IMPLICATIONS OF RESEARCH AND DEVELOPMENT ON BUSINESS PERFORMANCE: EVIDENCE FROM FIRM'S SURVEY IN UTTAR PRADESH, INDIA

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ABSTRACT

The key objective of this study is to analyse the implications of research and development on the performance of business sector in Uttar Pradesh, India, based a comprehensive survey of 525 firms operating in the state and conducted under the World Bank's Enterprise Survey, 2014. The survey contained information on a variety of enterprise characteristics such as location, size of firms, type of firms, age and gender of ownership and business performance indicators such as cost of production, employment generation and output. To understand the difference in business performance, the surveyed business firms have been categorized into two groups (i) firms with formal research and development expenditure and (ii) firms without formal research and development expenditure. Simple statistical tools such as descriptive statistics and t-test have been used to analyse the data using Statistical Package for the Social Sciences (SPSS) version 20.0. Empirical evidences clearly indicate that there has been positive relationship between firm's performance and research and development investment across industries and countries. Out of the total 525 firms surveyed under the World Bank's Enterprise Survey, about 40 percent have reported investment in formal research and development and collaboration with academic institutions. Results of chi-square and t-test indicate a significant difference in business performance across R&D firms versus non-R&D firms. This study provides insight in designing policies for promoting research and development activities and their implications in business enterprises in a focused manner.

Keywords*: business performance, research and development, comprehension survey.*

Introduction:

Uttar Pradesh in one of the important states of the country, contributing about 8 percent to the national gross domestic product (GDP) and 16.4 percent to the country's population. It is one of the fastest growing states with annual growth of more than 9 percent in the state gross domestic product (SGDP) with industrial growth target of 11.2 percent during the 12th Five Year Plan (2012-17). Research and development is the key for bringing innovation in the production process and achieving organizational efficiency and effectiveness, particularly in highly technology-based industry (Eng and Shackell, 2001; Le et al., 2006; Fortune and Shelton, 2012; Lu and Karpova, 2012; Swift, 2013). Belderbos et al. (2004) emphasized on the importance of the customers and universities as important sources of knowledge for firms pursuing radical innovations. India is considered as the intellectual capital for most of the leading

multinational corporations due to availability of conducive research ecosystem. The government has been taking several steps over the years for promoting R&D sector in the country by adding a number of technical management institutions of national importance.

Several empirical studies have analyzed the implication of research and development on a firm's growth and performance (Aiello and Cardamone, 2008; Ming-Liang et al., 2010; Arvanitis, 2012; Falk, 2012; Warusawitharana, 2015). Vithessonthi and Racela (2016) argued that investment for building knowledge and capacity through enhanced research and development is likely to have positive impact on the firm's performance in the long-run, but normally impacts negatively in the short-run. Chen et al. (2013) examined the spillover effect of research and development (R&D) on the firms' long-run performance. Sharma (2012) analyzed that R&D intensity has a positive and significant effect on total factor productivity growth of the firms. However, Fortune and Shelton (2012) argued that impact of research and development on firm's outcome indicates mixed results. In the era of strengthening domestic manufacturing and promoting the Make-in-India campaign, it becomes imperative to enhance the research and development in the industrial sector for rapid growth and performance.

Objectives of the Study:

This study aims at analyzing the implications of spending on formal research and development on firms' performance in the state of Uttar Pradesh, India. Followings are the specific objectives of the study:

1. To analyse the difference in profiles of business enterprises across spending and non-spending on formal research and development in Uttar Pradesh
2. Analyze the difference in business performance of firms across spending and non-spending on formal research and development in Uttar Pradesh

Data and Methods:

Data Sources:

This study is based on the World Bank's Enterprise Survey of 525 firms operating in the state of Uttar Pradesh in 2014. The survey data of Uttar Pradesh has been extracted from a large survey conducted by the World Bank across 27 states of the country covering various aspects of enterprise operations. Based on the requirement of the study, two sets of variables have been identified for further analysis i.e. enterprise characteristics such as age, size of firms, type of firms and locations; and business performance indicators such as cost of production, employment generation and output. The surveyed business firms have been categorized into two groups (i) firms with formal research and development spending and (ii) firms without formal research and development spending.

Data Analysis:

Simple statistical tools such as descriptive statistics, chi-square test and t-test have been used to analyse the data using Statistical Package for the Social Sciences (SPSS) version 20.0. Chi-square test has been used to analyse the difference in business enterprises across spending and non-spending on formal research and development in Uttar Pradesh. Similarly, independent sample t-test has been used to analyze the difference in business performance of firms across spending and non-spending on formal research and development in Uttar Pradesh in terms of cost of production, employment generation and output.

Results and Discussion:

Firm's Characteristics by Spending on Formal Research and Development:

Table 1 provides difference in profile of firms across spending and non-spending on research and development. In terms of location of the business firms, organizations spending on research and development are located in bigger cities as compared to firms with no spending on research and development. Spending on research and development is directly related to the size of the firm. The result of chi-square test clearly indicates that there is significant difference in the spending and non-spending on research and development by the size of the firms. Majority of research and development firms belong to medium and large categories while firms with no spending on research and development primarily belong to small category. As far as the type of firms is concerned, limited companies and partnership firms are comparatively spending more on research and development, whereas majority of the sole proprietorship firms have not been found to spend on research and development.

Analysis indicates that there is an inverse relationship between age of the firm and the spending on research and development. Firms with comparatively lesser age are reported to be spending more on research and developmental activities, which decreases with the increase in the age of the firm. Results of chi-square test indicate a significant difference in distribution of firms by age and spending on research and development. Gender has a significant role in spending on research and development. Analysis indicates that a firm with female top manager tends to spend more on research and development as compared to their male counterparts. Similarly, a firm with female as an owner also reported more spending on research and development. The overall analysis indicate that there is a significant difference in the

profiles of organizations spending and not spending on research and development.

Difference in business performance by Spending on Research and Development:

The performance of business firms has been analyzed in terms of cost of production, employment generation and output. Table 2 provides result on difference in business performance by spending/ non-spending on research and development. Results of the analysis show that there is no significant difference in terms of various costs of production such as labour cost, cost of raw material, fuel and electricity charges, and rent. A closer look on average cost of production per unit indicates that R&D firms are spending more on various costs of production except raw material.

As far as employment is concerned, firms with spending on research and development are significantly employing permanent manpower, whereas firms with no spending on research and development have reported employing comparatively more of temporary manpower. Output has been measured in terms of annual sales turnover and capacity utilization of the firm. Sales turnover per unit of firms with spending on research and development is higher than of those with no spending. However, this is not significantly different between the firms by research and development expenditure. In terms of capacity utilization, firms with spending on research and development have reported the capacity utilization to the extent of 78 percent on an average, whereas firms with no spending are utilizing 82 percent of their capacity. Overall, there is no implication of research and development on firm's performance in terms of cost of production and output. However, firms spending on research and development have potential to create more employment than firms with no spending on research and development.

Conclusion and Managerial Implications:

A sustainable performance of business sector is the key in the process of growth and development of a state/country. Uttar Pradesh plays an important role in contributing towards the social, political, and economic environment of the country. The state of Uttar Pradesh contributes about 8 percent to the national gross domestic product (GDP) and 16.4 percent to the workforce in the country. The governments at the national and state levels have shown concerns on promoting R&D for developing business enterprises by adding a number of technical and management institutions. Besides, business firms also consider research and development as an important initiative in bringing innovation in the production process and achieving organizational efficiency and effectiveness. This study provides difference in profile of business enterprises and business performance by spending and non-spending on research and development. Analysis of chi-square test clearly indicates that there is significant difference in the profiles of organizations with spending and non-spending on research and development in term of location, size of firms, type of firms, age and gender of ownership.

Analysis of difference in business performance indicates that there is no implication of research and development on firm's performance in terms of cost of production and output. However, firms with spending on research and development has comparatively more potential for employment generation. This study provides policy prescription for promoting research and development activities and its implications for performance of business enterprises as per the needs of the organizations.

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Table 1: Firm's characteristics by spending on R&D

Characteristics	R&D Firms (N=209)		Non-R&D Firms (N=316)		Chi square	df	p
	N	%	N	%			
Locality size of the firms					23.179**	3	.000
City with population over 1 million	77	36.8	108	34.2			
Over 250.000 to 1 million	77	36.8	161	50.9			
50.000 to 250.000	54	25.8	38	12.0			
Less than 50.000	1	0.5	9	2.8			
Size of the firms					35.583**	2	.000
Small >=5 and <=19	53	25.4	159	50.3			
Medium >=20 and <=99	95	45.5	110	34.8			
Large >=100	61	29.2	47	14.9			
Type of firm					11.616**	3	.009
Limited Company	33	15.8	41	13.0			
Sole Proprietorship	64	30.6	138	43.7			
Partnership	112	53.6	134	42.4			
Others	0	0.0	3	0.9			
Age of firms					21.184**	3	.000
<10 years	81	39.1	68	21.6			
10-20 years	58	28.0	96	30.5			
21-30 years	43	20.8	86	27.3			
> 30 years	25	12.1	65	20.6			
Is the Top Manager Female?					32.933**	1	.000
Yes	33	15.8	7	2.2			
No	176	84.2	309	97.8			
Amongst the owners of the firm, are there any females					13.469**	1	.000
Yes	35	16.7	21	6.6			
No	174	83.3	295	93.4			

**significant at 0.01 level, *significant at 0.05 level

Table 2: Difference in business performance by spending on R&D

Business Performance Indicators	R&D Firms		Non-R&D Firms		t	df	Sig.
	N	Mean	N	Mean			
Cost of production (Rs. in lakhs)							
Total Labour Cost (Incl. Wages, Salaries, Bonuses, Etc)	209	197.3	316	125.0	1.422	523	.156
Cost of Raw Materials and Intermediate Goods	163	952.3	219	1498.9	-.617	380	.538
Total Annual Costs of Fuel	163	36.5	219	13.6	1.226	380	.221
Total Annual Costs of Electricity	209	35.6	316	35.0	.050	523	.960
Total Rental cost of land, buildings machinery, vehicles and equipment	163	8.1	219	5.8	.492	380	.623
Employment							
Number of permanent employees	209	151.6	316	70.3	2.513*	523	.012
Number of Temporary Employees	209	1.9	316	14.1	-4.941**	523	.000
Output							
Total Annual Sales (Rs. in lakhs)	209	4560.6	316	2252.4	1.167	523	.244
Capacity Utilization (%)	163	78.2	219	81.6	-1.539	380	.125

**significant at 0.01 level, * significant at 0.05 level

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