BAB IV
RESEARCH ANALYSIS

4.1 Measurement Model Evaluation

The measurement model evaluation aims to assess the reliability and validity of the constructs used in the structural model. Since this study employs formative indicators, the evaluation emphasizes indicator reliability (through outer loadings) and construct reliability using Composite Reliability (CR).

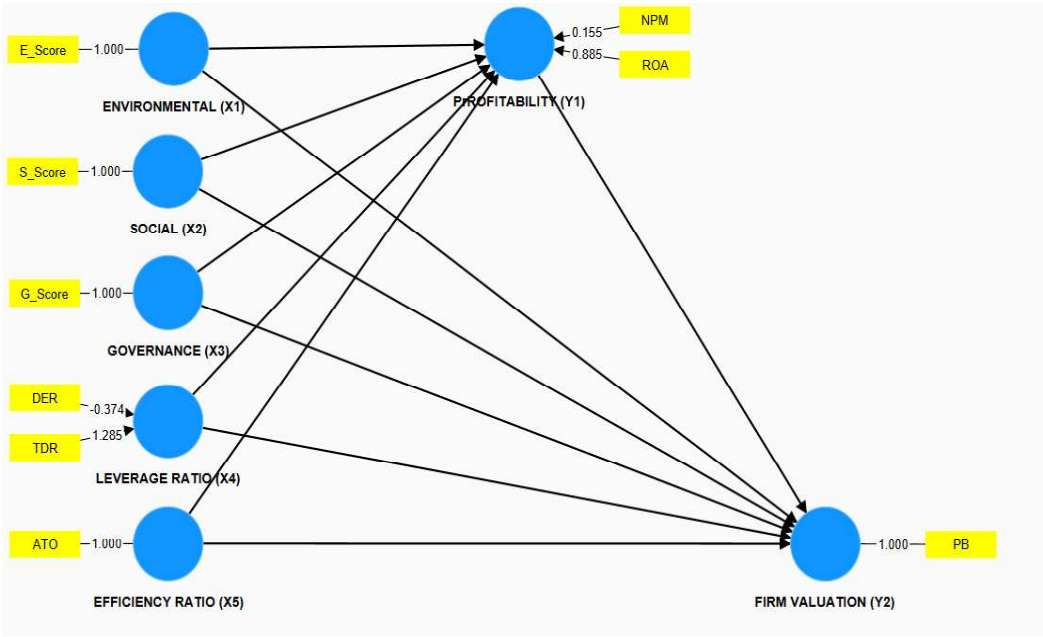

Figure 4.1 Initial Structural Model before Dropping CR < 0.7

As illustrated above, the initial model includes indicators for five exogenous variables: Environmental (X1), Social (X2), Governance (X3), Leverage Ratio (X4), and Efficiency Ratio (X5). It also includes two endogenous variables: Profitability (Y1) and Firm Valuation (Y2). Each construct was tested for internal consistency reliability using Composite Reliability (CR), and for indicator reliability using the outer loadings.

The results revealed that two indicators, namely Debt-to-Equity Ratio (DER) under the Leverage construct and Net Profit Margin (NPM) under the Profitability construct, had CR values below the recommended threshold of 0.70 as suggested by Hair et al. (2019). Their outer loadings were below 0.70, which indicated low reliability in measuring their respective latent variables.

To enhance the model validity and improve measurement precision, both DER and NPM were excluded from the analysis. All of the following reasons contributed to the exclusion:

- Composite Reliability values were below the threshold of 0.70 demonstrating weak internal consistency.
- Outer loading values were below the threshold of 0.70 providing a low contribution to the construct.
- The model is more parsimonious retaining only statistically meaningful indicators.

The modified model excluding DER and NPM indicating improved reliability for all the measurement and was used for all subsequent structural model evaluations and in further hypothesis. Following the exclusion of the indicators that did not meet the reliability criteria, the measurement model was updated. The updated model is shown below:

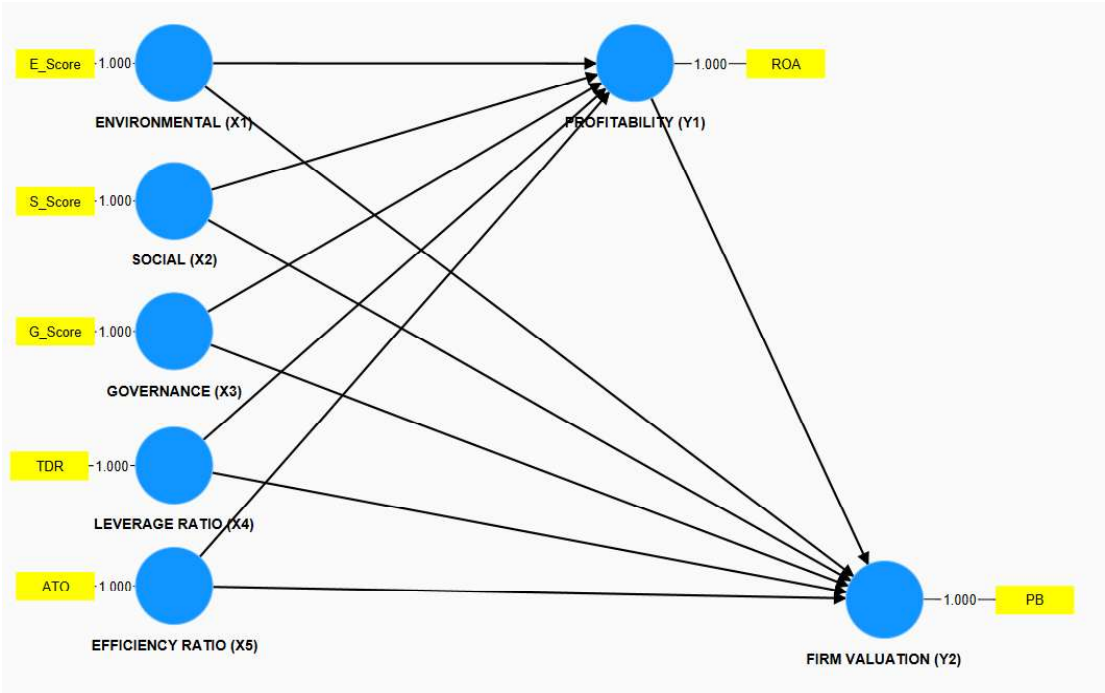

Figure 4.2 Structural Model after Dropping CR < 0.7

Only the Total Debt Ratio (TDR) indicator stays as the indicator for the construct Leverage Ratio (X4), and likewise the Profitability (Y1) construct now only has the Return on Assets (ROA) indicator as its indicator. All other indicators have outer loading values larger than 0.70, and Composite Reliability for all constructs was larger than 0.70, indicating internal consistency and reliability of the measurement model. This

modified model is used to evaluate the structural model and hypothesis testing in the upcoming sections.

4.2 Structural Model Evaluation

4.2.1 Path Coefficient Analysis

This section examines the strength and direction of the relationships between the exogenous and endogenous constructs. Path coefficients indicate the direct effect of one variable on another within the structural model, with values ranging from -1 to +1. Positive coefficients suggest a direct positive influence, while negative coefficients imply an inverse relationship.

The structural model and corresponding path coefficients are illustrated below:

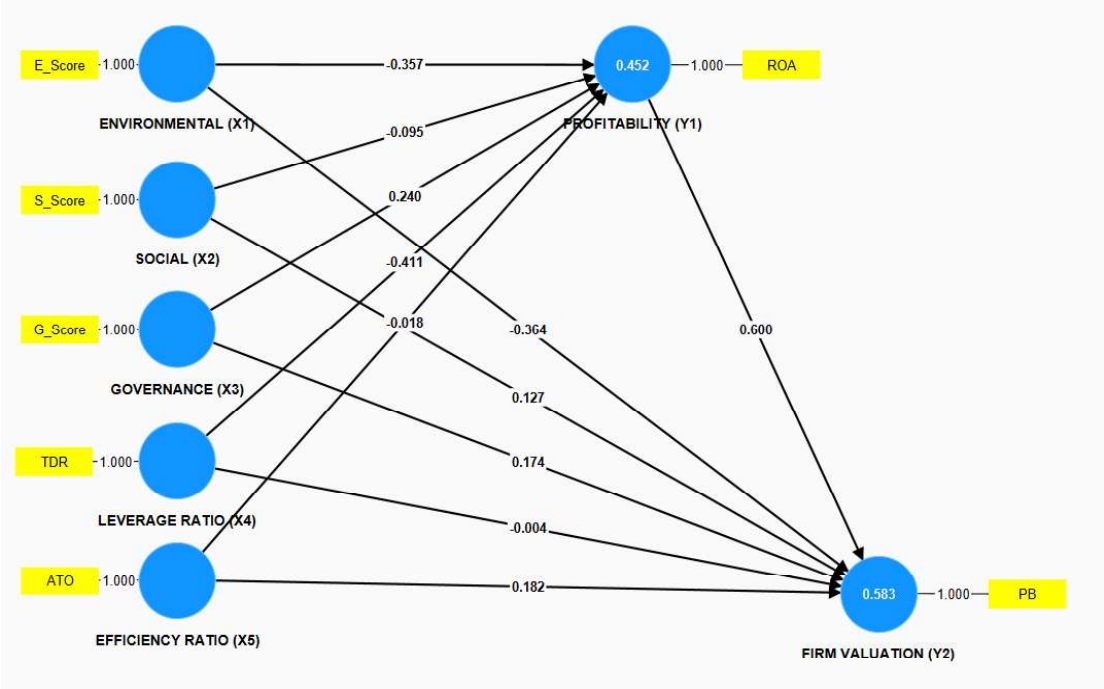

Figure 4.3 Structural Model Evaluation before Bootstrapping

As shown in the figure, the Environmental (X1), Social (X2), and Governance (X3) scores represent ESG factors, while Leverage (X4) and Efficiency (X5) represent financial ratios. These constructs were analysed to determine their impact on Profitability (Y1), measured by Return on Assets (ROA), and Firm Valuation (Y2), measured by Price-to-Book Value (PB).

Key observations from the path coefficient analysis are as follows:

- Environmental Score (X1) has a negative effect on both Profitability (β = -0.357) and Firm Valuation (β = -0.364), indicating that higher environmental risk exposure is associated with lower performance and valuation.
- Social Score (X2) shows a negative relationship with Profitability (β = -0.0,95) but a positive effect on Firm Valuation (β = 0.127).
- Governance Score (X3) has a positive relationship on both Profitability (β = 0.240) and Firm Valuation (β = 0.174).
- Leverage Ratio (X4) has a positive relationship on both Profitability (β = -0.411) and Firm Valuation (β = -0.004).
- Efficiency Ratio (X5) has minimal to no effect on Profitability (β = -0.018), but a small positive influence on Firm Valuation (β = 0.182).
- Profitability (Y1) itself significantly contributes to Firm Valuation (Y2) with a strong positive path coefficient (β = 0.600), suggesting that firms with higher profitability tend to have higher valuation.

These path coefficient results offer a preliminary understanding of how ESG scores and financial indicators influence firm profitability and valuation in 2024 cross-sectional sample of 56 NYSE-listed energy companies. The statistical significance of these relationships will be further analysed in Section 4.2.1, through hypothesis testing using bootstrapping.

4.2.2 Coefficient of Determination (R^2)

The coefficient of determination (R^2) is used to measure the model's explanatory power. It reflects the proportion of variance in the endogenous (dependent) constructs that can be explained by the exogenous (independent) constructs. According to Hair et al. (2019), R^2 values of 0.75, 0.50, and 0.25 are considered substantial, moderate, and weak, respectively.

In this study, the R^2 values for the two endogenous constructs are as follows:

- Profitability (Y1): $R^2 = 0.452$

  This indicates that 45.2% of the variance in profitability, as measured by ROA, is explained by the Environmental, Social, Governance, Leverage, and Efficiency variables.

- Firm Valuation (Y2): $R^2 = 0.583$

  This suggests that 58.3% of the variance in firm valuation, as measured by Price-to-Book Value, is explained by the same five variables along with profitability.

These values indicate that the model has a moderate to strong explanatory power, particularly in predicting firm valuation. The R^2 value for profitability, while slightly lower, still meets the threshold for moderate explanatory strength.

4.2.3 Effect Size (f^2)

The effect size (f^2) assesses the individual contribution of each exogenous construct to the R^2 value of an endogenous construct. According to Hair et al. (2019), f^2 values of 0.02, 0.15, and 0.35 are categorized as small, medium, and large effects respectively.

The table below summarizes the effect size of each path in the model:

Predictor Relationship	**f^2 Value**	**Interpretation**
Environmental (X1) → Profitability (Y1)	0.176	Medium
Environmental (X1) → Firm Valuation (Y2)	0.203	Medium
Social (X2) → Profitability (Y1)	0.010	Small
Social (X2) → Firm Valuation (Y2)	0.024	Small
Governance (X3) → Profitability (Y1)	0.066	Small
Governance (X3) → Firm Valuation (Y2)	0.043	Small
Leverage Ratio (X4) → Profitability (Y1)	0.220	Medium
Leverage Ratio (X4) → Firm Valuation (Y2)	0.000	None
Efficiency Ratio (X5) → Profitability (Y1)	0.000	None
Efficiency Ratio (X5) → Firm Valuation (Y2)	0.068	Small
Profitability (Y1) → Firm Valuation (Y2)	0.473	Large

Table 4.1 f-square List

From the table, it is evident that Profitability (Y1) has a large effect on Firm Valuation (Y2) with an f^2 value of 0.473. This is the largest effect in the model, indicating that profitability contributes strongly to the explained variance of valuation in the 2024 sample. Among the ESG variables, Environmental Score (X1) has the largest effect on profitability and firm valuation, which is a medium effect in both cases, indicating strong within-sample associations for the Environmental

dimension versus the other ESG variables. The effect of the Leverage Ratio (X4) on Profitability was of medium effect on Profitability, however there was no calculable effect on Firm Valuation. The Efficiency Ratio (X5) and Social Score (X2) were also identified to have small or negligible effects in most paths which indicates that they are likely to have little influence in the model.

4.2.4 Predictive Relevance (Q^2)

Predictive relevance (Q^2) evaluates the potential of the model to predict endogenous constructs using a blindfolding procedure. A Q^2 value above zero suggests that the model has predictive relevance for a certain endogenous construct and a value of zero or less indicates a lack of predictive ability.

The Q^2 values for this study are presented in the figure below:

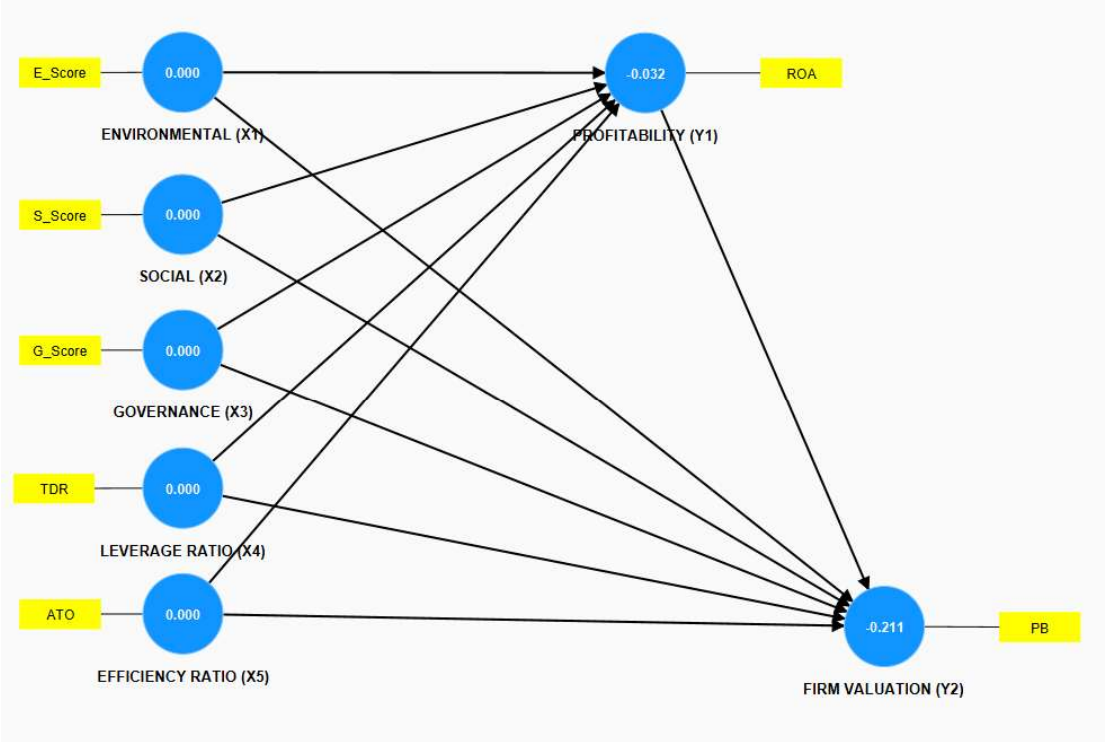

Figure 4.4 Structural Model Evaluation - Predictive Relevance (Q^2)

Both Q^2 values are negative, which indicates that the model lacks predictive relevance for these two endogenous constructs. Although the model has moderate explanatory ability (R^2 analysis), it does not have strong out-of-sample predictive power. It has been suggested by Hair et al. (2019) that the negative Q^2 values may be indicative of overfitting, or that the model does not result in generalizable

information outside of the current sample. The fact of negative Q^2 should be regards when dealing with the practical implications of the model.

4.3 Hypothesis Testing using Bootstrapping

Bootstrapping with 5,000 subsamples was performed to evaluate the statistical significance of the hypothesized relationships in the structural model. This assessment provided the path coefficients, t-statistics, and p-values used to evaluate whether each of the hypotheses in the structural model is supported or not.

The bootstrap output is displayed in the figure below. For each path, the standardized path coefficients and the corresponding p-values are displayed in parentheses:

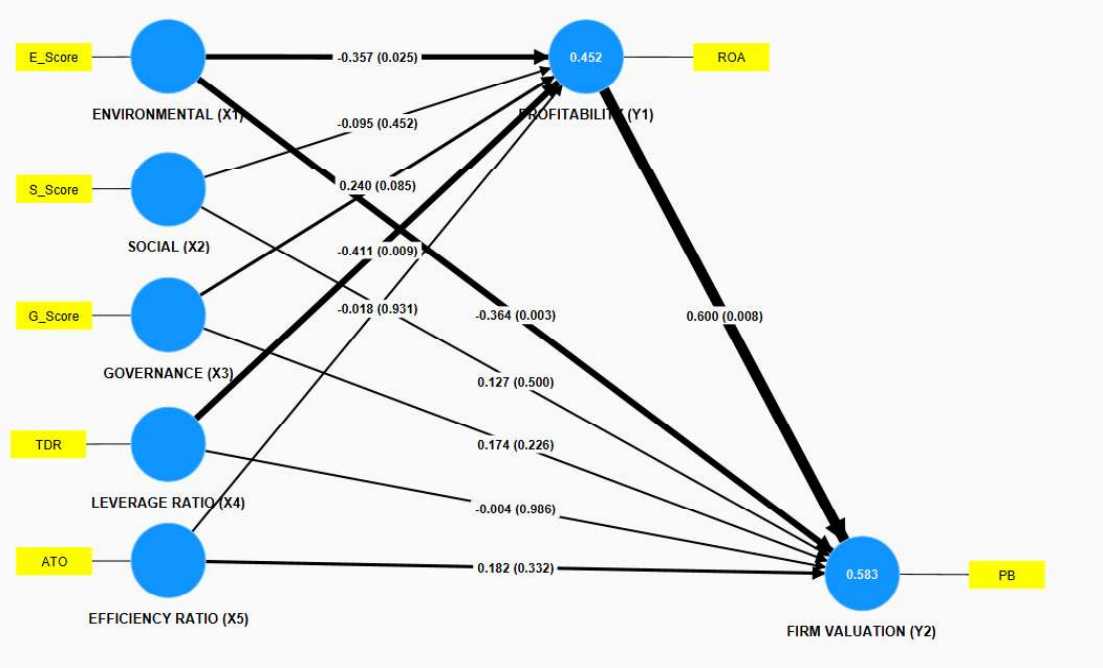

Figure 4.5 Structural Model Evaluation - Bootstrapping

The table below summarizes the results of each hypothesis:

Hypothesis	Path	Coefficient (β)	T-statistic	p-value	Significance
H1	Environmental (X1) → Profitability (Y1)	-0.357	2.244	0.025	Significant
H2	Social (X2) → Profitability (Y1)	-0.095	0.753	0.452	Not significant
H3	Governance (X3) → Profitability (Y1)	0.240	1.722	0.085	Not significant
H4	Leverage (X4) → Profitability (Y1)	-0.411	2.617	0.009	Significant
H5	Efficiency (X5) → Profitability (Y1)	-0.18	0.086	0.931	Not significant
H6	Environmental (X1) → Firm Valuation (Y2)	-0.364	3.004	0.003	Significant
H7	Social (X2) → Firm Valuation (Y2)	0.127	0.674	0.500	Not significant
H8	Governance (X3) → Firm Valuation (Y2)	0.174	1.211	0.226	Not significant
H9	Leverage (X4) → Firm Valuation (Y2)	-0.004	0.018	0.986	Not significant
H10	Efficiency (X5) → Firm Valuation (Y2)	0.182	0.970	0.332	Not significant
H11	Profitability (Y1) → Firm Valuation (Y2)	0.600	2.658	0.008	Significant

Table 4.2 Hypothesis Result

Testing hypotheses were performed for the structural model paths based on the bootstrapping process with 5,000 subsamples. The outcomes showed that out of 11 hypotheses, there were four statistically significant hypotheses at the 5% level ($p < 0.05$) and seven hypotheses were not supported.

Environmental Score → Profitability (H1)

Bootstrapping indicates a negative, statistically significant relationship between the Environmental Score and Profitability ($\beta = -0.357$, $t = 2.244$, $p = .025$). Therefore, H1 is supported. In this study, the Environmental Score reflects

environmental risk exposure, and a higher Environmental Score indicates increased environmental risk. Consistent with this orientation, firms that experienced greater exposure to environmental risk were correlated with lower measures of profitability for the 2024 cross-section.

Methodically, this makes sense for energy firms. Environmental risk can impose recognized period costs and operational friction, particularly compliance and monitoring costs, penalties, inefficiencies in processes, and reduced stakeholder support. Each of these costs may pressure margin in the short term, and they are consistent with the sector's exposure to emissions, pollution, and other environmental liabilities.

Interpretation should be bounded by the scope. This association is within-sample for the 2024 cross-section and does not imply causality or out-of-sample predictive power. As demonstrated in Section 4.2.4, both Q^2 values are negative, so the model should be treated as explanatory rather than predictive beyond the observed period and sample.

Overall, H1 is supported, and in this sample and period, higher environmental risk exposure is correlated with lower profitability. This finding should not be interpreted as an endorsement to abandon environmental practices. Rather, it indicates that transition and compliance costs can be recognized as upfront costs in the financial statements, and many of the identifiable or intangible benefits or returns of being environmentally mindful and investing environmentally will often occur in time periods beyond the scope of the study.

Leverage Ratio → Profitability (H4)

Bootstrapping indicates a negative, statistically significant relationship between Leverage (Total Debt Ratio) and Profitability ($\beta = -0.411$, $t = 2.617$, $p = 0.009$). Therefore, H4 is supported. Leverage has a medium effect on the explained variance of profitability in this specification, which is consistent with the f^2 diagnostics.

This pattern of reasoning is plausible in capital-intensive energy firms where a greater burden of debt overshadows interest obligations and the pressures of covenants, contributes to a lesser degree of financial flexibility, and an increased exposure to refinancing risk as well as commodity and regulatory shocks. These pathways can limit margins and options to operate over the near term, which is consistent with the negative coefficient.

Interpretation should be bounded by the scope. This association is within-sample for the 2024 cross-section and does not imply causality or out-of-sample predictive power. As demonstrated in Section 4.2.4, both Q^2 values are negative, so the model should be treated as explanatory rather than predictive beyond the observed period and sample.

Overall evidence suggests higher leverage, with respect to profitability for energy firms, in this sample, this time, granted caution taken into consideration with capital-structure choices: debt can support growth effects when underlying cashflows are very good, but too much leverage can amplifies transition, regulatory, and commodity event risks that can conflict with near-term earnings.

Environmental Score → Firm Valuation (H6)

Bootstrapping indicates a negative, statistically significant relationship between the Environmental Score and Firm Valuation ($\beta = -0.364$, $t = 3.004$, $p = 0.003$). Therefore, H6 is supported. Interpreted in this study's framework, higher exposure to environmental risk is associated with lower market value for NYSE-listed energy firms within the 2024 timeframe.

Effect size diagnostics are consistent with this finding. The Environmental Score has a medium effect on Valuation as one of the ESG components, indicating meaningful contribution to the variance explained in this specification as compared to the other dimensions of ESG.

Interpretation should be bounded by the scope. This association is within-sample for the 2024 cross-section and does not imply causality or out-of-sample predictive power. As demonstrated in Section 4.2.4, both Q^2 values are negative, so the model should be treated as explanatory rather than predictive beyond the observed period and sample.

In conclusion, as observed in this sample and the time period, more exposure to environmental risk is associated with lower firm valuation. This is not to be interpreted as a recommendation to lessen environmental practices. This is evidence that markets account for environmental risk, additionally credible environmental management can be important in retaining valuation in ESG sensitive industries.

Profitability → Firm Valuation (H11)

Bootstrapping indicates a negative, statistically significant relationship between Profitability (ROA) and Firm Valuation (Price to Book) ($\beta = 0.600$, $t = 2.658$, $p = 0.008$). Therefore, H11 is supported. This result is consistent with the model specification where ROA represents the profitability, and Price to Book represents firm valuation.

Methodically, greater profitability can represent operational effectiveness, cash-flow stability, and ability to return value, which the markets may reward through higher valuation multiples.

Effect-size diagnostics are consistent with this inference. Profitability has a substantial effect on Firm Valuation ($f^2 = 0.473$), the largest of the model, indicating that it is a robust contributor to the explained variability of valuations in the 2024 sample.

Interpretation should be bounded by the scope. This association is within-sample for the 2024 cross-section and does not imply causality or out-of-sample predictive power. As demonstrated in Section 4.2.4, both Q^2 values are negative, so the model should be treated as explanatory rather than predictive beyond the observed period and sample.

In conclusion, the evidence indicates that, in this sample and time period, increased profitability will be associated with higher firm valuation. Practically, this added support for focusing on earnings quality and earning sustainability during transition planning, will help firms combine profitability discipline with the legitimatizing of environmental risk management to maintain valuation in sectors sensitive to ESG issues.

Bootstrapping with 5,000 subsamples indicates that seven hypotheses are not supported at the 5% level in the 2024 cross-section of 56 NYSE-listed energy firms.

Social → Profitability (H2)

Bootstrapping indicates statistical insignificance between Social Score and Profitability ($\beta = -0.095$, $t = 0.753$, $p = 0.452$). Therefore, H2 is not supported. In a one-year cross-section, many Social channels work institutionally in subtle graduality, for example reducing incidents, creating stability as a workforce, and even in community acceptance, or embracing the intentions of Social programs. Effects or benefits are often

achieved over multiple periods, and in many cases are not observable in the same year as programs are initiated. The model indicates a small impact of social factors on profitability, which is not surprising, as social factors may have only a small impact on profitability for 2024. This minor impact could come from measurement issues with the social data and a small sample in the model, which could limit a larger impact being clearly observed.

Governance → Profitability (H3)

Bootstrapping indicates statistical insignificance between Governance Score and Profitability ($\beta = 0.240$, $t = 1.722$, $p = 0.085$). Therefore, H3 is not supported. Governance practices can often be mediated by cost of capital and risk pathways that may not convert yet into an accounting return. These pathways can include things like a lower cost of capital, reduced probability of extreme loss in terms of risk, and then these pathways include compliance outcomes. As Governance pathways can take longer than a single period to turn to ROA, the p-value is indicative of a suggestive short-run signal, but not strong enough in this sample for this dataset looking at Governance practices (the p-value is close to 0.085). Assuming the model does not achieve predictive relevance, the constituent of Governance can only be read as a within-sample association that did not meet the 5 percent threshold.

Efficiency → Profitability (H5)

Bootstrapping indicates statistical insignificance between Efficiency and Profitability ($\beta = -0.18$, $t = 0.086$, $p = 0.931$). Therefore, H5 is not supported. In capital heavy energy businesses, big asset bases and big cycle projects lessen any immediate relationship between turnover and margins. Combined with timing variances when considering capital maintenance schedules, downtimes, and capital commissioning, it blurs a one-year association with ROA. Effect-size diagnostics classify Efficiency as a small contributor in this specification, which is consistent with the limited incremental change in R^2 for 2024.

Social → Firm Valuation (H7)

Bootstrapping indicates a statistically insignificant relationship between Social Score and Firm Valuation ($\beta = +0.127$, $t = 0.674$, $p = 0.500$). Therefore, H7 is not supported. Market recognition of potential benefits from Firm improvement Social initiatives

and/or in Social Score is less likely to be instantaneous and becomes dependent on credibility, scale, and temporality in the market. Reputation and customer-loyalty effects often accrue relatively slowly and are not to be captured in a one-year snapshot. Consistent with this, the model indicates a small effect size for Social, implying a limited incremental contribution to valuation variance in 2024.

Governance → Firm Valuation (H8)

Bootstrapping indicates a statistically insignificant relationship between Governance Score and Firm Valuation ($\beta = +0.174$, $t = 1.211$, $p = 0.226$). Therefore, H8 is not supported. Governance signals can vary across energy sub-sectors and across rating approaches, making a single indicator less sensitive to differences that markets may price. Governance may also act indirectly through profitability and risk, which are only partly captured in a cross-sectional design. These features can reduce statistical power in a one-year setting and help explain the absence of a significant coefficient for 2024.

Leverage → Firm Valuation (H9)

Bootstrapping indicates a statistically insignificant relationship between Leverage Ratio and Firm Valuation ($\beta = -0.004$, $t = 0.018$, $p = 0.986$). Therefore, H9 is not supported. Capital structure appears to influence internal performance more than it is directly priced into valuation in the short run. Market participants may already reflect leverage through expectations about earnings, hedging practices, and covenant headroom, producing a decoupling between leverage levels and price-to-book within a single year. This interpretation aligns with the broader discussion that leverage affects operations while not acting as a standalone driver of market multiples in this period.

Efficiency → Firm Valuation (H10)

Bootstrapping indicates a statistically insignificant relationship between Efficiency Ratio and Firm Valuation ($\beta = +0.182$, $t = 0.970$, $p = 0.332$). Therefore, H10 is not supported. Similar to the profitability path, in the energy business (and in any industry with long-lived capital assets and intermittent capital expenditures), lagging turnover differences may result in a delay of any related signal into valuation as well. Pricing movements in commodities and in terms of transition spending would complicate the use of a one-period measure. Once again, the effect-size patterns returned by the model indicate a trivial incremental contribution to the explained variance for 2024.