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DYNAMIC PANEL DATA GENERALIZED METHOD OF MOMENT ARELLANO-BOND APPROACH IN ECONOMETRIC MODEL RETURN ON ASSETS OF PHARMACEUTICAL COMPANIES

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ABSTRACT

The impact of the Covid-19 pandemic has resulted in a significant decline in the pharmaceutical sector's stock price, so investors are hesitant to invest in the pharmaceutical sub-sector. This study aims to apply dynamic panel data regression analysis with the Arellano-Bond Generalized Method of Moment (GMM) approach to model the profitability of pharmaceutical sub-sector companies on the Indonesia stock exchange. Therefore, investors need to know the profitability of the pharmaceutical sub-sector to make an investment decision. This research will produce a profitability model for pharmaceutical sub-sector companies. The data in this study was obtained from observations of stock price movements of pharmaceutical sub-sector companies listed on the Indonesia Stock Exchange (IDX) in 2013-2022. From the resulting model, it is hoped that it can provide an overview for investors to take action to invest in shares of the pharmaceutical sub-sector. The study results show that the model meets the consistency of parameters based on the results of the Arellano-Bond test and valid instruments based on the results of the Sargan test. The t-test results show that the previous period's ROA has a positive and significant influence on ROA, CR has a negative and significant influence on ROA, DR has no significant effect on ROA, and inflation has a positive and significant effect on ROA. So, the variables that significantly affect ROA are the ROA of the previous period, CR, and inflation. Based on the study's results, investors must choose companies with a higher ROA value compared to the ROA of the previous year. And choose a company that has a low CR value.

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1. INTRODUCTION

Stock price developments are always an exciting object to predict and analyze. Success and accuracy in predicting stock price developments are desired by capital market participants, especially investors who invest their funds. The stock price is a price that occurs in the stock market, which is very meaningful for the company because the stock price determines how much the value of a company and can show the success achieved by the company in management. If the company achieves exemplary achievements, then the company's shares will be in great demand by investors.

According to Nurmasari, stock prices can be used to see the condition of a company apart from the total income it earns[1]. The total shares offered or requested, company conditions, information or news on the stock exchange, and current news issues in a region can affect stock price fluctuations[2]. In making stock investments, an investor always tries to make a profit. The profit of one of the companies can be seen from the profitability ratio. This profitability ratio includes return on assets (ROA). Return on Assets (ROA) is a ratio that shows the return on the amount of assets used in the company[3].

The Covid-19 pandemic has not only impacted public health but has also paralyzed various sectors. Many sectors have suffered losses due to this pandemic. Still, there is a sector that is considered to be able to survive the conditions of the Covid-19 pandemic, namely the pharmaceutical sector. The COVID-19 pandemic has positively influenced the acquisition of shares from the pharmaceutical sector; the movement of shares from pharmaceutical issuers listed on the Indonesia Stock Exchange showed a significant increase[4]–[6]. Although not all issuers experienced good financial performance during the first quarter of 2020, investors were interested in prospects. Many stocks from the pharmaceutical industry are hunted, which results in the price of pharmaceutical stocks experiencing a very high increase[7], [8]. However, after the COVID-19 pandemic subsided, the pharmaceutical sector experienced a significant decline, resulting in stock prices declining and investors lacking confidence in investing in the pharmaceutical sub-sector.

Panel data combines cross-*section* data with time series data originally introduced by Howles around 1950. Time series data includes one variable in several periods or periods, such as daily, weekly, monthly, quarterly, yearly, etc. Cross-section data consists of several or many objects or in the form of respondents. Panel data combines time series and cross-section data to have more observations than time series or cross-section data alone. Hsiao noted that using panel data in economic research has several advantages over cross-section and time series data[9].

Along with the popularity of time series models, the thought arose to formulate a panel data model that included the lag of the dependent variable as a regressor in regression. This results in endogeneity problems, so if the model is estimated with a fixed effect or random effects approach, it will produce biased and inconsistent estimators. To solve this problem, Arellano and Bond proposed a method of moments approach called the Generalized method of moments (GMM)[10]. There are two estimation procedures commonly used in the GMM framework to accommodate the above problems, namely the First-Differences GMM (FD-GMM) Arellano-Bond Approach and GMM System Reform carried out by Blundell and Bond (1998)[10]. The dynamic panel data model is used in this study, considering the advantages of the dynamic panel data model, which can overcome the endogeneity problem associated with the use of dependent variable lag. In contrast, in the static panel data model, the use of dependent variable lag causes the estimated results to be biased and inconsistent.

Previous research related to this is Shina's research estimating dynamic panel data parameters using Arellano-Bond GMM on the Simultaneous equation[11]. The research of Nafngiyana et al. uses a GMM approach to the simultaneous equation of dynamic panel data for economic growth[12]. Febriyanti and Setiawan conducted a study entitled ASEAN Export Modeling Dynamic Panel Data with Generalized Method of Moments Arellano-Bond Approach[13]. Ratno conducted research entitled The Effect of Direct Spending and Indirect Spending on the Economic Growth of Karisidenan Surakarta (Dynamic Panel Data Analysis)"[14]. In addition, Gunawan et al. conducted research entitled "Econometric Model of Economic Growth In Indonesia Using Dynamic Panel Data Using the FD-GMM Arellano-Bond and SYS-GMM Blundell-Bond Approaches"[15]. Then, Uspri et al. researched "the effect of inflation on income inequality: Evidence from a non-linear dynamic panel data analysis in Indonesia"[16].

Considering this, this study aims to model the Return on Assets of Pharmaceutical Sub-Sector Companies with a Generalized Method of Moment Arellano-Bond Approach. This research will produce a profitability model for pharmaceutical sub-sector companies. From the resulting model, it is hoped that it can provide an overview for investors to take action to invest in shares of the pharmaceutical sub-sector.

2. RESEARCH METHODS

2.1 Data and Variable Outlines

The data in this study was obtained from observations of stock price movements of pharmaceutical *sub-sector* companies listed on the Indonesia Stock Exchange (IDX) in 2013-2022. Observations are conducted online via https://www.idnfinancials.com/ at each stock issuer, allowing for greater flexibility and the ability to conduct them anywhere and anytime. The population in this study is pharmaceutical sub-sector companies listed on the Indonesia Stock Exchange (IDX). In this study, the research sample is a company that has published an annual report for the last 10 years. In this study, the research sample is shown in **Table 1**. The variables involved in this study are shown in **Table 2**.

Table 1. Research Samples

No	Stock Code	Company
1	KLBF	PT. Kalbe Farma Tbk
2	SIDO	PT. Industri Jamu dan Farmasi Sido Muncul Tbk
3	KAEF	PT. Kimia Farma Tbk
4	TSPC	PT. Tempo Scan Pacific Tbk
5	INAF	PT. Indofarma Tbk
6	DVLA	PT. Darya-Varia Laboratoria Tbk
7	MERK	PT. Merck Tbk
8	PYFA	PT. Pyridam Farma Tbk
9	SCPI	PT. Organon Pharma Indonesia Tbk

Table 2. Research Variables

Variable	Symbol	Indicator	Unit
Dependent	ROA	Return on Assets (ROA) is a measure that indicates the return on the number of corporate assets[17].	Percent
Independent	Inflasi	Inflation can be interpreted as continuously increasing the price of goods and services over a certain period[18].	Percent
	CR	Current ratio (CR) or ratio measure is a ratio that measures a company's ability to pay short-term obligations or debts that are immediately due at the time of collection[3].	Percent
	DR	Debt ratio (DR) measures the ratio between total debt and assets. That is, how much of the company's assets are financed by debt or how much the company's debt affects the management of assets[3].	Percent

2.2 Panel Data Regression

Panel data regression is a regression with a data structure combined with cross-section data and time series data. According to Baltagi, the panel data regression model is generally written in **Equation (1)** below[19]:

$$y_{i,t} = \alpha_{i,t} + \boldsymbol{x}'_{i,t}\boldsymbol{\beta} + u_{i,t} \tag{1}$$

With:

i worth 1, 2, ..., n and t worth 1, 2, ..., T. Index i shows the dimensions of the cross-section, whereas the t index shows the dimensions of the time series.

y_{it} : dependent variables on the i-th and t-time observation units

α_i : Intercept

$\boldsymbol{x}'_{i,t}$: observation vector on an independent variable of size 1 x K

$\boldsymbol{\beta}$: vector coefficient variable predictor size K x 1

$u_{i,t}$: panel regression error for i-th cross-section unit in t-th period

2.3 Dynamic Panel Data Regression

Panel data analysis can be used in dynamic models because panel data is suitable for dynamic adjustment analysis. As a result, endogeneity problems arise, so if the model is estimated with a fixed-effect or random-effect approach, it will produce biased and inconsistent estimators. For this reason, the GMM (Generalized Method of Moments) approach emerged. As an illustration, it can be known by the dynamic panel data model that has been proposed by Baltagi as follows[19]:

$$y_{i,t} = \delta y_{i,t-1} + \boldsymbol{x}'_{i,t}\boldsymbol{\beta} + u_{i,t} \quad i = 1,2,3,\cdots n\,; \; t = 1,2,3,\cdots,T \tag{2}$$

With *i* worth 1, 2, ..., *n* and *t* worth 1, 2, ..., *T*. Index *i* shows the dimensions of the cross-section, whereas the *t* index shows the dimensions of the time series.

If $y_{i,t}$ is a function of $u_{i,t}$, then $y_{i,t-1}$, is also a function of $u_{i,t}$. The regressor on the right side (explanatory endogenous) $y_{i,t-1}$ correlates with $u_{i,t}$. Static panel estimation models such as OLS in dynamic panel equation models will be biased and inconsistent [19].

An autoregressive dynamic model is one in which the lag-dependent variable appears as an independent variable on the right side of the equation. One of the dynamic models used in this study is the autoregressive dynamic model. The equations of autoregressive dynamic models can be seen in **Equations (3)**.

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \ldots + \beta_k X_{kt} + \delta Y_{t-1} + u_t \tag{3}$$

with

t : 1, 2, ..., T

Y_t : Observation of the unit in the *t*-th period

β : Short-term effects

x_{1t} : The independent variable of the *i*-th cross-section unit in the *t*-th period

u_t : The common error

Lai et al. said that in the dynamic panel data regression model, the β coefficient is also a short-term effect of $X_{i,t}$ changes[20].

2.4 Variable Instrumental Method

The instrumental variable method obtains new variables that do not correlate with errors but will correlate with explanatory endogenous variables. These variables are expected to be able to produce unbiased and consistent estimated values. The variable of this instrument is, e.g., with the symbol z_1. If there is a linear model in the following equation:

$$y = \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_{k-1} x_{k-1} + \beta_k x_k + u \tag{4}$$

with exogenous explanatory variables are $x_1, x_2, \ldots, x_{k-1}$ and endogenous explamatory variables are x_k.

Model **Equation (3)** shows that the variable *xk correlates with u (error) so that* $\text{cov}(x_k, \text{u}) \neq 0$. Then, the OLS estimate for β in **Equation (3)** will result in a biased and inconsistent estimate. Therefore, it is necessary to have the z_1 instrument variable obtained from the instrumental method of the variable. Instrument variables must meet the following two conditions.

1. z_1 does not correlate with u, so cov(z_1, u) = E(z_1, u) = 0
2. z_1 correlates with the explanatory endogenous variable x_k *so that* cov(z_1, x_k) $\neq 0$

2.5 Generalized Method of Moment (GMM) Arellano-Bond

Arellano and Bond (1991) used GMM principles to estimate parameters in a dynamic panel data model called Arellano-Bond GMM. The dynamic panel data model is a model that correlates between the explanatory endogenous variable ($y_{i,t-1}$) and *error*. Using OLS estimation it makes the dynamic panel data model biased and inconsistent. So, this study uses the Arellano-Bond GMM estimation method to produce unbiased, consistent, and efficient estimates. The steps for estimating Arellano-Bond GMM parameters will be explained below[19].

1. Perform the *first differencing* in **Equation (3)** to overcome the *correlation of lag* of explanatory endogenous variables with *errors*. So that **Equation (3)** becomes **Equation (5).**

$$(y_{i,t}-y_{i,t-1})=(y_{i,t-1}-y_{i,t-2})\delta+(\mathbf{x}_{i,t}-\mathbf{x}_{i,t-1})\boldsymbol{\beta}+(v_{i,t}-v_{i,t-1}) \quad (5)$$

Equation (5) can be converted into **Equation (6)**.

$$\Delta y_{i,t}=\Delta y_{i,t-1}\delta+\Delta\mathbf{x}'_{i,t}\boldsymbol{\beta}+\Delta v_{it} \quad (6)$$

If there are as many observations as N observations, T periods, and K exogenous variables, then **Equation (6)** becomes **Equation (7)**.

$$\Delta\mathbf{y_i}=\Delta\mathbf{y_{i,t-1}}\delta+\Delta\mathbf{x'_{i,}}{}_K\boldsymbol{\beta}+\Delta\mathbf{v}_i \quad (7)$$

Then the *error* of **Equation (7)** is **Equation (8)**.

$$\Delta\mathbf{v_i}=\Delta\mathbf{y_{i,}}-\Delta\mathbf{y_{i,t-1}}\delta+\Delta\mathbf{x'_{i,}}{}_K\boldsymbol{\beta} \quad (8)$$

When it comes to beheading,

$$\gamma=\begin{pmatrix}\delta\\ \beta_1\\ \vdots\\ \beta_K\end{pmatrix}=\begin{pmatrix}\delta\\ \boldsymbol{\beta}\end{pmatrix},\ \hat{\gamma}=\begin{pmatrix}\hat{\delta}\\ \hat{\beta}_1\\ \vdots\\ \hat{\beta}_K\end{pmatrix}=\begin{pmatrix}\hat{\delta}\\ \hat{\boldsymbol{\beta}}\end{pmatrix}$$

dan $\boldsymbol{Q}=(\Delta\boldsymbol{y}_{i,t-1},\boldsymbol{x}_{i1},\ldots,\Delta\boldsymbol{x}_{iK})=(\Delta\boldsymbol{y}_{i,t-1},\Delta\boldsymbol{x}_i)$

so that

$$\Delta\mathbf{v_i}=\Delta\mathbf{y_{i,}}-\mathbf{Q}\boldsymbol{\gamma} \quad (9)$$

2. After performing *the first difference*, *the* individual effects of $u_i$have disappeared, but the error ($v_{i,t}-v_{i,t-1}$) is still correlated with the predictor variable $y_{i,t-1}-y_{i,t-2}$. So, the OLS estimator will produce biased and inconsistent estimates. Then first carried out the variable instrumental method.

   - For t = 3, then

$$(y_{i,3}-y_{i,2})=\delta(y_{i,2}-y_{i,1})+(v_{i,3}-v_{i,2}) \quad (10)$$

   In the above case, y_{1i} is the right instrument variable because it correlates with ($y_{i2}-y_{i1}$) and does not correlate with ($v_{i3}-v_{i2}$).

   - For t = 4, then

$$(y_{i,4}-y_{i,3})=\delta(y_{i,3}-y_{i,2})+(v_{i,4}-v_{i,3}) \quad (11)$$

In the above case, y_{i1} and y_{i2} are appropriate instrument variables because they correlate with $(y_{i3} - y_{i2})$ and do not correlate with $(v_{i4} - v_{i3})$.).

- For t = 5, then

$$(y_{i,5} - y_{i,4}) = \delta(y_{i,4} - y_{i,3}) + (v_{i,5} - v_{i,4}) \quad (12)$$

In the above case, y_{i1} and y_{i2} are appropriate instrument variables because they correlate with $(y_{i4} - y_{i3})$) and do not correlate with $(v_{i5} - v_{i4})$.

For every addition of one time period, one instrument variable is added. So in the T-th period, there is $(y_{i1}, y_{i2}, \ldots y_{iT-2})$ the correct set of instrument variables.

3. Determining the valid instrument matrix for **Equation (6)** is below:

$$\mathbf{Z}_i = \begin{bmatrix} [\mathbf{y}_{i,1}] & 0 & \cdots & 0 & \vdots \Delta x_{i,3,1} \cdots \Delta x_{i,3,K} \\ 0 & [\mathbf{y}_{i,1}, \mathbf{y}_{i,2}] & \cdots & 0 & \vdots \Delta x_{i,4,1} \cdots \Delta x_{i,4,K} \\ \vdots & \vdots & \ddots & \vdots & \vdots \;\; \vdots \;\; \cdots \;\; \vdots \\ 0 & 0 & 0 & [\mathbf{y}_{i,1}, \mathbf{y}_{i,2}, \cdots, \mathbf{y}_{i,T-2}] & \vdots \Delta x_{i,T,1} \cdots \Delta x_{i,T,K} \end{bmatrix}$$

4. Determine the moment of population condition with the condition $E(z_i^{'} \Delta vi) = 0$ (a condition in **Equation (12)**. $\mathbf{Z}_1$ as instrument matrix)

$$E(g_i(\boldsymbol{\gamma})) = E(\boldsymbol{Z}_i^{'} \boldsymbol{\Delta v}_i) = E\left(\boldsymbol{Z}_i^{'}(\boldsymbol{\Delta y}_i - \boldsymbol{Q\gamma})\right) = 0 \quad (13)$$

5. Determine the moment of condition of the sample in **Equation (14)**.

$$\bar{g}(\boldsymbol{\gamma}) = N^{-1} \sum_{i=1}^{N} \left(\boldsymbol{Z}_i^{'}(\boldsymbol{\Delta y}_i - \boldsymbol{Q\gamma})\right) \quad (14)$$

6. Building a GMM function is a quadratic function of the sample moment.

$$J(\boldsymbol{\gamma}) = \bar{g}(\boldsymbol{\gamma})' \widehat{\boldsymbol{W}} \bar{g}(\boldsymbol{\gamma})$$

7. Estimating GMM to get by minimizing $J(\gamma)$.

$$\frac{\partial J(\boldsymbol{\gamma})}{\partial(\widehat{\boldsymbol{\Upsilon}})} = 0$$

8. The results of the estimation of GMM Arellano-Bond one step consistent in **Equation (15)** below:

$$\begin{pmatrix} \hat{\boldsymbol{\delta}} \\ \hat{\boldsymbol{\beta}} \end{pmatrix} = \left[\left(N^{-1} \sum_{i=1}^{N} (\boldsymbol{\Delta y}_{i,t-1}, \boldsymbol{\Delta x}_i)' \boldsymbol{Z}_i\right) \widehat{\boldsymbol{W}} \left(N^{-1} \sum_{i=1}^{N} \boldsymbol{Z}_i' (\boldsymbol{\Delta y}_{i,t-1}, \boldsymbol{\Delta x}_i)\right)\right]^{-1}$$

$$\left[\left(N^{-1} \sum_{i=1}^{N} (\boldsymbol{\Delta y}_{i,t-1}, \boldsymbol{\Delta x}_i)' \boldsymbol{Z}_i\right) \widehat{\boldsymbol{W}} \left(N^{-1} \sum_{i=1}^{N} \boldsymbol{Z}_i' \boldsymbol{\Delta y}_i\right)\right] \quad (15)$$

9. Get the estimated results of GMM Arellano-Bond *two-step efficiency* in **Equation (16)** below:

$$\begin{pmatrix} \hat{\boldsymbol{\delta}} \\ \hat{\boldsymbol{\beta}} \end{pmatrix} = \left[\left(N^{-1} \sum_{i=1}^{N} (\boldsymbol{\Delta y}_{i,t-1}, \boldsymbol{\Delta x}_i)' \boldsymbol{Z}_i\right) \widehat{\boldsymbol{\Lambda}}^{-1} \left(N^{-1} \sum_{i=1}^{N} \boldsymbol{Z}_i' (\boldsymbol{\Delta y}_{i,t-1}, \boldsymbol{\Delta x}_i)\right)\right]^{-1} \quad (16)$$

$$\left[\left(N^{-1}\sum_{i=1}^{N}(\Delta y_{i,t-1},\Delta x_i)'Z_i\right)\hat{\Lambda}^{-1}\left(N^{-1}\sum_{i=1}^{N}Z_i'\Delta y_i\right)\right]$$

2.6 Arellano-Bond Test

Arellano and Bond (1991) proposed a test to test that no second-order serial correlation of errors exists in the first difference equation. Δv_{it} Is the first differential of an uncorrelated $E(\Delta v_{it}, \Delta v_{it-1})$ Does not estimator be zero, but the consistency of the GMM estimator depends on the assumption $E(\Delta v_{it}, \Delta v_{it-2}) = 0$. Arellano and Bond test hypotheses and test statistics on **Equation (17)**.

H_0: There is no autocorrelation in the remaining first difference of the first-order

H_1: There is an autocorrelation on the remains of the first difference of the i-th order

$$m(2) = \frac{\Delta\hat{\mathbf{v}}'_{i,t-2}\Delta\hat{\mathbf{v}}_*}{(\Delta\hat{\mathbf{v}})^{\frac{1}{2}}} \sim N(0,1) \tag{17}$$

With:

$\Delta\hat{v}'_{i,t-2}$: Error vector on 2nd lag of order $q = \sum_{i=1}^{N} T_i - 4$

$\Delta\hat{v}*$: Truncated *error* vector

H_0 is rejected if prob<0.05. This means that GMM consistency is indicated by an insignificant statistical value (failing to reject H_0) on m_2.

2.7 Sargan Test

The Sargan test is used to determine the validity of instrument variables whose number exceeds the estimated parameters (overidentifying restriction conditions). Sargan test hypothesis and test statistics on **Equation (18)**.

H_0: Overidentifying restriction condition in valid model estimation

H_1: Invalid overidentifying restriction condition in model estimation

Test Statistics[19]:

$$S = \hat{v}'Z\left(\sum_{i=1}^{N} Z'_i\hat{v}_i\hat{v}_i{}'Z_i\right)^{-1}Z'\hat{v} \sim \chi^2_{L-(k+1)} \tag{18}$$

The statistics of the test S distributed $\chi^2_{L-(k+1)}$ where L is the number of columns of the matrix Z and (k+1) is the number of estimated parameters. H_0 is rejected if the statistical value of the S test is greater than the chi-square table or the p-value of the < α.

2.8 Parameter Significance Test

Partial significance testing is used to determine whether coefficient values significantly affect the model using the t-test. Hypothesis and statistics of t-test in **Equation (19)**.

$H_0: \beta j = 0$

$H_1: \beta j \neq 0, j=1, 2, 3$

Test Statistics:

$$t = \frac{\hat{\beta}_j}{se(\hat{\beta}_j)} \tag{19}$$

If the value of t > t is critical, reject H_0, or if the value of Prob < 0.05, then reject H_0[21].

2.9 Method

The analysis steps to be carried out in this study are as follows:

a. Conduct a characteristic analysis on the Profitability of Pharmaceutical Subsector Companies and variables that are thought to influence.

b. Estimate the parameter model of a dynamic data panel using the Arellano-Bond GMM method.

c. Model specification test

   1) Test the consistency of model parameters using the Arellano-Bond Serial Correlation Test.

   2) Testing instrument validity with the Sargan test

d. Testing the Significance of model parameters partially using the t-test.

e. Draw conclusions based on the results of the analysis.

3. RESULTS AND DISCUSSION

Description Data

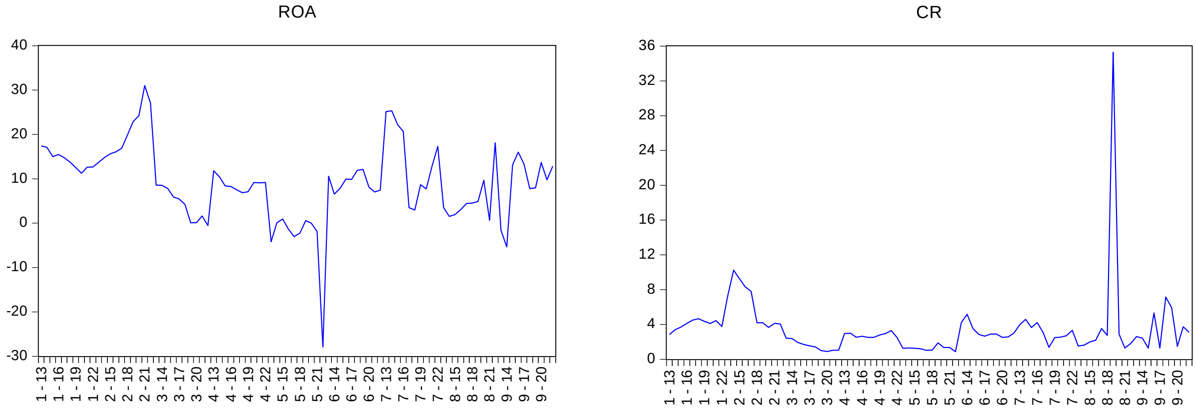
Descriptive data provides a general explanation of the problem being analyzed so that the data is easier to understand. Descriptive statistical analysis provides an overview of the distribution and behavior of research sample data by looking at each independent and dependent variable's minimum value, maximum value, mean, and standard deviation. The results of the descriptive analysis in this study can be seen in **Table 3**.

Table 3. Descriptive Statistics

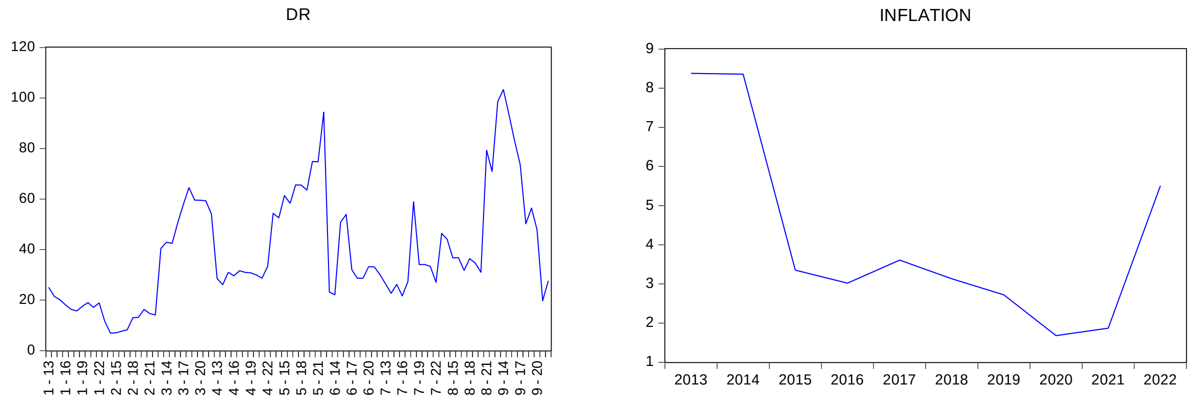
	ROA	CR	DR	Inflation
Mean	9.04	3.47	39.44	4.16
Median	8.63	2.81	32.58	3.24
Maximum	30.99	35.28	103.31	8.38
Minimum	-27.93	0.88	6.92	1.68
Std. Dev.	8.50	3.86	22.46	2.34

Return on Assets (ROA) is a measure that shows the return on the amount of a company's assets[17]. According to the data shown in **Table 3** and **Figure 1** **(a)**, it can be observed that the ROA values varied among different shares. The highest recorded ROA value of 30.99% was observed in SIDO shares in 2021, while the lowest ROA value of -27.93% was observed in INAF shares in 2022.

The current ratio or ratio size is a ratio that measures the company's ability to pay short-term obligations or debts that are immediately due at the time of collection. In other words, how many current assets are available to cover short-term liabilities that are immediately due? Calculating the current ratio involves comparing a company's total current assets with its total current liabilities. The current ratio can be seen as a measure of a company's security[3]. Based on **Table 3** and **Figure 1** **(b)**, it is known that the highest CR value was 35.28% in PYFA shares in 2019, and the lowest of 0.88% in INAF shares in 2022.



(a) **(b)**



(c) **(d)**

Figure 1. (a) Return on Assets of pharmaceutical sub-sector 2013-2022
(b) Current Ratio of pharmaceutical sub-sector 2013-2022
(c) Debt Ratio of pharmaceutical sub-sector 2013-2022
(d) Inflation 2013-2022

Debt Ratio is a debt ratio used to measure the ratio between total debt and assets. In other words, how much of the company's assets are financed by debt or how much the company's debt affects asset management. From the measurement results, if the ratio is high, funding with more debt will be more difficult for the company to obtain additional loans because it is feared that the company will not be able to cover its debt with its assets. Similarly, if the ratio is low, the smaller the company is financed with debt[3]. Based on Table 3 and Figure 1 **(c)**, it is known that SCPI in 2014 had the highest DR value of 103.31%, and SIDO in 2014 had the lowest DR value of 6.92%.

Inflation is the tendency to increase the price of goods and services continuously. If the price of goods and services in the country increases, then inflation increases. The increase in the price of goods and services causes a decrease in the value of money. Thus, inflation can also be interpreted as a decrease in the value of money against the value of goods and services in general[22]. The highest inflation occurred in 2013 at 8.38%, and the lowest in 2020 at 1.68%.

3.1 Estimation of the Dynamic Panel Data Regression Model

At this stage, estimation is carried out in a dynamic panel data regression model with first-difference GMM two-step estimator strengthening. The intercept and slope values for each independent variable with the FD-GMM approach are shown in Table 4.

Table 4. Parameter Estimation with FD-GMM Approach

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ROA(-1)	0.200780	0.062859	3.194136	0.0021
CR	-0.223776	0.095390	-2.345904	0.0219
DR	-0.069904	0.047331	-1.476918	0.1443
INFLATION	0.162657	0.056438	2.882043	0.0053

3.2 Model Specification Test

a. Arellano-Bond Test (AB-Test)

The Arellano-Bond test determines the correlation between one residual component and another in the FD-GMM model. The hypothesis is as follows:

H_0: There is no autocorrelation in the i-order remainder

H_1: There is autocorrelation in the remainder of the first-order

Table 5. Arellano-Bond Test Results on FD-GMM Models

Test order	m-Statistic	rho	SE(rho)	Prob.
AR(1)	-0.645845	-187.395744	290.155971	0.5184
AR(2)	-1.540238	-253.057167	164.297417	0.1235

In **Table 5**, the results of the Arellano-Bond test show that the AR(2) test got a value of prob = 0.1235 > 0.05, so it did not reject H_0. This shows that estimates with the FD-GMM method are consistent and that autocorrelation does not happen.

b. Sargan Test

The Sargan test determines the validity of instrument variables whose number exceeds the estimated parameter (overidentifying restriction condition). The results of the Sargan test on the FD-GMM model are shown in **Table 6.** The hypothesis is as follows:

H_0: Overidentifying restriction condition in valid model estimation

H_1: Invalid overidentifying restriction condition in model estimation

Table 6. Sargan Test Results on FD-GMM Models

J-statistic	4.908354
Prob(J-statistic)	0.427167

The Sargan test results in **Table 6** show that the value of Prob=0.4271>0.05 and thus did not reject H_0, which indicates that the *overidentifying restriction condition* in the model estimation is valid.

3.3 Parameter Significance Test

A partial test determines the effect of each independent variable on the dependent variable. Based on the results of parameter estimation in **Table 4**, the following results are obtained:

a. ROA(-1) has a prob value = 0.0021<0.05, so it can be concluded that lag (ROA) significantly affects the ROA of pharmaceutical companies for the 2013-2022 period.

b. CR has a value of prob= 0.0219<0.05, so it is concluded that CR significantly affects the ROA of pharmaceutical companies for the 2013-2022 period.

c. DR has prob=0.1443>0.05, so it is concluded that DR has no significant effect on the ROA of pharmaceutical companies for the 2013-2022 period.

d. Inflation has Prob = 0.0053<0.05, so it is concluded that inflation significantly affects pharmaceutical companies' ROA for the 2013-2022 period.

3.4 Interpretation of Results

Based on the results in **Table 4**, the FD-GMM equation model can be presented as follows:

$$ROA_{i,t} = 0.200 * ROA_{i,t-1} - 0.224 * CR_{i,t} - 0.07 * DR_{i,t} + 0.162 * Inflation_{i,t} + e_{i,t} \quad (20)$$

The model in **Equation (20)** can be described as follows:

a. The value of the ROA(-1) coefficient shows a value of 0.200, which explains that if the ROA in the previous period increased by 1%, then the ROA of this period will increase by 0.200%.

b. The value of the CR coefficient shows a value of -0.224, explaining that if the CR (current ratio) increases by 1%, then the ROA decreases by 0.224%.

c. The DR coefficient value of -0.07 explains that if DR increases by 1%, the ROA will decrease by 0.07%. In other words, the higher the DR value, the lower the profit obtained by the company. This is because of the amount of money used to pay debts owned by the company so that profits are reduced.

d. The value of the Inflation coefficient of 0.162 explains that if inflation increases, ROA will also increase. If inflation rises by 1%, then ROA rises by 0.162%.

4. CONCLUSIONS

Based on the results of the research that has been carried out, the following conclusions are obtained:

a. The results of profitability modeling (*Return on Assets) of the* pharmaceutical sub-sector with the FD-GMM equation are as follows:

$$ROA_{i,t} = 0.200 * ROA_{i,t-1} - 0.224 * CR_{i,t} - 0.07 * DR_{i,t} + 0.162 * Inflation_{i,t} + e_{i,t}$$

b. The ROA of the pharmaceutical subsector is heavily influenced by the ROA of the preceding period, the cost of capital, and inflation.

c. In the following study, a comparison of the results between FD-GMM and the GMM system can be done to get the best results.

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