INFLATION OF FOOD AND ITS EFFECT ON DIFFERENT EXPENDITURE GROUPS IN TURKEY

Yiğit Muzaffer YILDIZ

1. Project Overview and Scope

Every country has an **inflation** which might be either positive or negative. It is stated that positive inflation points to a country's economic status regarding people's power to buy and maintain their lives. For the last few years, Turkey has been one of the countries that have suffered from high inflation. The inflation word consists of many sub-categories, some of which are food, clothing, education, and transportation consumer price index (CPI). This project mainly focuses on the **CPI of food** and its effect on various groups of **people with different total expenditure levels**. To analyze the impact and infer, "Consumer price index (2003=100) according to main and sub-main groups, 2005-2025" and "Distribution of household consumption expenditure by quintiles ordered by expenditure, Türkiye, 2002-2023" data are driven from the website of TUIK, which is short for Turkey Statistics Institute.

2. Data

2.1 General Information About Data

The data files used for in-depth analysis are derived from the TUIK website. The data named **"Distribution of household consumption expenditure by quintiles ordered by expenditure, Türkiye, 2002-2023"** consists of the distribution of consumption expenditure types of different expenditure groups. This data is also referred to as *"comparison_of_consumption_types"* and *"COCT data"* throughout the project. There are 5 groups in the columns named "First quantile", "Second quantile", "Third quantile", "Fourth quantile", and "Last quantile". Each represents 20% of the people who are the subject of the data research in an ascending order of expenditure amount. Namely, the First quantile represents the 20% of the people who spend the least, while the Last quantile represents the people who spend the most. There are different expenditure types for the years in the rows.

COCT Data on TUIK Website

Another dataset used is named **"Consumer price index (2003=100) according to main and sub-main groups, 2005-2025"**, which is also referred to as *"consumer_price_index_data"* and *"CPI data"* throughout the project. This data shows the consumer price index value of 288 different main and sub-groups of expenditure according to each month of the years from 2005 to 2025. Year and month information is on the rows while the group names form the columns. Only the columns directly related to food are considered in the scope of this project.

CPI Data on TUIK Website

The years between **2005-2023** for both of the data sets are selected as the interval of the project.

2.2 Reason of Choice

The inflation of a country tells a lot about its economic status. It tells so many things that the food aspect might be underestimated. Nevertheless, access to food has been one of the major concerns of mankind. Over the decades, this concern has become more crucial for Turkish people, especially those with a low level of income and belonging to the first and second quantiles of expenditure level groups. The data chosen for this project helps the readers to navigate which group of people spends what percentage of their money on food and how this rate changes according to the inflation and consumer index of food. The conclusion of the project might shed light on the facts like a sign of socioeconomic differences among Turkish people.

2.3 Preprocessing

To begin with, the raw data which are in Excel (.xlsx) format driven from the website of TUIK are browsed as they are. Some of the rows and columns are deleted since they include text providing information about the data. Later, Turkish headings are removed from each row and column in the files. After a few operations in the Excel format of the files, they become ready to be imported to R. Both datasets are also saved in RData format to be processed in R.

Downloadable COCT Data in .RData version

Downloadable CPI Data in .RData version

Table 1: Table 1: Dimensions of the Unprocessed Data

data_set_name	number_of_rows	number_of_columns
consumer_price_index_data	243	291
comparison_of_consumption_types	275	8

2.3.1 Comparison of Consumption Types (COCT) Data

All the spaces (" ") among the headings of the colmuns are replaced by"_" sign. All the year values in the first column are arranged so that all have only 4 digits. Moreover, only the rows having food and non-alcoholic beverages expenditure are kept. There is no data from the years 2020 and 2021, even though the data is named by 2002-2023. Besides, there are two types of expenditure categorization for 2022. The 2 rows belonging to 2022 are reduced to one row by taking their average. Finally, the class of Year column is turned into a numeric from character and only years between 2005-2023, excluding 2020 and 2021, are kept.

The final version of the data after the operations is as shown in Table 2:

Table 2: Table 2: Change of Food Expenditure Percentage According to Quintiles by Years

Year	First_quintile	Second_quintile	Third_quintile	Fourth_quintile	Last_quintile
2005	40.63172	34.88343	30.04158	27.07178	16.74860
2006	39.47612	33.15669	29.56472	26.00507	17.51656
2007	37.30757	31.51043	27.88232	24.10312	16.89984
2008	36.44696	30.21248	26.02253	23.32254	16.28410
2009	34.25025	29.84173	26.33608	24.63697	16.95754
2010	32.52000	27.85000	26.37000	23.09000	15.83000
2011	31.69000	27.42000	24.82000	22.39000	14.61000
2012	31.34000	26.76000	24.05000	21.06000	13.53000
2013	30.42000	26.90000	24.76000	21.36000	13.67000
2014	30.12000	27.41000	23.86000	21.61000	13.60000
2015	31.69000	27.83000	25.07000	21.89000	13.96000
2016	30.93000	27.49000	24.23000	21.39000	13.08000
2017	30.73000	26.48000	24.88000	22.11000	13.35000
2018	30.89000	27.91000	25.63000	22.74000	13.55000
2019	33.36000	28.55000	25.54000	22.19000	14.26000
2022	39.24000	34.28500	30.34500	26.48000	14.19000
2023	39.18000	31.91000	27.60000	23.77000	12.52000

2.3.2 Consumer Price Index (CPI) Data

As an initial glance, there are too many columns as groups of expenditure, some of which are not the topic of this project. These columns are removed from the data. Only the rows including general food CPI values are kept. On the row side, there is year and month information. An additional row for each year is created as the average value of the months of the year. Thanks to this operation, the CPI value of food and how it changes can be evaluated not only by months but also by years. The month column and its relative rows are kept for further analysis.

The final version of the data after the operations is as shown in Table 3:

Table 3: Table 3: Food CPI by Years

Year	CPI_of_food
2005	112.0787
2006	122.9450
2007	138.2108
2008	155.8842
2009	168.3875
2010	186.2000
2011	197.8150
2012	214.4567
2013	233.9725
2014	263.4925
2015	292.8617
2016	309.8108
2017	349.1550
2018	411.8717
2019	492.3342
2020	560.5175
2021	696.5883
2022	1293.1833
2023	2144.2950

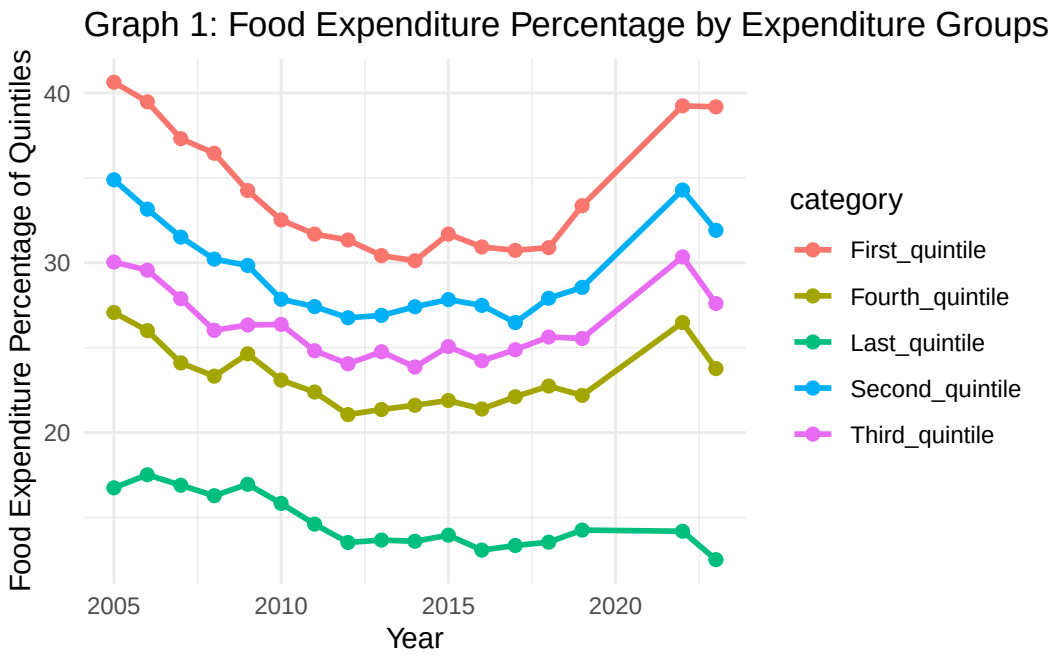
3. Analysis

The analysis part of the project consists of 3 subheadings. There are fundamental explanations and demonstrations of datasets' analysis. The plots comparing the CPI within years, expenditure group behaviors, and food expenditure rates relative to the food CPI values are used to visualize.

3.1 Exploratory Data Analysis

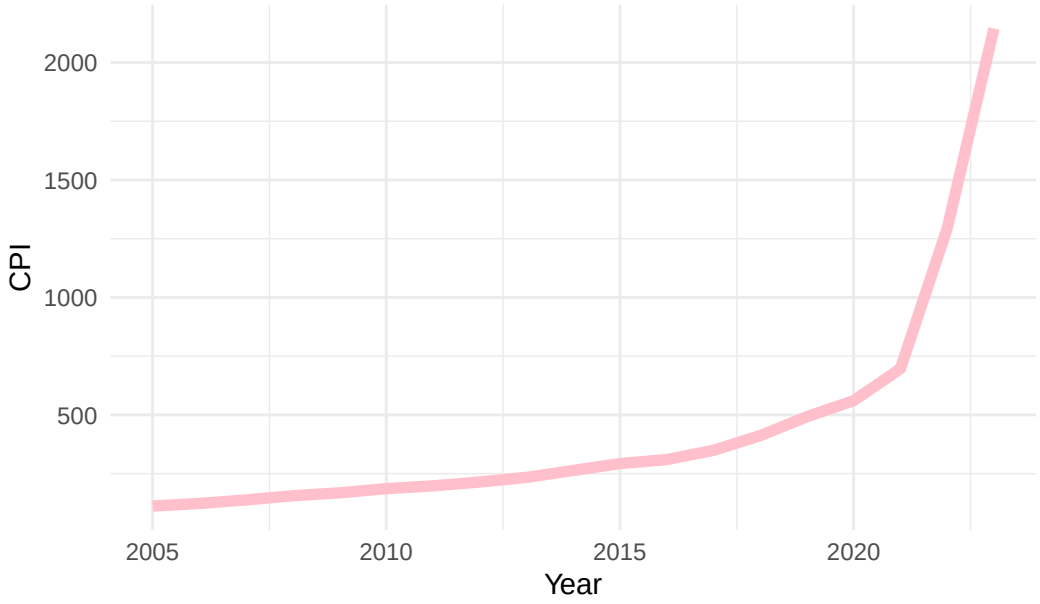
After the preprocessing phase, looking at the graphical reflection of the updated data is a good start for analysis. Initial plotting is done separately to have a general understanding of what the datasets say. As a general conjecture, people with the lowest income level naturally are the ones who spend the least. It is quite obvious that in Graph 1, the fewer people have money to spend less the greater the percentage of their money is spent on food. People who spend very little spend at least one-third of their money on food. This demonstrates that this part of society does not have much to spend on more than the fundamentals, like food and housing. Their major concern is to access food.

Another crucial point is as follows. The food expenditure level has not been more than 15% of the total expenditure amount for the people belonging to the last quintile. However, this much expenditure might be so close to or even more than the other quintiles. This shows how the spending trend changes by the total expenditure of people.



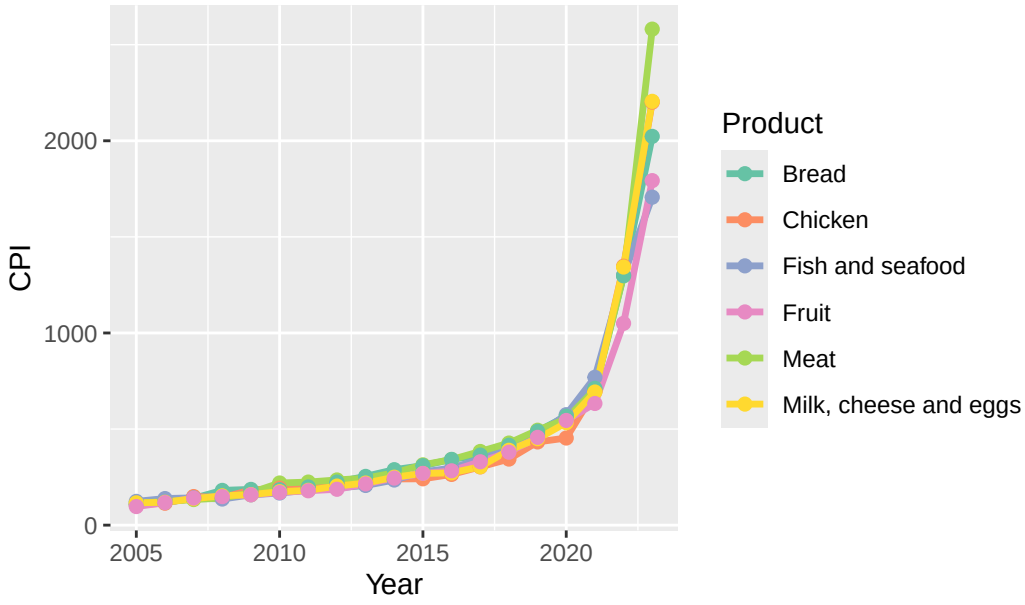
The food CPI value has been increasing from 2005 with an increasing slope over the years, as shown in Graph 2.

Graph 2 : Change in Food CPI Over the Years



On the other hand, the quality food CPI shows the same behavior. Here, high quality phrase is used for food containing high protein like meat, which is hard to access for people with a low income level.

Graph 3 : Change in High Nutritious Food CPI Over the Years



3.2 Multiple Linear Regression

To analyze the impact of a change in the CPI of food, the multiple linear regression (MLR) technique is used. The reason why MLR is preferred rather than linear regression is that there are different expenditure groups in this study, and it is aimed to see the influence of CPI change on these groups separately.

The two processed datasets are merged before starting the analysis. After investigating the output below, the value at the intercept of CPI_of_food and Estimate, which is 0.00094, shows that people in the first quintile spend their money with more percentage as CPI increases. On the other hand, other coefficient values, which are all negative, are statistical evidence that other quintiles spend a smaller percentage of their money on food. Different outputs also show that all quintile groups have different characteristics and react differently to changes in CPI.

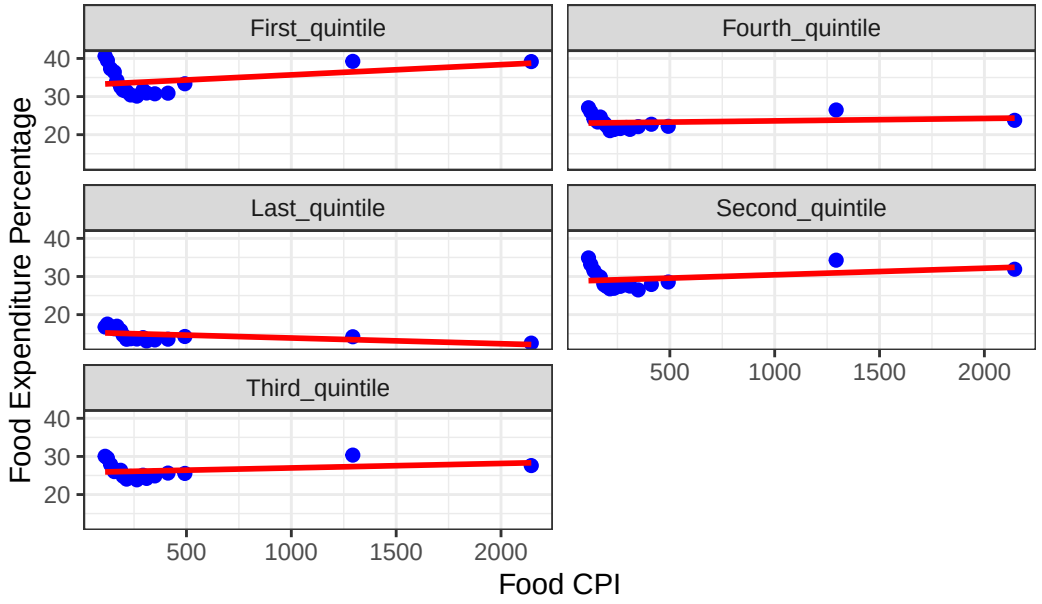
```
Call:
lm(formula = Food_Spending ~ CPI_of_food + Quintile, data = df_long)

Coefficients:
            (Intercept)              CPI_of_food  QuintileFourth_quintile
              33.737206                 0.000944                -10.882537
  QuintileLast_quintile  QuintileSecond_quintile   QuintileThird_quintile
             -19.392117                -4.695462                 -7.836493
```

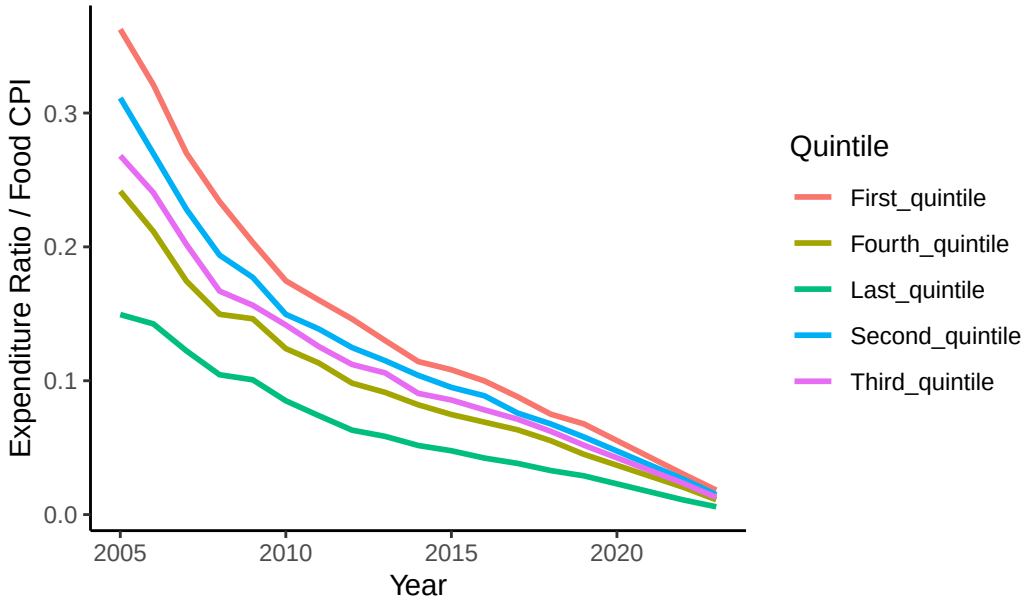
3.3 Trend and Elasticity Analysis

In Graph 4, the slope of the red lines represents the reaction of quantiles to the change in CPI. There are big gaps in the graphs. The reason why there are big gaps in the graphs is that after 2020, when the food CPI value is around 560, the values increase dramatically due to the country's political and economic status. It starts to nearly double each year after 2021.

Graph 4: Food Expenditure Percentage and Food CPI Relation



Graph 5: Normalized Expenditure Ratios by Food CPI



In addition, it can be observed that the ratio of food expenditure/food CPI ratio of quantiles gets closer to each other over the years according to Graph 5. What this means is that the decrease in the ratios points lower ability to purchase. Moreover, the first few quantiles have a much more dramatic decrease in their ratio. This is a sign of their more intense vulnerability

against the rise of food CPI.

How food expenditure percentage changes by a 1% increase in CPI of food is a measure of the **elasticity of the expenditure groups**. After conducting the analysis, it is observed that the groups have elasticity around 0, slightly more or less. This tells that any expenditure group cannot directly respond to the change of CPI since there is no substitution of food. Moreover, the first quintile seems to be the one that suffers the most from the increase in CPI of food, according to the results obtained so far. Nevertheless, the response to the change is similar for different expenditure levels of groups in Turkey.

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Food CPI Elasticity of Food Expenditure (First_quintile): 0.012

Food CPI Elasticity of Food Expenditure (Second_quintile): 0.01

Food CPI Elasticity of Food Expenditure (Third_quintile): 0.007

Food CPI Elasticity of Food Expenditure (Fourth_quintile): -0.004

Food CPI Elasticity of Food Expenditure (Last_quintile): -0.095
```

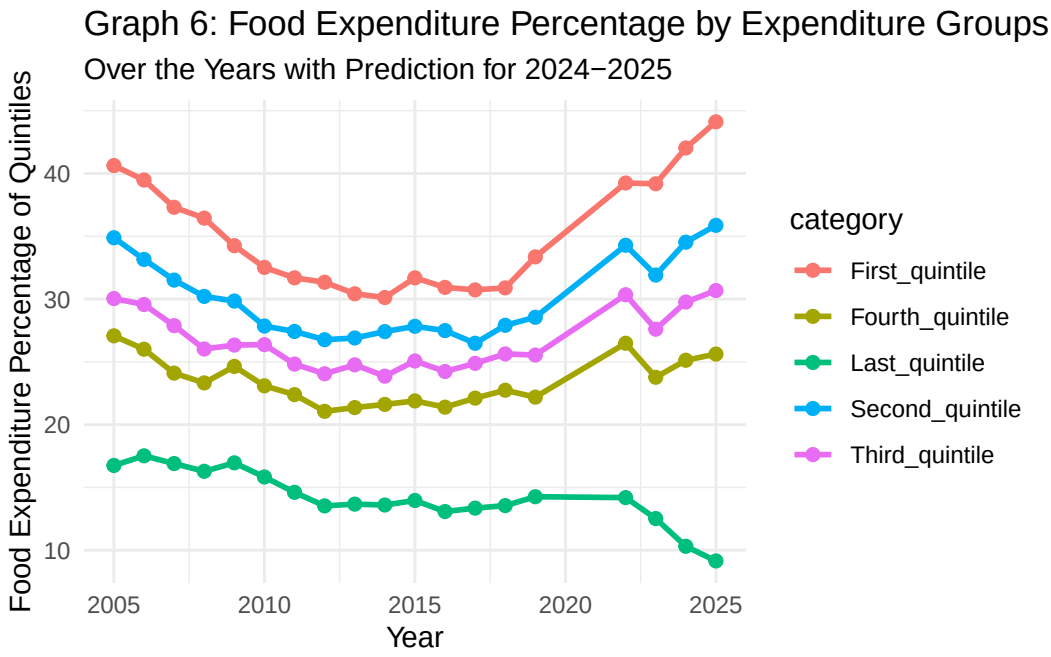
3.4 Expenditure Percentage Prediction for 2024-2025

To predict the future food expenditure percentages, regression analysis and the *predict* function of R are used. The CPI values for food are derived from the raw data, where rows from 2024 and 2025 were removed at the beginning of the project. According to these CPI values, the expenditure percentage for food is predicted for each quintile. The results are shown in Table 4.

Table 4: Table 4: Expenditure Percentage Prediction of Quintiles (2024-2025)

Year	First_quintile	Second_quintile	Third_quintile	Fourth_quintile	Last_quintile
2024	42.03211	34.52911	29.76349	25.12559	10.31143
2025	44.11366	35.87105	30.67744	25.62017	9.14512

After taking a look a Table 4 and plotting Graph 6 of updated COCT data, we can see that predictions for 2024 and 2025 are quite straightforward. However, it gives an idea of how and in which way the change occurs. In this case, food expenditure percentage increases for all the quintiles except the last (fifth) quintile. It might be a correct prediction at least in terms of the direction of the graph. There is no data to validate this in the CPI dataset.



4. Results and Key Takeaways

Not just high levels of inflation but also the concern about the effort to access food is one of the major and recent agendas in Turkey. This study tries to shed light on the food aspect of inflation's impact on people's expenditure attitudes with different expenditure levels. Two datasets are used for analysis, visualization, and inference. It is not all about the numbers since inflation does not affect every person in the same way.

This study created the main key takeaways as listed in the following:

- People spending the least have to spend a larger percentage of their money on food than others. For the last 20 years, more than one-third of their money has been spent on food.
- An increase in CPI of food leads to an increase in the percentage spent on food of the first quintile the most. Namely, it affects the lowest income group the most.
- Any expenditure group cannot directly respond to the change in CPI since there is no substitution of food. Therefore, their food expenditure elasticity is very low.

Even though it is known that Turkey suffers from high consumer price index values and relatively high inflation rates, a deeper resolution of the impact should be investigated. The study aims to encourage the authorities to take a deep look at the impact on people's lives and take action accordingly. Isn't this what the government must do for the citizens after all?

*ChatGPT was utilized for certain code blocks.