

Value determinants: The role of cash holdings, investment opportunity set, and institutional ownership with firm size as a moderator

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Abstract

This study examines the effect of cash holdings, investment opportunity set (IOS), and institutional ownership on firm value in energy sector companies listed on the Indonesia Stock Exchange (IDX) during the 2020–2024 period. Firm size is also examined as a moderating variable. This research was motivated by the declining firm value of energy companies in recent years, which may be associated with inefficient cash management, risky investment decisions, and agency conflicts. Using panel data regression with a random-effects model, the results show that only IOS has a significant effect on firm value. Furthermore, firm size moderates the relationships between cash holdings, IOS, institutional ownership, and firm value. These findings indicate that company scale plays an important role in shaping how financial policy, investment opportunities, and ownership structure affect firm value. This study contributes to the literature by emphasizing the moderating role of firm size and provides practical implications for energy companies and investors in evaluating financial strategy and stock performance.

Keywords

Agency conflicts, Investment opportunities, Price to book value, Stock performance

Introduction

Firm value in energy sector companies has decreased from 1.97 in 2021 to 1.38 in 2023 [1]. This decrease indicates that investors interpret energy sector companies as generating low financial performance. In fact, financial performance can affect firm value [2]. Firm value is an important indicator, especially for shareholders, as it can signal the dividends they will receive. Some factors that affect firm value include cash holdings, the investment opportunity set (IOS), and institutional ownership.

COVID-19 has been a contributing factor to the decline in cash holdings and financial performance of energy sector firms in Indonesia since 2020 [3]. High cash holdings can

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increase a firm's opportunities to invest profitably, and external funding can increase firm value [4]. Moreover, cash holdings are essential for firms, especially as a precaution in the event of a financial crisis [5]. The higher the firm value, the greater the expected profits and investment opportunities. This condition encourages firms to hold more cash and to assess cash shortages negatively [6].

The COVID-19 pandemic has caused a drastic decline in energy demand. However, from 2021 to 2024, the energy sector has shown significant improvement, with investment increasing from USD 26.3 billion in 2020 to USD 32.3 billion in 2024 [7]. An increase in investment may increase firm value. Thus, an increase in IOS can also increase firm value. Significant investment potential reflects increased firm value. Therefore, an IOS focused on increasing value consistently aligns with firm objectives [8]. Moreover, firms with increasing IOS values have strong prospects and can increase firm value [9]. As a firm grows, its investment value will move in line with economic dynamics, creating investor optimism that ultimately raises share prices and strengthens the firm's value [10].

Institutional ownership can also affect firm value. Institutional ownership provides an incentive for firms to conduct more intensive performance monitoring to increase firm value [11]. The participation of institutions as shareholders is seen as contributing to improving the firm's oversight mechanisms [12]. The higher a firm's value, the greater the interest of institutional investors, especially in firms with strong market performance [13].

Firm size becomes one factor that can enhance or weaken the impact of cash holdings, IOS, and institutional ownership on firm value. Firm size can moderate the effect of institutional ownership on firm value [14]. The larger the firm size, the stronger the influence of the IOS on increasing firm value, thanks to the ease with which large firms can gain public recognition and expand investment opportunities [15].

Many previous studies have investigated the impact of cash holdings on firm value [4], [6], [16], [17], [18]. Moreover, the impact of IOS on firm value has been explored by many researchers [8], [9], [19], [20], [21]. Furthermore, the impact of institutional ownership on firm value has been discussed in previous studies [11], [12], [13], [22], [23]. In fact, these studies yielded different results and methodologies. Thus, this research will examine the impact of cash holdings, IOS, and institutional ownership on firm value using a random-effects model (RE).

Despite extensive research on these relationships, a comprehensive analysis of cash holdings, IOS, and institutional ownership, simultaneously with firm size as a moderator, in the Indonesian energy sector during the post-pandemic period (2020-2024) remains limited. This study addresses this gap by providing an integrated examination of these factors in a sector and timeframe that have received insufficient attention.

Many previous studies have discussed the role of firm size as a moderator of the effect of IOS and institutional ownership on firm value [14], [15], [24]. However, few studies have discussed the role of firm size as a moderator of the effect of cash holdings on firm

value. Thus, this research also examines the role of firm size as a moderator variable of the impact of cash holdings on firm value.

The impact of cash holdings on firm value is explained by the pecking order theory [6]. Previous studies have discussed the effects of cash holdings on firm value. Cash holdings contribute to a firm's increased independence in financing its own needs and reduce dependence on external parties [6]. Therefore, an increase in cash holdings reflects improved financial performance in terms of funding independence and liquidity. This boosts investor confidence in the firm and ultimately increases its value. [6] discussed the influence of cash holdings on the firm value of manufacturing companies listed on the Amman Stock Exchange from 2010 to 2017. This research used a fixed-effects (FE) regression model. [6] employed the market to book value (MBV) as a firm value estimator. [6] revealed that cash holdings have a positive and significant influence on firm value. First, firms use cash holdings to finance investments that can increase firm value. Furthermore, firms retain more cash, reducing their reliance on external financing sources and providing a buffer against unforeseen circumstances. [16] examined the role of cash holdings as determinants of the firm value of firms listed on the Ho Chi Minh City Stock Exchange, Vietnam, from 2009 to 2014. [16] employed an FE regression model to estimate the impact of cash holdings on firm value. [16] also found that cash holdings have a positive and significant impact on firm value. A large cash holding reflects a strong ability to generate cash flow from business operations and to pay debts and expenses. [4] analysed the influence of cash holdings on the firm value of food and beverage sector companies listed on the Indonesia Stock Exchange (IDX) from 2017 to 2021. [4] also showed that cash holdings have a positive and significant influence on firm value. High cash holdings increase potential investment opportunities and external financing, thereby increasing firm value.

The impact of IOS on firm value has been explained by signalling theory, as outlined by [9] and [19]. The greater the firm's opportunity to invest in profitable projects, the higher investor confidence in the firm, which in turn increases share prices and firm value. On the other hand, a decrease in IOS is a negative signal for investors, which may lower the share price and firm value. Previous research has explored the impact of IOS on firm value. [9] investigated the effect of IOS on the firm value of industrial services companies listed on the IDX from 2013 to 2015. [9] employed multiple regression to examine the impact of IOS on firm value. [9] used the price earnings ratio (PER) as an IOS indicator. [9] showed that IOS has a positive and significant effect on firm value. An increase in the IOS value indicates a good prospect for the firm, which can ultimately improve firm value. [10] explored the impact of IOS on the firm value of banking sector companies listed on the Pakistani Stock Exchange from 2010 to 2019. [10] applied path analysis using AMOS to examine the effect of IOS on firm value. [10] showed that IOS and firm value have a positive relationship. Firms that are growing and tend to increase investment value can generate positive sentiment among investors, boosting share prices and ultimately increasing firm value. [19] analysed the influence of IOS on the firm

value of consumer goods companies listed on the IDX from 2017 to 2019. [19] employed the Tobin's Q ratio as a firm value indicator. Multiple regression analysis was used to measure the effect of IOS on firm value. [19] found that IOS has a positive and significant influence on firm value. This result suggests that firms with increasing asset holdings are more likely to invest heavily. This can reflect strong firm performance, leading to increased investor confidence, higher demand for shares, higher share prices, and ultimately higher firm value.

This research employs agency theory to explain the impact of institutional ownership on firm value following [22]. According to this theory, the dominance of institutional ownership can give rise to conflict between majority and minority shareholders. Thus, this may affect the investor's decision to invest in the firm's shares, and eventually it will affect the firm's value. Many previous researchers have investigated the impact of institutional ownership on firm value. [13] examined the relationship between institutional ownership and the firm value of 104 firms listed on the Borsa Istanbul Industrial Index from 2006 to 2018. Tobin's Q was used as a measure of firm value. [13] applied ordinary least squares (OLS) and two-stage least squares for data analysis. [13] revealed that institutional ownership has a positive and significant relationship with firm value. Institutional investors are attracted to firms with strong market performance; therefore, increasing institutional ownership can boost firm value. [11] examined the contribution of institutional ownership to the firm value of manufacturing companies in the Metal sub-sector listed on the IDX from 2019 to 2021. PER estimated firm value. [11] found that institutional ownership has a positive contribution to firm value. Large institutional ownership can increase oversight of a firm's management, thereby improving its performance. This can increase investor interest, leading to higher share prices and firm value. [12] explored the contribution of institutional ownership to the firm value of 170 manufacturing companies listed on the IDX from 2014 to 2018. [12] used multiple regression analysis to investigate the contribution of institutional ownership to firm value and applied Tobin's Q as a firm value indicator. [12] showed that an increase in institutional ownership will increase firm value. Greater institutional ownership of a firm's shares is thought to enhance oversight of the firm's performance and governance. This can boost investor confidence in purchasing the firm's shares, which, in turn, can increase the share price and firm value.

The role of firm size as a moderator of the impact of cash holdings on firm value will be explained by the pecking order theory. Firms with significant assets do not rely on cash holdings. In contrast, smaller firms do. [25] discussed the impact of firm size on cash holdings of manufacturing companies listed on the IDX from 2015 to 2017 using multiple regression analysis. [25] showed that firm size has a positive and significant impact on cash holdings. [26] investigated the effect of firm size on cash holdings of real estate companies listed on the IDX from 2019 to 2021. Multiple regression analysis was employed to examine the impact of firm size on cash holdings. [26] found that firm size and cash holdings have a positive and significant relationship. Large firms typically hold

substantial cash reserves as a precaution against financial difficulties. Furthermore, they tend to fund diversified investments, requiring more cash to capitalise on various investment opportunities. [27] analysed the contribution of firm size to cash holdings of non-financial and non-utility listed companies in the United Kingdom from 2010 to 2018 using panel data regression analysis. [27] found that firm size is inversely related to cash holdings. Smaller firms tend to hold more cash due to financing constraints than larger firms, which can leverage existing economies of scale.

Signalling theory will be employed to explain the role of firm size as a moderator of the impact of IOS on firm value. [24] examined the role of firm size as a moderator of the effect of IOS on the firm value of companies listed on the IDX from 2018 to 2020 using multiple regression analysis. [24] found that firm size can enhance the effect of IOS on firm value. The larger the firm, the stronger the influence of the IOS on firm value, because a large scale makes the firm better known to the public and easier to penetrate the market and expand investment opportunities.

The role of firm size as a moderator of the impact of institutional ownership on firm value will be explained by agency theory. The larger the firm, the greater the role of institutional ownership in supervising firm management, and this condition can reduce agency problems and increase firm value. [14] explored the role of firm size as a moderator of the effect of institutional holdings on the firm value of 23 firms in India from 2011 to 2021 using OLS. [14] revealed that firm size can moderate the effect of institutional holdings on firm value. [15] investigated how firm size can moderate the impact of institutional holdings on the firm value of consumer goods companies listed on the IDX from 2015 to 2019. [15] applied the estimated generalised least squares (EGLS) for data analysis. [15] found that firm size successfully moderated the impact of institutional holdings on firm value.

The first part of this research discusses the introduction, which encompasses the research background and literature review. The second part of this research examines the methodology. The third part of this research discusses the results and discussion. Additionally, the conclusion forms the last part of this research.

Method

The population of this research comprises energy sector companies listed on the IDX. Moreover, the total sample for this research consists of 60 energy sector companies from 2020 to 2024. This study employs a balanced panel dataset composed of 60 energy sector companies observed over five years (2020-2024), yielding a total of 300 firm-year observations. This research employed a quantitative, explanatory research design. The study utilised panel data regression analysis to examine causal relationships between variables.

The sample selection employed purposive sampling based on the following criteria: (1) companies consistently listed on the IDX during 2020-2024, (2) companies with

complete financial data for all variables, and (3) companies not undergoing mergers, acquisitions, or delisting during the observation period. This resulted in a final sample of 60 companies, yielding 300 company-year observations.

This research utilised secondary data obtained from the audited annual financial reports of energy sector companies listed on the IDX. Data were collected from the IDX official website, firm yearly reports, and financial databases. All financial data were cross-verified to ensure accuracy and reliability.

The first independent variable of this research is cash holdings. Cash holdings refer to the amount of cash a firm has and play a role in maintaining economic stability, helping firms address financial risks [28]. Cash holdings are estimated by cash and cash equivalents divided by total assets [17]. The second independent variable is the IOS, measured as the market value of assets divided by the book value of assets, following [29] and [30]. The IOS represents the size of investment opportunities or opportunities for a firm, determined by the firm's expenditure for future interests [20]. Furthermore, the third independent variable is institutional ownership. Institutional ownership is the proportion of a firm's shares owned by various institutions, such as banks, governments, insurance companies, investment companies, or other institutional entities. This variable is measured by the percentage of outstanding shares held by institutions following [13]. On the other hand, the dependent variable in this research is firm value. This variable is calculated as the price-to-book value following [2]. Firm value reflects investors' perceptions of a firm's past performance and prospects and is reflected in its share price. In addition, firm size serves as a moderator variable. This variable is estimated as the natural logarithm of total assets, following Table 1 [31].

Table 1. Summary of variables

Variable	Measurement	Formula	Source
Firm Value	Price to Book Value	Market Price Per Share / Book Value Per Share	[2]
Cash Holdings	Cash Ratio	(Cash + Cash Equivalents) / Total Assets	[17]
IOS	Market-to-Book Ratio	Market Value of Assets / Book Value of Assets	[29] [30]
Institutional Ownership	Ownership Percentage	(Shares Held by Institutions / Total Outstanding Shares) × 100%	[13]
Firm Size	Natural Logarithm of Assets	Ln (Total Assets)	[31]

This research employed an RE model in analysing the impact of cash holdings, IOS, and institutional ownership on firm value. This regression model was also used to examine the role of firm size as a moderator. Moreover, this research used two regression model analyses.

The first regression model estimated the impact of cash holdings, IOS, and institutional ownership on firm value:

$$\text{Firm Value} = \beta_0 + \beta_1 \text{Cash Holdings} + \beta_2 \text{IOS} + \beta_3 \text{Institutional Ownership} + \epsilon_i \dots \dots \dots (1)$$

The second regression model analysed the role of firm size as a moderator variable in the effect of cash holdings, IOS, and institutional ownership on firm value:

$$\text{Firm Value} = \beta_0 + \beta_1 \text{Cash Holdings} + \beta_2 \text{IOS} + \beta_3 \text{Institutional Ownership} + \beta_4 \text{Size} + \beta_5 \text{Cash Holdings} \times \text{Size} + \beta_6 \text{IOS} \times \text{Size} + \beta_7 \text{Institutional Ownership} \times \text{Size} + \varepsilon_i \dots \dots (2)$$

Where: β_0 = intercept/constant; $\beta_1 - \beta_7$ = regression coefficients; ε = error term. This research also employed a normality test using the Shapiro-Wilk, following [32]. Moreover, the variance inflation factor (VIF) test was used to identify multicollinearity. A VIF value < 10 indicates that there is no multicollinearity problem. Furthermore, the Breusch-Pagan test was used to assess heteroscedasticity. The Lagrange multiplier test was also used in this research to determine the better regression model between OLS and the RE model. Additionally, the Hausman test was employed to determine the better regression model between the RE and FE models. A probability value of the Hausman test > 5% indicates that RE is better to be employed than FE. If multicollinearity is detected (VIF \geq 10), the problematic variable will be removed or transformed. If heteroscedasticity is present (Breusch-Pagan test p -value < 0.05), robust standard errors will be employed.

Results

Descriptive statistics

Table 2 presents descriptive statistics. The average firm value, estimated using price-to-book value (PBV), is approximately 1.95. This value indicates that the share price is traded 1.95 times higher than its book value. A PBV value above 1 indicates that the market values firms above their book value, suggesting investor optimism. The lowest PBV is -84.09, suggesting that some firms have share prices below their book value and are undervalued. Meanwhile, the highest PBV is 113.5.

The average cash holding is 0.12; this means the firm holds 12% of its total assets in cash. This value indicates that most energy sector companies have good liquidity. The highest value of cash holdings is 0.81. Meanwhile, the lowest value is 0.0005, suggesting that a firm holds cash at only 0.05% of its total assets.

The mean value of IOS is approximately 1.76, which is greater than 1, indicating that the firm's market value is 76% higher than its book value. This value also indicates that most energy sector companies have positive investment opportunities. The lowest value of IOS is 0.18, or lower than 1; this means the market value of this firm is lower than its book value, indicating no positive investment opportunities.

Institutional ownership has a mean value of approximately 0.76. This value indicates that most energy sector companies are approximately 76% owned by institutions such as banks, insurance companies, pension funds, and other financial institutions. The highest value of institutional ownership is 1, which reflects that the firm is owned 100%

by institutions. On the other hand, the lowest institutional ownership percentage is approximately 0.048, or 4.8%.

Firm size as a moderator variable has a mean value of approximately Rp 13,838,218,129,435. This value shows that most energy sector companies have significant assets that can be utilised to increase profitable investments, thereby boosting profits and impacting share prices and firm value. The highest firm size is Rp 169,616,471,417,000, while the lowest is Rp 64,597,186,000.

Table 2. Descriptive statistics

Variable	Obs	Mean	Max	Min
Firm Value	300	1.95	113.5	-84.09
Cash Holdings	300	0.12	0.81	0.0005
IOS	300	1.76	43.03	0.18
Institutional Ownership	300	0.76	1	0.048
Firm Size	300	Rp 13,838,218,129,435	Rp 169,616,471,417,000	Rp 64,597,186,000

Source: Authors' calculation

The impact of cash holdings, IOS, and institutional ownership on firm value

The Shapiro-Wilk test indicates that all variables have p -values greater than 0.05. Cash holdings have a probability value of approximately 0.822; IOS, approximately 0.295; institutional ownership, approximately 0.861; firm size, approximately 0.987; and PBV, approximately 0.324. These results indicate that all data are normally distributed.

Table 3 presents the VIF values of the first regression model. The VIF values of cash holdings and IOS are 1.02. Moreover, the VIF value for institutional ownership is approximately 1.04. Hence, these results indicate that all variables have VIF values below 10, suggesting that the regression model is free of multicollinearity.

Table 3. Variance inflation factor (VIF)

Variable	VIF	1/VIF
Cash Holdings	1.02	0.976
IOS	1.02	0.985
Institutional Ownership	1.04	0.964

Source: Authors' calculation

The Breusch-Pagan test value is greater than 0.05, indicating that the first regression model is free of heteroscedasticity. Moreover, the LM test value is approximately 0.000, or lower than 0.05, indicating that the RE model is preferable to OLS. In addition, the Hausman test value is approximately 0.507, which is greater than 0.05. This value indicates that the RE model is preferable to the FE model.

Table 4 shows the regression results for the first regression model. According to Table 4, cash holdings have a coefficient value of approximately 0.85 and a z -statistic of approximately 0.17. Unfortunately, this value is not significant. This result means that cash holdings have a positive impact on firm value; unfortunately, this impact is not substantial. The insignificant results may be due to investors treating excess cash as an idle asset rather than a means to increase profits and firm value. Moreover, the IOS

coefficient is 1.79. The z-statistic for IOS is approximately 8.80; this value is significant at the 1% level. This value indicates that IOS has a positive and significant impact on firm value. This value also means that the higher the IOS, the higher the opportunity to increase profits and firm value. In addition, the coefficient value of institutional ownership is -0.01, and the z-statistic value is approximately -0.99. In fact, this value is not significant. Investors may focus only on short-term profits, neglecting the long-term goal of increasing the firm's value.

Table 4. Result of the first regression model

Variable	Coefficient	z-statistics
C	-1.22	-1.16
Cash Holdings	0.85	0.17
IOS	1.79	8.80***
Institutional Ownership	-0.01	-0.99

Source: Authors' calculation

*** Significant at 1% level

The role of firm size as a moderator

Table 5 presents the VIF of the second regression model. According to Table 5, all variables have VIF values below 10. The VIF value for cash holdings is 2.53, IOS is approximately 2.26, and institutional ownership is approximately 7.44. Moreover, firm size, as a moderator variable, has a VIF of approximately 1.48. The interaction variable between cash holdings and firm size has a VIF of approximately 2.81. The VIF value for the interaction between IOS and firm size is approximately 2.39, and the VIF value for the interaction between institutional ownership and firm size is approximately 8.35. Furthermore, the tolerance values for all variables are lower than 1. Hence, these results indicate that the second regression model is free from multicollinearity problems.

Table 5. Variance inflation factor (VIF)

Variable	VIF	1/VIF
Cash Holdings	2.53	0.36
IOS	2.26	0.44
Institutional Ownership	7.44	0.12
Firm Size	1.48	0.67
Cash Holdings × Firm Size	2.81	0.35
IOS × Firm Size	2.39	0.42
Institutional Ownership × Firm Size	8.35	0.12

Source: Authors' calculation

Table 6 shows the regression results for the role of firm size as a moderating variable. According to Table 6, the coefficient value of cash holdings is approximately 0.09, and the z-statistic value is 0.04. In fact, this value is not significant. Moreover, the existence of firm size as a moderator changed the direct effect of IOS on firm value to negative and significant at the 1% level (coefficient = -0.04, z-statistic = -2.98). However, the interaction term (IOS × firm size) is positive and highly significant (coefficient = 1.62, z-statistic = 26.6), indicating that firm size successfully moderates and enhances the positive effect of IOS on firm value. This suggests that while IOS alone may have a negative direct effect in the presence of the moderator, the combined effect

(considering the interaction) is positive for larger firms. The coefficient value of institutional ownership is -3.79, and the z-statistic is approximately -1.88. This value is significant at the 10% level. The negative coefficient suggests that, without considering firm size, higher institutional ownership is associated with lower firm value. This may occur when institutional investors prioritise short-term gains over long-term value creation, or when their oversight creates additional constraints on management flexibility. However, the positive and significant interaction term (institutional ownership \times firm size = 0.14, z-statistic = 1.98) indicates that this negative effect is mitigated in larger firms.

Table 6. Result of the second regression model

Variable	Coefficient	z-Statistics
C	0.41	0.24
Cash Holdings	0.09	0.04
IOS	-0.04	-2.98***
Institutional Ownership	-3.79	-1.88*
Firm Size	-0.2	-3.32***
Cash Holdings \times Firm Size	-0.06	-2.42**
IOS \times Firm Size	1.62	26.6***
Institutional Ownership \times Firm Size	0.14	1.98**

Source: Authors' calculation

*** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level

Discussion

According to Table 4, cash holdings have a positive impact on firm value. In fact, this value is not significant. Cash holdings do not have a substantial effect on firm value, as investors are likely to be more focused on profitability and investment opportunities. This result contradicts the pecking-order theory, which holds that cash holdings affect firm value. Indeed, this result is inconsistent with [4], [6], and [16].

Table 4 also shows that IOS has a positive and significant impact on firm value. The IOS has a significant positive influence on firm value because it indicates growth prospects, investment attractiveness, and competitive advantage. Firms with a high IOS are perceived by the market as more promising, thus increasing their value. This result aligns with signalling theory: the higher the IOS value, the better the firm's financial performance. This increases investor confidence in purchasing the firm's shares and ultimately increases the firm's value. In addition, this positive and significant result is also consistent with [9], [19], [10].

Table 4 presents that institutional ownership has a negative but insignificant impact on firm value. This suggests that the mere presence of institutional ownership, without adequate oversight mechanisms, may not translate into value creation. Firm value will only be significantly influenced by institutional ownership when institutional investors actively play a supervisory role and participate in critical decision-making. This research is inconsistent with [11], [12], [13], which found positive relationships in different market contexts.

Table 6 shows that firm size can moderate the impact of cash holdings on firm value. In fact, firm size weakens the association between cash holdings and firm value. Specifically, the negative interaction coefficient of -0.06 (cash holdings \times firm size, z -statistic = -2.42 , $p < 0.05$) indicates that for every one-unit increase in firm size (measured as the natural logarithm of total assets), the positive effect of cash holdings on firm value decreases by 0.06 units. This means that while cash holdings may benefit smaller firms by providing financial flexibility, this benefit diminishes significantly as firms grow larger. The larger the firm size, the greater the opportunity to obtain funding from external parties and the less the dependence on internal funding. This result aligns with the pecking order theory, which states that larger firms are less dependent on cash.

Table 6 also presents that firm size successfully enhances the impact of IOS on firm value. The interaction coefficient of 1.62 (IOS \times firm size, z -statistic = 26.6 , $p < 0.01$) suggests that for every one-unit increase in firm size (natural logarithm of total assets), the positive effect of IOS on firm value increases by 1.62 units, holding other variables constant. This substantial magnitude indicates that firm size is a powerful moderator, amplifying the value-creation potential of investment opportunities in larger firms. The larger a firm, the greater its investment opportunities. This can increase investor interest in purchasing its shares, ultimately increasing its value. This result aligns with [24]. Furthermore, this result is also consistent with signalling theory. The larger a firm, the greater its investment opportunities, which in turn signal positive returns to investors. Investors will become more confident in the firm's financial performance, which will impact the firm's share price and firm value.

Finally, **Table 6** also shows that firm size moderates the impact of institutional ownership on firm value in a complex manner. The direct effect of institutional ownership on firm value is negative and significant (-3.79 , $p < 0.10$), suggesting that institutional ownership may impose constraints or encourage a short-term focus, thereby reducing firm value. However, the positive and significant interaction term (institutional ownership \times firm size = 0.14 , $p < 0.05$) indicates that this negative effect is mitigated in larger firms. Specifically, the interaction coefficient of 0.14 (institutional ownership \times firm size, z -statistic = 1.98 , $p < 0.05$) indicates that for every one-unit increase in firm size (natural logarithm of total assets), the negative effect of institutional ownership on firm value is reduced by 0.14 units. To illustrate, while institutional ownership may decrease firm value by 3.79 units for smaller firms, this negative effect becomes progressively smaller as firm size increases, potentially becoming neutral or even slightly positive for the largest firms in the sample. This suggests that larger firms possess stronger governance structures and more sophisticated management systems that can effectively channel institutional oversight into value-creating activities. In contrast, smaller firms may experience institutional oversight as overly constraining. These results align with agency theory, which recognises that the effectiveness of governance mechanisms varies across firms. In larger firms, institutional investors' oversight complements existing governance

mechanisms, while in smaller firms, it may create redundancy or operational constraints. Indeed, these results are consistent with the contingent nature of governance effectiveness documented by [14] [15].

Conclusion

This research reveals that IOS has significantly increased the value of companies in Indonesia's energy sector. The opportunity to invest in productive projects increases the chances of profits, which are ultimately reflected in increased share prices and firm value. On the other hand, the firm's value is not significantly influenced by the amount of cash held, because investors place greater emphasis on the firm's profit potential and its strategy for exploiting investment opportunities. Institutional ownership does not significantly influence firm value, though the effect is negative. Firm value will increase considerably if institutional investors assume a supervisory role and participate in key decisions.

Firm size can moderate the impact of cash holdings, IOS, and institutional ownership on firm value. Large firm size weakens the effect of cash holdings on firm value. Larger firms have easier access to external financing, thus reducing the need for internal funding. Moreover, larger firms have been shown to enhance IOS's impact on firm value. Broader investment opportunities increase investor confidence in purchasing shares, thereby increasing firm value. Furthermore, the relationship between institutional ownership and firm value is moderated by firm size in a nuanced way. While institutional ownership has a negative direct effect on firm value, this negative effect is mitigated in larger firms, as indicated by the positive interaction term. In smaller firms, institutional oversight may create operational constraints or encourage a short-term focus that reduces value. However, in larger firms with more sophisticated governance structures, institutional oversight can be more effectively integrated with existing governance mechanisms, reducing the negative impact.

The theoretical contribution of this study is threefold. First, it provides empirical evidence supporting the pecking order theory by demonstrating that firm size moderates the relationship between cash holdings and firm value, with larger firms showing reduced dependence on internal cash reserves. Second, it extends signalling theory by showing that the positive signal of high IOS is amplified in larger firms, which have greater market visibility and credibility. Third, it contributes to agency theory by revealing that the effectiveness of institutional oversight in reducing agency costs diminishes in larger firms, where internal governance mechanisms and external regulations play a more prominent role. Furthermore, this study advances methodological approaches by applying a random-effects panel-data regression model to the Indonesian energy sector, providing insights into an under-researched market context.

This research has several practical implications. First, for firms: (1) Energy firms should maintain cash holdings at approximately 12% of total assets (the sample mean), with

adjustments based on firm size. Smaller firms may need higher reserves (15-20%), while larger firms can operate efficiently with lower levels (8-10%). The negative interaction coefficient of -0.06 indicates that the benefit of cash holdings diminishes as firms grow larger, with each unit increase in firm size reducing the positive effect by 0.06 units. (2) Firms should actively seek to increase their IOS, as a one-unit increase in IOS is associated with a 1.79-unit increase in firm value. This can be achieved through R&D investments, strategic acquisitions, and market expansion. The interaction coefficient of 1.62 represents the most substantial moderating effect observed, indicating that larger energy firms will experience substantially greater value enhancement from expanding their IOS compared to smaller firms; and (3) Firms should aim for institutional ownership levels around 76% (the sample mean), with particular attention to firm size. The interaction coefficient of 0.14 suggests that firms with total assets exceeding approximately Rp 6 trillion begin to experience neutral or positive effects from institutional ownership. In contrast, smaller firms may face value-reducing constraints and should therefore carefully structure institutional oversight to maximise benefits.

Second, for investors: Investors should prioritise energy firms with high IOS values (above the median of 1.76) and adequate institutional ownership, particularly when evaluating smaller firms. The magnitude of the moderating effects indicates that firm size is a critical factor in investment decisions, with larger firms showing stronger value creation from investment opportunities but reduced benefits from cash holdings.

Third, for policymakers: Regulators should consider firm size when designing governance requirements, recognising that smaller firms (with assets below Rp 6 trillion) may benefit more from mandatory institutional representation on boards. In comparison, larger firms require different governance approaches that complement their existing sophisticated structures. Policy incentives for the energy sector should be differentiated by firm size, with targeted financial support and reduced regulatory compliance costs for smaller firms to overcome financing constraints, while encouraging larger firms to pursue innovative, large-scale investment projects that can drive sector transformation, particularly in renewable energy development. Additionally, policymakers should facilitate better information flow and the disclosure of investment opportunities to enhance market efficiency, as the strong positive effect of IOS on firm value suggests that policies promoting transparent communication about investment prospects can effectively enhance firm value and attract both domestic and foreign investment to the Indonesian energy sector.

This study has several limitations that present opportunities for future research. First, the research focused exclusively on energy sector companies in Indonesia from 2020 to 2024, which may limit the generalisability of findings to other sectors, countries, or time periods. The study period was significantly influenced by the COVID-19 pandemic and subsequent recovery, which may have affected firm behaviour regarding cash management, investment decisions, and governance structures. Future research could

conduct cross-country comparative studies examining energy companies across ASEAN or other emerging markets to identify regional patterns and contextual factors.

Second, this study examined three main determinants (cash holdings, IOS, and institutional ownership) and one moderating variable (firm size). Other potentially important variables, such as leverage, profitability, firm age, board characteristics, dividend policy, and macroeconomic factors, were not included in the analysis. Future research could incorporate these additional variables to provide a more comprehensive understanding of the determinants of firm value.

Third, while this study used firm size as an internal moderating variable, external factors such as government regulations, industry competition, energy price volatility, and policy changes (particularly those related to renewable energy transitions) could also moderate these relationships. Future research could examine how these external factors influence the effectiveness of cash holdings, investment opportunities, and institutional ownership in creating firm value.

Fourth, the study employed price-to-book value (PBV) as the measure of firm value. While widely used, this measure has limitations. Future research could use alternative measures, such as Tobin's Q, market capitalisation, or the market-to-book ratio, to validate and extend the findings.

Fifth, the random-effects panel regression model used in this study assumes time-invariant unobserved heterogeneity. Future research could employ dynamic panel models (such as GMM) to capture temporal dynamics better and address potential endogeneity issues, or investigate non-linear relationships and threshold effects to identify optimal levels of cash holdings, IOS, and institutional ownership that maximise firm value.

Finally, this study identified relationships between variables but did not examine the underlying mechanisms. Future research could conduct mediation analysis to understand how cash holdings, IOS, and institutional ownership affect firm value through intermediate variables such as profitability, risk reduction, investment efficiency, or cost of capital. Additionally, qualitative research through interviews with managers and institutional investors could provide deeper insights into decision-making processes and governance dynamics.

In conclusion, this study contributes to understanding the determinants of firm value in the Indonesian energy sector by demonstrating the significant role of investment opportunities and the complex moderating effects of firm size. The findings underscore that financial and governance strategies must be tailored to firm characteristics, with larger and smaller firms requiring fundamentally different approaches to cash management, investment prioritisation, and institutional oversight. As the energy sector continues to evolve—particularly amid the global transition towards renewable energy and sustainable practices—understanding these nuanced relationships

becomes increasingly critical for corporate strategy, investment decision-making, and policy formulation aimed at fostering sustainable firm value creation.

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