

INTRODUCTION – MEASURING FIRM PERFORMANCE

Globalization and the fast-paced changing world have played a significant role in shaping businesses of the modern society. In light of today's economic landscape and global challenges, a proper measure of firm performance is crucial. A study of 60 Fortune 1000 firms by Hansen & Wernerfelt (1989) tested three models of firm performance, Economic models which captured industry variables, market position, and firm size; Organizational models focused on managerial actions, human resources, and organizational climate; and an integrated model of two, using return on asset as a firm performance measure to dissect variance in profit rates. Although both models were significant and the integrated model explained more variance in firm performance, organizational factors explained twice as much variance in profit rates and had a strong correlation with elements in climate factors. Palaniappan (2017) examined the relationship between firm performance (includes ROA, ROE, and Tobin's Q) and board characteristics using 275 Indian manufacturing firms listed in the Bombay Stock Exchange between 2011 and 2015 and concluded a positive correlation between CEO duality and performance. Regression results of board size, independence, meetings, and duality had coefficients of -2.4, -2.3, 1.04, and 1.92 with ROE reminding the importance of effective corporate governance to sustain performance and investors' confidence.

Chaudhuri et al., (2016) used the MIMIC approach using firm-level Indian data from 2001 to 2008 to estimate indicator variables (performance: ROA and Tobin's Q) and causal variables. The results show a U-shaped relationship for Indian promoters and an inverted U for institutional investors in influencing performance where size, age, advertising, and R&D significantly impact firm performance. A study exploring ownership structure and firm performance of 1005 Indian firms by (Douma et al., 2006) through regressions of ownership variables (such as foreign and domestic corporations, financial institutions, directors, and relatives, along with control variables) to explain corporate performance measured by Return on Assets (ROA) and Q-ratio. The results of the study reveal foreign ownership (by corporations and financial institutions), and domestic corporate ownership positively impact firm performance (when measured by ROA). Domestic corporate ownership and owner-managed firms have a negative influence on firm performance. As this project is based on ROE as firm performance measure, a study by Alshirah et al., (2022) used panel regression to examine the impact of corporate governance structure and ownership patterns in Jordan from 2018 to 2020, and concluded female representation, CEO duality, family ownership negatively impacts firm performance (ROE).

For this project, we will be using data from India for the measures of firm performances (return on equity), along with age of the firm and its square, size of the firm and its square, advertising expenditure as a ratio to sales, debt-equity ratio, foreign, Indian private promoter, and Indian institution share and its square. The description of the variables:

Variable	Variable Name in the Data File	Description of the Variable
Company identification number	co	Identification used to identify companies in the data
Year	year	2001-2008
Return on Equity	roe	Net Income/Average Shareholders' Equity
Age	age	Number of years from the incorporation year
Square of Age	sqage	Square of Age
Size	size	Natural logarithm of Total Sales
Square of Size	ssize	Square of size
Advertising Intensity	adv_intensity	Advertising Expenditure as a ratio to total sales
Debt – Equity	debtequity	Ratio of Debt to total equity
Indian promoters share holding	indian_promoter	Percentage of shares held in a firm by the Indian owner-managers
Foreign promoter share holding	foreign_promoter	Percentage of shares held in a firm by foreign promoters
Institutional Shareholding	institution	Percentage of shares held in a firm by institutions such as banks, etc.
Square of Indian Promoter holding	indian2	Square of percentage of shares held in a firm by the Indian owner-managers
Square of foreign Promoter holding	for2	Square of percentage of shares held in a firm by foreign promoters
Square of institutional Shareholding	inst2	Square of percentage of shares held in a firm by institutions such as banks, etc.

ANALYSIS

Estimating a pooled OLS, a random effect, and a fixed effects panel data model using ROE as the dependent variable where performance depends on age, size, advertising intensity, and debt-equity ratio. Appropriate tests are conducted to choose between the three models: pooled OLS, random effects and fixed effects models. The outcome from pooled OLS:

$$\text{ROE} = 0.0644 - 0.0010\text{Age} + 0.0196\text{Size} + 0.2444\text{Adv_Intensity} + 0.0003\text{DebtEquity}$$

The model fit as explained by R-squared, i.e., only 1.8% of variations in ROE are explained by the independent variables age, size, advertising expenditure, and debt to equity ratio. All the variables are significant at 5% level of significance except for debt-to-equity ratio (p-value of 0.512). One unit increase in Adv-intensity would result in 0.244 unit increase in ROE, the highest impact among the variables.

Random effect and fixed effect models are carried out in Stata. The results are summarized below:

Fixed effect					Random effect				
R-squared	Within	0.0139	F (4,4988)	17.61	R-squared	Within	0.0116	Wald chi2(4)	68.58
	Between	0.0003	Prob>F	0.000		Between	0.025	Prob>chi2	0.000
	Overall	0.0023	corr(u_i, Xb)	- 0.5218		Overall	0.0181	corr(u_i, Xb)	0 (assumed)
roe	coefficient	P> t	sigma_u	0.2233	roe	coefficient	P> t	sigma_u	0.1597
age	0.0031	0.074	sigma_e	0.2399	age	-0.001	0.000	sigma_e	0.2399
size	0.0445	0.000	rho	0.4642	size	0.025	0.000	rho	0.3071
adv_intensity	-0.0825	0.676	F test that all u_i=0		adv_intensity	0.1105	0.361		
debtequity	0.00002	0.575	F (967,4988)	2.89	debtequity	0.00002	0.563		
_cons	-0.2062	0.000	Prob>F	0.0000	_cons	0.0432	0.017		

Table 1 RE and FE Stata Output

FE: $\text{ROE} = -0.2062 + 0.0031\text{Age} + 0.0445\text{Size} - 0.0825\text{Adv_Intensity} + 0.0002\text{DebtEquity}$

In case of fixed model, only size is significant at the conventional 5% significance level, a unit increase in size would increase ROE by 0.044 units. Other variables are insignificant, which is shown by

the p-value. In terms of model fit, 1.39% variation in ROE is explained by the independent variables within each of 968 companies over the 8-period data and between the companies is only 0.03%. 46.42% of variation of ROE is due to the differences between companies as explained by the rho. To test individual fixed effects, u_i (null hypothesis $H_0: u_i=0$), the associated p-value suggests rejecting null and concluding the existence of significant differences in ROE across the 968 companies.

RE: $ROE = 0.0432 - 0.001Age + 0.025Size + 0.1105Adv_Intensity + 0.0002DebtEquity$

In the random model, only age and size are significant at 5% confidence level, where one unit change in age and size decreases ROE by 0.001 units and increases ROE by 0.025 units respectively. 1.16% of variation in ROE is explained by independent variables within companies and 2.5% is explained by differences between companies. In random model, it is assumed that individual effects (u_i) are uncorrelated with independent variables. 30.71% of variation in ROE is caused by differences in the companies. Wald test (value=68.58) is used to test joint-significance suggesting at least one independent variable having a significant relationship with ROE.

Breusch and Pagan Lagrangian Multiplier (LM test) is used to choose between POLS and RE. Hypothesis $H_0: Var(u_i)$ is zero

$H_A: Var(u_i)$ is non-zero

Since the p-value is less than the 5% confidence level, we reject the null and conclude existence of significant variation in individual company-specific effects i.e., presence of random effects. Thus, RE is chosen over POLS to address unobserved heterogeneity across firms.

To choose between RE and FE, Hausman test is conducted where the null hypothesis is H_0 : covariance between company-specific effects (a_i) and regressors (x_{it}) is zero. The chi-test score of 34.40 and p-value less than 0.05, H_0 is rejected and FE is chosen due to its reliability in estimates, it accounts for the correlation between unobserved company-specific factors and independent variables. FE controls for all time-invariant differences among firms.

On the same model, we now add Indian promoter, foreign promoter, and institutional shareholding as additional explanatory variables, along with the model specification. We test whether the set of new explanatory variables is jointly significant or not in explaining ROE. We also check if adding the square of Indian promoter, foreign promoter, and institutional shareholding changes the results. We also examine if the shareholding variables are significant individually and jointly. Model specification:

$ROE = -0.2204 + 0.0033age + 0.0442size - 0.0889adv_intensity + 0.000028debtequity + 0.000244indian_promoter - 0.00028foreign_promoter + 0.000224institution$

R-squared			
Within	0.0140	F(7, 4985)	10.21

Between	0.0000		
Overall	0.0016	Prob>F	0
roe	Coefficient	SE	P value
age	0.0033159	0.0017863	0.0630
size	0.0442993	0.0072474	0.0000
adv_intensity	-0.0889186	0.1976417	0.6530
debtequity	0.0000284	5.040E-05	0.5740
indian_promoter	0.0002449	0.0005087	0.6300
foreign_promoter	-0.0002828	0.0006507	0.6640
institution	0.0002247	0.0005607	0.6890
_cons	-0.2204366	0.0618246	0.0000
sigma_u	0.2258663	rho	0.469713
sigma_e	0.23998881	F test that u_i=0	2.85

Table 2 FE Output after additional variables

Talking about the model fit, only 1.41% of the variation in ROE is explained by the independent variables within companies. There is a negative correlation of -0.54 between company-specific error terms (u_i) and predicted values of ROE (Xb). $F(7,4985)$ takes the value of 10.21 with associated p-value less than 0.05 indicating a statistically significant model. Foreign promoter and advertising expenditures impact ROE negatively but are not significant, only age and size of the companies are significant at conventional 5% confidence level. Null hypothesis for the group F-test is that there are no systematic differences in ROE across companies, where the outcome of 2.85 and a p-value less than 0.05 indicate rejection of the null that there are significant differences in ROE across companies. 46.97% of variance is due to differences between companies while the remaining is due to differences within companies.

The joint significance of new explanatory variables using test command in Stata sets the null hypothesis as: new explanatory variables ($\beta_5, \beta_6, \beta_7$) are jointly significant. Concerning F-test and p-value of 0.79, we fail to reject the null and conclude that the new set of board characteristics variables jointly does not affect ROE.

Adding squares of Indian promoter, foreign promoter and institutional shareholding:

$$ROE = -0.2216 + 0.0033age + 0.043size - 0.095adv_intensity + 0.000029debtequity + 0.00039indian_promoter - 0.00151foreign_promoter + 0.00154institution - 2.63 \times 10^{-6}indian^2 + 0.000017for^2 - 0.000027inst^2$$

In the model, 1.48% of variance in ROE is explained by independent variables within each company. 47.11% of variance in ROE is due to differences between companies as explained by rho. The model as a whole is statistically significant with F-stat of 7.47. None of the shareholding variables and their

squares are individually significant at 5% confidence level reflected by $P > |t|$. The null hypothesis for joint test would be that coefficients of *indian2*, *for2* and *inst2* are equal to zero. Since the F-stat is 1.08 and p-value is 0.3558, higher than 0.05, we fail to reject the null and conclude that individually and collectively shareholding variables do not have a significant impact on ROE. Joint test of all the shareholding variables and their squares is also not significant with p-value of 0.6383.

Given the estimated model in which ROE depends on age, size, advertising intensity, debt-equity ratio, Indian promoter and its square, foreign promoter and its square, institutional shareholding and its square, we add year dummies and re-estimate the model to check if the year dummies are jointly significant. Inclusion of year dummies (from year *ye1* to *ye8*), none of the year dummies are significant at 5% conventional level although *ye3* is significant at 10%. The model only explains 0.16% of variations in ROE, though the model is statistically significant with an F-stat of 4.75. Similar to part-b, age, size and *ye3* are significant at 10% level of confidence. The standard deviation of random effects (u_i) and error term (e_i) are 0.22 and 0.24 respectively. The intra-class correlation coefficient of 0.47 explains variance in ROE caused by differences between companies while the remaining is due to differences within companies over time. Stata has removed the *ye8* year dummy which can be due to existence of collinearity. From the output and dataset, it seems to be collinear with the intercept term. Stata typically drops a variable with the highest multicollinearity with another variable.

The joint significance test of year dummies (from *ye1* to *ye7*, *ye8* omitted by Stata for collinearity) is not statistically significant at the conventional 5% significance level. F-stat of 0.88 and p-value of 0.5211 indicate that we fail to reject the null, which states coefficients for all year dummies are equal to zero. Thus, year dummies don't have a significant impact on explaining variations in ROE accounting for all the independent explanatory variables. Time trends and heterogeneous effects might be the reason for this, i.e., the effect of time on ROE does vary across the given companies or might be influenced by other unobserved factors. Year-specific shocks or trends don't influence ROE.

Now we estimate the same model but for two sub-samples. The first sub-sample consisting of data only from 2001-2004 and the second one consisting of data only from 2005-2008. We check if the result changes concerning share-holding variables (Indian promoter, foreign promoter, institutional shareholding, and their square). In the first part, data consisting from 2001 to 2004 is taken. In this first sub-sample, the model was not significant with a p-value of 0.2533. Overall R-squared to see the model fit was only 0.55% with high negative correlation of -0.83 between company-specific error terms u_i and predicted values of ROE. Except for age, none of the variables were significant at the 5% significance level. 70.72% of variance is due to u_i as explained by rho. With F-stat of 1.98 and associated p-value less than 0.05, we reject the null that company-specific effects are zero, i.e., there are significant differences in ROE across companies after inclusion of fixed effects as well. Fixed effects in the model are jointly significant in explaining the

variations in ROE. In the first sub-sample, shareholding variables and their squares are insignificant at 5% confidence level with coefficients almost near to zero and p-values higher than 0.05, indicating no impact of these variables to explain fluctuations in ROE.

In the second part, the dataset including years 2005 to 2008 is taken. In this sub-sample, the model is significant with F-stat 4.41 and p-value less than 0.05. In terms of model fit, R-squared presents 2.48% variance in ROE is explained by independent variables within each company. Although there is a negative correlation between individual-specific error u_i and X_b , the predicted values of ROE. Size, advertising expenditure, debt to equity ratio and year 5 are significant at 5% confidence level whereas age is significant at 10% level. Advertising expenditure has the highest negative impact on ROE, i.e., one unit increase in advertising expenditure and debt-equity decreases ROE by 0.7051 units and -0.0025 units respectively. 62.56% of fluctuations in ROE are due to the differences between companies as reflected by the rho. The F-stat of joint significance of fixed effects is 2.86 with p-value less than 0.05 explaining variations in ROE across companies.

CONCLUSION

The findings of this project align with famous literature by Modigliani & Miller (1958) that firm size, market strategy, and capital structure influence the financial outcome. Similar to Hansen & Wernerfelt (1989), where size and debt-to-equity ratio significantly impact ROE, the role of ownership structure has no notable impact similar to Palaniappan (2017) which can be due to specific characteristics of the Indian Market. Results are consistent with Douma et al., (2006) and Chaudhuri et al., (2016) where foreign ownership influences firm performance. Year-specific policies didn't have differentiated impact on firms' ROE. Lastly, the first sub-sample had no clear relationship between ROE and shareholding variables and their squares while in the second sub-sample, institutional shareholding and its square were significant at 10% confidence level i.e., a small but significant impact on performance. This variance can be pointed to different external factors like market conditions, business laws, or any economic factors.

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