Hard Resource Enhancement – Assessing Impact on Market Performance of Firms

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*Practitioners and academicians have lent credibility to frameworks such as the VRIO (**V**aluable, **R**are, Difficult to **I**mitate and **O**rganized to capture value) by observing industry practices. However, the paper observes that the hard resource additions by way of technology investments by firms is viewed favorably by the markets. Fewer papers address the reasons behind firms' rationale for investing in competency generating assets. Based on secondary data, the study utilizes a Data Envelopment Analysis (DEA) technique to compare performance of firms using relevant inputs and outputs. The findings are enhanced through other empirical tools that strengthen and reinforce the derived constructs.*

Keywords: Hard Resource Additions, Technology Investments, Resource Based View, Market Performance, Data Envelopment Analysis

1. Introduction

Our interest has been directed towards understanding market performance of firms - a basic question serves as a starting point: How are firms able to generate and deliver value? The fundamental question has several possible responses based on studies. For instance, firms may use size and age as fulcrums to communicate value (Clarysse, et al., 2014; Arkolakis, et al., 2018); firms may rely on business networks built over years of toil (Li & Zhou, 2010; Zhang, et al., 2015); firms may depend on innovation to drive growth (Mansfield, 1962; Stuart, 2000; Guarascio &Tamagni, 2019) besides relying on a combination of the factors to deliver value to customers across markets. A different, yet closely related question that has often confounded academicians and industry executives alike is the mixture of tangible and intangible assets leading to superior firm performance. Firms that chose to deliver value through intangibles emphasized services as the revenue driver in their corporate strategy. Services seems to be the new buzz word: evidence from large conglomerates like IBM who chose the tough route to growth by focusing on consultancy services as the value driver (Sawhney et al., 2003) for the new century is quite substantial. In striking contrast, we also have giant firms that have built substantial assets on their way to sustained market dominance – for instance, Shell, Exxon Mobil and Wal-mart which have reinforced their global superiority (Anderson, 2008) through continuous investments in tangible assets besides deploying their valuable and rare competencies in a competitive marketplace.

A particular point of concern for industries is the efficiencies that can be generated from a finite resource base- wherein the inputs available to different firms in the industry remain the same; hence what are the means through which some firms distinguish themselves from others? Practitioners may be interested to understand, for instance how Apple Inc is able to differentiate itself from Research in Motion Inc (Hicks, 2012), the firm which sold the erstwhile Blackberry handsets. Was it the result of not being foresighted enough? Was it an inability to understand the forces of platform driven competencies – for instance, Android, iOS or was it the key functionality of internet browsing capability (West & Mace, 2010) or was it a mixture of other firm-intrinsic factors? Academic research has also attempted to understand how firms are able to operate on the frontier given a mix of key inputs. Therefore, our paper provides a unique contribution in the sense that efficiency measures and methods are used in juxtaposition with traditional multivariate techniques such as regression to provide a two dimensional view of the performance measures of firms. So far, while most traditional research attempts to use any one of the methods, we find that studies undertaken by Gong, Liu and Zhu (2019) use Data Envelopment Analysis (DEA) and hierarchical regression with each empirical approach explaining a set of different research questions. Hence, our paper utilizes the learnings therein and has used similar structures to explain the performance of firms, considering different contexts, mixture of input and output metrics.

2. Literature Review

While Andrews (1971) framed a traditional perspective of strategy in terms of resource position of the firm, most of the economic analysis focused on the product-market side. Werner felt (1984) observed that firms often utilized a mix of existing resources and newer forms in their quest to grow their businesses. Subsequently, Barney (1991) stressed the exploitation of resources leading to competitive advantage for firms. Our paper seeks to develop a better understanding of the resource levers, especially the hard resources and how they may lead to competitive advantage for firms; the empirical analysis strongly supports the stance that resource-led strategy results in sustained competitive advantage for firms. Early scholars looked at the Resource Based View (RBV) through multi-dimensional lenses such as a multi-faceted posture that could comfortably embed itself in industrial economics, strategy and diversification literature (Mahoney & Pandian, 1992), a mixture of idiosyncratic resources influencing firm results (Lado, et al., 1992; Konner, 1991), dynamics of firms that prevail

over longer horizons (Hopenhayn, 1992), the role of complementarity leading to unique resource position and value (Schmidt &Keil, 2013; Makadok, 2001) and innovative use of resources leading to competitive advantage (Park et al., 2004)

The acquisition of various types of assets by a firm is viewed as a signaling mechanism to competitors (Batsakis et al., 2018; Weale & Wieladek, 2016) in the marketplace; in some cases, the intangibles such as knowledge may be communicated tacitly (Ndofor & Levitas, 2004) to the industry. Within the larger umbrella of assets, firms often focus on those assets that leverage the technological advancements in a particular industry; for instance, firms in the manufacturing of heavy machinery may acquire technology assets such as advanced CNC machines that would give them an edge in the production part of the overall value chain. Studies have observed that such additions in the technology infrastructure benefit firms (Bernat & Karabag, 2019; Mitra et al., 2019; Tassey, 1991). Our study reinforces the insights and learnings gained by earlier research; the technology infrastructure investments are perceived in a positive frame of light by the investors.

Considering that competition across industries has intensified and a few large firms account for a disproportionately high market share, the others have to showcase their performance not only to appease the C-Suite executives and promoters, but also to satisfy and delight the larger stakeholder community of investors, society and shareholders. Here, we find that recent research has identified a host of factors such as crowd sourcing (Cappa et al., 2019; Xu et al., 2015), corporate governance (Ciftci, et al., 2019), leveraging internationalization experience and technology (Wu et al., 2019; Todd & Javalgi, 2006) influencing firm performance. Research has in sum identified a host of factors both intrinsic and extrinsic to the firm and assessed their impact on performance. From industry practice, we find that emerging markets are on the radar since they have maximum potential to perform in the midst of stiff competition (Schwartz and Saltmarsh, 2009). Extending the argument to include an example from India, we find that a barometer of the Indian economy, the Sensex has been noticed (Dunkley, 2018) as being an outperformer compared to other emerging markets. Therefore, our paper has attempted to understand the reasons and rationale behind the performance of firms; clearly the stock market performance is dependent on prevailing sentiments which in turn is influenced by sustained profit growth of firms.

While considering firms' sustainable competitive advantage, we can observe the need for comparing the efficiency of firms operating within an industry. The reasoning stems from the fact that firms need to deliver value, considering a combination of inputs (Ulaga & Reinartz, 2011; Fawcett & Fawcett, 1995). The combination, as understood from practice and academic research focuses on the firms as entities involved in value creation (Stabell & Fjeldstad, 1998; Bowman & Ambrosini, 2010), catering to customers, both institutional and retail – each differing in nature of their expectations. While one part of our paper understands the inputs from the perspective of impact on performance, the second part of the paper supports the analysis of the first part through the use of operational measures evident from using methods dominant in the field of operations research. From the literature in operations and operations research, we find that the DEA method that draws upon concepts of linear programming offers scope to identify the efficient frontier (Rezaeiani & Foroughi, 2018) considering that firms use multiple inputs and generate multiple outputs, judiciously utilizing finite set of resources (Coad, 2007) available to them.

3. Research Questions and Data

Our study focuses on understanding the performance of firms wherein multiple output measures are used while inputs are also multiple in nature. Hence it leads us to frame a research question that can help identify efficient frontier of performance, considering a smaller subset from a larger array of firms. In this context, we may frame the first research question thus:

R1: How can we empirically understand the role of resources of multiple kinds on outputs that are predominantly determined by the market – market comprising of several stakeholders, predominantly, the investor community?

Secondly, we also need to understand the effect of hard resource enhancements of two kinds on the market performance of firms. Hence, this leads us to frame the resource question thus

R2: What is the influence of resource enhancements – both quantum and nature on the market performance of firms? Can this be empirically assessed?

3.1 Sample Selection

With a view to answering R1, we adopt the DEA approach whereby we utilize a sample of firms belonging to the same industry. The database under consideration is PROWESS managed by CMIE that tracks and maintains record of annual performance of firms, including fine grained details relating to balance sheet, profit and loss accounts; it also provides for deep dive analysis that may be required to cull out specific data slices.

We begin by taking the universe of firms (about 5400 in number) listed on the Bombay Stock Exchange (BSE). Subsequently, we remove firms that are less than INR 10 billion in size. This yields a sample of 586 firms. Removing firms that have data missing on Price to Earnings ratio and Price to Book value, we arrive at the sample size of 417. We find that the pharmaceutical industry has 31 firms which we consider for the purpose of DEA

To answer R2, we proceed to logically arrive at three hypotheses which would then be empirically tested. The resource enhancement of firms is viewed by the market in a positive frame of light; hence, we posit that this would influence the performance of firms. Hence, considering the impact of decisions that add to tangible assets for the firm, we state our hypothesis

R2H$_{1a}$Tangible Resource bases of Firms have a Positive Influence on their Market Performance

Extending the line of thinking, we have also observed that firms that invest in support infrastructure such as machinery and factory assets of diverse sorts are also signals seen by the stakeholders – investors, shareholders and the community.

However, research has often thrown up mixed results in terms of the nature of the relationship. In the modern economy, investors view such resource additions with a dose of skepticism, since the expectation is that firms should be able to generate value from existing resource base in addition to providing services such as consulting which finds greater acceptance from stakeholders; consequently, this leads us to frame the second hypothesis thus

R2H$_{1b}$ Additions to the Tangible Resource base of firms is Negatively Linked to their Market Performance

While considering the consistency of resource additions that are more in line with recent advancements in technology, most investors introspect and ascribe greater value to firms that have been consistent in such investments. Such investments are also more likely to aid in the adoption of industry 4.0 since the call of industry is to adopt digital interfaces, use algorithms that enable artificial intelligence; in short, hardware and software that enables leveraging of such support resources for organizational gain and competitive outlook, in addition to traditional plant and machinery is viewed positively leading the framing of the next hypothesis thus

R2H$_{1c}$ Consistency of Resource Additions, Especially Relating to the Information Technology Domain has a Positive Influence on the Firms' Performance.

3.2 Variables

To develop answers to R1, we adopt the sub sample of20 firms from the Drugs and Pharmaceutical industry. Here the input variables are 1) Resource Base – referring to the net value of plant and machinery that is owned by firms, 2) Resource base enhancement referring to the additions. Output variables are 1) Profit After Tax (PAT) – an accounting metric that reflects the performance of firms and 2) Price-Earning multiple – a market based measure that reflects sentiments of the business environment; effectively the stakeholders determine this index.

Our research defines variables relevant for answering R2: Here we define the dependent variable that reflects the market performance of firms. Dependent variable chosen is Price-Earning multiple (abbreviated as P_E), a ratio that reflects the market based measure. This metric is taken at the end of the fiscal year 2017. Independent variables taken up reflect the tangible resources. To represent the resource base, we utilize the data relating to the Plant and Machinery relevant for the year 2017; this is computed as the ratio of Plant and Machinery to the Profit After Tax for the year, following relevant research literature in this domain; representative variable is termed RES_PATRATIO. Additions or resource enhancements is represented as the net additions during the year, which is termed RESADDIT_PATRATIO. Consistency of deployment of resources directed towards procurement of hard resources, infrastructure related to computers and information technology is taken as 1, if a firm has invested consistently across the previous three years leading to Year 2017; zero otherwise. The representative notation adopted is IT_INFRA_DATA. Control variables taken up are age and size of firms. To depict size (SIZE), we take the sales of the firm for the year 2017. AGE is calculated from the inception year of the firm till the year 2017.

4. Methods and Analysis

4.1 Data Envelopment Analysis

DEA has been used in recent research with a view to analyze performance, strategic orientation (Staessens et al., 2018), assessing efficiency of firms (Hatami-Marbini, 2018) and to understand impact of regulatory practices on reporting practices of firm efficiency (Bhatia &Tripathy, 2018). The studies have been featured in journals that stress operations research concepts primarily because the technique involves application of linear programming concepts at the background.

Table 1 *Input oriented VRS Efficiency*

DMU No.	DMU Name	Input-Oriented VRS Efficiency	Optimal Lambdas with Benchmarks			
1	Aarti Drugs Ltd.	0.17883	1.000	Abbott India Ltd.		
2	Abbott India Ltd.	1.00000	1.000	Abbott India Ltd.		
3	Ajanta Pharma Ltd.	0.96780	0.880	Abbott India Ltd.	0.120	DMU 15
4	Alembic Pharmaceuticals Ltd.	0.28813	0.917	Abbott India Ltd.	0.083	DMU 15
5	Alkem Laboratories Ltd.	0.54900	0.627	Abbott India Ltd.	0.049	DMU 14
6	Aurobindo Pharma Ltd.	0.34273	0.080	Abbott India Ltd.	0.158	DMU 14
7	Biocon Ltd.	0.36392	0.631	Abbott India Ltd.	0.246	DMU 14
8	Cadila Healthcare Ltd.	1.00000	1.000	Cadila Health C		
9	Cipla Ltd.	0.17845	0.376	Abbott India Ltd.	0.258	DMU 14
10	Divi'S Laboratories Ltd.	0.61943	0.583	Abbott India Ltd.	0.417	DMU 15

For our study, DEA has been used to understand the performance of firms in a small cluster; identify firm(s) which operate at the highest efficiency possible and also help compare the laggards. Since the sample size of 10 is drawn from the same industry, it is easier to justify the comparison and understand learnings.

Following Zhu (2014), we adopt the Variable Returns to Scale (VRS) model from DEA, since the relationship between the input variables chosen and the output may not follow linear patterns and prior research has reported lack of conclusive evidence. On the output side, since the measures are market driven, several combination of inputs may not necessarily lead to a linear impact on the output variable (in our case, Price-earningratio). The results of the DEA – relating to the efficiency measurement, using the DEA Frontier Excel Add-In, and VRS assumption are given in Table 1

From Table 1, we can observe that the Decision Making Units (DMU) Aarti Drugs, Abbott, GlaxoSmithKline, Glen mark are operating at the highest efficiency compared to the other firms. Also the corresponding λ (Lambda) values indicated helps us compare the relative performance of a DMU against a counterpart.

Table 2 gives the slack of the inefficient firms. This indicates that, for instance, the DMU 5 Alkem Laboratories has a resource addition slack of 489, representing inefficiencies in the process of conversion of inputs into outputs; this has to be viewed in terms of how firms perform-both from an accountant's perspective and from the stock market's perspective.

Table 2 *Slack – Input and Output Parameters*

DMU No.	DMU Name	Input Slacks *RESOURCE BASE*	RESOURCE ADDITION	Output Slacks PAT	P_E
1	Aarti Drugs Ltd.	189	0	2012	17
2	Abbott India Ltd.	0	0	0	0
3	Ajanta Pharma Ltd.	0	360	0	2
4	Alembic Pharmaceuticals Ltd.	0	63	0	7
5	Alkem Laboratories Ltd.	0	489	0	0
6	Aurobindo Pharma Ltd.	0	816	0	0
7	Biocon Ltd.	52	0	0	0
8	Cadila Healthcare Ltd.	0	0	0	0
9	Cipla Ltd.	0	323	0	0
10	Divi'S Laboratories Ltd.	2030	0	0	10

4.2 OLS Regression

To answer R2, we use regression analysis wherein the dependent variable is the firm's market performance as represented by the Price-Earnings ratio

The descriptive statistics and correlations are available in Table 3. Subsequently, the multivariate technique of regression yields key data that are captured in Table 4. The F-value is 21.16, significant at the 1% confidence level. The value of R^2 is 0.204 indicating that 20.4% of the variation in the market measure (Price-Earning ratio) is explained by the variation in the independent variables. For strategy studies, we find that such explanatory power is a common occurrence in several research papers.

Table 3 *Descriptive Statistics, Correlations*

Descriptive Statistics	Mean	Std. Deviation	(1)	(2)	(3)	(4)	(5)	(6)
(1) P_E	33.5367	33.68	1.00	0.42	0.21	0.08	0.10	-0.07
(2) Res_Patratio	4.29	7.91		1.00	0.68	0.02	0.04	-0.01
(3) Resaddit_Patratio	0.66	1.13			1.00	0.05	-0.04	0.00
(4) It_Infra_Data	0.44	0.49				1.00	-0.27	-0.08
(5) Age	41.94	21.71					1.00	-0.09
(6) Sales	94411	360983						1.00

Table 4 *Regression Output*

VARIABLE	B	Std. Error	Beta	t	p value
(Constant)	17.345	4		4.336	0.000
Res_Patratio***	2.103	0.256	0.494	8.213	0.000
Resaddit_Patratio**	-3.629	1.789	-0.122	-2.033	0.042
It_Infra_Data**	7.009	3.106	0.103	2.257	0.024
Age**	0.168	0.071	0.108	2.355	0.018
Sales	-6.091	0	-0.062	-1.474	0.141

Based on the output represented in Table 4, we make certain inferences. Firstly, resource base of firms has a positive influence on firm performance, supporting R2H$_{1a}$. Secondly, the ratio of resource addition to profit after tax also has a significant influence on the firm performance; however, the sign is negative, which is along expected lines, supporting R2H$_{1b}$. Thirdly, the consistency of addition of IT infrastructure has also been found to positively influence firm performance, supporting R2H$_{1c}$

5.   Conclusions

The study has thrown up some interesting findings. Firstly, DEA analysis has helped us to identify firms that could serve as benchmarks in a particular sector. In the pharmaceutical space, the analysis helps provide benchmarks for efficiency and utilization of resources. For firms which are not leading on key metrics, it serves as cues to work on improving their efficiencies by way of targeting the resource base, lending credence to theories espoused by Barney (1991).

Secondly, we find that market performance of firms is influenced in a significant way by the resource intensity. With greater emphasis on resource additions, investors and stock markets place a premium on such firms. In terms of addition of resources, firms do not view it positively since our regression indicated a negative sign. However, addition of technology infrastructure by way of expenditure on hardware and software is viewed positively by the markets, indicating the importance of technology as an enabler and accelerator (Tsui & Malhotra, 2005) of firm performance.

Thirdly, the findings hold greater promise for further fine grained research in this domain. Growth of firms, performance of firms and perception created in the marketplace continue to hold points of interest not only for corporate chieftains, but also for academicians and aspiring managers. Hence, more longitudinal studies in this domain are likely to enhance our understanding of firms' performance, especially in a tough business environment. Moreover, studies that rely upon a multiplicity of methods are likely to find

6.   References

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