

## The Effects of Leverage and Profitability on Firm Value across Quantile Levels

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### Abstract

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*This study examines the effect of leverage and profitability on firm value across different quantile levels. Leverage, profitability, and firm value are measured by debt to equity ratio, return on asset, and enterprise value respectively. The method used is quantile regression. The results show that DER has a positive and statistically significant effect on firm value in the lower and middle quantiles, but its influence weakens and becomes insignificant at higher quantiles. This finding suggests that leverage contributes to value creation primarily for Indonesian infrastructure firms with lower valuation levels, consistent with the trade-off theory, whereas high-performing firms may derive less marginal benefit from additional debt.*

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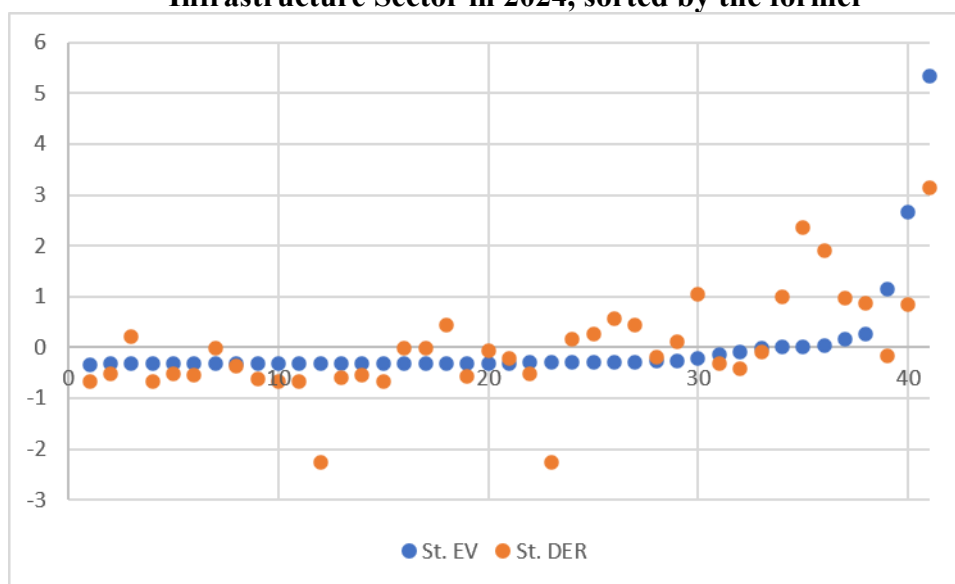
## INTRODUCTION

Companies in fixed asset heavy industries tend to have high debt because their projects often require substantial financing. Theoretically, they tend to have lower cost of debt because their fixed assets can serve as collateral (Vu et al., 2023) and that long term contracts provide them with relatively predictable cash flows and financing maturity that match the lengthy asset life. Hence, according to Modigliani-Miller leverage theory, getting relatively high leverage ratio would be beneficial to them due to tax benefit of debt.

However, in reality there are a lot of financially distressed fixed asset heavy companies, notably in infrastructure sector in Indonesia, due to having too much debt such as PT Waskita Karya and Wijaya Karya was running at a loss for quite some time (Bloomberg, 2024). This is in line with Deng & Deng (2025) that companies with high debt policy indicates firm agency issues that lead to diminished enterprise value. Optimizing capital structure is important to increase firm value, as noted by Du et al (2024) that it would add values to enterprises along with size and profitability.

As the infrastructure sector generally requires long term investment to operate, the amount of financing available from retained earnings alone is oftentimes less than sufficient. Such companies tend to depend on debt as an important source of capital. While debt supports firm growth by financing productive assets and providing tax benefit, excessive amount would reduce financial flexibility with interest obligations as well as rising chance of financial distress. This opposing relationship between leverage and firm value is still subject to discussion on optimization of capital structure. Companies with low enterprise value might be more reluctant to employ high leverage due to financing constraints or more financial vulnerability, while companies with high enterprise value may have better financial access and capacity that allows them to afford higher leverage, controlling for profitability.

**Figure 1. Standardized Enterprise Value and Standardized Leverage of Infrastructure Sector in 2024, sorted by the former**



Source: Author's calculation

This research aims to show that such effect is not necessarily linear, that firms follow both pecking order theory and Modigliani Miller tax benefit theory. We argue that firms with low enterprise value would rather have low leverage for fund flexibility and shield against bankruptcy, but otherwise would have high leverage due to nominally large tax benefit. Figure 1 shows when sorted by enterprise value, firms from the first and second quantile tend to have negative debt to equity ratio, but the tendency to have positive ratio greatly increases in the third and fourth quantile.

We examine firm value as a function of profitability, leverage, and firm size. We define profitability as the firm's ability to generate earnings from its asset, leverage as the extent of its debt financing to its equity, and firm size as control variable due to larger operating capacity of bigger firms. Quantile regression is applied to investigate whether there's difference in the magnitude of the effect of leverage and profitability on firm value across different quantiles. We hope this approach can identify how beneficial or harmful high leverage is at various valuation levels.

The state of the art in research on the relationship between profitability, leverage, and firm value typically revolves around two dominant financial theories: the Trade-Off Theory (TOT) and the Pecking Order Theory (POT). While previous studies have extensively examined how profitability influences firm value, the role of leverage as a mediating variable remains an area with mixed empirical results, particularly in sector-specific contexts. Additionally, research on the Indonesian infrastructure sector remains limited, despite its strategic importance and unique capital structure characteristics, such as high debt dependency for long-term projects and government involvement. By focusing on this sector and employing quantile regression to capture variations across different leverage levels, my study advances the understanding of how profitability translates into firm value through leverage, offering more precise insights into capital structure decisions in emerging markets.

This study is expected to enhance insight on capital structure literature as well as to add perspective to relevant managers in designing financing policies.

## LITERATURE REVIEW

According to trade-off theory, leverage generally improves firm value, yet there has been mixed findings regarding the relationship of leverage and firm value. Dang and Do (2021) found that the direction of leverage effect varies among sectors in which positive in food and beverage industry but negative in wholesale trade and construction. Yet, Martini (2024) found significantly positive impact of debt policies on enterprise value in similarly fixed asset heavy mining sector. When considering the type of debt measured in leverage, further differences occurs. Bui et al (2023) shows that while total debt leverage positively affect firm value, the same cannot be said if we only consider long term debt, in which it does not yield in any significant effect in emerging market of Vietnam. However in another emerging market of Macedonia, the opposite relationship is found, in which long term debt positively affect market value, but short term ones have negative effect (Danevska et al, 2023). On the other hand, Vukovic et al. (2024) found dominantly negative relationship in european companies.

Alghifari et al. (2022) argues that the leverage effect is only significant for the debt dominant group, but not for firms that predominantly use equity for financing. Similarly, Evianti et al. (2024) suggest that only moderate level of leverage create positive effect to firm value since it signals growth potential with low cost of capital, while excessive use of debt leads to risk of financial distress instead, which reduces firm value. Zhao et al. (2022) also found that at higher quantile, pecking order theory is applied more than trade off theory. On the same note, Panda et al. (2023) notes that leverage positively affect firm values on lower percentile in Indian firms. The different signals that levels of leverage gives suggest the relationship might vary each quantile. Therefore, we hypothesize that

*H1: Leverage positively affects firm value up until certain quantile*

Profitability measures the ability of firms to generate income through the amount of asset or funding available to them. While theoretically high profitability should increase the value of the firm from stakeholder's point of view, such is found by Inrawan & Lie (2024) and Margono and Gantino (2021), there are evidences that it has negative effect instead (Wijaya et al., 2023; Panjaitan & Supriyati, 2023). Maharani & Mawardhi (2022) explains that higher profitability creates higher long term growth expectations in firms in emerging market, hence its often-negative impact. In terms of quantile regression, Soydas (2025) found that it has generally negative relationship in which effect is significant in higher quantiles. On similar note, Ramezani et al. (2019) found that profitability has positive impact up to an optimal point and decreases shareholder value beyond. Therefore, we hypothesize that

*H2: Profitability negatively affects firm value*

Akin et al. (2024) reveals that business size along with leverage have positive impact on enterprise value. Similarly, Kaulika and Imronudin (2023), Atiningsing and Izzaty (2021), as well as Rahma (2024) found that company size positively impacts firm value because larger companies tend to have competitive advantage.

There are also evidence of negative effect such as found by Septyanto and Nugraha (2021) in which explained that investors set high profit expectations on large companies and as such having excessive assets might be considered inefficient. However, similar researches in indonesian infrastructure sector tend to conclude in positive relationship such as in Ardelia et al. (2024) and Kirana and Dewi (2025). Therefore, we hypothesize that

*H3: Firm size positively affects firm value*

## METHODOLOGY

This study focuses on firms within the infrastructure sector listed on the Indonesia Stock Exchange (IDX). The objective is to examine the role of leverage in this sector, specifically analyzing its direct relationship with firm value. The sample consists of panel data covering firm-level observations on profitability, leverage, and firm size from 2022 to 2024, allowing for the identification of patterns and consistency of effects across time. This longitudinal approach offers stronger explanatory power than a single-year cross-section, as it incorporates variation both across firms and over time during the post-pandemic recovery period.

We use panel quantile regression for this study to capture the potentially non linear relationship of the variables across firms and years in varying levels of firm value distribution. This approach is used to identify whether leverage and profitability have stronger effect in lower quantile value or higher. The independent variables include profitability defined as return on asset (ROA) to align with investors' perspective, capital structure or leverage level being proxied by debt to equity ratio (DER), and firm size is noted by total asset normalized in its logarithmic value (LN\_TA) to avoid scaling issue. The dependent variable used is firm value proxied by enterprise value (LN\_EV) in which value is similarly logarithm to account for the sector's large disparities in capital intensity.

If the relationship of the sample abides to trade-off theory, then it's expected that leverage enhances firm value up to an optimal level, the its positivity diminishes the further up quantiles. Likewise, if the relationship is negative or insignificant across quantiles, then pecking order theory would explain the relationship better. The panel data setting is also expected to mitigate endogeneity and unobserved heterogeneity issues.

The quantile regression works by estimating conditional quantiles of the dependent variable. In this study, there are four quantiles divided by three points ( $\tau = 0.25, 0.5$ , and  $0.75$ ) to see how the coefficient estimation of leverage and profitability vary across distribution of enterprise value. The model can be written as:

$$LN\_EV_{i,t,\tau} = \beta_{0,\tau} + \beta_{1,\tau}ROA_{i,t,\tau} + \beta_{2,\tau}DER_{i,t,\tau} + \beta_{3,\tau}LN\_TA_{i,t,\tau} + \varepsilon_{i,t}$$

Where LN\_EV is natural logarithm of enterprise value for firm  $i$  at quantile  $\tau$ ,  $\beta_0$  is Quantile-specific intercept term,  $\beta_1, \beta_2$ , and  $\beta_3$  are slope coefficients at quantile  $\tau$ , ROA is return on assets as proxy for profitability, DER is debt to equity ratio as proxy for capital structure, LN\_TA is natural logarithm of total assets as proxy for firm size, and  $\varepsilon$  is error term at each quantile.

ROA captures the firm's internal profitability. A higher ROA is generally expected to increase enterprise value, although your results show this effect is not statistically significant at most quantiles. DER represents the firm's leverage. It is the key independent variable in your analysis, showing that its effect on firm value is significant at lower to median quantiles but weakens at higher quantiles. LN\_TA accounts for firm size. Larger firms tend to have higher enterprise value due to economies of scale and market influence. It consistently shows a strong and significant positive relationship across quantiles. By allowing the coefficients  $\beta$  to vary across quantiles, the model captures heterogeneous effects which in this case, how DER influences enterprise value differently depending on whether a firm is low-valued or high-valued in the market.

The tests are conducted as follows, first descriptive analysis gives a broad picture of the values, then quantile assumption test is conducted through Ramsay test for linearity and covariance matrix to confirm the absence of multicollinearity. After which quantile regression result is provided with the estimated coefficient for each quantile. We then show the quantile

process graph and test the differences between quantiles are significant through quantile slope equality test.

## RESULTS AND DISCUSSION

We provide the descriptive characteristics of our data in the Table 1 below.

**Tabel 1. Descriptive Analysis**

|                  | <i>LN EV</i> | <i>DER</i> | <i>ROA</i> | <i>LN TA</i> |
|------------------|--------------|------------|------------|--------------|
| <i>Mean</i>      | 22.53620     | 0.740419   | 0.029298   | 22.77475     |
| <i>Median</i>    | 22.42867     | 0.651171   | 0.037869   | 22.69247     |
| <i>Maximum</i>   | 27.23734     | 3.230421   | 0.242362   | 26.42470     |
| <i>Minimum</i>   | 17.07521     | -1.696913  | -0.418788  | 18.25974     |
| <i>Std. Dev.</i> | 2.242974     | 0.877421   | 0.082615   | 1.804782     |
| <i>Skewness</i>  | -0.080799    | 0.327008   | -2.591790  | -0.148965    |
| <i>Kurtosis</i>  | 2.544175     | 4.453667   | 14.34400   | 2.667838     |

The average enterprise value (LN\_EV) is 22.54, with a standard deviation of 2.24, indicating moderate variation across firms. The distribution of LN\_EV is approximately symmetric, as suggested by a near-zero skewness (-0.0808) and a kurtosis of 2.54, which is close to the normal distribution benchmark of 3. This implies that firm value is fairly normally distributed across the sample.

The average debt to equity ratio (DER) is 0.74, with a wide dispersion (standard deviation = 0.88). The DER ranges from -1.70 to 3.23, suggesting that some firms operate with negative equity or financial distress, while others are highly leveraged. The DER distribution exhibits positive skewness (0.33) and a leptokurtic nature (kurtosis = 4.45), indicating a concentration of firms around the mean with occasional extreme values. The profitability variable, measured by ROA, presents a mean of 2.93% and a relatively high standard deviation of 8.26%, highlighting significant variability in firm performance. The ROA distribution is strongly left-skewed (-2.59), suggesting the presence of loss-making firms, and highly leptokurtic (kurtosis = 14.34), indicating extreme outliers and clear non-normality. Firm size, as measured by LN\_TA, has a mean of 22.77 and a standard deviation of 1.80, showing moderate dispersion. The distribution is nearly symmetric (skewness = -0.15) and slightly leptokurtic (kurtosis = 2.67), indicating a slight deviation from normality but no extreme distortions.

The presence of skewness and heavy-tailed distributions, particularly in DER and ROA, signals that standard OLS assumptions of normality and homoscedasticity may not hold, which further justifies the use of quantile regression method.

In Table 2, the Ramsey RESET test was employed by including the square of the fitted values as an omitted variable. The results indicate that the QLR L-statistic is 1.126 with a p-value of 0.2885, which is well above the conventional 5% significance level. This implies that there is no evidence of model misspecification due to omitted nonlinear relationships, and the null hypothesis of correct linear specification cannot be rejected. In support of this, the

coefficient for the squared fitted value is small (0.018) and statistically insignificant ( $p = 0.3508$ ), further confirming that no substantial nonlinearity is present in the model. Therefore, the linearity assumption is satisfied. Furthermore, Table 3 matrix reveals that no variable is perfectly or nearly perfectly linearly related to another, as indicated by the absence of extreme off-diagonal values and the presence of positive. Thus, the assumption of no perfect multicollinearity is also fulfilled.

**Table 2. Ramsay Test Output**

|                      | Value    | df | Probability |
|----------------------|----------|----|-------------|
| QLR L-statistic      | 1.126435 | 1  | 0.2885      |
| QLR Lambda-statistic | 1.123150 | 1  | 0.2892      |

**Table 3. Covariance Matrix**

|       | C             | ROA           | DER           | LN_TA         |
|-------|---------------|---------------|---------------|---------------|
| C     | 2.12696473... | -0.0227579... | 0.12260924... | -0.0977364... |
| ROA   | -0.0227579... | 1.90944836... | -0.0058669... | -0.0016762... |
| DER   | 0.12260924... | -0.0058669... | 0.01624097... | -0.0060812... |
| LN_TA | -0.0977364... | -0.0016762... | -0.0060812... | 0.00453176... |

The result of the quantile regression model is shown in Table 4. The coefficient for the debt to equity ratio (DER) is 0.266 and statistically significant at the 5% level, with a p-value of 0.039. This indicates that leverage has a positive and meaningful association with enterprise value at the 50th percentile. In other words, firms with higher leverage tend to have higher median enterprise value, supporting the argument that debt may enhance firm value up to a certain threshold. This finding aligns with the trade-off theory of capital structure, which suggests that firms balance the tax advantages of debt with the costs of financial distress. The significance of DER in the quantile regression context is even more important when viewed alongside its descriptive traits of positive skewness and leptokurtosis, which imply that some firms are highly leveraged or operating under financial strain, such as those with negative equity. The robustness of quantile regression allows it to neutralize the influence of these extreme observations and uncover the general trend more clearly than OLS would.

**Table 4. Quantile Regression Output**

| Variable               | Coefficient | Std. Error         | t-Statistic | Prob.    |
|------------------------|-------------|--------------------|-------------|----------|
| C                      | -0.824711   | 1.458412           | -0.565486   | 0.5729   |
| ROA                    | 0.272834    | 1.381828           | 0.197444    | 0.8439   |
| DER                    | 0.265991    | 0.127440           | 2.087185    | 0.0393   |
| LN_TA                  | 1.014107    | 0.067318           | 15.06434    | 0.0000   |
| Pseudo R-squared       | 0.566946    | Mean dependent var |             | 22.53620 |
| Adjusted R-squared     | 0.554573    | S.D. dependent var |             | 2.242974 |
| S.E. of regression     | 1.405919    | Objective          |             | 43.51063 |
| Quantile dependent var | 22.42867    | Restr. objective   |             | 100.4740 |
| Sparsity               | 1.864425    | Quasi-LR statistic |             | 244.4223 |
| Prob(Quasi-LR stat)    | 0.000000    |                    |             |          |

Meanwhile, the coefficient for ROA is positive (0.273), but statistically insignificant ( $p = 0.844$ ), suggesting that profitability does not have a decisive role in explaining firm value at the median level in this model. On the other hand, firm size, measured by the natural logarithm of total assets (LN\_TA), shows a strong and statistically significant relationship with enterprise value, with a coefficient of 1.014 and a p-value of 0.000. This confirms the commonly observed association between larger firm size and greater market valuation. The model fits well for a quantile regression specification. The pseudo R-squared is 0.567, and the adjusted R-squared is 0.555, indicating that about half of the variation in enterprise value is explained by the model at the median quantile. The Quasi-LR statistic which measures the reliability of the regression's explanatory power is also highly significant.

**Table 5. Quantile Process Table**

|       | Quantile | Coefficient | Std. Error | t-Statistic | Prob.  |
|-------|----------|-------------|------------|-------------|--------|
| C     | 0.200    | -0.350229   | 2.751101   | -0.127305   | 0.8989 |
|       | 0.400    | -0.589488   | 1.675047   | -0.351923   | 0.7256 |
|       | 0.500    | -0.824711   | 1.458412   | -0.565486   | 0.5729 |
|       | 0.600    | -1.152854   | 1.156706   | -0.996670   | 0.3212 |
|       | 0.800    | -0.070147   | 1.314804   | -0.053352   | 0.9576 |
| ROA   | 0.200    | -1.473796   | 4.734803   | -0.311269   | 0.7562 |
|       | 0.400    | -0.121238   | 1.496065   | -0.081038   | 0.9356 |
|       | 0.500    | 0.272834    | 1.381828   | 0.197444    | 0.8439 |
|       | 0.600    | 0.548945    | 1.293488   | 0.424391    | 0.6721 |
|       | 0.800    | -0.914671   | 0.722134   | -1.266623   | 0.2081 |
| DER   | 0.200    | 0.529976    | 0.255002   | 2.078327    | 0.0401 |
|       | 0.400    | 0.250792    | 0.148615   | 1.687534    | 0.0945 |
|       | 0.500    | 0.265991    | 0.127440   | 2.087185    | 0.0393 |
|       | 0.600    | 0.167281    | 0.111539   | 1.499750    | 0.1367 |
|       | 0.800    | 0.055298    | 0.076025   | 0.727372    | 0.4686 |
| LN_TA | 0.200    | 0.959090    | 0.134444   | 7.133743    | 0.0000 |
|       | 0.400    | 0.998586    | 0.078271   | 12.75801    | 0.0000 |
|       | 0.500    | 1.014107    | 0.067318   | 15.06434    | 0.0000 |
|       | 0.600    | 1.039513    | 0.052424   | 19.82902    | 0.0000 |
|       | 0.800    | 1.014293    | 0.056767   | 17.86777    | 0.0000 |

The quantile regression estimates across the 20th to 80th percentiles reveal how the effect of capital structure, specifically the debt to equity ratio (DER), on enterprise value varies across different segments of the firm value distribution. The relationship between DER and firm value is most pronounced and statistically significant in the lower to median quantiles. At the 20th percentile, the DER coefficient is 0.530 and significant at the 5% level ( $p = 0.041$ ), suggesting that for firms in the lower tail of the value distribution, increased leverage is associated with higher enterprise value. A similar pattern holds at the 40th percentile, where the coefficient (0.251) is marginally significant ( $p = 0.090$ ), and at the 50th percentile (coefficient = 0.266,  $p = 0.039$ ), where the relationship is again significant at the 5% level. These results support the idea that leverage may act as a signaling mechanism or provide financing advantages, particularly for firms that are not yet high performers. However, as we move toward the upper quantiles, the effect of DER diminishes. At the 60th percentile, the coefficient declines to 0.167 and becomes statistically insignificant ( $p = 0.136$ ), and this trend continues at the 80th percentile where the coefficient drops further to 0.055 with a high p-value of 0.466, indicating no statistically significant effect. This weakening pattern implies that for

firms already in the higher echelons of firm value, additional leverage does not provide the same benefit and may even reflect diminishing marginal utility or increased financial risk perceptions by the market.

**Figure 2. Quantile Process Graph**

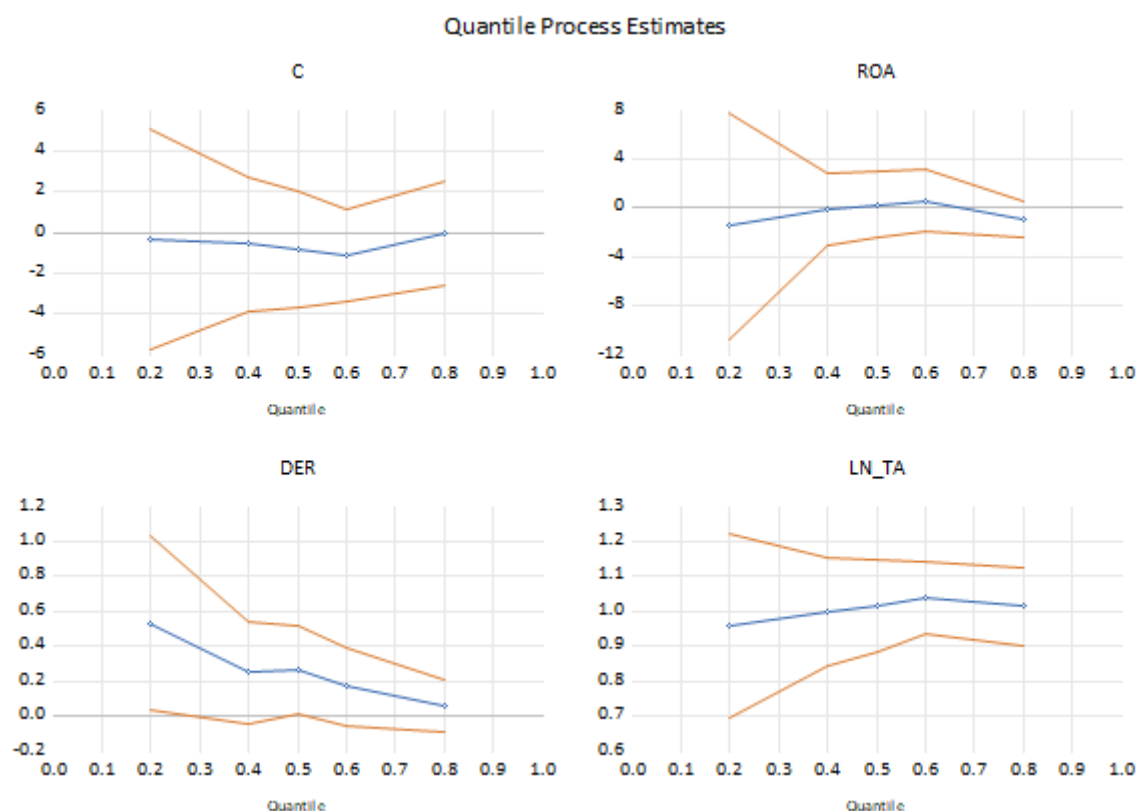


Figure 2 visualizes that the effect of independent variables differs significantly across quantiles of the firm value. The intercept hovers around zero thus unlikely to be significant. The estimated effect of ROA also roams around zero, which indicates its insignificance, especially in lower quantiles where the confidence interval being very wide that it largely covers both positive and negative values, despite being slightly positive around the median.

On the other hand, DER has overall positive coefficient but we can see that the magnitude drops toward zero at higher quantile, indicating that it's only positively significant on lower quantile, in line with the earlier interpretation that leverage only significantly benefit firms with lower firm values. Firm size is shown to be positive in all quantiles.

Table 6 shows the result of quantile slope equality test. Most notably, it shows significant difference between third quantile and highest quantile for DER within 10% significance level with  $p = 0.0554$  (just slightly above the conventional 5%), even though there's no difference between the lowest two quantiles. There are no significant global difference otherwise, nor within ROA and firm size.



**Table 6. Quantile Slope Equality Test**

Quantile Slope Equality Test

Equation: EQ01

Specification: LN\_EVC ROADER LN\_TA

Estimated equation quantile tau = 0.5

Number of test quantiles: 4

Test statistic compares all coefficients

| Test Summary | Chi-Sq. Statistic | Chi-Sq. d.f. | Prob.  |
|--------------|-------------------|--------------|--------|
| Wald Test    | 8.736611          | 6            | 0.1889 |

Restriction Detail:  $b(\tau_h) - b(\tau_k) = 0$

| Quantiles | Variable | Restr. Value | Std. Error | Prob.  |
|-----------|----------|--------------|------------|--------|
| 0.25, 0.5 | ROA      | -2.086061    | 1.628631   | 0.2002 |
|           | DER      | 0.137329     | 0.150346   | 0.3610 |
|           | LN_TA    | -0.018138    | 0.080266   | 0.8212 |
| 0.5, 0.75 | ROA      | 1.404525     | 1.143504   | 0.2193 |
|           | DER      | 0.205005     | 0.107004   | 0.0554 |
|           | LN_TA    | -0.033410    | 0.057989   | 0.5645 |

## CONCLUSION AND SUGGESTION

### Conclusion

This study is conducted with purpose of identifying whether there's quantile effect of leverage and profitability on firm value. We find that leverage has significantly positive effect on firm value which weakens the higher value the firm is and insignificant at highest quantile. This result suggests that debt supports economic worth of infrastructure business unless it already possesses high value, then equity balancing would be preferable.

Also notably, profitability doesn't pose significant influence on firm value when measured by enterprise value and controlled by size and leverage. Firm size, on the other hand, positively influences firm value at all level.

### Suggestion

Future research should explore the underlying mechanisms that cause DER to exert differential effects across firm value quantiles, such as industry-specific capital structures, investor perceptions, or variations in risk tolerance. Expanding the sample size or period may also improve the statistical power and allow for deeper subgroup analyses, such as by sector or ownership structure. Additionally, exploring non-linear models or interaction effects could offer further insights into capital structure dynamics. From a policy and managerial perspective, the findings imply that financial leverage should be managed strategically, with particular attention to the firm's current market position, as its impact on value is context-dependent.

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