Real Options and the Drivers of Firm Performance: An Empirical Study

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ABSTRACT

This paper provides empirical evidence for the intuitive incorporations of real options in the key drivers of firm performance. It argues that the industry and business-specific factors identified in the industrial organization and strategic management literatures are real options and their noticeable effects on firm performance are due to the varying intensities of real options that are embedded in them. Panel regression models are developed to analyse the relationships between the industry and the firm-level factors and the real options' measures. The study uses the financial and other organization-specific data of firms listed on the Nigerian Stock Exchange. The results show that the industry and the firm-level factors have significant relationships with the real options' measures. The findings therefore suggest that industry and business-specific determinants of firm performance have embedded real options and whatever effects the factors have on firm profitability can be explained using the real options theory. The paper thus further extends the literature on real options by presenting evidence for the presence of real options in the drivers of firm performance.

1. INTRODUCTION

The study of real options and its effects on other topics in management including firm performance has attracted the attention of management theorists in recent times. Real options logic has been used to provide further support and/or explanations to other theories in management. Interestingly, management theories and practices that have been closely linked with firm performance are now being studied using real options framework. In strategic management such theories and/or practices include organizational change (Power & Reid, 2013), resource allocation (Adner & Levinthal, 2004a; Klingebiel & Adner, 2015; Krychowski & Quélin, 2010), divestment (Damaraju, Barney, & Makhija, 2015), venture capitalists' investment decisions (Li & Chi, 2013) and managerial incentives (Alessandri, Tong, & Reuer, 2012) among others. These theories and practices are studied using real options framework with findings showing that real options can provide further explanations of these theories / practices and their relationships with other topics in management. Although extant literatures on applications of real options have shown that the use of real options can add value to the firm and hence improve firm performance, there is a gap in the literature on the link between real options and the key drivers of firm performance. Extant real options studies have examined isolated cases of real options applications in investment projects and their incremental effects on firm performance. Current studies have also examined how real options theory can be used to offer further insights into other management theories. It will therefore be interesting to investigate the determinants of firm performance using real options framework.

Empirical evidence that shows that firm performance can be linked to real options will boost the study of real options and encourage managers to adopt the real options tool as part of their capital budgeting process. If intuitively incorporating managerial flexibilities into firms' investment decisions can positively affect firm performance, then going a step further to

formally structure investment decisions as real options will remarkably improve firm profitability. Analysing the drivers of firm performance using real options and providing empirical evidence for the relationship between real options and firm performance will also be of interest to researchers in firm performance and performance improvement practitioners. It will bridge the gap between the industry organization economists and strategic management experts and bring them to common understanding of the drivers of firm performance. The paper thus set out to identify common real options and option-like strategic investments in the various determinants of firm performance identified in the literature.

The next section of the paper reviews the key drivers of firm performance and identifies common real options and option-like strategic investments in the determinants of firm performance. The section discusses how the industry and firm-level drivers of firm performance have embedded real options and are therefore expected to have significant relationship with the real options' measures. Section three discusses the methodology used in the paper and also includes discussions on the sample and the data used including the method of analysis of the data. Findings from the analysis are discussed in the fourth section while section five concludes the paper.

2. REAL OPTIONS IN THE DRIVERS OF FIRM PERFORMANCE

This paper proposes that the determinants of firm performance identified in the industrial organization and strategic management literatures are real options. These drivers of firm performance have option-like features and are therefore in form of prices or premiums by firms to limit their downside losses and optimize their upside potentials.

2.1 Industry Factors and Real Options

The key industry factors identified in the literature and considered in this paper are industry concentration and entry and exit barriers. Industry concentration measures the degree of competitiveness of the industry. A highly concentrated industry has very few firm(s) having 100 or close to 100 per cent market share of the industry. Using real options framework, this/these firm/firms must have incurred some costs, in forms of real options, which give them some rights to investment decisions that lead to high concentration of the industry. Incorporation of real options in investment decision by few firms in an industry thus leads to high concentration of the industry which in turn leads to superior performance of the industry when compared to other industries. On the other hand, entry and exit barrier characteristics of an industry are determined by a number of factors. Key among these is the capital intensity of the industry. Entry into a highly capital intensive industry involves huge upfront capital investment and in almost all the cases require licensing by regulatory bodies. These industries include natural resource exploration, biotechnology/pharmaceutical, oil & gas and utilities. These requirements create high barrier to entries for new entrants. The barriers can be measured by investments in capital assets and R&D by the industry players. These investments are forms of flexibilities or real options for the firms and expand the firms' values under uncertainties of future economic environments. It is hypothesized that the higher these option values, the higher the degree of the industry barriers. Another related industry

factor that can be analyzed using real options logic is the industry growth rate. Industries with growth opportunities have real options embedded in the investment decisions of the firms in these industries. These investments may be in form of tangible or intangible assets with future growth options. For example an industry sub-sector being created as a result of changes in technology. An example is the emergence of electronic/mobile payment sub-sector under financial services sector. Investments in physical / intellectual assets in this sub-sector are in forms of real options with abilities to drive the future growth of the industry. Real options values therefore drive industry growth which in turn leads to increased industry performance.

2.2 Firm-level Factors and Real Options

The business-specific factors investigated in strategic management literature are many. While some of them have been shown to consistently have positive relationships with firm performance, the findings from studies on some other ones have been mixed. The key organization-specific factors considered in this paper include relative market size, firm size, diversification, financial leverage, firm age, firm capital intensity, firm R&D investment and firm growth rate. It is argued that these variables are driven by the presence of real options in firms' strategic and operational investment decisions. Real options embedded in firms' investment decisions can contribute to increased relative market share of the firm. Option to alter operating scale, option to switch, staging option and growth options are key real options that can be incorporated in investment decisions which can increase a firm's volume of sale when compared to its competitors. Industry players that positively position themselves for future uncertainties in demand for their products by embedding these options can maximize their relative market shares. It is therefore expected that there will be a positive relationship between relative market share and firm performance driven by the presence of real options in

a firm's strategic and operational investment decisions. Firm size has been traditionally identified as a key driver of firm performance. Economies of scale and scope have been used in industrial organization to explain the relationship between firm size and firm performance. It is explained that as a firm grows in size, it enjoys economies of scale and scope as average total cost decreases leading to better performance. It has however been shown that it is possible for a firm to have diseconomies of scale if the size increases beyond the optimal level. In terms of real options, it is theorized that the effect of firm size on firm performance will depend on the unfolding operating environment. Key real options that can influence the size of a firm are options to wait, option to alter operating scale, staging option and growth option. When these options are embedded in a firm's investment decisions and there are favourable operating environments, the options are exercised leading to increase in size of the firm and the attendant increase in firm performance. From real options logic, it is expected that the effect of size on firm performance will depend on the operating environments which are also shared by the other industry players.

Diversification is a strategic practice that reduces a firm's exposure to product market risk. A firm engages in the production and marketing of two or more related or unrelated products and/or services. Diversification strategy can lead to improved firm performance because the firm is able to limit its downside losses from one product market and benefit from the upside potential of the other product market(s). The effects of diversification on firm have been shown to depend on how the diversification is achieved (Graham, Lemmon, & Wolf, 2002; Hashai, 2015). Using real options logic, when a firm diversifies, the firm incurs costs or option prices, which give the firm the right to future investment decisions that limit its losses and or optimizes its gains. When the operating environment for one product is unfavourable, the firm can reduce scale of production of that product. On the other hand for the product with favourable revenue potentials, the firm can improve its performance by expanding the

scale of production for the product. Just like in finance's portfolio theory, the firm is likely to benefit more from diversification if the correlation between the products is low. It is therefore suggested in this paper that real options incorporated in diversification strategy explains the effects of diversification on firm performance. Financial leverage by firms is another form of flexibility. Although in the absence of tax and transaction costs, financial leverage has been shown to be immaterial in finance literature, financial leverage can however be shown to matter using real options framework. The higher the ratio of debt to total asset in a firm, the more the firm is constrained to invest in future opportunities and optimize its future returns on investment. Corporate debts come with restrictive covenants that restrict strategic and operational flexibilities of firms. On the other hand, equity finance which is more expensive gives the firm more leverage. Financial leverage can therefore be viewed as driven by real options where the option price is increased cost of finance that gives the firm the right to enjoy favourable future investment decisions. It is therefore theorised that because of real options, financial leverage will have a positive effect on firm performance. Another important firm-specific factor that can be examined using real options thinking is firm age. Age gives the firm some forms of flexibilities to optimally adjust to unfolding future environments. Older firms are more likely to have invested more in their operations and processes than younger firms thereby giving them some forms of strategic and operational flexibilities in their future investment decisions. These costs incurred by older firms can be viewed as option prices and can therefore expand firm values under uncertainty. It is thus proposed that firm age have embedded real options which drive the effects of firm age on firm performance.

Another set of business-specific factors that have embedded real options that drive their effects on firm performance are firm capital intensity, firm R&D intensity and firm growth rate. Firms with relatively more investments in capital assets, other things being equal, are more likely to perform financially better than the ones with low capital intensity. From real

options framework, investments in ‘real’ or capital assets give a firm the right to invest in follow-on investments in the future. Firms with these upfront investments enjoy these rights in the future and therefore can maximize their returns on investments. On the other hand, firms without these investments will not be able to optimize their returns in the event of upsurge in the demand for their products. This paper therefore hypothesizes that real options are incorporated in investments in capital assets which explains the effects of these investments on firm performance. Using the same argument, investments in R&D by firms can give the firms making the investments strategic and even operational flexibility to make some other follow-on investments in the future which then affects the firms' financial performances. Positive results from researches undertaken by firms can give them the right to develop the research outputs. Therefore any noticeable effects of R&D investments on firm performance are linked to the real options embedded in the investments. Research outputs can also lead to more efficient production processes reducing production. The last variable in this set is the firm growth rate. It is argued that relatively high growth rates recorded by some firms are driven by real options. Real options embedded in investment projects by firms create growth opportunities for the firms. Exercises of such real options as option to alter operating scale, time-to-build option and growth option can lead to growth in revenues of the firms that have incorporated these options into their investment decisions. The effect of growth rates on firm performance is argued in this paper to be due to the presence of real options.

2.3 The Real Options' Measures

Incorporating a number of common real options into a firm’s managerial decisions presents the firm with the opportunity for future investments. Such real options as option to wait, staging option, option to alter operating scale and growth option give firms opportunities for

future or follow-on investments. Therefore, the presence of investment opportunities in a firm shows the incorporation of the identified common real options. It therefore follows that a measure of investment opportunities at either the firm or the industry level gives the degree of common real options embedded in the firm. In the same manner, option-like strategic investments such as irreversible, flexibility, modular, platform and learning investments present opportunities for future investments. Measures of the level of investment opportunities at firm and industry levels will therefore reveal the degree of these option-like strategic investments and hence the degree of real options in the firm and/or industry.

Another key measure of real options is strategic flexibility. Incorporation of real options gives firm managers flexibilities in their strategic and operational decisions. It will be easier to expand/contract the scale of a production plant as a result of unfolding operating environment if the option had been built into the design and development of the plant. Strategic flexibility measures the ease at which a firm makes or changes its strategies or strategic investment decisions. A firm may need to make investments that will make the firm the cost leader in the industry. This may require the firm to alter its operating scale. The presence of real options such as staging option or option to alter operating scale gives the firm this strategic flexibility. The level of strategic investments made by a firm per period in relation to its size therefore shows the degree of common real options earlier embedded in the firm's decisions. Similarly option-like strategic investments including irreversible, flexibility, insurance, modular, platform and learning investments give a firm strategic flexibility. Exploring the relationships between the firm- and industry-level factors and strategic flexibility will therefore relate these factors with real options.

The last real options measure to consider in this paper is operational flexibility. In addition to providing investment opportunities and giving the firm strategic flexibility, incorporation of common real options and investing in option-like strategic investments give a firm

operational flexibility. Firm operations involve product creation/development, production and distribution of products. Incorporating common real options improves the ease at which a firm makes changes to its operation. A firm can easily alter its operating scale and hence its production volumes if such real options as staging option, option to alter operating scale and growth options among others had been embedded in the firm's earlier investment decisions. In the same way the ease at which a firm makes strategic investments is used in this paper to measure strategic flexibility part of real options, the ease at which a firm makes operational investments (or incurs operational expense) is used to measure operational flexibility. Likewise option-like strategic investments provide the firm with operational flexibility; for example flexibility investment gives the firm the option to easily alter its production creation/development, production and distribution decisions.

3. METHODOLOGY

The paper provides evidence for the presence of real options in the industry and firm-level drivers of firm performance. The industry and organizational drivers of firm profitability are analysed to contain option-like features and the relationships between these factors and the identified real options' measures are analysed. The industry- and firm-level data of the firms listed on the Nigerian Stock Exchange (NSE) are used in the analysis. Regression models are developed using the data to investigate the relationships using panel data modelling. The required financial data of companies listed on all the sectors of the NSE excluding the financial services sector were sourced from the published financial reports of these firms and from Bloomberg.

3.1 Sample and Data

The financial data of firms listed on the non-financial sectors of the NSE are used in this paper. These sectors include agriculture, construction/real estate, consumer goods, healthcare, industrial goods and information & communication technology. Others are natural resources, oil & gas, services, utilities and conglomerates. The financial data were extracted from published financial reports of these quoted firms and from Bloomberg. The firm-specific variables are either direct or computed figures from the published income and/or balance sheet statements of the companies. The data used cover a period of five years: from year 2010 to year 2014 for the 130 firms considered in this study for a total of 650 firm-year data. However, 114 firms have their complete five-year data used in this study for a total of 570 firm-year data. The sourced data constitute the data needed for the industry variables, firm-specific variables and real options' measures.

Industry Variables

The industry explanatory variables used in this study are industry concentration, industry capital intensity, industry R&D intensity, industry growth rate and industry sectors of the firms. These variables are as defined in the data definition section and their values are estimated from the relevant data extracted from the companies' financial statements.

Firm-Specific Variables

Firm-specific variables estimated from the sourced data include relative market share, firm size, diversification, financial leverage and firm age. Others include firm capital intensity, firm R&D intensity and firm growth rate

Real Options Variables

Real options' measures used in this paper include firm investment opportunities, firm strategic flexibility, firm operational flexibility, industry investment opportunities, industry strategic flexibility and industry operational flexibility. The data for these measures are extracted from the financial statements and reports of the firms studied in the paper.

Data Definition

The independent and the dependent variables to be used in this paper are summarised in Table 3.1.

Table 3.1 Descriptions of Variables

Variable	Type / Level	Description
Industry Concentration	Industry	The measure used is four-firm concentration ratio which is the total percentage market shares of the four largest firms in the industry in a year
Industry Capital Intensity	Industry	Average of the net value of property, plant and equipment to net sales across all firms in the industry for each year
Industry R&D Intensity	Industry	Average of the ratio of the research and development expenditure to net sales across all firms in the industry for each year
Industry Growth Rate	Industry	Annual average rate of growth of net sales for firms in the industry
Industry Sector	Industry	The sectors in which the firms are listed
Relative Market Share	Firm	Ratio of the firm's market share (the firm's net sales to the total net sales of all firms in the industry) to the market share the firm does not control (the firm's market share subtracted from one) in a year
Firm Size	Firm	The natural logarithm of the value of book assets of the firm for each year
Diversification	Firm	Number of sub-sectors in the industry for which the firm's products and services are reported for each year
Financial Leverage	Firm	The ratio of the firm's book value of debt to total assets in a year
Firm Age	Firm	The difference between the current year and the founding year or incorporation year of the firm
Firm Capital Intensity	Firm	The net value of property, plant and equipment to net sales of the firm for each year
Firm R&D Intensity	Firm	The ratio of R&D expenditure to net sales of the firm for each year
Firm Growth Rate	Firm	Annual rate of growth of net sales of the firm
Firm Investment Opportunities	Real Options' Measure	The net value of property, plant & equipment (PPE) and R&D investments to net sales of the firm for each year
Firm Strategic	Real Options'	The ratio of the firm strategic investment in acquisition / divestment of business unit(s)

Flexibility	Measure	(extraordinary loss/gain) to its net income for each year
Firm Operational Strategy	Real Options' Measure	The annual rate of growth of the firm's operating expenses
Industry Investment Opportunities	Real Options' Measure	Average of the net value of property, plant & equipment (PPE) and R&D to net sales across all firms in the industry for each year
Industry Strategic Flexibility	Real Options' Measure	The average annual ratio of strategic investments in acquisitions / divestments of business units of all firm in the industry to their net incomes
Industry Operational Strategy	Real Options' Measure	The average annual rate of growth of operating expenses of all firms in the industry

3.2 Method of Analysis and Model Specification

Regression models for panel data analysis are employed to analyse the data over the five-year period. The data is first analysed using pooled ordinary least square (OLS) regression models. The panel data is then analysed for individual and/or group effects using fixed effect and random effect modelling. Models in forms of pooled OLS are first developed for the relationship between industry- and firm-specific factors and real options. Pooled OLS assume that there are no unobserved firm-specific effects. Fixed and random effects models are then developed to analysed the fixed effects and the random effects of the above-identified relationships respectively. To test whether fixed effects exist in the panel data, F-test is conducted on the model for each of the relationship. The test shows whether or not the fixed effect model produces better goodness-of-fit. On the other hand for random effect models, Lagrange multiplier (LM) test is carried out to show whether random effects are significant in the models examined. Finally Hausman test is carried on the models for each relationship studied in this paper to compare the relative effects of fixed and random effects on the

models. The test suggests the model with the better goodness-of-fit for analysing the relationship under study.

3.3 The Model Specifications

Industry- and firm-level factors and real options

Pooled OLS, fixed effects and random effects regression models are developed to analyse the hypothesized relationship between the industry- and firm-level variables and real options' measures. The relationship between the industry factors and the industry real options' measures and the relationship between the firm-specific factors and firm real options' measures are investigated.

Industry factors - industry real options' measures models

The relationship between the industry factors (industry concentration, industry capital intensity, industry R&D intensity, industry growth rates and industry sectors) and the industry real options' measures (industry investment opportunities, industry strategic flexibility and industry operational flexibility) are investigated using the pooled OLS, the LSDV & the within group fixed and the FGLS (random effects) estimation models. The pooled OLS models for the relationship are specified in the models 1.1.1, 1.1.2 and 1.1.3 for industry investment opportunities, industry strategic flexibility and the industry operational flexibility respectively.

$$\begin{aligned} ind\_invopp_i \;=\; & \beta_{0,1} + \beta_{1,1} ind\_conc_{i,1} + \beta_{2,1} ind\_capint_{i,1} + \beta_{3,1} ind\_rdint_{i,1} + \\ & \beta_{4,1} ind\_growth_{i,1} + \beta_{5,1} agric_{i,1} + \beta_{6,1} conglom_{i,1} + \beta_{7,1} const\_re_{i,1} + \\ & \beta_{8,1} cons\_goods_{i,1} + \beta_{9,1} healthcare_{i,1} + \beta_{10,1} ict_{i,1} + \beta_{11,1} ind\_goods_{i,1} + \\ & \beta_{12,1} nat\_resrc_{i,1} + \beta_{13,1} oil\_gas_{i,1} + \varepsilon_{i,1} \end{aligned} \qquad \mathbf{1.1.1}$$

$$ind\_strflex_i = \beta_{0,2} + \beta_{1,2}ind\_conc_{i,2} + \beta_{2,2}ind\_capint_{i,2} + \beta_{3,2}ind\_rdint_{i,2} + \beta_{4,2}ind\_growth_{i,2} + \beta_{5,2}agric_{i,2} + \beta_{6,2}conglom_{i,2} + \beta_{7,2}const\_re_{i,2} + \beta_{8,2}cons\_goods_{i,2} + \beta_{9,2}healthcare_{i,2} + \beta_{10,2}ict_{i,2} + \beta_{11,2}ind\_goods_{i,2} + \beta_{12,2}nat\_resrc_{i,2} + \beta_{13,2}oil\_gas_{i,2} + \varepsilon_{i,2} \quad \mathbf{1.1.2}$$

$$ind\_opflex_i = \beta_{0,3} + \beta_{1,3}ind\_conc_{i,3} + \beta_{2,3}ind\_capint_{i,3} + \beta_{3,3}ind\_rdint_{i,3} + \beta_{4,3}ind\_growth_{i,3} + \beta_{5,3}agric_{i,3} + \beta_{6,3}conglom_{i,3} + \beta_{7,3}const\_re_{i,3} + \beta_{8,3}cons\_goods_{i,3} + \beta_{9,3}healthcare_{i,3} + \beta_{10,3}ict_{i,3} + \beta_{11,3}ind\_goods_{i,3} + \beta_{12,3}nat\_resrc_{i,3} + \beta_{13,3}oil\_gas_{i,3} + \varepsilon_{i,3} \quad \mathbf{1.1.3}$$

The ind_invopp_i, $ind\_strflex_i$ and ind_opflex_i are the industry real options' measures industry investment opportunities, industry strategic flexibility and industry operational flexibility respectively. $\beta_{0,1}$, $\beta_{0,2}$ and $\beta_{0,3}$ are the intercepts of the three models; $ind\_conc_{i,1}$, $ind\_conc_{i,2}$ and $ind\_conc_{i,3}$ are the industry concentration variables for the three performance measures; $ind\_capint_{i,1}$, $ind_capint_{i,2}$and $ind\_capint_{i,3}$ are the industry capital intensity variables; $ind\_rdint_{i,1}$, $ind\_rdint_{i,2}$ and $ind\_rdint_{i,3}$ are the industry R&D intensity variables; $ind\_growth_{i,1}$, $ind_growth_{i,2}$and $ind\_growth_{i,3}$ are the industry growth rates variables while $agric_{i,j}$, $conglom_{i,j}$, $const\_re_{i,j}$, $cons\_goods_{i,j}$, $healthcare_{i,j}$, $ict_{i,j}$, $ind\_goods_{i,j}$, $nat\_resrc_{i,j}$, $oil\_gas_{i,j}$ (j=1,2,3) are agriculture, conglomerates, construction/real estates, consumer goods, healthcare, information & communication technology, industrial goods, natural resources and oil & gas sectors respectively; $\beta_{1,1}$, $\beta_{1,2}$ and $\beta_{1,3}$ are the coefficients for the industry concentration variables for the roa, roe and tobinq models respectively; $\beta_{2,1}$, $\beta_{2,2}$ and $\beta_{2,3}$ are the coefficients for the industry capital intensity variables; $\beta_{3,1}$, $\beta_{3,2}$ and $\beta_{3,3}$ are the coefficients for the industry R&D intensity variables; $\beta_{4,1}$, $\beta_{4,2}$ and $\beta_{4,3}$ are the coefficients for the industry growth rates variables while $\beta_{5,j}$ to $\beta_{13,j}$ (j=1,2,3) are the coefficients of the industry

sectors; and finally $\boldsymbol{\varepsilon_{i,1}}$, $\boldsymbol{\varepsilon_{i,2}}$ and $\boldsymbol{\varepsilon_{i,3}}$ are the error terms for the models 1.1.1, 1.1.2 and 1.1.3 respectively.

The LSDV fixed effect models are also developed for the relationship between the industry factors and the real options' measures to examine the presence of fixed effects in the relationship. The LSDV are specified in the models 1.2.1, 1.2.2 and 1.2.3.

$$\boldsymbol{ind\_invopp_i} = \boldsymbol{\beta_{0,1}} + \boldsymbol{\beta_{1,1}ind\_conc_{i,1}} + \boldsymbol{\beta_{2,1}ind\_capint_{i,1}} + \boldsymbol{\beta_{3,1}ind\_rdint_{i,1}} + \boldsymbol{\beta_{4,1}ind\_growth_{i,1}} + \boldsymbol{\beta_{5,1}agric_{i,1}} + \boldsymbol{\beta_{6,1}conglom_{i,1}} + \boldsymbol{\beta_{7,1}const\_re_{i,1}} + \boldsymbol{\beta_{8,1}cons\_goods_{i,1}} + \boldsymbol{\beta_{9,1}healthcare_{i,1}} + \boldsymbol{\beta_{10,1}ict_{i,1}} + \boldsymbol{\beta_{11,1}ind\_goods_{i,1}} + \boldsymbol{\beta_{12,1}nat\_resrc_{i,1}} + \boldsymbol{\beta_{13,1}oil\_gas_{i,1}} + \boldsymbol{u_{1,1}firm_{1,1}} + \boldsymbol{u_{2,1}firm_{2,1}} + \boldsymbol{u_{3,1}firm_{3,1}} + \cdots + \boldsymbol{u_{113,1}firm_{113,1}} + \boldsymbol{\varepsilon_{i,1}} \quad \mathbf{1.2.1}$$

$$\boldsymbol{ind\_strflex_i} = \boldsymbol{\beta_{0,2}} + \boldsymbol{\beta_{1,2}ind\_conc_{i,2}} + \boldsymbol{\beta_{2,2}ind\_capint_{i,2}} + \boldsymbol{\beta_{3,2}ind\_rdint_{i,2}} + \boldsymbol{\beta_{4,2}ind\_growth_{i,2}} + \boldsymbol{\beta_{5,2}agric_{i,2}} + \boldsymbol{\beta_{6,2}conglom_{i,2}} + \boldsymbol{\beta_{7,2}const\_re_{i,2}} + \boldsymbol{\beta_{8,2}cons\_goods_{i,2}} + \boldsymbol{\beta_{9,2}healthcare_{i,2}} + \boldsymbol{\beta_{10,2}ict_{i,2}} + \boldsymbol{\beta_{11,2}ind\_goods_{i,2}} + \boldsymbol{\beta_{12,2}nat\_resrc_{i,2}} + \boldsymbol{\beta_{13,2}oil\_gas_{i,2}} + \boldsymbol{u_{1,2}firm_{1,2}} + \boldsymbol{u_{2,2}firm_{2,2}} + \boldsymbol{u_{3,2}firm_{3,2}} + \cdots + \boldsymbol{u_{113,2}firm_{113,2}} + \boldsymbol{\varepsilon_{i,2}} \quad \mathbf{1.2.2}$$

$$\boldsymbol{ind\_opflex_i} = \boldsymbol{\beta_{0,3}} + \boldsymbol{\beta_{1,3}ind\_conc_{i,3}} + \boldsymbol{\beta_{2,3}ind\_capint_{i,3}} + \boldsymbol{\beta_{3,3}ind\_rdint_{i,3}} + \boldsymbol{\beta_{4,3}ind\_growth_{i,3}} + \boldsymbol{\beta_{5,3}agric_{i,3}} + \boldsymbol{\beta_{6,3}conglom_{i,3}} + \boldsymbol{\beta_{7,3}const\_re_{i,3}} + \boldsymbol{\beta_{8,3}cons\_goods_{i,3}} + \boldsymbol{\beta_{9,3}healthcare_{i,3}} + \boldsymbol{\beta_{10,3}ict_{i,3}} + \boldsymbol{\beta_{11,3}ind\_goods_{i,3}} + \boldsymbol{\beta_{12,3}nat\_resrc_{i,3}} + \boldsymbol{\beta_{13,3}oil\_gas_{i,3}} + \boldsymbol{u_{1,3}firm_{1,3}} + \boldsymbol{u_{2,3}firm_{2,3}} + \boldsymbol{u_{3,3}firm_{3,3}} + \cdots + \boldsymbol{u_{113,3}firm_{113,3}} + \boldsymbol{\varepsilon_{i,3}} \quad \mathbf{1.2.3}$$

The variables are as defined for pooled OLS models. $\boldsymbol{firm_{1,1}}\ldots\boldsymbol{firm_{113,1}}$, $\boldsymbol{firm_{1,2}}\ldots\boldsymbol{firm_{113,2}}$ and $\boldsymbol{firm_{1,3}}\ldots\boldsymbol{firm_{113,3}}$ are dummy variables for the 113 firms in the study (the 114th firm is left out to avoid perfect collinearity). $\boldsymbol{u_{1,1}}\ldots\boldsymbol{u_{113,1}}$, $\boldsymbol{u_{1,2}}\ldots\boldsymbol{u_{113,2}}$ and $\boldsymbol{u_{1,3}}\ldots\boldsymbol{u_{113,3}}$ are the coefficients of the dummy firm variables.

The within group estimation models and the random effects models are also estimated for the relationship. The effects' tests are also carried out to investigate the relative strength of fixed and random effects in the relationship.

Models for the firm-specific factors and firm real options' measures relationship

Models are also developed to investigate the relationship between firm-specific variables and the firm real options' variables. The models examine whether firm-specific variables (relative market share, firm size, diversification, financial leverage, firm age, firm capital intensity, firm R&D intensity and firm growth rate) are related to the firm real options' variables (firm investment opportunities, firm strategic flexibility and firm operational flexibility). The pooled OLS models for the relationship are specified in the models 2.1.1, 2.1.2 and 2.1.3.

$$\boldsymbol{frm\_invopp_i} = \boldsymbol{\beta_{0,1}} + \boldsymbol{\beta_{1,1}rel\_mktshr_{i,1}} + \boldsymbol{\beta_{2,1}size_{i,1}} + \boldsymbol{\beta_{3,1}divers_{i,1}} + \boldsymbol{\beta_{4,1}fin\_lev_{i,1}} + \boldsymbol{\beta_{5,1}age_{i,1}} + \boldsymbol{\beta_{6,1}frm\_capint_{i,1}} + \boldsymbol{\beta_{7,1}frm\_rdint_{i,1}} + \boldsymbol{\beta_{8,1}frm\_growth_{i,1}} + \boldsymbol{\varepsilon_{i,1}} \quad \mathbf{2.1.1}$$

$$\boldsymbol{frm\_strflex_i} = \boldsymbol{\beta_{0,2}} + \boldsymbol{\beta_{1,2}rel\_mktshr_{i,2}} + \boldsymbol{\beta_{2,2}size_{i,2}} + \boldsymbol{\beta_{3,2}divers_{i,2}} + \boldsymbol{\beta_{4,2}fin\_lev_{i,2}} + \boldsymbol{\beta_{5,2}age_{i,2}} + \boldsymbol{\beta_{6,2}frm\_capint_{i,2}} + \boldsymbol{\beta_{7,2}frm\_rdint_{i,2}} + \boldsymbol{\beta_{8,2}frm\_growth_{i,2}} + \boldsymbol{\varepsilon_{i,2}} \quad \mathbf{2.1.2}$$

$$\boldsymbol{frm\_opflex_i} = \boldsymbol{\beta_{0,3}} + \boldsymbol{\beta_{1,3}rel\_mktshr_{i,3}} + \boldsymbol{\beta_{2,3}size_{i,3}} + \boldsymbol{\beta_{3,3}divers_{i,3}} + \boldsymbol{\beta_{4,3}fin\_lev_{i,3}} + \boldsymbol{\beta_{5,3}age_{i,3}} + \boldsymbol{\beta_{6,3}frm\_capint_{i,3}} + \boldsymbol{\beta_{7,3}frm\_rdint_{i,3}} + \boldsymbol{\beta_{8,3}frm\_growth_{i,3}} + \boldsymbol{\varepsilon_{i,3}} \quad \mathbf{2.1.3}$$

The $\boldsymbol{frm\_invopp_i}$, $\boldsymbol{frm\_strflex_i}$ and $\boldsymbol{frm\_opflex_i}$ are the firm real options' measures firm investment opportunities, firm strategic flexibility and firm operational flexibility respectively. $\boldsymbol{rel\_mktshr_{1,1}}$, $\boldsymbol{rel\_mktshr_{1,2}}$ and $\boldsymbol{rel\_mktshr_{1,3}}$ are the relative market share variables for return on asset, return on equity and Tobin's Q firm performance measures respectively; $\boldsymbol{size_{1,1}}$, $\boldsymbol{size_{1,2}}$ and $\boldsymbol{size_{1,3}}$ are the firm size variables; $\boldsymbol{divers_{1,1}}$, $\boldsymbol{divers_{1,2}}$

and $\boldsymbol{divers_{1,3}}$ are the diversification variables; $\boldsymbol{fin\_lev_{1,1}}$, $\boldsymbol{fin\_lev_{1,2}}$ and $\boldsymbol{fin\_lev_{1,3}}$ are the financial leverage variables, $\boldsymbol{age_{1,1}}$, $\boldsymbol{age_{1,2}}$ and $\boldsymbol{age_{1,3}}$ are the firm age variables; $\boldsymbol{frm\_capint_{1,1}}$, $\boldsymbol{frm\_capint_{1,2}}$ and $\boldsymbol{frm\_capint_{1,3}}$ are the firm capital intensity variables; $\boldsymbol{frm\_rdint_{1,1}}$, $\boldsymbol{frm\_rdint_{1,2}}$ and $\boldsymbol{frm\_rdint_{1,3}}$ are the firm R&D intensity variables while $\boldsymbol{frm\_growth_{1,1}}$, $\boldsymbol{frm\_growth_{1,2}}$ and $\boldsymbol{frm\_growth_{1,3}}$ are the growth rates variables for the three performance measures. $\boldsymbol{\beta_{1,j}}$ (j=1,2,3), $\boldsymbol{\beta_{2,j}}$, $\boldsymbol{\beta_{3,j}}$, $\boldsymbol{\beta_{4,j}}$, $\boldsymbol{\beta_{5,j}}$, $\boldsymbol{\beta_{6,j}}$, $\boldsymbol{\beta_{7,j}}$ and $\boldsymbol{\beta_{8,j}}$ and the coefficients of relative market share, firm size, diversification, financial leverage, age, firm capital intensity, firm R&D intensity and firm growth rates variables respectively..

The LSDV fixed effects models are specified in the models 2.2.1, 2.2.2 and 2.2.3.

$$\boldsymbol{frm\_invopp_i} = \boldsymbol{\beta_{0,1}} + \boldsymbol{\beta_{1,1}rel\_mktshr_{i,1}} + \boldsymbol{\beta_{2,1}size_{i,1}} + \boldsymbol{\beta_{3,1}divers_{i,1}} + \boldsymbol{\beta_{4,1}fin\_lev_{i,1}} + \boldsymbol{\beta_{5,1}age_{i,1}} + \boldsymbol{\beta_{6,1}frm\_capint_{i,1}} + \boldsymbol{\beta_{7,1}frm\_rdint_{i,1}} + \boldsymbol{\beta_{8,1}frm\_growth_{i,1}} + \boldsymbol{u_{1,1}firm_{1,1}} + \boldsymbol{u_{2,1}firm_{2,1}} + \boldsymbol{u_{3,1}firm_{3,1}} + \cdots + \boldsymbol{u_{113,1}firm_{113,1}} + \boldsymbol{\varepsilon_{i,1}} \quad \mathbf{2.2.1}$$

$$\boldsymbol{frm\_strflex_i} = \boldsymbol{\beta_{0,2}} + \boldsymbol{\beta_{1,2}rel\_mktshr_{i,2}} + \boldsymbol{\beta_{2,2}size_{i,2}} + \boldsymbol{\beta_{3,2}divers_{i,2}} + \boldsymbol{\beta_{4,2}fin\_lev_{i,2}} + \boldsymbol{\beta_{5,2}age_{i,2}} + \boldsymbol{\beta_{6,2}frm\_capint_{i,2}} + \boldsymbol{\beta_{7,2}frm\_rdint_{i,2}} + \boldsymbol{\beta_{8,2}frm\_growth_{i,2}} + \boldsymbol{u_{1,2}firm_{1,2}} + \boldsymbol{u_{2,2}firm_{2,2}} + \boldsymbol{u_{3,2}firm_{3,2}} + \cdots + \boldsymbol{u_{113,2}firm_{113,2}} + \boldsymbol{\varepsilon_{i,2}} \quad \mathbf{2.2.2}$$

$$\boldsymbol{frm\_opflex_i} = \boldsymbol{\beta_{0,3}} + \boldsymbol{\beta_{1,3}rel\_mktshr_{i,3}} + \boldsymbol{\beta_{2,3}size_{i,3}} + \boldsymbol{\beta_{3,3}divers_{i,3}} + \boldsymbol{\beta_{4,3}fin\_lev_{i,3}} + \boldsymbol{\beta_{5,3}age_{i,3}} + \boldsymbol{\beta_{6,3}frm\_capint_{i,3}} + \boldsymbol{\beta_{7,3}frm\_rdint_{i,3}} + \boldsymbol{\beta_{8,3}frm\_growth_{i,3}} + \boldsymbol{u_{1,3}firm_{1,3}} + \boldsymbol{u_{2,3}firm_{2,3}} + \boldsymbol{u_{3,3}firm_{3,3}} + \cdots + \boldsymbol{u_{113,3}firm_{113,3}} + \boldsymbol{\varepsilon_{i,3}} \quad \mathbf{2.2.3}$$

The terms in the models have been defined in the paper.

Stata commands are used to estimate the within group fixed effects and the random effects for the relationship. The tests for the fixed and random effects and their comparisons are also carried out on the relationship

4 RESULTS AND DISCUSSION

The models are implemented using the five-year industry- and firm-level financial data of 114 firms listed in ten sectors of NSE. This makes a total of 570 observations. The model outputs for the identified relationships are discussed in the following sections.

4.1 Industry- and Firm-Specific Factors and Real Options

This paper sets out to provide evidence for the incorporations of real options in the industry- and firm-level determinants of firm performance. This section analyses the relationship between the industry- and firm-specific factors and real option measures. Evidence of direct relationship between the factors and real options' measures suggest that whatever effects the factors have on firm performance can be attributed to real options. This section examines the between the industry factors and industry real options' measures and the relationship between the firm-level factors and firm real options' measures.

Industry Factors and Real Options

The outputs of the models that explore the relationships between the industry factors and the industry real options' measures are analysed for any direct links between the factors and real options. The relationships between the industry factors and industry investment opportunities, industry strategic flexibility and industry operational flexibility, the key industry real options' measures used, are examined.

Industry Factors and Industry Investment Opportunities

The relationship between industry concentration, industry capital intensity, industry R&D intensity, industry growth rates and industry sectors and industry investment opportunities are analysed using the pooled OLS model 1.1.1, the LSDV fixed effect model 1.2.1 (with the

within group fixed effect model) and the random effect model. The results of the model are summarised in Appendix A.

Industry investment opportunities, the real options' measure, is computed from industry capital intensity and industry R&D intensity (by definition industry investment opportunities is the addition of industry capital and R&D intensities). The two factors are therefore excluded from the models since they already have perfect positive relationships with industry investment opportunities. The pooled OLS model for the relationship between the remaining industry factors and industry investment opportunities is statistically significant thus providing evidence that industry factors are related to industry investment opportunities and hence to real options. F- and LM tests show that while there are significant fixed effects there are no significant random effects implying that fixed effect model present the best model for analysing the relationship when compared to pooled OLS and random effect models.

The fixed effect model is significant at 0.01 level providing evidence that the industry factors are related to industry investment opportunities even when industry capital and R&D intensities are excluded from the analysis. The results also show that the factors account for 57 percent of the variance in industry investment opportunities. This is a strong evidence and the relationship between the industry factors and industry investment opportunities becomes even stronger when industry capital and R&D intensities are considered along with the industry factors used in the models. The relationships between each of the industry factors and industry investment opportunities are discussed below:

Industry concentration: The coefficient of industry concentration is 8.729879 and is statistically significant at 0.05 level. The results provide evidence that there is a positive relationship between industry concentration and industry investment opportunities, a real options' measure. This shows that industry concentration, as an industry-level factor, has

common real options embedded in them. The results support the argument in this paper that industry-level determinants of firm performance are real options and the effects they have on firm profitability are partly due to real options embedded in them. The results show that the higher the level of industry concentration, the higher the intensities of real options embedded in the firm's investment decisions as measured by industry investment opportunities. A highly concentrated industry implies that the firms have made upfront investments in forms of option prices that give them rights to exercise embedded options (by taking a number of investment decisions) in the face of uncertainties. The results show that industry concentration as an industry factor has common real options or option-like investment decisions embedded in them and its effects on firm performance can be largely explained by real options theory.

Industry Capital Intensity: Industry capital intensity has a perfect positive relationship with industry investment opportunities since the real options' measure is computed from it. This shows that industry capital intensity as an industry factor is also a real options' measure. This implies that the effects of industry investment opportunities and hence real options on firm performance will be the same as effects of industry capital intensity on firm performance. Therefore effects of industry capital intensity on firm performance can be explained using real options theory. Long term or capital investments that firms make are regarded as option prices and the more of these investments the firms make, the more rights they have to exercise future investment decisions as future uncertain conditions are resolved.

Industry R&D Intensity: Just like industry capital intensity, industry investment opportunities is computed directly from industry R&D intensity. This implies that the industry factor is directly related to industry investment opportunities. The effects of industry R&D intensity on firm performance can therefore be explained using real options theory. Investments in

R&D by firms are like option prices paid by the firm to enjoy the rights to make follow-on investment decisions in the future. The higher the industry R&D intensities, the higher the common real options embedded in the firms' decisions or option-like investments that can be made by the firms.

Industry Growth Rate: The relationship between industry growth rate and industry investment opportunities is statistically significant at 0.01 level and negative. Although there is evidence to show that industry growth rate is related to industry investment opportunities, the results show that the relationship is negative. This implies that the higher the growth rate in an industry, the lower the level of investment opportunities and hence real options in that industry. These results do not support earlier arguments that industry factors including industry growth rate are positively related to real options. Using real options' arguments, it is expected that high industry growth rate would translate to more investment opportunities in the industry and hence more real options, the data however suggest otherwise. The results show that high industry growth rate attracts less long term tangible and intangible investments and hence less real options while relatively low industry growth attracts more long term capital and R&D investments in the industry. These results are compared with the results for the relationships of industry growth rate with the other industry real options' measures, viz., industry strategic and operational flexibilities.

Industry Sector: It is argued using real options theory that a highly capital intensive industry would have high industry investment opportunities while the opposite will be the case for a relatively low capital intensive industry. The results show the relationship between the ten industry sectors and industry investment opportunities and hence with real options. The outputs show that the relationship between agriculture industry sector and industry investment opportunities is statistically significant at 0.05 level and positive. This implies that

agricultural sector presents higher investment opportunities when compared to other industry sectors. Natural resources sector is another industry sector with high positive relationship with industry investment opportunities. These sectors require relatively high capital and R&D investments that can be regarded as option prices which then give the firms rights to exercise future investment decisions. On the other hand, industry sectors such as conglomerates, construction/real estate, consumer goods, healthcare, ICT, industrial goods, oil & gas and services have negative relationships with industry investment opportunities and hence with real options. The results suggest that these industries / sectors have relatively low investment opportunities or real options. Using real options theory, managers of firms in these industries have lower number of options to exercise in forms of taking follow-on investment decisions when compared to managers of firm in agriculture and natural resources sectors. While investments in the oil & gas sector are expected to be capital-intensive, the fact that firms listed in the sector mostly play in the downstream / marketing sub-sector may be responsible

The analyses of the industry factors above have shown that the factors have strong relationships with a real options' measure, the industry investment opportunities. The factors can thus be regarded as real options. Therefore their effects on firm performance can be largely explained using real options theory.

Effects of Industry Factors on Industry Strategic Flexibility

The industry strategic flexibility is another key real options' measure used in this paper. The results of the pooled OLS model 1.1.2, the LSDV fixed model/within group fixed effect model and the random model that examine the relationships between the industry factors and industry strategic flexibility are summarised in Appendix B.

The pooled OLS model is significant at 0.01 level. Although the random effect model is significant at 0.01 level while the fixed effect model is not significant, the F- and LM tests show that there are neither fixed nor random effects in the relationship. The OLS pooled model can thus be used to analyse the relationship. From the results, there is evidence that industry factors account for about 21 percent of the variance in industry strategic flexibility. Although the relationship is not as strong as that between the industry factors and industry investment opportunities, it however provides further evidence that industry-level factors are related to real options. The coefficient of industry concentration is 20.86316 and is significant at 0.01 level. This shows that industry concentration has a strong positive relationship with industry strategic flexibility. In terms of real options, it shows that firms in highly concentrated industry can more quickly adjust their strategies to unfolding realities when compared to industries with lower industry concentration. Firms in the industry have paid option prices to enjoy strategic flexibility rights.

The other industry factors (industry capital intensity, industry R&D intensity, industry growth and the listed industry sectors) however have negative relationships with industry strategic flexibility. While the relationships of industry capital intensity and industry R&D intensity with industry strategic flexibility are not statistically significant, the relationships of industry growth and the listed industry sectors (agriculture, conglomerates, construction/real estate, consumer goods, healthcare, ICT, industrial goods, natural resources, oil &gas and services) are statistically significant and negative. The results provides evidence that increased industry growth lowers the strategic flexibilities that can be enjoyed by firms in the industry. Using real options theory it is expected that with industry growth, firms in the industry are more likely to exercise their strategic flexibility rights. The results however show that the rights are not exercised suggesting that the higher the rate of growth in an industry, the less the option prices (in terms of prior decisions that incorporate strategic flexibility options) and hence the

less flexible the firm managers are in taking strategic decisions. The results also show that the various industry sectors have negative relationship with industry strategic flexibility. The findings show that being listed in the any of the industry sector does not give the firms flexibility in terms of strategic decisions.

Effects of Industry Factors on Industry Operational Flexibility

Another key measure of real options used in this study is industry operational flexibility. Appendix C summarises the outputs of the pooled OLS model 1.1.3, the LSDV fixed effect model 1.2.3 (with the within group fixed effect model) and the random effect model that depict the relationship between the industry-level factors and industry operational flexibility.

The models (the pooled OLS, fixed and random effects) are all significant at 0.01 level providing evidence that the identified industry factors are related to industry operational flexibility as a measure of real options. However while F-test shows that there are fixed effects in the relationship, the LM test shows that there are insignificant random effects between the industry factors and industry operational flexibility. The fixed effect model is therefore used to analyse the relationship. The model shows that the industry factors can be used to explain about 38 percent of the variance in industry operational flexibility. The analyses of the relationships of the factors with industry operational flexibility are discussed below:

Industry Concentration: The coefficient of industry concentration is -0.5740186 and is significant at 0.05 level. This implies that for every one unit increase in industry concentration, industry operational flexibility decreases by approximately 0.57. Unlike the positive relationships of industry concentration with industry investment opportunities and with industry strategic flexibility, the results show that firms in highly concentrated industries

are less flexible in their operations when compared to firms in less concentrated firms. Using real options, the results provide evidence that high industry concentration tends to reduce firms' operational flexibilities. On the other hand, highly competitive industry with low industry concentration are more flexible in their operations.

Industry Capital Intensity: Industry capital intensity with coefficient of 0.0072093 is positively related to industry operational flexibility at a significant level of 0.05. This shows that the more capital-intensive an industry is, the easier it is for firms in the industry to alter their operations. In terms of real options, this shows that firms in the industry have paid option prices in forms of investments in capital assets giving them opportunities or rights to alter their operations as uncertainties are resolved. There is thus evidence to show that high industry capital intensity tend to lead to increase in such real options as option to alter operating scale and options to switch between inputs and/or outputs. The firms can quickly increase or decrease their operating scales or quickly change from one input/output to another input/output depending on how favourable or unfavourable the operating environments are. The effects of industry capital intensive on firm performance can thus be explained using industry operational flexibility as a measure of real options.

Industry R&D Intensity: Unlike industry capital intensity, industry R&D flexibility's relationship with industry operational flexibility is negative and significant at 0.01 level. The results do not provide evidence to show that investments in intangible assets by firms in the sectors analysed lead to more operational flexibilities for the firms. On the contrary, the findings show that the more the firms in an industry invest in R&D, the less flexibilities the firms have in terms of changing their operational decisions should the need arise. In terms of real options the results imply that, unlike capital investments, R&D investments do not embed real options in forms of operational flexibilities for the firms in the industry. However

as earlier shown, more investments in R&D in an industry lead to more industry investment opportunities and hence more real options.

Industry Growth: The coefficient of industry growth is 0.134705 and is significant at 0.01 level. This shows that industry growth has a significant positive relationship with the industry operational flexibility and that for every one unit increase in industry growth, there is approximately 0.135 increase in the measure of operational flexibility in the industry, all other things being equal. The results thus provide evidence that industry growth has a direct positive relationship with industry operational flexibility and hence with real options. It therefore follows that the effects of industry growth on firm performance can be explained using real options. In terms of real options, the higher the growth in an industry, the more real options in forms of operational flexibilities are exercised in the industry.

Industry Sector: Of the ten industry sectors studied in this paper, nine of them have positive relationship (six of them have significant positive relationship) with the industry operational flexibility. This thus provides evidence that the industry to which a firm belongs is related to industry operational flexibility, a measure of real options. The evidence shows that firms in the conglomerates, construction/real estates, ICT, natural resources, oil & gas and services sectors have embedded real options that allow the managers of these firms to exercise flexibilities in their operations. The embedded real options may include option to wait/defer, option to switch between inputs/outputs, option to alter operating scale and staging option.

Firms that are conglomerates, for example, have embedded options to switch between inputs/outputs. The firms produce diversified products and can therefore switch between any of their products depending on the prevailing demand for the products. They can also alter the operating scales for the products that are relatively in high demand. Construction/real estate firms, on the other hand, can exercise option to wait/defer construction and staging options

depending on the resolutions of uncertainties. ICT firms also enjoy operational flexibilities in terms of altering the scales of software and/or hardware deployments and in staging of ICT deployments. Natural resources and oil & gas firms can also exercise the rights to wait/defer, alter operating scale and/or switch between inputs/outputs based on resolutions of uncertainties in prices of commodities and/or oil & gas products.

Table 4.1 summarises the relationships between the industry-level factors and real options' measures.

Table 4.1 Relationship between Industry-level Factors and Real Options' Measures

Real Options' Measures / Industry Factors	**Industry Investment Opportunities**	**Industry Strategic Flexibility**	**Industry Operational Flexibility**
Industry Concentration	Significant positive relationship	Significant positive Relationship	Significant negative relationship
Industry Capital Intensity	Significant positive relationship	Little or no evidence	Significant positive relationship
Industry R&D Intensity	Significant positive relationship	Little or no evidence	Significant negative relationship
Industry Growth	Significant negative relationship	Significant negative relationship	Significant positive relationship
Industry Sectors	Sectors with significant positive relationship: agriculture Sectors with significant negative relationship: conglomerates, construction/real estate and ICT Sectors with little or no evidence: consumer goods, healthcare, industrial	Sectors with significant positive relationship: nil Sectors with significant negative relationship: agriculture, conglomerates, construction/real estate, consumer goods, healthcare, ICT, industrial goods, natural resources, oil & gas and services	Sectors with significant positive relationship: conglomerates, construction/real estate, ICT, natural resources, oil & gas and services Sectors with significant negative relationship: nil Sectors with little or no evidence: agriculture, consumer goods,

	goods, natural resources, oil & gas and services	Sectors with little or no evidence: nil	healthcare and industrial goods
Overall Model	**Significant relationship**	**Significant relationship**	**Significant relationship**

4.2.2 Effects of Firm-level Factors on Real Options

The business-specific factors studied in this paper are analysed for evidence of direct relationship with firm real options' measures. The results of the models depicting the relationships between the firm-level factors (relative market share, firm size, diversification, financial leverage, firm age, firm capital intensity, firm R&D intensity and firm growth rate) and the real options' variables; firm investment opportunities, firm strategic flexibility and firm operational flexibility, are analysed. The findings are expected to show whether or not real options' theory can be used to explain the effects of the identified firm-level factors on firm performance.

Effects of Firm-level Factors on Firm Investment Opportunities

Earlier findings have shown that industry-level factors have strong relationship with industry investment opportunities. Investment opportunities at either industry or firm level are a key real options' measure. Pooled OLS model 4.1.1, LSDV fixed effect model 4.2.1/within group effect estimation model and the random effect model are used to analyse the relationship between the business-specific variables and firm investment opportunities. The results of the models are presented in Appendix D

The three models are significant (pooled OLS and fixed effect models are significant at 0.01 level while random effect model is significant at 0.1 level). Firm investment opportunities, as a real options' variable, is the addition of firm capital and R&D intensities, therefore the two factors are not included in the models. They have perfect positive relationships with firm

investment opportunities. Just like for the relationship between industry factors and industry investment opportunities, Table 4.12 shows that the included firm-level factors account for 56.11 percent variance in firm investment opportunities. When firm capital and R&D intensities are considered in the relationship, firm-level factors account for far more variance in firm investment opportunities and hence in real options. F- and LM tests show that fixed and random effects are significant in the relationship (at 0.01 level). However while Hausman test returns -26.64 (chi2<0) implying that random effects are more significant, the test warns that the data fails to meet the asymptotic assumptions.

The factors and their relationships with firm investment opportunities are analysed as follows:

Relative Market Share: The results show that the coefficient of relative market share is not significant. Although the coefficient is negative suggesting a negative relationship between relative market share and firm investment opportunities, there is little or no evidence to support the relationship

Firm Size: The coefficient is insignificant and negative providing little or no evidence for the relationship between firm size and firm investment opportunities as a measure of real options. Using real options, it is argued that as a firm increases its size, it incurs a cost in form of an option price and therefore stands to enjoy a right to make future investment decisions based on its earlier investments to scale up its size. The results however fail to provide significant evidence to support or refute the real options' claim

Diversification: Using real options theory. It is hypothesized that as firms diversify their product/service offerings, they make additional investments incurring costs or option prices in the process and therefore stand to enjoy more rights to exercise future investment

decisions. There rights may include options to switch between outputs or to alter the operating scale of their product(s). In terms of real options, the higher the degree of diversification, the higher the level of firm investment opportunities and hence the more the real options that are embedded in the diversification decisions. Although there is no evidence to support this argument from the data, there is little or no evidence to refute the claim.

Financial leverage: The coefficient of financial leverage is 4.414403 and is significant at 0.05 level. The results provide evidence that financial leverage has a strong positive relationship with firm investment opportunities. The results suggest that the more a firm is financed by debt as opposed to equity, the more investment opportunities are created by the firm and hence the more real options are embedded in the financial leverage decision.

Firm age: The coefficient of firm age as a firm-level factor is negative and not significant. There is therefore no evidence to show that firm age is positively related to firm investment opportunities as argued using real options. In terms of real options, it is argued that as a firm becomes older, it is assumed it has made more tangible and intangible investments when compared to a younger firm and should therefore stand to enjoy more rights or opportunities for future investments. There is however no evidence to support this claim. It thus shows that older firms may not have made more investments in forms of options prices to enjoy better future investment opportunities. The results also provide little or evidence that older firms have less investment opportunities and hence less real options when compared to younger firms.

Firm Capital Intensity: Firm capital intensity has direct positive relationship with firm investment opportunities and is a key determinant of the intensity of real options embedded in firm's investment decisions. Using real options theory, high intensity of capital investments by a firm increases the firm's capital cost (this is regarded as option price or premium) and

then gives the firm the right to make follow-on investment decisions as uncertainties are resolved. These capital investments limit the firm's downside losses in unfavourable business environment and improve the upside potential if business environment becomes highly favourable. The effects of firm capital intensity on firm performance can therefore be explained using real options theory.

Firm R&D Intensity: Firm R&D intensity, just like firm capital intensity, has a direct positive relationship with firm investment opportunities. A firm's investments in R&D give the firm opportunities for future investments. The firm however incurs costs in forms of option prices to enjoy the right to make the future investments. The outputs of R&D can be commercialised leading to follow-on investments in new product creations. High R&D intensive firms are therefore expected to have more investment opportunities and hence more real options when compared to less R&D intensive firms.

Firm Growth Rate: The coefficient of firm growth rate is negative and not significant (random effect model). There is no evidence to show that high rate of growth in a firm's revenues are embedded real options that can lead to future investment opportunities. The results show that just like high industry growth rate does not lead to better industry investment opportunities, high growth rate at the firm level also does not translate to improved investment opportunities for the firm. There is no positive relationship between improved firm's sales and how intensive the firm make tangible and intangible long-term investments.

The analyses above have shown that there is a strong overall relationship between the identified firm-level factors with a number of the factors (financial leverage, firm capital and R&D intensities) having strong positive relationships with firm investment opportunities as a real options' measure. However the relationships between some of the factors and firm

investment opportunities are not conclusive. The relationships of firm-level factors and other measures of firm real options (firm strategic and operational flexibilities) are explored in the following sections.

Effects of Firm-level Factors on Firm Strategic Flexibility

Firm strategic flexibility measures real options or managerial flexibilities that can be enjoyed by a firm in terms of making strategic investment decisions. Evidence of relationship between firm-level factors and firm strategic flexibility shows that the factors can be regarded as real options and therefore their effects on firm performance can be explained using real options. Pooled OLS model 4.1.2, the LSDV fixed effect model 4.2.2 (with the within group fixed effect model) and the random effect model are developed to investigate the relationship between the factors and firm strategic flexibility. The results of the model are presented in Appendix E.

The results show that none of the models (pooled OLS, fixed and random effect models) representing the relationship between firm-level factors and firm strategic flexibility is significant. This implies that there is little or no evidence to show that the identified firm-level factors are related to firm strategic flexibility as a measure of real options. The results thus show that firm strategic flexibility, as a measure of real options, may not be used to explain the effects of firm-level factors on firm performance. Follow-on research is therefore needed to further test the relationship between firm-level factors and firm strategic flexibility.

Effects of Firm-level Factors on Firm Operational Flexibility

Operational flexibility at the firm level measures the intensity of real options that a firm enjoys in terms of the ease in which the firm changes its operational decisions. The pooled OLS model 4.1.3, the LSDV fixed model 4.2.3/within group effect estimation model and the

random effect model are used to explore the relationship between the firm-level factors and firm operational flexibility. The models' outputs are presented in Appendix F.

The three models are significant providing evidence that the firm-level factors are related to firm operational flexibility and hence with real options. The pooled OLS and the fixed effect models are significant at 0.01 level while random effect model is significant at 0.05 level. F- and LM tests confirm that both fixed and random effects exist in the relationship. Hausman test to test the relative effects of random and fixed effects on the relationship returns -3.44 (chi2<0) showing that random effect model better represent the relationship but warns that data fails to meet asymptotic assumptions. The analyses of the relationships between the firm-level factors and firm operational flexibility using random effect model's results are presented below:

Relative market share: The coefficient of relative market share is negative but not significant. This shows that there is little or no evidence to show that there is any direct relationship between relative market share and firm operational flexibility. In terms of real options, it is assumed that firms incur costs in forms of option prices to increase their relative market shares and therefore should enjoy more operational flexibilities because of these embedded real options. There is however no evidence to support the real options' argument.

Firm size: The coefficient of firm size is .0563794 and is significant at 0.01 level. This shows that firm size is positively related to firm operational flexibility providing evidence that firm size as a firm-level factor has embedded real options that can give a firm the right to exercise operational flexibility options. It can thus be deduced from the results that as firms grow in size, the costs they incur can be regarded as option prices that then give them the rights to enjoy flexibilities in their operational decisions at a later date. According to the results, all other things being equal, a one unit increase in firm size will be accompanied by an increase

of about 0.056 in the measure of firm operational flexibility. With the evidence of direct relationship between firm size and firm operational flexibility, the effect of firm size on firm performance can thus be explained using real options theory.

Diversification: The relationship between diversification, as a firm-level factor, and firm operational flexibility is negative but not significant. It thus shows that there is little or no evidence to show that diversification is related to firm operational flexibility. Using real options theory, it is hypothesized that as firms diversify their product/service offerings, they incur costs or option prices in the process, which in turn give them the rights to take flexible operational decisions. There is however no evidence to support the hypothesis from the results.

Financial leverage: The results also show that the relationship between financial leverage and firm operational flexibility is negative and insignificant providing little or no evidence for any direct relationship between the factor and the real options' measure. Further evidence is therefore needed to establish a link between financial leverage and firm operational flexibility as a measure of real options.

Firm age: The coefficient of firm age is -.0026229 and is significant at 0.1 level. This shows that firm age has a negative relationship with the real options' measure. The results show that as firms grow older, they become less flexible in their operational decisions. It thus provide evidence that older firms do not necessarily incur costs or options prices to enjoy operational flexibilities at a later date. On the contrary the findings imply that the older a firm, the less flexibility real options are embedded in the firm as a result of its age, and the less flexible the firm is at taking operational decisions in the future.

Firm capital intensity: The results show that the relationship between firm capital intensity and firm operational intensity is positive but not significant. There is thus little or no evidence to support the real options' argument that capital intensive firms incur costs in forms of option prices which give them the right to exercise embedded real options on/or before maturity of the options. In terms of real options, it is argued that the more long-term tangible investments a firm makes, the more real options are embedded in the investment decisions and the more rights the firm enjoys in taking flexible operational decisions in the future. Further evidence is however needed as there is little or no evidence to support the real options' argument.

Firm R&D intensity: The relationship between firm R&D intensity is negative but not significant. There is therefore little or no evidence to support the hypothesized relationship between firm R&D intensity and firm operational flexibility.

Firm growth rate: The results show that there is a positive significant relationship between firm growth rate and firm operational flexibility. The coefficient of firm growth rate is .1056483 and is significant at 0.05 level. This shows that, all other things being equal, a one unit increase in annual growth of firm revenue will lead to about 0.1 increase in the measure of the firm operational flexibility. The results thus provide evidence for the real options' hypothesis that an increase in firm growth rate is accompanied by an increase in incorporated real options which then make firms to enjoy more flexibilities in their operations. Firms incur costs (regarded as option prices) to grow their revenues which then give them the rights to exercise such options as option to alter operating scales and/or to switch between inputs/outputs at a later date. With the evidence of a relationship between firm growth rate and firm operational flexibility, the effects of the factor on firm performance can thus be explained using real options.

The relationships between the firm-level factors and the real options' measures are summarised in Table 4.8.

Table 4.8 Relationship between Firm-level Factors and Real Options' Measures

Real Options' Measures / Firm-level Factors	**Firm Investment Opportunities**	**Firm Strategic Flexibility**	**Firm Operational Flexibility**
Relative Market Share	Little or no evidence	Little or no evidence	Little or no evidence
Firm Size	Little or no evidence	Little or no evidence	Significant positive relationship
Diversification	Little or no evidence	Little or no evidence	Little or no evidence
Financial Leverage	Significant positive relationship	Little or no evidence	Little or no evidence
Firm Age	Little or no evidence	Little or no evidence	Significant negative relationship
Firm Capital Intensity	Significant positive relationship	Little or no evidence	Little or no evidence
Firm R&D Intensity	Significant positive relationship	Little or no evidence	Little or no evidence
Firm Growth Rate	Little or no evidence	Little or no evidence	Significant positive relationship
Overall Model	**Significant relationship**	**Little or no evidence**	**Significant relationship**

The results show that all the firm-level factors have significant relationship with at least one of the firm's real options' measures except relative market share and diversification. The models' outputs show that the firm-level factors have significant relationships with firm investment opportunities (the factors account for at least 56% variance in firm investment opportunities) and firm operational flexibility (they account for about 33%). The results provide evidence that significant number of firm-level factors have real options embedded in

them, therefore real options theory can be used to explain the effects of the factors on firm performance.

CONCLUSION

The drivers of firm profitability are argued to be common real options or products of option-like strategic investments as firm managers incur cost in form of option prices under uncertainties to produce the factors. The key industry factors analysed include industry concentration, industry capital intensity, industry R&D intensity, industry growth rate and industry sectors of the firms. The business-specific drivers of firm performance discussed are relative market size, firm size, diversification, financial leverage, firm age, firm capital intensity, firm R&D intensity and firm growth rate. It is argued that these factors have varying effects on firm profitability because of the varying intensities of real options that they incorporate. The paper provides evidence for the presence of real options in these factors by developing models that show the relationship of the factors with the real options' measures. The real options' measures used are investment opportunities, strategic flexibility and operational flexibility at both the industry and firm levels. The results of the models showing the relationships between the industry factors and industry investment opportunities, industry strategic flexibility and industry operational flexibility are analysed.

The results show that the industry factors have significant relationships with the industry real options' measures with most of them having significant positive relationships with the measures. The findings thus provide empirical evidence for the intuitive incorporations of real options in the industry factors and whatever effects the factors have on firm profitability can be explained using real options theory. The outputs of the models for the relationship between the firm-level factors and the firm real options' measures (firm investment opportunities, firm strategic flexibility and firm operational flexibility) also show the significant relationship of the business-specific factors with two of the three real options' measures. The firm variables have significant relationships with firm investment

opportunities and firm operational flexibility with evidence for significant positive relationships with the measures for some of the factors

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APPENDICES

Appendix A

Effects of Industry Factors on Industry Investment Opportunities

Industry Investment Opportunities	Pooled OLS	Fixed Effect Model	Random Effect Model
Industry Concentration	5.480045**	8.729879**	5.480045**
	(2.519116)	(3.606618)	(2.519116)
Industry Capital Intensity			
Industry R&D Intensity			
Industry Growth	-1.649075***	-1.69888***	-1.649075***
	(.4898807)	(.542625)	(.4898807)
Agriculture	6.761869***	5.03238**	6.761869***
	(1.420038)	(2.365507)	(1.420038)
Conglomerates	-2.601815**	-4.118814*	-2.601815**
	(1.243123)	(2.169794)	(1.243123)
Construction / Real Estate	-2.817851**	-4.728111**	-2.817851**
	(1.383888)	(2.345984)	(1.383888)
Consumer Goods	-.8771899*	-1.455122	-.8771899*
	(.5200131)	(1.511669)	(.5200131)
Healthcare	-1.882258*	-3.328799	-1.882258*
	(1.031545)	(2.01697)	(1.031545)
ICT	-2.19062*	-3.642103*	-2.19062*
	(1.190311)	(2.115784)	(1.190311)
Industrial Goods	-1.609804	-3.005039	-1.609804
	(1.115657)	(2.06666)	(1.115657)
Natural Resources	3.792446***	2.031946	3.792446***
	(1.447758)	(2.387415)	(1.447758)
Oil & Gas	-1.56388*	-2.521503	-1.56388*
	(.8096758)	(1.735021)	(.8096758)
Intercept	-1.412358	-2.905773	-1.412358
	(1.172541)	(1.91928)	(1.172541)
F-test (Model)	66.53***	5.23***	731.85***
DF	558	454	454

R^2	0.5674	0.5700	
SSE (SRMSE)	2139.40467	2126.71544	
SEE or $\hat{\sigma}_v$	1.9581	2.1643	2.1643464
$\hat{\sigma}_u$			0
θ			0
Effect Test		4.403***	0.00
N	570	570	570

Standard errors in parenthesis; Statistical significance: *<.1, **<0.05, ***<0.01

APPENDIX B

Effects of Industry Factors on Industry Strategic Flexibility

Industry Strategic Flexibility	Pooled OLS	Fixed Effect Model	Random Effect Model
Industry Concentration	20.86316***	21.69321***	20.86316***
	(3.461171)	(5.019236)	(3.461171)
Industry Capital Intensity	-.0264328	-.027426	-.0264328
	(.0578885)	(.0643156)	(.0578885)
Industry R&D Intensity	-5.056544	-5.981476	-5.056544
	(21.15113)	(23.73208)	(21.15113)
Industry Growth	-1.570186**	-1.589174**	-1.570186**
	(.6846777)	(.7629117)	(.6846777)
Agriculture	-10.40316***	-10.83935***	-10.40316***
	(1.989867)	(3.294274)	(1.989867)
Conglomerates	-9.283014***	-9.617758***	-9.283014***
	(2.05354)	(3.16867)	(2.05354)
Construction / Real Estate	-10.90922***	-11.35305***	-10.90922***
	(1.908333)	(3.265605)	(1.908333)
Consumer Goods	-3.686791***	-3.835381*	-3.686791***
	(.7144949)	(2.080796)	(.7144949)
Healthcare	-3.933029***	-4.307164	-3.933029***
	(1.426182)	(2.806671)	(1.426182)
ICT	-8.855915***	-9.184802***	-8.855915***
	(1.859111)	(3.014602)	(1.859111)

Industrial Goods	-7.899439***	-8.258314***	-7.899439***
	(1.534175)	(2.864249)	(1.534175)
Natural Resources	-11.33546***	-11.78561***	-11.33546***
	(2.008509)	(3.323198)	(2.008509)
Oil & Gas	-5.94239***	-6.186784**	-5.94239***
	(1.111342)	(2.392822)	(1.111342)
Intercept	-9.444586***	-9.818013***	-9.444586***
	(1.607894)	(2.641949)	(1.607894)
F-test (Model)	11.42***	1.03	148.52***
DF	556	452	452
R^2	0.2108	0.2109	
SSE (SRMSE)	3986.08165	3985.5008	
SEE or $\hat{\sigma}_v$	2.6775	2.9694	2.9694241
$\hat{\sigma}_u$			0
θ			0
Effect Test		0.816	0.00
N	570	570	570

Standard errors in parenthesis; Statistical significance: *<.1, **<0.05, ***<0.01

APPENDIX C

Effects of Industry Factors on Industry Operational Flexibility

Industry Operational Flexibility	Pooled OLS	Fixed Effect Model	Random Effect Model
Industry Concentration	-.425984**	-.5740186**	-.425984**
	(.1849706)	(.2680378)	(.1849706)
Industry Capital Intensity	.0070321**	.0072093**	.0070321**
	(.0030937)	(.0034346)	(.0030937)
Industry R&D Intensity	-7.468754***	-7.303797***	-7.468754***
	(1.130351)	(1.267343)	(1.130351)
Industry Growth	.1313186***	.134705***	.1313186***
	(.0365903)	(.0407411)	(.0365903)
Agriculture	.0200084	.0978005	.0200084
	(.1063417)	(.1759212)	(.1063417)

Conglomerates	.52303***	.58273***	.52303***
	(.1097445)	(.1692137)	(.1097445)
Construction / Real Estate	.399554***	.4787089***	.399554***
	(.1019844)	(.1743903)	(.1019844)
Consumer Goods	-.0488195	-.0223192	-.0488195
	(.0381838)	(.1111189)	(.0381838)
Healthcare	-.0049042	.0618211	-.0049042
	(.0762175)	(.1498822)	(.0762175)
ICT	.387663***	.4463185***	.387663***
	(.0993539)	(.1609862)	(.0993539)
Industrial Goods	.1242208	.1882245	.1242208
	(.0819888)	(.152957)	(.0819888)
Natural Resources	.3020014***	.3822843**	.3020014***
	(.107338)	(.1774658)	(.107338)
Oil & Gas	.1923437***	.2359302*	.1923437***
	(.0593919)	(.1277818)	(.0593919)
Intercept	.5600009***	.6265998***	.5600009***
	(.0859285)	(.1410857)	(.0859285)
F-test (Model)	26.30***	2.39***	341.95***
DF	556	452	452
R^2	0.3808	0.3818	
SSE (SRMSE)	11.3842736	11.3657983	
SEE or $\hat{\sigma}_v$	.14309	.15857	.15857355
$\hat{\sigma}_u$			0
θ			0
Effect Test		1.912***	0.00
N	570	570	570

Standard errors in parenthesis; Statistical significance: *<.1, **<0.05, ***<0.01

APPENDIX D

Effects of Firm-Level Factors on Firm Investment Opportunities

Firm Investment Opportunities	Pooled OLS	Fixed Effect Model	Random Effect Model
Relative Market Share	.0324561 (.3356771)	-2.550143 (2.475072)	-.1707618 (.5289756)
Size	-.3624685** (.1533225)	-.7068315 (.9168592)	-.2930279 (.2365204)
Diversification	-.1089669 (.3004971)	-.0887363 (.8322003)	-.0477547 (.4318593)
Financial Leverage	8.749784*** (1.886845)	-1.627735 (2.84365)	4.414403** (2.205629)
Age	-.0191604 (.0121419)	.2425453 (.1532452)	-.0236258 (.0189898)
Firm Capital Intensity			
Firm R&D Intensity			
Firm Growth Rate	.2463708 (.5264526)	-1.154127** (.4790886)	-.7592114 (.4613143)
Intercept	10.13029*** (3.363504)	47.47046*** (17.47133)	9.208647* (5.2111)
F-test /Wald (Model)	6.07***	4.84***	11.60*
DF	563	450	450
R^2	0.0608	0.5611	
SSE (SRMSE)	20035.2801	9361.72462	
SEE or $\hat{\sigma}_v$	5.9655	4.5611	4.5611218
$\hat{\sigma}_u$			3.7223643
θ			.51943926
Effect Test		4.540***	166.57***
N	570	570	570

Standard errors in parenthesis; Statistical significance: *<.1, **<0.05, ***<0.01

APPENDIX E

Effects of Firm-Level Factors on Firm Strategic Flexibility

Firm Strategic Flexibility	Pooled OLS	Fixed Effect Model	Random Effect Model
Relative Market Share	-.2753587 (.5909961)	1.108578 (5.690729)	-.2746283 (.5988033)
Size	-.0647124 (.2710303)	-3.692612* (2.106391)	-.0675633 (.2745228)
Diversification	.5241495 (.541524)	2.81939 (1.909238)	.5296661 (.5480072)
Financial Leverage	-3.31641 (3.378994)	-1.76802 (6.526263)	-3.281594 (3.407113)
Age	-.0297649 (.0221298)	.4361 (.3530475)	-.029783 (.0224134)
Firm Capital Intensity	.0167003 (.0739777)	-.0097455 (.1081631)	.0162695 (.0743602)
Firm R&D Intensity	-5.743407 (9.054306)	-3.366221 (25.53471)	-5.733306 (9.156332)
Firm Growth Rate	-.4673924 (.9247908)	-.2882914 (1.110546)	-.4673049 (.9260549)
Intercept	2.961322 (5.955253)	61.98228 (40.42726)	3.016011 (6.032182)
F-test /Wald (Model)	0.38	0.96	2.94
DF	561	448	448
R^2	0.0053	0.2067	
SSE (SRMSE)	61503.7001	49053.1566	
SEE or $\hat{\sigma}_v$	10.471	10.464	10.463922
$\hat{\sigma}_u$			.8598457
Θ			.01646501
Effect Test		1.006	0.07
N	570	570	570

Standard errors in parenthesis; Statistical significance: *<.1, **<0.05, ***<0.01

APPENDIX F

Effects of Firm-Level Factors on Firm Operational Flexibility

Firm Operational Flexibility	Pooled OLS	Fixed Effect Model	Random Effect Model
Relative Market Share	-.0352784 (.0324981)	.0473535 (.2922906)	-.0334956 (.0405763)
Size	.0569037*** (.0149036)	.0997664 (.1081897)	.0563794*** (.0184771)
Diversification	-.0224887 (.0297777)	-.0652475 (.0980634)	-.0245971 (.0361268)
Financial Leverage	-.2485665 (.1858064)	-.1627156 (.3352058)	-.2424726 (.2090944)
Age	-.0025639** (.0012169)	-.0297756 (.0181334)	-.0026229* (.0015072)
Firm Capital Intensity	.0023378 (.0040679)	.0005279 (.0055555)	.0015478 (.0043147)
Firm R&D Intensity	-.1194449 (.4978843)	-.209449 (1.311529)	-.1359958 (.594463)
Firm Growth Rate	.1007746** (.050853)	.1028587* (.0570405)	.1056483** (.0506177)
Intercept	-.8353835** (.3274714)	-1.126223 (2.076449)	-.8178441** (.4063074)
F-test /Wald (Model)	3.14***	1.86***	18.26**
DF	561	448	448
R^2	0.0428	0.3340	
SSE (SRMSE)	185.972085	129.407959	
SEE or $\hat{\sigma}_v$	.57576	.53745	.53745423
$\hat{\sigma}_u$			.21886181
θ			.26060463
Effect Test		1.733***	17.52***
N	570	570	570

Standard errors in parenthesis; Statistical significance: *<.1, **<0.05, ***<0.01