Research on the synergy of the G20 inflation cycle

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Abstract. This paper studies the synergy of the inflation cycle of the G20 and its influencing factors. The results show that there is a strong synergy among the cyclical fluctuations of inflation in member states. The main influencing factors include the quality of the world economy, the degree of independence of central banks, the level of industrialization in industrial countries, and the differences in economic zones in different regions, and so on. The numerical outputs of factor analysis and cluster analysis show that the G20 inflation cycle can be divided into three types, namely as stable, relatively stable and unstable type. Although China currently belongs to the stable type, under the trend of accelerating global economic integration, it will inevitably be affected by the economic turmoil of other countries and resulting in fluctuations. Under this circumstances, this article provides a series of measures that can be taken against global inflation for China.

1.   Introduction

The Group of 20[1] (G20, for short), as the world's top multilateral economic forum, was proposed in Germany in June 1999 to promote the reform of the international financial system and to lay a broad foundation for discussion and consultation on substantive issues in order to seek cooperation and promote stability and sustained growth in the world economy. The G20 originally implemented a meeting mechanism for finance ministers and central bankers. After the 2008 Global Financial Crisis, which triggered by the United States, the G20 summit has been held to broaden the voice of countries. These countries account for about 90% of the world's gross national product and nearly two-thirds of the world's population, including all of the world's "systemically important" economies. G20 has acted a leading part in the stability and direction of the world economy and is increasingly playing the role of "strategic planner" in global economic affairs. Therefore, it is of great importance to study the coactivity of the economic cycle of the G20 member countries and its influencing factors, which can reflect the changes and co-effects of the global economic cycle to a certain extent.

Inflation has traditionally been considered by academics to be one of the most complex, unpredictable, and devastating factors to economic operations. Looking around the history of global economic development in the past sixty years, inflation has undoubtedly become the main force of economic recession in major economic and financial crises. At present, the global economy has shown a new pattern. The globalization of inflation and the characteristics of regional integration have been strengthened. The study of global inflation not only has a positive effect on the development of economics, but also has a strong guiding role in the prediction and treatment of domestic inflation [1-7].

Foreign researches on inflation are mainly concentrated in some countries and regions. Canova and Nicoló (2002) [8] used the symbol response shock of cross-correlation function to analyze the

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[1] The G20 is now composed of 19 countries plus the European Union (EU). The current members are Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom, the United States and the European Union.

importance of currency disturbance to actual activity and cyclical fluctuations of inflation, and found that the determined currency oscillations have reasonable properties, which had greatly contributed to the output and inflation cycles of all G7 countries. This proves the existence of a world economic cycle.

The study of inflation by domestic scholars focuses on the causes of inflation and the countermeasures of governance, including the relationship among inflation, exchange rate changes and economic growth, the analysis of the formation of inflation, and so on. Song Guoqing (2012) pointed out that cost promotion is not the root cause of the current round of inflation, but that monetary factors account for the dominant part [9]. Wang Chaocui and Wang Miaoying (2014) believed that China's inflation is the result of the combination of cost and demand factors [10]. In the short term, the influence of the cost factor is greater than the demand factor. In the long run, the contribution of the cost factor to inflation has not changed significantly, and the contribution of the demand factor will slowly increase and last for a long time. Ji Wei (2016) [11] pointed out that with the continuous development of financial innovation, the effect of monetary policy implemented by China to adjust the amount of money has been weakened. Although the timing for China to fully implement the inflation system is not yet mature in the short term, it is necessary to study the inflation target system carefully, create and improve various conditions, establish a monetary system with inflation as the intermediate target, and shift the monetary target system to a flexible inflation target system.

From the domestic and foreign research situation, the study on inflation mainly focuses on the relationship between inflation and macroeconomics, and the development trend of global inflation. However, there is less researches about the global inflation cycle and its synergy. Using factor analysis and cluster analysis, this paper studies the global economic cycle synergy, obtains the key factors of affecting global inflation, and puts forward some effective suggestions to curb the inflation of China.

2. Analysis of the current situation of the cycle synergy in G20 member countries

This paper collects monthly data on the inflation rate of G20 member countries from January 2011 to January 2019, and studies the inflation rate and its synergy. It is not difficult to see from the collected data that some countries have experienced fluctuating inflation, such as Russia, India, Brazil, India, etc., with large values of the extreme value, mean and variance of inflation rates. (As shown in Table 1) Argentina's average monthly inflation rate is 28.435%, Russia's monthly inflation rate range is 14.7, and India's monthly inflation rate standard deviation is 2.851.

Table 1 Descriptive Statistical Analysis of Inflation Rate in G20 Member Countries

Country	Range	Mean	Standard Deviation	Country	Range	Mean	Standard Deviation
China	5.70	2.613	1.339	Saudi Arabia	6.80	3.304	1.742
South Africa	3.80	5.328	0.906	Turkey	8.98	8.417	1.738
US	4.10	1.712	0.913	France	2.90	1.041	0.762
Canada	2.90	1.662	0.665	Germany	2.80	1.270	0.693
Mexico	4.64	3.934	1.072	Italy	3.99	1.232	1.149
Russia	14.70	7.506	3.557	UK	5.30	2.271	1.385
Brazil	8.25	6.247	1.957	EU	3.60	1.302	0.982
Japan	5.00	0.429	1.147	India	11.70	7.286	2.851
Korea	4.30	1.903	1.098	Argentina	30.50	28.435	7.292
Indonesia	6.00	5.177	1.623	Australia	2.60	2.194	0.713

By plotting the monthly inflation rate of G20 member countries (due to the large number of countries involved, it is not shown in the text), it is found that the change cycle of most of the G20 countries' economic indicators has a relatively obvious synchronous rise or downward trend in some

time periods. Such as 2010-2011, 2013-2014, 2015-2016, the inflation rate has a synchronous upward trend, and there is a downward trend in 2011-2013 and 2014-2015. That is to say, the economic cycle change between the G20 member states (measured by the inflation rate) showed a certain synergy.

We can also calculate the Pearson correlation coefficient and the Spearman correlation coefficient. The calculation results show that China, the United States, Japan, Australia, the European Union, the United Kingdom, France, Italy, Canada, South Korea and other countries have a greater influence on each other and have significant significance at the 1% confidence level. Meanwhile, Russia, India, and South Africa, Mexico, Indonesia, Turkey, Brazil and other countries have significant significance at the 1% confidence level, that is, the degree of mutual influence among these countries is large. It can be concluded that during the data survey period, the changes in the inflation cycle of the G20 countries showed significant block cooperation.

3. Factor analysis and cluster analysis of the coordination of inflation cycle in G20 member countries

3.1 Prerequisites for factor analysis

In order to ensure the validity of the factor analysis results, the KMO sampling suitability test and the Bartlett spherical test are first performed. The KMO test value of the inflation cycle data of the G20 member countries is 0.766, indicating that factor analysis can be performed on the data. At the same time, Bartlett's spherical test value is 2818.369, and the corresponding P value is 0, indicating that the variables are not independent of each other, i.e. there is a certain correlation. Thus, it is suitable for factor analysis.

3.2 Extraction of common factors

The purpose of factor analysis is to represent all the original variables with as few common factors as possible, so there is no need to extract all the characteristic roots. As shown in Table 2, the characteristic roots of the first five common factors are greater than 1, and their cumulative contribution rate of the variance reaches 86.083%. Therefore, it is appropriate to extract five factors.

Table 2 Factor Analysis of the Interpretation of the Ttotal Variance of the Original Variables

Ingredient	Initial Eigenvalue			Extraction Sums of Squared Loadings		
	Total	Variance Contribution %	Cumulative Variance Contribution %	Total	Variance Contribution %	Cumulative Variance Contribution %
1	8.779	43.895	43.895	8.779	43.895	43.895
2	3.744	18.720	62.615	3.744	18.720	62.615
3	1.943	9.714	72.329	1.943	9.714	72.329
4	1.539	7.697	80.026	1.539	7.697	80.026
5	1.211	6.056	86.083	1.211	6.056	86.083
6	0.695	3.474	89.556			
…	…	…	…			
20	0.009	0.047	100.000			

After determining the number of extracted common factors, the results of the inflation cycle factor analysis of the G20 member states in Table 3 are based on the main decomposition, showing that the five common factors can explain the percentage of the original variables. Except for the slightly lower percentages in Argentina and Australia, the percentages in other countries are above 80%, which means that these five common factors can represent most of the information of the original variables.

Table 3 Initial Solution of Factor Analysis

Country	Originate	Extract	Country	Originate	Extract	Country	Originate	Extract
China	1.000	0.894	Japan	1.000	0.839	Italy	1.000	0.849
South Africa	1.000	0.870	Korea	1.000	0.893	United Kingdom	1.000	0.957
US	1.000	0.924	Indonesia	1.000	0.864	EU	1.000	0.911
Canada	1.000	0.909	Saudi Arabia	1.000	0.775	India	1.000	0.888
Mexico	1.000	0.912	Turkey	1.000	0.685	Argentina	1.000	0.769
Russia	1.000	0.826	France	1.000	0.933	Australia	1.000	0.780
Brazil	1.000	0.904	Germany	1.000	0.834			

3.3 Naming and interpretation of factors

The main difficulty in data dimensionality reduction is to give a reasonable explanation for the extracted common factors. Table 4 lists the factor load matrices before and after rotation using maximum variance rotation method.

Table 4 Factor Load Matrix Before and After Rotation

Country	Factor Load Matrix Before Rotation					Factor Load Matrix After Rotation				
	1	2	3	4	5	1	2	3	4	5
China	0.750	0.494	0.192	0.195	-0.114	0.865	-0.313	0.168	-0.140	0.023
South Africa	-0.171	-0.198	0.667	-0.232	0.550	-0.090	0.039	0.085	0.923	-0.032
US	0.823	-0.201	0.433	0.123	0.059	0.865	0.306	0.037	0.273	-0.086
Canada	0.579	0.125	0.511	0.449	-0.309	0.866	-0.115	-0.366	0.064	0.088
Mexico	0.330	-0.827	-0.309	0.153	-0.025	0.105	0.928	-0.089	-0.181	0.010
Russia	-0.510	0.661	-0.155	0.177	-0.271	-0.315	-0.732	-0.174	-0.342	0.209
Brazil	-0.541	0.665	0.360	-0.170	-0.099	-0.285	-0.867	-0.130	0.220	-0.074
Japan	-0.400	-0.218	0.146	0.708	0.331	-0.182	0.148	-0.326	0.279	0.775
Korea	0.884	0.174	0.145	0.111	-0.221	0.910	0.008	0.098	-0.182	-0.152
Indonesia	-0.146	0.508	-0.445	0.490	0.384	-0.120	-0.307	0.339	-0.301	0.741
Saudi Arabia	0.468	0.676	0.098	-0.274	0.120	0.452	-0.520	0.515	-0.008	-0.188
Turkey	0.009	-0.827	-0.011	-0.018	-0.015	-0.123	0.761	-0.241	0.137	-0.121
France	0.961	-0.011	0.000	-0.091	-0.022	0.818	0.253	0.348	-0.138	-0.246
Germany	0.863	-0.270	0.005	0.009	0.129	0.702	0.492	0.297	-0.007	-0.106
Italy	0.895	0.037	-0.042	-0.211	0.011	0.715	0.200	0.427	-0.134	-0.310
UK	0.973	-0.046	-0.041	0.075	0.029	0.847	0.316	0.324	-0.165	-0.081
EU	0.946	-0.027	-0.015	-0.118	-0.032	0.791	0.265	0.348	-0.145	-0.271
India	0.506	0.429	-0.239	-0.253	0.571	0.278	-0.127	0.890	-0.003	0.050
Argentina	-0.548	-0.057	0.664	0.108	0.110	-0.247	-0.236	-0.441	0.664	0.132
Australia	0.681	0.316	-0.107	0.413	0.186	0.696	-0.034	0.326	-0.211	0.379

Based on the rotated factor load matrix, we name these five common factors separately. Firstly, according to Keynes's open economy theory, during the global economic boom or recession, inflation and unemployment rates will change in some countries. Through the transmission between countries and countries, global inflation will have a certain degree of convergence. Meanwhile, G20 countries have relatively large load values on the first factor, so it can be called *economic situation factor*. Secondly, Mexico, Brazil, Turkey, Russia, Saudi Arabia, Germany, the United Kingdom, China, Indonesia and the United States have higher loads on the second factor. The United States, Germany, the United Kingdom and Russia are all industrial powers. Light industry and heavy industry are highly developed, such as steel, petroleum, metallurgical and other industrial sectors. China, Brazil, India and other emerging industrialized countries have also greatly improved their industrialization level. Countries with higher levels of industrialization are more affected by commodity prices such as oil and raw materials. The financial nature of commodities and the price formation mechanism are also the important boosting mechanism for inflation. Therefore, we name the second factor as the *industrialization level factor.* Thirdly, monetary authorities in many countries around the world have made price stability an important goal. Some countries have established anti-inflation systems to curb inflation, such as establishing inflation target ranges, increasing monetary policy transparency and strengthening central bank independence. The United States, Germany, the United Kingdom, Japan, Canada, etc. have a relatively large load on the third factor, and these countries with strong independence are generally implemented the measures of granting the right to operate and related responsibilities to the central bank. Therefore, the third factor we extracted is called the *central bank independence factor*. Finally, according to the rotated factor load matrix, South Africa, Russia, and Argentina have higher loads on the fourth factor, and these countries belong to the Pacific Rim countries. Japan, Indonesia, Australia, and Italy have higher loads on the fifth factor. These countries belong to the Eurasian continent, so the factors can be named according to geographical factors. So, the fourth factor is called the *Pacific Rim factor*, and the fifth factor is called the *Eurasian factor*.

The next step is to demonstrate the rationality of the naming of these factors. Table 5 gives the factor score matrix based on the regression analysis method.

Table 5 Factor Score Coefficient Matrix

Country	Factor				
	1	2	3	4	5
China	0.176	-0.131	-0.087	-0.028	0.052
South Africa	-0.011	0.017	0.211	0.552	0.030
United States	0.166	0.029	-0.073	0.187	0.038
Canada	0.268	-0.103	-0.367	0.013	0.087
Mexico	-0.024	0.255	-0.044	-0.118	0.065
Russia	0.010	-0.185	-0.136	-0.225	0.036
Brazil	0.016	-0.244	-0.053	0.098	-0.127
Japan	0.067	0.089	-0.066	0.149	0.508
Korea	0.065	-0.059	-0.136	-0.072	-0.044
Indonesia	-0.027	-0.006	0.211	-0.088	0.468
Saudi Arabia	0.028	-0.159	0.192	0.080	-0.101
Turkey	-0.036	0.202	-0.067	0.031	-0.042
France	0.081	0.025	0.049	-0.016	-0.077
Germany	0.063	0.108	0.081	0.056	0.029
Italy	0.044	0.017	0.109	-0.008	-0.125

UK	0.098	0.052	0.039	-0.026	0.036
EU	0.073	0.029	0.051	-0.023	-0.095
India	-0.084	0.004	0.492	0.148	0.099
Argentina	0.067	-0.071	-0.130	0.322	0.062
Australia	0.115	-0.005	0.068	-0.032	0.305

According to the factor score coefficient in Table 5, we use the global CPI, the growth rate of the world's major economies, and the global unemployment rate to represent the impact factors of the global inflation cycle. By calculating the correlation between the factor scores and these factors, it is found that there is a significant correlation between the score of the first factor and the global CPI, which indicates that the first factor can reflect to some extent the great correlation between inflation and the global economic situation. Therefore, it is reasonable to name the first factor as the economic situation factor. The score of the second factor has significant correlation with the GDP growth of the major economies and the global unemployment rate both. There is no significant correlation with the global CPI. It can be understood that developed countries or emerging industrial countries can better resist global cyclical inflation. However, these countries are more dependent on raw materials, commodities, labor capital, etc. needed for industrial development, so the second factor name makes sense. Factor 3 has a significant correlation with GDP growth in major economies. This may be because countries or regions with higher levels of independence of the central bank are able to formulate monetary policies more flexibly, such as the implementation of loose monetary policy, adjustment of import and export by adjusting interest rates and foreign exchange reserves, etc. At the same time, the change in the circulation of money between different countries will also bring inflation, so the interpretation of factor 3 is also correct. There is a significant correlation between the fourth factor and the major economies. Many of these major economies are in the Pacific Rim. There is a significant correlation between Factor 5 and global CPI. Eurasia, including most countries in the world, is naturally an area that must be considered for global inflation. Therefore, the 4th and 5th factors are named reasonably.

Combined with the results of the above factor analysis, it can be seen that common factors can be extracted in G20 member countries, which indicates that there is a common influencing factor between them. However, inflation in the G20 member countries is affected by the state of the world economy, and cyclical fluctuations in a certain period of time are also normal economic phenomena [12]. However, inflation in various countries is heterogeneous. Central banks in developed countries have higher independence in dealing with inflation and can effectively suppress their inflation in a timely and effective manner. Therefore, their inflation rate is generally stable. Some emerging industrial countries, including China, may have more economic pressures in the face of inflation, but the mechanisms and methods of regulating inflation are more diverse, so the inflation rate is relatively stable. In addition, there are countries that have not responded so much to the expansion, or have been less geographically diverse with the world's major economies, resulting in greater volatility.

3.4 Cluster analysis of inflation cycle in G20 member countries

In order to further analyze the cooperation of inflation in G20 member countries, the Ward method was used for cluster analysis, and the number of classifications was selected to be three categories. For the purpose of eliminating the difference in magnitude, we used the standardized data of the inflation rate in each country. The results are shown in table 6.

Table 6 Cluster Analysis Results Based on 5 Common Factors

The First Category	US、the United Kingdom、China、Italy、EU、France、Germany、Canada、Korea、Australia、Japan
The Second Category	Brazil、Turkey、Mexico、South Africa、Indonesia、Saudi Arabia、Russia、India
The Third Category	Argentina

Cluster analysis brings together countries such as the United States, the United Kingdom, China, and Japan. The inflation rate in these countries is stable. The first category can be called stable countries. Brazil, Turkey, Mexico and other countries have a slightly weaker inflation rate, so the second category can be called weakly stable countries. The third category contains only one country in Argentina, and its monthly inflation data shows an extremely unstable state, which is called an unstable country.

4. Conclusion

The empirical analysis of this paper shows that there is a relatively obvious synergy in the inflation cycle of G20 countries. The main reasons for this result include the quality of the world economy, the degree of independence of central banks, the level of industrialization in industrial countries, and the differences in economic zones in different regions. According to the results of cluster analysis, although China is temporarily stable, it has a tendency to move closer to a stable one. According to the above data analysis results, some favorable revelations of stable inflation rate can be obtained.

First, the world economy is accelerating the process of integration. Although the Chinese economy is currently in a stable period, under the trend of accelerating the process of world economic integration, the possibility of inflation in China is increasing. Therefore, China should innovate the system based on its own national conditions and be fully prepared to enhance its international influence. We should focus on the overall situation, strive to create an economic path in line with China's national conditions, and establish a global development strategy. On the basis of adapting to the laws of the global market, we should work hard to actively expand foreign economic exchanges. Pay more attention to the development of science and technology, and the training strategy of human resources.

Second, a typical feature of global inflation is the rise in the price of commodities. The right to speak in the construction of the coordination mechanism for international commodity prices is also very important. As an industrial power, China must strive to seize the pricing power of commodity prices. With the rapid development of the international commodity futures market, it is not difficult to find that the pricing power of almost all commodities is monopolized. For example, the London Metal Exchange determines the price of metals such as copper, aluminum, lead and tin. Therefore, we must work hard to improve the function and structure of our futures market in order to enhance international influence. At the same time, the industrial concentration will be upgraded, thereby enhancing the right of domestic enterprises to the pricing of the international commodity market.

Third, strengthen the independence of the central bank, improve the transparency of monetary policy, and establish an anti-inflation mechanism. The realization of the inflation target mechanism has a very important premise that the central bank has a certain voice and maintains the transparency of the policy. In 1997, the Bank of England obtained the right to set its own interest rate. After that, the effect of dealing with inflation was significant, and an inflation target range was established. Although other countries have not announced specific anti-inflation target ranges, their monetary authorities are also staring at relevant variables to varying degrees.

Finally, we must pay attention to the promotion and development of regional economic integration. As an Asian power, China should take the lead in promoting regional trade talks between Asia-Pacific countries. China should use APEC, various cooperation platforms and mechanisms to promote economic cooperation in the Asia-Pacific region. It also can lead the economic forces in the

Asia-Pacific region to overcome the difficulties and economic difficulties of cooperation, promote economic growth in the Asia-Pacific region, and exert a strong advantage and positive role in the process of integration in the Asia-Pacific region.

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