

Evaluating the Big Mac Index as a Predictor for Inflation

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2023-03-27

Abstract

The Big Mac index is used traditionally in economic studies as a metric for determining whether the exchange rate between two countries is reflective of their real purchasing power. The aim of this paper is to evaluate the Big Mac Index as a predictor of the inflation rate within a currency's economy. The Big Mac prices and inflation rate of Canada, the United Kingdom, and Japan between 2000 and 2022 are analyzed using Pearson's R and a linear regression model. From this analysis we conclude that despite a weak to moderately strong correlation between the Big Mac Index and inflation in a given year, the rise of Big Mac prices is not a good predictor of inflation within a single, isolated economy.

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1 Introduction

The Big Mac Index (BMI) was introduced by *The Economist* in 1986 as an informal means of measuring purchasing power parity (PPP) between currencies. Mathematically, the BMI is the price ratio of Big Macs between two countries. The index provided a more tangible method of determining the difference between the real purchasing power between two countries that exchange rate alone may not reflect. Although the BMI is an informal measurement, its application is rooted in PPP theory which states that the exchange rate between two currencies is proportional to the ratio of price levels in their respective countries. The use of the Big Mac as a tool for economic analysis was subsequently coined the term ‘Burgernomics’. Discrepancies between the BMI and the exchange rate of two countries suggests that one currency is overvalued (or undervalued) compared to the other. Since its conception in 1986, the BMI has been written about and evaluated extensively by economists, academics, and journalists for its strengths and limitations as a measure for real exchange rates between two currencies.¹ Since the evaluation of the BMI as a measure of PPP has taken the spotlight, there is a limited amount of literature that discusses the use of Burgernomics as a predictor for inflation rate within a country. The inflation rate measures the price changes in a predetermined basket of goods in a given economy and is meant to reflect changes in consumer purchasing power from year to year. This paper extends the use of the BMI as a validator of exchange rates between two currencies to a validator of reported inflation rates of a currency between two periods in time.

In this paper we examine the differences between the inflation rate and the changes in the price of Big Macs in three countries: Canada, Japan, and the United Kingdom between 2000 - 2022. By examining differences between the inflation rate of Big Macs (which will be the Big Mac Index in the context of this paper) and the reported inflation rates of each country, we hope to determine whether the BMI can be an accurate predictor of the inflation rate, and whether reported inflation rates reflect the real changes in purchasing power from one year to the next within a country’s borders. To evaluate our findings, we propose the following hypotheses:

Null Hypothesis: The Big Mac Index is not an accurate predictor of the inflation rate.

Alternative Hypothesis: The Big Mac Index is an accurate predictor of the inflation rate.

In section 2 we discuss: the source of the Big Mac and inflation data, how the BMI is calculated, how local currencies are calculated, the strengths and limitations of our source and methodology for analysis, and assumptions we made prior to analysis. In this section, we also provide summaries of our datasets. In section 4 we show the results from evaluating Pearson’s R and the linear regression of each country. Section 5 discusses the implications that the results in section 4 means for our hypotheses and the broader economic context.

2 Data

2.1 Sources

The price of Big Macs in local currencies is sourced from data provided by the *The Economist*² and the exchange rate used to calculate the price of Big Macs in U.S. Dollars (USD) is provided by *Reuters*.³ The CSV file that combines this data was downloaded from a GitHub repository.⁴ We also added to the dataset by calculating the BMI, the price of Big Macs in USD, and the inflation rate in a given year. The Big Mac Index was calculated by finding the percentage change difference of prices in the local currency from one year to the next. USD prices of Big Macs which was calculated by dividing the price of Big Macs in the local currency by the reported exchange rates during the given year. The inflation rate of Canada was sourced

¹Kenneth W. Celements and Seah (2012)

²Economist (2023)

³Reuters (2022)

⁴futuraprime (2022)

from the Bank of Canada’s website.⁵ The inflation rate of the United Kingdom was sourced from the Office for National Statistics⁶ and the inflation rate of Japan was sourced from macrotrends.⁷

2.2 Limitations

A limitation of our dataset is the small subset of countries used. Our analysis is only focused around three countries: Canada, the United Kingdom, and Japan. This leads to the possibility of bias in our findings and limits the validity of our results in the broader context, as they may not apply to countries outside of this sample set. Future studies could utilize datasets with a wider range of countries to more accurately represent global economic conditions.

Another limitation of our dataset is the possibility of human error in calculations. Variables in our dataset such as the Big Mac Index (BMI), the price of Big Macs in USD, and the inflation rate in a given year are calculated by ourselves. A single error in our calculations significantly impacts the results of our study and compromises the integrity of our analysis. Although we cross checked our calculations to ensure accuracy, human error cannot be entirely eliminated. Thus, our study’s findings must be interpreted with caution.

2.3 Strengths

A strength of our dataset is that the data used are derived from credible sources. We sourced each respective country’s inflation rates from reputable sources such as the Bank of Canada, Macrotrends, and the Office of National Statistics, which are widely used within academia and government organizations. The Economist and Thomson Reuters, where we sourced the price of Big Macs and exchange rates, are also well-known sources for economic and financial analysis. By using credible sources, we minimized the risk of errors and inaccuracies in our analysis.

2.4 Overview of Data

2.4.1 Summary of Canadian data

```
##      name          iso_a3      currency_code      local_price
## Length:23      Length:23      Length:23      Min.      :2.850
## Class :character Class :character Class :character 1st Qu.:3.425
## Mode  :character Mode  :character Mode  :character Median :4.730
##                                     Mean  :4.844
##                                     3rd Qu.:5.985
##                                     Max.   :6.880
##
##      dollar_ex      GDP_dollar      GDP_local      date
## Min.      :0.9458      Min.      :22341      Min.      :33191      Min.      :2000-04-01
## 1st Qu.:1.0637      1st Qu.:34308      1st Qu.:43007      1st Qu.:2005-11-15
## Median :1.2823      Median :43626      Median :49912      Median :2011-07-01
## Mean    :1.2417      Mean    :40903      Mean    :49608      Mean    :2011-06-06
## 3rd Qu.:1.3341      3rd Qu.:47201      3rd Qu.:56274      3rd Qu.:2016-12-30
## Max.    :1.5700      Max.    :52744      Max.    :65300      Max.    :2022-07-01
##
##      big_mac_index      inflation_rate
## Min.      : -4.890      Min.      : -0.900
## 1st Qu.: 0.000      1st Qu.: 1.300
```

⁵Canada (2023)

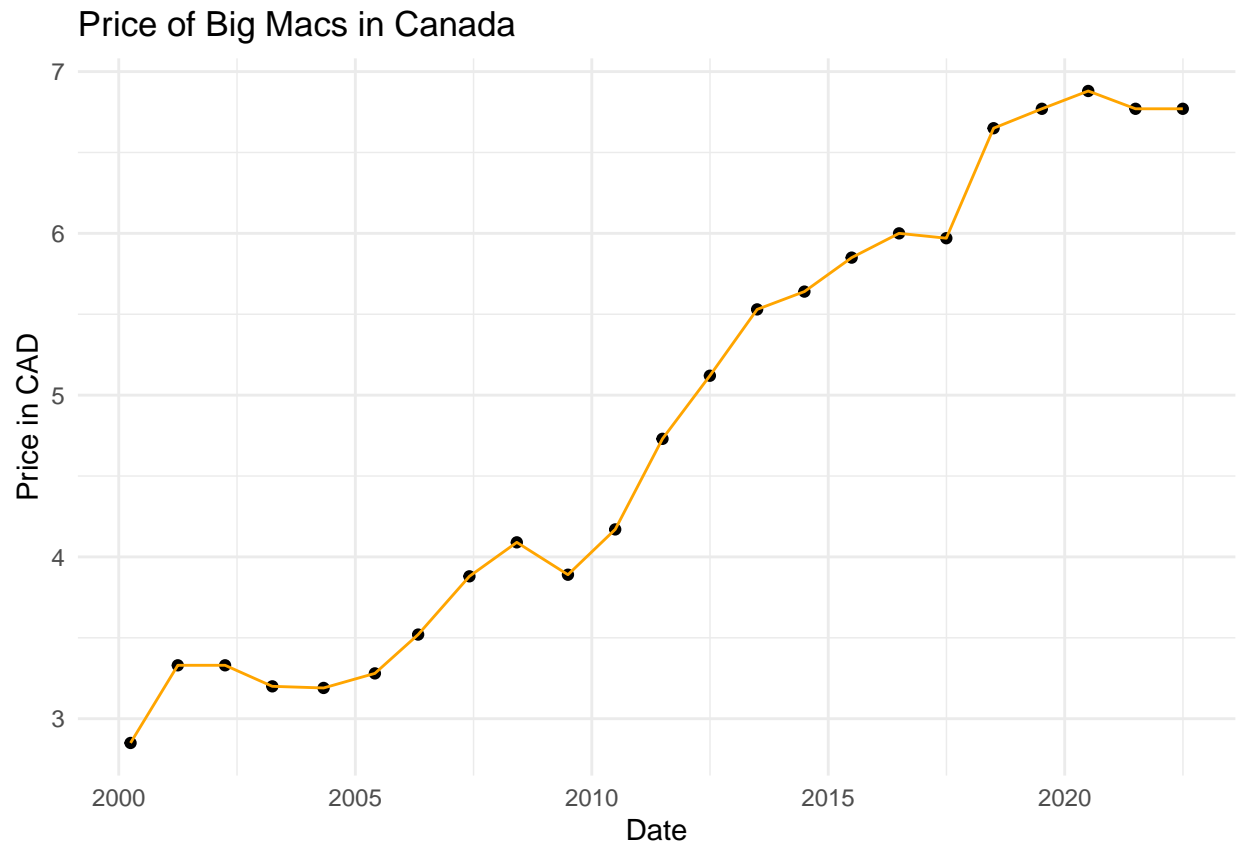
⁶National Statistics (2023)

⁷macrotrends (2023)

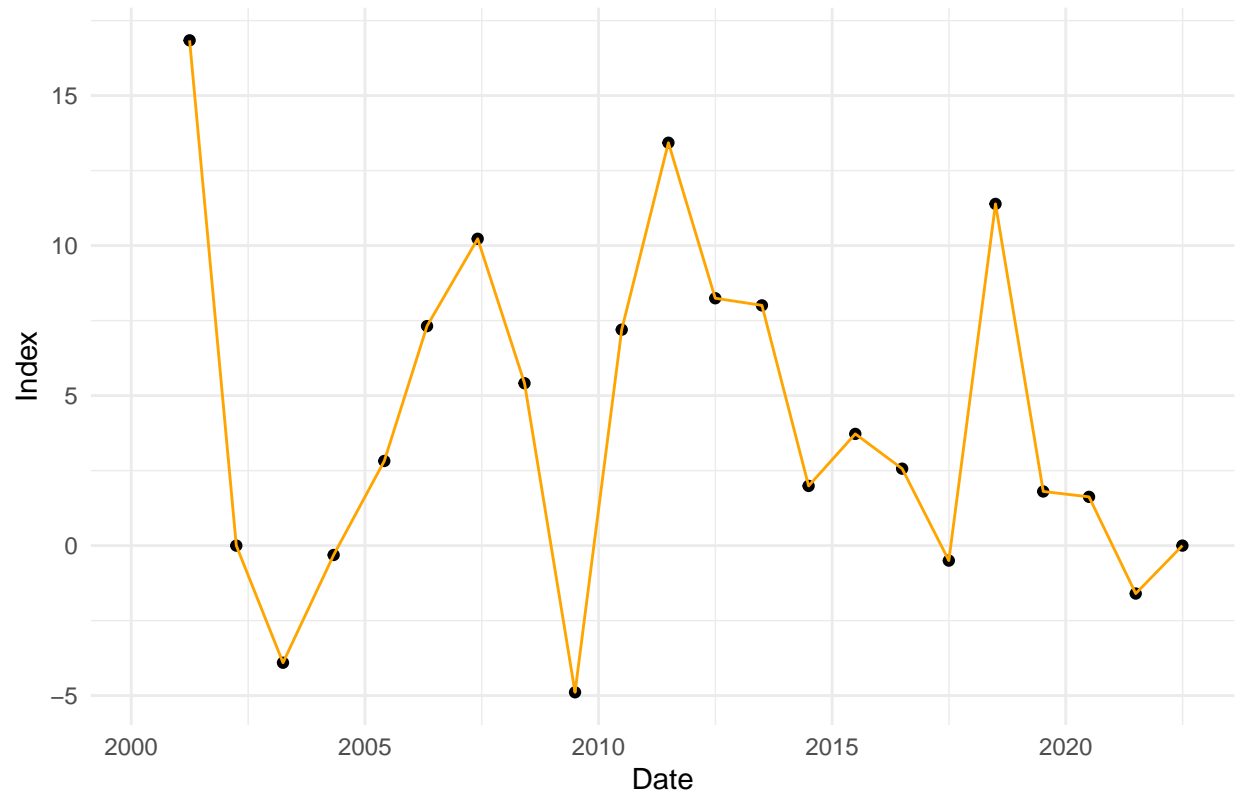
```
## Median : 2.693   Median : 2.050
## Mean   : 4.154   Mean   : 2.218
## 3rd Qu.: 7.835   3rd Qu.: 2.875
## Max.   :16.842   Max.   : 7.600
## NA's   :1        NA's   :1
```

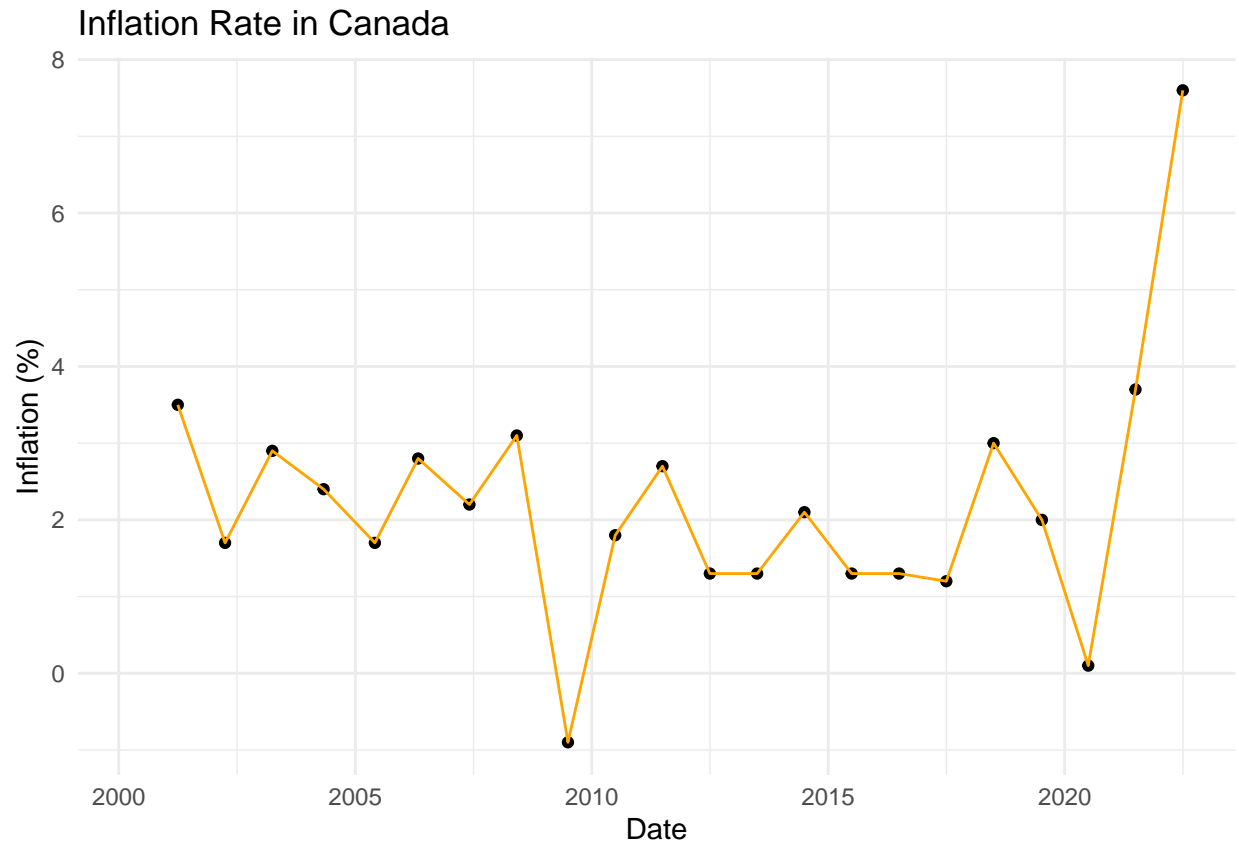
Top 10 rows of Canadian data

local_price	big_mac_index	inflation_rate	date
2.85	NA	NA	2000-04-01
3.33	16.842105	3.5	2001-04-01
3.33	0.000000	1.7	2002-04-01
3.20	-3.903904	2.9	2003-04-01
3.19	-0.312500	2.4	2004-05-01
3.28	2.821317	1.7	2005-06-01



Big Mac Index in Canada





2.4.2 Summary of British data

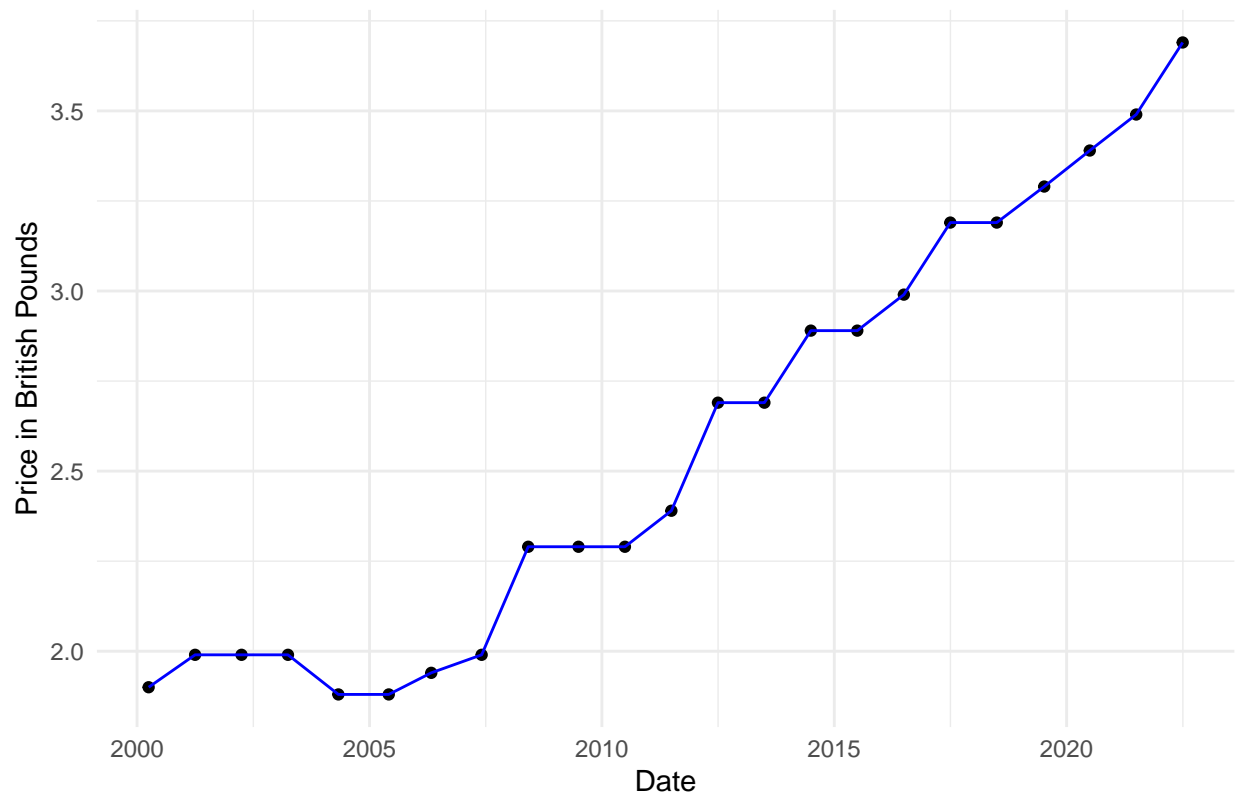
```
##      name                iso_a3      currency_code      local_price
## Length:23              Length:23      Length:23          Min.   :1.880
## Class :character       Class :character Class :character  1st Qu.:1.990
## Mode  :character       Mode  :character Mode  :character  Median :2.390
##                                     Mean   :2.574
##                                     3rd Qu.:3.090
##                                     Max.   :3.690
##
##      dollar_ex      GDP_dollar      GDP_local      date
## Min.   :0.4966      Min.   :27817      Min.   :17756      Min.   :2000-04-01
## 1st Qu.:0.6005      1st Qu.:39416      1st Qu.:22617      1st Qu.:2005-11-15
## Median :0.6463      Median :42171      Median :25860      Median :2011-07-01
## Mean   :0.6597      Mean   :40608      Mean   :26251      Mean   :2011-06-06
## 3rd Qu.:0.7443      3rd Qu.:44245      3rd Qu.:30221      3rd Qu.:2016-12-30
## Max.   :0.8311      Max.   :50676      Max.   :34311      Max.   :2022-07-01
##
##      big_mac_index      inflation_rate
## Min.   : -5.528      Min.   :0.500
## 1st Qu.: 0.000      1st Qu.:1.525
## Median : 2.995      Median :2.050
## Mean   : 3.155      Mean   :2.323
## 3rd Qu.: 4.644      3rd Qu.:2.475
## Max.   :15.075      Max.   :8.800
```

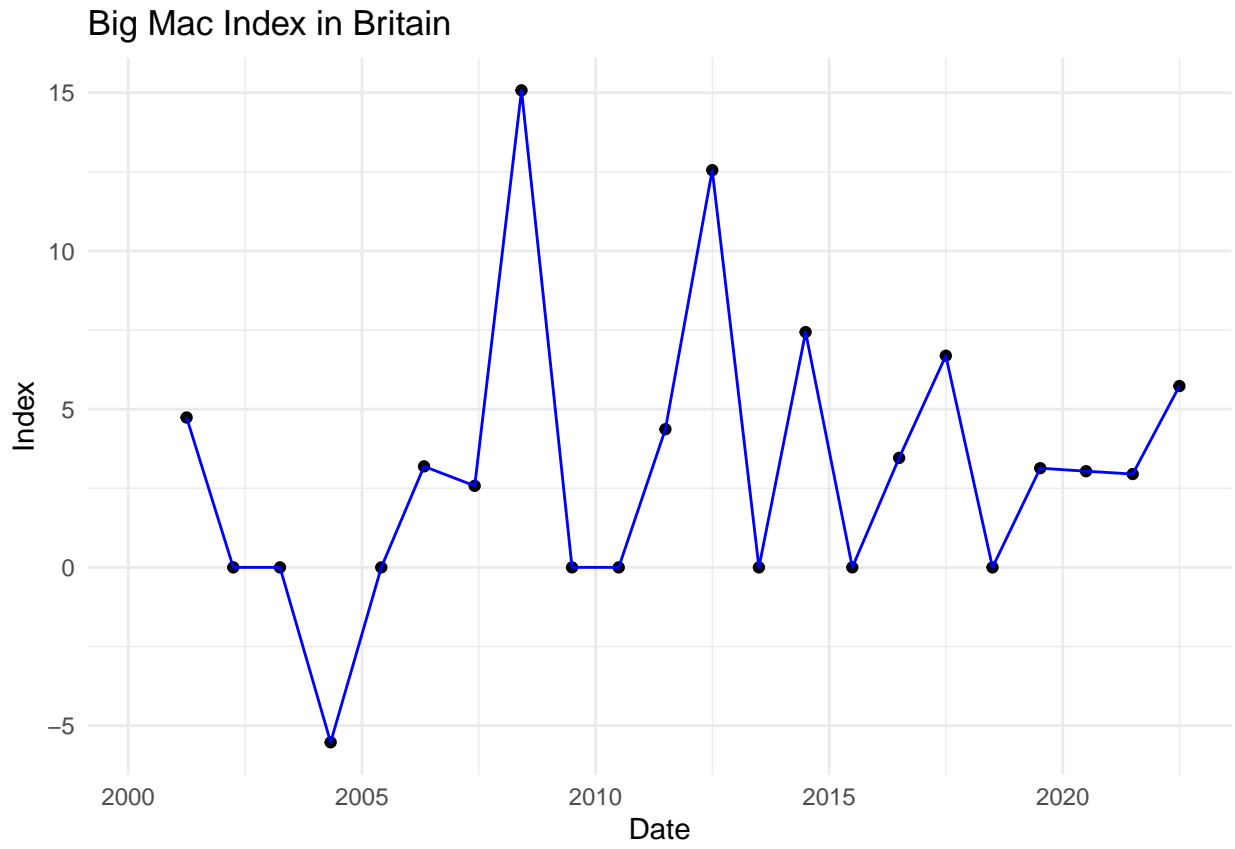
```
## NA's :1      NA's :1
```

Top 10 rows of British data

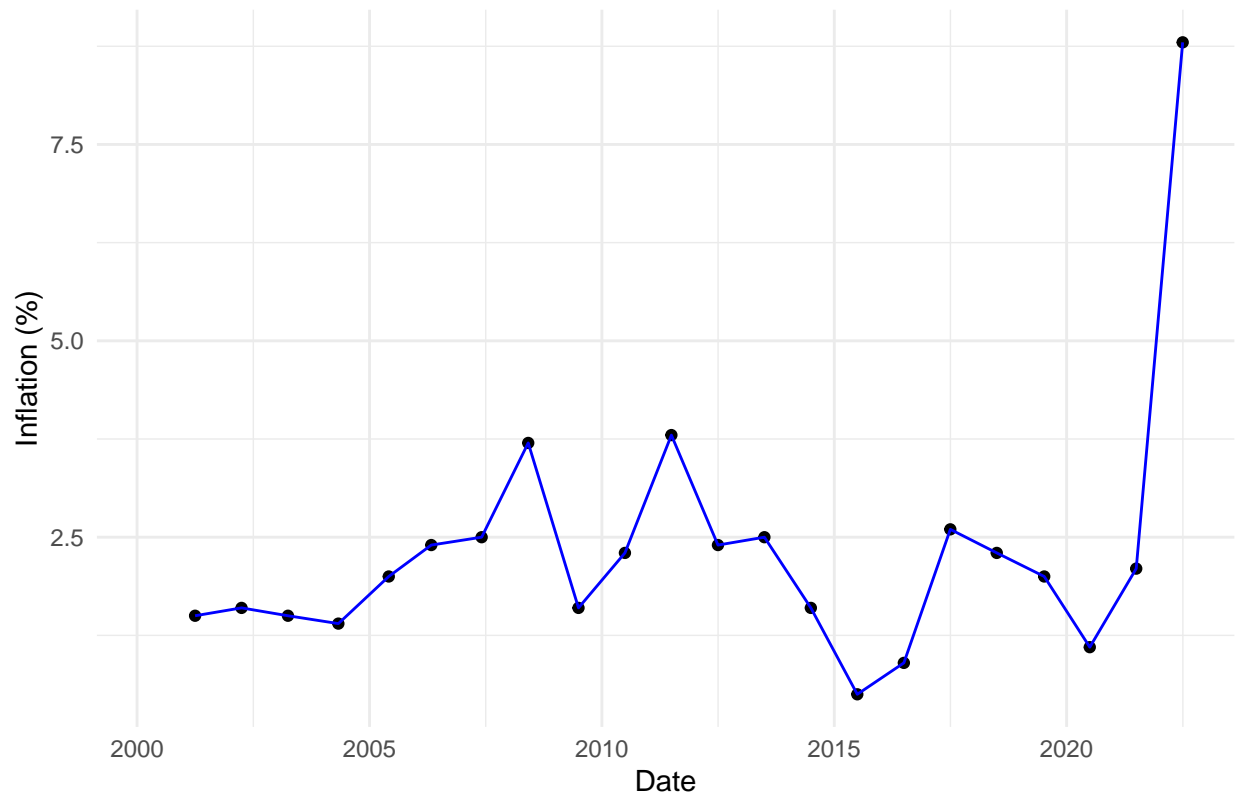
local_price	big_mac_index	inflation_rate	date
1.90	NA	NA	2000-04-01
1.99	4.736842	1.5	2001-04-01
1.99	0.000000	1.6	2002-04-01
1.99	0.000000	1.5	2003-04-01
1.88	-5.527638	1.4	2004-05-01
1.88	0.000000	2.0	2005-06-01

Price of Big Macs in Britain





Inflation Rate in Britain



2.4.3 Summary of Japanese data

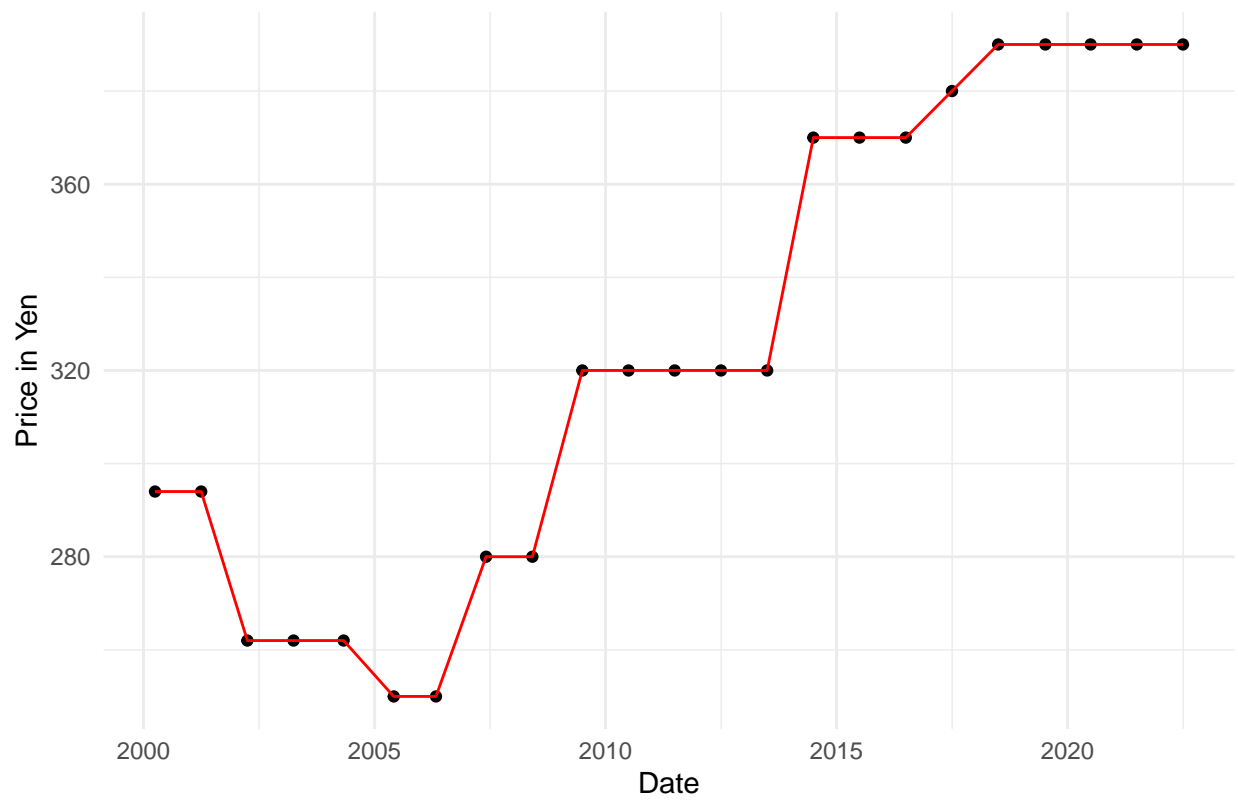
```
##      name            iso_a3      currency_code      local_price
## Length:23          Length:23      Length:23          Min.    :250
## Class :character    Class :character  Class :character  1st Qu.:280
## Mode  :character    Mode  :character  Mode  :character  Median :320
##                                     Mean   :325
##                                     3rd Qu.:375
##                                     Max.   :390
##
##      dollar_ex      GDP_dollar      GDP_local      date
## Min.    : 78.22    Min.    :32832    Min.    :3880330    Min.    :2000-04-01
## 1st Qu.:103.77    1st Qu.:36322    1st Qu.:4093258    1st Qu.:2005-11-15
## Median :108.77    Median :39173    Median :4171596    Median :2011-07-01
## Mean   :108.60    Mean   :39285    Mean   :4160551    Mean   :2011-06-06
## 3rd Qu.:116.53    3rd Qu.:40320    3rd Qu.:4256717    3rd Qu.:2016-12-30
## Max.   :137.87    Max.   :49175    Max.   :4424718    Max.   :2022-07-01
##
##      big_mac_index      inflation_rate
## Min.    : -10.884    Min.    : -1.3500
## 1st Qu.:  0.000    1st Qu.: -0.2675
## Median :  0.000    Median : -0.0150
## Mean   :  1.445    Mean   :  0.2295
## 3rd Qu.:  0.000    3rd Qu.:  0.4775
## Max.   : 15.625    Max.   :  2.7600
```

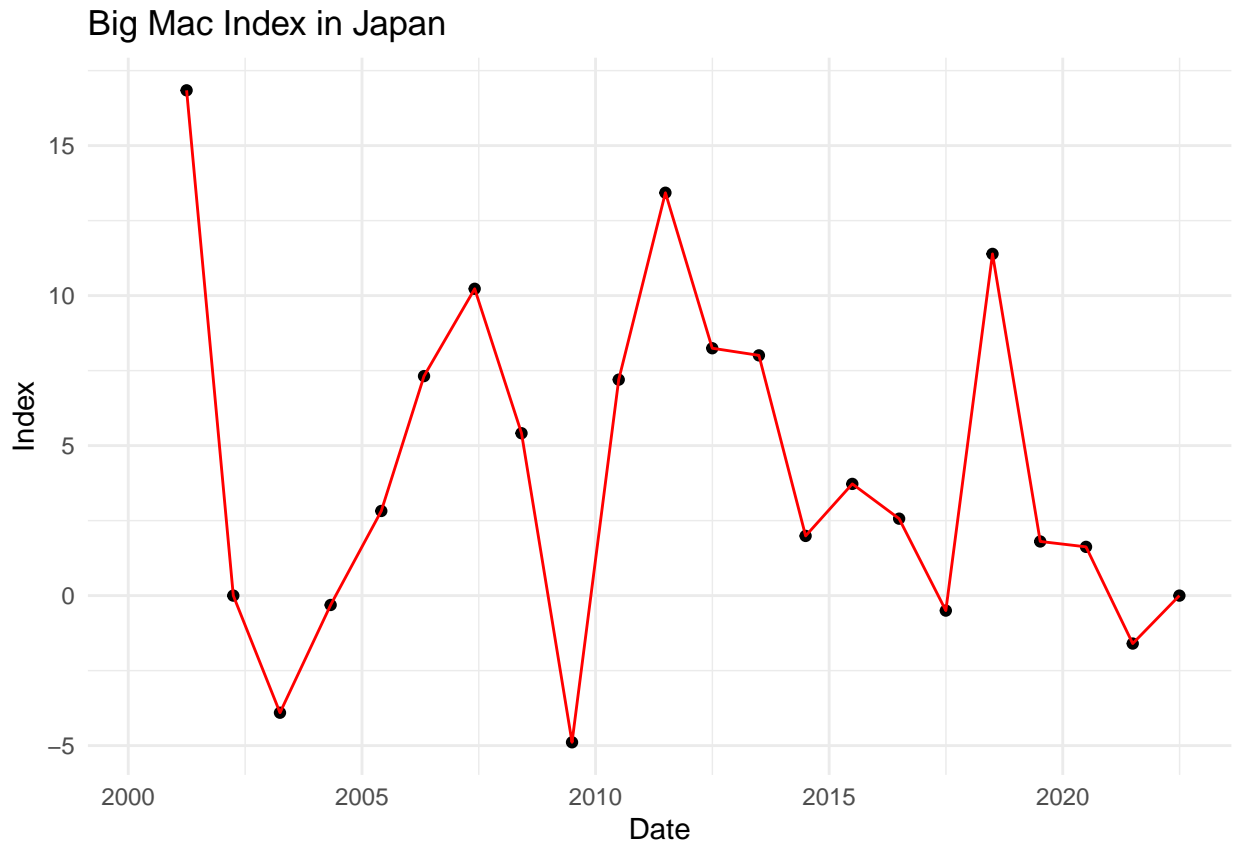
NA's :1 NA's :1

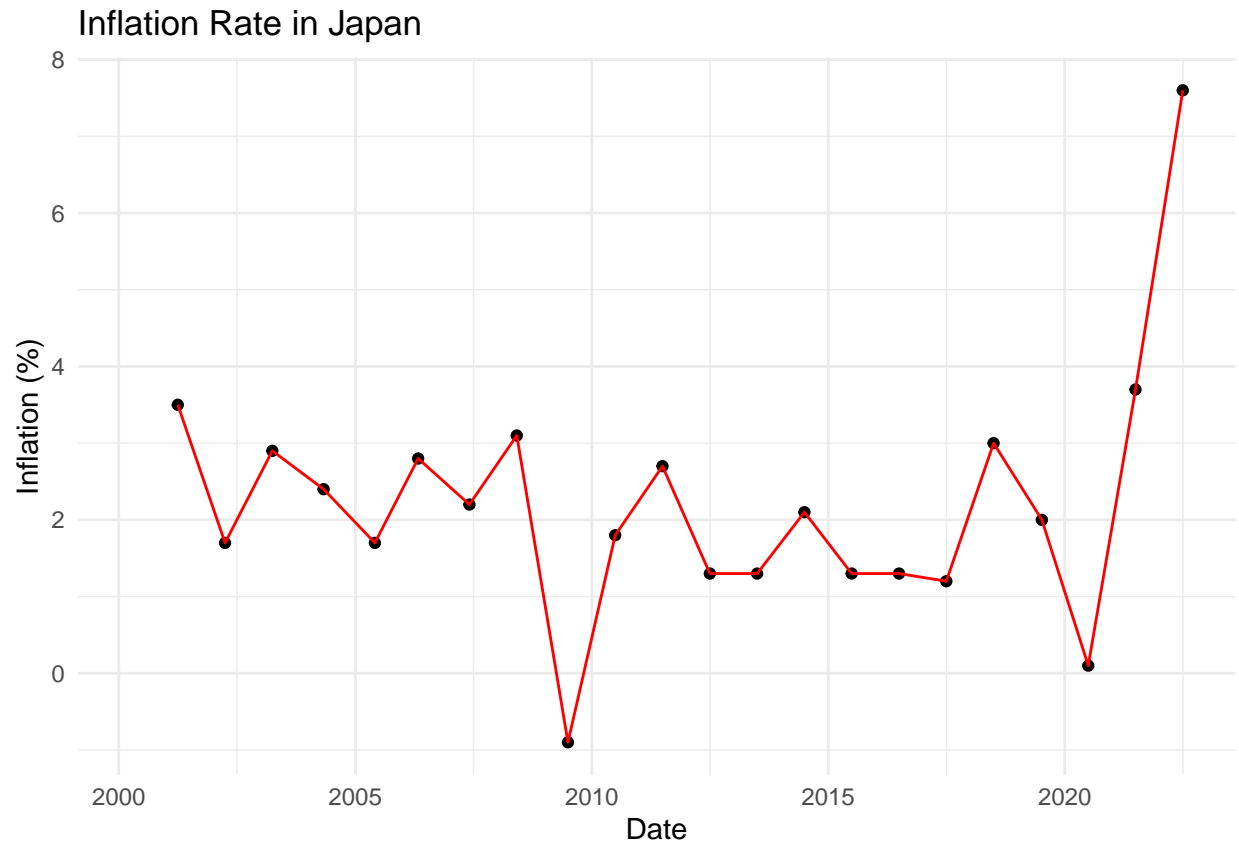
Top 10 rows of Japanese data

local_price	big_mac_index	inflation_rate	date
294	NA	NA	2000-04-01
294	0.000000	-0.74	2001-04-01
262	-10.884354	-0.92	2002-04-01
262	0.000000	-0.26	2003-04-01
262	0.000000	-0.01	2004-05-01
250	-4.580153	-0.28	2005-06-01

Price of Big Macs in Japan





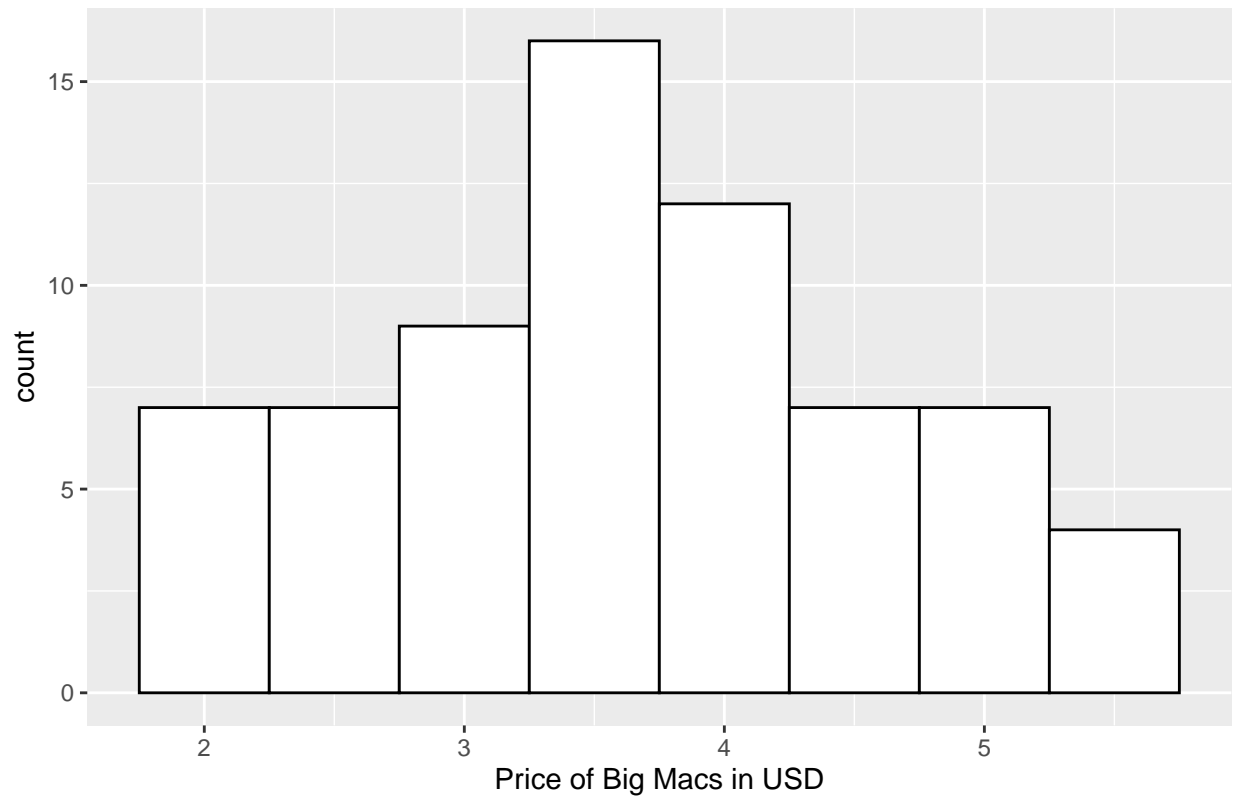


2.4.4 Summary of Combined data:

```
##      name                iso_a3      currency_code      local_price
## Length:69              Length:69      Length:69          Min.   :  1.88
## Class :character        Class :character  Class :character    1st Qu.:  2.99
## Mode  :character        Mode  :character  Mode  :character    Median :  4.73
##                                     Mean   :110.79
##                                     3rd Qu.:280.00
##                                     Max.   :390.00
##
##      dollar_ex      dollar_price      GDP_dollar      GDP_local
## Min.   :  0.4966    Min.   :1.939    Min.   :22341    Min.   : 17756
## 1st Qu.:  0.7539    1st Qu.:2.885    1st Qu.:36440    1st Qu.: 30719
## Median :  1.2823    Median :3.644    Median :40904    Median : 49912
## Mean   : 36.8333    Mean   :3.644    Mean   :40266    Mean   :1412137
## 3rd Qu.:101.5300    3rd Qu.:4.277    3rd Qu.:45136    3rd Qu.:4081287
## Max.   :137.8650    Max.   :5.314    Max.   :52744    Max.   :4424718
##
##      date                big_mac_index      inflation_rate
## Min.   :2000-04-01      Min.   : -10.8844    Min.   : -1.3500
## 1st Qu.:2005-06-01      1st Qu.:  0.0000    1st Qu.:  0.3725
## Median :2011-07-01      Median :  0.8124    Median :  1.5500
## Mean   :2011-06-06      Mean   :  2.9179    Mean   :  1.5902
## 3rd Qu.:2017-07-01      3rd Qu.:  5.2435    3rd Qu.:  2.4000
## Max.   :2022-07-01      Max.   : 16.8421    Max.   :  8.8000
```

2.5 Distributions

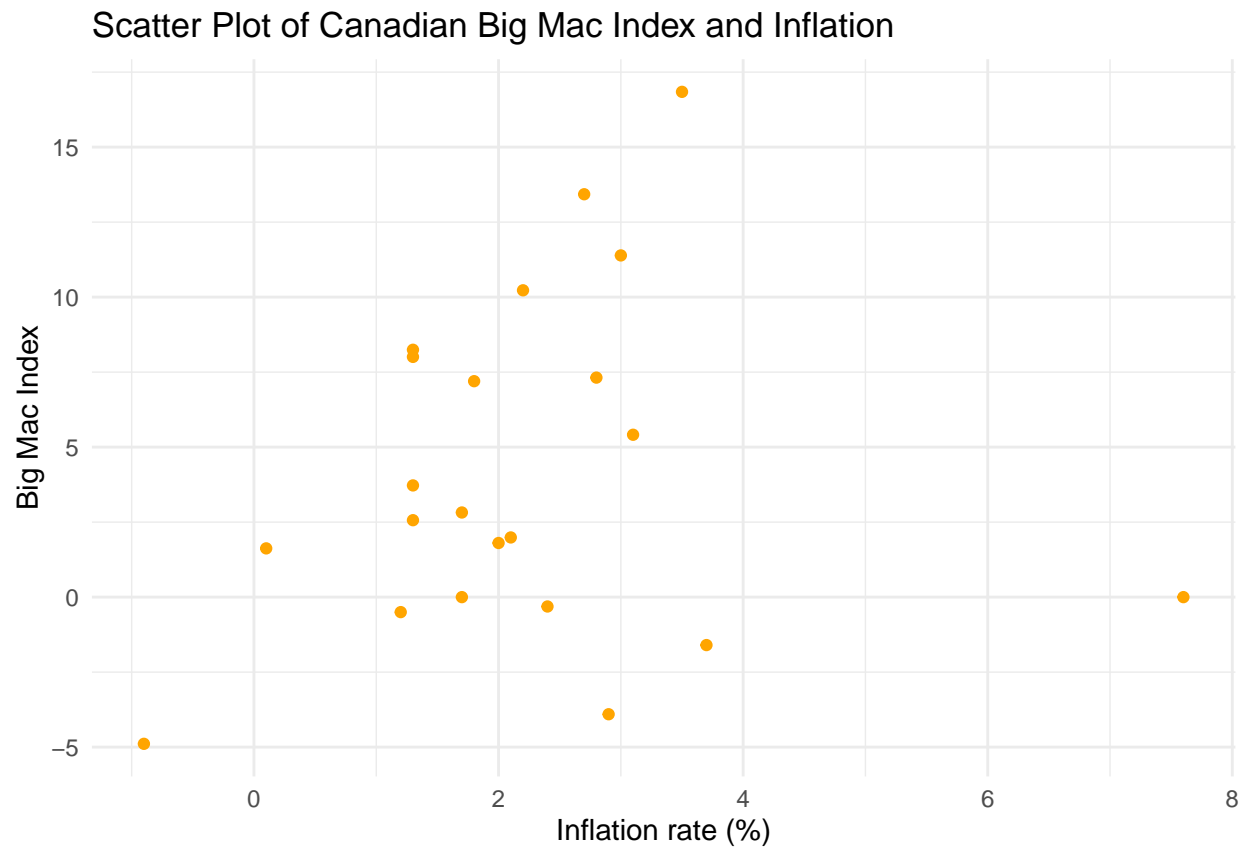
Distribution of Big Mac Prices

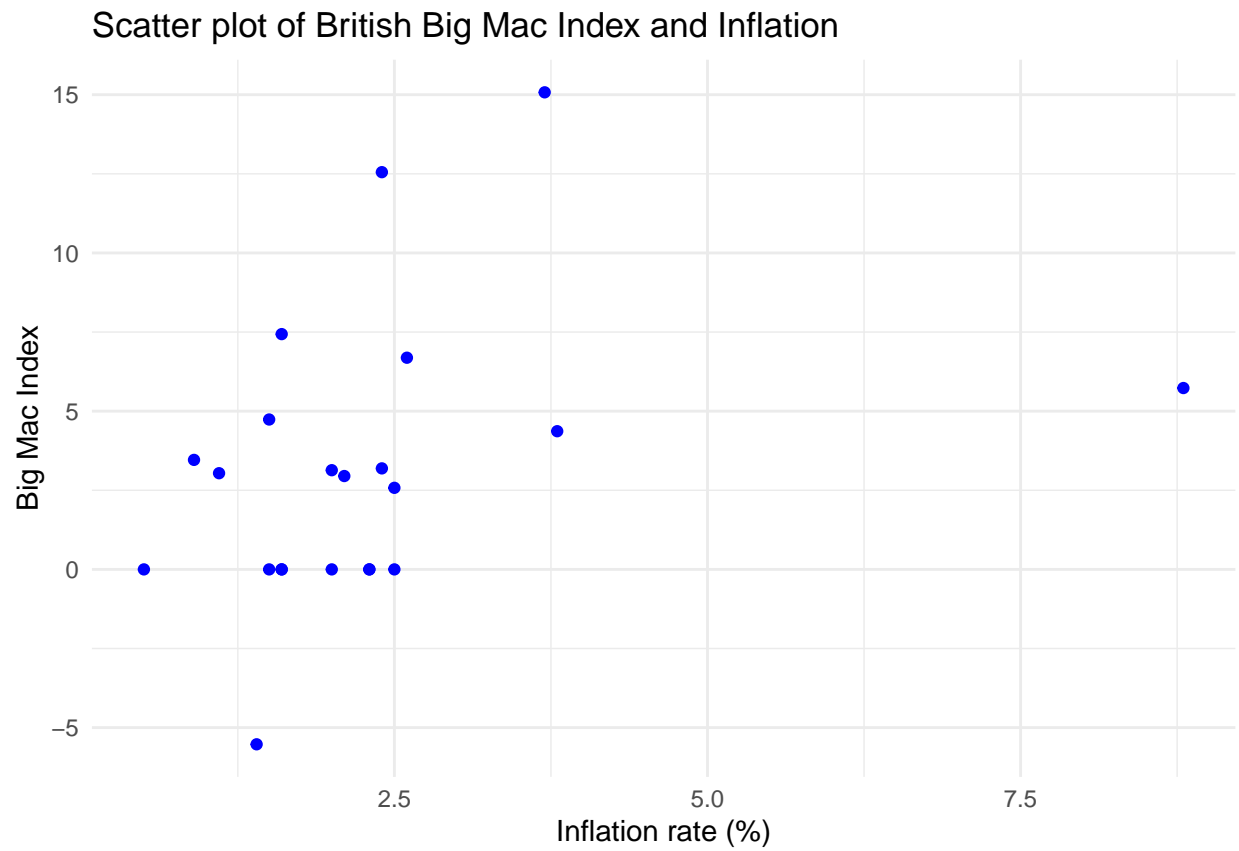


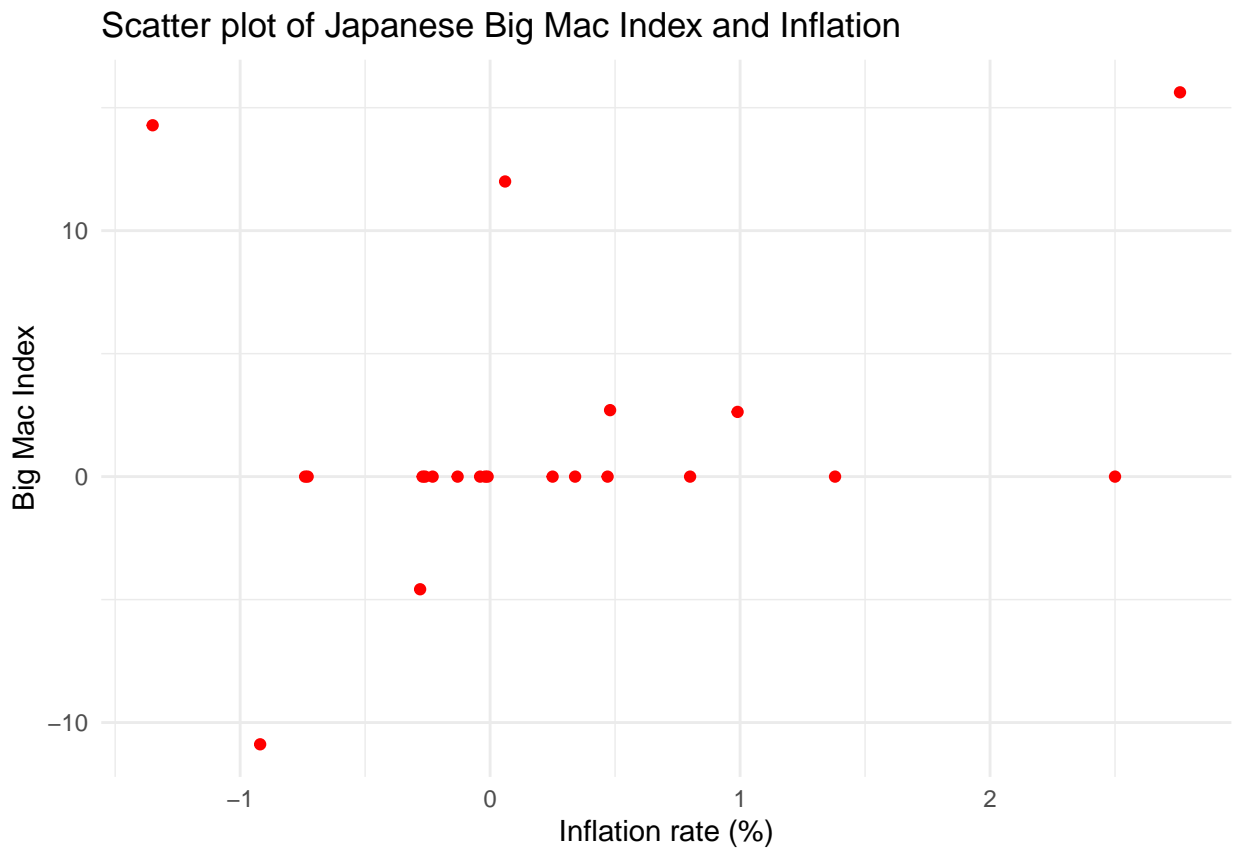
Density Curve of Big Mac Prices

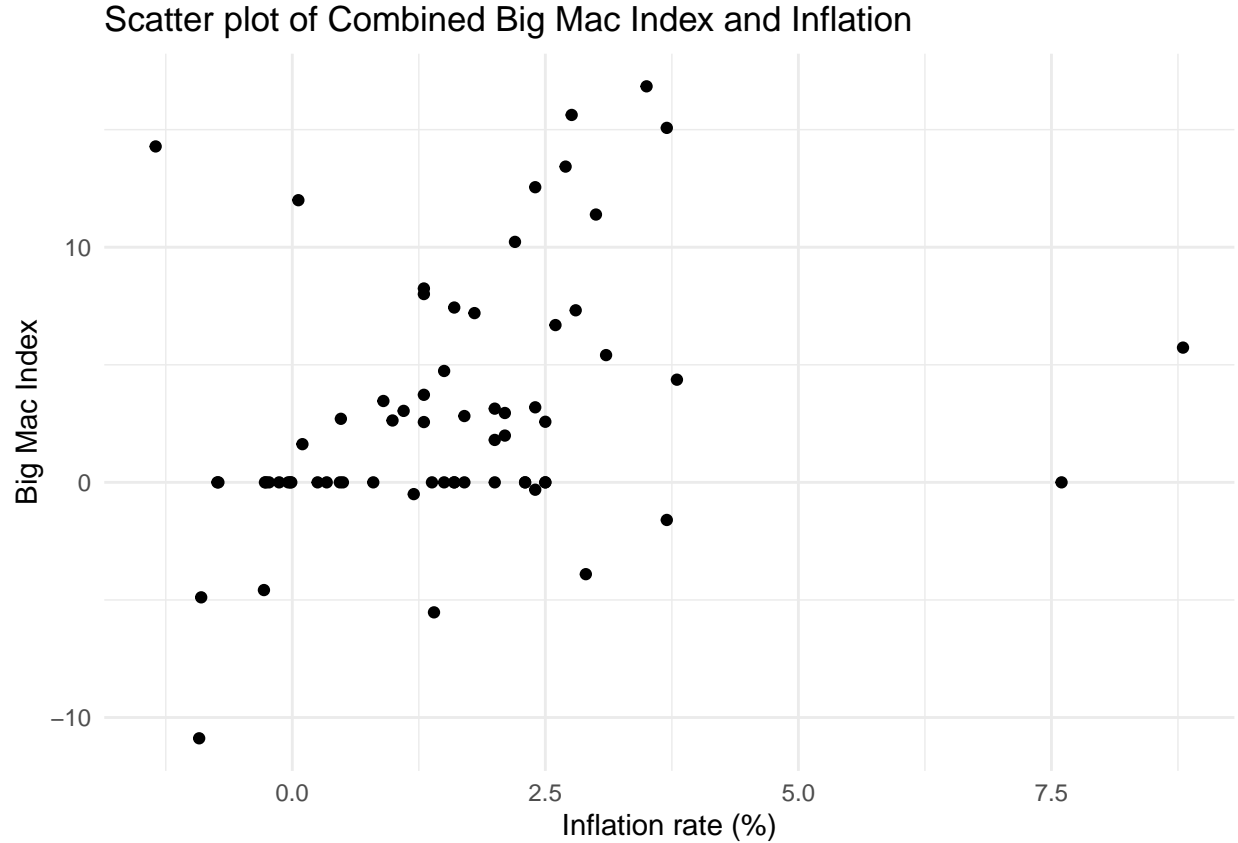


2.6 Scatterplots









3 Methodology

To conduct this analysis, the Pearson's R between the BMI and the inflation rate will be calculated for Canada, the United Kingdom, and Japan separately and combined. Pearson's R is used to measure whether there is a linear correlation between the BMI and inflation rate and ranges from -1 to +1. A Pearson's R of +1 suggests that the independent and dependent variables have a perfectly positive correlation. A Pearson's R of 0 suggests that there is no correlation between the independent and dependent variables and a Pearson's R of -1 suggests that there is a perfectly negative correlation. For this paper, the Pearson's R will be analyzed using the following scale:

R > 0.5:

Strength = Strong | Direction = Positive

0.5 > R > 0.3:

Strength = Moderate | Direction = Positive

0.3 > R > 0.0:

Strength = Weak | Direction = Positive

R = 0:

Strength = None | Direction = None

0 > R > -0.3:

Strength = Weak | Direction = Negative

-0.3 > R > -0.5:

Strength = Moderate | Direction = Negative

-0.5 > R:

Strength = Strong | Direction = Negative

In addition to Pearson's R, we are also going to use a linear regression model to determine whether

correlations established by Pearson's R is statistically significant. For the purpose of this paper, a p-value < 0.05 will classify a correlation as statistically significant while a p-value > 0.05 will classify a correlation as not statistically significant. If correlations are statistically significant, the linear regression will inform us how much inflation rate will increase per 1% increase of the BMI. A Pearson's R ≥ 0.3 and a p-value < 0.05 will lead to the rejection of the null hypothesis and acceptance of the alternative hypothesis.

4 Results

4.1 Pearson's R

Canada

```
## [1] 0.1427985
```

United Kingdom

```
## [1] 0.3418725
```

Japan

```
## [1] 0.2683515
```

Combined

```
## [1] 0.2953589
```

Linear regression for Canada

```
##
## Call:
## lm(formula = inflation_rate ~ big_mac_index, data = canada_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.7481 -0.8468 -0.1944  0.4774  5.5518
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   2.04822    0.43711   4.686 0.000142 ***
## big_mac_index  0.04091    0.06341   0.645 0.526114
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.636 on 20 degrees of freedom
## (1 observation deleted due to missingness)
## Multiple R-squared:  0.02039,    Adjusted R-squared:  -0.02859
## F-statistic: 0.4163 on 1 and 20 DF,  p-value: 0.5261
```

Linear regression for United Kingdom

```
##
## Call:
## lm(formula = inflation_rate ~ big_mac_index, data = britain_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.4608 -0.8724 -0.1806  0.2276  6.1555
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   1.92858    0.41619   4.634 0.00016 ***
## big_mac_index  0.12492    0.07679   1.627 0.11941
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.587 on 20 degrees of freedom
## (1 observation deleted due to missingness)
## Multiple R-squared:  0.1169, Adjusted R-squared:  0.07272
## F-statistic: 2.647 on 1 and 20 DF,  p-value: 0.1194
```

Linear regression for Japan

```
##
## Call:
## lm(formula = inflation_rate ~ big_mac_index, data = japan_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.1751 -0.4300 -0.1925  0.2786  2.3375
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   0.16255    0.21676   0.750  0.462
## big_mac_index  0.04638    0.03723   1.246  0.227
##
## Residual standard error: 0.9849 on 20 degrees of freedom
## (1 observation deleted due to missingness)
## Multiple R-squared:  0.07201, Adjusted R-squared:  0.02561
## F-statistic: 1.552 on 1 and 20 DF,  p-value: 0.2272
```

Linear regression for all countries combined

```
##
## Call:
## lm(formula = inflation_rate ~ big_mac_index, data = combined_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -4.0195 -1.0406 -0.0749  0.6418  6.9428
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   1.31310    0.23331   5.628 4.33e-07 ***
```

```
## big_mac_index 0.09495 0.03839 2.473 0.0161 *
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.663 on 64 degrees of freedom
## (3 observations deleted due to missingness)
## Multiple R-squared: 0.08724, Adjusted R-squared: 0.07297
## F-statistic: 6.117 on 1 and 64 DF, p-value: 0.01606
```

4.2 Canada

With a Pearson's R of approximately 0.142 between the Big Mac Index and the inflation rate, there is a weak positive correlation between the BMI and inflation rate in Canada. This weak correlation suggests that in Canada, the BMI is not a good predictor of the inflation rate. This is further reinforced by the results of the linear regression calculations which reveal a p-value of approximate 0.53 suggesting that the relationship between the BMI and inflation rate is not statistically significant in Canada.

4.3 United Kingdom

Data from the United Kingdom has similar results, however there is a stronger correlation in the U.K. than Canada. The Pearson's R value for the U.K. is approximately 0.341 which shows a moderate positive correlation between the BMI and inflation rate in Canada. However, the p-value of approximately 0.119 suggests that this correlation is not statistically significant.

4.4 Japan

The calculations for Japan once again show a weak (albeit positive) correlation between the BMI and inflation rate. The Pearson's R for Japan is approximately 0.268 while the p-value from the linear regression model is 0.227.

4.5 Combined data

Combining the data for all 3 countries, however, leads to different results. The Pearson's R for the combined data is approximately 0.295 which is close to being moderately positively correlated while the p-value from the linear regression model is 0.0161 which suggests that the correlation is statistically significant.

5 Discussion

The results from all three countries' Pearson's R and linear regression models show that the alternative hypothesis should be rejected and the null hypothesis is accepted; the Big Mac Index is **not** an accurate predictor of the inflation rate when applied within a single country's economy and currency. Although there is a weak to moderate positive correlation between the BMI and inflation rate within the three countries, the low p-values suggests that the correlation is not statistically significant enough to reject the null hypothesis. The presence of a correlation, however, also suggests that there are confounding variables that may contribute to the inflation rate and that although the BMI alone is not enough to predict the inflation rate, broadening the study to include other variables may lead to statistically significant results. The higher correlation observed by the United Kingdom compared to the Japan and Canada may be due to the difference in price weights and number of items in the consumer baskets of the respective countries. Since Big Macs are included in the CPI-basket used for measuring inflation, there will undoubtedly be some level of correlation between

the BMI and inflation. The more items are included in the CPI basket, and the less weight is put on the category Big Macs are included in for each country, the less strength the correlation will have.

The linear model for the combined data shows that for every 1% increase in the BMI, inflation goes up by approximately 0.095%. The contrasting results from evaluating the BMI in a localized context versus the international context is an interesting result that may be explained as an example of Simpson's Paradox. Simpson's Paradox describes the phenomenon where a correlation between two variables can emerge or disappear when the population is divided into subpopulations. In this case, the correlation between the BMI and inflation rate emerges when the subpopulations of BMI and inflation data between different countries are combined. A possible interpretation of this result is that although the BMI is not a good predictor of inflation in a localized context, the collective increase in the rise of Big Mac prices across the globe is a good predictor of a worldwide decrease in purchasing power across all economies (extrapolated from our 3 economies from North America, Europe, and Asia). Another possibility for this result is the conversion of local prices to USD before modelling. Since prices from Canada, the United Kingdom, and Japan were converted to USD in the combined dataset, the correlation calculations may reflect a relationship between the strength of each given country's currency against the U.S. dollar and inflation rather than the BMI and inflation. Since inflation and the value of currency are strongly correlated, as described by popular economic theory⁸, the conversion of local prices to another currency leads to distortion in the correlation and significance measures.

The statistical insignificance between the BMI and inflation rate also has implications on the effectiveness of the BMI as a measure for exchange rates between countries. Specifically, it implies that the BMI is not a useful metric for exchange rate speculators and currency investors to determine the inflation trajectory of a currency in the short-term. Currently, the BMI is used to determine (roughly) whether the exchange rate between two currencies reflects the real purchasing power in their respective economies. Changes in the price of the Big Macs in one economy may lead investors to believe that the total purchasing power of a currency is going to change. However, our study has shown that changes in the price of Big Macs is not indicative of a future change in the purchasing power of a currency.

6 Conclusion

Through the use of Pearson's R, our analysis indicates that the BMI is not a reliable predictor of inflation for Canada, Japan, and the United Kingdom, individually. For each country, our results showed that correlation between the BMI and inflation rates are fairly weak, with none being statistically significant. However, when conducting analysis for all three countries combined, the results yielded a statistically significant and slightly positive correlation. Therefore, it is possible that the BMI is a good predictor of inflation on a global scale. This is an area of research we wish to research moving forward. Our current analysis focuses on only three countries, but perhaps by including more countries we would be able to gain a better understanding on the relationship between the BMI and inflation on a global scale. Additionally, it is important to note that the countries chosen for this analysis have the highest Gross Domestic Products (GDP) in the world, which is not representative of the varying economic states of other countries. Therefore, another research venture of ours would be to explore the correlation of the BMI and inflation rates in countries with lower GDPs and then compare these results with those of countries with higher GDPs.

⁸Economic Research (2016)

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