Research Papers with Abstract

Sujit Bhattacharya

- Bhattacharya, S. (2018) Eugene Garfield: Brief Reflections (2018) *Scientometrics* 114(2) pp. 401-407 IF 2.147 (SCI)

https://link.springer.com/article/10.1007/s11192-017-2620-7

Eugene Garfield ubiquitous presence in scientometrics masks to some extent his influential contributions in diverse areas. Taking this as a premise for this study, the article attempts to trace Garfield's contributions in four key domains: in data analytics, in influencing scholars involved in the study of science as an epistemic practice and a knowledge product, his engagement with scholars in developing countries and in innovation and entrepreneurship. The article however provides only a glimpse of his deep engagement in the above domains. The study concludes by arguing for scientometrics to develop strong connect with the different strands of research in science studies and other cross-disciplinary areas which pioneer like Garfield undertook through his writings, developing social networks and creating knowledge products.

- Shilpa and Sujit Bhattacharya (2017) Indo-French cooperation in water sciences: capturing research dynamics through co-authorship analysis. *Current Science* 113(9):1668-1674. IF 0.843 (SCI)

https://www.currentscience.ac.in/Volumes/113/09/1668.pdf

Water scarcity and quality are among the key challenges of the 21st century. Compelling necessity to address this problem has led to the emergence of various types of international collaboration. India is one of the countries seriously affected by water scarcity and quality. International collaboration has emerged as an important component of India's strategy for mitigating the water-related challenges. One of the key linkages in India's international cooperation in water sciences is observed with France. This cooperation has led to the establishment of two joint laboratories: Indo-French Centre for Groundwater Research and Indo-French Cell for Water Sciences. The present study examines the structure of this research cooperation through co-authorship analysis. Analysis over a period of time showed that authors from the two laboratories played a key role in developing the network. The importance of this network is also discussed.

- Bhattacharya. S. and Shilpa (2016) Capturing the Growth Dynamics of Science: A Publication based Analysis. *Current Science* 110 (8), pp. 1429-1425. IF 2.147 (SCI)

https://www.currentscience.ac.in/Volumes/110/08/1419.pdf

This article attempts to identify the dynamics of knowledge production. Conceptual framework is based on research publications taken as 'proxy' indicator of research process and outcome. Indicators are constructed from research publications to capture the dynamics of research. The rationality of this approach is discussed. The study also shows that publications are increasing exponentially underscoring the intensive research undertaken globally. Determinants of publication growth have changed significantly in comparison to earlier periods. The study argues

that the above determinants are indicators of changing global research structure and dynamics, and should be considered in national research and innovation policy making

- Bhattacharya, S., Shilpa, Kaul, A. (2015). Emerging Countries Assertion in the Global Publication Landscape of Science: A Case Study of India. *Scientometrics*, 103(2): 387-411. http://link.springer.com/article/10.1007%2Fs11192-015-1551-4

https://link.springer.com/article/10.1007/s11192-015-1551-4

Global landscape of scientific activity is changing and becoming more diverse with emerging economies particularly China redrawing the contours of scientific research in the twenty-first century. Research publications, the most cherished output of science, provides robust evidence of this changing landscape. The global publication share of advanced scientific countries is decreasing with significant rise in publication share of China and also of other emerging economies such as India, South Korea, and Brazil. Their publications though are still lagging in global reception as measured through citations. However, with increasing international collaboration and publishing in promising areas and high impact journals, the citation reception of their papers is increasing. Indian publication growth is much behind China whose growth has been dramatic! However, India's emergence is interesting as from a leading country among developing economies in scientific publications till early 1980s, her publication growth exhibited sharp decline in the late 1980s. Only from 1995 onwards India started making an assertion in the global publication race and in some promising areas of high relevance such as nanotechnology her publication growth has been impressive. India to a large extent epitomises the scientific activity of emerging economies. Thus through the lens of India's publication trend, the paper underscores the changing global landscape of science. To place India's publishing activity in proper context, the paper broadly examines the publication activity of some advanced OECD countries and BRICKS (Brazil, Russia, India, China, South Korea and South Africa) countries. Implications of this study are discussed.

- Bhattacharya, S., Kaul, A., Shilpa, Sharma, P. (2014). Role of Bilateral Institution in Influencing Collaboration: Case Study of CEFIPRA- A Bilateral S&T Institution Established by India and France. *Scientometrics*, 102 (1): 169-194.

http://link.springer.com/article/10.1007%2Fs11192-014-1454-9

International collaboration has become a strategic policy initiative for building scientific competency in different countries. This is driven by increasing realisation that no country possess all the wherewithal to address complexities of scientific research, dedicate huge funding, and confront global challenges. Varied institutional mechanisms have been created by different countries for strategising international collaboration such as signing bilateral agreements, initiating dedicated programs with partner countries in different S&T areas. Some countries have further deepened their relationship by creating bilateral S&T organisations/specialised centres. The role of bilateral organisation in strengthening inter-country research and innovation partnership is not explicitly underscored in collaboration studies. The present study addresses

this issue by taking up the case study of a bilateral organisation IFCPAR/CEFIPRA (Indo-French Centre for Promotion of Advanced Research/Centre Franco-Indien pour la Promotion de la Recherche Avancée) which was established by India and France in 1987 to support their science and technology partnership. Through this case study the paper draws insight of inter-country collaboration in S&T and show how its dynamics and structural aspects are affected by a bilateral organisation.

- Shrivats, S. V., Bhattacharya, S. (2014). Forecasting the trend of international scientific collaboration. *Scientometrics*, 101 (3): 1941-1954.

http://link.springer.com/article/10.1007%2Fs11192-014-1364-x

The study demonstrates an integrated method of forecasting the trend of a country's publications. In this context the paper examines international collaboration in a country's overall publication and forecasts its future trend. The integrated method is based on regression and scaling relationship. India is taken as a case study for this examination. The study shows some interesting features of India's publication pattern based on time-series data. One observes exponential nature of her publication growth from 2002 onwards. International collaboration also exhibits exponential growth roughly from the same period. Also one observes the faster growth of international collaborative papers than the overall growth of research papers. The study predicts values of number of internationally collaborative papers for the years 2015 and 2020. The robustness of the method is also demonstrated

- Koen, B., Bhattacharya, S. (2013). Emerging technologies in India: Developments, debates and silences about nanotechnology. *Science and Public Policy*, 40 (5): 628-643.

http://spp.oxfordjournals.org/content/40/5/628.full

In the last decade nanotechnology entered the policy arena as a technology that is simultaneously promising and threatening, and with a similar Janus-like face, nanotechnology entered the development agenda. How does a developing country like India deal with nanotechnology? Combining a quantitative and qualitative approach, this paper outlines the developments, discussions, and silences concerning nanotechnology in India. The nanotechnology landscape in India is dominated by government initiatives. Government investments led to a steady rise in global publication rankings, scientific collaborations and the number of institutions involved. This growth is mainly rooted in fundamental research and public research institutes. Industry involvement and patenting activity are at a nascent stage and developing slowly. Issues that were raised in the Indian context relate to funding, capacity, commercialization, regulation of risks, and the distribution of benefits. Nanotechnology is positively viewed across the board, with notable silences on ethical issues and the relation to the public..

- Bhattacharya, S., Shilpa, Bhati, M. (2012). China and India: The Two New Players in the Nanotechnology Race. *Scientometrics*, 93(1): 59-87.

http://link.springer.com/article/10.1007%2Fs11192-012-0651-7

Nanotechnology is promising to be the 'transformative' technology of the 21st century with its boundless potential to revolutionize a wide range of industries. Stakes are high as projected estimate of market value and economic and social benefits are immense for countries that can attain competency in this technology. This has stimulated OECD countries as well as emerging economies to channel huge resources for developing core capabilities in this technology. Unlike, other key technologies, recent influential reports highlight China in particular and to some extent India, Brazil and other emerging economies competing with advanced OECD countries in 'nanotechnology'. The present paper investigates through bibliometric and innovation indicators to what extent China and India have been able to assert their position in the global stage. The paper also underscores the importance of capturing indications from standards and products/processes along with publications and patents to capture more accurately the latent variable 'performance'. Study shows that China's progress is remarkable; it has already attained leading position in publications and standard development. India is making its presence more visible particularly in publications. China's research is more sophisticated and addresses nano-materials and its applications whereas India's research shows healthy trend towards addressing developmental problems

- Krishna, V.V., Patra, S.W., Bhattacharya, S. (2012). Internationalisation of R&D and global nature of innovation: Emerging trends in India. *Science, Technology & Society*, 17(2): 165-199.

http://sts.sagepub.com/content/17/2/165.abstract\

Till the end of 1980s, offshoring of R&D (Research and Development) by TNCs (Trans National Corporations) were mainly confined to industrially advanced countries, particularly among the 'Triad' (US, Europe and Japan). Even if TNCs moved to the developing countries, during the early to mid-1990s, their R&D activities were mainly restricted to 'one way technology transfer' or oriented towards 'adaptive R&D' rather than 'creative R&D'. This study finds that during the last two decades, this paradigm has changed significantly. India has emerged as an important destination for about 471 TNCs with about 649 R&D units. Indian R&D and innovation threshold has moved up quite dramatically in the last decade to transform from 'one way' to two-way knowledge transfer. Now many foreign R&D units are developing products from India for their global product mandate. The exploration of TNCs and their impact in the Indian context advances the view that India is emerging as an important partner in the globalization of innovation. Another important trend of globalization and the global nature of innovation emerging is the rise of the Indian firms that expand business and link up with the global production networks.

- Bhattacharya, S., Shilpa. (2012). China Moving Ahead in the Global Nanotechnology 7Race: Evidences from Scientometric Study. *COLLNET Journal of Scientometrics & Information Management*, 6(1)

http://www.tandfonline.com/doi/abs/10.1080/09737766.2012.10700927

Nanotechnology is emerging as a key technology of the 21st century wherein stakes are high as projected estimate of economic and social benefits are immense for countries that can attain competency in this technology. A Country/firm's competency can be judged from various dimensions: from research outcomes to final product/processes developed, its international market reach and monopoly position in domestic and high value markets. Unlike other key technologies, in nanotechnology we observe emerging economies particularly China competing with advanced OECD economies. This sends an important signal as emerging economies are generally involved in adaptive R&D and undertake follow on innovation. Keeping this in context, the paper attempts to capture the contemporary position of nanotechnology development in China through bibliometric and innovation indicators. We argue that applying innovation indicators such as standards and products/processes developed along with bibliometric indicators provide a deeper insight of a country's development. The study shows China has been able to make an assertion in this area and has potentiality to forge ahead. It is emerging as a leading country in publication and standardization activity.

- Das, A., Arora, P. and Bhattacharya, S. (2012). Webliography of STI indicator databases and related publications. *Journal of Scientometric Research*, 1(1): 86-93.

http://eprints.rclis.org/19410/

The Science, Technology and Innovation (STI) indicators have become essential tools for assessing knowledge capacity in a country or a region and as evidence for setting policy actions. Indicator development has become possible primarily because of two parallel efforts: collection and compilation of global, regional and national statistics on various dimensions of STI, and development of manuals/guidelines for their proper collection. These statistics and indicators are mostly available in the form of print or online publications as well as in the form of online databases or as sub data sets of online data portals. An indicative list of global, regional and national databases and publications is given in this webliography for engaging readers with STI indicators and related tools. Some of the key manuals/guidelines are also highlighted.

- Jayanthi, A.P., Bhatti, M, Bhattacharya, S. (2012). Nanotechnology: Risk, and Governance in India. *Economic & Political Weekly*, 47(3): 34-40.

http://www.epw.in/perspectives/nanotechnology-risk-governance-india.html

This article analyses the potential consequences of the application of nanotechnology in the Indian context and studies the institutional arrangements for "risk governance" of nanotechnology in other countries. It is argued that nanotechnology governance in India requires a separate agency - similar to the one established for biotechnology - to develop human resources, infrastructure, and research and to monitor issues and concerns in the field.

- Bhattacharya, S., Bhati, M. (2011). China's Emergence as a Global Nanotech Player: Lessons for Countries in Transition. *China Report*, 47 (4): 244-262.

http://chr.sagepub.com/content/47/4/243

Nanotechnology is developing as a strategic branch of science and engineering in the twenty-first century, a key technology that can fundamentally restructure the technologies currently used in varied industries. Nanotechnology appeals to developing economies as it can provide novel interventions in areas that are of pressing concern such as the environment, water purification, agriculture, energy and so on. Thus, it becomes important to assess the extent to which developing countries are creating capacity in this technology and whether it is providing a 'window of opportunity' for them to 'catch up' with the developed world. This study highlights the significant achievements by China in capacity creation which is already showing tangible outcomes. Government-affiliated research institutes and universities are playing a leading role in this endeavour and developing novel partnerships particularly with foreign firms. Through the lens of nanotechnology development, the study examines China's policies, strategies and governance that are helping it to create capacity and make a strong assertion at the global stage in a high-technology area. The study discusses the lessons from China for other emerging economies that are trying to 'catch up' using technological intervention

- Bhattacharya, S., Shilpa (2011). Mapping Nanotechnology Research and Innovation in India. *Journal of Library & Information Tec*hnology, 31(5): 349-358.

http://publications.drdo.gov.in/ojs/index.php/djlit/article/view/1191

Nanotechnology has generated a great deal of excitement world-wide and is being cited as the key technology of the 21st century. Nanotechnology provides a window of opportunities for countries like India that tends to address developmental problems and forge economic growth through technological intervention. Emerging technology such as nanotechnology provides a level playing field as even advanced OECD economies are developing competency in this technology. From 2001 onwards, Government of India has given special attention to this area. The present study examines, through bibliometric and other innovation indicators (standards, products/processes developed), the present state of development of nanotechnology research and innovation in India. These findings are discussed in the context of China's activity in this field.

- Bhattacharya, S., Jayanthi, A.P. (2011). Research and Innovation for Drug Development in Neglected Diseases: A case study of India'. *African Journal of Science, Technology, Innovation and Development*. 30(1): 236-258.

http://reference.sabinet.co.za/sa_epublication_article/aa_ajstid_v3_n3_a12

This study investigated the research and innovation in 'neglected diseases' in India and the various modalities being undertaken to develop 'novel' drugs for these diseases. In spite of increase in scientific research and patent filing, examination of Indian pharmaceutical firm's activities shows that only a few firms are involved in the domain of neglected disease. Government is trying to bridge the 'translational gap' by stimulating public-private research partnership; however, private firms primarily exhibit profit motive for coming into public partnership. This model, as the evidences show, is not suitable for drug development in neglected diseases. The study explores other models that can broadly be placed under open innovation and argues that they are more promising for drug development in neglected diseases. It calls for more attention to these approaches as they provide incentives for actors to participate and moves away from the 'market centric' focus on drug development by firms leading to research only for lifestyle diseases effecting the north.

- Bhattacharya, S., Patra, S. (2010). Assessing Competency of a Developing Country in High Technology?: A Case Study based on Indian Patenting Activity in the Biotechnology Sector. COLLNET *Journal of Scientometrics and Information Management*, 4(2): 21-34.

http://www.tandfonline.com/doi/abs/10.1080/09737766.2010.10700890

Technological capability at the national/firm level provides competitive advantage and is intrinsic to the ‘catch up’ process. However, it is difficult to capture ‘properly’ technological capability attained by a country in a particular industry/sector and gauge future trends; particularly so for a country in transition. Present paper addresses this issue. We argue that in high technology sectors, patents can provide relevant indications. Based on this argument, we analyse India’s patenting activity in biotechnology (a country epitomising developing economies). Global patenting trends shows core activity areas and changing dynamics. In addition comparison with BRIC countries assess India’s activity in proper perspective.

Analysis was undertaken for ‘biotechnology domain’ and individual technology classes that constitute this domain. To assess role of different organisational categories in technology creation; patenting activity was delineated under Indian organisations, foreign R&D centres and resident individuals. Along with trend, types of actors involved, collaboration, linkages with other industries, etc were investigated. The Study shows that India is developing technological capability both in terms of depth and breadth. However, in comparison to global landscape, it is still in infancy. We conclude that in spite of limitations, novel indications derived from patent statistics is a good indication of measuring a country’s technological capability.

- Kostoff, RN., Bhattacharya, S. (2010). Identification of Military-related Science and Technology. *Defence Science Journal*, 60(3): 259-270.

http://publications.drdo.gov.in/ojs/index.php/dsj/article/viewFile/352/213

A proof-of-principle demonstration for extracting military-related technologies from a country's total technology publications has been performed, and applied to the Indian science and technology literature#. The method is general and can be applied to the extraction of any meta-category (e.g., intelligence-relevant technologies, infrastructure-relevant technologies, etc) which is not easily obtained from document clustering or factor analysis. The methodology for identifying relevant literature on military science appears to provide credible results. The volume of literature retrieved will vary depending on how strongly relevant is the desired literature. For the same definitions of 'military relevant', the volume of India's literature in the Ei Compendex database was an order of magnitude less than that of the USA or China.

- Bhattacharya, S., Garg, K. C., Sharma, S. C., Dutt, Bharvi. (2007) Indian Patenting Activity in International and Domestic Patent System: Contemporary Scenario. *Current Science*, 92(10): 1366-1369.

A detailed assessment of Indian patenting activity over the period 1990-2002 was undertaken by (a) examining patents g ranted by the US, European and Indian Patent Office; (b) delineating pat- ents under various types, i.e. entity-wise (Indian organizations, foreign R&D centres in India, resi- dent individuals), proprietary protections (utility, design, plant patents), organization-wise (industry, research organizations, specialized institutions, etc.), industrial sector-wise, category-wise (proc- ess/product), etc.; (c) assessing impact through citation analysis, and (d) benchmarking with pat- ents activity of some developed and developing countries. Patent filing through the Patent Cooperation Treaty and patenting during the period 2003-04 in the US was analysed. The strategic options for commercialization of patents were also investigated. Recommendations have been given for strengthening the patenting activity in the country.

- Kostoff, RNK., Briggs,M.B., Rushenberg,R.L., Bowles, C.A., Bhattacharya, S, Johnson, D., Icenhour, A.S., Nikodym, K., Barth, R.B., Dodbele, S., Pecht, M. (2007). Assessment of China's And India's Science and Technology Literature As Reflected In The SCI/SSCI. *Current Science*, 93(8): 1088-1092.

http://www.sciencedirect.com/science/article/pii/S0040162507000534

Science and technology (S&T) allows (1) automation to replace human labor, (2) enhanced human labor capabilities, (3) quicker and cheaper production of goods, and (4) more complex products and processes. In order to maintain competitive advantages, it is critical for any country to understand what other countries are producing in S&T, and what intrinsic S&T capabilities are being developed. India and China are the two most populous countries in the world. These two dynamic economies are advancing rapidly in S&T, and it is prudent to assess the quantity and quality of their research output as well as to examine trends in their S&T capabilities.

This paper, the first of four in a Special Section on China's and India's S&T, introduces the remaining three papers. Specifically, this paper describes the motivation for the studies, the background for understanding national S&T assessments, an overview of text mining, a brief

picture of the Indian and Chinese S&T establishments, and a summary of the analytical techniques used in the assessments

- Bhattacharya, S., Arora, P. (2007). External Linkages in Indian Universities: What they reveal and what they imply? *Scientometrics*, 70(2): 277-300.

http://link.springer.com/article/10.1007%2Fs11192-007-0204-7

The study investigated industrial interactions in science and 'applied science' departments of seven universities in India. Motivating factors and constraints perceived by university departments and the role of the government in initiating and sustaining interactions were examined. Different types of interactions with industry were exhibited in the seven selected universities. Some specific initiatives like creation of special centers to facilitate interaction with industry were observed in the majority of the selected universities. Personal contact was indicated as the major motivator in the initiation of linkages. The government had taken some important initiatives to strengthen the university-industry link. The study points to the need of developing further linkages so that they can lead to successful and mutually beneficial outcomes for both university and industry.

- Bhattacharya, S, (2007). Delineating the patent data: A case study of prolific patenting institutions of India and China. Special Issue on Measurement- *DESIDOC Bulletin of Information Technology*, 27(1), 87-95.

http://www.researchgate.net/profile/Sujit_Bhattacharya2/publication/228661590_

Technological capability/strength, market monopoly/success of R&D efforts are some of the indications, patents that belong to an entity signify. However, a simple patent count provides only a limited indication. Informetric analysis can be successfully applied to reveal the underlying hidden characteristics of the patent statistics. At the same time, caveats in analysing patent data and understanding the different attributes of a patent/patenting system is required to undertake a proper analysis. An investigation of prolific patenting institutions of India and China was undertaken to support the above argument. Their patenting activity in the US was investigated for the period 1998-2002. The attributes of the US patent system were used to distinguish the patent data. Patent profiles in terms of technological domains/applications were uncovered by informetric analysis. Effectiveness of the patenting activity, strategic and policy aspects were derived from this exercise. The paper attempts to make contribution towards integrating the features of the patent system, different aspects of patent statistics and tools of informetrics for deriving meaning that can be used by a wider audience.

- Kostoff, R.N.K., Johnson, D., Bowles, C.A., Bhattacharya, S., Icenhour, A.S., Nikodym, K., Barth, R.B., Dodbele, S, (2007) Assessment of India's Research Literature. *Technological Forecasting and Social Change*, 74(9): 1574-1608.

http://www.sciencedirect.com/science/article/pii/S0040162507000558

The structure and infrastructure of the Indian research literature were determined. A representative database of technical articles was extracted from the Science Citation Index/Social Science Citation Index (SCI/SSCI) [SCI. Certain data included herein are derived from the Science Citation Index/Social Science Citation Index prepared by the THOMSON SCIENTIFIC®, Inc. (Thomson®), Philadelphia, Pennsylvania, USA: ©Copyright THOMSON SCIENTIFIC® 2006. All rights reserved. [1]] for 2005, with each article containing at least one author with an India address. Document clustering was used to identify the main technical themes (core competencies) of Indian research. Aggregate India bibliometrics were also performed, emphasizing the value of collaborative research to India. A unique mapping approach was used to identify networks of organizations that published together, networks of organizations with common technical interests, and especially those organizations with common technical interests that did not co-publish extensively. Finally, trend analyses were performed using other year data from the SCI/SSCI to place the 2005 results in their proper historical context.

- Kostoff, R.N.K., Briggs, M.B., Rushenberg, R.L., Bowles, C.A., Pecht, M., Johnson, D., Bhattacharya, S., Icenhour, A.S., Nikodym, K., Barth, R.B., Dodbele, S. (2007). Comparisons of the Structure and Infrastructure of Chinese and Indian Science and Technology. *Technological Forecasting and Social Change*, 74(9): 1609-1630.

https://www.researchgate.net/publication/223079678_Comparisons_of_the_structure_and_infrastructure_of_Chinese_and_Indian_Science_and_Technology

A comparison was made of the research output literatures of India and China. Both bibliometric and computational linguistics approaches were used in the comparison. China has rapidly outpaced India in both volume and citation performance of publications. China's rapid publication growth rate over the past two decades is continuing, while India's is re-starting after a relatively dormant period of almost two decades.

- Bhattacharya, S. (2004). Implications for Indian pharmaceutical sector in the new WTO regime. *Medicinal Chemistry Research*, 13(6/7): 369-389.

https://link.springer.com/article/10.1007/s00044-004-0042-6

The paper examines the factors that are likely to influence the pharmaceutical industry in India in the new WTO regime and the preparedness of government, research organizations and firms to compete in this scenario. The study shows that government has made some important changes after the signing of WTO agreement in 1994, but there are still some contentious issues that require attention. Beginnings have been made by firms and research organizations to confront the challenges ahead by increasing R&D investment, patenting activity and adopting novel strategies. Implications of this study in the policy context are discussed.

- Martin, M., Bhattacharya, S. (2004). Commonalities and differences between scholarly and technological collaboration, *Scientometrics*, 61(3): 443-456.

https://link.springer.com/article/10.1023/B%3ASCIE.0000045120.04489.80

Co-authorship analysis is a well-established tool in bibliometric analysis. It can be used at various levels to trace collaborative links between individuals, organisations, or countries. Increasingly, informetric methods are applied to patent data. It has been shown for another method that bibliometric tools cannot be applied without difficulty. This is due to the different process in which a patent is filed, examined, and granted and a scientific paper is submitted, refereed and published. However, in spite of the differences, there are also parallels between scholarly papers and patents. For instance, both papers and patents are the result of an intellectual effort, both disclose relevant information, and both are subject to a process of examination. Given the similarities, we shall raise the question as to which extent one can transfer co-authorship analysis to patent data.

- Bhattacharya, S. (2004). Mapping inventive activity and technological change through patent analysis: A case study of India and China, *Scientometrics*, 61(3): 361-381.

https://link.springer.com/article/10.1023/B%3ASCIE.0000045115.23375.50

The characteristics of Indian and Chinese patenting activity in the US patent system are examined by delineating two categories of patents; 'nationally assigned', and 'invented not nationally assigned' patents (not-nationally assigned patents in short). Further within the above two categories, patents are distinguished and analysed in terms of patent types: utility, design, and plant patents. Indian patents are mainly of utility type whereas China's activity falls in both utility and design.In the 'nationally assigned' patents, the different types of institutions involved and linkages are much higher for China. However, 'not-nationally assigned' patents of both the countries are dominated by industry and inter-institutional collaborations are sparse. Patents addressing technology sectors (analysis based on utility patents) do not exhibit major differences between the two categories in Chinese patents and address with varying degree all technology sectors. Unlike China, India's 'nationally assigned' patents are concentrated in chemical and drugs & medical whereas their 'not-nationally assigned' patents are similar to that of China in addressing technology sectors. In design patents, Chinese 'nationally assigned' patents mainly cover ornamental design of lighting equipments whereas their 'not-nationally assigned' patents are mainly in design equipment for production, distribution or transformation of energy. Further, few firms are active in design patents in both the categories. India's design activity is insignificant in both the categories. The paper concludes by examining the results in the policy context.

- Gupta, B.M., Bhattacharya, S. (2004). A Bibliographic Approach towards Mapping of Science. *DESIDOC Bulletin of Information Technology*, 24: 3-8.

https://www.researchgate.net/publication/228997675_Bibliometric_approach_towards_mapping_the_dynamics_of_science_and_technology

This paper attempts to highlight the role of bibliometrics in studying the dynamics of science and technology. Tools and techniques available in bibliometrics to address and understand the complexities of scientific fields are explored. The paper concludes that for wider acceptance

among academicians and policy makers, bibliometric approach should ingrain itself within sociology and philosophy of science in studying the different facets of science and technology.

- Bhattacharya, S., Martin, M. (2003). Large firms and the Science/technology interface-Patents, patent citations, and scientific output of multinational corporations in thin films, *Scientometrics*, 58(2): 265-279.

https://link.springer.com/article/10.1023/A%3A1026284510104

Firms operating in science-based technological fields reflect some of the complexities of the science-technology interaction. The present study attempts to investigate these interactions by analyzing patent citations, publication and patent outputs of multinational corporations (MNCs) in 'thin film' technology. In particular we explore different characteristics of knowledge production and knowledge utilization of these firms. The results indicate no correlation between intensity of research activity and patents produced by the MNCs. The relationship between scientific and technological knowledge generation as well as the linkage between science and technology appear to be firm-specific rather than dependent on a technological or industrial sector. The dispersion of journal sources for the majority of patent citations of scientific literature as well as for the majority of scientific outputs is narrow. Basic journals play an important role in patent citation as well as in addressing research of MNCs in thin-film technology.

- Bhattacharya, S., Hildrun K., Martin, M. (2003). Characterizing Intellectual spaces between science and technology, *Scientometrics*, 58(2): 369-390.

https://link.springer.com/article/10.1023/A%3A1026244828759

The paper presents a methodology for studying the interactions between science and technology. Our approach rests mostly on patent citation and co-word analysis. In particular, this study aims to delineate intellectual spaces in thin-film technology in terms of science/technology interaction. The universe of thin-film patents can be viewed as the macro-level and starting point of our analysis. Applying a bottom-up approach, intellectual spaces at the micro-level are defined by tracing prominent concepts in publications, patents, and their citations of scientific literature. In another step, co-word analysis is used to generate meso-level topics and sub-topics. Overlapping structures and specificities that emerge are explored in the light of theoretical understanding of science-technology interactions. In particular, one can distinguish prominent concepts among patent citations that either co-occur in both thin-film publications and patents or reach out to one of the two sides. Future research may address the question to what extent one can interpret directionality into this.

- Bhattacharya, S., Nath, P. (2002). Using patent statistics as a measure of ‘technological assertiveness’: A China-India comparison, *Current Science*, 83(1).

https://www.researchgate.net/publication/255639257_Using_patent_statistics_as_a_measure_of_'technological_assertiveness'_A_China-India_comparison

The article compares relative technological assertiveness of India and China by using patenting as a strategic act for protection of respective trading interest. Patenting activities (in the US) of both these countries in the pre- and post-WTO period have been analysed for this purpose. The analysis suggests that India, although has covered much ground vis-à-vis China in patent-related activities, is yet to activate the process of utilization of the patented technology for economic benefit. The article concludes that India needs a long -run trade-related technology strategy for creation of economic wealth from patent.

- Bhattacharya, S., Moh'D T.R. Khan. (2001). Monitoring Technology Trends through Patent Analysis: A Case Study of Thin Film, *Research Evaluation*, 10: 25-37.

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The trends and directions of an important area, thin film technology, is explored through analysis of US patents, comparing activity in 1989, 1993 and 1997, and 1993–1997 in detail. A classification system for all the patents in our data set under technological sector(s) and subsector(s) helps determine the major application areas of thin film technology, and thence broader subunits. The commonality and specificity of these sub-units over the time periods are delineated. The profiles of companies active in this technology are examined, including major application areas, changes in their application profile over the time periods, their main operational areas, international rankings, etc. Detailed inspection of the profile in 1993–1997 shows what the future trend might be in this technology. Copyright , Beech Tree Publishing.

- Sujit Bhattacharya and Prajit Basu (1998)"Mapping research at the micro level using co-word analysis", *Scintometric*s, 43(3).

https://link.springer.com/article/10.1007/BF02457404

The present study investigates the use of co-word analysis method to understand the micro structure of a research speciality. This study is done in the area of Condensed Matter Physics (CMP) taking two time-periods, 1990 and 1995. Based on concurrent set of journals occurring in the subject heading list of CMP in these two time-periods, a database is created after downloading articles present in these journals from the INSPEC database. Using words extracted from the titles from the created database, suitable co-word pairs are constructed. These words, and co-word pairs are explored further to understand their linkages with each other through network analysis methods. Dynamics, within the CMP across 1990 and 1995, are investigated through the comparison of the words, co-word pairs and structurally equivalent blocks. The results are projected using multi-dimensional scaling. The important conclusions of this study are discussed.

- Bhattacharya, Sujit (1997) "Tracking Changes in Research Priorities of Physics: A Macro Level Analysis" *Scientometrics*, 40(1), 1997.

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This paper attempts to monitor the changes in research priorities in Physics by analyzing the research profile of thirty three countries in major fields of Physics as classified under PACS (Physics and Astronomy Classification scheme). Data is taken from INSPEC (CD-ROM) version under two different time periods—1990 & 1995. Priority Index (PI) is used to understand the priorities of countries in major fields and shifts in their priorities during these two time periods. Correspondence analysis is applied to the matrices of research priorities to understand the multivariate relationships between countries and fields and reveal the dynamics of changes taking place in two time periods. The results and its implications for policy studies are discussed.

- Bhattacharya, Sujit (1997) "Cross-National Comparison of Frontier Areas of Research in Physics using Bibliometric Indicators" *Scientometrics*, Vol.40, No. 3.

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This paper attempts to reveal the characteristics of high activity areas of world research in Physics. "Frontier areas"-areas of high activity and areas of low activity are identified. Research activities in "Frontier areas" for twenty six countries (major countries) contributing maximum research output in Physics are analyzed for two time periods (1990 & 1995). The main objective of this study is to reveal the areas of research priorities, trends, gaps and similarity of research efforts of major countries in these "frontier" areas. Key countries in these areas in both the time periods are identified. Multivariate Scaling Algorithm is applied to the countries and fields in each time period, and also simultaneously to understand the relationship between countries and fields and the dynamics of change in research priorities. Results and implications of this study for policy research is highlighted