



Interpolation and Correlation between Inflation and Financial Variables: New Evidence from Thailand

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Abstract

This study aims to investigate and summarize the impact of inflation on GDP, THB/USD exchange rate and stock prices including SET50, SET100, SETHD and MAI in Thailand between 2018 - Q1 and 2022 - Q2. Since the time and frequency of inflation and financial variables are technically different based on their observation, the interpolation techniques were used to generate the missing value of data and Spearman correlation coefficient was then employed for determining the relationship between inflation and other financial variables. At the significance level of 0.05, inflation showed high positive correlations with GDP and MAI whereas low correlations with other variables. Considering the economic cycle, the time series datasets were divided into four periods and the Spearman correlation coefficient was evaluated in every period. It was found that inflation had direct variation with GDP as inflation raises the production costs leading to the higher customer price and high amount of cash circulating in the economic system. In contrast, inflation showed its reverse variation with THB/USD exchange rate, SET50, SET100 and SETHD which can be considered as the signs of economic instability. The correlation between inflation and MAI was moderately positive due to the fact that inflation can lead to an increase in demand for goods and services; thus, the new business opportunities for SMEs and their revenue are directly varied. Regarding numerical results, this study has emphasized why interpolation technique is important for the bivariate data with different sampling frequencies. Therefore, it is essential to address how much the national impact of inflation on relevant financial variables and raised concern about inflation as it can make money saved today worth less tomorrow.

Keywords: Exchange Rate, Financial Variables, GDP, Inflation, Interpolation, Stock Price, Spearman Correlation

1. Introduction

Inflation and economic growth are the two important macroeconomic factors affecting the national economy and they are the most widely cited indices of economic development (Saungweme & Nicholas, 2021). Meanwhile, the stock market is an important mechanism of the financial system driving toward the growth of developing countries' economies (Nongnit, Kanokporn, Surachai, & Pannatorn, 2022). The recent study has been interested in the relationship among the GDP, inflation and stock price about the relationship and how each factor affects each other (Atigala et al., 2022; Ekinici, Tüzün, & Ceylan, 2020; Eldomiaty et al., 2020). Interestingly, it is still questioned about the effect of inflation on GDP, exchange rate and stock prices in Thailand in recent years.

For the quantitative historical correlational study about the impact of IMF and foreign direct investment on economic growth, the researcher employed the Pearson correlation and simple linear regression analyses by using long period annual historical data (Dabo, 2021). Studying investment determinants of economics of economic growth, the researcher used statistical methods, panel studies, correlation and regression analysis, the Pearson correlation coefficient to test the hypothesis of the significance (Boonkrong et al., 2020; MykyTiuk et al., 2020). Taking into account the relationships among technology, education, and economic growth, the Pearson correlation and the Spearman correlation coefficients were employed to examine such relationship. (Donou-Adonsou, 2019). Likewise, the Spearman correlation was used to investigate interrelation of inflation rate and construction materials price (Musarat et al., 2020). According to the study about the impact of government expenditure on economic growth in Nepal, the researcher analyzed the Pearson correlation coefficient and the regression analysis (Gupta, 2018). To study the impact of

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economic factors affecting the change of some financial variables in Thailand such as inflation, exchange rate, SET Index, interest rate, GDP and many others, the Pearson correlation coefficient is popularly used to analyze and describe such relationships (Boonkrong et al., 2021; Nasiri et al., 2019). Focusing on the impact of inflation on other financial variables in Thailand, Figure 1 shows the historical data of inflation time series during 2018 – Q1 to 2022 – Q2, i.e., there were 48 quarters and the GDP was evaluated quarterly over 1092 days (NESD, 2023). Literally, the acceptable level of inflation should be below 2%.

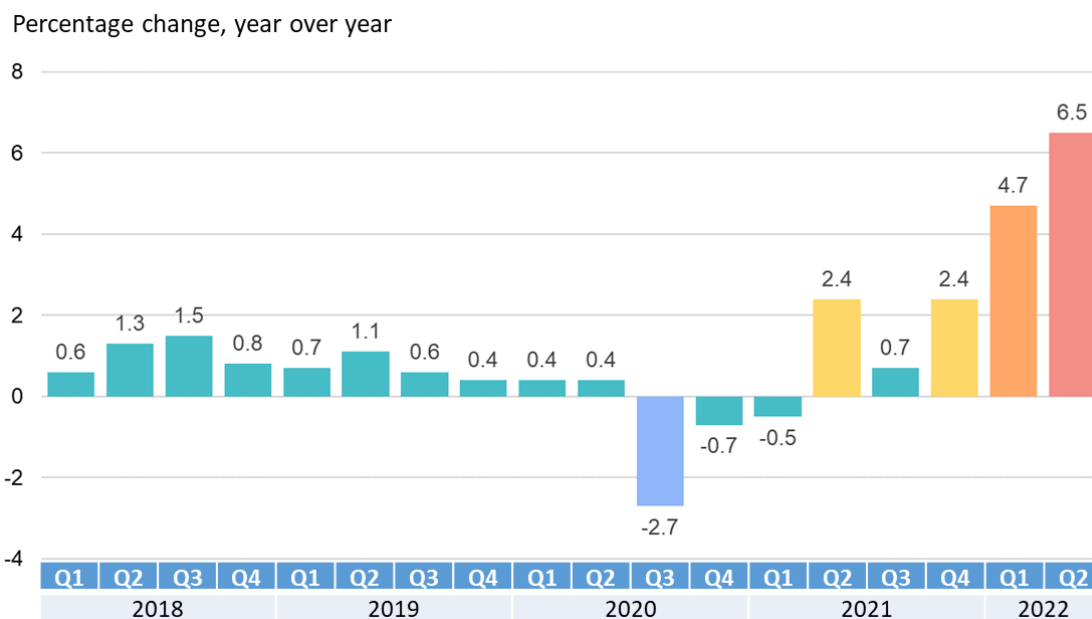


Figure 1 Historical inflation in Thailand during 2018-2022

However, the pattern of historical inflation in Thailand are distinctively divided into four periods as follows:

- Period 1 (2018 – Q1 to 2019 – Q4): The acceptable inflation rate ranges between 0.4 – 1.5%, i.e., this period showed the secure level of inflation. Advantageously, the mild inflation positively affected to economy which rose customer demand and increased the amount of cash circulating in an economic system.
- Period 2 (2020 – Q1 to 2020 – Q4): There were the outbreak of COVID-19 pandemic and its preventing measures including social distancing, self-isolation, quarantine, mobility restrictions, lockdown and etc. Consequently, the demand in food, drug and necessities was exponentially increasing and caused deflation rate of - 2.7%. The pandemic led to disruptions in supply chains, reduced demand for certain goods and services, and increased unemployment, which can all contribute to deflationary pressures.
- Period 3 (2021 – Q1 to 2021 – Q4): The inflation rate in this period was between -0.5% to 2.4%. As the COVID-19 pandemic situation has constantly existed, the recession occurred so that the inflation tended to raise making the manufacturing cost increasing. The long-term effects of the pandemic on inflation rates are still uncertain and will depend on various factors, including the pace of economic recovery, changes in consumer behavior, and government policies.
- Period 4 (2022 – Q1 to 2022 – Q2): There was not only the COVID-19 pandemic, but also the Russia-Ukraine War in this period. The Russia-Ukraine war is a political conflict that can also have economic consequences. For example, economic sanctions imposed by Western countries on Russia in response to the conflict can lead to higher prices for some goods and services due to trade disruptions and reduced supply. In particular, both countries are leading exporters of agricultural and chemical products, but the export restriction



was announced and this led to the growth in commodities price and the inflation globally. By the aforementioned reasons, the inflation rate in Thailand was higher than 2% and even exceeded 6.5%.

In Thailand, the walking inflation (3-10%) is considered to have a signal which can harm the economy if there is the continuous growth in prices of goods and services. To prevent the running inflation period (>10%), the government should launch some financial and fiscal policies. In this study, the research objectives and methodology are illustrated in Sections 2 and 3. Then, the numerical results are presented and interpreted in Section 4. Finally, the discussion and conclusion are given in Section 5.

2. Objectives

This empirical research aims to investigate and summarize the impact of inflation on GDP, Thai baht and stock price. There are few papers exploring the relationship between inflation and stock prices as they have different time and frequency in recordation. Thus, the interpolation was introduced to solve such problem and the research objectives are as follows:

- 1) To introduce some interpolation techniques for correlation analysis.
- 2) To investigate the relationship between inflation and macroeconomics, especially the GDP.
- 3) To observe how inflation impacts on USD/THB exchange rate.
- 4) To study the association between inflation and stock prices including SET50, SET100, SETHD and MAI.

3. Research Methodology

Considering the relationship between inflation and other financial variables, it is hypothesized that inflation has the impact on the variation of such financial variables. The inflation was assigned as the explanatory variable whereas GDP, THB/USD exchange rate, SET50, SET100, SETHD and MAI are response variables. The definition of each variable is given as follows:

- INF (Inflation, % YoY): The rate of price growth over a period of time. Based on speed, there are 4 types of inflation which are and creeping, walking, galloping and hyperinflation.
- GDP (Gross Domestic Product, % YoY): A monetary indicator of the total market value of finished goods and services that contains four factor which are private consumption, private investment, government investment, government spending. Additionally, GDP is used for indicate the economic growth.
- THB/USD exchange rate: The rate of Thai Baht for conversion to United States dollar.
- SET50 (Stock exchange of Thailand 50 Index, Million USD): The top 50 companies ranked by market capitalization.
- SET100 (Stock exchange of Thailand 100 Index), Million USD: The top 100 companies ranked by market capitalization.
- SETHD (Stock exchange of Thailand High Dividend 30 Index, Million USD): The high dividend 30 companies with dividend over 3.5%.
- MAI (Thailand Market for Alternative Investment, Million USD): The market for alternative investment and be a long-term source of funds for small and medium-sized businesses (SMEs).

This section presents the essential methodology used in this study including data preparation, interpolation techniques and correlation coefficient in the consecutive subsections as follows.

3.1 Data Preparation

Data on Thailand's Inflation and GDP for each quarter from 2018 – Q1 to 2022 – Q2 were gathered from the National Economic and Social Development Council of Thailand website (NESD, 2023). The USD-THB exchange, SET50, SET100, SETHD and MAI was gathered from the investing.com website (Investing, 2023). Observing the time series of variables for $N = 1092$ days, their important descriptive statistics are shown in Table 1. The Kolmogorov-Smirnov test was used to determine statistical data whether each dataset is normally distributed at the significance level $\alpha = 0.05$. As a results, all of variables have non-normal distribution so that the non-parametric statistics is recommended to use for further analysis.



3.2 Interpolation

Since the correlation coefficient is going to be used as the main indicator examining the relationship between variables, it is required to have bivariate data so that all variables need to have their values in every single time step. Nevertheless, the time series of INF and GDP are collected annually or quarterly while others are daily updated. Since there were only 48 datapoints of GDP and 1092 datapoints of financial variables, interpolation techniques were employed in approximating the missing values of GDP in each period $[x_i, x_{i+1}]$ to be 1092 points and suitable for further analysis. Three interpolation techniques used in this study are as follows:

- 1) Piecewise constant interpolation: The same value is assigned for each interval $[x_i, x_{i+1}]$.
- 2) Linear interpolation: The straight line ($y = \beta_0 + \beta_1 x$) is drawn to connect two points of INF and the values in each interval $[x_i, x_{i+1}]$ are assigned linearly.
- 3) Cubic spline interpolation: The cubic polynomial ($y = \beta_0 + \beta_1 x + \beta_2 x^2 + \beta_3 x^3$) is drawn to link two points of INF and the values in each interval $[x_i, x_{i+1}]$ are assigned by low-degree polynomials.

After the interpolation techniques are performed, the time series of all datasets have the same dimension, ready for correlation analysis. The correlations between INF from three different interpolations and each response variable are also investigated.

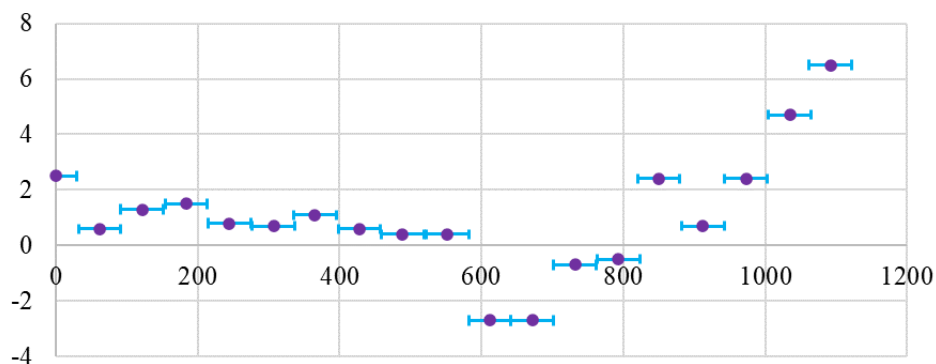
3.3 Correlation Coefficient

To investigate the linear relationship between inflation and other variables, the correlation coefficient is the most popular statistical tool. Regarding the failure in normality of data distributions, the Pearson correlation coefficient is not applicable. Thus, the non-parametric statistics, namely Spearman correlation, is more appropriate for this study. The Spearman correlation coefficient was used to analyze the monotonic relationship between two variables and ranges between -1 and 1. The hypothesis were defined as follows:

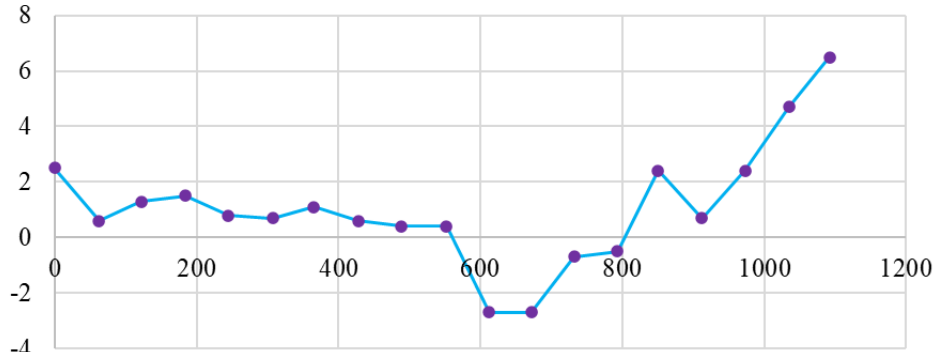
$$H_0 : \rho = 0 \quad (\text{There is no correlation between bivariate data})$$

$$H_1 : \rho \neq 0 \quad (\text{There is correlation between bivariate data})$$

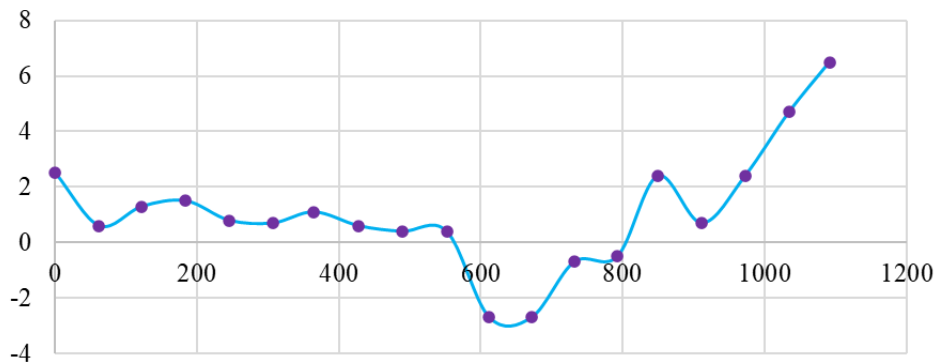
Whenever $\rho \neq 0$, there exist the linear relationship in such bivariate data. However, the degree of correlation coefficient needs to be considered whether there is a high or low relationship in bivariate data as shown in Figure 3.



(a) Piecewise constant interpolation



(b) Linear interpolation



(c) Cubic spline interpolation

Figure 2 Visualization of three different interpolation techniques

In this study, the Spearman correlation coefficient laying only in moderate, high and very high levels are considered, i.e., the value of correlation between ± 0.5 and ± 1.0 is taken into consideration. Otherwise, it is insufficient to consider the relationship between those variables. To ascertain the relationship between inflation with GDP, USD/THB exchange rate and stock prices in Thailand, the Spearman correlation coefficient was used to examine the correlation of all the variables. The explanatory variable is inflation and the response variables are GDP, Stock Price and currency exchange. Furthermore, it is investigated whether there is a positive or negative impact from inflation on each dependent variable. Therefore, the hypotheses examining relationship between bivariate data are given in Table 2.

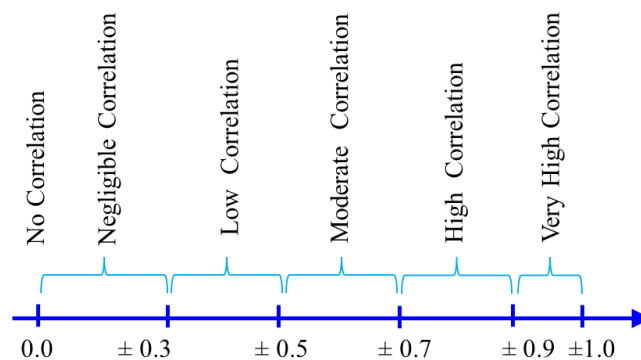


Figure 3 Interpretation of correlation coefficient

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**Table 1** Descriptive statistics of financial variables used in this study

Period		INF	GDP	THB	SET50	SET100	SETHD	MAI
1	N_1	489	489	489	489	489	489	489
	Mean	1.006	3.424	0.032	35.113	77.628	39.250	12.760
	Std. Deviation	0.396	1.012	0.001	1.604	3.690	1.973	1.898
	Skewness	1.099	0.224	-0.012	0.010	0.060	0.641	0.779
	Sig.	0.000	0.000	0.000	0.002	0.000	0.000	0.000
2	N_2	243	243	243	243	243	243	243
	Mean	-1.269	-5.397	0.032	28.154	62.277	29.376	9.369
	Std. Deviation	1.248	3.802	0.001	3.303	7.081	3.961	1.099
	Skewness	0.217	0.124	-0.086	0.721	0.572	0.606	-0.989
	Sig.	0.000	0.003	0.000	0.000	0.000	0.000	0.000
3	N_3	241	241	241	241	241	241	241
	Mean	0.870	0.873	0.032	30.567	69.453	35.242	15.444
	Std. Deviation	1.038	3.257	0.001	1.056	2.158	1.415	1.758
	Skewness	-0.309	0.187	-0.349	-0.103	-0.081	0.668	-1.170
	Sig.	0.000	0.000	0.000	0.086*	0.200*	0.000	0.000
4	N_4	119	119	119	119	119	119	119
	Mean	4.549	2.221	0.030	29.943	68.096	35.730	19.199
	Std. Deviation	1.190	0.207	0.000	0.668	1.487	0.738	0.769
	Skewness	-0.105	-0.474	0.708	-0.883	-1.037	-0.761	0.060
	Sig.	0.200*	0.000	0.000	0.000	0.000	0.042	0.200*
Total	N_{Total}	1092	1092	1092	1092	1092	1092	1092
	Mean	0.856	0.767	0.032	31.998	71.369	35.785	13.300
	Std. Deviation	1.819	4.227	0.001	3.524	7.512	4.507	3.318
	Skewness	0.487	-1.264	-0.022	-0.309	-0.507	-0.861	0.313
	Sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000

* Statistically significant at $\alpha = 0.05$ by Kolmogorov-Smirnov test of normality.

Table 2 Hypotheses for considering linear relationship between variables

Hypothesis Test for Correlation	
Hypothesis 1	Hypothesis 4
H_0 : There is no correlation between INF and GDP	H_0 : There is no correlation between INF and SET100
H_1 : There is correlation between INF and GDP	H_1 : There is correlation between INF and SET100
Hypothesis 2	Hypothesis 5
H_0 : There is no correlation between INF and THB	H_0 : There is no correlation between INF and SETHD
H_1 : There is correlation between INF and THB	H_1 : There is correlation between INF and SETHD
Hypothesis 3	Hypothesis 6
H_0 : There is no correlation between INF and SET50	H_0 : There is no correlation between INF and MAI
H_1 : There is correlation between INF and SET50	H_1 : There is correlation between INF and MAI

4. Numerical Results

The overall relationship between an independent variable and dependent variables was investigated by Spearman Correlation as given in Table 3. The results showed that all hypotheses rejected H_0 . there was evidence to conclude that inflation had significant linear relationship ($\rho \neq 0$) with GDP, THB, SET50, SET100, SETHD and MAI at the significant level $\alpha = 0.05$. In particular, the linear interpolation showed good relationships in INF-GDP, INF-THB and INF-MAI with the Spearman correlation coefficients of 0.825,

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-0.603 and 0.830, respectively. There were the Spearman correlation coefficients lower than 0.5 in INF-SET50, INF-SET100 and INF-SETHD so that it is insufficient to conclude the relationship.

Table 3 Spearman correlations between inflation and other variables during 2018 – Q1 to 2022 – Q2

Variables	GDP	THB	SET50	SET100	SETHD	MAI
INF – Step function	.838**	-.571**	.131*	.163*	.298*	.802**
INF – Linear interpolation	.825**	-.603**	.189*	.221*	.319*	.830**
INF – Cubic spline	.513**	-.583**	.148*	.178*	.267*	.779**

* Statistically significant at $\alpha = 0.05$

** Statistically significant at $\alpha = 0.05$ and $\rho \geq \pm 0.5$

Visualizing linear relationships, Figure 4 exemplifies the negative moderate correlation in INF-THB and INF-SET50, but positive moderate correlation in INF-MAI. Considering the Spearman correlation coefficients against the four periods of INF, Table 4 separately shows Spearman correlation coefficients between inflation and other variables in each period. Regarding Hypothesis 1, the correlation in INF-GDP was highly positive in periods 2 and 4, but it was low in period 1 and moderate in period 3. For Hypothesis 2, the correlation in INF-THB was moderately negative in periods 1 and 3 whereas it was weak in period 2. In words, the inflation reversely varied with THB/USD exchange rate, i.e., inflation resulted in lower THB/USD exchange rate while deflation caused higher THB/USD exchange rate. Taking into account of SET50, SET100 and SETHD as mentioned in Hypotheses 3, 4 and 5, their correlations with INF were positive, but lower than 0.5 in period 2 when the deflation occurred, i.e., people felt more confident to trade in stock markets. Obviously, their correlations were negative in periods 3 and 4 indicating that the high inflation lessened people's confidence in stock trading. Interestingly, the correlation between INF and MAI was moderately positive in periods 1 and 3 when the inflation was mild, nearly 2%. Based on the numerical results in Table 4, there are four important relationships including INF-GDP, INF-THB, INF-SET and INF-MAI.

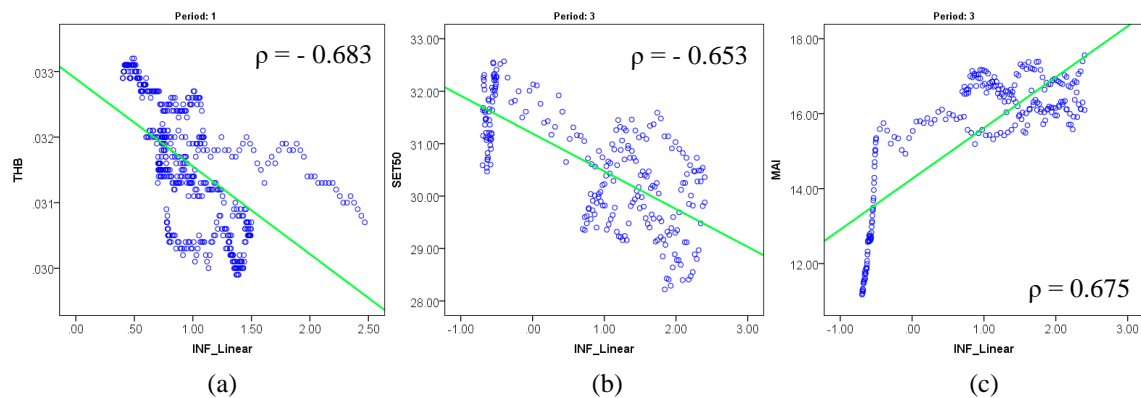


Figure 4 Scatterplots of three different correlations between INF and financial variables

**Table 4** Spearman correlation coefficients between inflation and other variables in four different periods

	Financial Variables	GDP	THB	SET50	SET100	SETHD	MAI
Period 1	INF – Step function	.488*	-.745**	-.407*	-.360*	.098*	.358*
	INF – Linear interpolation	.486*	-.683**	-.096*	-.015	.325*	.667**
	INF – Cubic spline	.406*	-.688**	-.200*	-.119*	.206*	.534**
Period 2	INF – Step function	.737**	.602**	.324*	.334*	.371*	.263*
	INF – Linear interpolation	.734**	.235*	.271*	.232*	.207*	-.191*
	INF – Cubic spline	.827**	.231*	.265*	.226*	.197*	-.189*
Period 3	INF – Step function	.563**	-.569**	-.416*	-.332*	-.234*	.604**
	INF – Linear interpolation	.574*	-.667**	-.653**	-.560*	-.594*	.675**
	INF – Cubic spline	.471**	-.666**	-.644**	-.563*	-.616*	.628**
Period 4	INF – Step function	.864**	.404*	-.314*	-.266*	-.367*	.105
	INF – Linear interpolation	.865**	.172	-.315*	-.324*	-.314*	-.219*
	INF – Cubic spline	.865**	.420*	-.317*	-.281*	-.323*	-.005

* Statistically significant at $\alpha = 0.05$ ** Statistically significant at $\alpha = 0.05$ and $\rho \geq \pm 0.5$

5. Discussion and Conclusion

Investigating the impact of inflation on GDP, THB/USD exchange rate and stock prices, the Spearman correlation accordingly reflect how each financial variable is related with inflation.

5.1 Discussion

According to the numerical results in Section 4, the relationship dynamic and natural mechanisms in INF-GDP, INF-THB, INF-SET and INF-MAI are discussed and some reasons behind the relationship are also provided as follows:

1) The result showed that inflation was positively influenced to GDP, i.e., the increase in inflation leads to the increase in GDP. There are four factors used for GDP calculation including private consumption expenditure, gross private investment, government investment and government spending (Investopedia, 2023a). The mild inflation can stimulate the customer's purchasing power. In fact, the inflation arises production costs leading to the higher customer price. In macroeconomics overview, the mild inflation (< 2%) leads and maintains the amount of cash circulating in an economic system because the demand is gradually growing (Investopedia, 2023b; Leamer, 2009). Additionally, the higher production leads to a lower unemployment rate and increases higher wages which can also lead to the demand of consumers spending. However, the mild inflation rate can stimulate the economic growth, but the economic system is harmed whenever the inflation rate is exceeding 2%.

2) Exchange rates can have a major impact on a country's economy, trade, investment, tourism, and monetary policy, making them an important factor to consider in global economic analysis and decision-making. From numerical results, the inflation was negatively influenced on THB/USD exchange rate, i.e., the higher inflation rate causes the depreciation of THB/USD exchange rate. Generally, the inflation can be the factor of declined of the exchange rates. Increase in inflation reduces the currency's buying power since its relative value to the main currencies (e.g., USD, EUR, JPY, GBP and CHF) is lowered (Christy, 2022). In this situation, the costs of goods and services are expensive are overpriced and people tend to save more money.

3) In general, high inflation rate can lead to decreased consumer purchasing power and decreased corporate profits, which can negatively impact stock prices (Eldomiaty et al., 2021). For SET50, SET100 and SETHD, the higher inflation reduces purchasing power and can lead to lower consumer confidence, causing a decrease in demand for stocks. On the other hand, lower inflation can boost consumer confidence and lead to higher demand for stocks, causing prices to rise. It is important to note that other factors such as interest rates, economic growth, and company-specific factors also play a role in determining stock prices.

4) MAI is the market for alternative investment which contains the small and medium-sized businesses (SMEs) that was indirectly affected by inflation. Because of cost rising and the companies has

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been struggled with the pandemic, many SMEs had to increase the prices of services and goods which increased the amount of cash circulating and might affected positively to the business profits. (Webster, 2023). In fact, inflation can increase the cost of goods and services, leading to higher prices and potentially reducing the purchasing power of consumers. This can negatively affect SMEs' sales and profits. On the other hand, inflation can also lead to an increase in demand for goods and services, providing new business opportunities for SMEs and boosting their revenue. Ultimately, the impact of inflation on SMEs will depend on various factors, including the level of inflation, the competitiveness of the market, and the ability of SMEs to adapt to changing economic conditions.

5.2 Conclusion

This study has illustrated how inflation plays important role in economic system. The impact of inflation on GDP, THB/USD exchange rate and stock prices were investigated in Thailand during from 2018–Q1 to 2022–Q2. Three interpolation techniques including piecewise constant, linear and cubic spline interpolations were employed in approximating the missing values and the Spearman correlation coefficient was used to analyze the relationship between inflation and each financial variable. The time series of inflation was divided into four periods corresponding with its severity and its influence on each financial variable was investigated in every period. Based on the empirical results, there was statically positive correlation between inflation and Thailand's GDP, i.e., the higher level of inflation, the larger amount of cash circulating in economic system. Unlike the GDP, inflation showed its negative correlation with THB/USD exchange rate. It is said that inflation led to the depreciation of THB/USD exchange rate. Taking into account the stock market, a moderate rate of inflation can indicate a growing economy, which can boost consumer and business spending, leading to increased corporate profits and positive stock performance. However, high inflation can erode consumer purchasing power and reduce corporate profits, causing a negative impact on the SET50, SET100 and SETHD. The mile inflation showed its positive correlation with MAI such that the demand for goods and services is higher as well as the business opportunities of SMEs. Expectedly, the findings in this study can be a guiding signal for risk management or research development to pursue the proper strategy and prepare to cope with financial crisis.

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