Evaluating the Big Mac Index as a Predictor for Inflation

Marco Chau, Julia Wong, Cindy Ly

2023-03-27

Abstract

Insert abstract paragraph here.

Contents

0.0.1 Load in Big Mac and inflation data from directory

0.0.2 Convert date columns from character class to date class

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 3 we show the results from evaluating Pearson's R and the linear regression of each country. Section 4 discusses the implications that the results in section 3 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

[1] Kenneth W. Celements and Seah (2012)
[2] Economist (2023)
[3] Reuters (2022)
[4] futuraprime (2022)

from the Bank of Canada's website.[5] The inflation rate of the United Kingdom was sourced from the Office for National Statistics[6] and the inflation rate of Japan was sourced from macrotrends.[7]

2.2 Overview of Data

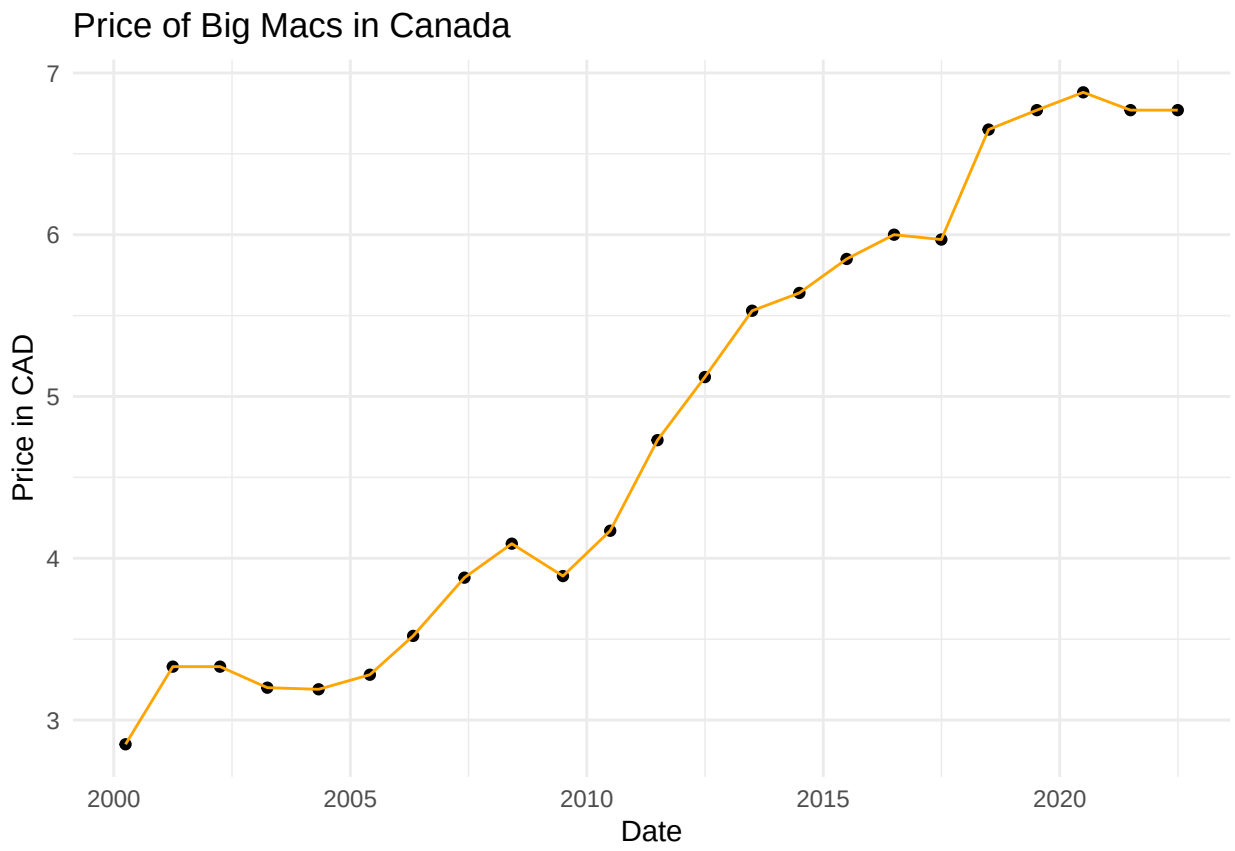
2.2.1 Summary of Canadian data

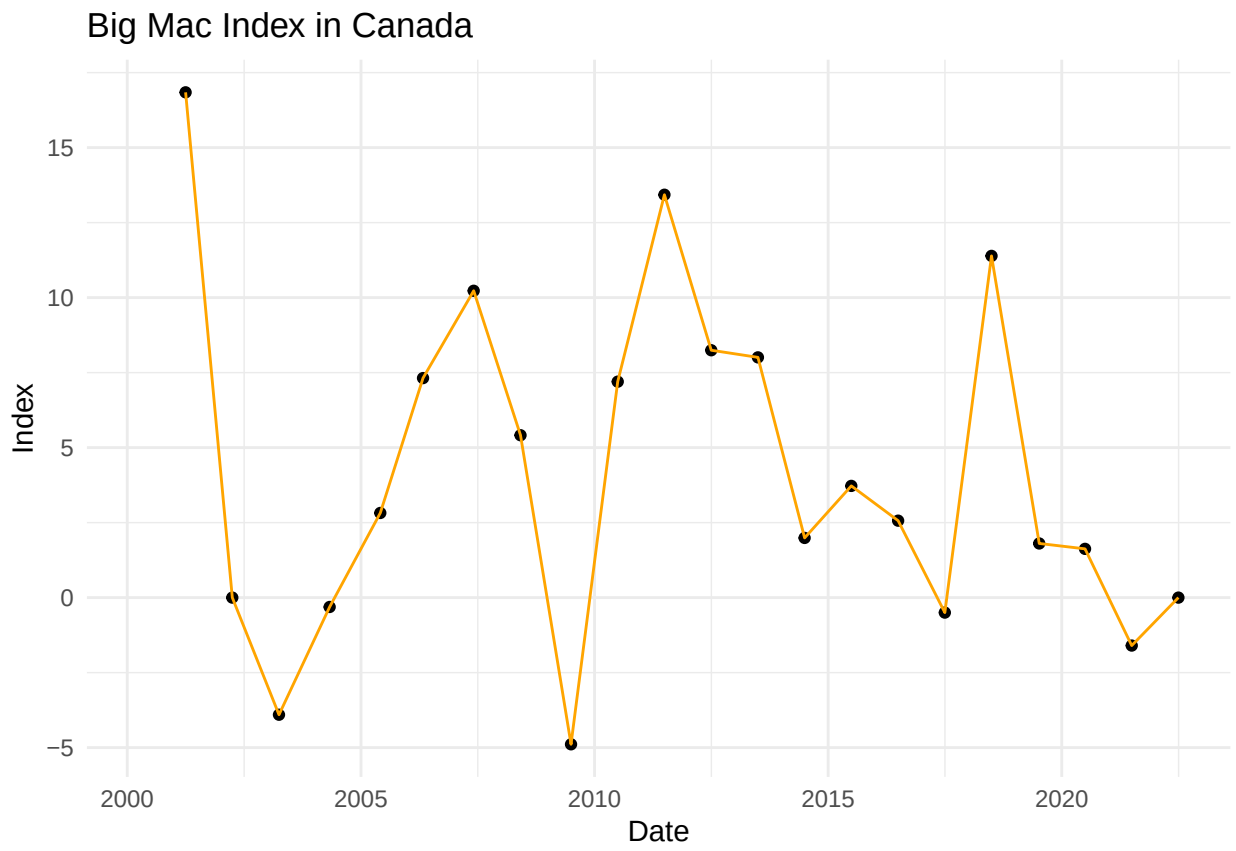
```
##      name              iso_a3          currency_code       local_price
##  Length:23          Length:23          Length:23          Min.   :2.850
##  Class :character   Class :character   Class :character   1st Qu.:3.425
##  Mode  :character   Mode  :character   Mode  :character   Median :4.730
##                                                           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
##  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
```

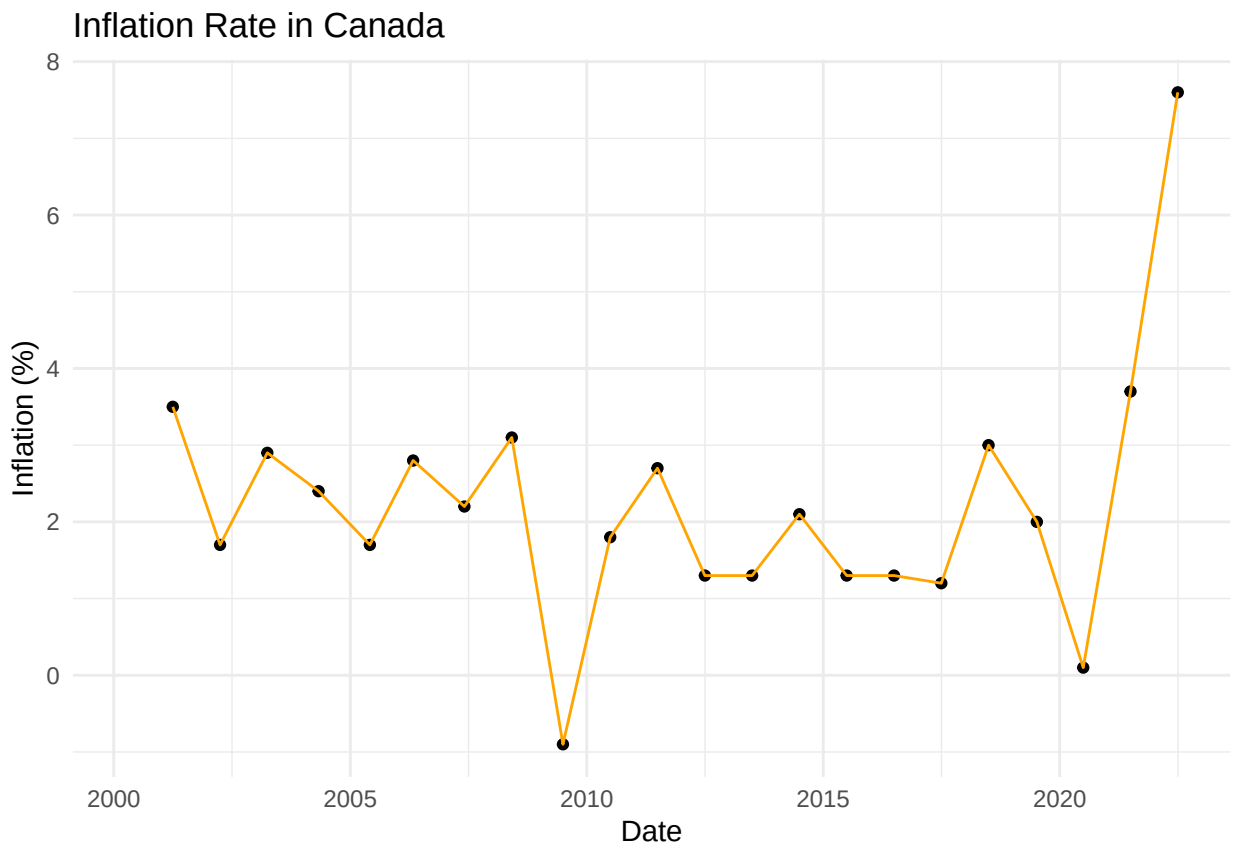
Top 10 rows of Canadian data

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

[5] Canada (2023)
[6] National Statistics (2023)
[7] macrotrends (2023)

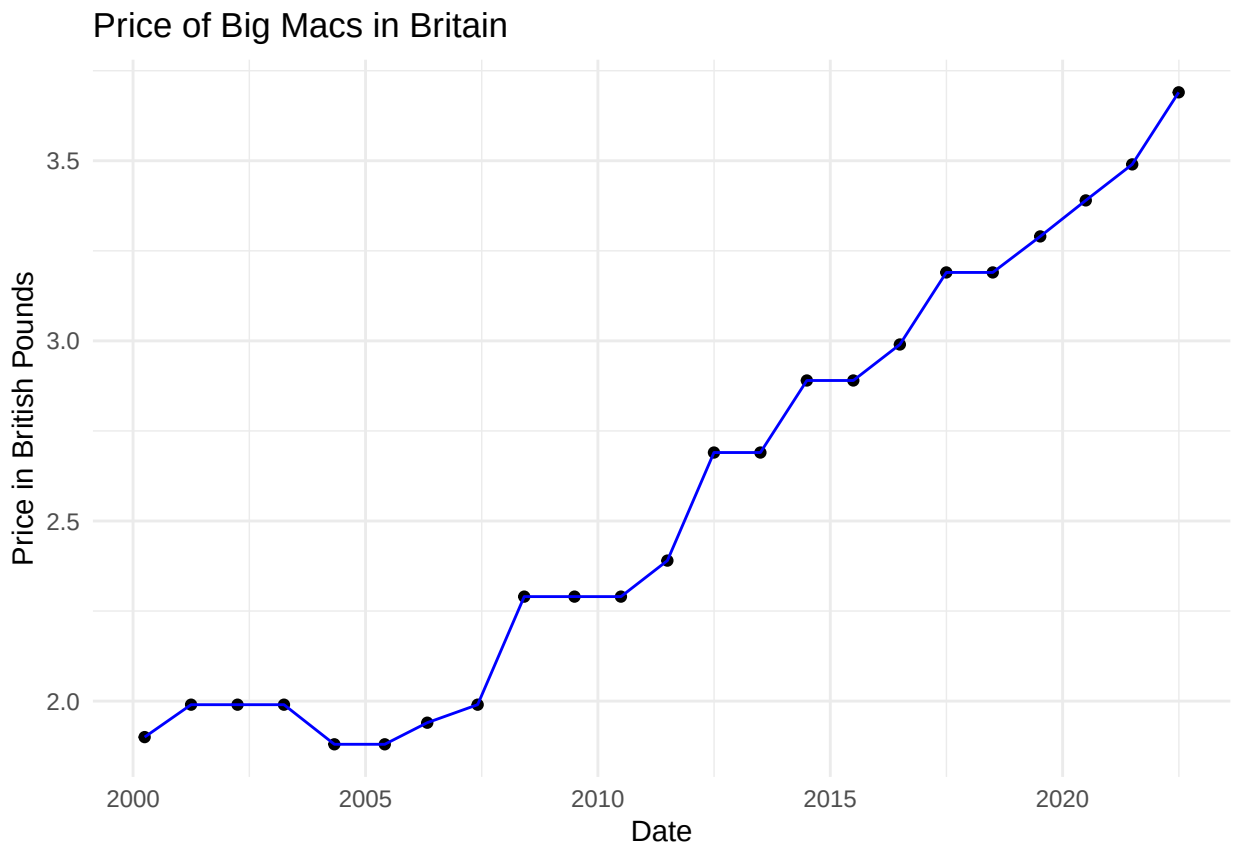

Price of Big Macs in Canada
Price in CAD
7
6
5
4
3
2000
2005
2010
2015
2020
Date

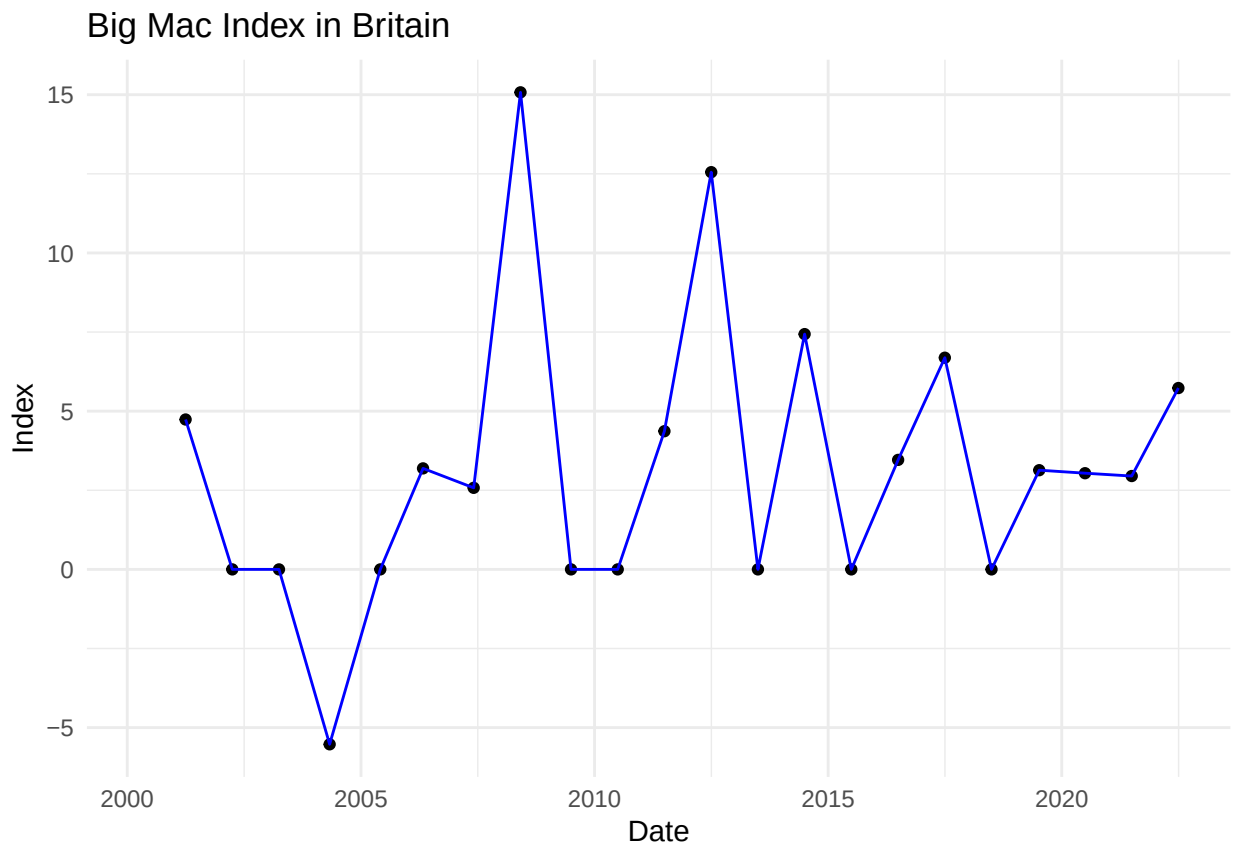

Big Mac Index in Canada
Index
15
10
5
0
−5
2000
2005
2010
2015
2020
Date

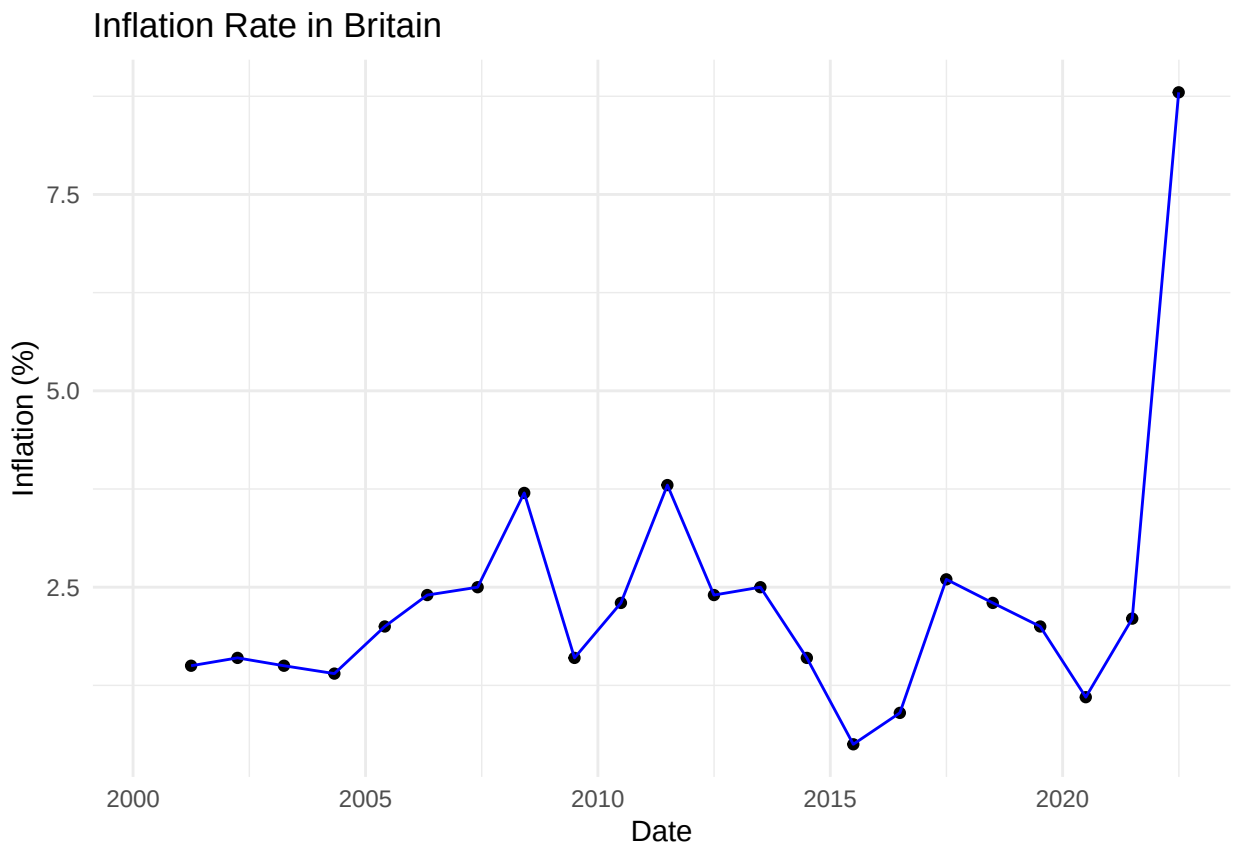


Summary of British data

```
##      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
```


Price of Big Macs in Britain
Price in British Pounds
3.5
3.0
2.5
2.0
2000
2005
2010
2015
2020
Date


Big Mac Index in Britain
15
10
5
0
−5
Index
2000
2005
2010
2015
2020
Date



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

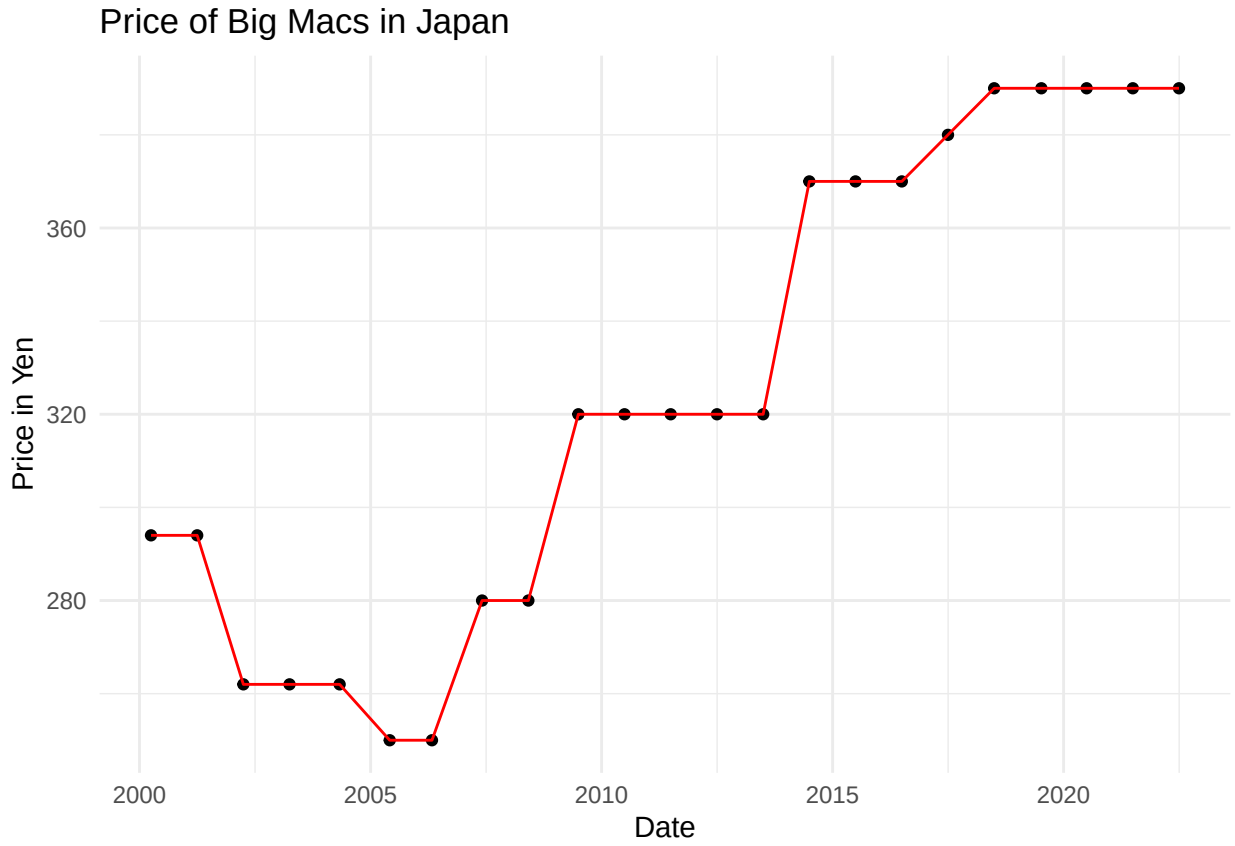
2.2.2 Summary of Japanese data:

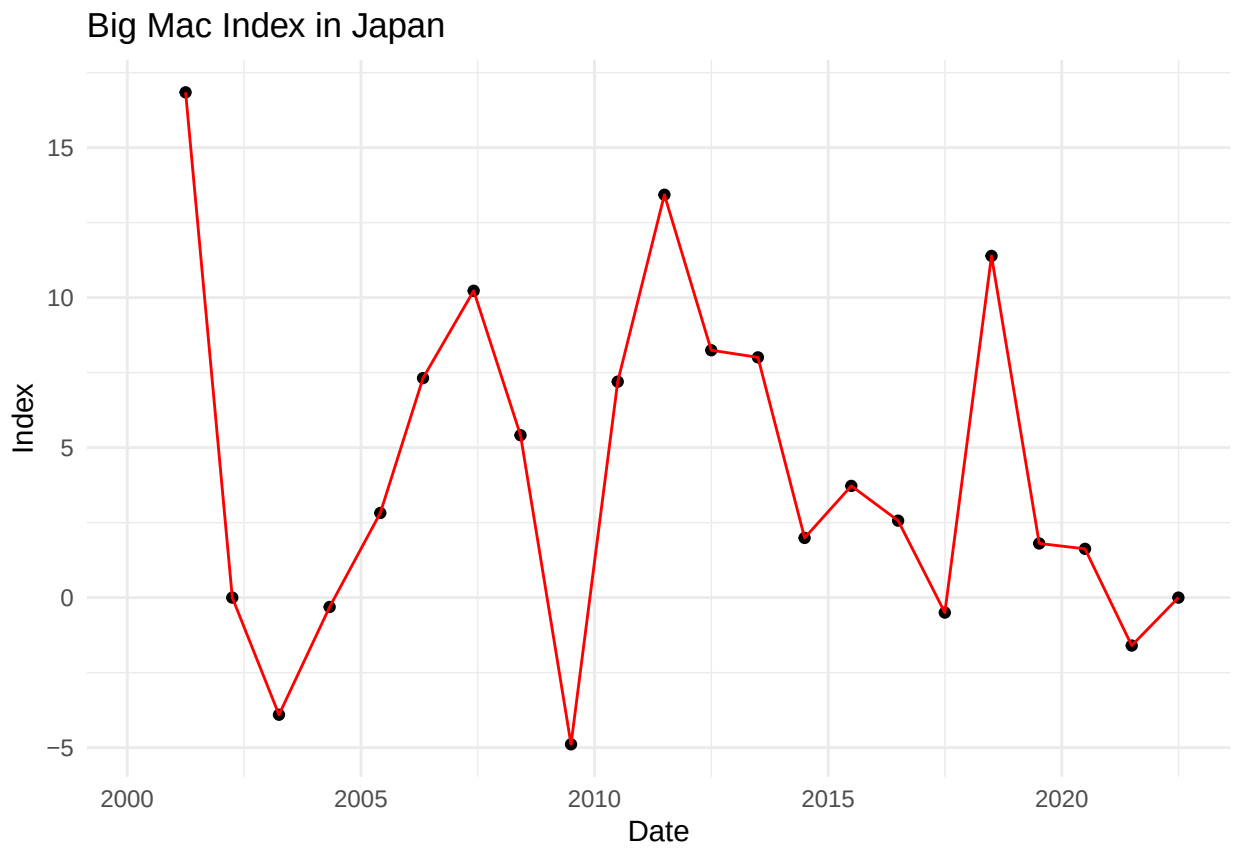
```
##      name               iso_a3          currency_code       local_price
##  Length:23          Length:23          Length:23          Min.   :250
##  Class :character   Class :character   Class :character   1st Qu.:280
##  Mode  :character   Mode  :character   Mode  :character   Median :320
##                                                           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
```

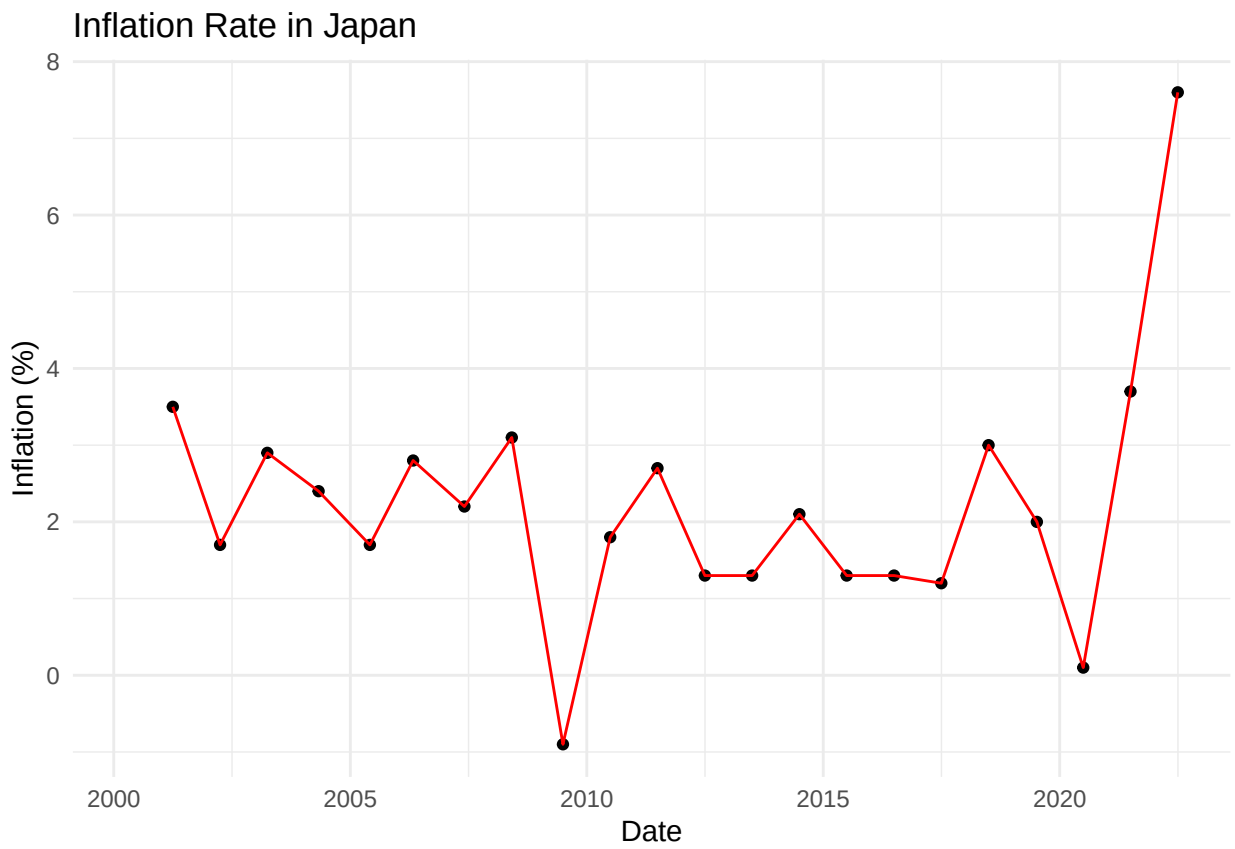
```
##  3rd Qu.:116.53   3rd Qu.:40320   3rd Qu.:4256717   3rd Qu.:2016-12-30
##  Max.   :137.87   Max.   :49175   Max.   :4424718   Max.   :2022-07-01
##
##  big_mac_index     inflation_rate
##  Min.   :-10.884   Min.   :-1.3500
##  1st Qu.:  0.000   1st Qu.:-0.2675
##  Median :  0.000   Median :-0.0150
##  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



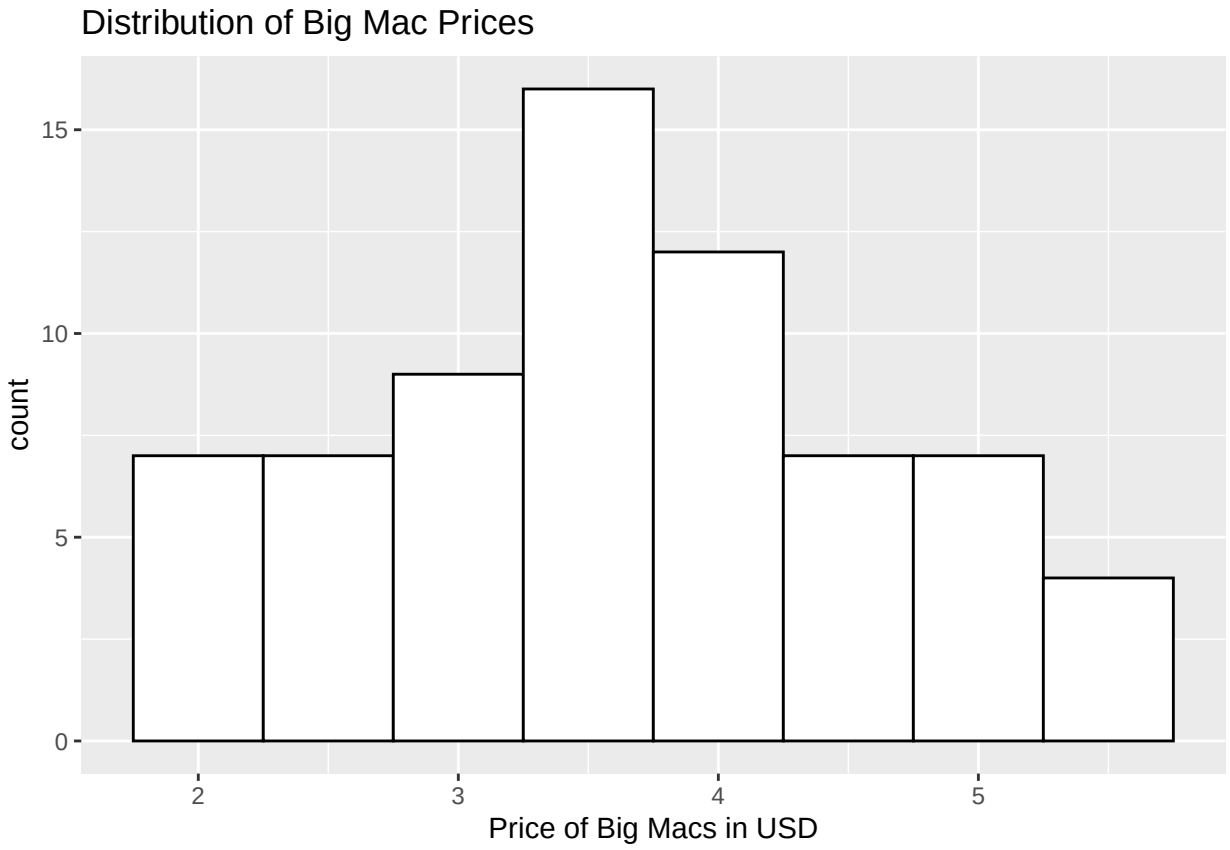

Big Mac Index in Japan
15
10
5
0
−5
Index
2000
2005
2010
2015
2020
Date

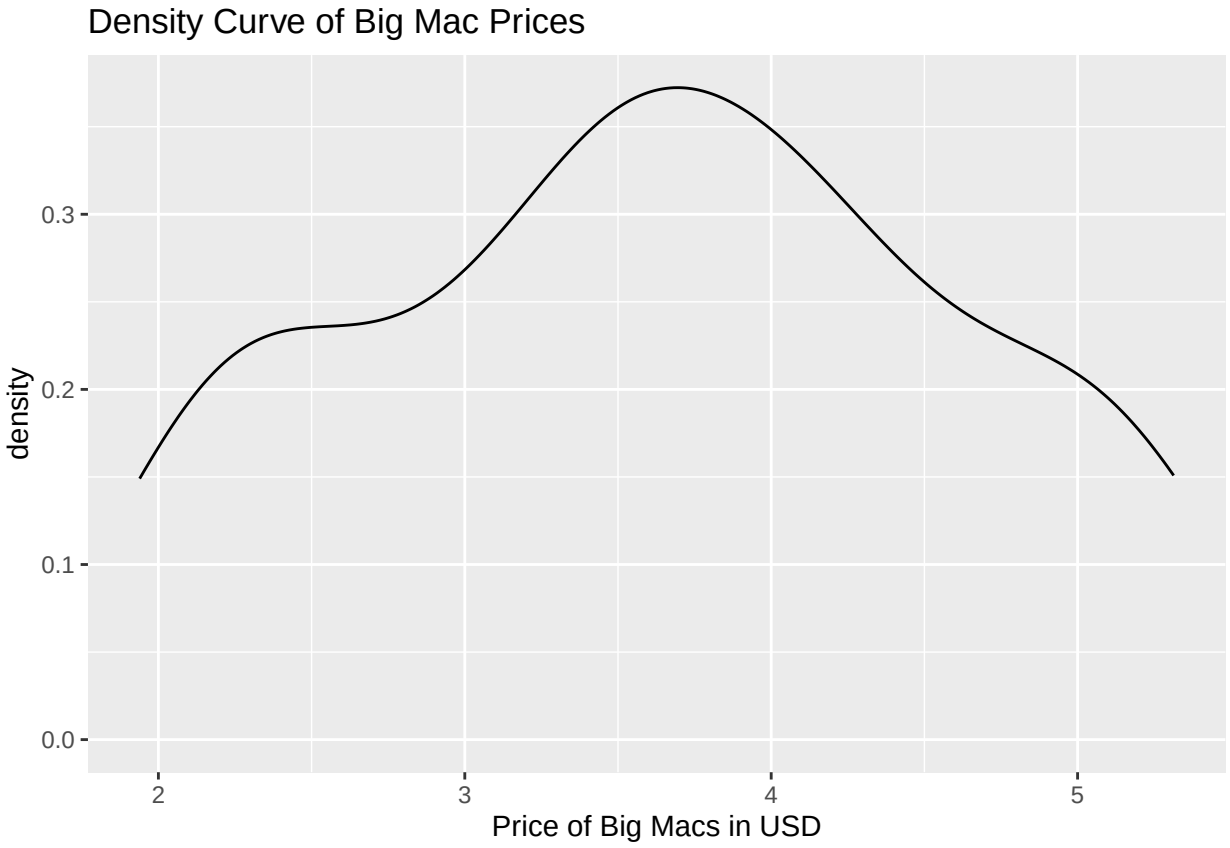


Summary of Combined data: summary of combined data:

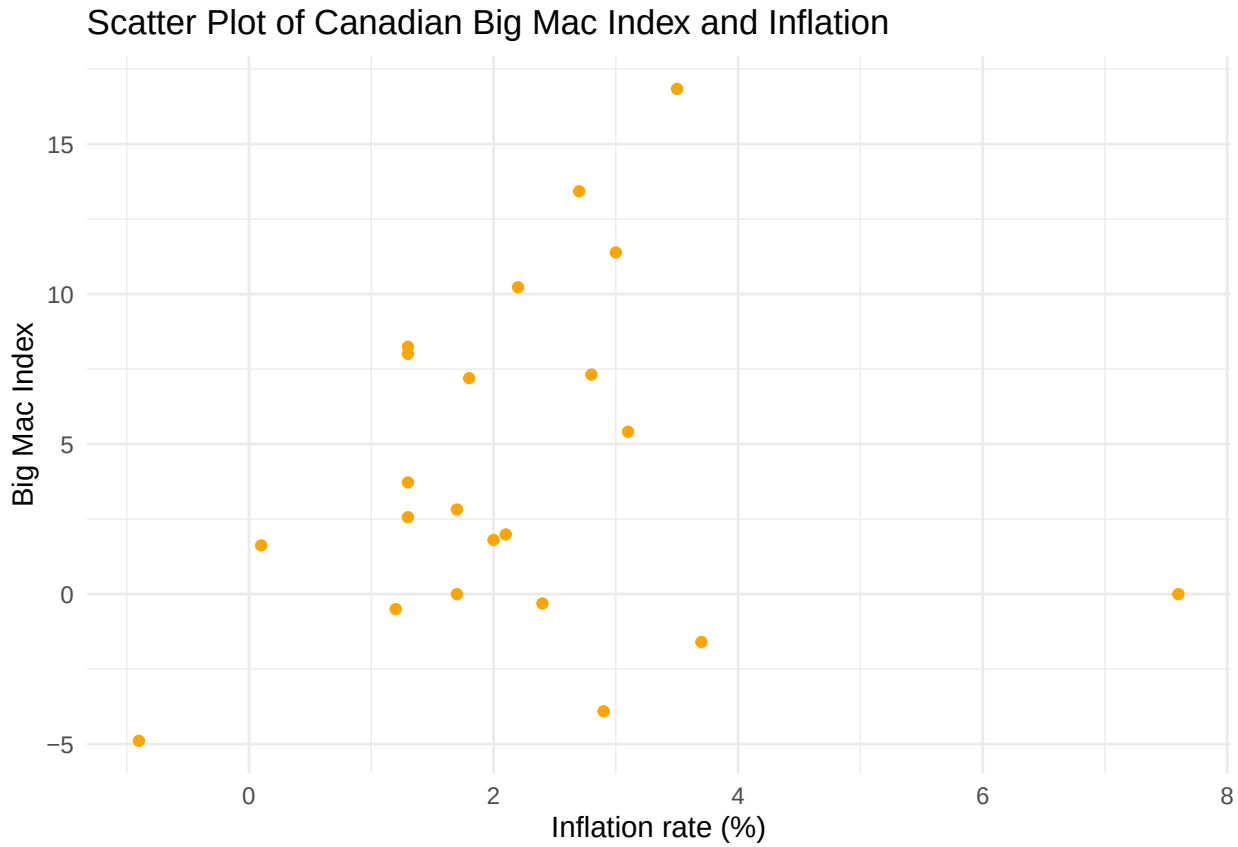
```
##      name              iso_a3          currency_code       local_price
##  Length:69          Length:69          Length:69          Min.   :  1.88
##  Class :character   Class :character   Class :character   1st Qu.:  2.99
##  Mode  :character   Mode  :character   Mode  :character   Median :  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
##                       NA's   :3          NA's   :3
```

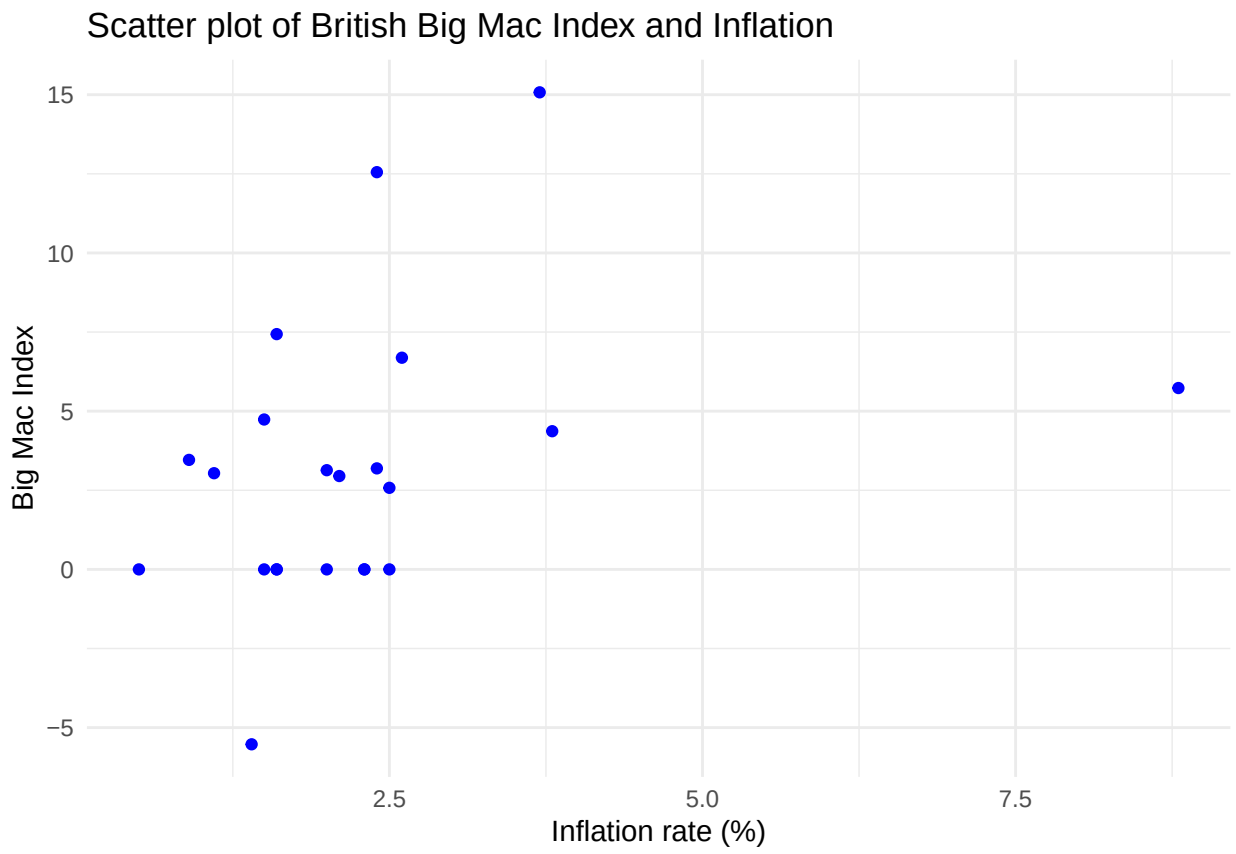
2.3 Distributions

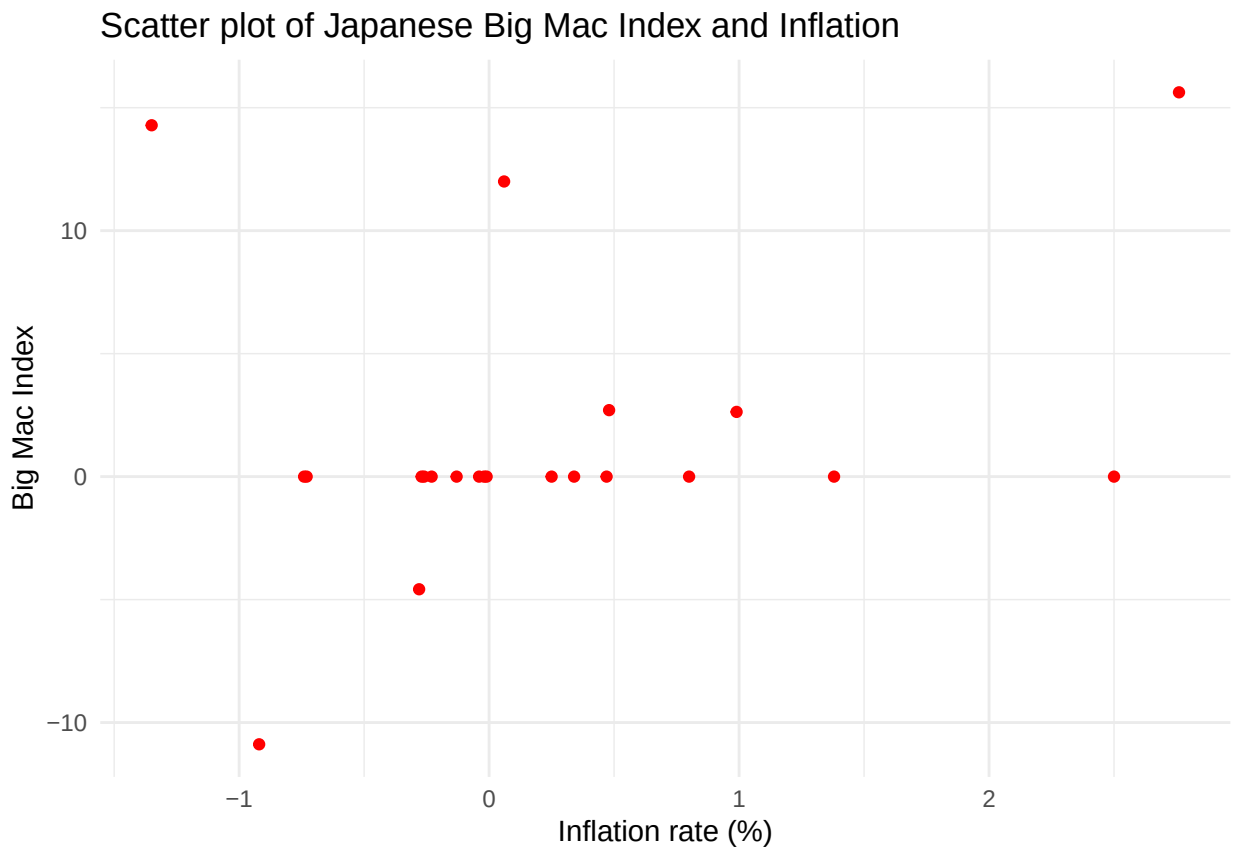


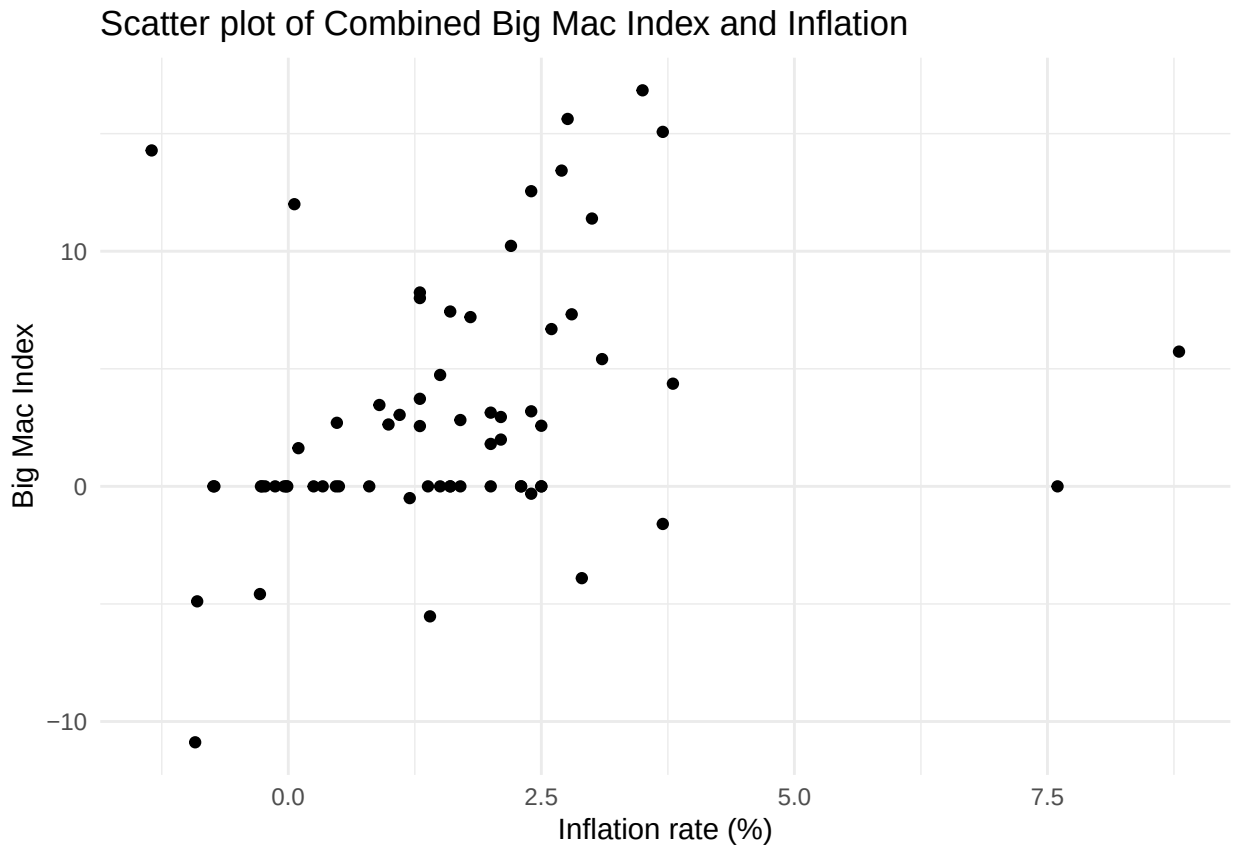


2.4 Scatterplots




Scatter plot of British Big Mac Index and Inflation
15
10
5
0
−5
Big Mac Index
2.5
5.0
7.5
Inflation rate (%)


Scatter plot of Japanese Big Mac Index and Inflation
Big Mac Index
10
0
−10
−1
0
1
2
Inflation rate (%)



3 Results

3.1 Pearson's R

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

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

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

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

```
##
## 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
```

```
##
## 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
```

```
##
## 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
```

```
##
## 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 Discussion

4.0.1 Pearson's r

Simple Linear Regression

Canada, Bank of. 2023. "Key Inflation Indicators and the Target Range." 2023. https://www.bankofcanada.ca/rates/indicators/key-variables/key-inflation-indicators-and-the-target-range/.

Economist, The. 2023. "Our Big Mac Index Shows How Burger Prices Are Changing." 2023. https://www.economist.com/big-mac-index.

futuraprime. 2022. "TheEconomist/Big-Mac-Data." 2022. https://github.com/TheEconomist/big-mac-data.

Kenneth W. Celements, Yihui Lan, and Shi Pei Seah. 2012. "The Big Mac Index Two Decades on: An Evaluation of Burgernomics." *International Journal of Finance and Economics* 17 (1): 31–60.

macrotrends. 2023. "Japan Inflation Rate 1960-2023." 2023. https://www.macrotrends.net/countries/JPN/japan/inflation-rate-cpi.

National Statistics, Office for. 2023. "CPIH Annual Rate 00: All Items 2015=100." 2023. https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/l55o/mm23.

Reuters. 2022. "Currencies." 2022. https://www.reuters.com/markets/currencies/.