Inflation Measurement in the Era of COVID-19

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Abstract. The outbreak of COVID-19 and the conflict between Russia and Ukraine have led to instability in the global economy and serious inflation in various countries, mainly due to sudden changes in household consumption patterns, countries differ in their initial response to the outbreak and the implementation of relevant policies, the sharp rise in energy prices and the monetary policies of various countries. The Chinese market has been the least affected due to China's timely control of the outbreak and the implementation of relevant policies to promote the economy in the later stage, while the US and European markets have not recovered to the pre-epidemic economic level so far. This paper analyzes the CPI and core-CPI data of the United States, Europe and China since the outbreak of COVID-19 in 2019, in order to judge the inflation situation of the United States, Europe and China under the double blow of COVID-19 and the Russia-Ukraine conflict.

Keywords: COVID-19 Pandemic; Russia-Ukraine conflict; CPI; Inflation; Core-CPI.

1. Introduction

The COVID-19 epidemic has recently caused profound changes in how households work, spend their time, and buy, leading to new shopping habits and quick price fluctuations for specific commodities. For example, during the COVID-19 pandemic, the demand of medical supplies such as masks and protective suits has rapidly increased. This led to a significant increase in the prices of masks, protective clothing and some medicines in the immediate period of the outbreak. In addition, due to the different measures taken by different countries in the face of COVID-19, the market of each country will be affected to different degrees. For example, China has adopted a policy of “not going outside unless it is necessary” because the population base is so large that China must prevent the rapid spread of the virus as much as possible, but in contrast, foreign countries are more likely to choose to let it develop and eventually achieve the goal of universal immunization, while because of the different policies on COVID-19 in China and aboard have made it inconvenient for most passengers who want to travel in China or travel aboard, which has also greatly influenced the development of global tourism and aviation. These elements contribute to inflation and have an impact on the CPI (consumers price index). The pertinent notes found that the Asian markets (Hang Seng, Nikkei 225, and Kospi) had fully regained efficiency at the same time as the European and American markets had not, even after the initial bounce, reached their pre-crisis efficiency levels due to various COVID-19 regulations [1]. All things considered, the unexpected COVID-19 epidemic has had some impact on the real economy and inflation in several nations.

Combined with the outbreak of the Russia-Ukraine conflict, the Russia-Ukraine conflict not only made the global energy market very unstable but also hurt economies that have been gradually recovering from the pandemic. Russia's energy products cover a variety of energy products such as oil, natural gas and coal. Russia as one of the world's most important energy exporters making inflation worse all over the world. However, from a different angle, the struggle is also an economic one between Russia and the United States and its allies, rather than only a military one between Russia and Ukraine.

The first reason why this paper mainly analyze the Chinese market, the European market and the American market is that these three markets are the three major economies in the world, which can better reflect the global economic changes and inflation boom under the impact of COVID-19 and the conflict between Russia and Ukraine. The second reason is that these three markets are closely related to these and directly affected by these two events. Secondly, regarding the CPI is a given measure for determining the cost of living and also a standard measure of household inflation which directly or indirectly affects households. Because its calculations exclude key areas of household spending, the single CPI cannot accurately reflect the inflation situation [2]. In order to address that, the Core-CPI will also be taken into account in this article in order to more precisely examine how the COVID-19 and the Russia-Ukraine conflict have affected the inflation situation in the Chinese market, the European market, and the American market.

2. The U.S. Market

As Figure 1 and Figure 2 shown, Since the outbreak of COVID-19 in late 2019, CPI and core-CPI in the US market have continued to rise. In terms of trend, the US market and the European market are roughly the same in terms of the upward trend of CPI, but the inflation situation in the US is more serious. In order to accurately judge the long-term trend of price rise, this paper adds the analysis of core-CPI to the analysis of the US market. Because changes in the food and energy components are much higher than changes in other components, the US excludes them from the core- CPI, just as they are also highly influential in the Ukraine conflict.

During the pandemic, the main reasons of inflation has come from other sectors than food and energy. According to relevant surveys and studies, the COVID-19 pandemic has mainly changed residents' consumption patterns**.** Due to the restrictions of relevant policies, residents spend on transportation, travel and other aspects, and induce residents to spend on food, groceries and other aspects, which seriously changes the CPI and also leads to the price rise of food and other aspects. The US differs from China in that the majority of general transportation in the US is by air and the coronavirus outbreak has affected both the airline and tourism sectors, as well as casinos and gambling. In addition, the study demonstrates that low-income households are more affected by inflation during the crisis, with an annual inflation rate of 1.12% in May 2020, compared to just 0.57% for high-income households. [3]. It can be seen that in the United States, low consumers have had a harder time, not only facing the risk of unemployment, but also bearing the high price of food and drink after inflation, but the United States has no other policy on the welfare of the poor. Historically, the inflation rate of the United States is related to that of all developed economies in the world. According to relevant data, the inflation rate of the United States is the fastest in 2021, which is caused by the government's failure to prevent the epidemic in time at the early stage of the outbreak. In order to recover this huge loss, the United States government has introduced relevant monetary policies. So the Fed will continue to buy agency debt to back securities and Treasuries to combat the economic impact of the pandemic. Even so, the epidemic caused the US GDP to contract for the first time since 2009, the US inflation has been affected by a number of factors and has remained at a historically high level without a downward trend. Persistently high inflation in the United States is not a good thing for the global economy.

As for the impact of the Ukraine conflict on the US market, it is mainly due to the rise in energy prices and import and export issues, because the US itself is a large agricultural country and does not need to import from Ukraine. The conflict in Ukraine has led to higher commodity prices around the world, exacerbating inflation in markets already hit by the COVID-19 pandemic and weighing heavily on US economic growth. The conflict between Russia and Ukraine, which primarily affected international financial markets through inflation and economic sanctions, is regarded as the most serious incident to occur in Europe since World War II because it occurred during the COVID-19 pandemic and interfered with the general economic recovery of several nations after the COVID-19 pandemic. However, the Russia-Ukraine conflict is not only a conflict between Russia and Ukraine, but also a means for major powers to impose sanctions on each other. Therefore, the US repeatedly incitement in this conflict led to the further deterioration of Russia-Ukraine relations. Although the conflict led to export restrictions and port closures in Ukraine, Russia and Ukraine, large exporters of agriculture and energy, drove up the prices of oil, gas and other commodities in a matter of days, fueling global inflation, according to relevant data [5]. According to studies, the Russia-Ukraine conflict significantly altered supply and prices in important commodity markets (oil, gas, platinum, gold and silver). The study found that all commodities and markets are extremely interrelated. Alam et al. (2022) employed the time-varying parameter vector autoregression (TVP-VAR) technique, which captures how spillovers are produced by various crisis times (G7 and BRIC). Their findings indicate that, during this invasion crisis, the stock markets of the United States, Canada, China, and Brazil, as well as gold and silver (commodities), have been the recipients of shocks from other commodities and markets. [4]. Although the outbreak of the Russia-Ukraine conflict has led to serious global inflation, during the Ukraine conflict, the US sold a large number of arms to Ukraine, from which it gained huge benefits. At the same time, U.S. exports of gas and oil to Europe have soared in the face of Russia's refusal to continue supplying Europe with energy. Despite the serious inflation in the United States, agricultural, military, energy and other businesses have all benefited.

To sum up, though the Ukraine conflict has led to serious inflation in the global market, it is not the main reason for the continuous rise of CPI and core-CPI in the United States the main cause of inflation in the United States is not food and energy problems, nor the impact of COVID-19, but the Federal Reserve's monetary policy to over-stimulate the market and the gap in the labor market, which the Federal Reserve has not responded to in a timely manner.

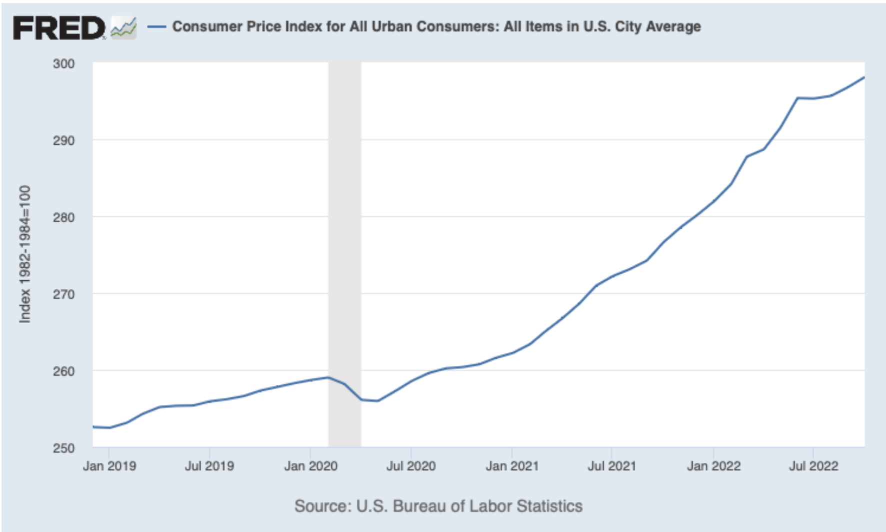

Fig. 1 CPI for All Urban Consumers: All Items in U.S. City Average [5]

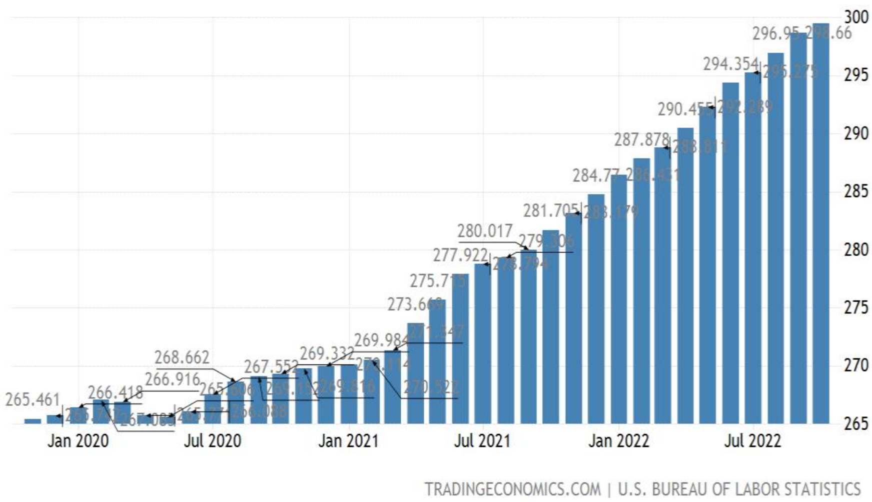

Fig. 2 Core-CPI in the U.S. [6]

3. EU Market

As for the analysis of the inflation in the European market, as Europe is affected by the Ukraine conflict, the trade of food and energy is greatly affected, so this paper considers the impact of core CPI here. As Figure 3 and Figure 4 shown, between 2019 and 2022, the CPI in the European market has generally shown an upward trend, especially since 2020, the CPI in the European market has continued to rise. There seems to be no downward trend in the short term. According to related news reports, the first outbreak of COVID-19 occurred in Wuhan, China, in late 2019, but the picture shows that over this period, European cpi has risen slightly and not changed much, and on the energy side it has been very stable and barely affected at all.

Due to different national policies, most countries in Europe did not take measures to strictly control the development of the epidemic as China did, but allowed it to develop, which also led to almost all of their citizens being infected, and even some of their citizens being repeatedly infected. Therefore, the outbreak of COVID-19 in Europe has been fierce and serious, which has seriously affected the consumption patterns and habits of European people. The sudden change of consumption habits has affected the income of European retailers [7]. For example, people want to buy less goods, and reduce overhead, so some takeaways and fast food are unsold, which also leads to people having to buy a large number of items from retailers. According to data from the Office for National Statistics (ONS), between the third and fourth weeks of March, the price of cough and cold medications rose sharply online by 11%. Prices increased by 1.1% in that week for all "high-demand products," including pharmaceuticals but also diapers, pet food, and rice (among others). These adjustments could be due to higher profit margins as well as higher costs for the companies as a result of the production and supply chain disruptions brought on by the lockdown. Such a series of chain reactions may lead to an increase in the rent of retailers' stores, and also affect the relationship between suppliers and retailers, which will lead to fluctuations in the prices of goods sold by retailers, and then affect consumers. It can be seen that the COVID-19 pandemic has had a huge impact on People's Daily life, which in turn has affected the volatility and collapse of global prices and stock indexes. For Europe, the epidemic mainly affects developed economies, especially some countries highly dependent on tourism. Because the epidemic in Europe is becoming more severe, relevant departments have started to pay attention to the situation and have enhanced relevant controls, which has led to an increase in unemployment in several businesses. Relevant study indicates that governments in the EU member states have to enact measures to seal the borders, limit the movement of people, and halt corporate operations in non-essential industries [8]. These restrictions threatened to result in the worst economic shock since the Great Depression of the 1930s [8]. Meanwhile, quarantine and travel-related bans have also greatly affected many industries. The loss of demand for some goods has led to a decline in productivity, which will not recover for some time.

The conflict in Ukraine has had a bigger impact on European markets than the covid. The Ukraine conflict is not only a conflict between Russia and Ukraine, but also a means for the United States and Europe to jointly sanction Russia. The United States and Europe suppress Russia in various aspects, which leads to changes in the global situation and seriously damages the global strategic balance and stability. Russia and the United States' relationship is changing and taking on a new direction. Europe is most affected by the energy game because it depends heavily on Russia for energy. Russia is the third-largest oil producer in the world after the United States and Saudi Arabia, producing about 10 million barrels of oil per day, half of which is exported to Europe. In addition, about 36% of the natural gas in Europe comes from Russia, while 43% of the natural gas in the European Union comes from Russia. Natural gas is a very important energy in Europe, accounting for 26% of its consumption. However, at present, natural gas in Europe is scarce and has to rely heavily on imports. Although the United States has reached out to Europe, there is currently no country that can replace Russia in exporting such a large amount of energy to Europe. From this point of view, the main cause of inflation in Europe is the increase in energy prices. According to reliable data, the price of natural gas in Europe has increased by 20% since the beginning of 2022 as a result of Russia's recent invasion on Ukraine, which also increased inflation and caused electricity bills to soar. Wisdomn (2022) [9].

Secondly, the war also had an impact on food in the euro area. Because of the war, the problems of importing and exporting goods will have a long-term impact on European food prices. Bodnar et al. (2022) examine euro zone food inflation and report that global energy and food commodity prices had been driving it upwards since the second half of 2021 and that the war has increased it further by hindering the import of energy and food commodities [10].

Although the eurozone is self-sufficient in agricultural products, producing more than it consumes, and does not need large quantities of additional imports from major agricultural exporters such as Ukraine, the outbreak of the Russia-Ukraine conflict has intensified the market pressure in the eurozone food market itself. Overall, supply chain issues and rising energy prices in European markets hit by the COVID-19 pandemic and the conflict between Russia and Ukraine are predicted to push the economic growth curve of countries that use the euro down, while the conflict could lead to higher inflation due to the uncertainty of the conflict between Russia and Ukraine.

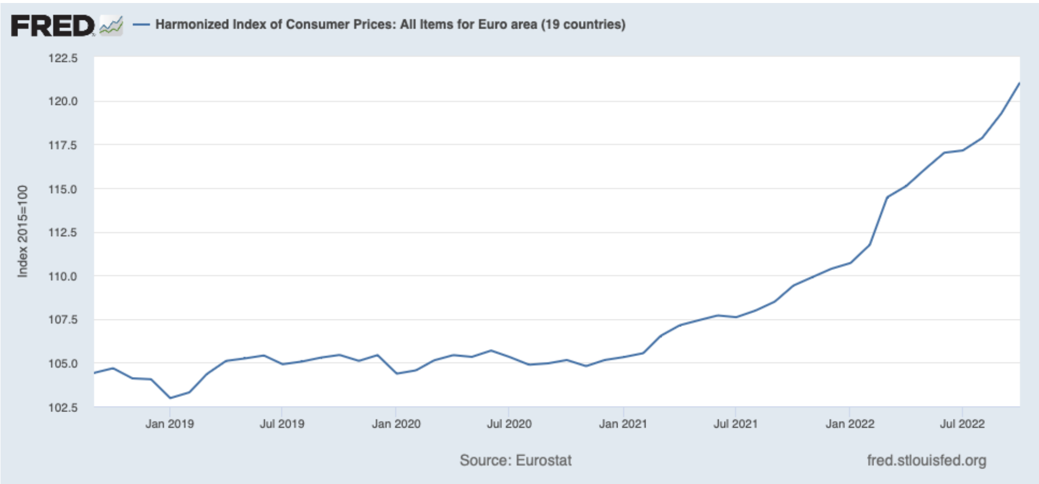

Fig. 3 Harmonized Index of Consumer Prices: All Items For Euro area (19 countries) [5]

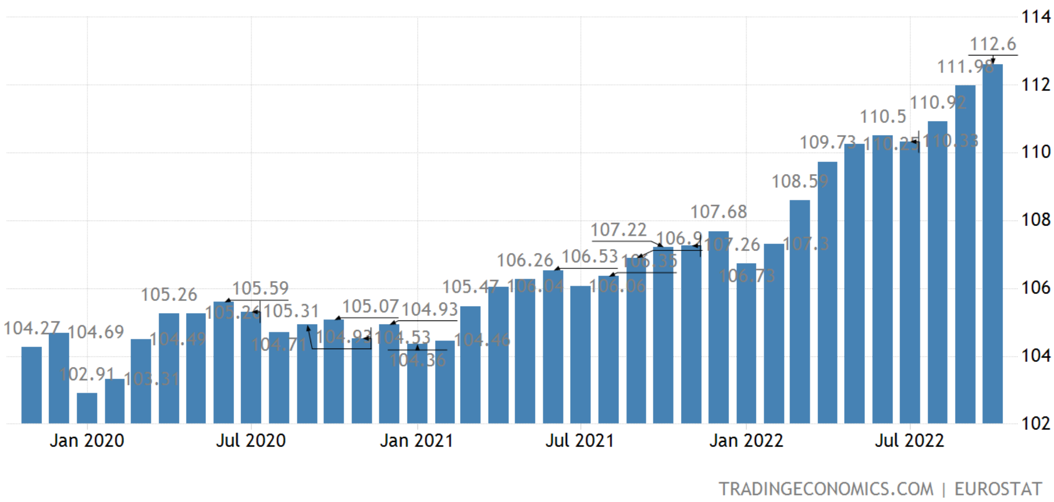

Fig. 4 Core-CPI in the Euro Area [6]

4. China Market

As Figure 5 shown, from 2019 to 2022 the CPI of China market is fluctuant. CPI fluctuations are normal. If CPI continues to rise, it will increase inflationary pressure, which will break the current pattern of interests and seriously damage the interests of the majority of the people. As can be seen, at the end of 2019 and the beginning of 2020, China's cpi fell sharply and continued to the second half of 2020. According to the comparison news, this period was the most serious period of COVID-

19 in China. From the outbreak in December 2019 to the second half of 2020, the Chinese government strictly controlled the spread of the virus. Strict prevention and control were carried out through the first time control of infected people, the rapid establishment of makeshift cabins and the treatment of integrated traditional Chinese and western medicine. It is also during this time that the way Chinese people work, consume and shop has changed dramatically. As the new coronavirus spreads rapidly and in various ways, most residents are working from home. Working from home has a less noticeable effect on some jobs that can be performed online, but it has a significant negative impact on some sectors of the real economy, such as those in the food and beverage industry, manufacturing sector, transportation and communication sector, commercial service sector, construction sector, cultural sector, and other industries involved in the production of goods and services. This has also led to an increase in unemployment. According to the relevant data and the analysis after the establishment of the model, it is obtained that the total loss caused by the COVID-19 epidemic on China's unemployment rate is 1.23%, and the 95% confidence interval is [1.11%,1.36%] [11]. Compared with the United States, the impact of the epidemic on China's unemployment rate is smaller and shorter [11]. The rapid recovery of China's real economy is mainly due to the fact that the Chinese government immediately implemented relevant policies, such as tax and fee reduction policies for micro, small and medium-sized enterprises, lowered the threshold, reduced the process, and cancelled relevant restrictions. The purpose is to make the relevant policies implemented to enterprises most quickly, so that all small, medium and micro enterprises hit hard by the epidemic can return to the right track at the fastest speed. At the same time, in order to promote residents' consumption, relevant local governments also issued a large number of consumption vouchers to stimulate residents' purchase desire, so as to further help small, medium and micro enterprises to return to the right track as soon as possible. The Washington Post pointed out that China's decision to close major transportation hubs during COVID-19 was a very strong measure [12]. Rose Meng and Director of the Analysis Center of China Dream) also believed that in the face of the epidemic, the Chinese government and people "strictly controlled Wuhan, a major city, with the highest level of discipline, and built a new Great Wall, so as to save the rest of the country from the disaster of COVID-19 [12]. At the same time, Chinese scientists successfully isolated the virus and published its genome in a very short time, it has also made a significant contribution to research on the COVID-19 virus in other countries. Of course, praise and criticism for China's epidemic prevention measures are mixed, but the rebound in China's CPI in late 2020 shows that China's policies are the right ones for China.

About Ukraine conflict, it began at February 2022, as Figure 5 shown that at that time China’s CPI increased constantly. According to relevant information, Russia and Ukraine are the major suppliers of grains and plants in the world. Due to the outbreak of the Russia-Ukraine conflict, Ukraine's grain export ports have been blocked, and the risk of production reduction has been exacerbated by the volatility of the global grain market goods cannot be shipped to the world. The agricultural products exported by Russia and Ukraine have the substitution for other countries, which means that some countries can only obtain these agricultural products through import. However, these are not irreplaceable for China, so the impact on China's agricultural trade is small and under control. Therefore, with the rapid and effective adjustment of relevant policies by the Chinese government, investment and industrial sector production jointly promoted China's economic recovery, resulting in stable inflation in China even under the impact of the epidemic and the conflict between Russia and Ukraine.

The Russia-Ukraine conflict also has an impact on China in energy traders. As the trade between China and Russia covers a variety of energy products such as oil, natural gas and coal, the energy trade between China and Russia plays an important role in both China's import and Russia's export. Until now, Russia has become China’s largest importer of energy, its largest source of electricity and its second largest source of oil, natural gas and coal. Therefore, the outbreak of the Russia-Ukraine conflict not only leads to the instability of the global energy market, but also leads to the rise of energy prices in China and affects the content and way of Sino-Russian transactions as well as the future trend. In addition to this, China is a gas-poor country, and as its domestic demand for natural gas and crude oil increases, China will become more dependent on energy transactions with Russia, because if the Sino-Russian energy trade goes wrong, China's Henan province will find a substitute country to supply the same amount of energy in a short time, which is a major risk for China.

To sum up, the reason why China's economy recovered rapidly and market inflation stabilized after COVID-19 is that the Chinese government implemented certain policies on the affected industries. As a result of this series of positive policies and investment, China's economy is still developing and has not been greatly affected.

Fig. 5 CPI (All Items) Total for China [5]

5. Conclusion

The impact of the COVID-19 pandemic is largely similar across the globe of these three markets, China has been the least affected, mainly because of the better containment of the spread of COVID-19. For the US market, the higher death rate is a good thing, which is strange. The outbreak of COVID-19 has led to changes in consumption patterns, which, coupled with the prevention and control measures of various countries, has severely hit the real economy and led to an increase in unemployment. According to this study, Asian markets (Hang Seng, Nikkei 225, and Kospi) have fully recovered their efficiency, whereas the European and US markets, despite an initial rebound, have yet to reach their pre-crisis efficiency levels. The inefficiency of the US and European markets is what causes the volatility to be moderately high.

The Ukraine conflict has led to an increase in global inflation, the most serious of which is in the European market, mainly due to the rise in oil prices, and the inflation in the United States is also extremely serious. However, this paper does not believe that this is mainly caused by the Russia-Ukraine conflict but the monetary policy and labor market of the Federal Reserve. China's economic development trend this year is relatively slow, and the outbreak of the Russia-Ukraine conflict has led to an unstable future trend of China-Russia trade. According to relevant studies, the European and American markets did not recover to the pre-epidemic level after the COVID-19 epidemic, and only the Chinese market fully recovered, which also confirms the correctness of the relevant policies adopted by the Chinese government.

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