

International Collaboration in Patenting: A Case Study of Contributions of Indian Inventors

BHARVI DUTT¹

¹National Institute of Science Technology and Development Studies,
Pusa Gate, K.S.Krishnan Marg, New Delhi 110012, India

Abstract

This paper investigates international collaboration of Indian inventors in patenting, using United States Patent and Trademark Office (USPTO) database from 1976-2004. The result indicates that Indian inventors had 911 patents with the inventors of 28 countries. It examines these patent documents in terms of patent assignees and their countries, type of assignees, areas of patenting, joint ownerships and key players holding these patents. It is observed that Indian inventors have contributed mostly in the areas of information and communications technology (ICT), medicines, drugs & pharmaceuticals, veterinary medicine & hygiene, organic chemistry, and organic macro molecular compounds, etc. The paper also attempts to gain an insight for policy relevance.

1. Introduction

The world is fast moving towards knowledge-based economy. India is making endeavours to keep pace with changing scenario and taking formal initiatives to meet challenges. One such step in this direction is the constitution of National Knowledge Commission by Government of India. The quality and quantum of knowledge and information workers are the key indicators of the level of development of a country. Accordingly, there is a need for reformulating the strategies and policies to meet the existing and forthcoming challenges of advancing knowledge-based era. The advancement of knowledge-based innovation is best reflected through patent as an indicator. The collaboration among inventors across the national boundaries has become significant as co-invention of patents gives an indication of globalisation of science and technology.

The international collaboration among scientists has increased over a period of time as indicated by bibliometric indicators using co-authorships of publications as indicator of collaboration [1,2,3]. However, the collaboration among inventors in patenting is more significant than collaboration in publications as in case of patents the collaboration is directed to inventive features of technology, which are likely to generate wealth, and are of financial value. Also, unlike publications, as the commercial benefits from patents

accrue to the collaborative team of inventors, their participation is likely to be seriously contended and scrutinised. There are several studies that indicate co-authorship of Indian scientists with those from other countries in case of publications [4,5]. There is, however, very little information on how Indian inventors collaborate with the inventors of other countries in patenting. Do Indian inventors contribute to patentable technologies in collaboration with inventors from other countries? If so, there is a need to understand the patterns of such collaborations, such as the extent of collaborations, patent assignees and their countries, type of assignees, joint ownership, key players holding the patents and the areas of core competencies of Indian scientists / inventors contributing to such collaborations. The present paper investigates these issues and presents the salient features of international collaboration of Indian inventors in patenting and attempts to gain an insight for policy relevance.

Data and Methodology

In order to obtain patents by Indian inventors in collaboration with inventors from other countries, a search was made in United States Patent and Trademark Office (USPTO) patent database for the issued patents using “Quick Search Mode”. The query in “Quick Search Mode” provides options for twin search tools, namely, *Term 1* in *Field 1*, operator “AND” and *Term 2* in *Field 2*. For India the country code “IN” was selected in *Term 1* and the option “Inventor Country” as the *Field 1*. Similarly, the country code of another country was used in *Term 2* and the option “Inventor Country” as the *Field 2*. For example, on choosing *Term 1* as “IN” and *Field 1* as “Inventor Country”, using the operator “AND”, and the *Term 2* as AU for Australia and *Field 2* as the “Inventor Country”, the search result would list collaborative patents of Indian inventors with the inventors from Australia. Following this methodology, the search for collaborative patents of Indian inventors was made for all other countries. The USPTO patent database includes data from 127 countries whose country codes are listed in the USPTO website under “PCT Contracting States”. The list of collaborative patents of Indian inventors with each of these countries was thus obtained. In case of the US, collaborative patents were obtained by searching collaboration with inventors from 50 different states of the US, as there was no single country code for the US. The codes for the respective states of the US were used in *Term 2* and *Field 2* as “Inventors State”. There were no collaborative patents of Indian inventors with the inventors from 98 countries. The search resulted in 1181 collaborative patents with the inventors from 28 countries during 1976 to December 31, 2004. There were overlapping records of patents due to collaboration among more than one state of the US as well as involving more than one country. Such patents were counted once only by identifying the patent numbers and overlapping patents were removed. By removing this overlap, in all 911 collaborative patents were taken for analysis.

The first page of these 911 patent documents was obtained and a database was created in Microsoft Excel with data elements as patent number, year of issue of patent, countries of inventors with which Indian inventors had collaborative patents, name of assignee, country of assignee, the International Patent Class and the type of assignee categorised into government agency, private sector firm, research institution, and

academic institution. The data was analysed to study the features of collaborative patenting activity and to draw policy inferences.

Results and discussion

Extent of Collaboration

The analysis of data of 911 collaborative patents shows that the Indian inventors have extensively collaborated with inventors from other countries in patenting activity. There is a gradual increase in the collaborative patents since 1991. India embarked on a path of economic liberalisation in 1990. There were 130 collaborative patents during 1976-90, 111 during 1991- 95 (pre-WTO period), which increased to 672 collaborative patents during 1996 to December 2004 (post-WTO period), indicating a spurt in collaboration in patenting during the post - WTO period.

There are two important dimensions to assess the collaboration. In one case, it is important to know the number of collaborating countries. In other case it is significant to assess the extent of collaboration among the inventors. The collaborations of Indian inventors in patenting involved inventors from one country as well as from more than one country. In case of multiple collaborative patents involving inventors from more than two countries, the Indian collaboration is defined by counting the same patent as many times as the number of collaborating countries. In this manner, we obtained 66 collaborative patents in which inventors from more than one country have contributed with the Indian inventors. These collaborations mostly involved inventors from the US, Germany, Belgium, Sweden, Canada, UK, Austria, Poland, Spain, Switzerland, Italy, Australia, Brazil, Japan, Israel, Singapore, Iran, Thailand, Taiwan and China.

In case of later, the analysis revealed that 210 patents (23%) were obtained by teams comprising of 2 inventors, 525 (57%) patents by teams of 3 to 5 inventors, and the remaining 176 (20%) patents were obtained by teams comprising 6 or more inventors. It indicates that the majority of the collaborative patenting involved team of three or more than three inventors.

Ownership of Patents

The ownership of patents signifies the roles of firms, academia, government, and research laboratories in the promotion and performance of collaborative patenting.

Table 1 – Patents obtained by Country of Assignee Vs Type of Assignee

S.N.	Country of Assignee	Firms	Academia	Govt.	Res. Instt	Total (%)
1.	USA	562	78	44	2	686 (75.3)
2.	Europe	107	1	-	8	116 (12.7)

3.	India	13	-	-	11	24 (2.6)
4.	Canada	10	4	-	-	14 (1.5)
5.	Japan	12	-	2	1	15 (1.6)
9.	Israel	5	-	-	-	5 (0.6)
11.	Developing countries	6	5	-	2	13 (1.4)
	NA	-	-	-	-	38 (4.2)
	Total (%)	715 (78.5)	88 (9.6)	46 (5.0)	24 (2.6)	911 (100)

Table 1 gives the distribution of collaborative patents by the type of assignees. It is observed that 78% patents were owned by private firms, followed by academic institutions (9%), government departments (5%) and the research institutes (2%). About 75% of the patents were owned by the US while the European countries held about 12% of the patents and the rest 9% were owned by Canada, Japan, Israel and the developing countries. The data on assignees of 38 (4%) patents was not available. The government entities from the US owned the maximum number of patents.

The leading US private firms with collaborative patenting activity where Indian inventors were a part of the team of inventors included Texas Instruments, General Electric Company, International Business Machines, Lucent Technologies, Intel Corporation, Cypress Semiconductors, Liposome Company (Table 2). The US universities with collaborative patenting activity where Indian inventors collaborated with the inventors of other countries included the University of California, University of Florida, University of Massachusetts, Massachusetts Institute of Technology, Boston University, Cornell Research Foundation and Vanderbilt University.

The firms from Europe with which Indian inventors collaborated with the inventors of other countries included Hoechst AK from Germany that owned 36 collaborative patents, the maximum number held by any European firm. A few other European firms that held patents included NTC Technology, Aventis Pharma, Degma AG, Robert Bosch GmbH from Germany, Rosy Blue NV (Belgium), Ciba Geigy (Switzerland), Unpaid Systems Ltd. (France), NRDC (UK), SGS Thomson Microelectronics and Fermitalic Carlo from Italy, etc.

Indian firms that owned patents include Dr. Reddy's Lab, Dabur Research Foundation, Ranbaxy Laboratories, Polymermann (Asia) Pvt. Ltd., Sami Chemicals and Extracts Limited, Sami Labs Ltd. and Wockhardt Ltd. Indian research institutions that owned patents were Council of Scientific and Industrial Research (CSIR), and National Institute of Immunology (NII). The collaborative patents of Indian inventors held by Indian firms and research institutions, included contributions by inventors from the UK, USA, France, Germany, Japan, Australia, Portugal, Taiwan and Thailand. Out of 24 patents owned by Indian firms and research institutions, in almost half of the cases non-resident Indians based in the USA, UK, Thailand and Taiwan were involved.

Joint ownerships

In a few cases more than one organisation in the same country or more than one country involving inventors from those countries have collaborated to develop technologies and jointly owned patents. Out of 911 collaborative patents, there were 34 patents that had joint ownerships.

Indian firms, research institutes, and university had 16 patents in joint ownership with the entities from other countries. These included, CSIR, India with Laboratoire des Matériaux Organiques a Propriétés Spécifiques, France, Korea Institute of Energy Research, Korea with Indian Petrochemical Limited, India, Intel Corporation, USA with Indian Statistical Institute, India, ISIS Pharmaceuticals Inc, USA with University of Allahabad, Indian Institute of Chemical Technology of CSIR (India) with University of California, USA, NEC Research Institute Inc., USA with Tata Institute of Fundamental Research, India and Bhabha Atomic Research Centre, India, and Ranbaxy Laboratory, India with Toyama Chemicals Co Ltd, Japan and Vittal Mallya Scientific Research Foundation jointly owned a patent with the University of Leicester, UK, Renaissance Herbs Inc. USA and Vittal Mallya Scientific Research Foundation, India, Société Nationale d'Étude Construction de Moteurs d'Aviation, France, Defence Research and Development Organisation, India and Association pour la Recherche et le Développement des Méthodes et, France, Dr. Reddy's Research Foundation India and Reddy-Chemisor Inc. USA, Satyam Enterprises Solutions Limited with In Touch Technologies Ltd., USA, Sabinsa Corporation, USA with Sami Chemicals & Extracts Pvt. Ltd. India and Norton Co., USA with Grindwell Norton Limited, India.

Indian inventors also collaborated in 14 patents jointly owned by entities from within Germany, USA, Japan, and Singapore. In few other cases collaborative patents of Indian inventors were held by entities from different countries, like Canada-USA, Japan-USA and Sweden-USA.

Key players in collaboration

A key player in collaborative patenting activity is defined as the one who owns 10 or more patents. There were 10 different entities that held 35% of the total 911 patents. This analysis suggests that leading key players were multinational giants mostly based in the United States (Table 2).

Majority of these patents related to information and communication technology (ICT). Texas Instruments, IBM, Lucent Technologies, Cypress Semiconductor, and Intel Corporation have focussed on developing ICT related technologies. Hoechst AK, Liposome Co. Inc., and Ciba Geigy had all their patents in the area of “medicines, drugs and pharmaceuticals” including “peptides” and “heterocyclic compounds”.

Table 2 – Top Ten Major Assignee of Inventions of Indian Inventors in Collaboration with Inventors of other Countries

S.N.	Assignee	Patents	Major areas of inventing activity
1.	Texas Instruments, USA	80	Computing, calculating; counting,

			Information storage, measuring, testing, Basic electronic circuitry
2.	General Electric Co., USA	62	Organic macromolecular compounds and their preparations; Basic electric elements
3.	US Government, USA	46	Medical or Veterinary Science; Hygiene, Organic Chemistry, Alloys, Measuring electric and magnetic variables, Organic Macromolecular Compounds and Investigating materials
4.	Hoechst AK, Germany	36	Preparations for medical, dental or toilet purposes; Peptides; heterocyclic compounds
5.	International Business Machines USA	37	Electrical digital data processing
6.	Lucent Technologies, USA	15	Electrical digital data processing
7.	Intel Corporation, USA	14	Electrical digital processing, recognition of data
8.	Ciba Geigy, USA & Switzerland	13	Acyclic, carbocyclic compounds, Heterocyclic compounds
9.	Cypress Semiconductor, USA	11	Pulse technique, amplifiers, information storage
10.	Liposome Co Inc, USA	10	Preparations for medical, dental or toilet purposes, heterocyclic compounds
	Total	323	

Areas of patenting

The scientific and technological areas in which most Indian inventors were involved in developing technologies in collaboration with inventors from other countries signify their

contribution and the recognition of their core competence. The analysis of the areas of patenting was undertaken from this perspective. The broad areas of these collaborative patents were identified on the basis of the classification system of the International Patent Classification. There were 14 different broad technological domains in which 10 or more patents were obtained which accounted for about 81% of the total 911 patents (Table 3).

Table 3 – Broad Area-wise Distribution of Collaborative Patents of Indian Inventors

S.N.	IPC Code Class	Broad technological domain	Patents
1	A61	Medicine, drugs and pharmaceuticals, veterinary medicine and hygiene	130
2.	A01	Agriculture, Forestry, Animal Husbandry, Hunting, Trapping, Fishing	23
3.	B01	Physical or Chemical Processes and Apparatus in General	20
4.	B32	Layered products	15
5	C07	Organic Chemistry	92
6	C08	Organic macro-molecular compounds, their preparations or chemical working up	62
7.	C12	Biochemistry, microbiology, enzymology, mutation or genetic engineering	38
8.	G06	Computing, calculating and counting	159
10.	G11	Information storage	18
9.	G01	Measuring, Testing	38
11.	G05	Controlling and regulating	10
12.	H01	Basic electric elements	47
13.	H04	Electric communication technique	47
14.	H03	Basic electronic circuitry	40
Total			739

According to the definition given by OECD [6] to calculate ICT related patents, it is observed that 339 patents amounting to 37% of total 911 patents pertained to ICT. The majority of the ICT related patents were held by the US.

“Organic chemistry”, “organic macromolecular compounds, their preparations or chemical working up; compositions based thereon”, and “biochemistry; beer; microbiology; enzymology; mutation or genetic engineering” together had 192 patents, out of which India owned 10, US had 137 and Germany 21 patents.

Another significant technological domain was dominated by patents obtained under the class “medical or veterinary science, hygiene” that had 130 patents out of which, 100 pertained to “medicine, drugs and pharmaceuticals”.

The patenting also indicated contributions of Indian inventors in the areas like “physical or chemical processes or apparatus in general”, “layered products”, “robotics”, “automobiles”, “transportation”, “earth & rock drilling or mining”, “dyeing & printing processes of textiles and papers”, and “precious stone design”. All the patents in “dyeing and printing processes” were owned by Switzerland and all “precious stone design” related patents were held by Belgium. Indian inventors contributed their skills significantly in collaboration with inventors from mostly US, Germany, UK Italy, Switzerland, Belgium Canada and Korea.

Findings

The paper summarizes several findings of policy relevance. It empirically establishes that Indian inventors do contribute extensively to patenting by way of collaboration with the inventors of other countries. Out of 126 countries, the Indian inventors collaborated with the inventors from 28 countries including the US and had no collaborative patents with the inventors of 98 countries. The rate of collaboration has increased substantially during post WTO period.

It is significant to note that Indian inventors have demonstrated their skills in patenting technologies in a wide spectrum of areas, such as “drugs and pharmaceuticals”, “ICT”, “organic chemistry”, “organo-macromolecular compounds”, etc. The majority of the collaborative patenting by Indian inventors was carried out in collaboration with the inventors from the US and European countries. Most of these patents were owned by private firms in the US and Europe. US academia and government departments too held collaborative patents of Indian inventors. Ten key players owned one third of the total patents and most of them belonged to the US. Fourteen technological domains comprised more than three fourth of the collaborative patents.

It is not unravelled from the data how these collaborations have come into place. The above analysis indicates that definite policy related initiatives could be taken to further enhance the collaboration of Indian inventors with the inventors of other countries. The involvement of Indian inventors in private firms in India and abroad can be further catalysed by creating more awareness about such opportunities in the areas of strength and core competence. However, in case of Indian research institutions and firms there is a need to enhance international collaboration in patenting through conscious policy of public private partnerships.

References:

1. G. Melin and O. Persson, Studying research collaboration using co-authorship. *Scientometrics*, 36; 363-377, Akademiai Kiado with Springer Science, 1996.
2. D. Beaver and R. Rosen, Studies in scientific collaboration: Part I – The professional origins of scientific co-authorship. *Scientometrics*. 1; 65-84, Akademiai Kiado with Springer Science, 1978.
3. D. Beaver and R. Rosen, Studies in scientific collaboration: Part II – Scientific co-authorship, research productivity and visibility in the French scientific elite, 1799-1830. *Scientometrics*. 1; 133-148, Akademiai Kiado with Springer Science, 1979.
4. M.K.D. Rao and B.M. Gupta, Indo-German collaboration in S&T: An analysis through co-authored publications, 1996-2000. *Annals of Library and Information Studies*. 51; 64-71, National Institute of Science Communication and Information Resources, 2004.
5. B.M. Gupta et al., India's collaboration with Australia in science and technology: A scientometric study of co-authored papers during 1995-99. *DESIDOC Bulletin of Information Technology*. 22; 21-35, Defence Scientific Information and Documentation Centre, 2002.
6. OECD, Science Technology and Industry Scoreboard, 2005. <http://www.oecd.org/sti/scoreboard>.

Acknowledgements

The author wishes to express his sincere thanks to Dr. V.K.Gupta, Scientist, at National Institute of Science Technology and Development Studies, New Delhi, India, for his valuable suggestions in the preparation of this paper.