IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

PANEL DATA ANALYSIS OF RETURN ON INVESTED CAPITAL

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Abstract

It is needless to emphasize that the term 'Panel Data' signifies the focus on the data that contain information about the same individuals (or entities) viewed at several moments in time. Panel data is also called a time series of cross sections (or, equivalently, a cross section of time series). Panel Data have both cross-sectional and time dimensions and, therefore, the biases that plague the studies based on a single cross-section or a single time section can be detected and corrected by the application of panel-data regression models.

Keywords: Return on Invested Capital, Operating Margin, Capital Turnover, Tax Effect Ratio, Fixed Effect Model, Random Effect Model.

Introduction

The amount of invested capital may be the same; but the ROIC may be different between the companies. Similarly, the quantity of input or input mix may be the same; but the quantum of production may be different among the cross-sectional units. These differences in return, the volume of production, etc; may be due to variations in managerial competencies, workers' ability, company location, the composition of managerial team, etc. These differences across sectional units are called unit-specific effects caused by cross-sectional heterogeneity. Similarly, there may be some time-specific effects, which may be due to changes in experience, weather conditions, floods, cyclones, drought conditions, corporate restructuring decisions, etc. These time-specific effects would also affect the different variables like return, operating cost, the volume of production, etc in different ways. In nutshell, these unit-specific effects and time specific effects may be due to several unobserved and immeasurable factors. If these unit-specific and time-specific effects associated with different cross-sectional units and different years of study period are not duly considered while specifying the regression model planned to be used in the study, the regression results are likely to be non-reliable and invalid and, therefore, the research findings and the suggestions

made thereon would be misleading. Moreover, some of these unit-specific and time-specific effects may have been correlated with the independent variables and, therefore, need to be accounted for by including all the relevant theoretical variables to represent the causes of unit-specific and time-specific effects in the regression model to be used for processing he data for drawing meaningful, valid and logical conclusions. In such a context, the panel data regression models would come to the rescue of the researcher.

Need for the Study

Business enterprises are not the charitable entities. Basic purpose of their existence is to earn or add a fair return to the shareholders after meeting out all external obligations; so that the existing shareholders are motivated to park their funds in the same company. This whole exercise of earning reasonable return on shareholders' wealth depends fundamentally upon:

i. how a company can increase sales,
ii. how a company can effectively manage the operating cost,
iii. what kind of investment is required,
iv. what pattern of financing (equity or debt or both) is followed; and
v. What type of retention policy the company is followed.

In view of multivariable nature of shareholder value creation and lack of uniformity among them in the application of shareholder value drivers for assessing corporate performance, a need was felt by the researcher to analyze the impact of different value drivers on the shareholder value created by the selected few software companies in India which have built their own image in the society.

Review of Literature

Several empirical studies have been undertaken to go into the details of shareholder value creation process, measurement models, assessing the relative strengths of shareholder value drivers, etc. In order to identify the research gap in the area of shareholder value creation that too in the Indian software industry, the review of the following studies has been made:

S.Suresh and A. Sengottaiyan (2015) studied on performance of selected Automobile companies in India with a focus on shareholder value creation and it was found that EVA and MVA both witnessed high fluctuations in their trend values based on the data collected from CMIE-PROWESS for the period from 2003-04 to 2012-13.

John Henry Hall (2016) studied on industry specific-determinants of shareholder value creation and concluded that, of the two dependent variables namely Market Adjusted Return (MAR) and Market Value Added (MVA), MVA was preferred for shareholder value measurement based on the data collected from the companies listed on the Johannesburg Stock Exchange for the period 2001 to 2011.

K. Kirankumar and D.A.R. Subramanyam (2016) studied on stock market returns with reference to Indian Cement Industry and concluded that economic profit and market value were the main metrics for the measurement of shareholder wealth based on the data for the period from 2005-06 to 2014-15.

Chitra Gunshekhar Gounder and Dr. M. Venkateshwarlu (2017) studied on the importance of EVA in Indian Banking Sector and found that EVA was not efficiently used for analysis and decision making regarding creation of value based on the data from 40 Indian commercial listed banks for the period 2001 to 2015.

Rohit Bansal, Arun Singh, Sushil Kumar and Rajni Gupta (2018) studied on the association between the net profit margin and ROA based on the data of private banks and public banks in Indian Banking Sector and found that no variables were found to be significant when ROA was considered as a dependent variable.

Nizamulmulk GUNES (2014) studied on profitability in Turkish Banking Sector and analysed the ROA through the panel data analysis and concluded that capital and liquidity were the important variables for the profitability, based on the data for the period 1990 to 1999.

P. Muraleetharan and Kosalathevi. T (2014) studied on an analysis of impact of EVA and MVA, based on the data collected from seven private banks in Sri lanka for the period from 2006 to 2012 and revealed that there was significant relationship between EVA and MVA.

The review reveals that no study has been undertaken so far for exploration multivariable responsible for positive or negative change in the shareholder value creation through the application of econometric tools like Multiple Linear Regression Analysis (MLRA). Hence, the present Study.

Objectives:

Following are the objectives of the present study:

- To identify the value drivers of Return on Invested Capital (ROIC).
- To test the significance of the influence of the value drivers including financial strategies, together or individually, on shareholder value creation under ROIC Model.
- To give the necessary suggestions in the light of the findings.

Methodology:

The Study is based on the secondary data collected from the annual reports of top five software companies i.e., TCS, Infosys, Wipro, HCL and Tech Mahindra for the period from 2008-09 to 2017-18. The data collected from the financial statements were suitably classified, tabulated and the relevant ratios which are having the power to explain the variation in ROIC were constructed besides testing the fitness of the Regression model.

Tools used for Analysis

For the analysis of the data in the light of objectives of the study the econometric tools like Simple linear Regression Model, Fixed Effect Model, Random Effect Model and Ratio Analysis.

Analysis and Interpretation of Data

Panel Data Regression Models Used

With the above noted idea in the mind, an attempt is made in the present study to apply two popular panel data regression model, viz., Fixed Effect Model and Random Effect Model for analysing the impact of shareholder value drivers on the Return on Invested Capital (ROIC).

Fixed Effect Regression Model (FEM)

The Fixed Effect Regression Model is:

$$\mathbf{Y_{it} = \alpha_i + \beta_1 X_{1,it} + \ldots\ldots\ldots\ldots\ldots + \beta_K X_{K,it} + \varepsilon_{it}}$$ **(For more than one explanatory variables)**

$$\mathbf{Y_{it} = \alpha_i + \beta_1 X_{1it} + \varepsilon_{it}}$$ **(For only one explanatory variable)**

Where,

- the subscript ‘i’ refers to i^{th} entity (or firm) and runs from i=1 to i=n.
- the subscript ‘t’ refers to t^{th} point of time of observation and runs from t=1 to t=T.
- Y_{it} denotes the response variable observed for i^{th} entity at t^{th} point of time of T periods.
- $\beta_1 \ldots\ldots\ldots\ldots \beta_K$ denote the partial regression coefficients.
- X_{Kit} denotes the value of K^{th} explanatory variable for i^{th} entity at t^{th} point of time.

- α_i denotes the entity specific intercept.
- ε_{it} denotes the disturbance term or random error term of i^{th} entity at t^{th} point of time.

The fixed effect model is based on the assumptions as stated below:

1. α_i is the effect on dependent variable of unobserved variable of i^{th} entity and it varies from one entity to another entity but remains constant over time in respect of a particular entity. Therefore, α_1…….. α_n are "entity fixed effects";
2. The slope remains constant across both entities and time; and
3. The random error term varies across both entity and time.

Random Effect Regression Model (REM)

In FEM, α_i is entity specific Y intercept and it varies across the cross sectional units. But in REM, α_i is defined as sum of common intercept and entity specific random error term, i.e., $\alpha_i = \alpha + v_i$. In view of the aforesaid definition of α_i, the equation for random Effect Regression Model runs as follows:

$$\mathbf{Y_{it} = \beta_1 X_{1,it} + \ldots\ldots\ldots\ldots\ldots + \beta_K X_{K,it} + \alpha + v_i + \varepsilon_{it}}$$ **(For more than one explanatory variables)**

Or

$$\mathbf{Y_{it} = \beta_1 X_{1,it} + \ldots\ldots\ldots\ldots\ldots + \beta_K X_{K,it} + \alpha + u_{it} (= v_i + \varepsilon_{it})}$$ **(For more than one explanatory variables)**

$$\mathbf{Y_{it} = \beta_1 X_{1it} + \alpha + u_{it} (= v_i + \varepsilon_{it})}$$ **(For only one explanatory variable)**

The REM is based on the assumption that:

- α is an intercept common to all the entities,
- the slope remains constant across both entity and time,
- the random error term is composite in nature and it consists of two error components, viz.,

  v_i (which is entity specific but time invariant random error), and

  ε_{it} (which is the usual random error components varying across both firms and time, also called idiosyncratic error term).

As the random error component in REM, consists of two error components, the REM is also called as "Error Components Model (ECM)".

Against this background of FEM and REM panel data regressions, the impact of value drivers on the shareholder value creation is examined and the relevant hypotheses are tested and test results are presented in the present study.

Analysis of Value Drivers of Post-Tax ROIC (Panel Data Analysis)

The post-tax ROIC is a multi-variable. In the present study, the variables, which are either driving-up or driving-down the level of the post-tax ROIC, used in the study, are:

- Operating Margin,
- Invested Capital Turnover, and
- Tax Effect Ratio.

Hence, panel data regression is run under:

- Fixed Effect Model; and
- Random Effect Model.

Regression of ROIC on its Value Drivers (Fixed Effect Model)

Under this model, as stated at the beginning of panel data analysis section, the panel data regression model runs as follows:

$$\mathbf{Y_{it} = \alpha_i + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_3 X_{3,it} + \varepsilon_{it}}$$

i.e., $[(ROIC)_{it} = \alpha_i + \beta_1(\text{Operating margin})_{1,it} + \beta_2(\text{Invested Capital Turnover})_{2,it} + \beta_3(\text{Tax Effect Ratio})_{3,it} + (\text{Random Error Term})_{it}]$

Where,

- α_i = entity specific intercept (i.e., firm-variant but time invariant intercept called Individual Fixed Effect);
- β_1 = Marginal effect on ROIC of a unit change in operating margin, holding X_2 and X_3 constant;
- β_2 = Marginal effect on ROIC of a unit change in invested capital turnover, holding X_1 and X_3 constant;
- β_3 = Marginal effect on ROIC of a unit change in tax effect ratio, holding X_1 and X_2 constant; and
- ε_{it} = Random error factors consisting of all other factors affecting ROIC, which vary across both firms and time periods.

Specification and Testing of Hypotheses

The following hypotheses are specified and tested at 5% level of significance:

- **For testing the overall fitness of the regression model (F-test):**

  Null Hypothesis (H_0): $\beta_1 = \beta_2 = \beta_3 = 0$

  Alternative Hypothesis (H_1): At least one of β's is not equal to zero.

- **For testing the individual significance of regression coefficients:**

  i. For operating margin (t-test):

  H_0: $\beta_1 = 0$ and **H_1:** $\beta_1 \neq 0$

ii. For invested capital turnover (t-test):

H_0: $\beta_2=0$ and **H_1:** $\beta_2\neq0$

iii. For tax-effect ratio (t-test):

H_0: $\beta_3=0$ and **H_1:** $\beta_3\neq0$

- **For testing the significance of the differences among the individual (cross-sectional) fixed effects (Restricted F-test):**

H_0: $\alpha_{TCS}=\alpha_{Infosys}=\alpha_{Wipro}=\alpha_{HCL}=\alpha_{Tech\ Mahindra}$ (i.e., There are no cross-sectional fixed effects)

H_1: $\alpha_{TCS}\neq\alpha_{Infosys}\neq\alpha_{Wipro}\neq\alpha_{HCL}\neq\alpha_{Tech\ Mahindra}$ (i.e., There are cross-sectional fixed effects)

The E-views output relating to the regression results of association between the value drivers and the ROIC are exhibited in Table 1:

Table 1: Regression of ROIC and its Drivers – Panel Data Analysis (FEM)

Dependent Variable: ROIC
Method: Panel Least Squares
Sample: 1 50
Periods included: 10
Cross-sections included: 5
Total panel (balanced) observations: 50
White period standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-67.09952	5.845923	-11.47800	0.0000
OPERATING_MARGIN	1.149425	0.058975	19.48999	0.0000
CAPITAL_TURNOVER	20.50144	0.568724	36.04814	0.0000
TAX_EFFECT_RATIO	47.46076	6.291338	7.543826	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.986320	Mean dependent var	24.61006
Adjusted R-squared	0.984040	S.D. dependent var	8.654743
S.E. of regression	1.093396	Akaike info criterion	3.162100
Sum squared resid	50.21160	Schwarz criterion	3.468024
Log likelihood	-71.05251	Hannan-Quinn criter.	3.278598
F-statistic	432.5828	Durbin-Watson stat	1.231858
Prob(F-statistic)	0.000000		

(Source: E-views Software output based on the input data)

Table 2: Cross-section Fixed Effects Values (ROIC and its Drivers)

	COMPANY	Effect
1	TCS	-0.281356

2	Infosys	-1.440665
3	WIPRO	0.476662
4	HCL	-0.117430
5	Tech Mahindra	1.362789

(Source: E-views Software output based on the input data)

Table 3: Redundant Fixed Effects Test Results (ROIC and its Drivers)

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	3.421575	(4,42)	0.0165
Cross-section Chi-square	14.103228	4	0.0070

(Source: E-views Software output based on the input data)

Table 1 indicates that:

- the p-value of the F-test (Table 1), Prob.(F-Statistic) -0.000000, is less than the critical p-value of 0.05. Hence, the null hypothesis needs to be rejected. The joint influence of operating margin, invested capital turnover and tax effect ratio is favourable and accounts for 98.63% variation in ROIC;
- the p-values of the t-statistics of operating margin, capital turnover and tax effect ratio (Table 1), all are less than the critical p-value of 0.05 and, therefore, the null hypotheses of all the individual regressors become eligible for rejection. Hence, it is concluded that all the value drivers have contributed positively towards increase in the return on invested capital; and
- the p-values of both F-statistic and the chi-square test (Table 3) are less than the critical value of 0.05 and, therefore the null hypothesis that all the individual fixed effects are equal to each other needs to be rejected. The presence of cross-sectional fixed effects is also confirmed by non-zero values of Fixed Effects exhibited in Table 2.

Hence, it is concluded that the entity specific heterogeneity in terms of unobserved and unmeasured variables in area of operation cost management, investment decision and tax planning and management have caused the cross-sectional random effect to vary across cross-sectional units but not over time.

Regression of ROIC on its Value Drivers (Random Effect Model)

Under this model, as stated at the beginning of panel data analysis section, the panel data regression model runs and follows:

$$Y_{it} = \alpha + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_3 X_{3,it} + u_{it} \ (=v_i + \varepsilon_{it})$$

Where,

- α (without any subscript) either i or t indicates the common intercept, applicable to all the sample companies;
- β_1, β_2 and β_3 indicate the marginal effects on ROIC of a unitary change in operating margin, invested capital turnover and tax effect ratio respectively;
- u_{it} denotes a composite random error term consists of company specific random error component (i.e., v_i) and the usual random error component (i.e., ε_{it}).

Specification and Testing of Hypotheses:

The following hypotheses are specified and tested at 5% level of significance:

- **For testing the overall fit of two regression model (F-test):**

  Null Hypothesis (H_0): $\beta_1 = \beta_2 = \beta_3 = 0$

  Alternative Hypothesis (H_1): At least one of β_i's is not equal to zero.

- **For testing the individual significance of regression coefficients:**

  iv. For operating margin (t-test):

  H_0: $\beta_1 = 0$ and **H_1:** $\beta_1 \neq 0$

  v. For invested capital turnover (t-test):

  H_0: $\beta_2 = 0$ and **H_1:** $\beta_2 \neq 0$

  vi. For tax-effect ratio (t-test):

  H_0: $\beta_3 = 0$ and **H_1:** $\beta_3 \neq 0$

- **For testing the significance of the differences among cross-sectional random effects:**

  H_0: There are no cross-sectional random effects.

  H_1: There are cross-sectional random effects.

Table E-views output relating to regression results of association between the value drivers and the ROIC under the REM are shown in Table 4:

Table 4: Regression of ROIC and its Drivers – Panel Data Analysis (REM)

Dependent Variable: ROIC
Method: Panel EGLS (Cross-section random effects)
Sample: 1 50
Periods included: 10
Cross-sections included: 5
Total panel (balanced) observations: 50
Swamy and Arora estimator of component variances
White period standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-67.18772	5.631598	-11.93049	0.0000
OPERATING_MARGIN	1.103532	0.047345	23.30831	0.0000
CAPITAL_TURNOVER	20.68960	0.591092	35.00233	0.0000
TAX_EFFECT_RATIO	48.66551	6.583407	7.392147	0.0000

Effects Specification		
	S.D.	Rho
Cross-section random	0.916417	0.4126
Idiosyncratic random	1.093396	0.5874

Weighted Statistics			
R-squared	0.979936	Mean dependent var	8.687533
Adjusted R-squared	0.978627	S.D. dependent var	7.423262
S.E. of regression	1.085233	Sum squared resid	54.17565
F-statistic	748.8862	Durbin-Watson stat	1.067447
Prob(F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.979377	Mean dependent var	24.61006
Sum squared resid	75.69448	Durbin-Watson stat	0.763987

(Source: E-views Software output based on the input data)

Table 5: Cross-section Random Effects Values (ROIC and its Drivers)

	COMPANY	Effect
1	TCS	-0.106143
2	Infosys	-0.877404
3	WIPRO	0.315421
4	HCL	-0.290411
5	Tech Mahindra	0.958538

(Source: E-views Software output based on the input data)

Table 4 reveals that:

- the p-value of F-test (for testing the joint hypothesis), which appears in the 'Weighted Statistics' part of Table 4 is less than the critical p-value of 0.05 and, therefore, the null hypothesis that $\beta_1 = \beta_2 = \beta_3 = 0$ gets rejected. Hence, it is concluded that all the value drivers have positive influence and their Joint effect on ROIC of all the value drivers for 0.98%; which indicates the good fit of the model;
- the p-values of the regression coefficients of all the value drivers of ROIC are less than the critical p-value of 0.05 and, hence, the null hypotheses of all the value drivers viz., operating margin, invested capital turnover and tax effect ratio become eligible for rejection. Hence, it is concluded that the value drivers have positively contributed towards increase in the ROIC; and
- the 'specification part' of Table 4 indicates that the variance of individual specific random component (i.e., v_i) is $(0.916417)^2$. Hence, the null hypothesis that $\sigma_{v_i}^2 = 0$ gets rejected. Hence, it is concluded that the cross-sectional random error component (V_i) has caused the random effects to change across the cross-sectional units. The presence of cross-sectional random effects is also confirmed by the non-zero value of the cross-sectional random effects exhibited in Table 5.

Findings

i. Regression of Post-tax ROIC on its Value Drivers (TCS Ltd.) reflects that all the value drivers, Operating margin, Capital turnover and Tax-effect ratio, have jointly and individually influenced the ROIC significantly as the null hypothesis of F-test for joint influence and the t-tests for individual influence are not supported by regression results. Hence, it is concluded that the co-hensiveness among operational strategies, investment strategies and tax planning & management strategies is responsible for positive influence on value creation;

ii. Regression of Post-tax ROIC on its Value Drivers (Infosys Ltd.) reveals that all the value drivers (Operating margin, Capital turnover and Tax-effect ratio) have both jointly and individually influenced the ROIC positively as the null hypothesis of the F-test for joint influence and t-tests for individual drivers' influence is not supported by the regression results;

iii. Regression of Post-tax ROIC on its Value Drivers (Wipro Ltd.) exhibits that all the value drivers (Operating margin, Capital turnover and Tax-effect ratio) have jointly and individually influenced the ROIC in a significant way as the respective null hypotheses of F-test and t-tests are not supported by the regression results;

iv. Regression of Post-tax ROIC on its Value Drivers (HCL Ltd.) reveals that all the value drivers, both jointly and individually have significantly influenced the ROIC as the respective null hypotheses are not supported by the regression results and

v. Regression of Post-tax ROIC on its Value Drivers (Tech Mahindra Ltd.) manifests that all the drivers, both jointly and individually, have influenced the ROIC in a positive way as their respective null hypotheses are not upheld by the regression results.

Suggestions

Following are few suggestions given in light of findings;

1. Increasing the magnifying power of the Financial Strategies by recapitalization
2. Assessing the linkage between Financing Strategies and Investment Strategies
3. Boosting the Capital turnover.
4. Capitalizing the presence of Entity-varying but time in-variant Cross-sectional Fixed Effects for wealth maximization of the owners.

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