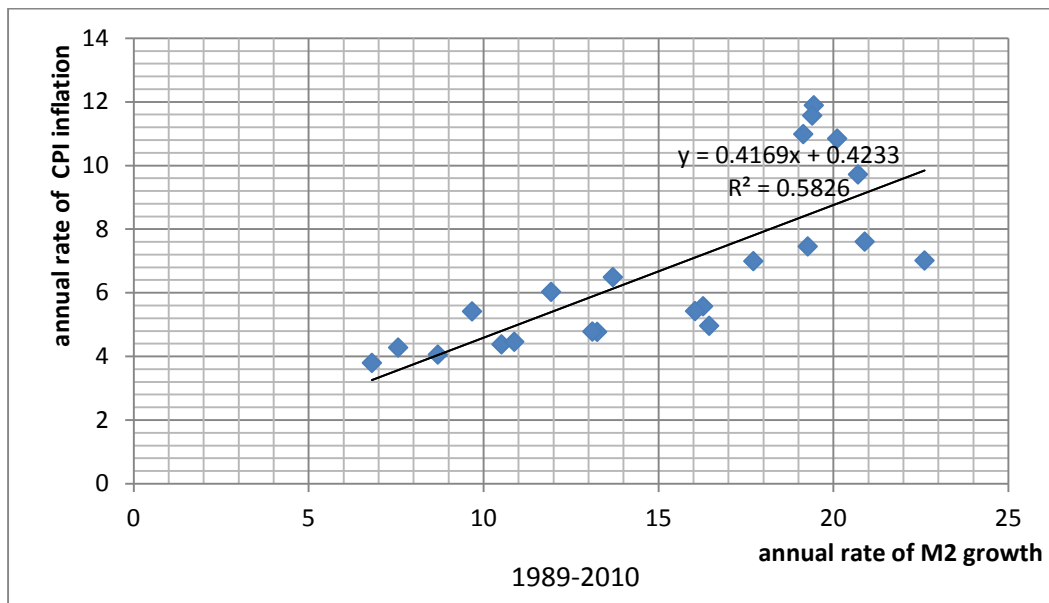
F-statistic	15.14722	Prob. F(2,18)	0.0001
Log likelihood ratio	21.71279	Prob. Chi-Square(2)	0.0000
Wald Statistic	30.29445	Prob. Chi-Square(2)	0.0000

The F-test result: the variances of recursive coefficient are markedly different before, and after 1997.

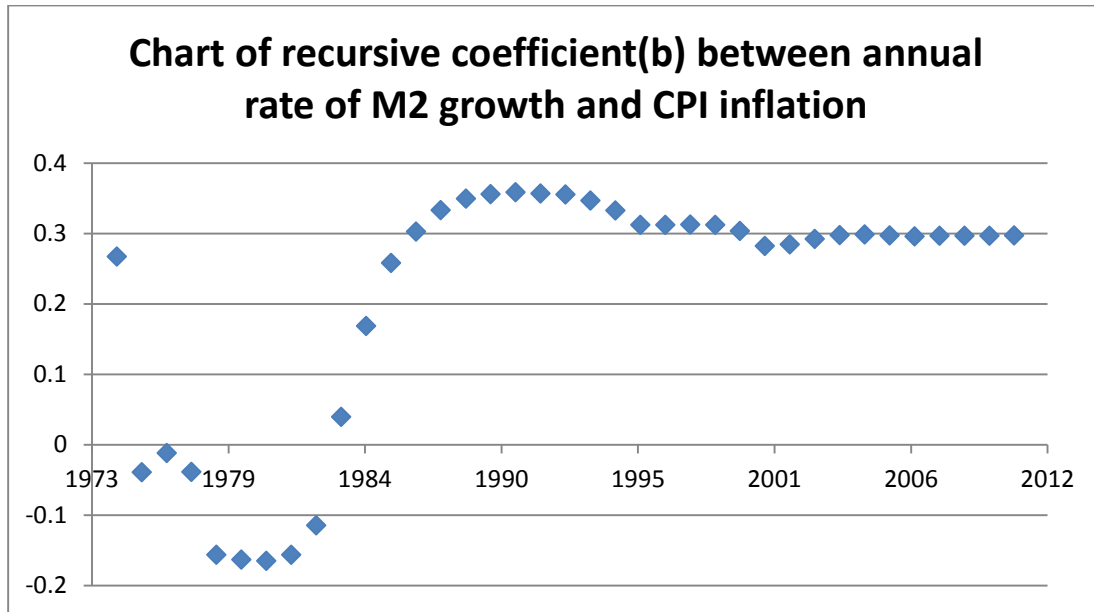
F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	-1.05915	0.381508
Variance	0.292557	0.003093
Observation	7	13
Df	6	12
F	94.57156	
P(F<=f) one-tailed	2.13E-09	
F one-tailed critical	2.99612	

Linear regression for M2 and CPI of Philippines as follows:



14. Empirical study results of the relationship between annual rate of M2 growth and CPI inflation in Malaysia



The Chow test result: the relationship between annual rate of M2 growth and CPI inflation changes before, and after 2000.

Breakpoint Chow Test: 2000

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1972 2010

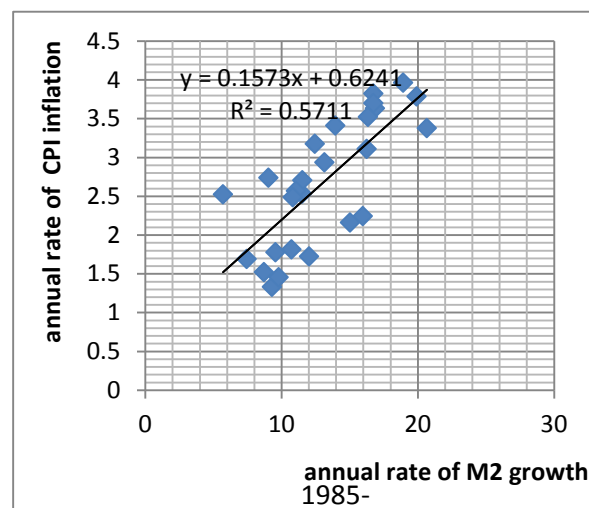
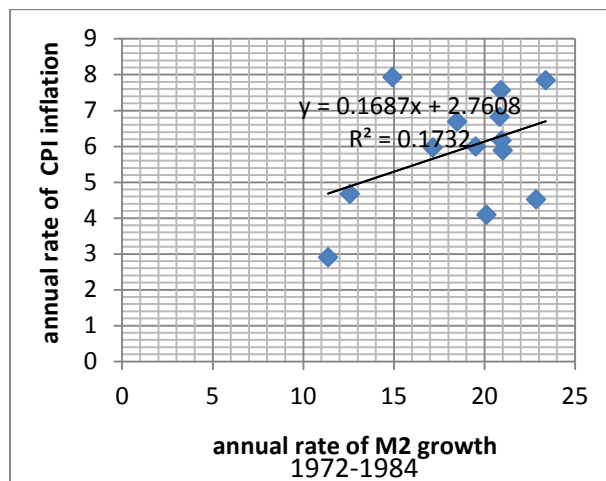
F-statistic	3.287991	Prob. F(2,35)	0.0491
Log likelihood ratio	6.714809	Prob. Chi-Square(2)	0.0348
Wald Statistic	6.575982	Prob. Chi-Square(2)	0.0373

The F-test result: the variances of recursive coefficient are markedly different before, and after 2000.

F-test: variance analysis of two samples

	Variable 1	Variable 2
Mean	0.178322	0.295277
Variance	0.040557	1.77E-05
Observation	27	10
df	26	9
F	2290.921	
P(F<=f) one-tailed	2.18E-14	
F one-tailed critical	2.886414	

Linear regression for M2 and CPI of Malaysia during different periods as follows:



APPENDIX B
ARTICLES REVIEW

Theory:

The theory guiding this study is the famous quantity theory of money propounded by Fisher (1911). The theory in its simplest form depicts that change in the stock of money supply will be translated into equi-proportionate change in the general price level (inflation rate). This is based on the assumption that at full employment, the level of transaction (national output) and velocity is constant, or at least change slowly. Thus, inflation will be directly proportional with the quantity of money stock.

However, central banks at best say they use aggregates as one of many indicators of economic activity, but certainly not as the key nominal anchor. For example, Ben Bernanke (2006) said:

It would be fair to say that monetary and credit aggregates have not played a central role in the formulation of U.S. monetary policy since [1982], although policymakers continue to use monetary data as a source of information about the state of the economy.

Although a heavy reliance on monetary aggregates as a guide to policy would seem to be unwise in the U.S. context, money growth may still contain important information about future economic developments. Attention to money growth is thus sensible as part of the eclectic modeling and forecasting framework used by the U.S. central bank.

The European central bank says it pays a bit more attention to M3 growth, but only as one of many indicators of long term inflation rather than a central target and nominal anchor (see, for example, European Central Bank 2004). Many regressions have been run to characterize what central banks actually do, finding at best weak evidence that they pay any attention to monetary aggregates.

Sims (1994, p. 381) neatly summarized a long history of monetary wisdom with:

“The existence and uniqueness of the equilibrium price level cannot be determined from knowledge of monetary policy alone; fiscal policy plays an equally important role.”

Following de Vroey (1984), the money injected into the economy through a violation of market rules is called *extra money*.

The problem of defining money supply is still associated with a lot of controversy. According to Anyanwu (1993), money supply is the total amount of money (e.g. currency and demand deposits) in circulation in a country at any given time. Currency in circulation is made up of coins and notes, while demand deposits or current account are those obligations which are not related with any interest payment and accepted by the public as a means of exchange drawn without notice by means of cheque. The stock of money can be measured in any given time in an economy. There are two criteria employed in measuring money supply. The first criteria defines the stock of narrow money (usually designated by M1) as currencies and coins in circulation in the hands of the non-banking public and the demand deposit (of the non-banking public) with commercial bank (Ajakaiye, 2002). This definition can be synonymous with that given by Anyanwu (1993). The second concept defines money stock (designated by M2) as M1 plus time and savings (fixed) deposit. Thus, economists use the stock of money to mean narrow money since savings and time deposit are not usually a medium of exchange. The component of narrow money is usually called the stock of high-powered money (Iyoha, 1998).

Positive Relationship:

The monetarist led by Milton Friedman believes that inflation is always and everywhere a monetary phenomenon. This monetary view is based on the quantity theory of money by Irving Fisher (1948) depicts that changes in money supply growth

are followed by equal and proportionate changes in the inflation rate.

Using quarterly data, Osakwe (1983) attempted to verify the amount of government expenditure that affected money supply in the ten-year period 1970–1980. Significant statistical evidence obtained from the analysis showed strong relationships between increases in net current expenditure and growth in money supply, on the one hand, and growth in money supply and inflation, on the other hand. Further increases in money wage rate and money supply (with a lag in effect) were identified as the two most important factors that influenced the movement of prices during the period.

Fashoyin (1984) in a study with respect to the impact of structural phenomenon on inflation in Nigeria identified ten structural variables (agricultural bottlenecks, industrial production, imports, exports, food import and production, trade union militancy, indirect taxation on companies, wage bill, government expenditure – deficit financing and money supply) responsible for inflation in Nigeria. Regressing the rate of inflation on the ten variables using the Ordinary Least Square (OLS) approach, the results indicated that money supply; wages, imports, exports, food import and indirect taxation had significant positive relationships with inflation.

Manser and McDonald (1988), studied the role of a veritable source of variation in the level of prices, albeit often neglected, the parallel market for foreign currency, which is relied upon for the finance of unofficial short-term trade in intermediate inputs and consumer durables. Applying a partial equilibrium model based on micro foundations, and using annual data, a solution was obtained for the price level using the two stage least squares (2SLS) instrumental variable method. The results confirm for the period 1971 to 1995 that the parallel market exchange rate dynamics, in addition to the traditional Monetarist variables contribute to the inflation behavior in Nigeria.

Currency inconvertibility allows the state (and the banks) to smooth out the cycles, through the manipulation of the supply of extra money in order to alleviate temporary cash flow problems and, more controversially, through direct support to failing companies or banks (Guttman, 1994). However, this is not likely to eliminate the crisis entirely, and it may lead to permanent inflation (Aglietta, 1980; Clarke, 1994; Grou, 1977; Mattick, 1978; Perelman, 1996).

The relationship between money supply and inflation in Nigeria has been empirically examined by several authors like Malina (1980), Chibber and Nemat (1990); Adeyeye and Fakiyesi (1980), Osakwe (1983), and Ogunmuyiwa (2004). In an earlier study, Ogunmuyiwa (2004) while conducting an enquiry into the factors that cause of inflation in Nigeria noted that although M2 is insignificant in explaining inflation movements in Nigeria, the Central Bank's monetary tools are more responsive to inflation and could be used to control it. In addition, Osakwe (1983) found that increase in money supply and money wages (with lag-in-effect) were the important factors influencing price movements between 1970 and 1980 in Nigeria. Furthermore, Adeyeye and Fakiyesi (1980) found that there exist some significant relationship between growth in bank credit, growth of money supply and growth of government expenditure and inflation rate while an unclear relationship exists between government revenue and inflation.

Other studies that have found support for empirical relationship between money supply and inflation while considering a host of other factors include Asogu (1991), Fakiyesi (1996) and Manser and McDonald (1988).

Fernando Alvarez, Robert E. Lucas: The outstanding principle of this harmony are that the mechanisms of monetary policy ought to be the short term interest rate that policy should be focal point on the control of inflation and that inflation can be reduced

by increasing short term interest rates. These recommendations are taken as given would seem to involve the exclusion of the quantity theory of money, the class of theories that intimate that inflation rates can be controlled by controlling the rate of growth of the money supply. Such a rejection is a difficult step to take because the regular demonstration that continue linking with monetary policy, inflation and interest rates and there is an excessive amount that consists almost perfectly of evidence that increases in average rates of money growth that are correlated with equal increases in average inflation rates and in interest rates. According the quantity theory, rapid money growth is distinguished characteristic of monetary contentment and it is also correlated with high interest rates as well as with high inflations.

B. Fatukasi (1988) shows the determinant of inflation in Nigeria using the data between 1981 and 2003. This shows that fiscal deficit, money supply, interest rate and exchange rate positively influence over inflation in Bangladesh.

L. H. Cheng and P. Laura, (1997), "An Econometric Analysis of the determinant of Inflation in Turkey" Working Paper, International Monetary Fund.

L. H. Cheng and P. Laura, (1997) shows that high inflation is appeared in the Turkish economy since the 1970s. They found that monetary variables specially money supply and exchange rate play main role to the Turkish inflation process. Public sector deficit and depreciation also contribute to inflation in Turkey.

According to Nyong (2001), inflation varies *ceteris paribus* positively in relation to the growth in money supply and negatively with respect to growth in real income or output. In support of this argument, Ogun and Adenikinju (1995) found that the period of oil boom in Nigeria characterized by rapid monetary growth was consistent with the periods when the country experienced double-digit inflation.

In 2005, Graude and Polan examined the link between money supply and inflation in 160 countries using 30 years data range. Although they accepted that inflation is a monetary phenomenon, they claimed that the link between inflation and money supply is much stronger only in the countries with high inflation rates. They further noted that in countries with a relatively low inflation rate the long run linkage cannot be easily identified. Thornton (2008) found evidence to support Graude and Polan (2005) claim, after employing panel and cross section analysis to empirically estimate the applicability of QTM on 36 countries in Africa. He concluded that, money strongly determines inflation in countries with more than 10 percent inflation and money growth rates.

Malik (2006) studied the effects of monetary policy actions on inflation using Near-VAR approach. His results showed that effect of monetary policy transmits into inflation with a lag of half year and then take another year to reach the peak. This study suggested the identification of variables that are most important in explaining inflation in Pakistan by considering monetary policy actions, supply side factors and foreign inflation.

Aikaeli (2007) examined the money supply and inflation relationship in the country by employing a GARCH model while M2 and M3 monetary aggregates were used as proxies for money supply. The analysis was made basing on monthly data ranging between 1994 and 2006. From the study, the author identified that it takes a period of 7 months for any fluctuations in money supply to have an impact on inflation rates in Tanzania.

Omokeet. al., (2010), tested the causal long-term relationship between budget deficit, money growth and inflation in Nigeria. Augmented Dickey-Fuller (ADF) and Philip-Perron (PP) test were carried out to test the stationarity of the variables used. The

result of the study pointed to a close long-term relationship between inflation and money supply.

Bakare (2011) conducted a study on the determinants of money supply growth and its implications on inflation in Nigeria. The study employed quasi-experimental research design approach. The results showed that credit expansion to the private sector determines money supply growth and inflation in Nigeria. He therefore concluded that changes in money supply are concomitant to inflation in Nigeria.

Hossain and Islam(2013): The objective of this study is to examine the determinants of inflation using the data from 1990 to 2010. The Ordinary Least Square (OLS) method has been used to explain the relationships. The empirical results show that money supply, one year lagged value of interest rate positively and significantly affect inflation. Results also indicates that one year lagged value of money supply and one year lagged value of fiscal deficit significantly and negatively influence over inflation rate. There is an insignificant relationship between interest rate, fiscal deficit and nominal exchange rate. The explanatory variables accounted for 87 percent of the variation of inflation during the study period. This study suggests that money supply is to be controlled to reduce inflation. In addition to this reduction of last year interest rate will reduce inflation.

Negative Relationship:

Cheng and Tan (2002) employed the Johansen's co-integration test and VECM approach to examine the long run equilibrium relationship and the causality direction between inflation and its determinants (i.e. money supply, output, interest rate, exchange rate and trade balance) in Malaysia. They found that the variables are co-integrated, but there is no evidence of direct causal effect runs from money supply to inflation in Malaysia.

In the same vein, Tang and Lean (2007) found that the effect of money supply (M1) on inflation in Malaysia is negative and statistically significant at 1 per cent level. This finding did not support the monetarists' view that inflation is a result of excessive rate of expansion of money supply.

Sellin, Peter(2001): The Keynesian economists indicate that change money supply will directly affect the stock prices only if the change in the money supply develop probability about future monetary policy. According to these economists, positive money supply encounter that will lead the people to forecast the tightening monetary policy in the future. They instruct for funds in prediction of tightening of money supply in the future which will push up the current rate of interest.

Bigyan Shrestha: The Price, GDP, M1 and M2 all are stagnant at first difference level. GDP and Price are unified with both of M1 and M2. M1 and M2 both are important variables for attention. As per the monetarist anticipation, the inflation is purely a monetary experience. But in Nepal it is found that, for the analyzed data for 1980-2009, the price is not affected by money supply, but the money supply is caused by price level. Granger causality tests do not prescribe a clear cut independent causality flowing from money to prices. This may have been the effect of configuration of monetary policy that is based upon the current price level and setting the targets but not proficient to fulfill the monetary function.

The findings of Us (2004) contradict this claim after detected a zero correlation between money and inflation in country with high inflation rates. According to Us (2004), for more than 30 years Turkey has been facing high and increasingly inflation rates. The author's empirical findings suggested that the higher rates are mainly as a result of the depreciating of the country's currency and increases in the prices in the public sector.

Ndanshau (2010) applied an Autoregressive Distributed Lag (ADL) and Error Correction Model (ECM) on quarterly data ranging from 1967 to 2005 to examine the role of money in explaining inflation dynamics in Tanzania. Using M0, M1 and M2 as money aggregates, the regression couldn't identify any relationship between money and inflation. He concluded by giving less importance to money as a determinant of inflation in Tanzania. Unlike his previous study, Ndanshau (2012) included budget deficit in the investigation of the impact of changes in money supply on inflation rates in Tanzania. The study used pair-wise Granger causality test, Vector Error Correction model and data for the period between 1967 and 2010. The findings revealed that changes in monetary policy regime have an influence on the inflation rates in Tanzania.

Summary:

The following table summarizes the empirical findings of some studies with different data set, monetary variables and time period. Some papers employ cross-section data on a group of countries for a period of time where mostly those countries have the same stage of economic development. While others use time series data examining the correlation of money supply and inflation in a single country for a long period of time. The common monetary variables that are often employed in the chosen papers are M1, M2 and M3. The general conclusion that can be drawn from the surveyed articles is that, as postulated by the monetarist most authors detected a long run impact of changes in money supply on inflation rates. Nevertheless most papers ignored all other possible determinants of inflation and concentrated only on money growth in the analysis as the main determinant of inflation.

Author	Monetary Variable	Data Coverage(Country)	Data Period	Findings
Vuslat Us (2004)	Base Money (M0)	Turkey	1990:01-2002:04	No Relationship
Altimari (2001)	M1,M2 & M3	Euro Area	1980-1997	Positive Relationship
Diouf (2007)	Broad Money	Mali	1979:1-2006:1	Long & short run correlation
Pindiriri (2012)	M3	Zimbabwe	2009-2011(Monthly)	Positive
Jones & Khilji (1998)	M1 & M2	Pakistan	1973 to 1985	Positive
Nikolic (2000)	Extended broad money(M2X), M2, mb & M0	Russia	1992-1998	Weak Correlation
Darrat (1986)	Narrow Money	North Africa	1960-1980(quarterly)	Positive
Saini	M1 & M2	Six Asian countries	1951-1980	Very week relation
Thornton (2008)	Money in circulation,M1 and M2	African economies	1960-2007	Weak for countries with inflation and money growth below 10%
Drevall & Ndung'u (2001)	M1 & M2	Kenya	1974-1996	Exist only in the short run
Simwaka at.ol (2012)	M2	Malawi	Monthly (1995-2007)	Positive Relationship
Morana & Bagliano (2007)	M1,M2 & M3	USA	1959:1-2003:2	Positive long run correlation
Kabundi, A (2012)	M3	Uganda	Monthly (1991-2011)	Positive
Akinbobola (2012)	M1 & M2	Nigeria	1986:1-2008:4	Positive
Zhang (2012)	M2	China	1980-2010	Positive