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Optimizing Inventory Management of MFD Studio to Reduce The High Lost Sales

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Abstract

This research delves into optimizing inventory management at MFD Studio by implementing demand forecasting to mitigate lost sales. Notably, the company has encountered a significant loss of sales, approximately 31.26% of the revenue generated by their flagship product, Outer, which has consistently held the position of the best-seller from 2021 to 2023, contributing approximately 60% to MFD Studio's overall product line during this period. The research aims to enhance inventory management efficiency by employing demand forecasting techniques. The methodology includes a thorough literature review, analysis of root causes, and conceptual framework development. The findings underscore the substantial impact of demand forecasting on inventory management, leading to a noteworthy reduction in lost sales. The study advocates for adopting a quantitative approach to demand forecasting, explicitly endorsing the ARIMA, Holt, and Winter models. Notably, the ARIMA model stands out with the lowest error, boasting a 0.0059 RMSE value, 0.0025 MAE value, and 0.0363 MAPE value. The forecast generated by the ARIMA model is anticipated to diminish the likelihood of future lost sales to 5.5%, representing a substantial decrease from the initial 31.26%. In conclusion, this research underscores the pivotal role of demand forecasting as a crucial tool for businesses, particularly in similar industries, to enhance inventory management and curtail lost sales. The practical recommendations contribute significantly to inventory management, offering actionable insights for businesses seeking to optimize their inventory processes.

Keywords: ARIMA model; Demand forecasting; Holt's model; Lost sales; Winter's model

A. INTRODUCTION

The fashion industry in Indonesia has been experiencing steady growth over the years, contributing significantly to the country's creative economy. This growth is attributed to Indonesian people's increasing awareness and lifestyle, making fashion a primary and artistic need. According to (BEKRAF, 2019), the export value of creative products in Indonesia rose from 21.24 billion USD to 22.07 billion USD, with the fashion industry being one of the top contributors. This growth has had a significant impact on the enthusiasm of Indonesia's creative economy, with the fashion industry being a significant player in the industry. (Kompas, 2021).

One of the online shops operating in the fashion sector in West Java is MFD Studio. MFD Studio is an online women's fashion shop in Bandung City, West Java. The company had several experiences under understock conditions. From that condition, the company has lost sales of around Rp39.114.000,0 in the last 3 years or 31.26% of the revenue Rp125.133.000,00. Since they are still categorized as Small Medium Enterprise (SME), stockouts are significant issues for the company (Ibrahima et al., 2021). The customer will probably look for another company and be dissatisfied with the company if they can't fulfill the demand. The satisfaction and loyalty of consumers have emerged as crucial intangible assets for companies (Kandampully et al., 2015). The detrimental impact of high lost sales in SMEs often stems from the pervasive issue of stockouts resulting from an inappropriate forecasting system (Fairlie & Fossen, 2021). The inappropriateness of the forecasting system exacerbates the vulnerability of these enterprises to stockouts, disrupting their ability to fulfill customer orders and meet market demand.

Uncertainty in demand is prevalent across various industries, and no singular forecasting model can universally address the needs of all sectors (Fildes et al., 2019). The fashion industry is marked by intrinsic uncertainties in both supply and demand, a protracted and inflexible supply process, a brief product life cycle, extensive product diversity (such as style and color variations), a propensity for impulsive buying (Şen, 2008),

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seasonal product patterns, and a preference for specific attributes over others (Minner & Kiesmüller, 2012). As a result, forecasting demand for fashion products becomes an intricate and intriguing field of study, given the complexity and challenges inherent in this domain. Various approaches include exponential smoothing, the Holt-Winters (HW) model, Regression models, Clustering, different Neural Networks, Fuzzy methods, and Survey-based methods (Swaminathan & Venkitasubramony, 2023). In a study conducted by (Vo et al., 2021), a comparison between the Autoregressive Integrated Moving Average (ARIMA) and Holt's regression model for demand prediction revealed that ARIMA exhibited the least error, signifying higher accuracy in forecasting.

This research contributes to the growing body of knowledge within the realm of fashion industry management, emphasizing the pivotal role of a robust forecasting system in meeting customer demand, maintaining customer relationships, and streamlining revenue. Effective inventory management becomes indispensable in the dynamic and fast-paced fashion landscape, where consumer preferences and trends constantly evolve. The success of a fashion business hinges on its ability to accurately predict and respond to market demands, ensuring that products are available when and where customers seek them.

The specific focus on MFD Studio's high lost sales issue underscores the practical implications of this research. By delving into the unique challenges this particular online women's fashion shop faces, the study aims to tailor a forecasting method that aligns with the business's short-term needs, particularly over the next two months. This timeframe is chosen strategically to provide MFD Studio with immediate and actionable insights, allowing them to implement changes swiftly and observe the impact on their inventory management and sales performance.

The outcomes of this research are anticipated to go beyond the confines of MFD Studio, offering valuable insights and recommendations applicable to other SMEs in the fashion industry grappling with similar inventory challenges. The findings may inform industry best practices, empowering businesses to adopt more effective forecasting methods, thereby enhancing their resilience to market fluctuations and customer demands. As the research unfolds, it will shed light on the intricacies of forecasting systems in the fashion industry and propose practical solutions that can be widely adopted. Ultimately, the aim is to contribute to the sustainable growth and competitiveness of businesses like MFD Studio, fostering an environment where they can thrive in the ever-evolving landscape of the fashion market.

B. RESEARCH METHODS

This research aims to identify the root cause of the business issue through interviews with the company owner. This process is expected to unveil existing challenges within the company and elucidate their expectations for future improvement. The model selection phase involves determining the most suitable forecasting method. This selection process relies on identifying the algorithm that produces the lowest error among various options, as portrayed in Figure 1.

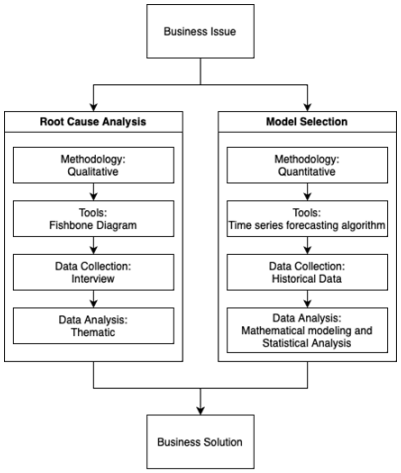

Figure 1. Root Cause Analysis
Source: Research data, 2023

The research encompasses several integral phases. Beginning with the preliminary study, the researcher identifies potential issues within MFD Studio, focusing on operations management and collecting concise details,

along with historical sales data from January to December 2023. Subsequently, in the problem identification phase, the researcher aims to pinpoint the core challenge by delving into the findings obtained in the preliminary study and conducting an interview with the owner. The theoretical foundation involves connecting theories to the research topic, employing time-series forecasting methods, and utilizing metrics such as MAD and MAPE. Data collection encompasses primary data gathered through interviews and observations and secondary data derived from historical sales and customer information. Finally, in the data processing and analysis phase, the researcher employs various time-series forecasting methods on compiled data, using R Studio and assessing the selected method's accuracy based on metrics like MAD, MSE, and MAPE. The research outcomes provide valuable insights and serve as a solution for MFD Studio, guiding the enhancement of forecasting techniques for improved accuracy in predicting future demand, as portrayed in Figure 2.

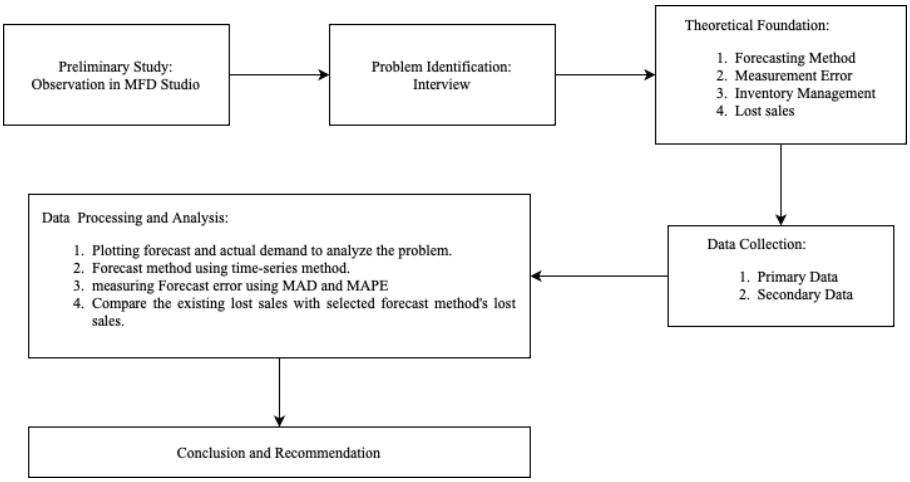

Figure 2. Research Flow
Source: Research data, 2023

C. RESULTS AND ANALYSIS

Fishbone Diagram

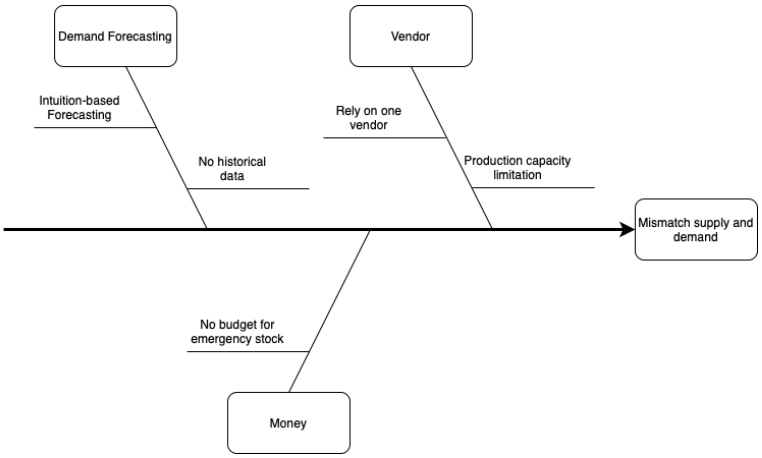

Figure 3. The Fishbone Diagram of Business
Source: Research data, 2023

At this stage, an observation was conducted to see the company's current condition. The author interviewed the owner to obtain all the information needed for the research, find the root cause of the issue they experienced, and know what they expect for the future business process, especially forecasting. From the conversation above,

it can be concluded that the company is still using intuition-based forecasting to determine the amount of the product. Then, if stockout happens in the middle of the month, the possibility of restocking can still be done, but there are some constraints, such as the vendor can't make sure the material is available, the limitation of the production capacity, and the emergency budget. Those constraints make the demand unmeet when the stockout happening. Within the company's operational framework, a crucial aspect contributing to the misalignment between supply and demand involves three primary factors.

Historical Data Decomposition

The historical data sales collected before need to be analyzed as the time series analysis focuses on understanding the dependencies in data as they change over time. In this research, the historical data were decomposed. The decomposition of a time series typically involves breaking it down into four main components: observed, trend, seasonal, and random (or residual).

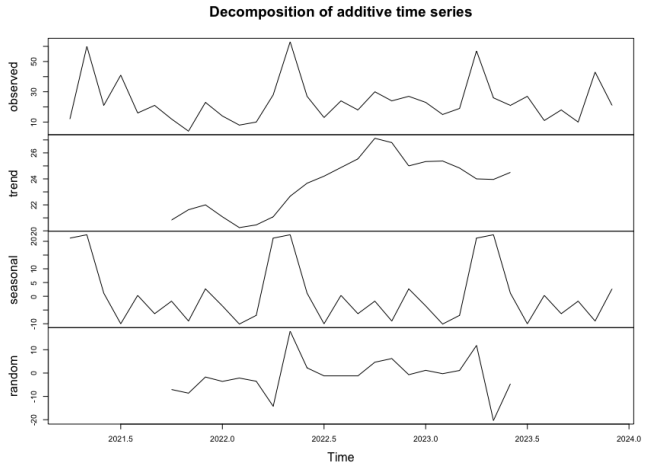

Figure 4. Historical Data
Source: Research data, 2023

The analysis comprises four crucial components derived from the time series data. The first component, observed and depicted in the initial row, offers a comprehensive view of the original data, encapsulating the interplay of trend, seasonal, and random elements. This provides insight into the intricate dynamics of factors influencing the time series. Moving to the second row, attention is directed to the trend component, which captures the long-term movement or direction in the data.

It is noteworthy that sales experienced a decline in the inaugural year (2021), followed by an upward trend from early 2022 until the end of that year. A relatively stable phase succeeded in early 2023. Transitioning to the third row, the seasonal component is introduced, elucidating regular fluctuations occurring at fixed intervals. The analysis applies yearly patterns, unveiling a consistent and significant increase in sales during the first quarter attributed to factors like Eid Al-Fitr. This categorization leans towards an additive model due to the constant seasonal amplitude.

In the final row, the fourth component represents the random or error term, indicating unexplained variability in the time series. While most fluctuations hover around zero, signifying a well-behaved random component, occasional deviations emphasize capturing underlying patterns through trend and seasonal components. This comprehensive analysis aids in understanding the nuanced dynamics of the time series data and provides a foundation for further exploration and refinement of forecasting models.

Forecast Analysis Result
ARIMA Method

The figure compares the actual sales indicated by "Original" and the ARIMA forecasting result data indicated by "ARIMA" from 2021 until 2023. The "Index" axis shows the period (monthly). It can be seen from the graph that the moving average tends to generate almost the same pattern as the actual sales. The forecasting model is evaluated using R Studio to determine the measurement error. The evaluation is shown in Table 1.

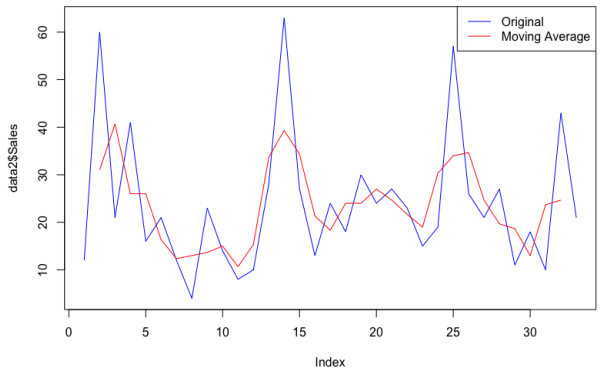

Figure 5. Forecasting by ARIMA Model

Source: Research data, 2023

The RMSE for the ARIMA method is reported as 0.0059. The MAE for the ARIMA method is approximately 0.0025. Similar to RMSE, a lower MAE is generally considered favorable in forecasting. The last measurement error considered is the Mean Absolute MAPE, and for the moving average method, it is reported as 0.0363.

Table 1. Model Fit of ARIMA Model

	RMSE	MAE	MAPE
Error	0.0059	0.0025	0.0363

Source: Research data, 2023

Table 2. shows the forecasting result using the moving average method for the next 3 months for MFD Studio to produce the outer product. Based on this forecasting method, the company will have a demand for around 9 products in January and 27 in February. If the company implements this method and follows the forecasting result, Table IV.4 shows the future lost sales due to understock events that can happen if this forecast method is missed.

Table 2. Forecasting Result Using Moving Average Method

Month	Point Forecast	Lo 80	Hi 80
Jan 24	9	8	10
Feb 24	27	26	28
March 24	0	0	1

Source: Research data, 2023

In January 2024, MFD Studio anticipates generating a revenue of approximately IDR1,431,000 based on a matched demand for 9 products. However, a potential forecasting error revealing an actual demand of 10 products could lead to an understock situation, resulting in an estimated lost sale of IDR159,000, constituting 11% of the projected revenue. In February 2024, the company foresees a revenue of around IDR4,293,000 from a matched demand for 27 products. An error in forecasting, indicating an actual demand of 28 products, might result in a lost sale of IDR159,000, equivalent to 3% of the projected revenue. Considering both forecasting instances using the moving average method, MFD Studio faces a prospective future lost sales rate of approximately 7% if predictions prove inaccurate. This represents a noteworthy improvement compared to the existing conditions in the company, indicating a potential 25% reduction in lost sales from the current rate of 32%.

Table 3. Forecast of Lost Sale

Month	Point Forecast	Hi 80	Gap	Lost Sale	%Lost Sales
Jan 24	9	10	1	IDR159.000	11%
Feb 24	27	28	1	IDR159.000	3%

Source: Research data, 2023

Holt's Model

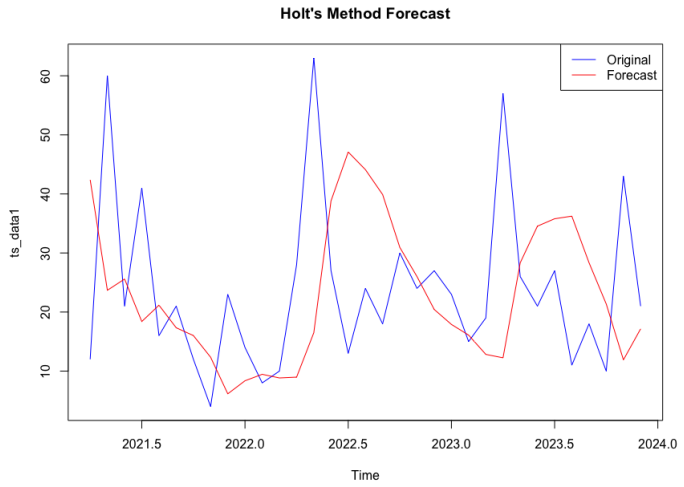

Figure 6. Forecasting by Holt's Model
Source: Research data, 2023

Table 4. Model Fit of Holt's Model

	RMSE	MAE	MAPE
Error	14.33996	10.21919	62.44498

Source: Research data, 2023

The evaluation of Holt's method reveals an RMSE (Root Mean Squared Error) of 14.34, notably higher than that of the moving average method, indicating lower accuracy in predictions than the ARIMA method. The MAE (Mean Absolute Error) for Holt's model is approximately 10.22, which is also higher than the MAE for the moving average method. This higher MAE suggests that, on average, the absolute forecasting errors are more significant with Holt's method than the moving average method. Additionally, Holt's method's MAPE (Mean Absolute Percentage Error) is reported as 62.44, surpassing the MAPE of the moving average method. In summary, the assessment based on these error measurements (higher RMSE, higher MAE, and higher MAPE) indicates that Holt's forecasting method exhibits more significant errors than the moving average method.

Panel data regression analysis with Lagrange Multiplier testing used in this study is intended to determine whether there is an influence of the independent variables of environmental performance, social performance, and governance performance on the dependent variable, namely the dividend payout ratio, this study also uses control variables to clarify the results of research on these variables, namely firm growth, free cash flow, and investment opportunities.

Descriptive Statistics

Table 5. Descriptive Statistical Analysis Results

Variable	Obs	Mean	Std. dev.	Min	Max
DPR	195	.5460703	.4659326	-.2461031	2.683633
ENV	226	38.16997	25.13762	0	88.775
SOC	226	57.86118	23.23.678	6.884659	95.74625
GOV	226	53.45824	22.39172	2.977333	92.27513
INVOPP	224	.079169	.1709682	-1	.7962989
FCF	192	.0821246	.1130113	-.194298	.4912833
FG	226	.0978615	.2243355	-.5386452	1.154.847

Source: research data, 2023

Table 1 shows the results of descriptive statistics in this study. The dependent variable in this study, namely dividend policy proxied by the dividend payout ratio, has a mean value of 0.5460703. This indicator means that the companies used as research samples distribute dividends with a net income or dividend payout ratio of 0.5460703 from 2017 to 2022. Next, the minimum value of the dependent variable or dividend payout ratio is -0.2461031. The minimum value figure was in PT Perusahaan Gas Negara Tbk in 2020. Finally, the maximum

value for the dependent variable in this study is 2.683633, owned by the company PT Bank Tabungan Negara Tbk in 2019.

The independent variables in this study are environmental performance, social performance, and governance performance, with proxy scores obtained from the Thomson Reuters Eikon database. The variables in Table 1 have a mean number greater than the standard deviation; this result shows that the data value of the independent variable has a representative picture of all independent variable data. The control variables in this study, namely firm growth, free cash flow, and investment opportunities, have a mean value smaller than the standard deviation; this result indicates that the control variable data value has a varied value.

Normality test

Table 6. Normality Test

Skewness and kurtosis tests for normality					
				Joint test	
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	Adj Chi2(2)	Prob>Chi2
Resd	191	0,387	0,034	5,24	0,0729

Source: research data, 2023

This test can be done by making the following hypothesis:
H0 = data is normally distributed
H1 = data is not normally distributed
Determination of the statistical test of the residual value is normally distributed, or H0 is accepted when Prob> Chi2 with Sig> α = 0.05.
The Prob> Chi2 value in Table 2 above shows a number of 0.0729 or more than 0.05. This data informs us that the data is normally distributed.

Heteroscedasticity Test

Tabel 7 Heteroscedasticity Test Results

Breusch–Pagan/Cook–Weisberg test for heteroscedasticity
Assumption: Normal error terms
Variable: Fitted values of **dpr**
H0: Constant variance
chi2(1) = **7.09**
Prob > chi2 = **0.0077**

Source: research data, 2023

Based on Table 3 above, it can be seen that the result (Prob>chi2) is worth 0.0077, which means that the value is smaller than the research alpha, which is 0.05. From the above value, it can be concluded that there is a heteroscedasticity problem. This problem occurs because some variants are not constant. The heteroscedasticity problem can be overcome using vce robust regression or Robust Standard Error.

Autocorrelation Test

Table 8. Autocorrelation results using the Wooldridge test

Wooldridge test for autocorrelation in panel data
H0: no First Orde Autocorrelation
F(1,27) = 3,698
Prob>F = **0,0651**

Source: research data, 2023

Based on Table 4 above, it can be seen that the value of the Wooldridge Autocorrelation test for Prob>F is 0.0651. This shows that the value is less than 0.05. Thus, it can be concluded that there is no autocorrelation between data sorted by time and regression models for the 2017-2022 period.

Multicollinearity Test

Table 9. Result Multicollinearity Test

Variable	VIF	1/VIF
SOC	2,6	0,383951
ENV	2,47	0,404508
FG	1,58	0,632414
INVOPP	1,55	0,646673
GOV	1,45	0,691843
FCF	1,13	0,883021
Mean VIF	1,8	

Source: research data, 2023

Based on Table 5, the data in this study has a VIF value <10. Not only that, the Mean VIF value of this study is less than ten or <10, which is 1.80. It is concluded that the test in this study is free from multicollinearity problems between variables in the regression model.

Lagrange Multiplier

Table 10. Result Lagrange Multiplier Test

	Var	SD = Sqet (Var)
dpr	0,1995055	0,4466604
e	0,1562281	0,395257
u	0	0
Test:	Var(u) =	0
	chibar2(01) =	0
	Prob>chibar2 =	1,00000

Source: research data, 2023

The Lagrange multiplier test is a test to determine which method is more appropriate to use between the common effect model and the random effect model with the hypothesis used as follows:
H0: Common Effect Model (CEM)
H1: Random Effect Model (REM):

Based on Table 6 above, the calculation number of Prob>chibar2 is 1.00; this shows that the value is more than 0.05. This figure shows that if H1 is rejected, the correct regression model based on the Lagrange multiplier test is determined using the Common Effect Model (CEM), provided that H0 is accepted.

Common effect Vce Robust and Random Effect Regression (OLS)

Table 11. Ordinary Least Square (OLS) vce Robust Regression Test Results

	Random Effect Model		***Common Effect Model Vce Robust***	
dpr	Coefficient	P>|t|	Coefficient	P>|t|
e	0,0047324	0,015	0,0047324	0,013
s	-0,0000633	0,977	-0,0000633	0,977
g	-0,0031493	0,059	-0,0031493	0,04
salesg	-0,3789731	0,003	-0,3789731	0,02
invopp	-0,5555291	0,034	0,8354081	0,00
fcf	0,8354081	0,023	-0,5555291	0,02
_cons	0,5534193	0	0,3856987	0,00
Prob > F	0		0,000	
R-squared	0,2287		0,2287	

Source: research data, 2023

T Test

The coefficient of the common effect model vce robust environmental performance variable of 0.0047324 has a positive sign. This means that if there is a 1% increase in environmental performance, the value of the dividend payout ratio will be increased by 0.0047324 under the condition or assumption that the value of the other variables is constant. The significance value of the first independent variable, Environmental Performance, is 0.013, smaller than 0.05, and the t value is 2.51. This shows that environmental performance significantly affects the dividend payout ratio in companies listed on the Indonesia Stock Exchange for 2017-2022.

The company's efforts with sustainable environmental practices, such as using resources efficiently and creating more energy-efficient operations, often lead to long-term operational cost reductions. For example, PT

Bukit Asam Tbk optimized the facility line at PLTU Banjarsari with the benefit of reducing hauling costs by 33% and reducing emissions by 700 tons of CO2eq per year, the use of hybrid vehicles, and smart refueling for dump trucks to reduce loss time and save up to 120,000 liters of fuel per year. These findings are also consistent with research by (Zahid et al., 2023; Mazzarano et al., 2021; Nguyen & Balachandran, 2017).

The coefficient of the common effect model vce robust social performance variable of -0.0000633 has a positive sign. This means that a 1% increase in social performance will increase the value of the dividend payout ratio by -0.0000633 under the condition or assumption that the value of the other variables is constant. The significance value of the second independent variable, social performance, is 0.977, greater than 0.05, and the t value is -0.03. This shows that social performance has no significant effect on the dividend payout ratio in companies listed on the Indonesia Stock Exchange for 2017-2022, or there is not enough evidence to determine the effect of social performance on the dividend payout ratio. Thus, it shows that social performance companies do not have enough evidence to significantly influence the high dividend payout ratio.

The value of the governance performance coefficient of -0.0031493 has a negative sign. This means that if there is a 1% increase in governance performance, it will increase the value of the dividend payout ratio by -0.0031493 under the condition or assumption that the value of the other variables is constant. The significance value of the third independent variable, governance performance, is 0.04, smaller than 0.05, and the t value is -2.07. This shows that governance performance significantly negatively affects the dividend payout ratio in companies listed on the Indonesia Stock Exchange for 2017-2022.

Thus, it shows that companies with good governance performance generally have a small dividend payout ratio. Companies with good governance make it easy to get funding loans. Usually, this funding is used for business expansion or paying maturing debts. For example, based on AKRA's 2022 Notes to Financial Statements (CALK), PT AKR Corporindo (AKRA) obtained a long-term bank loan of 750 billion, which was used to pay off the 2017 Phase 1 sustainable bonds. However, the consequence is that the greater the bank loan, the more the company must maintain its cash so it does not default.aThempany will be stricter in determining the amount of Divthe. The findings of this study are consistent with previous research conducted by (Nguyen et al., 2021 Setiawan & Phua, 2013; Lopez de Silanes et al., 2005).

The coefficient of the common effect model vce robust control variable growth of -0.3789731 is negative. This means that if there is a 1% increase in growth, the value of the dividend payout ratio will be increased by -0.3789731 under the condition or assumption that the value of the other variables is constant. The significance value of the Firm Growth control variable is 0.04, which is smaller than 0.05, and the t value is -2.35. This shows that Firm Growth significantly negatively affects the dividend payout ratio in companies listed on the Indonesia Stock Exchange for 2017-2022. The findings of this study are consistent with previous research conducted by (Dempsey et al., 2019; Fama & French, 2001; Silaban & Purnawati, 2016).

The coefficient of the common effect model vce robust control variable free cash flow of 0.8354081 is positive. This means that a 1% increase in free cash flow will increase the value of the dividend payout ratio by 0.8354081 under the condition or assumption that the value of the other variables is constant. The significance value of the free cash flow control variable is 0.00, which is smaller than 0.05, and the t value is 3.77. This shows that free cash flow significantly positively affects the dividend payout ratio in companies listed on the Indonesia Stock Exchange for 2017-2022. The findings of this study are consistent with previous research conducted by (Dwi, 2015; Rosdini, 2009; Thanatawee, 2011).

The coefficient of the common effect model vce robust control variable investment opportunities of -0.5555291 has a negative sign. This means that if there is a 1% increase in investment opportunities, the value of the dividend payout ratio will increase by -0.5555291 under the condition or assumption that the value of the other variables is constant. The significance value of the third control variable, investment opportunities, is 0.02, smaller than 0.05, and the t value is -2.36. This shows that investment opportunities significantly negatively affect the dividend payout ratio in companies listed on the Indonesia Stock Exchange for 2017-2022. The findings of this study are consistent with previous research conducted by (Abor & Bokpin, 2010 Marleadyani & Wiksuana, 2016; Suartawan & Yasa, 2017).

F Test

Based on the data shown in Table 7, it can be seen above that the Prob>F value is 0.000 for the common effect and random effect models. The Alpha value for this study was determined to be 0.5. This shows that the Alpha value used in this study is lower than the Prob> F calculation value. From the above calculations, it can be concluded that the independent and control variables in this study, namely environmental performance, social

performance, governance performance, firm growth, investment opportunities, and free cash flow, simultaneously significantly influence the company's dividend payout ratio.

R-Square Test

Based on Table 7 above, it can be seen that this study has an R-squared value of 0.2287 for the common effect and random effect models. This means that the dependent variable, namely dividend policy proxied by the dividend payout ratio, can be explained by the independent variables of environmental performance, social performance, and governance performance, as well as the control variables, namely firm growth, free cash flow, and investment opportunities by 22.8%. Furthermore, the remaining proportion of 72.2%% can be attributed to external variables beyond this study's scope.

CONCLUSION

This study aims to determine the relationship between emitten performance in the aspects of environmental performance, social performance, and governance performance with the dividend policy of companies listed on the Indonesia Stock Exchange for 2017-2022. Preliminary research findings indicate a statistically significant and positive relationship between environmental performance (ENV) and the dependent variable under study, namely dividend policy proxied by the dividend payout ratio. Thus, this explains that companies with high environmental performance pay out high dividends to their shareholders. The second research finding shows no statistically significant relationship between Social performance (SOC) and the dependent variable under study, namely dividend policy proxied by dividend payout ratio. Thus, this shows that there is not enough evidence to determine the effect of social performance on the dividend distribution amount. The third research finding shows a statistically significant and negative relationship between Governance (GOV) performance and the dependent variable under study, namely dividend policy proxied by dividend payout ratio. Thus, this explains that companies with high governance performance generally distribute small dividends to their shareholders. Future research can add several other variables, such as profitability, liquidity, leverage ratio, and macroeconomic variables, such as GDP growth, inflation, and interest rates.

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