The Analysis of Vital Food Cost

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Abstract. This paper analyzes the price fluctuation trends of four essential foods in Canada, Australia, Japan, South Africa and Sweden during 2018-2022, so as to explore the factors affecting the price of essential foods and predict the future trend of food prices. According to the sample data, the data cleaning work was carried out to obtain the price growth rate excluding the price factor, and the data visualization chart was established combining the characteristics of cpi index, time change, and national conditions. Combining a variety of data visualization charts to analyze and study the problem, it has good practicability and accuracy.

Keywords: Factors affecting the price; Price forecasting; CPi; Data visualization chart.

1. Introduction

Food price is an important part of the consumer price index, and the fluctuation of food price directly affects people's lives. The study has guiding significance for macroeconomic policy, social stability and consumer behavior. A deeper understanding of its impact mechanisms can help optimize policies, alleviate poverty, improve the efficiency of agricultural supply chains, and promote sustainable development of national economies and people's quality of life. In this paper, the food analysis system adopted by the cpi index is used to objectively reflect the fluctuations of various kinds of food and analyze the reasons. The gray forecasting method suitable for small data samples is also adopted to forecast the index data in the future period of time. By visualizing the data of various factors and the changes in food prices, the data is constructed and each visual table is studied. The following conclusions can be drawn. First of all, there are many factors affecting the price of essential food, such as seasonal factors and local comparative advantages. Seasonal factors can be attributed to seasonal factors and holiday factors, while local comparative advantages are closely related to national conditions. Secondly, we can find that the price of essential food is not sensitive to the change of exchange rate, so we can guess that people's demand for essential food will keep rising. In addition, food prices can be expected to continue to rise in the next few years.

2. Research object

2.1 Data Source

The sample data of this study are all from the database of the official website of Kaggle, which is linked as follows: https://www.kaggle.com/datasets/sumangoda/food-prices

2.2 Data Processing

Select 2018 as the base, with a base period of 100. If the price of subsequent periods is 120,140,180,200. Calculate the growth rate of each period. Then subtract the inflation rate. This growth rate is the growth rate without the price factor. Refer to bi(t) = S1/S0*100 - CPI2018.

For various food items, we begin by calculating the growth rates for different countries. Initially, we categorize them based on different nations, and for each country, we use 2018 as the base year for subsequent computations. By dividing the current year's price by the price of 2018, we derive the price growth rate, as depicted in Figure 1.

```
Growth rate

IF [Country] = "Canada" THEN
    IF [Year] = 2018 THEN 100
    ELSE ([Average Price] / { FIXED : AVG(IF [Year] = 2018 THEN [Average Price] END) }) * 100
    END
ELSEIF [Country] = "Australia" THEN
    IF [Year] = 2018 THEN 100
    ELSE ([Average Price] / { FIXED : AVG(IF [Year] = 2018 THEN [Average Price] END) }) * 100
    END
ELSEIF [Country] = "Japan" THEN
    IF [Year] = 2018 THEN 100
    ELSE ([Average Price] / { FIXED : AVG(IF [Year] = 2018 THEN [Average Price] END) }) * 100
    END
ELSEIF [Country] = "Sweden" THEN
    IF [Year] = 2018 THEN 100
    ELSE ([Average Price] / { FIXED : AVG(IF [Year] = 2018 THEN [Average Price] END) }) * 100
    END
ELSEIF [Country] = "South Africa" THEN
    IF [Year] = 2018 THEN 100
    ELSE ([Average Price] / { FIXED : AVG(IF [Year] = 2018 THEN [Average Price] END) }) * 100
    END
END
```

Fig.1

Furthermore, while calculating growth rates adjusted for price factors, a similar procedure is followed: we first perform country selection, then subtract the respective year's CPI index from the previously obtained growth rates for each country. This yields the final results, as illustrated in Figure 2.

```
IF [Country] = 'Canda' THEN ([Growth rate ] - 133.4)
ELSEIF [Country] ='Australia' THEN([Growth rate ] - 113.3)
ELSEIF [Country] ='Japan' THEN([Growth rate ] - 99.6)
ELSEIF [Country] ='Sweden' THEN([Growth rate ] - 328.4)
ELSEIF [Country] ='South Africa' THEN([Growth rate ] - 86.8)
END
```

Fig.2

3. Data Analysis

3.1 Time factors

First, we look at the annual change in the growth rate of food prices after removing the price factor, as shown in Figure 3, where the X-axis represents the years between 2018 and 2022, while the Y-axis represents the growth rate, and the different colored lines represent the different types of food items. From the trend of various food price curves, it is not difficult to find that the four lines have shown an upward trend, we can conclude that people's demand for essential food is gradually increasing. However, most of the growth rate is still negative. We can infer that due to the outbreak of COVID-19 at the end of 2019, people are affected by the epidemic, which leads to a decrease in people's consumption level. With the gradual remission and end of the epidemic, People's Daily life and work gradually begin to return to normal, and various restricted industries recover. Promote people's consumption level gradually began to rise, so the growth rate of food prices also began to gradually increase.
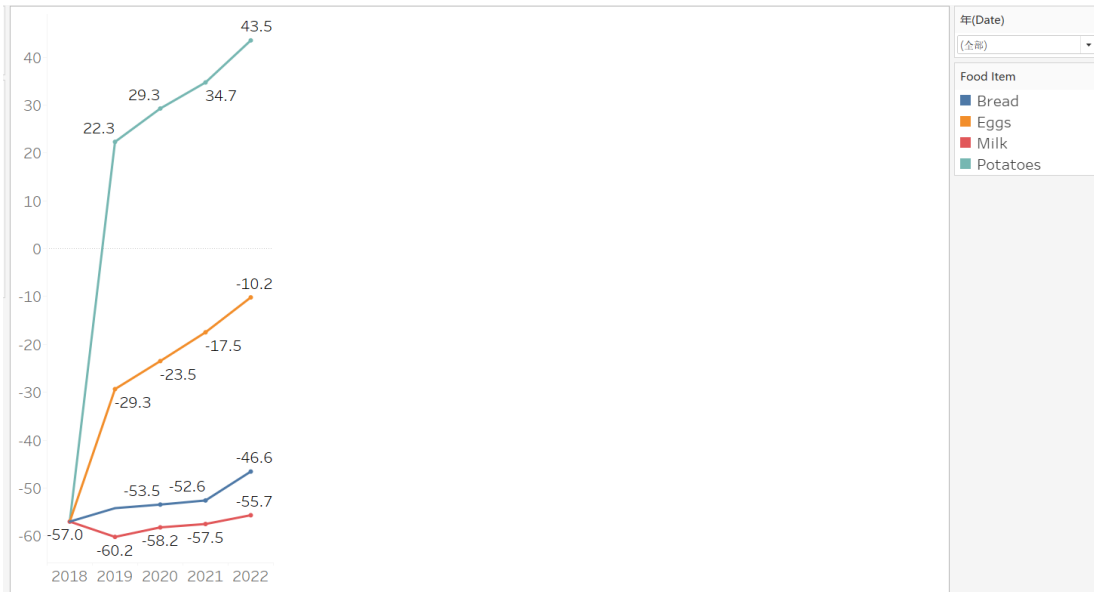
Fig.3

Next, we further analyze the quarterly changes in food prices, and take eggs as an example to analyze in detail. The price change chart is shown in Figure 4, where the X-axis represents the four quarters of the year, 1-4 represents spring to winter, and the Y-axis represents the corresponding average price. From the line chart, it can be found that throughout 2018-2022, the price of eggs has a clear seasonal change, with the price of eggs being the lowest in the first quarter, and starting to rise after that, reaching the highest value for the whole year.

The reasons for this regular change can be attributed to two points. On the one hand, it is related to the festival, and on the other hand, it is also closely related to the climate. In the spring, there is usually less demand for eggs in the market, and in June, there will be Meiyu season, because of the climate and other reasons, mold eggs and rotten eggs occur frequently, which leads to the depressed demand for eggs in the sales area. In the trade link, the sales merchants are basically not in stock, and it is the most common situation that the demand is weak but the supply is insufficient, so the bottom support is obvious. In July, although the rainy season was over, the construction units suspended work due to the holidays of major universities and the hot and rainy weather, so the market demand for eggs was still in a depressed state. At the same time as the opening of colleges and universities in September, the Mid-Autumn Festival stock was started, and the construction units resumed operation and so on were concentrated in late August. The market demand for eggs begins to rise at a time when supply from suppliers may remain relatively stable or grow more slowly. This imbalance between supply and demand has led to seasonal increases in egg prices.
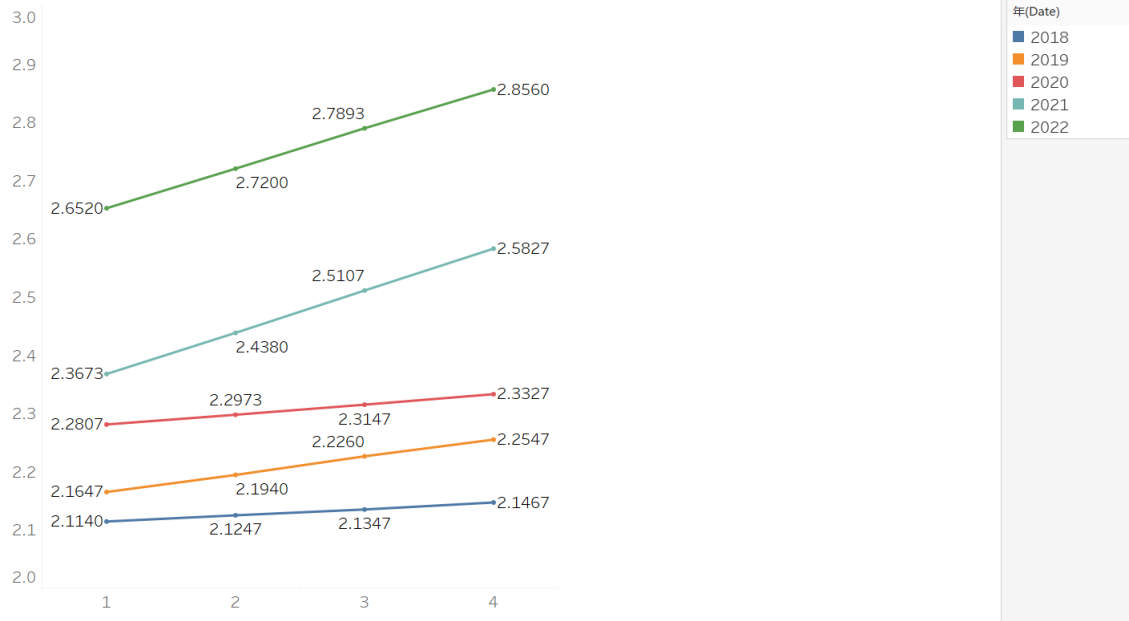
Fig.4

In conclusion, through the observation and analysis of the trend chart of food price growth rate with the removal of price factors and the trend chart of average food price with the change of quarter, we can draw the following conclusions. First of all, combined with the price volatility trend of the five years from 2018 to 2022, the price of these food products will continue to rise in the next few years, without considering the extreme situation. Secondly, season is a major factor affecting food prices, including festival factors and climate factors. Therefore, in the future, producers can reasonably adjust food production in different seasons according to the seasonal changes in food prices.

3.2 National and regional factors

Next, this paper will try to analyze and interpret the reasons leading to the different prices of cross-sectional regions from the price differences among countries. First, let's look at the price differences between countries, as shown in Figure 5[1].
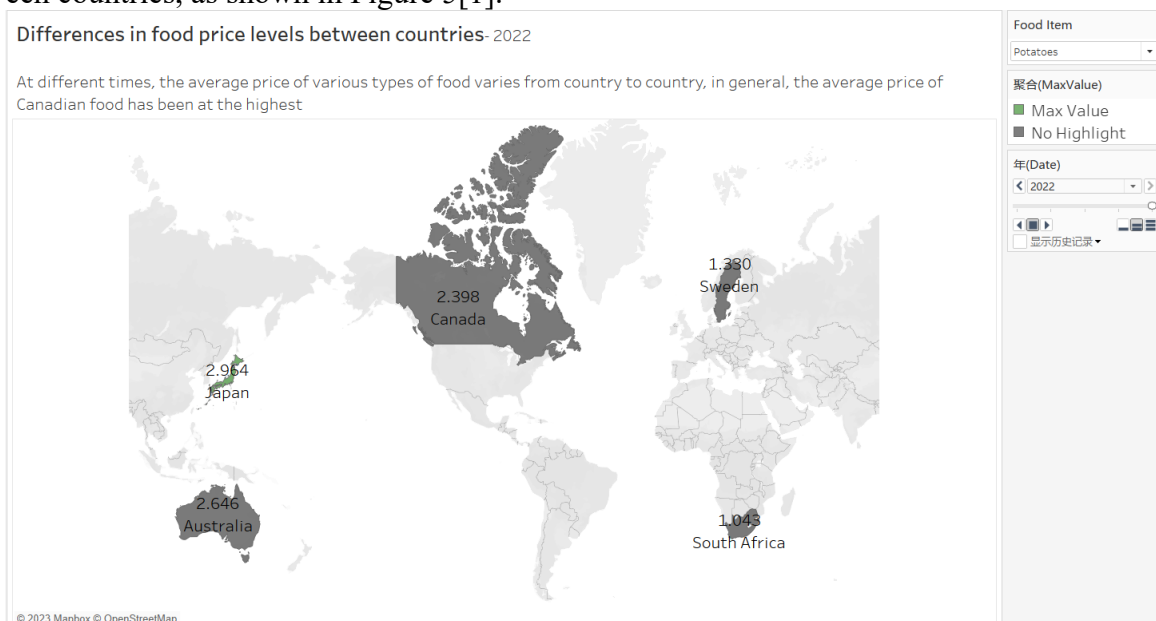

Fig.5

As can be seen from the figure, Japan represented by green is the country with the highest price of potatoes among the five countries, while in comparison, the price of potatoes in South Africa is very low, which can be attributed to the comparative advantages between the two countries.

First of all, due to Japan's limited land area, land scarcity and limited farmland area, the production cost of potatoes is relatively high, and the Japanese government is reluctant to use large areas of arable land for potato cultivation. Secondly, due to the geographical location of the country, Japan, as an island country, is vulnerable to natural disasters such as typhoons and floods. Such harsh climate conditions are not suitable for large-scale potato cultivation. For all these reasons, the Japanese government is reluctant to produce potatoes on a large scale in Japan, so it has to rely on importing potatoes from other countries, which results in the highest average price of potatoes in the five sample countries. In contrast, South Africa is not a vast country, but because South Africa straddles the equator to the high latitudes of the southern Hemisphere, it has a suitable climate for potato cultivation. In addition, since the labor cost of South Africa is much lower than that of Japan, a large number of labor forces are willing to participate in potato cultivation, which leads to the total cost of potato generation is much lower than that of Japan. These factors intertwine and ultimately lead to lower potato prices in South Africa.

Second, we shift our focus back to the differences in egg prices between Canada, Australia, Sweden, Japan and South Africa. Figure 6 shows the differences in egg prices between chicken countries.

Fig.6

From the map above, we can obviously find that Australia, represented by green, has the highest egg price among the five countries, while South Africa's egg price is cheaper. The reason for this situation can also be attributed to local comparative advantages.

First of all, Australia has a vast land area, but the population density is low, which results in a situation of sparse population, making the transportation of eggs from farms to markets requires more time and resources, increasing the transportation cost of eggs. Secondly, compared with South Africa, there are more high-quality talents in Australia, which is why the labor cost is higher. The Australian government is more willing to invest these resources in high-tech industries to promote the national economy through the development of these industries. Therefore, compared with producing eggs itself, Australia is more willing to import eggs. This results in Australia having the highest egg prices among the five sample countries. In contrast, there are more low-cost labor in South Africa, and the number of high-quality talents is far less than the other four countries, which leads to the South

African government is more willing to invest labor costs in the agricultural industry, which is also a major reason for the low price of eggs in South Africa.

To sum up, we can draw a conclusion that the comparative advantage of countries and geographical factors will greatly affect the fluctuation trend of food prices. In addition to these two factors, since it involves the price comparison of different foods in five different countries, the impact of exchange rate changes on food prices is also crucial. In the following article, the impact of exchange rate on food prices will be described in detail.

3.3 Exchange rate factor

The influence of exchange rate on food price will directly affect the import cost and export competitiveness of food. A weaker currency lowers the cost of imports and makes exports more competitive, but can lead to inflation. Exchange rate fluctuations also affect agricultural exports and domestic production costs, posing challenges to economic stability and market supply and demand. Therefore, it is important to study the impact of exchange rates on food prices.

First, this article will explain the theory of supply and demand balance in the food market. In a smoothly functioning food market, when supply St equals demand Dt, the market remains in equilibrium. Suppose that the supply and demand of food are determined jointly by the market price Pt and the exchange rate Ct. Ct can be a continuous variable that characterizes the exchange rate.

$$D_t(P_t, C_t) = S_t(P_t, C_t) \tag{1}$$

In this case, taking the derivative of formula (1) gives us the following formula

$$\frac{\partial D_t}{\partial P_t}dP_t + \frac{\partial D_t}{\partial C_t}dC_t = \frac{\partial S_t}{\partial P_t}dP_t + \frac{\partial S_t}{\partial C_t}dC_t \tag{2}$$

It can be obtained from formula (2)

$$\frac{dP_t}{dC_t} = \left(\frac{\partial S_t}{\partial C_t} - \frac{\partial D_t}{\partial C_t}\right) / \left(\frac{\partial D_t}{\partial P_t} - \frac{\partial S_t}{\partial P_t}\right) \tag{3}$$

Assuming market equilibrium St=Dt, equation (3) can be converted to the following expression

$$\frac{dP_t}{dC_t} \cdot \frac{C_t}{P_t} = \left(\frac{\partial S_t}{\partial C_t} \cdot \frac{C_t}{S_t} - \frac{\partial D_t}{\partial C_t} \cdot \frac{C_t}{D_t}\right) / \left(\frac{\partial D_t}{\partial P_t} \cdot \frac{P_t}{D_t} - \frac{\partial S_t}{\partial P_t} \cdot \frac{P_t}{S_t}\right)$$

Rewrite the above formula, and you end up with the following formula

$$\eta_{P.C} = \frac{\eta_{S.C} - \eta_{D.C}}{\eta_{D.P} - \eta_{S.P}} \tag{4}$$

In the equation, ηP and C represent the price elasticity of exchange rate, reflecting the degree of response of food prices to exchange rate changes. The greater the elasticity, the more sensitive food price fluctuations are to exchange rate changes, which is the focus of this study. ηS, C, and ηD, C represent the elasticity of food supply and demand at exchange rates, respectively. Similarly, ηD, P and ηS, P indicate the sensitivity of food supply and demand to fluctuations in food prices, respectively. In general, for normal food, $\eta D, P < 0$, $\eta S, P > 0$, so the symbol for ηP, C in equation (4) is the same as the symbol for (ηD, c-η S, C). Thus, food price fluctuations are determined by the difference between the elasticity of supply ηS, C and the elasticity of demand ηD, C of exchange rate changes.

After introducing the theoretical basis of the impact of exchange rate on the supply and demand balance of the food market, we imported the sample data into tableau and explored the impact of

exchange rate on food prices in the sample countries by making a data visualization table. As shown in Figure 7.
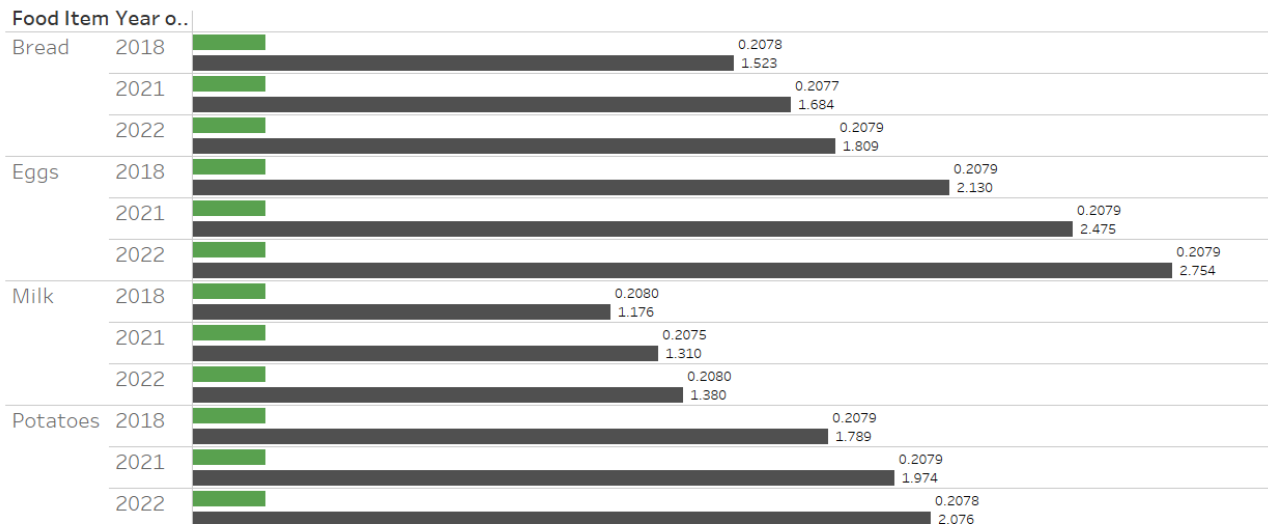

Fig.7

The chart is made up of bars in different colors, with the green bar representing the average foreign exchange index for each country during the year, and the gray bar representing the average monthly dollar price of the food during the year.

We can see that when the exchange rate rises, the price will also rise, and when the exchange rate falls very slightly, the price will not be affected. This could mean that food prices are insensitive to exchange rates. The reason for this phenomenon can be attributed to the regulatory role of the exchange rate on the food market.

Generally speaking, the decline of the local currency exchange rate, that is, the depreciation of the value of the local currency to the outside world, can promote exports and inhibit imports. On the contrary, if the exchange rate of the local currency rises, that is, the value of the foreign currency rises, it is conducive to imports and not conducive to exports. From the perspective of imported consumer goods and raw materials, the decline of the local currency exchange rate will cause the domestic price of imported goods to rise. The extent to which it affects the overall price index depends on the share of imported goods and raw materials in the gross national product. In other words, the depreciation of the local currency will lead to a decrease in the quantity of domestic imports, which is unfavorable to imports, and therefore the price of domestic imports will rise. On the contrary, the appreciation of the local currency, other conditions remain unchanged, the price of imported goods may be reduced, which can play a role in curbing the overall level of prices. That is, the appreciation of the local currency is conducive to imports, which leads to an increase in the number of domestic imports[2], so the price of domestic imports is reduced.

In this sample data, the decrease of foreign exchange reduces the purchasing power of the domestic currency, while the price of essential food does not decrease accordingly. The reason for this phenomenon may be that people are more willing to spend money on the purchase of essential food rather than non-necessities due to the decrease of the purchasing power of the domestic currency. In addition, when the foreign exchange index increases, the price of essential food also increases. This may be due to the increase in the purchasing power of the local currency, and people are willing to buy more daily necessities to maintain their livelihood in this period. Therefore, the food price did not decrease due to the decrease in the price of imported goods at this time, but the food price still rose during this period.

In general, through the analysis and interpretation of the above chart, we can draw the conclusion that for essential food, the price of food is not sensitive to the change of exchange rate, and the change of exchange rate will not be an important factor affecting the price of food within a reasonable range.

4. Summary

By studying the price trends of bread, milk, eggs and potatoes in Japan, Australia, Sweden, Canada and South Africa during 2018-2022, this paper explores the factors affecting food prices and reasonably predicts the future price trends of these foods in these five countries on a certain basis.

First of all, through the visual observation and analysis of various data, we can conclude that there are many factors affecting food prices. On the one hand, the time factor affects food prices to a certain extent, resulting in seasonal fluctuations in food prices. The reasons for such regular price fluctuations can be attributed to climate factors and holiday factors. On the other hand, national and regional factors also affect the fluctuation of food prices, because each country has its own comparative advantages, and each country is more willing to give full play to its advantages, which leads to the difference in food prices among countries. Finally, by looking at the trend of food prices over the past five years, we can predict that the prices of these four essential food items will continue to rise, regardless of extreme factors.

References

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