Study of the Impact of Inflation, Money Supply on Economic Growth

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Abstract: In a complex and volatile economic environment, the stability and sustainability of economic growth have always been the focus of attention for Governments and economists. Economic growth is not only a matter of national prosperity and stability, but also has a direct impact on the quality of life of the population and the overall well-being of society. However, the process of economic growth is often influenced by a variety of factors, among which inflation and money supply are two crucial economic variables. This paper selects the relevant data of China's consumer price index CPI, broad money and quasi-money supply M2 and gross domestic product GDP from 2003 to 2022 as the corresponding variable indicators, constructs the multiple linear regression model, and conducts the significance test for the model through statistical inference test, econometrics test, and other methods and makes relevant corrections to the model, and then arrives at the optimal model. The analysis shows that there is a close relationship between inflation and money supply, and inflation is an important factor driving China's economic growth, while changes in money supply have a relatively small impact on China's economic growth, and in the long run, inflation has a significant negative impact on economic growth, while money supply has a significant positive impact on economic growth.

Keywords: Economic Growth; Inflation; Money Supply; Multiple Linear Regression.

1. Introduction

1.1. Background of the Study

Inflation is a widespread economic phenomenon that manifests itself as a general increase in the prices of goods and services. Inflation can be caused by a variety of factors, including demand-pull, cost-push, and increased money supply. In economic theory, inflation is considered to have a negative impact on economic growth. Money supply is the total amount of money in circulation in an economy. In economics, an increase in the money supply usually leads to an increase in prices. Therefore, an increase in the money supply may promote economic growth, especially when the economy is in a downturn. However, too rapid an increase in the money supply may lead to increased inflation, which may have a negative impact on economic growth. Economic growth is an increase in the economic output of a country or region. Economic growth is often seen as a key indicator of a country or region's development. However, the impact of inflation and money supply on economic growth is complex and uncertain. Some studies have shown that moderate inflation and money supply increases can promote economic growth, while others have shown that excessive inflation and money supply increases can have a negative impact on economic growth.

The aim of government macro-control is to stabilize price levels and achieve economic growth. After the financial crisis, China's economy experienced a major turnaround due to changes in economic policies and trade environment. According to the data released by the People's Bank of China, the balance of money supply in 2010 was 72.6 trillion yuan, an increase of 19.7% year-on-year. 2010 National Bureau of Statistics reported that China's GDP reached 39.3 trillion yuan, surpassing that of Japan and becoming the second largest economy in the world. Economic growth cannot be separated from money supply, which is closely related to inflation. Therefore, there is an interaction mechanism between inflation, economic growth and money supply, and the 2013 government meeting suggested that monetary policy should be shifted from "moderately loose" to "prudent" in order to alleviate inflationary pressures. At the same time, the tight monetary policy should be adjusted moderately. Otherwise, it may have a negative impact on economic growth. Therefore, a correct understanding of the relationship between money supply, inflation and economic growth can provide an important reference for the government to implement effective monetary policy.

The basic research idea of this paper is to empirically analyze the relationship between inflation, money supply and economic growth by constructing econometric and time-series correlation models on the basis of literature review, utilizing annual data for the period of 2003-2022 in China.

1.2. Purpose and Significance of the Study

1.2.1. Purpose of the Study

First of all, there is a close relationship between inflation and money supply. According to the quantity theory of money, changes in the price level are directly related to the amount of money in circulation. If the money supply increases, the price level may rise because more money will be chasing established goods and services. Conversely, if the money supply decreases, the price level may fall.

Secondly, economic growth is the basis of social development and an important objective of governments. However, economic growth is affected by many factors, including inflation and money supply. Studying the impact of these factors on economic growth can help us understand the mechanism of economic growth and formulate policies to promote economic growth.

In addition, the government and the central bank can take a range of measures to effectively tackle inflation and promote economic growth. For example, the central bank can control the money supply through monetary policy to avoid excessive...
inflation. The government can curb inflation by raising the benchmark interest rate or implementing a tight monetary policy. At the same time, the government can adopt fiscal policy measures to promote economic growth, for example, by increasing public investment, encouraging private investment, improving productivity and upgrading the overall quality of the national economy.

Therefore, studying the effects of inflation and money supply on economic growth can help us understand macroeconomic operation and formulate corresponding economic policies, providing us with theoretical foundations and practical guidance about macroeconomic operation and formulation of economic policies.

1.2.2. Research Significance

Economic growth cannot be separated from money supply, and money supply is closely related to inflation, and there is an interactive mechanism between economic growth, inflation and money supply. Research on the impact of inflation and money supply on economic growth is of great significance, mainly reflected in the following aspects:

1) Policy Making. The impact of inflation and money supply on economic growth is an issue that policy makers must pay attention to. Understanding this impact can help policy makers formulate more rational and effective economic policies. For example, if inflation becomes a major problem, policy makers can control inflation and maintain price stability by adjusting monetary policy, such as reducing the money supply. Such decisions can effectively relieve social pressure and improve economic stability.

2) Economic Stability. Studying the effects of inflation and money supply on economic growth helps to improve economic stability. Economic stability is vital to the prosperity and stability of society. By understanding the impact of inflation and money supply on economic growth, we can take appropriate measures to avoid excessive economic fluctuations and thus maintain stable economic growth. This will reduce the risk of economic crisis and economic fluctuations and lead to sustained and healthy economic development.

3) Resource Allocation. The impact of inflation and money supply on economic growth also involves the allocation of resources. If the money supply is too large, it may lead to price increases, thus changing the relative price of resources and affecting the efficiency of resource allocation. Therefore, understanding these influences can help to better allocate resources and improve economic efficiency. Proper allocation of resources can make the economy more efficient and reduce waste and unnecessary consumption.

4) Investment and Consumption. The impact of inflation and money supply on economic growth is also directly related to investment and consumption. If inflation is severe, it may reduce consumers' purchasing power and inhibit consumption; at the same time, it may also affect investors' confidence and inhibit investment. Therefore, understanding these influencing factors can help better predict and respond to changes in investment and consumption. This is crucial for businesses and investors to help them make informed investment decisions and consumption plans.

5) Social Welfare. Economic growth is an important means of improving social welfare, and inflation and money supply have a significant impact on economic growth. Therefore, studying the effects of inflation and money supply on economic growth can help to increase the level of social welfare. An increase in social welfare can lead to more opportunities and benefits and improve the quality of life of the people.

Overall, the effects of inflation and money supply on economic growth are multifaceted, and it is important for policymakers, economists, investors, and ordinary consumers to understand these effects. These impacts are not only related to the stability and growth prospects of the economy, but also have a direct bearing on the life and well-being of every individual. Therefore, we need to continuously and thoroughly study the impact of inflation and money supply on economic growth in order to formulate more rational and effective economic policies and social development strategies.

2. Literature Review

2.1. Current Status of Foreign Research

In macro-control, money supply is often used as the intermediary target of monetary policy to regulate economic growth and inflation, and the three are closely linked. Friedman and Kuttner (1992) analyzed the U.S. data, and got that the relationship between its money supply, income and prices is stable [1]. McCandles and Web (1995) studied the relationship between economic growth rate, inflation rate and money supply growth rate in 110 countries on the relationship between economic growth rate, inflation rate and money supply growth rate and found that there is a strong correlation between inflation rate and money supply growth rate in the long run, but economic growth rate is not correlated with money supply growth rate [2]. Bernanke (1999) verified the transmission mechanism between money growth and price level in the U.S.A. and pointed out that the money growth firstly has an impact on the economic growth before it leads to price increases [3]. Favara and Giordani (2009) studied the output effect and price effect of money, and the results showed that money affects both output and price [4].

2.2. Current Status of Domestic Research

Domestic scholars Liu Bin (2002) pointed out that the change in output in the long run is not affected by changes in prices and money supply, and the change in output is mainly determined by the real sector; while both in the long run and the short run, changes in the money supply will have an impact on prices [5]. Liu Lin and Jin Yunhui (2005) argued that there is a long-run equilibrium relationship between economic growth, inflation and money supply, and that in the long run money supply can promote economic growth, while inflation hinders economic growth; meanwhile, economic growth stimulates the expansion of money supply, while inflation causes money supply to contract [6]. Yao Yuan (2007) pointed out that the impact of money supply on economic growth and inflation has a lagged effect, and money is non-neutral in the long run, but economic growth and inflation do not have an impact on money supply; i.e., money is exogenous [7]. Zhang Wei and Jun Su (2010) showed that the money supply has an impact on output in the short run, but is neutral in the long run; both long-term and short-term money supply has an impact on prices; at the same time, the money supply is affected by output and prices [8]. Wei Rongrong and Cui Chao (2011) found that there is a long-run stable equilibrium relationship between the economic growth rate, inflation rate and the growth rate of money supply; in the short term, economic growth has a positive effect on the money supply, while inflation has a negative effect on the money supply, the money supply does not have a significant effect on economic...
growth and inflation, and economic growth does not cause inflation but inflation has a economic growth has a promoting effect [9]. Zhang Chengsi (2012) pointed out that there is a long-term stable equilibrium relationship between China's economic growth rate, inflation rate and the growth rate of money supply, the growth rate of money supply has a significant effect on the inflation rate, but has no effect on the economic growth rate, and both the economic growth rate and the inflation rate will have an effect on the growth rate of money supply [10].

2.3. Literature Review

In summary, from the existing research literature, it can be seen that there are more studies on the relationship between economic growth, inflation and money supply, revealing the relationship between the variables, but the conclusions of the studies are more divergent, probably because of the selection of the relevant variables, sample intervals, and the application of different analytical methods. Secondly, there are quite a few literatures exploring the long-run equilibrium relationship among economic growth, inflation, and money supply, but either they simply consider the two variables involved, or they also take into account other variables related to them, but the cointegration equations obtained contain all the variables involved, and do not pay enough attention to the cointegration relationship between the two variables involved, and more importantly, the cointegration equations are not given enough attention to the cointegration equations, which directly affects the optimal policy setting of the monetary authority based on the long-run equilibrium under the dual objectives of growth and inflation. Therefore, this paper analyzes China's annual data and applies econometric modeling to study the relationship between inflation, money supply and economic growth, and puts forward more targeted suggestions and countermeasures, so as to provide references for the relevant government departments to formulate effective and feasible macroeconomic measures.

3. Establishment and Test of Multiple Linear Regression Models

3.1. Variable Selection and Data Description

In this paper, the consumer price index (CPI), broad money and quasi-money supply M2 and gross domestic product GDP are selected to represent inflation, money supply and economic growth, respectively. The sample data are obtained from the National Bureau of Statistics (NBS). In this paper, 20 years of data from China from 2003 to 2022 are selected.

3.2. Correlation and Trend Plots

From the trend chart, we can see that each explanatory variable changes in the same direction as the explanatory variables, and the gap is wider the further back we go.

Above is the correlation chart between each explanatory variable and the explanatory variables, and the results show that there is a positive and high linear correlation between each explanatory variable and the explanatory variables, and it can be initially believed that the changes in the consumer price index and the level of money supply will cause the changes in economic growth. In order to further verify the relationship between the factors, a multiple linear regression model will be constructed to analyze them.

\[ Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + u \]

3.3. Model Estimation

Using the ordinary least squares estimation equation, the function of the economic growth model is:

\[ \hat{Y} = -401220.9 + 1068.357X_1 + 0.3265X_2 \]

\[ \begin{align*}
    s &= (217.4197) \quad (0.0241) \\
    t &= (4.9138) \quad (13.5326) \\
    R^2 &= 0.9976 \quad R_\text{adj}^2 = 0.9973 \quad F = 3471.331 \quad D. W. = 2.2202 \quad n = 20 \\
    \hat{\sigma} &= 17796.46 \sum e_i^2 = 5.38E + 09
\end{align*} \]
It can be seen that in the short run the level of inflation is positively related to GDP and the money supply is also positively related to GDP and the level of inflation has a greater impact on GDP, i.e. economic growth.

3.4. Model Testing

3.4.1. Statistical Inference Test

(1) Goodness-of-fit test: According to the results of the chart, $R^2=0.9976>0.8$ and close to 1, which has a high degree of goodness of fit, indicating that the level of inflation and money supply have a strong fitting relationship.

(2) t-test: According to the results, the absolute value of the t-test of $x_1, x_2$ is >2 and the accompanying probability is <0.05, which is obviously significant. It indicates that inflation rate and money supply are the factors influencing the level of economic growth.

(3) F test: $F=3.471.331>F_0(k, n-k-1)=3.59$ and the accompanying probability $\text{prob}(f)$ is close to 0, the model linear relationship is significant, indicating that the inflation rate and money supply on the level of economic growth of the total impact is significant.

3.4.2. Econometric Tests

(1) Multicollinearity Test

<table>
<thead>
<tr>
<th></th>
<th>Y</th>
<th>X1</th>
<th>X2</th>
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<tbody>
<tr>
<td>Y</td>
<td>1.000000</td>
<td>0.985517</td>
<td>0.997040</td>
</tr>
<tr>
<td>X1</td>
<td>0.985517</td>
<td>1.000000</td>
<td>0.975428</td>
</tr>
<tr>
<td>X2</td>
<td>0.997040</td>
<td>0.975428</td>
<td>1.000000</td>
</tr>
</tbody>
</table>

From the correlation coefficient matrix, it can be seen that the correlation coefficients of the explanatory variables with each other are high, of which the minimum value of 0.975428>0.8 confirms that there is indeed a serious multicollinearity.

2) Assisted regression modeling. The F-statistics of the above auxiliary regression models, whose concomitant probabilities are close to zero or less than the significance level of 0.05, indicate that there is serious multicollinearity in the model.

3) Variance expansion factor method. According to the $R^2$ value of the above auxiliary regression model and using the formula of VIF, we can get $\text{VIF}_1=20.6012, \text{VIF}_2=20.6012$, which are both greater than 10, so there is a more serious multicollinearity between the explanatory variables $X_1, X_2$.

(2) Heteroscedasticity Test

1) White test. The auxiliary regression model of White test is:

$$\hat{\sigma}^2 = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_1^2 + \varepsilon_1$$

According to the results of White test, $nR^2 = 14.5571 > \chi^2_k(2) = 5.9915$, accompanying probability is 0.0124, which is smaller than the given significance level $\alpha=0.05$, that is, the original hypothesis that there is no heteroskedasticity is rejected, and it is considered that the regression model has heteroskedasticity.

2) ARCH test. For the regression model $Y_t = \beta_0 + \beta_1 x_{1t} + \ldots + \beta_k x_{kt} + \varepsilon_t$, the regression model is considered to be heteroskedastic if $\varepsilon_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2 + \varepsilon_t^2$ holds, where $\varepsilon_t$ is independently homogeneous and satisfies $E(\varepsilon_t)=0$ and $\text{Var}(\varepsilon_t)=\sigma^2$, there is a non-zero case in $\varepsilon_t$.

Since the sample information is time series data, ARCH test can also be used in testing heteroskedasticity. The accompanying probability $p$ obtained by ARCH test is less than the given significance level $\alpha=0.05$, that is, the original hypothesis of the non-existence of heteroskedasticity is rejected, and the regression model is considered to have heteroskedasticity.

(3) Autocorrelation Test

1) DW test. According to the distribution of the residuals, obvious periodic changes can be seen, which indicates that the model is likely to have autocorrelation. Further observation of the DW statistic is 2.2202, according to the sample size $n=20, k=2$, check the table to get the lower limit value of $d_L=1.100$, the upper limit value of $d_U=1.537$, $d_U<\text{DW}=2.2202<4-d_U$. It shows that the model does not have first-order autocorrelation.

2) Partial correlation coefficient test. From the bar chart of bias correlation coefficient, the histogram of bias autocorrelation coefficient of all lags is within the dotted line, and the $P$ value of $Q$ statistic is greater than 0.05. According to the results of bias correlation coefficient and DW test, it can be seen that the value of $P$ has not exceeded the value of the dotted line, i.e., the model does not exist autocorrelation.

3) B-G test. According to the results of B-G test, it can be seen that when the lag period is 1, $nR^2=0.3412 < \chi^2_1(1)=3.8416, \text{prob}(nR^2)=0.5591$ is greater than the given significance level $\alpha=0.05$, and the absolute value of t-statistic value of the et-1 regression coefficient is less than 2, and the regression coefficient is significantly non-zero, which indicates that the model does not have first-order autocorrelation.

The lag period is 2, $nR^2=0.5975 < \chi^2_2(2)=5.99147, \text{prob}(nR^2)=0.7417$ is greater than the given significance level of $\alpha=0.05$, and the t-statistic of the et-1 regression coefficient has a p-value of greater than 0.05 and the regression coefficient is significantly non-zero at the significance level of 0.05 while the t-statistic of the et-2 regression coefficient has a p-value of greater than 0.05, and the absolute value of the t-statistic of the regression coefficient is less than 2, indicating that there is no first-order autocorrelation in the model. The statistic value is still less than 2 in absolute value, indicating that the model has second order autocorrelation at significance level 0.05.

3.5. Model Correction

We use the logarithmic transformation method to modify the model to establish a double logarithmic model, the correlation between the new variables after the logarithmic transformation is greatly weakened, and the degree of multiple covariance of the regression model established by the new variables will be greatly reduced.

Based on the results of the logarithmic transformation of the variables in the above figure, a multiple regression model can be developed:

$$\hat{y} = -3.2341 + 1.2456 \ast \log(x_1) + 0.6153 \ast \log(x_2)$$

$$\ast (2.8914) \ast (0.7690) \ast (0.1461)$$

$$t= (-1.1185) \ast (1.6199) \ast (4.2124)$$

$$R^2 = 0.9964 \ast \frac{R^2}{0.9960} = 2346.206 \ast \text{D.W.}$$

$$= 0.752688 \ast \text{n=20}$$

$$\delta = 0.043102 \ast \sum e_i^2 = 0.031582$$

After the double logarithmic model transformation, it is found that $nR^2=10.6064 > \chi^2_k(2) = 5.9915$ still, and its prob $(nR^2)$ concomitant probability is 0.0314, which is still less than the given level of significance $\alpha=0.05$. 

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Therefore, the weighted least squares method is replaced to correct the model for heteroskedasticity.

Finally, the White test is performed on the weighted least squares estimation results. From the figure, it can be seen that the prob(\(nR^2\)) concomitant probability of \(nR\) of the modified model is 0.1019, which is greater than the given significance level \(\alpha = 0.05\), and the regression model does not have heteroskedasticity.

\[D.W. = 1.9109 < 4 - \alpha = 1.537, \alpha = 0.0196 \]

Thus, the modified model eliminates multicollinearity, heteroskedasticity and autocorrelation. The final model was derived as:

\[Y = -432703.61228 + 1140.22925652 \times X_1 + 0.317909150064 \times X_2 \]

\[s^2 = (158.8978) \times 0.0196 \]

\[t = (7.7159) \times 16.2097 \]

\[R^2 = 0.9983, \sigma = 13535.58, \sum e_i^2 = 3.11E + 09 \]

4. Conclusion and Suggestions

4.1. Conclusion

First of all, at the 5% confidence level, there is a certain relationship between the level of inflation and the money supply, that is to say, the regulation of monetary policy can affect the supply of money in China, and changes in the money supply will in turn affect the overall inflation rate, and changes in both the inflation rate and the money supply have a clear guiding relationship on the level of China's economic development, but the impact of money supply on economic growth is not as significant as the impact of the level of inflation. is not as effective as the effect of the level of inflation. China's price index, money supply and GDP interact with each other, and in the long run, there is an equilibrium relationship between economic growth, inflation and money supply, with all three influencing each other. Money supply expansion and inflation can drive economic growth, and economic growth increases the supply of money.

The growth of money supply has a certain impact on inflation, but compared with previous studies, its impact is not significant, which means that "inflation is ultimately only a monetary phenomenon" is not valid in China. Secondly, economic growth is more obvious to inflation, and moderate inflation will stimulate economic growth; inflation is more likely to be affected by its own fluctuations, and the public's inflation expectations have a certain impact on inflation.

This paper focuses on analyzing the interaction mechanism of inflation, money supply and economic growth in China after the financial crisis, but it lacks the comparative analysis before and after the financial crisis. As a result, it cannot further explain the internal law of China's economic development. Secondly, there are many factors affecting economic growth, and different combinations of variables may produce different conclusions. This paper only analyzes inflation, money supply and economic growth, which has certain limitations.

4.2. Suggestions

This paper combines theoretical analysis with empirical analysis on the basis of actively exploring the intrinsic relationship between inflation, money supply and economic growth in China, and finally puts forward corresponding policy recommendations based on the conclusions obtained.

4.2.1. Transform the Mode of Economic Development, Adjust the Industrial Structure

Since the reform and opening up for thirty years, China's rapid economic growth has always been accompanied by a high level of inflation, and China's rapid economic growth is characterized by high inputs, high consumption, high supply, which are not conducive to China's economic sustainable development strategy. To fundamentally change this situation, it is necessary to change the economic development mode and adjust the industrial structure. First, take the slowdown in economic growth as an opportunity to further accelerate industrial restructuring. Second, focus on the transformation of government functions, accelerate the reform of the administrative management system, further define the government's responsibilities, and adjust the central and local authority and financial power. Third, seize the reform of production factor prices and promote the marketization of resource prices. Give full play to the basic role of the price mechanism in resource and environmental constraints. For some monopolistic and basic commodities and factors still regulated by the government, the government should form a mechanism that can reflect the interests of all parties and is highly transparent; only in this way can some backward productive forces in the industrial structure be gradually eliminated in the process of market adjustment.

4.2.2. Accelerating the Process of Marketization and Promoting Economic Growth Through Price Adjustment

In order to maintain the rapid and steady development of the economy as well as stable prices, it is necessary to speed up the process of marketization so that the government can promote economic growth through price adjustment. There are several suggestions as follows: First, the marketization of commodity and labor prices should be accelerated, so that the prices of commodities and labor services will be determined entirely by supply and demand in the market. So far, most commodity prices have been liberalized, but for some monopolistic industries, such as petroleum, medicine, telecommunications, water, electricity, transportation and other important commodities and factors, the degree of price marketization is still very low. Therefore, the Government needs to further deregulate prices for some important commodities that can be marketized. For certain commodities that still need to be regulated, the Government should follow the laws of market economy and adopt scientific pricing methods. Second, it should raise the level of utilization of foreign capital and focus on the introduction of advanced technology. Third, continue to deepen the reform of state-owned enterprises in monopolized industries and improve their productivity. Fourth, safeguard the total supply of the market, especially the supply of daily necessities, and prevent demand-pull inflation caused by oversupply. In the early years of China's reform and opening up, the severe shortage
Flexible monetary policy is the first choice of governments to regulate economic activities. Inflation is controlled by adjusting the money supply in order to keep the price level stable and promote a balance between inflation and economic growth. To change people's consumption and saving habits by adjusting the interest rate, so as to change the ratio of consumption and saving in national income. To economically guide people's savings concept to the direction of investment, so as to achieve a reasonable allocation of resources. Second, the combination of monetary policy and fiscal policy, the flexible implementation of different policy combinations. Monetary policy to achieve the desired effect usually needs to be matched with fiscal policy, and the role of monetary policy can only be better played with financial support, to give full play to the role of fiscal policy in maintaining economic growth, expanding domestic demand, promoting structural adjustment, transforming the mode of economic development and safeguarding people's livelihoods.

References