The Role of Digital Economy in Improving Economic Growth in Indonesia

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Abstract

This study aims to determine the role of the digital economy in increasing economic growth in Indonesia. The variables in this study are Labor, Inflation, Investment and Unemployment. The analysis method used in this study is to use the Vector Auto Regression (VAR) model with the Impulse Response Function (IRF) test, Forecast Error Variance Decomposition (FEVD), stationarity test, cointegration test, lag structure stability test, and optimal lag length test. The results of the Vector Autoregression study using the lag 2 basis show that there is a contribution from each variable to the variable itself and other variables. The results of the Vector Autoregression analysis also show that past variables (t-1) contribute to the current variable both to the variable itself and other variables. From the results of the analysis, there is a reciprocal relationship between one variable and another. Response Function analysis shows the response of other variables to changes in one variable in the short, medium and long term, and it is known that the stability of the response of all variables is formed in a period of 5 years or the medium and long term. Variance AnalysisDecomposition shows the existence of variables that have the largest contribution to the variable itself in the short, medium and long term such as Inflation and Labor. While other variables that have the greatest influence on the variable itself and are supported by other variables in the short, medium and long term are Investment and Unemployment which are most influenced by Inflation and Labor.

Keywords: Labor, Inflation, Investment, Unemployment and VAR Method

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Introduction

Amidst the increasingly rapid dynamics of globalization, the digital economy has emerged as a new force capable of changing the face of a country's economy. Indonesia, as one of the countries with the fastest economic growth in Southeast Asia, is not free from this phenomenon. The potential of the digital economy in Indonesia is enormous, driven by the increasing number of internet users, the continued development of technological innovation, and the support of proactive government policies. The increase in economic growth through the digital economy can also be seen from its contribution to job creation and improving the quality of life of the community. In addition, the Indonesian government is also actively encouraging the development of the digital economy through various policies and programs, which aim to strengthen digital infrastructure and improve human resource skills.

Progress in economic growth cannot be separated from the influence of technological progress. The current era of technology is the empowerment of the role of digital integration in the industrial sector which is better known as the era of industry 4.0. Industry 4.0 empowers the role of digital manufacturing in the supply network by including the integration of information from various sources and locations which are then used to drive manufacturing and distribution physically. (Syafii Tanjung, 2022).

Digital economy, or the digital economy is a paradigm shift in information technology with a concept popularized by Don Tapscott, meaning an economic activity based on digital internet technology. Some other names for this digital economy include the internet economy, then there is the web economy, the digital-based economy, or also as a new economy. Digital transformation almost dominates the entire business process, from how products and services are produced to their marketing activities, how the company's structure and target achievements are, the dynamics of the competitive environment, to how the formula for a business's success is found(Efendi, 2023).

The digital economy has become a recent phenomenon and is important for predicting double-digit economic growth. One important factor in driving economic growth is the development of technological innovation. In the 1990s, economic change began to be associated with the internet, which became the basis for the growth of the digital economy. With the emergence of technology, accessibility has become stronger so that the economy can grow rapidly. Brynjolfsson & Kahin in Budiarta defines the digital economyas a new transformation and some have not yet been realized in all economic sectors supported by computers. In which, the transformation has not yet been realized in all economic sectors. Brynjolfsson & Kahin emphasize the understanding of the digital economy from the perspective of macroeconomics, competition, labor and organizational change(Abdillah, 2024).

The digital economy is an economic system that uses digital technology as a key element in the production, distribution, and consumption of goods and services. It encompasses everything from e-commerce, digital banking, instant messaging applications, and social media. One of the characteristics of the digital economy is the adoption of digital technology to improve efficient production processes, connect businesses with customers globally, and create

innovation to drive growth.economy. The digital economy has many benefits for a country, including:

a. Building international markets: The digital economy enables companies to sell products and services through digital platforms such as e-commerce, which expands markets and increases imports and exports.
b. Creating jobs: The digital economy is creating a wider range of jobs, from software developers to data analysts and cybersecurity experts.
c. Streamlining production processes: Adopting digital technologies to improve efficient production processes and connecting businesses with customers globally.
d. Reduced operational costs: The digital economy allows companies to save on operational costs that were previously required for physical stores.
e. Speeding up and simplifying transactions: The digital economy enables online transactions, which makes purchasing and ordering easier.
f. Facilitating investment: The digital economy enables online investment, making it easier for the general public to start their savings efforts.
g. Building collaboration and networks: The digital economy enables companies to more easily collaborate with business partners, suppliers and consumers.
h. Accelerating product and service development: The digital economy enables consumers to participate in the creation and curation of content, products and services, which reduces transaction costs and increases benefits for both parties.
i. Accelerating management and control: The digital economy enables the integration of different systems, applications and business processes to create an integrated ecosystem, which enables smoother information flow, better collaboration and more efficient management within the digital ecosystem.
j. Accelerating technology development: The digital economy enables companies to develop digital technologies to increase efficiency, improve consumer experience, and optimize overall company operations.(Suhanti, 2024).

Economic growth is briefly defined as the process of increasing output per capita in the long term. Economic growth is a process, not a picture of the economy at a certain time (one shot). The dynamic aspect of an economy, namely seeing an economy as something that develops or changes over time. According to Simon Kuznets economic growth is a long-term increase in a country's ability to provide more and more types of economic goods to its population. This ability grows in accordance with technological progress, and the institutional and ideological adjustments it requires. Technological change is considered the most important factor in the process of economic growth. This change is related to changes in production methods which are the result of innovation or the result of new research techniques.(Hesya, 2022).

Advances in information and communication technology have created new opportunities for direct investment to enter new digital-based sectors. However, on the other hand, these developments have also created new challenges in the legal framework governing direct investment. One of the main aspects of this transformation is its effect on investment practices, with direct investment becoming increasingly important and complex amidst the changing economic landscape. Direct investment, which involves channeling funds directly into productive assets such as companies, infrastructure projects, or startups, has become a

major focus for investors seeking higher returns and greater control over their investments. In the context of the digital economy, this hasgiving rise to new dynamics that need to be considered by market players and regulators.(Suhanti, 2024).

Innovation in technology is also needed to maintain economic stability, one of which is by maintaining price stability.*Inflation targeting*is one of the policies based on the regime for inflation targeting, because high inflation will harm economic growth. The digital economy affects inflation in a complex way, with the increase in online transactions, many new businesses have emerged which creates tighter competition. This competition often drives down prices, which can reduce inflation. On the other hand, efficiency and productivity are also increasing thanks to technology, businesses that use digital tools can reduce operational costs which in turn can stabilize or lower the price of goods and services. In addition, consumers now find it easier to compare prices online which encourages manufacturers to set more competitive prices(Supriyadi, 2023).

The digital sector also contributes to the creation of new jobs, from software development to digital marketing, providing opportunities for young workers. In addition, digitalization increases productivity by leveraging data and analytics for better decision-making. Investments in digital infrastructure, such as internet networks, support better connectivity and access to information. It also encourages skills development in information and communication technology, which is essential for competitiveness in the job market. The digital economy also brings financial inclusion, providing easier access to financial services, especially for those who were previously unbanked. With all these contributions, the digital economy is not only a driver of growth, but also strengthens the resilience of the Indonesian economy in facing global challenges.

Research Methods

The approach taken by quantitative researchers is based on secondary data from the period 2007-2022 through the Worldbank. The conceptual framework of the research is as follows:

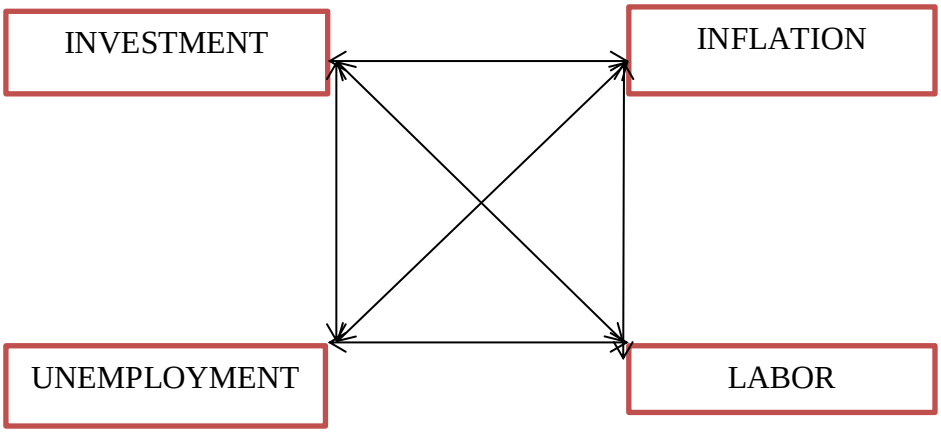


Figure 1. Conceptual Framework of Vector Auto Regression

The conceptual framework image explains the model used is the Vector Auto Regression (VAR) test to analyze monetary policy in strengthening economic fundamentals in Indonesia by looking at the formation of vectors that influence each other between variables.

According to Manurung (2009) it is impossible to distinguish between endogenous and exogenous variables if simultaneity between several variables is true. Testing simultaneous relationships and degrees of integration between variables in the long term using the VAR method is used because it is easier to use and to empirically prove the complex long-term reciprocal relationship of endogenous variables. The VAR analysis model consists of the following formula:

$$INV_t = \beta_{10} INV_{t-p} + \beta_{12} INF_{t-p} + \beta_{13} PG_{t-p} + \beta_{14} TK_{t-p} + \ldots + e_{t1}$$

$$INF_t = \beta_{10} INV_{t-p} + \beta_{12} INF_{t-p} + \beta_{13} PG_{t-p} + \beta_{14} TK_{t-p} + \ldots + e_{t1}$$

$$PG_t = \beta_{10} INV_{t-p} + \beta_{12} INF_{t-p} + \beta_{13} PG_{t-p} + \beta_{14} TK_{t-p} + \ldots + e_{t1}$$

$$TK_t = \beta_{10} INV_{t-p} + \beta_{12} INF_{t-p} + \beta_{13} PG_{t-p} + \beta_{14} TK_{t-p} + \ldots + e_{t1}$$

Where :

INV = Investment

INF = Inflation

PG = Unemployment

Kindergarten = Labor

p = length lag

Next is the analysis of the Impulse Response Function (IRF) model, conducted to understand how each variable affects the standard deviation of innovation. Ariefianto (2012) explains that IRF conducts a search related to the impact of shocks or shocks on a variable in the system within a certain period of time. The purpose of the IRF analysis is to determine whether each transmission variable is cointegrated in both the short and long term. Manurung (2005) states that IRF is an indicator of changes in the direction of movement of transmission variables as a result of changes in other transmission variables. To find out how important various shocks are to the variable itself and other variables, the Forecast Error Variance Decomposition (FEVD) is used. Manurung (2005) states that the purpose of the FEVD analysis is to determine the contribution or influence between transmission variables.

Further analysis is carried out with the Assumption test consisting of the Data Stationarity Test (Unit Roots Test) and the Johansen Cointegration Test. Data stationarity can be obtained from data that is initially non-stationary through testing the degree of integration or stationarity at the level of data differentiation. This process involves testing the availability of data stationarity at one level and then repeating the test at the differentiation level until it reaches a stationary condition. Dickey-Fuller recommends applying certain regression models to determine the presence of unit roots in the data, as follows:

$$\Delta Yt = \theta Yt\text{-}1 + et \quad (1)$$

$$\Delta Yt = \beta 1 + \theta Yt\text{-}1 + et \quad (2)$$

$$\Delta Yt = \beta 1 + \beta 2t + \theta Yt\text{-}1 + et \quad (3)$$

In equation (1), the variable that shows the difference in time trend is denoted as t, and there are two additional regressors that include constant and time trend variables. Each model

has two hypotheses considered: the null hypothesis Θ = 0, which indicates the non-stationarity of the data, and the alternative hypothesis Θ < 0, which indicates that the data is stationary. The DF statistic, represented by the t value of the coefficient ΘYt-1, is compared with its critical value; the rejection of the null hypothesis occurs if the absolute value of the DF statistic exceeds the critical value, indicating that the observed data is stationary. Conversely, if the value of the DF statistic is smaller than the critical value of the t distribution, then the data is considered non-stationary. The residuals et and the autocorrelation elements are often related and interrelated according to the assumptions in equations (1) and (2). Dickey Fuller then included the autocorrelation elements into his model, known as the Augmented Dickey-Fuller (ADF) to develop the unit root test. This ADF test is commonly used to assess the stationarity of data. The formulation of the ADF test can be explained as follows:

$$\Delta Yt = \gamma Yt-1 + \sum \beta \Delta Yt-1+1n\ t-1 + et \quad (4)$$

$$\Delta Yt = \alpha 0 + \gamma Yt-1 + \sum \beta \Delta Yt-1+1n\ t-1 + et \quad (5)$$

$$\Delta Yt = \alpha 0 + \alpha 1T + \gamma Yt-1 + \sum \beta \Delta Yt-1+1n\ t-1 + et \quad (6)$$

Where: Y = Research variable Yt = Yt – Yt-1 T = Time trend N = lag value The process of assessing whether the data is stationary or not involves comparing the ADF statistic value with the Mackinnon critical distribution value. The t statistic value of the coefficient γYt-1 is given in equations (4 to 6). If the absolute value of the ADF statistic exceeds its critical value, then the observed data shows a stationary nature. Conversely, if the absolute value of the ADF statistic is smaller than its critical value, then the data is considered non-stationary. It is also important to determine the length of the lag in the ADF test, and the Aikake Information Criterion (AIC) or Schwarz Information Criterion (SIC) can be used for this purpose. The model with the lowest AIC and SIC values is considered the most appropriate model. After knowing that the Export and Import data are stationary, the next step will determine whether there is a long-run equilibrium relationship between the two. There is one direction of Granger causality that is most uncertain if the two variables are integrated to degree one, I (1) and cointegrated. Based on the representation theorem, it is said that if a vector n/ (1) of time series data Xt is cointegrated with the cointegration vector, then there is an error correction representation, which can be mathematically represented by: A (L).Xt = -yaXt-1 + β(L) εt (7) Where: A(L) is a polynomial matrix in the lag operator with A(0) = I; Y is a (nx1) constant vector that is not equal to zero; β(L) is a polynomial scalar in L; and εt is a vector of error variables that are white noise. In the short term, any deviation from long-term equilibrium (a'X=0) will affect the change in Xt and will adjust back towards equilibrium. The cointegration test that will be used here uses a test procedure.

Results and Discussion

The results of Vector Autoregression show that with a lag of 1, the vector autoregression analysis shows the contribution of each variable to the variable itself and other variables, which is more clearly described in the following table:

Table 1. Vector Autoregression Results

Lag 1	Lag 2
Vector Autoregression Estimates Date: 09/24/24 Time: 18:31 Sample (adjusted):2 16 Included observations: 15 after adjustments Standard errors in()&t-statistics in[] Determinant resid covatiance (dofadj.) 1.7312. Determinant residual covariance 3.4211 Log likelihood -284.3110 Akaike information criteria 40.57480 Black criterion 41.51886 Number of coefficients 20	Vector Autoregression Estimates Date: 09/24/24 Time: 18:13 Sample (adjusted):3 16 Included observations: 14 after adjustments Standard errors in()&t-statistics in[] Determinant resid covatiance (dofadj.) 2.1711 Determinant residual covariance 3.5309 Log likelihood -233.3530 Akaike information criteria 38.47900 Black criterion 40.12229 Number of coefficients 36

Source: Author's Processed Data, 2024

In Table 1. above, the VAR results show a Lag 1 AIC value of 40.57480 < Lag value2 AIC 38.4790 also shows that the past variable (t-1) contributes to the current variable, both to the variable itself and to other variables. The analysis results show that there is a reciprocal relationship between the variables. Next is the Cointegration Test analysis with the results described as follows:

Table 2. Cointegration Test

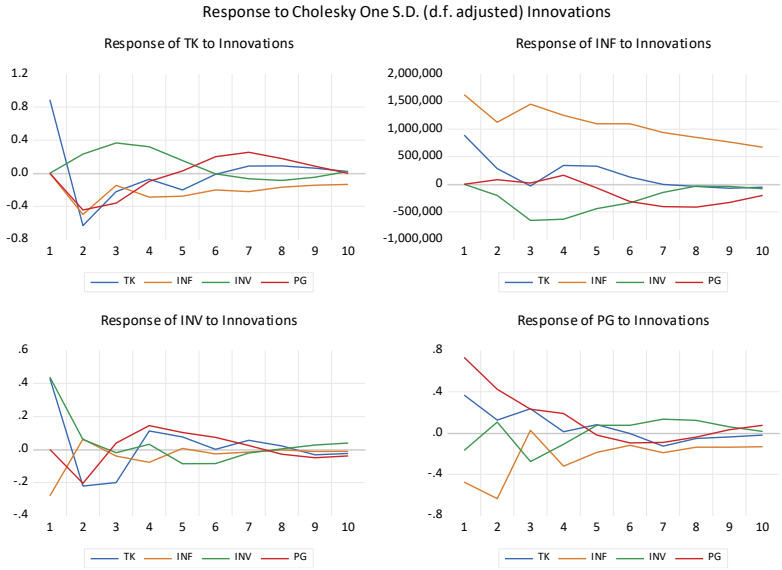
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics	0.05 Critical Value	Prob.**
None *	0.958429	78.58633	47.85613	0.0000
At most 1 *	0.731506	34.06128	29.79707	0.0152
At most 2 *	0.592278	15.65232	15.49471	0.0473
At most 3	0.198165	3.091934	3.841466	0.0787

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistics	0.05 Critical Value	Prob.**
None *	0.958429	44.52505	27.58434	0.0001
At most 1*	0.731506	18.40896	21.13162	0.1153
At most 2*	0.592278	12.56038	14.26460	0.0913
At most 3	0.198165	3.091934	3.841466	0.0787

Source: Eviews Output 2024

Based on table 2 above, the results of cointegration testing using the Johansen method are obtained, namely the trece statistic and max-eigen-statistic values at r = 0 are smaller than the critical value. This means that there is no cointegration. Based on the results above, it can be seen that among the four variables in this study there is cointegration. Thus, the results of the cointegration test identify that the variables, Investment, Labor and Unemployment have a relationship of equilibrium stability and similarity of movement in the long term. Next is the Impulse Response Function (IRF) analysis with the results described as follows:

Figure 2. Impulse Response Function (IRF) results



The image shows the results *Impulse Response Function (IRF)*from a VAR (Vector Autoregression) model, which describes the response of economic variables to a one standard deviation shock from the innovation in the model. The first graph shows how labor (TK) responds to innovations from inflation (INF), investment (INV), and unemployment (PG). The labor response fluctuates, showing an increase and decrease at the beginning of the period before finally stabilizing. The second graph shows how inflation responds to shocks from other variables. Initially, inflation shows a fairly large response, then gradually decreases and finally stabilizes after several periods. The third graph shows the response of investment to innovation. Like other variables, investment fluctuates at the beginning, but eventually shows a stable pattern in the long run. Finally, the fourth graph shows how unemployment responds to shocks from labor, inflation, and investment. At the beginning of the period, the unemployment response is quite large with significant fluctuations, indicating that unemployment is highly influenced by shocks to other variables, but then the response gradually stabilizes. Overall, it shows the dynamics between these macroeconomic variables and how each variable responds to innovations that occur in other variables.

The following table 3 is the result of the impulse response function (IRF) model which can be explained as follows:

Table 3. Digital Economy Recommendations to Increase Economic Growth

Period	Short Term (Period 1)	Medium Term (Period 5)	Long Term (Period 10)
INF itself	16.0%	10.0%	67.1%
Biggest 1	INF 16.0%	INF 10.0%	INF 67.1%
Biggest 2	Kindergarten 0.88%	Kindergarten 0.20%	Kindergarten 0.02%

Table 3. shows that the INF variable itself is responsible as a digital economy in increasing economic growth in the short, medium, and long term. Furthermore, INF control is responsible for other variables that can be used to control short, medium, and long-term labor.

From the results of the Forecast Error Variance Decomposition (FEVD) analysis, several interactions are known between the digital economy in increasing economic growth. The interaction of digital economy variables can be seen from the Forecast Error Variance Decomposition describing policy variables that are more effective against economic growth variables. For more details, here are the results of the interaction of the digital economy in increasing economic growth in Indonesia.

Table 4. Interaction of Digital Economy in Increasing Economic Growth

Variables	Digital Economy in Increasing Economic Growth				Period
	Kindergarten	INF	INV	PG	
Labor	0.88%	100.0%	0.00%	0.00%	Short-term
	54.29%	18.19%	13.23%	14.27%	Medium term
	48.28%	21.78%	12.15%	17.78%	Long-term
Inflation	23.07%	76.92%	0.00%	0.00%	Short-term
	9.97%	79.93%	9.73%	0.34%	Medium term
	7.20%	81.00%	7.78%	4.01%	Long-term
Investment	40.57%	17.21%	42.21%	0.00%	Short-term
	44.16%	13.61%	30.93%	11.29%	Medium term
	43.17%	13.25%	3.15%	12.41%	Long-term
Unemployment	14.54%	24.39%	3.08%	57.97%	Short-term
	11.06%	40.04%	6.96%	41.92%	Medium term
	11.02%	41.37%	8.32%	39.27%	Long-term

Source: Author's processed data, 2024

: Largest 1

: Largest 2

Based on Table 4 above,shows how the digital economy affects economic growth through the variables of labor (TK), inflation (INF), investment (INV), and unemployment (PG) in various time periods (short, medium, and long term). For the labor variable, in the short term, 100% of its variation is influenced by itself, and the influence of inflation is very small, only 0.88%. There is no visible influence from investment or unemployment in this period. When moving to the medium term, the contribution of other variables begins to be seen. Labor still has an influence on itself of 54.29%, but the influence of inflation increases to 18.19%, investment by 13.23%, and unemployment has an influence of 14.27%. This shows that in the medium term, labor is not only influenced by internal dynamics, but also by other variables such as inflation, investment, and unemployment. In the long term, the influence of labor on itself decreases to 48.28%, while inflation (21.78%), investment (12.15%), and unemployment (17.78%) have increasingly significant influences. In other words, in the long term, labor is influenced more equally by various external variables. For the inflation variable, in the short term, inflation is more driven by itself by 76.92%, while labor influences by 23.07%. There is no contribution from investment or unemployment in this period. In the medium term, inflation is still influenced by itself by 79.93%, but the influence of labor decreases to 9.97%, while investment begins to contribute by 9.73%, and unemployment by 0.34%. In the long term, the

influence of inflation on itself remains dominant at 81%, but investment and unemployment begin to have a more significant influence at 7.78% and 4.01% respectively, while labor contributes 7.20%. For the investment variable, in the short term, its variability is influenced by itself by 42.21%, with significant influences from labor (40.57%) and inflation (17.21%), while unemployment has no influence. This shows that in the short term, investment dynamics are mainly influenced by internal factors and labor, while inflation also plays a fairly important role. In the medium term, the influence of investment on itself decreases to 30.93%, while labor continues to dominate at 44.16%. The influence of inflation decreases slightly to 13.61%, and unemployment begins to have an influence of 11.29%. In the long term, investment is almost unaffected by itself (3.15%), with labor still playing a dominant role at 43.17%. The inflation effect is stable at 13.25%, while unemployment has increased to 12.41%. This shows that in the long term,investment is highly influenced by labor, inflation, and unemployment, with the role of investment on itself being very small. And the unemployment variable, in the short term, 57.97% of its variation is influenced by itself, while inflation also has a significant influence of 24.39%. Labor contributes 14.54%, while investment has a very small influence, only 3.08%. In the medium term, the influence of unemployment on itself decreases to 41.92%, while the influence of inflation increases to 40.04%. Labor contributes 11.06%, while investment increases slightly to 6.96%. In the long term, inflation continues to dominate with an influence of 41.37%, while the influence of unemployment on itself decreases further to 39.27%. The influence of labor and investment increases slightly to 11.02% and 8.32%, respectively. This shows that in the long term, inflation is the main factor influencing unemployment, followed by the influence of unemployment itself, labor, and investment.

Conclusion

1. Vector Autoregression analysis using the lag 2 basis shows that there is a contribution from each variable to the variable itself and other variables. The results of the Vector Autoregression analysis also show that the past variable (t-1) contributes to the current variable both to the variable itself and other variables. From the results of the analysis, there is a reciprocal relationship between one variable and another.
2. Response Function analysis shows the response of other variables to changes in one variable in the short, medium and long term, and it is known that the stability of the response of all variables is formed in a period of 5 years or the medium and long term.
3. Variance Decomposition analysis shows that there are variables that have the largest contribution to the variable itself in the short, medium and long term such as Inflation and Labor. While other variables that have the greatest influence on the variable itself in the short, medium and long term are Investment and Unemployment which are most influenced by Inflation and Labor.

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