The relationship between Inflation rate and Interest rate, and it can influence Stock and Cryptocurrency Market*

Market factors can be affected by Inflation rate and Interest rate changes

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This paper explores the correlation between inflation rate and interest rated since both of them increased significantly last few years and the both rates are the important factors of the global economy. Additionaly, In this In the past few years, many stock items and cryptocurrencies fluctuated wildly. This research studies the corellation between the inflation rate and interest rate, and how the two important factors in economy impact to the stock and cryptocurrency market. Overall, the inflation rate and interest rate can be considered for future market trends.

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1 Introduction

Throughout last few years, the inflation rate and the interest rate have been increased rampantly after pandemic, and every government tried to control the inflation rate and interest rate, but it requires a long duration to stabilize the inflation rate and interest rate since those are related to almost all factors in economy. According to "Pandemic Prices: Assessing Inflation in the Months and Years Ahead" (n.d.), stabilizing the inflation and interest rateswould take for a while. However, the rates will be stabilized gradually.

In this paper, we explore the relationship between inflation and interest rates and what and how both rates affect the global economy, especially in 'the stock market' and 'the cryptocurrency market.

Furthermore, Section 2 explains the data cleaning process and variables of interest that are the most important factor of this research. Section 3 explains the models that were built for this paper. Section 4 considers and describe the results from the models. Section 5 explain the results in three different perspectives and the weakness of the paper.

2 Data

The processes in this section were done by using R(R Core Team 2023), Tidyverse(Wickham et al. 2019), Lubridate(Vitalie Spinu 2023), Arrow(Richardson et al. 2024). The major 4 data sets in this research are "historical inflation rate in Canada"(Canada 2024b), "historical interest rate in Canada"(Canada 2024a), "historical NASDAQ index price"(Finance 2024b), and "historical Bitcoin price"(Finance 2024a). The raw historical inflation data contains the quarterly inflation rate in Canada in the last 10 years. The raw historical interest rate contains the monthly interest rates in Canada's last 10 years. In the case of the data sets containing the NASDAQ index and Bitcoin price containing the monthly price data of each index.

2.1 Data Cleaning

The raw data sets were cleaned with R(R Core Team 2023), Tidyverse(Wickham et al. 2019), Lubridate(Vitalie Spinu 2023), and Arrow(Richardson et al. 2024). Since the inflation rate and interest rate do not change frequently, the NASDAQ index price and Bitcoin price need to be analyzed in quarterly data. The collected daily raw NASDAQ index and Bitcoin price could be converted to quarter data by Lubridate(Vitalie Spinu 2023) package.

2.2 Variables of interest

The study focuses on the correlation between the inflation rate and the interest rate in Canada and how they impact the stock market and cryptocurrency prices. The variables of interest in this study are 'CPI inflation rate', 'interest rate', 'NASDAQ index close price', and 'Bitcoin close price'.

Note that the 'CPI inflation rate' and 'interest rate' do not fluctuate as often as other variables. Thus, the study will focus on the quarter data rather than other periods.

The below tablesTable 1 are examples of the cleaned data sets.

Table 1: Example of Cleaned data sets

Quarter	Inflation	Interest	NASDAQ_close	Bitcoin_close	Date
2014 Q3	2.0666667	1.2500000	4530.519	407.1824	2014-07-01
2014 Q4	1.9666667	1.2500000	4600.939	357.0751	2014-10-01
2015 Q1	1.0666667	1.0000000	4825.264	251.2097	2015-01-01
2015 Q2	0.9000000	1.0000000	5030.167	236.8583	2015-04-01
2015 Q3	1.2000000	0.7500000	4924.328	254.8597	2015-07-01
2015 Q4	1.3333333	0.7500000	4998.138	346.0371	2015-10-01
2016 Q1	1.5666667	0.7500000	4614.201	410.7288	2016-01-01
2016 Q2	1.5666667	0.7500000	4845.712	512.4928	2016-04-01
2016 Q3	1.2333333	0.7500000	5168.889	615.7026	2016-07-01
2016 Q4	1.4000000	0.7500000	5309.890	732.7220	2016-10-01
2017 Q1	1.9000000	0.7500000	5736.322	1034.7074	2017-01-01
2017 Q2	1.3000000	0.7500000	6095.442	1912.5522	2017-04-01
2017 Q3	1.4000000	1.0833333	6343.130	3482.1494	2017-07-01
2017 Q4	1.8000000	1.2500000	6758.381	9507.3762	2017-10-01
2018 Q1	2.0666667	1.5000000	7253.849	10568.0623	2018-01-01
2018 Q2	2.3000000	1.5000000	7355.939	7766.9677	2018-04-01
2018 Q3	2.6666667	1.7500000	7874.577	6821.3166	2018-07-01
2018 Q4	2.0333333	2.0000000	7215.114	5200.0905	2018-10-01
2019 Q1	1.6000000	2.0000000	7343.622	3799.3305	2019-01-01
2019 Q2	2.1333333	2.0000000	7874.739	7301.4462	2019-04-01

Table 1: Example of Cleaned data sets

Quarter	Inflation	Interest	NASDAQ_close	Bitcoin_close	Date
2019 Q3	1.9333333	2.0000000	8067.464	10381.6539	2019-07-01
2019 Q4	2.1000000	2.0000000	8445.709	8019.3628	2019-10-01
2020 Q1	1.8333333	1.6666667	8771.730	8267.6904	2020-01-01
2020 Q2	0.0333333	0.5000000	9091.000	8665.5917	2020-04-01
2020 Q3	0.2333333	0.5000000	10926.834	10633.9067	2020-07-01
2020 Q4	0.8000000	0.5000000	11954.430	16840.7206	2020-10-01
2021 Q1	1.4333333	0.5000000	13351.457	45323.7754	2021-01-01
2021 Q2	3.3666667	0.5000000	13848.436	46497.7816	2021-04-01
2021 Q3	4.0666667	0.5000000	14839.972	41988.7721	2021-07-01
2021 Q4	4.7333333	0.5000000	15390.787	55881.2525	2021-10-01
2022 Q1	5.8333333	0.5833333	14000.620	41298.6414	2022-01-01
2022 Q2	7.5333333	1.4166667	12195.240	32499.5540	2022-04-01
2022 Q3	7.1666667	3.0000000	11891.070	21252.3315	2022-07-01
2022 Q4	6.6666667	4.0000000	10871.376	18072.0500	2022-10-01
2023 Q1	5.1333333	4.6666667	11481.441	22876.9252	2023-01-01
2023 Q2	3.5333333	4.8333333	12676.756	28034.0847	2023-04-01
2023 Q3	3.7000000	5.2500000	13785.278	28091.3287	2023-07-01
2023 Q4	3.2000000	5.2500000	13910.687	36296.4282	2023-10-01

According to Table 1, all variables of interest are cleaned and appropriately combined by each quarter from the third quarter in 2014 to the fourth quarter of 2023.

According to ("How Higher Interest Rates Affect Inflation," n.d.), higher interest rates affect inflation rates. Based on the collected historical data, Figure 1 shows that the fluctuation of both factors has been similar over the last 10 years. The orange line represents the 'Inflation rate', and the blue line represents the 'Interest rate'. In addition, both rates significantly increased from 2021, the end of the COVID-19 pandemic.

According to the Figure 2, both the NASDAQ index and cryptocurrency (Bitcoin) have increased significantly in the past 10 years.

2.2.1 Note

The inflation rate and interest rate do not change as often as the NASDAQ index and cryptocurrency, and the fluctuations are not severe compared to the others. On the other hand, there is an open time and a close time for the stock market, but the cryptocurrency market never closes.
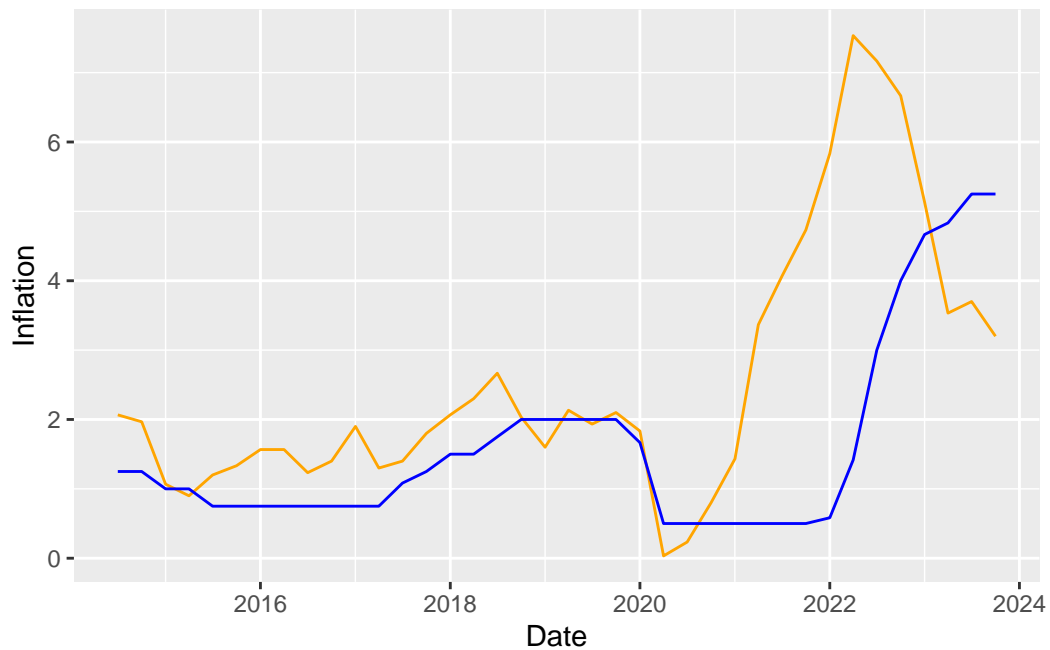
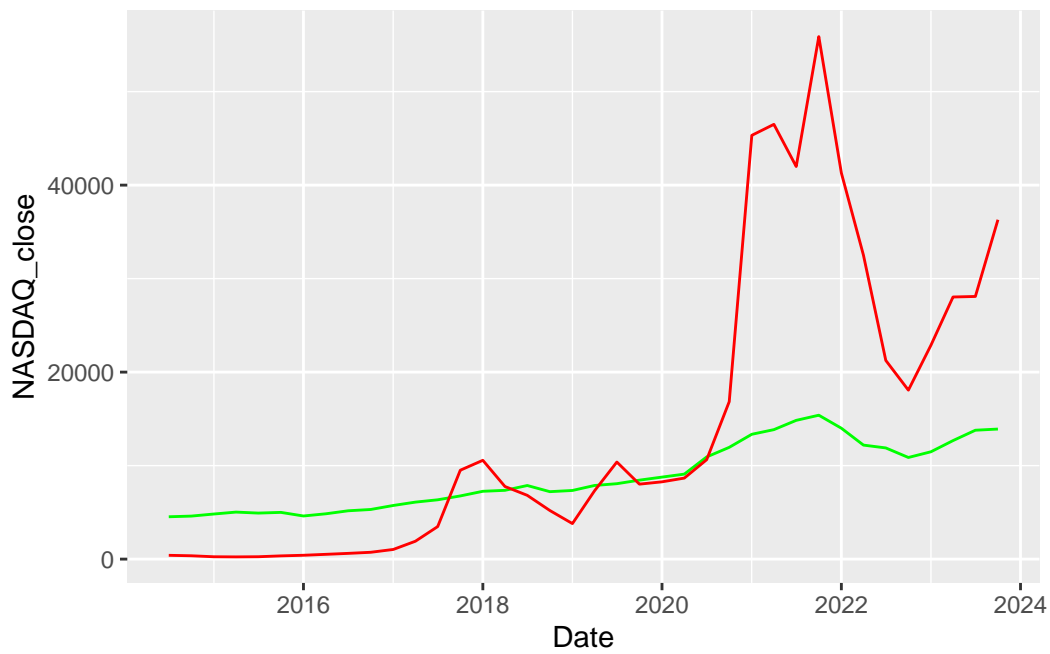Figure 1: Relationship between Inflation and Interest rate

Figure 2: Recent trends of NASDAQ index and Cryptocurrency (Bitcoin)

3 Model

First of all, the built models were based on the fluctuation of the inflation rate and interest rate.

3.1 Model set-up

Define y_i as a price of NASDAQ Index and Cryptocurrecy (Bitcoin) price(\$). Let β_1 is inflation rate and β_2 be interest rate(%).

$$y_{NASDAQ} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon \tag{1}$$

$$y_{Bitcoin} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon \tag{2}$$

The models were run in R (R Core Team 2023) by using 'rstanarm' (Goodrich et al. 2022).

3.1.1 Model justification

We expected that the inflation rate and interest rate would have a negative correlation with the NASDAQ Index and Bitcoin price since the market volume would decrease when the inflation rate and interest rate are high. However, we did not consider that the stock market and cryptocurrency market are still becoming larger and larger.

4 Results

The results of models are in Table 2 and Table 3.

Table 2: Model result of NASDAQ Index by Inflation and Interest Rate

	NASDAQ index model
(Intercept)	5672.81
	(835.11)
Inflation	1055.52
	(290.90)
Interest	249.52
	(384.36)
Num.Obs.	38
R2	0.363
R2 Adj.	0.267
Log.Lik.	-355.786
ELPD	-359.2
ELPD s.e.	3.7
LOOIC	718.4
LOOIC s.e.	7.3
WAIC	718.2
RMSE	2761.28

Table 3: Model result of Cryptocurrency (Bitcoin) by Inflation and Interest Rate

	Cryptocurrency (Bitcoin) model
(Intercept)	1798.10
	(3931.15)
Inflation	5548.11
	(1262.59)
Interest	-1020.61
	(1708.76)
Num.Obs.	38
R2	0.363
R2 Adj.	0.212
Log.Lik.	-413.288
ELPD	-417.9
ELPD s.e.	5.7
LOOIC	835.7
LOOIC s.e.	11.4
WAIC	835.0
RMSE	12 521.31

5 Discussion

As a result, the research considered the inflation rate and interest rate affected to both market. However, results for each market are quiet different from our expectation by both each predictor. In this section, we will discussion about the reason why the results are different from our expectation.

5.1 NASDAQ Index

According to the result, NASDAQ index price has a positive relationship with both of the inflation rate (1055.52Table 2) and the interest rate (249.52Table 2). We expected the relationship between the NASDAQ index price and the rates is a negative relationship since increasing of the inflation rate and the interest rate usually causes ecnomic recession. We expect that the cause of this relationship the stock market is still becoming larger.

5.2 Bitcoin

According to Lee (2024), cryptocurrency (Bitcoin) may be a good hedge against inflation. However, it is pretty new to the market, which means the cryptocurrency market is pretty volatile, which means there might be more critical invisible factors that affect to the market. As a result, from the model, the 'interest rate' has a positive relationship to the Bitcoin price (5548.11Table 3), which is much higher than inflation's result. In case of, the predicator 'inflation rate' has a negative relationship (-1020.61Table 3) with Bitcoin price. This might be cause the cryptocurrency market has yet to be stabilized since it is a new market that has become popular in society. However, the future result of the model should be similar to the NASDAQ Index model's result when the cryptocurrecny market is more stabilized.

5.3 COVID-19

From early 2021, the COVID-19 pandemic affected many factors in the economy. Eventually, this caused sudden variability in stock market and cryptocurrency market, and many governments tried to decrease the interest rate (Figure 3). Decreasing interest rate caused increasing inflation rate, and it caused a chain of inflation.

5.4 Weaknesses and next steps

The study focused on inflation and interest rates to explore the stock market (NASDAQ index price) and the cryptocurrency market (Bitcoin). However, other factors also affect the markets, such as cash liquidity. In addition, both the stock market and the cryptocurrency market are
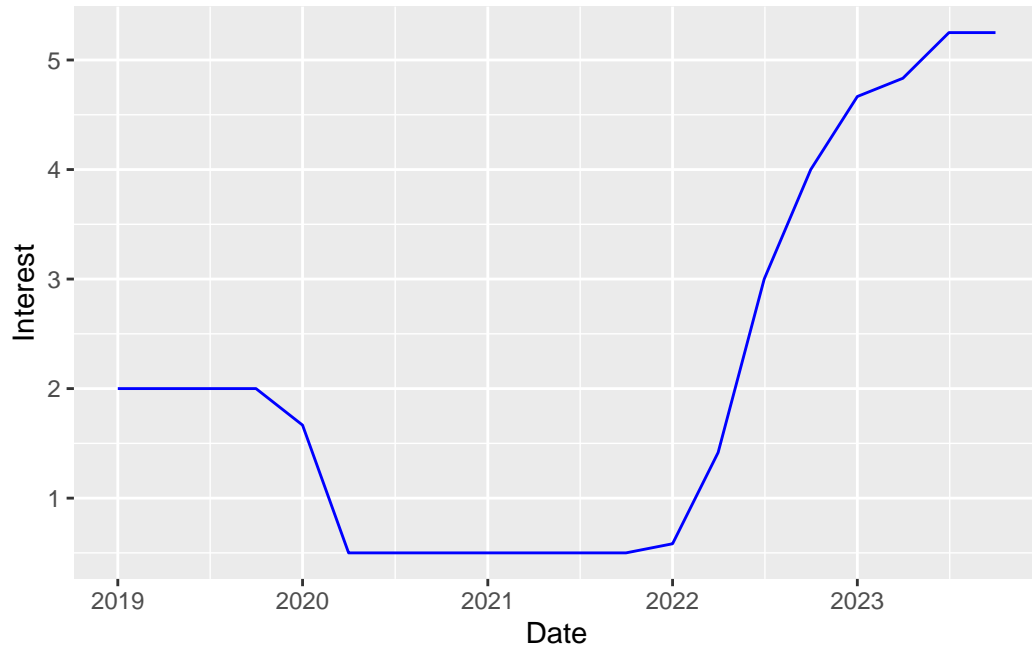
Figure 3: Interest rate from 2019

affected by many policy changes. Also, there will be a number of regulations for cryptocurrency since the cryptocurrency market is a new means of investment.

Appendix

A Additional data details

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