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Impact of Research & Development Activities on Economic Growth in Emerging Economies

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ABSTRACT

The present study aims to fins the effect of research & development activities on economic growth in emerging economies; India and China. The study is based on 21 years from 1996 to 2016 of historical data. GDP per capita growth has been taken as proxy of economic growth whereas Patent application, Trademark application, High technology exports and R&D expenses have been taken as variables for research & Development activities. Linear regression analysis has been performed in SPSS. The findings suggest that Patent Applications and Trademark Application have significant effect on economic growth in India whereas Trademark Applications, R&D Expenses and High Technology exports effect the economic growth in China. The study provide significant insights for the policy formulations for Government of India as it suggest the government to enhance its budget contribution on R& D expenses and technology advancement sector as they lead to stimulate the economic growth to next level.

Key Words - Research & Development, Economic Growth, India, China, Linear Regression

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Introduction

In current fragile global environment, the sustainable economic growth has been emerging as a big concern among all countries. Economists have been hunting consistently for effective dynamics of economic growth. With rapidly change in global economic scenario and complex business environment; the conventional tools of economic growth have lost their effectiveness. In current era, both researchers and economist are putting more weightage to find the relationship between innovation and economic growth. Innovation has been emerged as the major catalyst to face the challenges in the economic development of emerging economies. Innovation along with other economic drivers stimulates the development in the country. Technological advancements explode the economic growth pattern to new highs. Innovation plays a central role in growth dynamics across all walks of life. Romer (1986) examined that technological innovation, through research and development (R&D) sectors using man power and existing knowledge, increase the production of goods that further leads to rise in economic growth rate. Savvides and Zachariadis (2003) found that effective domestic Research & Development activities pump up the national productivity and economic growth. These activities are supposed to put multi dimensional effect on the economy like global competitiveness, infrastructure development, trade openness and financial development. Grossman and Helpman (1991) examined the role of the innovation activities on fostering economic development and observed a long term positive effect of innovation on economic growth. The need of investigation for the finding the effect of innovation and research and development activities on prospective economic growth among emerging economies has been intensified. The competitiveness of emerging economies at global platform is significantly connected with formulation and dissemination of innovative technologies at every stage of growth and development. New digital technologies, smart products and services, digital business models, new materials, changing societal structures, mass-individualization, crypto-currencies, new modes of knowledge creation and storage, and, finally, create global economic challenges. Being embedded into these dynamic environments, it is reasonable to assume that R & D and innovation, on the one hand, must reactively adapt to these changes, but, on the other hand, are also forced to actively explore and exploit new opportunities. This paper makes an attempt to investigate the relationship between economic growth and research & Development activities in emerging economies.

In order to achieve the objectives of the study, the present paper is structured into five parts: the first part consists of introductory remarks related to the significance and relevance of the

innovation, research and development activities and economic growth, second part of paper is focussed on the discussion on existing literature and research studies on the background of the paper, in the third part we described the data and methodology and the fourth part exposed the main results of the empirical analysis. The paper ends with a summary conclusion.

Review of Literature

Joseph Schumpeter (1934) examined innovation as a crucial component of economic performance. Rome (1990) found that innovation and technological advancements accelerate the economic growth of country. Audretsch and Feldman (1994) made an attempt to determine whether innovative activity is more localized than productive activity. Innovation plays critical role in fostering competitiveness and economic growth. Innovation can be categorised into four different categories. Romer (1986) categorised innovation as learning by doing, Lucas (1988) found it as a factor of human capital, Aghion and Howitt (1992) described innovation as Research & Development Activity whereas Barro (1990) observed public infrastructure as part of innovation. Innovation accounts major positive impact on per capita income. It drives almost all of the growth in economic output and productivity. Geroski, Machin and van Reenan (1993) argued that innovative firms yield high profit in economic recession, higher market shares and show less sensitivity to economic recession than non-innovative firms. Mansfield (1980) observed a strong and significant relationship between R&D and productivity growth. Borensztein, Gregorio and Lee (1998) examined the role of Foreign Direct Investment (FDI) in technological diffusion and economic growth. The results of the study suggests that Foreign Direct Investment has significant effect on the economic growth by adding advancement in technology diffusion and human capital. Pradhan et al. (2016) observed bidirectional linkage between innovation and economic growth. Aghion and Howitt (1998) claimed that significance of high spending on Research and Development for sustaining the growth in Total Factor Productivity. Porter (1990) observed a strong linkage between innovation with firm competitiveness. Technological innovation establish a link between development and acquisition of knowledge, expenditure in Research and Development, Marketing, Diffusion plays an important ingredient of innovation as it explores the usefulness of innovation across the economy. Engelbrecht (1997) described the widespread role of manpower and research and development activities in innovation and widespread of knowledge. This wide dissemination of knowledge leads to economic growth of country.

Research Gap

The growing rate of innovation and increase in concern related to the economic growth amidst fading global economic parameters has attracted the attention of researchers. After minutely reviewing the previous research studies, a significant gap has been observed as majority of the studies were confined to only one economy. None of the available research study focus on the effect of research and development activities on economic growth in asian emerging economies. The present study makes a sincere attempt to fill this void and compare the two global emerging economic powers: India and China.

Objectives

The main objective of this paper is to compare the effect of research and innovation activities on economic growth of emerging economies. The following specific objectives have been established to achieve the main objective of study:

a) To measure the effect of research & development activities on Economic growth in India
b) To measure the effect of research & development activities on Economic growth in China
c) To compare the effect of research & development activities on Economic growth among India and China.

Research Methodology

Research Sample

To achieve the objectives of the present study, India and China were taken as the sample as these are considered as major emerging economies in the world.

Time Frame & Data Collection

The present study was conducted over a time period of 21 years from 1996 to 2016. The historical annual data of dependent variables and independent variables was collected from official website of World bank.

Research Variables

The following research variables were taken to achieve the requisite objective of the study:

a) Dependent Variable

Economic Growth of India and China was taken as dependent variable in the current study. GDP (percentage per capita growth) has been taken as the proxy of economic growth.

b) Independent Variables

Research & Development related activities performed by India and China were taken as independent variables. Patent Applications, Trademark Applications, Research & Development expenditure (percentage of GDP), High Technology exports were taken as independent variable and as proxy of Research & Development activities.

Statistical Tests

The following statistical tests were performed through SPSS.

Variance Inflation Factor (VIF) – Multi Collinearity is considered an critical factor in research. The existence of Multi collinearity among variables leads to inappropriate results that may dilute the credibility of the research. VIF test was performed to examine the existence of collinearity among independent variables under study. The VIF value of lesser than 10 confirms the non existence of collinearity among independent variables.

Durbin Watson Test – Durbin Watson Test was performed to measure the auto correlation in the data. If the value of Durbin Watson test lies between 1.5 and 2.5 it means that the autocorrelation does not exist in the data.

F- Test - F-test explains the level of influence of independent variable on dependent variable. If the value of significance level (0.05) is higher than the significance F then it indicates that Independent variable has significance influence on dependent variable and vice versa

Linear Regression Model - Linear Regression has been deployed as statistical tool to measure the effect of independent variables on the dependent variable.

Data Analysis

The following section discuss the regression analysis output and their interpretation in context of India and China.

India

Table – I

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.637[a]	.406	.257	1.7709188	.406	2.732	4	16	.036	2.432

a. Predictors: (Constant), High Technology Exports (% of Manufactured), Patent Applications, Trademark Applications, R&D Expenses (% of GDP)

b. Dependent Variable: GDP Per Capita Growth (% Annual)

Source: SPSS Output by Author

The above statistical table – I depicts the regression output of the research data from Indian Context. The r - square value (0.406) signifies that independent variables explain 40.6% of variation in dependent variables. The significant f value 0.036 (0.036 < 0.05) indicates that model is significant. The Durbin Watson statistic value (2.432) lies between 1.5 and 2.5 that confirms the non existence of autocorrelation among the research data.

Table – II ANOVA Statistics

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	34.275	4	8.569	2.732	.036[b]
	Residual	50.178	16	3.136		
	Total	84.454	20			

a. Dependent Variable: GDP Per Capita Growth (% Annual)

b. Predictors: (Constant), High Technology Exports (% of Manufactured), Patent Applications, Trademark Applications, R&D Expenses (% of GDP)

The Anova Statistics (F Value) depicted in the above table indicates that model is fit and significant.

Table – III REGRESSION Statistics

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	23.434	12.315		1.903	.075		
	Trademark Applications	.439	.163	.550	2.684	.016	.885	1.130
	R&D Expenses (% of GDP)	.428	8.535	.449	1.457	.234	.391	2.557
	Patent Applications	.611	.338	.363	1.808	.042	.920	1.087
	High Technology Exports (% of Manufactured)	-.174	.103	-.488	-1.680	.112	.439	2.276

a. Dependent Variable: GDP Per Capita Growth (% Annual)

The above regression statistics indicate the regression coefficient for each independent variable and VIF values. VIF (Variance inflation Factor) values for each variable stand below 10. It confirms the non existence of collinearity among the independent variables. The significant values of variables shows their Trade Applications and Patent Applications have their significant value less than 0.05. It confirms the significant effect of these variables on the economic growth of India. In case of other variables, the significant values (R&D Expenses – 0.234 and High technology Exports – 0.112) are higher than 0.05 that further confirms the non significant effect of these variables on economic growth.

Regression Equation

GDP Per Capita Growth = 23.434 + 0.439*Trademark Applications +0.428* R&D Expenses + 0.611*Patent Applications -0.174*High Technology Exports

China

The following section describes the effect of Research & Development activities on economic growth in context of China.

Table – IV

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.806[a]	.650	.562	1.2665771	.650	7.419	4	16	.001	1.561

a. Predictors: (Constant), High Technology Exports (% of Manufactured), Patent Applications, Trademark Applications, R&D Expenses (% of GDP)

b. Dependent Variable: GDP Per Capita Growth (% Annual)

Table - IV shows the the statistical output of regression analysis of research data in context of China. The above statistics depict that independent variables explain 65% of variation in dependent variables. It is further confirmed by the r- square value (0.650). The lower F value (0.001 < 0.05) signifies that model is significant. The Durbin Watson statistic confirms the non existence of autocorrelation among the research data as its value (1.562) lies between 1.5 and 2.5.

Table – V ANOVA Statistics

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	47.610	4	11.902	7.419	.001[b]
	Residual	25.667	16	1.604		
	Total	73.277	20			

a. Dependent Variable: GDP Per Capita Growth (% Annual)

b. Predictors: (Constant), High Technology Exports (% of Manufactured), Patent Applications, Trademark Applications, R&D Expenses (% of GDP)

The Anova Statistics (F Value) depicted in the above table indicates that model is fit and significant.

Table – VI REGRESSION Statistics

Coefficients[a]

Model		Unstandardised Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4.299	1.388		3.097	.007		
	Patent Applications	-.010	.012	-.123	-.811	.429	.947	1.056
	Trademark Applications	-.058	.023	-.418	-2.546	.022	.813	1.229
	R&D Expenses (% of GDP)	-3.107	.754	-.843	-4.122	.001	.524	1.909
	High Technology Exports (% of Manufactured)	.400	.076	1.148	5.255	.000	.459	2.179

a. Dependent Variable: GDP Per Capita Growth (% Annual)

Table - VI indicates the regression coefficients for each independent variable and their VIF values. VIF (Variance inflation Factor) values for each variable stand below 10. It confirms the non existence of collinearity among the independent variables. The independent variables i.e. Trade Application, Research & Development Expenses and High Technology Exports Patent have low significant values (0.022, 0.001 and 0.000 respectively) that confirm their significant effect on the economic growth of India. Whereas Trademark Application does not signifies any effect on the economic growth as its significant value (0.429) lies above 0.05.

Regression Equation

GDP Per Capita Growth = 4.299 -0.010 *Patent Applications – 0.058 * Trademark Applications -3.107* R&D Expenses +0.400*High Technology Exports

Table – VI Comparison of India and China

S. No.	Variables	India	China
1	Patent Applications	0.012*	.429
2	Trademark Applications	0.016*	.022*
3	R&D Expenses	0.234	.001*
4	High Technology Exports	0.112	.000*

*indicates the significant variables

The above statistical table indicates the comparison between India and China. The statistics depicted in the above table indicates that in India, Patent Applications and Trademark Application have significant effect on economic growth whereas in context of China, Trademark, R&D expenses and High Technology exports effect the economic growth.

Findings and Implications

Innovation has been emerged as key factor that stimulates the economic growth. It helps not only in increase in production but also provide cutting edge in competitiveness across the

globe. The present paper examines the effect of Research and Development activities on the economic growth in emerging economies i.e. India and China. The results of the study suggest that R& D expenses, Trademark applications and High technology exports have significant effect on economic growth in China. China has emerged as global economic power on the basis of technology advancements in manufacturing and cheap labour. It provides cutting edge in global competitiveness that attract huge FDI in china and have further positive effect on the economic growth in china. In India Only Trademark and patents seems to have significant effect on economic growth. High technology exports and R&D Expenses emerged non significant factors in the study.

The findings of the study add some significant contribution in the existing literature. Indian government should increase its contribution to research & development expenses to strengthen the level of innovation that further stimulate the economic growth. The results suggest that government of India should also enhance its manufacturing advancements that provide India a cutting edge in manufacturing and enhance its high technology exports.

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