# VERIFICATION OF THE IMPACT OF SELECTED MACROECONOMIC ISSUES ON THE FORMATION OF THE WIG20 INDEX

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**Purpose:** The aim of the article was to assess the impact of selected macroeconomic variables on the WIG20 stock index.

**Design/methodology/approach**: The study included the following macroeconomic indicators: GDP, inflation and industrial production. The analysis included a Pearson linear correlation test and a Granger causality test. The study was based on quarterly data for the period from January 2000 to June 2023.

**Findings:** The research results suggest that the inflation rate does not have a significant impact on changes in the WIG20 index, which is confirmed by correlation analysis and causality tests. The industrial production index and the GDP index have a moderate impact on changes in the stock exchange index.

**Research limitations/implications**: The study used only selected macroeconomic variables affecting the value of the WIG20 index. It should also be noted that the study was based on statistical data on a quarterly basis, where the possibility of more accurate data could allow for more detailed results.

**Practical implications:** The conducted research can help investors make decisions by providing information on the relationship between selected macroeconomic factors and the stock market. The obtained results of correlation and causality allow us to understand how individual indicators, such as industrial production or GDP, may influence the behavior of the WIG20 stock exchange index.

**Originality/value:** This research allows for understanding the relationship between macroeconomic factors and the stock market, especially in the context of the Polish capital market. The study allows to re-analyze the impact of selected macroeconomic indicators on the stock market index for a new and broader research period.

**Keywords:** stock market, macroeconomics, investments.

**Category of the paper:** Research paper.

## Introduction

The stock market is seen as an indicator of the state of a country's economy. Stock market changes reflect different stages of the economic cycle, where changes in the stock market may confirm the relationship between the country's economic factors and stock market events. The WIG20 index is one of the important indicators on the Polish capital market, which plays a key role in assessing the country's economic dynamics. As a collection of the twenty largest and most liquid companies listed on the Warsaw Stock Exchange, it is an important point of reference for investors, stakeholders and analysts. This index serves as an indicator of the overall direction of the stock market in Poland, reflecting the general trend (upward or downward) of listed companies. Proper analysis of the index is a crucial tool for both individual investors, who use it in the investment decision-making process, and for financial institutions and investment funds, which utilize it in portfolio management. Additionally, the WIG20 index plays a significant role in international economic relations, as one of the key indicators reflecting the condition of the Polish economy. Changes in its value may impact the perception of Poland as a destination for foreign investment.

In the literature on financial markets, there are numerous descriptions of relationships indicating a close connection between the state of the capital market (especially the stock market) and the real economy. Many researchers have conducted studies on the relationship between macroeconomic indicators and stock market indices, and the results of these analyses have often been diverse. Empirical research conducted by M. Celej did not demonstrate a significant relationship between macroeconomic factors and stock prices of companies listed on the Warsaw Stock Exchange (Celej, 2014). J. Przybył, in his considerations on investments in capital markets with varying growth rates, arrived at similar conclusions. In his analyses, he found that there is no long-term relationship between GDP growth and stock returns (Przybył, year of report retrieval 2024). It is worth mentioning the study by Gajdek and Pietraszewski, who conducted an analysis of the relationship between the capital market and GDP growth in 11 countries of Central and Eastern Europe. Their findings indicate that the degree of dependence is not straightforward, with countries with less advanced capital markets showing a strong and positive correlation, while those with more developed capital markets exhibit no correlation or even a negative impact (Gajdka, Pietraszewski, 2014). Similarly, M. Radke presented a similar view, conducting an analysis of the relationship between economic growth and the capital market for 20 European countries. In the conducted analyses, he noticed that changes in stock market index values mostly correlate positively with GDP, although this correlation is low or moderate (Radke, 2021). This topic was also addressed by E. Widz, who suggests that there is a positive but moderate correlation between changes in the main stock market indices of the Warsaw Stock Exchange and changes in GDP in Poland. It appears that changes in stock market indices precede changes in GDP, although in the case of significant

changes in GDP, a stronger correlation is observed along with simultaneous changes in indices (Widz, 2016). Similar observations were made in analyses by another research team, where changes in the WIG index and GDP occurred practically simultaneously or with a slight quarterly delay (Brzeszczyński et al., 2009). The authors noted that if these relationships remain stable in the future, it can be assumed that the improvement in economic conditions will coexist with improvements in the stock market. Continuing this argument, it can be hypothesized that the existence of a solid correlation between economic trends and the stock market will allow investors and market analysts to use information about changes in GDP to forecast market direction, and vice versa.

In terms of macroeconomic indicators, the issue of the impact of inflation on the stock market is often discussed. According to the Polish Language Dictionary, inflation is defined as *a progressive decrease in the purchasing power of money and the associated increase in prices, caused by the circulation of too much money relative to the goods introduced* (PWM, 2024). Inflation, which signifies an increase in the prices of goods and services, theoretically can result in an increase in nominal company incomes, which in turn can affect the increase in the value of their stocks. However, high inflation primarily leads to negative effects, where (in the case of companies) price increases can raise business costs, leading to a decrease in their profit margins. High inflation also leads to an increase in interest rates, aimed at curbing price increases by restraining demand. The rise in interest rates may negatively impact stock prices, as higher loan costs can reduce firm profits and decrease the attractiveness of stock investments. In a study conducted by G. Adams and his team on the impact of inflation on stock prices, it was found that unexpected increases in both the PPI and CPI indices lead to a decrease in stock prices (Adams et al., 2004). A. Humpe and P. Macmillan examined how macroeconomic variables can explain long-term movements in the stock markets of the USA and Japan. Based on their research, it was found that in the case of the United States, there is a negative relationship between stock prices and the long-term high interest rate (resulting from inflation) (Humpe, Macmillan, 2007). As described by P. Fiszeder and S. Rowiński, the results of most empirical studies in the global literature suggest that inflation typically leads to a short-term decline in stock prices. The delayed effects of inflation on current increases in the WIG index are also negative, although not statistically significant (Fiszeder, Rowiński, 2012). The authors also noted that the relationship between economic activity and market sentiment on stock markets is quite complex because the stock market serves as an economic indicator. On the other hand, market sentiment can influence economic activity through wealth and investment effects. In the case of the European stock market, it is worth mentioning the study by P. Chodnicka-Jaworska and K. Niewińska, which focused on identifying macroeconomic factors affecting the banking sector in Europe. According to the analysis, high interest rates and the level of inflation have a favorable impact on bank stock returns (Chodnicka-Jaworska, Niewińska, 2016). Furthermore, the obtained results clearly demonstrated the significant

influence of elements such as: GDP growth rate, short-term and long-term market rate, and changes in the producer price index.

The widely discussed issue also includes the aspect of interdependence between industrial production and the stock market index. Industrial production can be seen as one of the key indicators of economic conditions, and its changes can significantly affect investor sentiment and asset valuation in financial markets. T. Chiang and X. Chen in their research pointed out that an increase in stock profits or market value positively contributes to industrial production growth (Chiang, Chen, 2017). They conducted their studies for 20 international markets (excluding the Polish market). Similar research results were obtained by another group of researchers, who determined that current changes in stock prices positively influence industrial production, but the pace of industrial production does not have a short-term impact on the Indian stock market (Sahu, Bandopadhyay, 2020). A different opinion on this matter is held by A. Bhattacharjee and J. Das, where it was found that inflation, interest rates, gold prices, and industrial production do not have a significant impact on the stock market (the study focused on the Indian stock market) (Bhattacharjee, Das, 2021).

It is worth noting that the majority of studies mentioned in the literature review analyzed relationships based on specific time series. The stock market is often perceived as an indicator that can predict future economic reality, and therefore it can influence various economic indicators. Information from the stock market affects social moods, which directly impacts the pace of consumption and domestic demand. Literature analysis suggests that a re-evaluation of the impact of macroeconomic factors on the main WIG20 stock index is necessary. This is motivated by the lack of clear conclusions from previous empirical research on these relationships. Through further empirical studies (for a new research period), it will be possible to establish more precise dependencies and better understand the dynamics of the stock market. This, in turn, will enable investors to make rational and accurate investment decisions, contributing to more efficient capital utilization in the financial market. Therefore, this article aims to empirically assess the impact of selected national macroeconomic variables on the examined WIG20 stock index.

## Research methodology

The study focused on an attempt to assess the interdependence of selected macroeconomic indicators on the WIG20 stock exchange index. The study included the following macroeconomic indicators: GDP, inflation and industrial production. In the first step of the study, appropriate statistical data were downloaded, available on the website: biznesradar.pl (historical values of the WIG20 index) and bankier.pl (selected macroeconomic data). The research period included data from the beginning of January 2000 to June 2023.

In connection with the implementation of the research goal, a research methodology was formulated, the graphical visualization of which is presented in Figure 1.
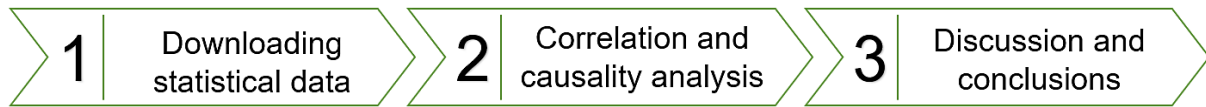


**Figure 1.** Research methodology.

Source: own study.

As part of the second step of the analysis, the linear correlation and Granger causality of selected macroeconomic indicators with the WIG20 index were examined. In the case of interdependence, the Pearson linear correlation formula was used (Aczel, Sounderpandian, 2009):

$$\hat{r} = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2 \sum(y - \bar{y})^2}}$$

Correlation scores range from -1 to 1, where numbers close to 1 indicate a strong linear relationship and numbers close to 0 indicate no such relationship. Negative values indicate that an increase in variable X results in a decrease in variable Y, while positive values mean that an increase in X leads to an increase in Y. We interpret the correlation obtained as follows (Kafle, 2019):

- $0 < r < 0.4$ – low correlation;
- $0.4 \leq r < 0.7$ – medium correlation;
- $0.7 \leq r < 1$ – high correlation;
- $r = 1$ – completely positive correlation.

To deepen the analysis of the relationship, it was also examined whether variable X (representing macroeconomic indicators) exerts a causal influence on variable Y (WIG20 index) through Granger causality analysis. In this case, we characterize the calculations as follows (Granger, 1969):

$$Yt = a_0 + \sum_{i=1}^{p} ay_i Yt - i + \sum_{i=1}^{p} ax_i Xt - i + \varepsilon Yt$$

$$Xt = \beta_0 + \sum_{i=1}^{p} \beta x_i Xt - i + \sum_{i=1}^{p} \beta y_i Yt - i + \varepsilon Xt$$

where:

$Y_t$, $X_t$ – research variables;

$a_0$, $\beta_0$ – free word;

$p$ – row of delays.

## Results

Comparing information on quarterly changes in macroeconomic indicators (year-on-year basis) with the WIG20 index allows us to observe whether there is a general relationship between changes in the values of these indicators and the overall trend in the WIG20 index. Table 1 presents the results of the correlation analysis, where the relationships between macroeconomic indicators and the point value of the WIG20 were examined.

**Table 1.**
*Results of the correlation analysis between selected macroeconomic indicators and the point value of the WIG20 index*

|  | Inflation rate (y/y) | Industrial production index (y/y) | GDP indicator (y/y) | WIG20 |
|---|---|---|---|---|
| Inflation rate (y/y) | 1.00 | -0.02 | 0.04 | -0.19 |
| Industrial production index (y/y) | -0.02 | 1.00 | 0.53 | 0.19 |
| GDP indicator (y/y) | 0.04 | 0.53 | 1.00 | 0.46 |
| WIG20 | -0.19 | 0.19 | 0.46 | 1.00 |

Source: own study.

The correlation coefficient between the WIG20 index and the GDP indicator is 0.46, indicating a moderate positive relationship between these two variables. Such a result suggests that when GDP increases, there is a higher likelihood that the WIG20 index will also increase, although this relationship is not very strong. Investors may be optimistic about the prospects of companies during economic growth periods, which can lead to an increase in stock prices on the stock exchange. The correlation coefficient between the WIG20 index and the inflation indicator is -0.19, indicating a weak negative relationship between these two variables. This result suggests that there is some inverse relationship in the behavior of the WIG20 index concerning changes in the inflation rate. However, this relationship is weak, which may mean that changes in inflation are just one of many factors influencing the behavior of stock markets. A weak correlation with the stock index was also observed in the case of the industrial production index, which was 0.19.

When examining the interdependence of such variables, it is advantageous to compare indicators to the percentage growth of the WIG20, allowing for an assessment of the economic growth rate relative to the pace of stock market growth. The results of such an analysis have been presented in Table 2.

**Table 2.**
*Results of the correlation analysis between selected macroeconomic indicators and the percentage change in the point value of the WIG20 index year to year*

|  | Inflation rate (y/y) | Industrial production index (y/y) | GDP indicator (y/y) | Change WIG20 index (y/y) |
|---|---|---|---|---|
| Inflation rate (y/y) | 1.00 | -0.02 | 0.04 | **-0.13** |
| Industrial production index (y/y) | -0.02 | 1.00 | 0.53 | **0.52** |
| GDP indicator (y/y) | 0.04 | 0.53 | 1.00 | **0.40** |
| Change WIG20 index (y/y) | **-0.13** | **0.52** | **0.40** | 1.00 |

Source: own study.

Analyzing the percentage change of the WIG20 concerning the same indicators, we observe similar trends, albeit with varying strengths of relationships. The negative correlation of the WIG20 percentage change to inflation (-0.13) suggests a potential decrease in the WIG20 value in response to inflationary growth, although this relationship is weaker than in the calculations from Table 1. Similarly, concerning the change in the GDP indicator, its correlation with the WIG20 decreased from 0.46 to 0.40, remaining interpreted as a moderate dependency. Conversely, there was an increase in the positive correlation of the WIG20 percentage change to the industrial production change (rising from 0.19 to 0.52). This implies that the growth in industrial production may correlate with the increase in the WIG20 value, which can be interpreted as a positive signal for stock market investors. However, it is essential to remember that correlation does not necessarily imply causation, and other factors may influence stock price movements on the stock market.

In the causality analysis, the focus was on a lag of 2, where the Granger test considered a maximum lag of two units of the chosen time (i.e., two quarters). The results of the Granger causality tests have been presented in Table 3.

**Table 3.**
*The results of Granger causality for individual indicators on the year-on-year change of the WIG20 index and the point-wise change of the WIG20 index*

|  | CAUSALITY OF THE INDICATOR ON THE INDEX | | | | | |
|---|---|---|---|---|---|---|
|  | Inflation rate (y/y) | | Industrial production index (y/y) | | GDP indicator (y/y) | |
|  | F | p-value | F | p-value | F | p-value |
| CHANGE WIG20 INDEX (Y/Y) | 0.25 | 0.78 | 4.95 | 0.01 | 4.22 | 0.02 |
| WIG20 | 0.60 | 0.54 | 2.41 | 0.09 | 2.36 | 0.10 |

Source: own study.

The causality test results suggest a significant relationship between the industrial production index and the year-on-year change in WIG20. With a p-value of 0.01, there is a very small probability that this relationship occurred by chance. Similarly, for the GDP indicator, where the p-value was determined to be 0.02. This indicates a strong basis for rejecting the hypothesis of no causality. Consequently, it can be inferred that changes in the industrial production index and changes in GDP may influence changes in WIG20 on a year-on-year basis. Different results were obtained when analyzing the causality of indicators directly on the

point change of the WIG20 index. In this case, none of the variables achieved a p-value less than 0.05. Regarding the industrial production index, the p-value was obtained at 0.09, meaning there is about a 9 percent chance that the observed relationship could have occurred by chance. This result is not sufficiently convincing to reject the hypothesis of no causality between the industrial production index and WIG20.

## Conclusions

The conducted research has shown a varied impact of selected macroeconomic factors on the WIG20 stock index. The results of correlation and causality analysis have helped identify which of the proposed variables should be considered in potential investments. The research findings suggest that the inflation index does not have a significant influence on changes in the WIG20 index, as confirmed by correlation analysis and causality testing. The industrial production index and GDP indicator have a moderate impact on changes in the stock index. A similar opinion was expressed by (Fiszeder, Rowiński, 2012) and (Bhattacharjee, Das, 2021). Satisfactory results were obtained in terms of the causality and correlation of these indicators in attempting to assess their impact on the value of the WIG20 index, albeit in a year-on-year percentage basis. The research results are consistent with the results of other researchers cited in the introduction (Brzeszczyński et al., 2009; Widz, 2016; Chiang, Chen, 2017; Sahu, Bandopadhyay, 2020; Radke, 2021). The final conclusions from the research suggest that considering the industrial production and GDP indicators may be significant in investment decision-making, while the inflation indicator may have less importance for changes in prices in the stock market. Like all studies, this one also has certain limitations. Firstly, only selected macroeconomic variables influencing the value of the WIG20 index were used in the study. Secondly, it should be noted that the study relied on quarterly statistical data, where the possibility of more precise data could lead to more detailed results. Thirdly, the study focused solely on the relationship between macroeconomic variables and the WIG20 index without considering potential non-linear relationships or interactions among variables, which could provide further insights into the dynamics of the stock market. Additionally, the study did not account for external factors such as geopolitical events or regulatory changes, which could also influence stock market movements independently of the selected macroeconomic indicators.

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