Financial Market Development on Economic Growth in Indonesia Using Principal Component Regression Analysis

M Yunus[1], Budi Setiawan[2*], Priya Rani Bhagat[3], Adil Saleem[4]
[1]UIN Sulthan Thaha Saifuddin Jambi, Jambi Indonesia
[2]Universitas Indo Global Mandiri, Palembang Indonesia
[3,4] Hungarian University of Agriculture and Life Sciences, Godollo Hungary
*Coresponding author: budi.setiawan@uigm.ac.id| Phone Number: 0812 7815 8505

A B S T R A C T

This study investigates the relationship between macroeconomic variables and financial market development on economic growth in Indonesia using principal component analysis. A quantitative data was collected from World Bank dataset from 2002 to 2019. Data were analysed using statistical software R. Findings reveal principal component analysis is better than multiple linear regression in explaining the correlation among independent and dependent variables. This study also reveals stock traded of total value as percentage of GDP has the biggest effect on the performance on Indonesian economy during research period. In contrast, unemployment has the smallest impact on economic growth in Indonesia. The results assist in understanding the importance of macroeconomic variables and financial market development on the performance of Indonesian economy.

INTRODUCTION

Economic growth plays a pivotal role in improving welfare and reducing poverty. The contribution of economic growth to the reduction of poverty levels is through income distribution (Adams, 2004; Rabah & Thorvaldur, 2011). However, rapid and stable economic growth is often difficult to achieve due to domestic and global uncertainties. From the local perspective, macroeconomics correlates with economic performance, while from the external side, geopolitical dynamics, fluctuations in commodity prices and volatility in the financial sector can also affect domestic economic performance (Tiago et al., 2015). Therefore, the studies of the factors that have an impact on economic growth attract many parties from academics, practitioners, and government.

Previous studies have been carried out to investigate the relationship several variables to economic growth, such as Pelinescu (2015) human capital on economic growth; Weil et al. (2005) health toward economic growth; Morck et al. (2005) corporate government, economic entrenchment and growth; El-Galfy and Khiyar (2012) Islamic banking and economic growth; Saleem and Ashfaque (2020) macroeconomic variables' effect on Islamic banking performance; Du et al. (2016) tourism and economic growth; Edison et al. (2002) international financial integration on economic growth.

Out of many variables integrate into economic growth, we focus on key macroeconomic variables, namely inflation, unemployment, and foreign direct investment (Abugamea, 2018; Gherghina et al., 2019; Şiklar & Kocaman, 2018). Fischer (1991) analyzes 73 countries and found that macroeconomic policies impact the level of economic growth. For example, inflation has a negative relationship with economic growth. Another study conducted by Öztürk et al. (2014) explains different results by stating that stable inflation promotes growth in developed and developing countries. The difference in academic finding has encouraged researchers to study macroeconomic variables and their correlation to economic growth.

In addition, globalization and technological development promote domestic and foreign investment activities to continue increasing, including investment in the financial sector. A developed and transparent financial sector is predicted to have a positive impact on business activities which able to boost economic growth (Arestis et al., 2001; Van Nieuwerburgh et al., 2006). In this study, we focus on three main factors of the stock market developed, proposed by Demirguc-Kunt and Levine (1996), namely market capitalization of listed domestic companies as a percentage of GDP (MCD), turnover ratio of domestic shares (STD), and the total value of stock traded as a percentage of GDP (STT). The most recent study conducted by Islam et al. (2020) states that the financial sector's development will encourage investment to support economic growth.

Indonesia has been experiencing a rapid and stable economic growth rate in the last two decade. Indonesia's economic growth averaged 5.37% from 2002 to 2019, higher than the world economic growth of 2.9% in the same period.
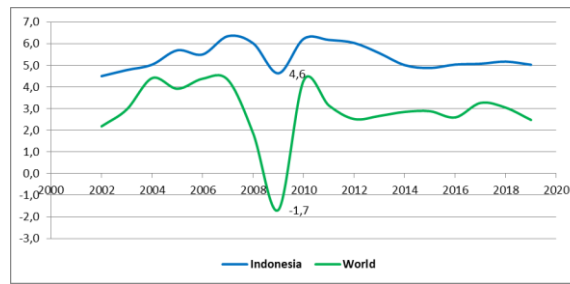

Figure 1. Economic growth in Indonesia and the world from 2002 to 2019

Indonesia's economic performance has always been better than the world economy for the last 18 years. In fact, during the global economic crisis in 2009, Indonesia continued to experience positive growth (4.6%) compared to the world economy, which had a correction of -1.7%. With relatively high and sustainable economic growth, several international organizations have forecasted that Indonesia will become a developed country in the next few years. Oberman et al. (2012) and Hawksworth and Chan (2015) predict Indonesia will become the fourth-largest economy based on purchasing power parity (PPP) by 2030.

Although research on the relationship between macroeconomic variables and stock market development on economic growth is often conducted, there are still differences in academic outcomes, thus it creates a gap for further research. Besides, investigations related to macroeconomic variables and capital market developments on economic growth, particularly in Indonesia, still need to be carried out to provide more comprehensive information to extend the literature and contribute to policymakers. Furthermore, this study also compares between multiple linear regressions and principal component analysis to explain macroeconomic variables and financial market development on economic growth.

LITERATURE REVIEW
Macroeconomics and Economic Growth

There has been extensive interest in the research community to study the various components of microeconomics on domestic economic development in different geographies. These are a series of empirical studies that have attempted to examine effects of inflation, unemployment and foreign direct investment (FDI) on domestic growth in host countries separately. The impact of these factors has been examined using various approaches and models to make significant conclusions. Nonetheless the outcomes of each study are distinct in its nature depending upon the time duration under observation, econometric methodologies, data source, socio-political differences and normative or positive approaches. The relationships amongst these variables provide us with the holistic view of the modern economic system in play but most of the studies using time series data in economics give an incomplete picture (Foster, 2011). Therefore, new studies with more pragmatic then theoretical are being done while trying to correlate economic analysis to the sparse data that is available.

Inflation

In their 1996 paper Boyd and Smith documented that high inflation rates tend to reduce the actual returns expected by citizens on their savings in the banks and leads to reduce the opportunity cost of funds borrowed through loans from the banks (Boyd & Smith, 1996). As the emerging stock markets improve and increase in numbers the possibility of improved capital structure of developing countries corporations become significant over time (Demirguc-Kunt, 1992). Even though it is established that high inflation rates negatively affect the growth in the economy of a country, Gylfason and Herbertsson (2001) explain that no inflation isn't ideal also as the optimum level is low inflation which is within control helps the growth. The macroeconomic elements such as budget deficits when interacting with inflation through saving behaviour, portfolio choice, financial development, and taxes show a tendency to restrict growth of the economy in the future forecast for developing nations. Studying the effect of inflation on transition countries Gillman and Harris (2010) mentioned that a greater money to GDP ratio for certain inflation value will lead to a lower expected growth rate as per observation.

Foreign Direct Investment

A recent study conducted by Long (2020) about the influence of FDI or investment from multinationals on economic development in ASEAN countries inferred that the effect of FDI is difficult to determine using the frequentist inference whereas through the Bayesian inference it is evident that foreign investment has a moderately significant developmental effect on economic improvement. Similarly, in-depth analysis of the relationship between FDI linkages with financial market linkages revealed that the host country of the FDI take advantage from the backward linkages relational to the international and local companies with positive domino effect in the rest of the economic state when the local financial markets within the host country are developed enough (Alfaro et al., 2010).

From the approach of FDIs influencing the local corporations or businesses Szkorupová (2015) studied the effect of crowd in and crowd out in central and eastern European countries namely Estonia, Czech Republic, Slovakia and Hungary noticed that as more multinational companies and investors entered the domestic markets, local businesses could

not catch up and compete with the qualities, capital and capabilities of these international companies. Erdal and Göçer (2015) investigated the effect of innovative research, advancements and technology export capabilities brought about by FDI in 10 developing Asian countries. Their study of panel data between 1996-2013 inferred that capital inputs from FDI are the most convenient opportunities to overcome the usual wealth and financial deficiencies a developing country faces to raise technological capabilities and overall productivity of the countries.

Unemployment

Aghion and Howitt (1994) studied the relationship between growth of economy and unemployment where, the effect was noticed to be manifested in two ways, the capitalization effect and the other being creative destruction effect. Capitalization effect caused by growth encouraged newer firms to enter the economy and higher job vacancies were hence created to fulfil the requirements also paving way for more entrepreneurs. On the other hand, the creative destruction is caused by the extensive application of technology, automation, and artificial intelligence in production assemblies, which in turn reduce human resource requirements and reduce the job matches for skilled and unskilled workers, eventually increasing the natural rate of unemployment in the country.

Despite this duality, the balance between entrepreneurship and innovation is required but financial repression with respect to countries which are still developing restricts the extent of products and services that can be provided by the financial system to creditors, borrowers, entrepreneurs, farmers and hence curbs economic growth rates and innovation (King & Levine, 1993). From the point of view of wage policies and compensation models Cahuc and Michel created a model in 1996 which showed that improved investment in human capital in a country with policies of minimum wage may cause the domestic economy to grow.

Financial Market Development and Growth of the Economy

The academic literature revolves around the finance growth theory where Demirguc-Kunt and Levine (1996) and Levine (1997) studied about stock-markets and economic advancement highlighted that nations with highly advance and sophisticated stock-markets have stronger banking systems and non-banking financial institutions for instance financial firms, investment companies, social security and funds for pension and the nations that have weaker stock-market comparatively are observed to have weaker financial intermediaries. The authors also mentioned that the analysis of any country's stock-market performance can also be used for predicting its economic growth. Most theoretical models highlight the importance of the size, integration or liquidity of a country's financial market for evaluation of its strength.

Ahmad et al. (2016) studied about the consequence of financial market performance on the economic improvement of 9 developing countries in Africa after the global financial crisis it is observed that a strong financial market and banking system helps in economic growth but a financial crisis similar to the 2008 crisis can reduce the beneficial rewards of financial market enhancement in developing countries. In relation to the exploration of correlation between development and financial market Greenwood and Jovanovic (1990) in their work on financial market improvement link between development and income distribution point that financial improvement gives a foundation of capital to enhance the structures in finance and this monetary body eventually resulted in greater development as funding opportunities were conveniently made available.

Market-capitalization of listed domestic companies as a percentage of GDP-MCD

The study conducted by Mauro (2003) assessed the correlated association between output-growth and staggered stock returns in nations with advanced and sophesticted stock markets and new emerging ones using panel data. According to the highly aclaimed American economist Levine greater turnover market capitalisation predicted faster growth (Levine, 1996). In the findings it was oserved that in the economies with greater market capitalization to GDP ratio large number of local firms that were listed and IPOs were significantly correlated between the growth output variable and stock-market returns.

Turnover ratio of domestic shares-STD

The Turnover ratio of domestic shares is the measure of liquidity, also widely known as turnover velocity of domestic shares when expressed as a percentage, is one of the significant indicators of economic funtioning of the country's financial market and their overall development levels. It is calculated by dividing the monthly electronic order book (EOB) with the market capitalization for that month, finally being annualised by multiplying th average of each month by 12 to get the ratio. The highest value of turnover ratio of domestic shares in 2019 was of China at 223.66% and Indonesia stood at 27th ranking with the turnover ratio of 22.53%, while the country with lowest value with 0% was Rawanda (The World Bank, 2020).

Total value of stock traded as a percentage of GDP-STT

The total value of stock traded can be one of the good indicators of liqudity and the magnitude of the stock-market of any particular country and can reflect the performance and ease of trading in the domestic market. It can be defined as the sum of number of shares traded including all local and international trade and the resultant multiplied with their corresponding market prices for the concerned country. This ratio does not simply measure the expenditure of purchasing and trading in securities at specified costs but it is an average of trade in the time duration and the value of equity exchanges as a share of domestic output is expected to be variable with the convinience of trading there(Levine, 1996).

In the context of technological advancements contribution to the economic growth of a developing country, a statement made by Galbis (1977) still stands true which meant that in developing economies, the incapability to gain and improve from technological advancements is difficult due to the limitations of weaker financial market structure. Evidently

certain expenses will have to be made to develop a strong and well-co-ordinated financial system taking into account which specific components of the macroeconomic principles have a significance in bring about development. The study similar to the theme of what is attempted in this paper is the study conducted by Wait et al. in which the effect of financial-market improvement on the growth of the economy in BRICS countries was conducted via implementing the standardised method-of-moments and elongated endogenous growth method with the expectation to determine the effect of a group of market indicators in finance (Wait et al., 2017), resulting in the conclusion that the economic growth of these countries was due to greater levels of private sector credits and stable financial market structures.

METHODS
Data and Sample
Data were documented from World Bank for the period of 19 years from 2002 to 2019. Macroeconomic variables consist of inflation, unemployment, and foreign direct investment. Stock market capitalization of listed domestic companies as a percentage of GDP, the percentage of stocks traded or turnover ratio of domestic shares, and stocks traded, total value as a percentage of GDP for financial market development. A purposive sampling was applied in this research, with several considerations including 1) Indonesia has rapid and stable economic growth in the last 20 year; 2) Indonesia is predicted will be the 7th largest economy in the world by 2045; 3) understanding the relationship between macroeconomics and financial market development to economic growth will be beneficial for policy maker to be more prudent in applying macroeconomic policy.

Variable Measurement
The variable measurements for macroeconomic variables are inflation, unemployment, and foreign direct investment. Financial market development are measured Stock market capitalization of listed domestic companies as a percentage of GDP, the percentage of stocks traded or turnover ratio of domestic shares, and stocks traded, total value as a percentage of GDP in Indonesia.

Table 1. Variables Measurement Description

Variable	Indicator
GDP	GDP (annual % growth rate in constant price)
INF	Inflation, GDP deflator (annual %)
UNP	Unemployment, total (% of total labor force) (national estimate)
FDI	Foreign direct investment, net inflows (% of GDP)
MCD	Market capitalization of listed domestic companies (% of GDP)
STD	Stocks traded, turnover ratio of domestic shares (%)
STT	Stocks traded, total value (% of GDP)

Source: World Bank (2021)

Linear Regression Analysis
Linear regression describes a relationship model between the independent and dependent variables (Mattjik & Sumertajaya, 2006). Draper and Smith (2014) defined a linear regression model as linear in parameters. Linear regression model has the following formula:

$$y = X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + X_5\beta_5 + X_6\beta_6 + \varepsilon$$

The X is the matrix of the independent variable of size $n \times (p + 1)$, y is the vector of the dependent variable of size $n \times 1$, ε is the random residual vector of size $n \times 1$, and $\beta = (\beta_0, \beta_1, \ldots, \beta_p)^T$. One of the methods used to estimate the value of the linear regression coefficient (β) is the least-squares method, which minimizes the number of squares residual (Hastie et al., 2009).

Principal Component Analysis
Principal component analysis (PCA) is a statistical analysis to reduce or summarize variables, from variables that are changed to a few variables and still contain most of the information contained in the original variables (Supranto, 2004). According to Mattjik and Sumertajaya (2006), the main component equation is as follows:

$$PC_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1p}x_p$$
$$\vdots$$
$$PC_p = a_{p1}x_1 + a_{p2}x_2 + \cdots + a_{pp}x_p$$

Then, the linear equation can be written in the form of a matrix as follows:

$$PC_{p\times1} = A_{p\times p}x_{p\times1}$$

Principal Component Regression Analysis

In this analysis, the independent variable is the main component formed in the main component analysis process. The value in the principal component regression analysis is the value obtained from the value of the principal component score formed. Furthermore, the principal component regression analysis using the least-squares method is used to estimate the price of the regression parameters. The least-squares method is used to estimate the parameter values $(\beta_0, \beta_1\ dan\ \beta_2)$ with the regression equation $(Y_i = \beta_0 + \beta_1 PC_1 + \beta_2 PC_2)$ (Myers & Thompson, 1989).

Technical Analysis

The analysis procedure with multiple linear regression analysis and principal component regression analysis in the case of economic growth data in Indonesia is as follows:
1. Looking at the Variance Inflation Factor (VIF) value to determine if there is multicollinearity in the data.
2. Looking at the correlation between the independent and dependent variables.
3. Modeling with multiple linear regression analysis.
4. Modeling with principal component regression analysis.
5. Determine the best model between multiple linear regression analysis and principal component regression analysis.

RESULTS

Multicollinearity can be detected using the Variance Inflation Factor (VIF) value. Here is the VIF value calculation using the R software:

Table 2. VIF Value for each Independent Variable

INF	UNP	FDI	MCD	STD	STT
5.744	10.075	1.862	24.746	18.917	17.217

Source: elaborated by authors

Based on the results of the VIF value in the regression analysis carried out in Table 2, the independent variables (UNP, MCD, STD, and STT) have a VIF value greater than 10. Variables that have a large enough VIF value will result in a violation of the assumptions on the data, which means there is a multicollinearity problem.

Correlation between Dependent and Independent Variables

The correlation between the dependent variable and the six independent variables is as follows:

Table 3. Correlation Value between GDP and INF, UNP, FDI, MCD, STD, STT

	INF	UNP	FDI	MCD	STD	STT
GDP	0.549	0.238	0.492	0.258	0.301	0.599

Source: elaborated by authors

Based on the results of the correlation value in Table 3, it shows that the relationship between the GDP and other independent variables are as follow, STT (0.5991531), INF (0.5497288), FDI (0.4921166), STD (0.3013908), MCD (0.2583851), and UNP (0.2389141). The independent variable that has the largest correlation is STT, and the variable with the smallest correlation is the UNP. This value is an initial detection that the STT variable should have the biggest influence on GDP and the UNP variable should have the least effect on GDP. Furthermore, multiple linear regression analysis and principal component regression analysis will be conducted to investigate the highest to the smallest correlation between independent and dependent variable.

Multiple Linear Regression Analysis Model

Based on multiple linear regression analysis using the R software, a model's form between GDP and six other variables, obtained a model below:

GDP = 3.10858 + 0.04510 INF + 0.07365 UNP + 0.20551 FDI + 0.02162 MCD + 0.00622 STD + 0.01140 STT

The estimate of the parameter b_0 of 3.10858 for the GDP means if the parameter estimator of all variables is zero. The parameter estimators are b_1 (0.04510), b_2 (0.07365), b_3 (0.20551), b_4 (0.02162), b_5 (0.00622), and b_6 (0.01140), respectively. This value means that each one-unit increase in INF, UNP, FDI, MCD, STD and STT will increase the average GDP by 0.04510, 0.07365, 0.20551, 0.02162, 0.00622 and 0.01140. Based on the analysis, the independent variable that had the greatest influence was the FDI variable, namely 0.20551, and the variable that had the smallest effect was the STD variable, namely 0.00622. The results of multiple linear regression analysis are not in line with the results of the

correlation between the dependent variable and the independent variable.

Principal Component Analysis Model

Based on the principal component analysis using the R application, the independent variables used are INF, UNP, FDI, MCD, STD, and STT, then the results obtained are as in Table 4 and Table 5, as follow:

**Table 4.** **The Coefficient for each Principal Component**

Var.	PC1	PC2	PC3	PC4	PC5	PC6
INF	0.492	-0.241	-0.252	-0.382	-0.678	0.171
UNP	0.519	0.076	0.091	-0.557	0.546	-0.326
FDI	-0.155	-0.559	-0.734	0.008	0.351	-0.011
MCD	-0.380	-0.502	0.354	-0.250	-0.239	-0.597
STD	0.510	-0.106	-0.050	0.673	-0.082	-0.514
STT	0.241	-0.599	0.509	0.164	0.230	0.492

Source: elaborated by authors

Table 5. **The Summary of Principal Component Analysis**

	PC1	PC2	PC3	PC4	PC5	PC6
SD*	1.7313	1.3204	0.8218	0.65333	0.37701	0.1224
PV*	0.4996	0.2906	0.1125	0.07114	0.02369	0.0025
CP*	0.4996	0.7901	0.9027	0.97382	0.99750	1.0000

*Standard deviation = SD, Proportion of variance (PV), Cumulative Proportion (CP)
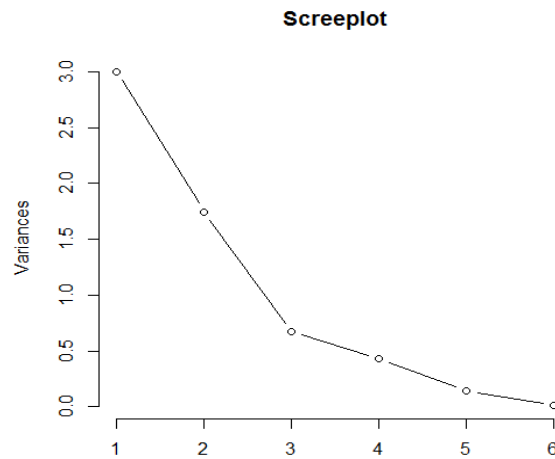
Figure 2. **Principal Component Analysis Screeplot**
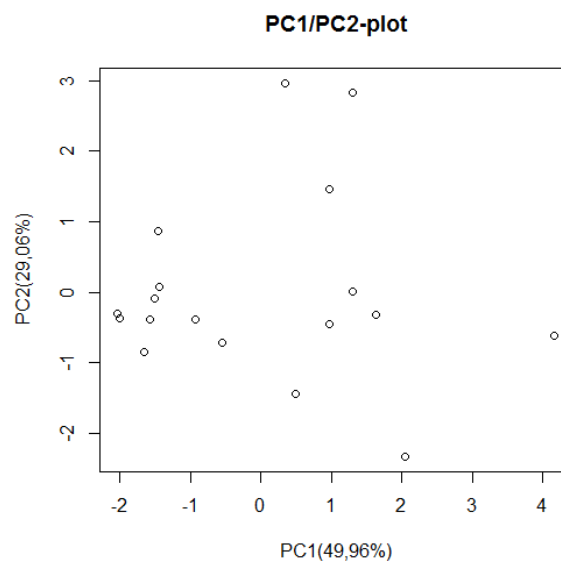
Figure 3. **Plot between the First and Second Principal Component**

Figure 2, there are six principal components form with their respective coefficients, namely positive and negative. This coefficient calculates the principal component score as a continuation of the principal component regression analysis. Based on Table 5 and Figure 2, there are two principal components (PC1 and PC2) which have a Standard Deviation value of more than 1, and a Cumulative Proportion value for PC1 and PC2 of 79.01%, so it can be concluded that the main

components formed are two principal components, (PC1 and PC2). Based on Figure 3, the plot of PC1 and PC1 do not create a pattern that shows a larger relationship either positively or negatively, so that the two components can be used for further analysis, namely the principal component regression analysis.

Principal Component Regression Analysis Model

Based on the principal component regression analysis using the R software, a model form between GDP and six other variables are shown below:

$$GDP = 5.36944 + 0.123536\ INF + 0.029144\ UNP + 0,155382\ FDI + 0.115261\ MCD + 0.084138\ STD + 0.207891\ STT$$

The estimated parameter of b_0 of 5.36944 is the estimated value for the GDP mean if the parameter estimator of all variables is zero. The estimated parameter of b_1 (0.123536), b_2 (0.029144), b_3 (0.155382), b_4 (0.115261), b_5 (0.084138), and b_6 (0.207891) are the estimated value for the change in average GDP variable. This value means that each one-unit increase in INF, UNP, FDI, MCD, STD and STT will increase the average GDP by 0.123536, 0.029144, 0.155382, 0.115261, 0.084138 and 0.207891. Based on the results of the principal component regression analysis, the independent variable that has the greatest influence is the STT (0.207891). Theoretically, the higher trading activity in the capital market with the proxy of STT reflects the higher liquidity in the financial market industry. The capital market with higher liquidity encourages domestic and foreign investors to provide a source of capital for companies. In aggregate, it has a positive impact on economic growth.

However, the smallest impact on economic growth in Indonesia is the UNP variable (0.029144). The theory link to the finding reveals unemployment impedes economic expansion since a reduction in job availability influences the income of individuals or families. In total, a rise in unemployment lowers actual domestic income and leads household consumption to decrease, lowering economic growth. The other argument for the UNP's low contribution to Indonesia's economic growth could be the government's policy choices, which focus on controlling inflation rather than the unemployment rate.

CONCLUSION

This study investigates the relationship between macroeconomic variables and financial market development on Indonesia's economic growth for 18 years from 2002 to 2019. Data were analyzed by comparing multiple linear regression and principal component analysis using R software. This study finds that STT and FDI have the first and second biggest effects, while UNP becomes the smallest variable influencing economic growth in Indonesia. In addition, this paper also reveals that principal component analysis is the best model to predict economic growth when it is correlated with macroeconomic variables and financial market development during the study period.

Limitation

This research focuses only on the impact of financial market developments and macroeconomics on economic growth in one country, namely Indonesia. Future research is expected to involve a broader range of objects, such as the Asia or Europe region, with broader data to provide comprehensive information on the impact of capital market developments and macroeconomics on economic growth.

Suggestion

The findings contribute to understanding the significance of macroeconomic variables and the growth of the financial markets on the performance of the Indonesian economy. This finding can be helpful for policymakers and stock market practitioners to make investment decisions.

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