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International Trade and R&D Investments of Multinational Firms.

S.Felix Sophia[1], and Dr.J.Gayathri[2],
[1]*Ph.D. Research Scholar, Department of Commerce and Financial Studies, Bharathidasan University.Tiruchirapalli-620024, India. E-Mail: sophiambamphil@gmail.com, Mobile: 9500637757*
[2]*Assistant Professor, Department Of Commerce and Financial Studies, Bharathidasan University, Tiruchirapalli- 620024, India.*

Abstract: *R&D activity helps to develop firm's capability, enhancing its ability to learn new technologies and to match technological possibilities which sustain its market position. This paper investigates the effect of international trade on firms' R&D investment. The objective of the study is to understand the role of Research and Development investments on the International Trade performance of the sample firms. Data for the study was collected from CMIE Prowess Database for the period of 10 years from 2008-2017. The statistical tools namely Correlation, Regression and Granger Causality were used for the study. The study revealed that variables Export Intensity and Technology Import Intensity alone had their impact on the Research and Development investments of the sample firms during the study period.*

Keywords: *International Trade, Multinational firms, Research and Development Investments, Correlation, Regression and Granger Causality.*

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I. Introduction

It is widely acknowledged that innovative firms can maintain an advantage in a competitive market by minimizing their production costs through their active Research and Development (R&D) practice enabling them to maintain larger market share and gain higher profits. R&D activity helps to develop firm's capability, enhancing its ability to learn new technologies and to match technological possibilities which sustain its market position. It also creates new technologies, products, and solutions designed to satisfy customer needs that are not easily imitated by competitors and hence gain competitive advantages. In modern industrial world, firms' investment in R&D is an important source of technological progress. Investment in R&D is required not only for introducing innovations, but also for adapting and absorbing technology from outside sources. Further, policy makers are usually told that with the liberalisation of trade, firms would have no choice but to modernise their techniques and cut their costs in order to compete with the foreign producers. International trade can affect firms' R&D investment through a number of channels and these include import competition, export and technology import. Export allows firms to produce on a large scale and thereby exploit increasing returns to scale, made possible by fixed investments like R&D. Since export market usually consists of several segmented markets and each sub-market varies from others in terms of consumers' preferences, entry barriers and elasticities, the likelihood that R&D will increase demand in some of these markets is higher than that in the domestic market. Secondly, if R&D is leading to product differentiation or the development of a new product, likely to be preferred by a small group of consumers, then export enables the firm to realise economies of scale in the production of this differentiated commodity. In this case, export possibilities allow the firm to make required R&D investment. In an open trade policy regime, firms can import foreign technology. This can be either in the form of capital goods embodying recent technology or in disembodied form such as blue prints and designs. Since most technologies consist of certain portion of tacit knowledge, absorption of imported technology requires some technological capability on the part of the firm and it can take the form of in-house R&D effort. Likewise, imported plants and machinery may also require adaptations and modifications to suit local conditions, raw materials and usage pattern, making some investment in in-house R&D necessary.

II. Review Of Literature

TakehikoIsobe, Shige Makino and David B. Montgomery (2000) examined whether early movers and technology leaders attained superior performance in emerging economic regions. The study found that both high commitment and early entry had positive impacts on the perceived economic performance of the Joint Ventures. **Toby E. Stuart (2000)** investigated the relationship between intercorporate technology alliances and firm performance. The study found that organizations with large and innovative alliance partners perform

better than firms that lack such partners. The findings also demonstrate that young and small firms are benefited more from large and innovative strategic alliance partners than old and large organizations. **Ulf Andersson et.al. (2001)** found that a positive, direct, impact on subsidiary market performance has been created by technology embeddedness and brings about indirect impact on the subsidiaries organizational performance.**Anthony Goren and Paul W. Beamish (2003)**, through an internalization theory, suggested that the traditional concept of geographic scope should be split into two related, but more precise, elements of international asset dispersion and country environment diversity. Subsequently, relationship between economic performance and international asset dispersion is positive, but that country environment diversity is negatively associated with performance, with a positive interaction between them. **SaradinduBhaduri& Amit S. Ray (2004)** analysed how Technological Capability augments export competitiveness of Less Developed Countries enterprises by introducing quantifiable concepts of technological capability and estimating econometric models of firm-level export performance for two R&D-intensive industries in India, Pharmaceuticals and Electronics/Electricals. **Natasha I.E. and Yanthi R.I. Hutagaol (2009)**examined the relationship between R&D with firm'soperation and market performance. The findings of the study indicate that all sample firms have reported their R&D activities accordingly tothe applied accounting standard. However, the hypothesis testing results shows that there isno relationship between R&D and firm's operation and market performance. **Savita Bhat & K. Narayanan (2009)** examined the role of technological efforts and firm size indetermining the export behaviour of firms belonging to the basic chemical industry in India. The results of the study confirm that technological efforts, firm size and otherfirm-specific characteristics are important in explaining the export behaviour of the firms. **Chandan Sharma (2012)** examined the impact of Research and Development (R&D) activities on firms' performance for the Indian pharmaceutical industry. The study found that the performance of foreign firms operating in the industry is more sensitive toward R&D than the local firms and propose further encouragement and incentives for doing in-house innovative activities in the Indian pharmaceutical industry.**Filip De Beule and Dieter Somers (2012)** examined the impact of the factors influencing the likelihood of foreign R&D; and the subsequent impact of foreign R&D on the parent firms' innovativeness. The study found that firm-specific technological advantages are important drivers of foreign R&D investments and that technology-seeking foreign R&D positively influences the innovation performance of Indian parent companies. **Miguel ManjónAntolín , et.al., (2012)** analysed whether the productivity gains associated with Learning-by-Exporting (LBE) depend on the intensity of the firm's exporting activity. The results from a representative sample of Spanish manufacturing firms indicate that the yearly average gains in productivity are larger for those firms that increase their export-to-sales ratio.**Pramod Kumar Naik(2014)** found that R&D investment have a positive impact on the market value of firm at the beginning, however, after a point these investments lower the market performance of firms. **Savita Bhat (2015)** found that investment on information technology has a positive effect on the export performance of the firms in this industry. Age of the firm and size of the firm also turn out to be important factors in determining export performance of firms in this industry.

The previous studies analysed the R&D Intensity and performance of Multinational Companies. It was found that the research relating to the role of International Trade on R&D investments of Multinational firms' was not carried out. Thus the present study aims to fill the research gap.

STATEMENT OF THE PROBLEM

In modern industrial world, firms' investment in R&D is an important source oftechnological progress. Due to liberalisation of trade, firms would have no choice but tomodernise their techniques and cut their costs in order to compete with the foreign producers.The results of R&D may be uncertain and lead to higher volatility in firm value with the increasing information asymmetries in the market. Consequently, it is bit difficult to predict how investment on such activities will impact on firm's international trade performance.

OBJECTIVES OF THE STUDY

- To examine whether International Trade and R&D Investments of Multinational firms are stationary during the study period.
- To analyze the relationship between International Trade and R & D Investments of the sample firms during the study period.
- To identify the impact of International Trade on the R & D Investments of the sample firms during the study period.
- To examine the casual relationship betweenInternational Trade and R & D Investments of the sample firms during the study period.

HYPOTHESIS OF THE STUDY

- **H01**: There isno stationarity between International Trade and R & D Investments of the sample firms during the study period.

- **H02**:There is no significant relationship between International Trade and R & D Investments of the sample firms during the study period.
- **H03:** There is no significantimpact of International Trade on the R & D Investments of the sample firms during the study period.
- **H04:** There is no casual relationshipbetween International Trade and R & D Investments of the sample firms during the study period.

III. Methodology Of The Study

- ***Selection of the Sample Size***

The constituents of the BSE S&P Index is considered for sample selection. The Index constitutes 500 companies. Out of these 456 companies are Multinational. The number of companies in the manufacturing sector comes to 417. Among these 417 companies, data relating to the selected variables during the study period 2008-2017 was available in the Prowess database only for 27 companies. Thus the sample companies are:Abbott India Ltd.,Ajanta Pharma Ltd.,Ambuja Cements Ltd.,Apollo Tyres Ltd.,Asian Paints Ltd.,Astra Microwave Products Ltd.,Castrol India Ltd.,CeraSanitaryware Ltd.,F A G Bearings India Ltd.,Hero Motocorp Ltd.,Hindustan Unilever Ltd.,J S W Steel Ltd.,Kansai Nerolac Paints Ltd.,Linde India Ltd.,Navin Fluorine Intl. Ltd.,Nestle India Ltd.,Rallis India Ltd.,Sanofi India Ltd.,Siemens Ltd.,Sterlite Technologies Ltd.,Tata Coffee Ltd.,Tata Elxsi Ltd.,Ultratech Cement Ltd.,Unichem Laboratories Ltd.,V I P Industries Ltd.,V S T Industries Ltd. and V-Guard Industries Ltd.

- ***Period of the Study***

The study covers the period of 10 years from 2008 to 2017.

- ***Source and Collection of the Data***

The secondary data relating to the study was collected from the CMIE "PROWESS" Database.

LIMITATIONS OF THE STUDY

This study suffers from the following limitations.

- All the limitations of secondary data are also applicable to this study.
- The period of study covers data only for 10 years.
- All the constraint of the tools are also applicable to this study.

IV. Analysis And Interpretation

Computation of the Variables

The study considers R&D Intensity as the dependent variable which is computed by Research and Development Expenses as a percentage of Sales. The independent variables are:TechnologyImport Intensity, Size of the Firm,Export Intensity, Rate of Profit,Advertisement and Marketing Intensity.

Technology Import Intensity is computed by measuring the amount of Import of Capital Goods and Raw materials as a percentage of Sales.Size of the Firm is the Logarithm of sales.Export Intensity is defined as the ratio of its export to its sales. Rate of Profit is measured as the ratio of Profit after Tax to its Sales volume and Advertisement and Marketing Intensity is computed using Advertising and Marketing Expenses as a percentage of Sales.

TABLE 1: Results OfAugmented Dickey–Fuller Test For The Sample Firms During The Study Period

	Augmented Dickey-Fuller test statistic (T-statistics)	Test critical values		
		1% level	5% level	10% level
AMI	-5.245819	-3.711457	-2.981038	-2.629906
EI	-5.274356	-3.711457	-2.981038	-2.629906
ITI	-5.465243	-3.752946	-2.998064	-2.638752
RDI	-5.099111	-3.711457	-2.981038	-2.629906
ROP	-3.820377	-3.737853	-2.991878	-2.635542
Size	-7.162161	-3.711457	-2.981038	-2.629906

Source: Data collected from Prowess Database and computed using E-views 7.0

EI= Export Intensity, TII= Technology ImportIntensity, RDI = Research and Development Intensity, ROP= Rate of Profit and AMI = Advertising and Marketing Intensity.

The Augmented Dickey–Fuller test results, of International Trade and R&D Investments for the sample firms during the study period are presented in **Table 1**.Augmented Dickey–Fuller test statistic values for Advertising and Marketing Intensity was found to be (-5.245819), Export Intensity was (-5.274356), Technology ImportIntensity (-5.465243),Research and Development Intensity (-5.099111), Rate of Profit (-3.820377) and Size (-7.162161) were less than the test critical values at 1%, 5% and 10%.The test results confirmedthat International Trade and R & D Investments of Multinational Firms were stationary at level difference. Hence, the null hypothesisNH01: "There is no stationarity between International Trade and R & D Investments of the sample firms during the study period", is rejected

TABLE 2: Results Of Descriptive Statistics Of The Sample Firms During The Study Period

	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
AMI	0.550837	1.696967	3.835798	17.5738	305.1552
EI	1.738266	5.623562	3.800213	16.7186	276.7124
ITI	0.238401	0.500399	2.801383	11.0554	108.3155
RDI	112.8543	584.6725	4.902896	25.03842	654.5761
ROP	0.057899	0.286395	-1.43142	7.791331	35.04684
SIZE	0.012665	0.015344	0.5585	4.688583	4.611378

Source: Data collected from Prowess Database and computed using E-views 7.0

EI= Export Intensity, TII= Technology Import Intensity, RDI = Research and Development Intensity, ROP= Rate of Profit and AMI = Advertising and Marketing Intensity.

Table 2 shows the results of Descriptive Statistics for the sample firms during the study period. The mean value was positive for all the variables such as Advertising and Marketing Intensity, Export Intensity,Technology Import Intensity, Research and Development Intensity, Rate of Profit and Size for all the sample firms during the study period. Research and Development Intensityrecorded the highest mean value of 112.8543and Sizerecorded the lowest mean value of 0.012665.The volatilities (Standard Deviation) exhibited low volatilityexceptAdvertising and Marketing Intensity, Export Intensity and Research and Development Intensity exhibited high volatility. The skewness was positive and skewed towards right exceptfor Rate of Profit which was negatively skewed and moved towards left.The Kurtosis value was greater than the normal distribution value 3 and it indicates leptokurtic distribution. The Jarque-Bera value was greater than 5 which indicates normality except for Size it was lesser than 5 which indicates non normality.

TABLE 3: Results Of Correlation Analysis Of The Sample Firms During The Study Period

		Size	EI	ROP	ITI	AMI
RDI	Pearson Correlation	-0.167	.896**	-0.064	.800**	0.072
	Sig. (2-tailed)	0.405	0.000	0.750	0.000	0.722

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Data collected from Prowess Database and computed using SPSS 16.0

EI= Export Intensity, TII=Technology ImportIntensity, RDI = Research and Development Intensity, ROP= Rate of Profit and AMI = Advertising and Marketing Intensity.

Table 3shows the results of the correlation analysis of the sample firmsduring the study period. The variable Research and Development Intensity witnessed significant 'p' value with the variables Export Intensity and Technology Import Intensity which reveals 89.6% and 80% relationship between the variables. Export allows firms to produce on a large scale and thereby exploit increasing returns to scale, made possible by fixed investments like R&D. Export can have a positive effect on innovation effort because elasticity of foreign demand with respect to R&D is likely to be greater than that of the domestic demand. Several reasons can be extended to support this point. For instance, since export market usually consists of several segmented markets and each sub-market varies from others in terms of consumers' preferences, entry barriers and elasticities, the likelihood that R&D will increase demand in some of these markets is higher than that in the domestic market. Secondly, if R&D is leading to product differentiation or the development of a new product, likely to be preferred by a small group of consumers, then export enables the firm to realise economies of scale in the

production of this differentiated commodity. In this case, export possibilities allow the firm to make required R&D investment.Technology Import Intensity can affect the incentive of the firm to invest in in-house R&D. The relationship between the two, however, has been a subject of intense debate in the development literature. One view suggests that these two are substitutes to each other, implying that it would reduce R&D investment. An opposing view, on the other hand, considers them as complementary. It argues that, since most technologies consist of certain portion of tatic knowledge, absorption of import technology requires some technological capability on the part of the firm and it can take the form of in-house R&D effort. Likewise, imported plants and machinery may also require adaptations and modifications to suit local conditions, raw materials and usage pattern, making some investment in in-house R&D necessary. Hence the null hypothesis Ho2: "There is no significant relationship between International Trade and R&D Investments of the sample firms during the study period" is rejected.

TABLE 4 :Model Summary Of Regression Result ForThe Sample Firms During The Study Period

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.925	0.856	0.821	247.213	1.97

a. Predictors: (Constant), AMI, EI, ROP, Size, TII

b. Dependent Variable: RDI

Source: Data collected from Prowess Database and computed using SPSS 16.0

EI= Export Intensity, ITI= TechnologyImport Intensity, RDI = Research and Development Intensity, ROP= Rate of Profit and AMI = Advertising and Marketing Intensity.

Table 4shows the results of model fitness for the International Trade and Research and Development Investments of the sample firms with Research and Development Intensity as dependent and Advertising and Marketing Intensity, Export Intensity, Rate of Profit, Size andTechnologyImport Intensity as independent variables. It is noted that 92.5% of relationship was noticed between Research and Development Intensity and Advertising and Marketing Intensity, Export Intensity, Rate of Profit, Size andTechnology Import Intensity as independent variables. Further only 85.6% of variation in Research and Development Intensity was explained jointly by the other independent variables. However the R square value is high which indicates the model is good.

TABLE 5: Anova Results of The Sample Firms During The Study Period

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7604491.71	5	1520898.34	24.89	0.000
	Residual	1283397.59	21	61114.17		
	Total	8887889.30	26			

a. Predictors: (Constant), AMI, EI, ROP, Size, TII

b. Dependent Variable: RDI

Source: Data collected from Prowess Database and computed using SPSS 16.0

EI= Export Intensity, TII= Technology Import Intensity, RDI = Research and Development Intensity, ROP= Rate of Profit and AMI = Advertising and Marketing Intensity.

The results of Analysis of Variance for the International Trade and Research and Development Investments of the sample firms with Research and Development Intensity as dependent and Advertising and Marketing Intensity, Export Intensity, Rate of Profit, Size andTechnology Import Intensity as independent variables are presented in **Table 5**. The F statistic value was found to be 24.89.The 'p' value was 0.000 which is lesser than 0.05 at 5% level. Hence the Ho3: "There is no significant impact of International Trade on the R&D Investments of the sample firms during the study period" is rejected.

TABLE 6: Co-Efficient Result ForThe Sample Firms During The Study Period

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			Std. Error	Beta		
1	(Constant	-125.22	68.75		-1.82	0.083

	)					
	Size	3087.39	3480.58	0.08	0.89	0.385
	EI	71.02	13.67	0.68	5.20	0.000
	ROP	-34.81	176.92	-0.02	-0.20	0.846
	TII	381.20	154.43	0.33	2.47	0.022
	AMI	-24.23	32.18	-0.07	-0.75	0.460

a. Dependent Variable: RDI

Source: Data collected from Prowess Database and computed using SPSS 16.0

EI= Export Intensity, TII= Technology Import Intensity, RDI = Research and Development Intensity, ROP= Rate of Profit and AMI = Advertising and Marketing Intensity.

Table 5 explains the co-efficients of International Trade and Research and Development Investments of the sample firms during the study period. It is to be noted from the results that the 'p' value of the Export Intensity and Import Intensity alone was less than 0.05. R&D Intensity was found to be a favourable factor in determining exports and that firms with large R&D units succeeded in the export markets. It was also found that R&D had a favourable effect on export intensity of firms in India and they were able to produce and export majorly by in-house R&D in terms of process development and reverse engineering. As firms of developing countries tend to have limited research capabilities todevelop their indigenous technological capabilities, they resort to imports of technologiesfrom abroad. A domestic firm can import technological inputs like plant and machineryand raw materials. Usage of these channels of technology imports related to ownin-house R&D activity of the firm. The imports of the sample firms influence the probability to undertake investments in R&D as well as its intensity. Hence it is clear that the variables Export Intensity and Import Intensity alone had its impact on the Research and Development Investments of the sample firms during the study period.

TABLE 7:RESULTS OF GRANGER CAUSALITY TEST FORTHE SAMPLE FIRMS DURING THE STUDY PERIOD

Null Hypothesis:	**F-Statistic**	**Prob.**
RDI does not Granger Cause AMI	0.08312	0.9206
AMI does not Granger Cause RDI	0.09269	0.9119
RDI does not Granger Cause EI	0.70304	0.5069
EI does not Granger Cause RDI	0.09156	0.9129
RDI does not Granger Cause TII	3.50105	0.0497
TII does not Granger Cause RDI	11.9155	0.0004
RDI does not Granger Cause ROP	0.23779	0.7906
ROP does not Granger Cause RDI	0.03891	0.9619
RDI does not Granger Cause SIZE	3.73857	0.0417
SIZE does not Granger Cause RDI	0.67187	0.5219

Source: Data collected from Prowess Database and computed using E-views 7.0

EI= Export Intensity, TII= Technology Import Intensity, RDI = Research and Development Intensity, ROP= Rate of Profit and AMI = Advertising and Marketing Intensity.

Table 7 exhibits the results of Granger Causality for International Trade and R&D Investments of the sample firms during the study period. The results of F-statistics values for Research and Development Intensity and Technology Import Intensity, were greater than 3 and further, the probability values were less than the significant value of 0.05. These results indicate bidirectional causation between Research and Development Intensity and Technology Import Intensity. Further, unidirectional causation was found between Research and Development Intensity and Size during the study period.Hence the null hypothesis Ho4: "There is no casual relationship between International Trade and R&D investments of the sample firms during the study period" is rejected.

FINDINGS AND IMPLICATIONS

The paper examined the impact of the selected variables on the Research and Development Investments of the sample firms during the study period. Trade can affect innovation effort of multinational firms through import competition and export. The major findings of the study were: The results of correlation and regression analysis indicate that the variables Export Intensity and Technology Import Intensity alone witnessed significant relationship and impact with the Research and Development Intensity. The Granger Causality results indicate bidirectional causation between Research and Development Intensity and Technology Import Intensity. Further, unidirectional causation was found between Research and Development Intensity and Size during the study period.

Suggestions Of The Study

- The sample firms should concentrate on Advertisement and Marketing activities, as they may help firms to enhance their product market and thereby increase the rate of return on innovation.
- One of the important sources to finance R&D expenditure is the profit of the firm. The rate of profit of the sample firms should be concentrated as higher profit can increase the internal resources of the firm and therefore, a positive relationship between profit and R&D investment can be expected.

Conclusion Of The Study

The study analysed the Impact of International Trade on the Research and Development Investments of the sample firms for the period of ten years from 2008 to 2017. The export and import activities of the firms can be increased by means of their research and development activities.The study revealed that the variables Import Intensity and Export Intensity alone had positive impact on the Research and Development Investments of the sample firms.

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