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Research Article

Examining the innovation capacity of India, Finland, South Korea and Japan: A comparative study

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Abstract

This research focuses on innovation capability and looks into how it has become a critical driving force for economic progress. Innovation is frequently viewed as one among the driving forces behind any country's long-term economic prosperity Innovation is critical to achieving long-term, sustainable growth. The main objective of this article is to look into the impact of innovation in India's economic development and compare it with nations like South Korea, Finland and Japan on selected innovation parameters to see India's readiness towards knowledge-based economy. These countries' governments must play a big role in reforming the innovation system to make it more adaptable to economic development, with a focus on R&D.

The term "innovation" is used in this study to refer to both the production of new goods and services as well as the inventive process of creating goods and services. This study's primary source is the World Bank's data bank. The variables were studied using time series data. Research and Development expenditure, Researchers per 1000, FDI Outflow, FDI Inflow are the key variables employed in this study to interpret economic growth.

Keywords: Economic Growth, Innovation, India.

Introduction

Recent history appears to suggest that one of the most essential determinants for knowledge economic growth is innovation. Economic expansion has always been an aim for humans, societies, and nations, according to history. The evolution of invention from the wheel to the internet reveals how humans thrive on inventing new items, services, and manufacturing processes. New product or manufacturing process innovation is essential for a nation

sustainable economic growth and higher level of living. R&D and innovation are words that refer to systemic creative practises aimed at expanding the supply of technology that can be used to improve products, processes, software, or innovations. The R&D structure is a network of organisations, rules, and procedures that affect how a country acquires, develops, disseminates, and utilises information. It is made up of private businesses, colleges, and government testing departments, as well as others that work for them. In a nutshell, such a structure encourages competition, and leads to new ideas, approaches, and expertise, and thereby provides a strategic edge for goods and sectors in today's global economy.{Citation}

In this context the aim of the study is to study one of the important indicators of knowledge economy that is innovation in Indian context compares with selected nations to provides a useful benchmark for monitoring performance and competitiveness. The nation is in what extent and direction is lacking would be area of concern of this study using important variables. We focus on innovation capacity in this study and propose to investigate how innovation capacity has become a major driver of economic growth in emerging economies. The following segments/sections make up this article: Section 2 presents a brief literature overview of innovation capability, and Section 3 describes the approach. The fourth section introduces our data and defines economic growth. Section 5 contains the results, conclusions, and recommendations, as well as the author's perspective and argument.

Literature Review

The literature study emphasises the significance and necessity of innovation for a country's economic progress. Long-term economic growth is dependent on the creation and maintenance of an environment that stimulates innovation and the application of new technologies, according to the Organization for Economic Cooperation and Development (OECD). (Chakrabarti & Bhaumik, 2009)seeks to explain the internationalization of technology development in India. The study used US patents: Globalization of R& D, Performance of R& D organizations in India, Global trends in patents, Trends in patents with Indian investors, sectoral distribution of patents, ownership pattern of patents with Indian investors as an indicators for measuring technical output between 1992 and 2007. The study's findings revealed that each phase of technology development is characterised by the intensity of patenting, the role of various institutions in technology development, and the concentration of technology. (Shukla, 2017) The primary goal of this article is to determine the influence of innovation in India's economic development. The variables were studied using time series data. The number of patent applications filed throughout the study period, education spending, and R&D spending were the variables examined. To attain this goal, the primary focus should be on increasing education and R&D spending, which will boost India's production.(Papadopoulos, 2012)) looked into innovation as a means of moving towards knowledge economy. According to the author, scientific and technological advancements, as well as the generation and administration of new knowledge, as well as a rapidly changing entrepreneurial economic environment, necessitate unique ways for adapting economic activities to ongoing changes. The study determined that innovation in the information economy is a multifaceted and dynamic notion that encompasses more than just ideas and

patents. (Mani, 2009) aimed at determining whether India's innovative activities have increased since 1991. The author also tries to figure out India's innovative performance by utilising measures like as R&D investment tendency, patenting trends, and technology which are then compared using various statistical tools (Bhattacharya, 2010) recognised the shifting features of the Indian economy in terms of innovation. Firstly, author analysed brief history of concept of knowledge and innovation. Then, the pape throws light on accomplishments in entrepreneurship and innovation in recent times, growth in S & T sector and some innovative business models that were initiated to get in depth knowledge about the growth of innovation sector in country. The paper dwells upon some challenges that impedes India's success as an innovative nation. (Cooper, 2015). On the basis of global competitive Index ranking 2015-16, author tried to assess the position of India with other benchmarking countries china, Taiwan, Singapore and South korea by studying three indicators basic requirements, efficiency enhancers and innovation and sophistication in detail. The finding of study shows that Singapore performance was comparatively good in all key drivers compared to other countries. India's position is low in all the indicators. The author argues that India has all potential to emerge as a knowledge economy, if right policy initiative will be framed and implemented. Its need of hour for nation to improve its knowledge economic position to compete with other leading economies globally. (Usman et al., 2015)in their paper investigates the innovation growth and economic development of Pakistan, India and Sri Lanka over a period ranging from 1999 to 2012. The paper uses documentary analysis and collects data from various international organisations like World Bank, Global Competitive Index respectively. (Goh, 2005) discusses why the pursuit of innovation as a major mover of economic development must be addressed in industrial policy-making, as well as the role of government in innovation-driven industrial policy. The growth of Singapore's industrialisation process is used as a case study to demonstrate the government's role in industrial policy-making.(Chen & Dahlman, n.d.) have agreed that the Knowledge Economy's defining pillars may help any country completely operate its economy if its institutions make full and effective use of knowledge.(Gorji & Alipourian, 2011) The knowledge economy framework is discussed in this study, which includes pillars like the Economic Incentive and Institutional Regime, Education and Human Resources, the Innovation System, and Information and Communication Technology.

Database and Methodology

The study analysed the effect of innovation on knowledge economy growth. Time frame of this paper is 10 years' data from 2009 to 2018. World Bank data, OECD, UNDP as the primary source of this research paper. To measure the growth of India in comparison with some leading economies in Knowledge economy primary variables are in this study are research and development expenditure, FDI outflow, FDI inflow and researchers in R & D per 1000. All the variables used in the study and their explanation.

1. Research and development expenditure: The R & D expenditure (percentage of GDP) ratio depicts the total amount of money spent on R&D in relation to gross domestic product .
2. FDI outflow: FDI outflow refers to the amount of direct investment made by domestic residents in another country.

3. FDI Inflow: FDI inflows are the amount of direct investment made in a local country by non-residents.
4. Researchers in R&D per 1000: This ratio represents the number of researchers, and research is defined as work done in a methodical manner to expand people knowledge and develop new devices or procedures based on it.
Following the data gathering, the gathered information will be organised in a tabular fashion. The acquired data was put to the test using the ANOVA-test. The ANOVA test is used to see if there is a difference between the samples.

Data Analysis

The economic growth of any country is also guided by, performance in innovation. This is evident the investment in research and development is one of the key factors that impact the economic growth of a country. Investment in Research and Development ensures the innovation and development of technology. It is observed that the return on investment of Research is Development in economic growth is highest. The challenge with research and development is that it is directly linked with the quality of education. However, this component is taken into consideration for all the countries under study. Following charts and tables present the analysis.

Innovation:

1.Research and Development Expenditure

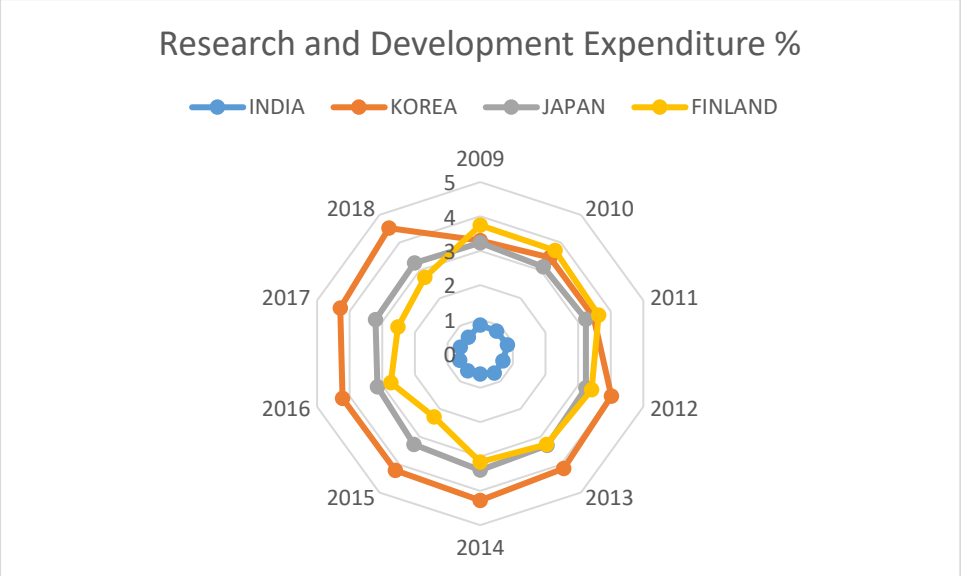

Figure – 1

Table –1

Summary Statistics Expenditure on Research and Development

Year	INDIA	KOREA	JAPAN	FINLAND
2009	0.833	3.29	3.23	3.74

2010	0.813	3.46	3.13	3.72
2011	0.831	3.47	3.24	3.63
2012	0.7	4.02	3.24	3.41
2013	0.7	4.14	3.31	3.28
2014	0.6	4.28	3.4	3.16
2015	0.62	4.21	3.28	2.28
2016	0.63	4.22	3.15	2.74
2017	0.61	4.29	3.21	2.52
2018	0.59	4.52	3.26	2.74
Average	0.6927	3.99	3.245	3.122

Groups	*Average*	*Variance*
INDIA	0.6927	0.009843
KOREA	3.99	0.180111
JAPAN	3.245	0.005939
FINLAND	3.122	0.274462

Table – 2

Null hypothesis H_{01}: The difference in R&D expenditure is not significant

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	61.529	3	20.510	174.418	0.000	2.866
Within Groups	4.233	36	0.118			
Total	65.762	39				

It can be observed that the Korea with an average of 3.99% of GDP expenses highest on research and development. Followed by Japan with a score of 3.245 and Finland with a score of 3.122. India, on the other hand is expensing least on Research and Development i.e. less than 1%. The variance in the Indian expenditure is lowest due to the reason that there is no significant change in the budget for Research and Development. From 2009 to 2012 Finland was expensing highest on research and development afterward Korea remained the highest investor in research and development. When the null hypothesis H_{01} is checked, it is found that

the expenditures on research and development are significantly different from each other. Since the p-value is less than the level of significance the null hypothesis H_{01} is rejected.

2. Outflow of FDI:

Outflow and Inflow of Foreign Direct Investment is yet another component that caters to the economic growth of any country. A higher inflow of foreign direct investment ensures the rising competition and creation more jobs. The FDI inflow also makes domestic firms more competitive. A great deal of learning and knowledge sharing also takes places with inflow of FDI. On the other hand the outflow of FDI ensures the exposure of Indian firms to the global market-place. The outflow of FDI also ensures the raised quality of good and services. The outflow of FDI creates new sources of foreign currency flowing to the country. Hence, the important factors of outflow and inflow of FDI for all the countries under study are analysed. First the outflow of the FDI is taken into consideration.

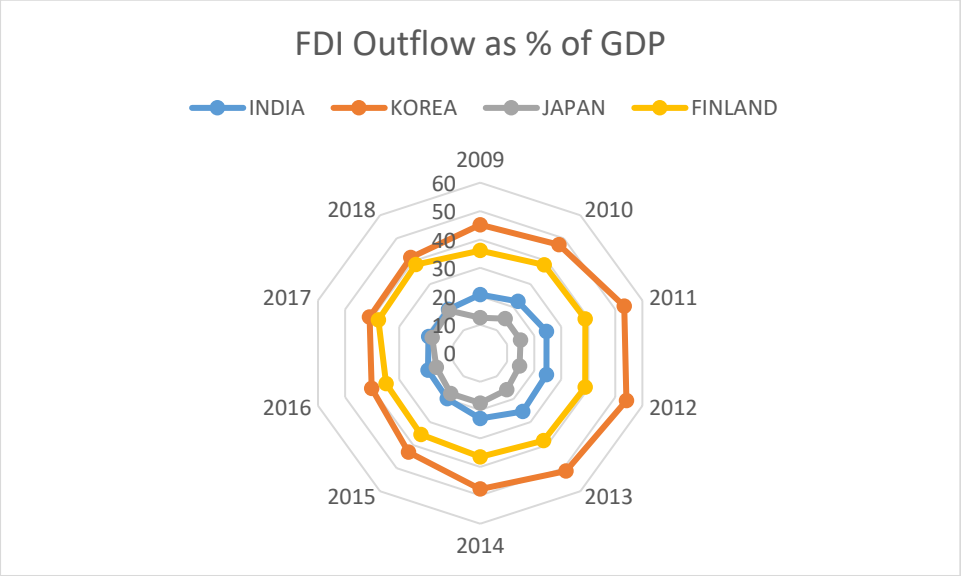

Figure - 2

Table - 3

Year	INDIA	KOREA	JAPAN	FINLAND
2009	20.62	45.19	12.52	36.08
2010	22.59	47.1	15.04	38.41
2011	24.54	53.34	14.92	38.9
2012	24.53	54.09	14.54	38.81
2013	25.43	51.29	15.92	38.02
2014	22.97	47.83	17.54	36.48

2015	19.82	42.99	17.61	35.41
2016	19.31	40.13	16.27	34.81
2017	19.05	40.93	17.75	37.68
2018	19.06	41.63	18.52	38.57
Average	21.792	46.452	16.063	37.317

Table – 4

Summary Statistics Expenditure on outflow of FDI

Groups	*Average*	*Variance*
INDIA	21.792	6.301
KOREA	46.452	26.533
JAPAN	16.063	3.416
FINLAND	37.317	2.253

Table – 5

Null hypothesis H_{02}: The difference in FDI Outflow is not significant

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5851.587	3	1950.529	202.63157	1.35E-22	2.866266
Within Groups	346.5355	36	9.625987			
Total	6198.122	39				

It could be observed that the outflow of FDI remained highest with Korea throughout the decade with an average of 46.452% of GDP. Followed by Finland with average of 37.317% and Indian with an average of 21.792%. Japan is the lowest with outflow of the FDI with an average of 16.053%. The variance with Korean FDI outflow is maximum while the highest consistency lies with the Finland with a lowest variance score of 2.253. This shows that the Korean companies are investing highly in foreign venture and that is ensuring their economic growth at a faster pace. When tested for statistical significance it is found that the null hypothesis H_{02} is rejected and it can be concluded that the FDI outflow is statistically significant with respect to the countries. The GDP shows a moderate positive Pearson's correlation with a value of 0.27. This shows a positive impact of outflow of FDI on GDP.

3. Inflow of FDI:

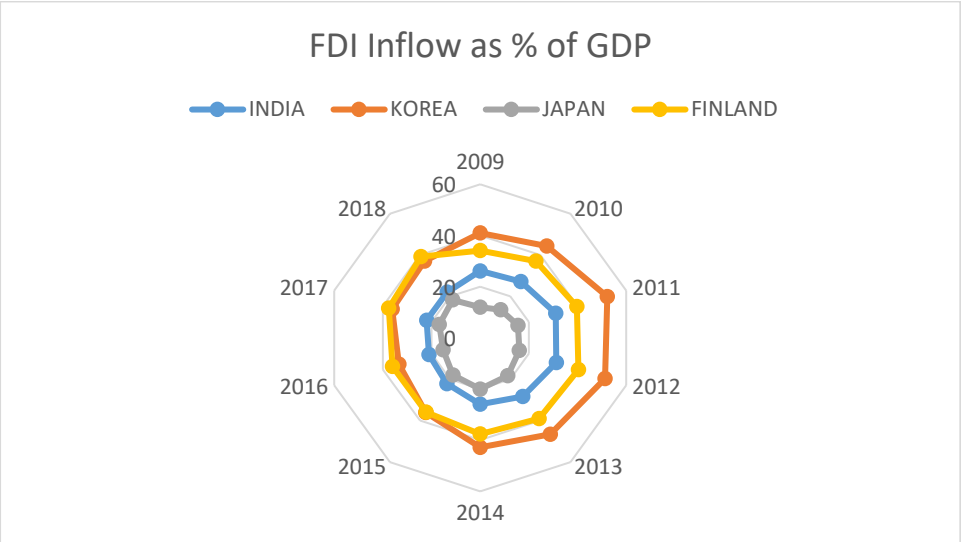

Figure – 3

Table- 6

Year	INDIA	KOREA	JAPAN	FINLAND
2009	26.16	40.95	11.97	34.09
2010	27.1	44.3	13.58	37.05
2011	31.08	52.23	15.47	39.68
2012	31.26	51.36	16.09	40.36
2013	28.41	46.66	18.23	39.08
2014	25.95	42.78	20.01	37.63
2015	22.12	36.14	18.03	35.98
2016	21.03	33.47	15.28	36.09
2017	22.03	36.19	16.82	37.56
2018	22.02	37.03	18.29	39.31
Average	25.716	42.111	16.377	37.683

Table –7

Summary Statistics Expenditure on Inflow of FDI

Groups	*Average*	*Variance*
INDIA	25.716	14.563
KOREA	42.111	42.935
JAPAN	16.377	5.842

FINLAND	37.683	3.835

Table – 8

Null hypothesis H_{03}: The difference in FDI Outflow is not significant

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	4087.53	3	1362.511	81.132	0.000	2.866
Within Groups	604.58	36	16.794			
Total	4692.11	39				

When we analyse the data for inflow of FDI it is found that Korea has the largest inflow of FDI along with largest outflow as % of GDP with an average of 42.11% of GDP followed by Finland with an average of 37.68% and India 25.71%. Likewise outflow Japan has the lowest inflow of FDI. This may be due to the fact that similar outflow and inflow policies are adopted by the governments. That is in case of trade agreement of two countries the benefits harvested are mutual. That is a good agreement ensures both inflow and outflow of the FDI and hence the figures. It can also be found that the p-value is less than the level of significance and hence the null hypothesis H_{03} is rejected. This clearly shows that the FDI inflow is sensitive to the countries. The GDP shows a Pearson's correlation value of 0.22 with Inflow of FDI which is a moderate positive correlation and shows that with increase in inflow of FDI the GDP is bound to go up.

4. Number of Researchers per 1000:

Apart from the indexes that are developed and studied above, it is very important that how the citizens of any country are responding to the whole idea of economic growth. That is what the interest of the citizens is when it comes to contributing to the economic growth. Therefore, the data with respect to number of researchers per 1000 citizens is analysed for all countries under study.

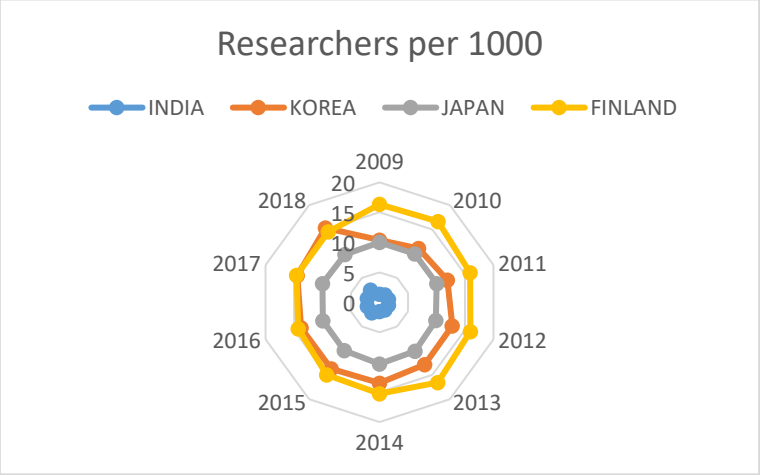

Figure – 4

Table - 9

Year	**INDIA**	**KOREA**	**JAPAN**	**FINLAND**
2009	1.34	10.38	9.98	16.33
2010	1.56	11.08	10.01	16.67
2011	1.56	11.91	10.03	15.92
2012	1.56	12.78	9.91	15.94
2013	1.56	12.84	10.07	16.55
2014	1.56	13.49	10.3	15.26
2015	2.16	13.74	9.99	14.98
2016	2.16	13.77	9.95	14.26
2017	2.16	14.43	10.01	14.56
2018	2.52	15.32	9.84	14.51
Average	1.84	12.974	10.009	15.498

Table – 10

Summary Statistics Number of Researcher per 1000

Groups	*Average*	*Variance*
INDIA	1.814	0.156
KOREA	12.974	2.290
JAPAN	10.009	0.014
FINLAND	15.498	0.806

Table – 11

Null hypothesis H_{04}: The difference in Researchers per 1000 is not significant

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1060.616	3	353.5387	432.752	0.000	2.866
Within Groups	29.41033	36	0.816954			
Total	1090.026	39				

It can be observed that the researchers per 1000 is significantly lower in India and remained lowest throughout the decade. The Finland leads the way of decade with an average of 15.49 researchers per 1000 followed by Korea with an average of 12.97 researchers per 1000. In fact

after 2014 the Korea remained neck to neck with the Finland. Japan is the third country from the top with an average of 10 researchers per 1000. India however remained with the lower of 1.8 researchers per 1000. This shows a direct impact on research and development and innovation. Both these factors contribute significantly to the economy of a country. However, it is found that 9% variation in GDP is caused by Researchers per 1000. The difference between the researchers per 1000 with respect to the countries is significant as hypothesis H_{04} is rejected.

Conclusion:

When it comes to expenditure on research and development India is expensing significantly low in comparison to other countries. This may be due to the requirement of funds in other sectors in comparatively. India is a developing country and hence has the different level of challenges. It is also true that the quality of education impacts the research and development. If the quality of education of the country is high the funds allocated to research and development can be channelized in right direction otherwise the investment goes for a waste. It is recommended that the India shall invest more on research and development for making GDP and economy of the country grow at a faster pace.

For economic growth the outflow of FDI is one of the key functions of economic growth. The outflow of FDI ensures that the revenues earned from the foreign markets flow into the economy ultimately. The domestic firms develop a sustainable competence with the international firms. The domestic firm therefore become capable of delivering the quality product to the international market with better acceptability. The increasing outflow of the FDI also ensures the rise in domestic human skills for global competence. Hence, India need to look forward to the outflow of FDI as much as they could. The international relations with another countries shall be so strengthened so that the Indian companies find a smooth way of investment in other countries. It can further be observed that there is no significant improvement in the inflow of FDI in last decade and hence the impact on economy hasn't been felt very significant. India needs to work on their foreign policy to increase both inflow and outflow of the FDI.

India needs to work on promoting the Research and development and need some resources to be pushed in this direction less than .01% researchers per 1000 is a matter of worry with such a large population. The smaller number of researchers leave negative impact on innovation and development which in turn leaves negative impact on global business competence and further it leads to reduced FDI's and indirectly impacts the economy. Hence, India shall look forward for not only quantity of education but also for quality of education. India shall develop suitable infrastructure and ecosystem for the researchers to grow.

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