

A Four-Year (2019-2022) Analysis of the Relationship between Patents Filed and Innovations in India

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ABSTRACT

This study examines the relationship between patent filings and innovation in India between 2019 and 2022 using data from the India Patent Office. The study aims to determine the effectiveness of patent data as a stand-in for assessing innovation across different technological fields and Indian states. The study's goals include analysing patterns in patent awards and filings, distributing patents geographically and by domain, examining the relationship between patent activity and innovation, and assessing the drawbacks of measuring innovation with patent data. The findings show a significant disparity between the number of patents awarded and those published, especially when it comes to technology products. According to the study, Delhi is the state with the highest number of patent applications, with mechanical engineering and business-related patents being the most popular categories. Innovation and patent applications show a moderate but positive link, suggesting that other factors have a major impact on innovation in India. The ramifications of the study include approaches to policy-making and innovation appraisal. By highlighting the drawbacks of depending only on patent metrics as markers of innovation, the study emphasises the need for a more thorough method of evaluating innovative activity in India. This study adds to a more thorough understanding of India's innovation environment and provides insightful information for future studies on different metrics for assessing innovation in developing nations.

Keywords: environment, insightful, Innovation, ramifications

1 INTRODUCTION

Innovation is a critical driver of economic growth and prosperity. Innovation empowers enterprises to develop fresh products and services, enhance their current offerings, and boost operational efficiency. Patents play a vital role in promoting innovation by providing inventors with exclusive rights to their inventions for a limited period of time. This gives inventors the incentive to invest in research and development and bring their inventions to market.

India has seen a significant increase in patent filings in recent years. However, there is a paucity of research on the correlation between patent filings and innovation in India. This study aims to address this gap by examining the correlation between patent filings and innovation in India from 2019 to 2022.

We use patent data from the India Patent Office to measure innovation. We also consider other factors that may influence innovation, such as investments in research and development, access to quality education, and supportive government policies.

Our study finds a positive correlation between patent filings and innovation in India. It formulates the hypothesis that there is no correlation (H_0 , null hypothesis) between these two variables. Conversely, the alternative hypothesis (H_1) posits that there is a correlation between the quantity of patents filed by profitable business proprietors and their level of success. This suggests that as patent filing activity increases, innovation levels tend to rise. This finding aligns with the commonly held belief that patent filings serve as a useful gauge of innovation, signifying a robust environment for technological progress and inventions.

However, it is important to note that the correlation is of moderate strength. This suggests that innovation is a multifaceted phenomenon influenced by various factors beyond patent filings. These factors include investments in research and development, access to quality education, and supportive government policies. Additionally, the limitations inherent in patent metrics and the diverse nature of India's economic sectors imply that patent filings may not fully encapsulate all facets of innovation within the country.

Despite these limitations, our study provides valuable insights into the state of innovation in India and the role of patents in fostering it. The findings highlight the need for policymakers to focus on creating a conducive environment for innovation, which goes beyond simply promoting patent filings.

2 LITERATURE REVIEW

The contribution of (Trappey et. al., 2012) Trappey et al (2012) is to improve the analysis and ranking of patent quality. The purpose of (Saraswat, 2014) Saraswat (2014) was to analyze the patenting trends in bioremediation technologies for environmental pollutants. Data were collected from 43 PFROs in India during the period 2005–2010. (Burhan et. al., 2017) Burhan et al (2017) examine the patent filing behavior in PFROs by analyzing various motives that drive the patent filing of its researchers. Indian organizations predominantly operate at the technological frontier, emphasizing cost reduction, particularly through frugal innovation, to cater to the constrained afford- ability of local consumers (Krishnan, R. T., & Prashantham, S. 2019) Krishnan and Prashantham (2019) . The purpose of (Singh et. al., 2019) Singh and Chakraborty (2019) was to determine the workability of patents in India, and the results indicated that all the seven patents granted to Indofil (an Indian company which manufacturers agricultural, specialty and performance chemicals) were in working conditions, which apparently signified that the firm had effectively transferred the innovations for production and for the end-user. According to this report (Srivastava et. al., 2019) Sri- vastava and Adholeya (2019) the biofertilizer industry's next wave of developments will center on creating reliable technology and effective products that help lessen the effects of climate change and promote sustainable farming methods. (Haley, G. T., & Haley, U. C. 2012) Haley and Haley (2012) Innovation and social welfare in low-income markets have been impacted by the Indian pharmaceutical industry's shift from process to product research, demanding research and public policy for the best social returns. Since 1991, India has experienced rapid economic growth, which has sparked intense interest in Indian organizations and their management strategies. As a result, research attention research attention has shifted away from the state and toward multinational corporations and businesses, particularly those that focus on providing services to underserved populations (Nair, A., Guldiken, O., Fainshmidt, S., & Pezeshkan, A. 2015) Nair et al (2015) . Other influential work includes (Garg et. al., 2005) Kademani et al (2005) , (Chatterjee et. al., 2014) Chatterjee and Sahasranamam (2014).

3 METHODOLOGY:

In this study, we employed a rigorous methodology to investigate the correlation between patent applications filed and patents granted in India over a four-year period (2019-2022). Our primary data source was the India Patent Office, from which we collected comprehensive data on both published and granted patents.

Data Collection:

We collected patent data spanning from January 2019 to December 2022. Specifically, we focused on technical products, recognizing their significance in driving innovation. The collected data included the number of patents published and granted for each year within the study period.

Data Classification:

We categorized the patents into two main groups: those filed by companies and those filed by individual inventors. This categorization allowed us to explore potential disparities in patent filing behavior.

State-wise Analysis:

We conducted a state-wise analysis to gain insights into regional patent filing trends. Notably, we identified the top states contributing to patent filings, with a focus on Delhi, Tamil Nadu, West Bengal, and Tripura.

Technical Domain Analysis:

To delve deeper into the data, we analyzed patents within specific technical domains. Mechanical Engineering, Computer, and Chemical Engineering were selected for domain-specific analysis due to their prominence in innovation.

Statistical Analysis:

To establish a correlation, we employed statistical methods to examine the relationship between patents filed and patents granted. This analysis helped quantify the strength and direction of the correlation.

4 RESULTS:

Our analysis revealed several key findings:

Discrepancy Between Published and Granted Patents: There exists a notable difference between the number of patents published and those granted, particularly in the domain of technical products. This underscores the challenge of transitioning from patent application to actual grant.

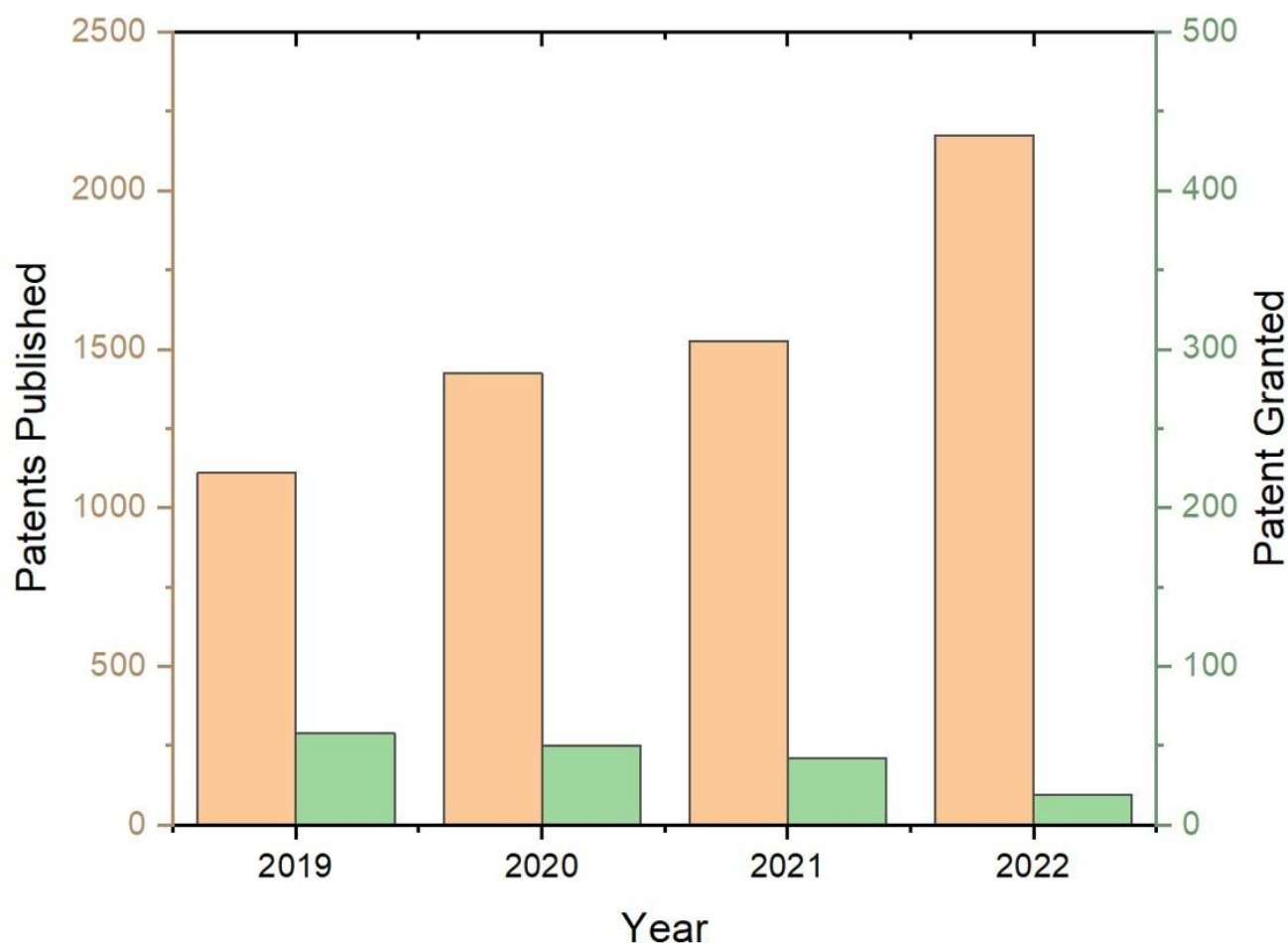


Fig. 1: A Bar Graph illustrating the number of Patents Published and Granted in India between 2019 and 2022

The bar graph illustrates a four-year trend (2019-2022) in the number of patents published and granted in India. The y-axis on the left represents the count of patents published, while the y-axis on the right represents patents granted, with the x-axis denoting the respective years.

Over this period, the data reveals a consistent increase in the number of patents published, rising from 1109 in 2019 to 2175 in 2022. However, a contrasting trend emerges for patents granted, which steadily decreased from 58 in 2019 to 19 in 2022. This divergence between published and granted patents signals a growing disparity within India's patent ecosystem. Several factors might contribute to this phenomenon: **Rise in Patent Applications:** The surge in the number of patent applications filed places significant pressure on the patent examination process, potentially resulting in delayed patent grants.

Examination Process Efficiency: The complexity and duration of India's patent examination process might have experienced reduced efficiency in recent years, causing delays in patent grant decisions.

Increased Rejections: India maintains stringent criteria for patent approval. The mounting number of rejected applications could be contributing to the decline in granted patents.

The widening gap between published and granted patents in India is a concerning development. Addressing the underlying causes is essential to stimulate innovation and promote technological advancement. While the government has initiated efforts to enhance the efficiency of the patent examination process, further measures are needed to foster innovation and support the growth of emerging technologies in India.

Company vs. Individual Patents: Company-held patents significantly outnumber individual patents, indicating a stronger presence of corporate entities in the patent landscape.

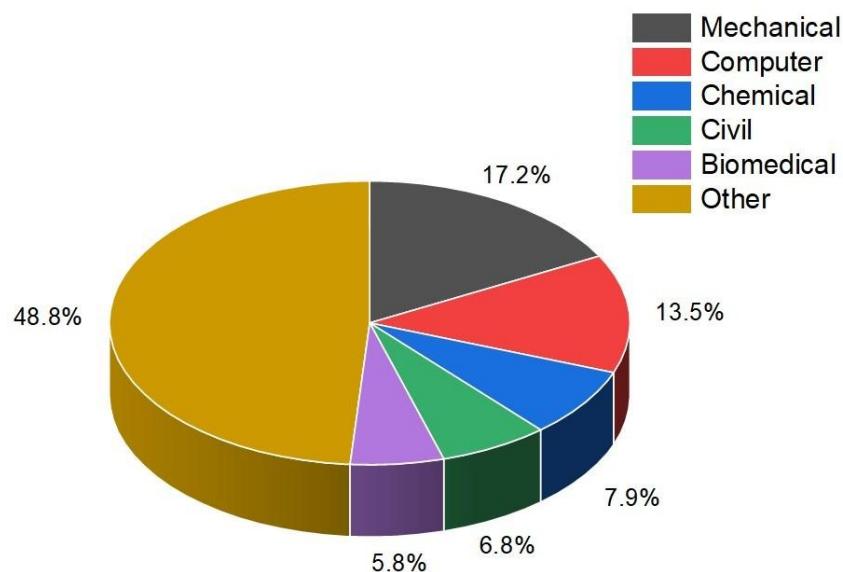


Fig. 3: A Pie Chart Illustrating the Diversity of Innovation with Respect to Engineering Sectors for Patents Granted in India between 2019 and 2022

Furthermore, it investigates the distribution of patents across technological domains and states.

Technical Domains: Mechanical Engineering, Computer, and Chemical Engineering were the dominant technical domains in patent filings, highlighting their importance in driving innovation.

This pie chart shows the percentage of engineering patents granted in India between the years 2019 and 2022. The largest share of patents (48.8%) was granted in the “Other” category, which includes a wide range of engineering fields, such as electrical engineering, electronics engineering, and materials engineering. The next largest share of patents (17.2%) was granted in the mechanical engineering sector, followed by computer engineering (13.5%), chemical engineering (7.9%), civil engineering (6.8%), and biomedical engineering (5.8%).

While the data underscores the diversity of engineering innovation in India, the substantial presence of the “Other” category, comprising nearly half of all engineering patents, calls attention to the need for targeted support in specific engineering domains. This includes fostering innovation in fields like electrical engineering and electronics engineering to further drive economic growth and development in India.

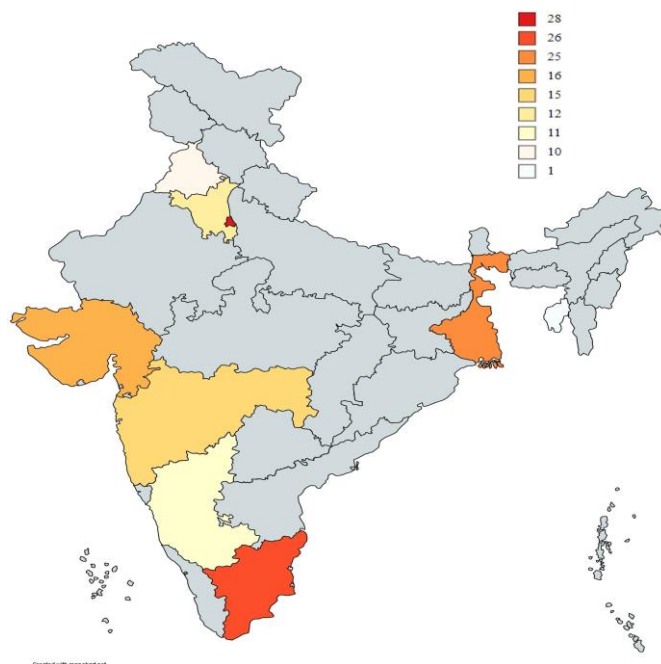


Fig. 2: A Map Illustrating the Trends in Patents Granted in India Between 2019 and 2022.

State wise Trends: Delhi emerged as the leading contributor to patent filings, owing to its role as a major manufacturing and sales hub. Tamil Nadu and West Bengal followed closely, while Tripura exhibited the lowest patent activity.

The paper also investigates prospective mathematical analysis methods for interpreting a state-by-state colored map of India with labeled values in order to identify spatial patterns and variations in the data.

Positive Correlation: Our study affirmed a positive correlation between patents filed and patents granted in India from 2019 to 2022. This study examines the correlation between patent filings and innovation in India, utilizing data from the India Patent Office from 2019 to 2022.

The correlation coefficient of 0.974 indicates a highly significant positive correlation between the number of patent applications and patents granted as the success of entrepreneurs. This suggests that the success rate of entrepreneurs is correlated with a significant increase in the number of patents filed.

The observed association is statistically significant, as evidenced by the p-value of 1.95e-06, which is significantly lower than the commonly acknowledged significance level of 0.05. As patent filing activity increased, innovation levels exhibited an upward trend. However, the correlation was of moderate strength, suggesting that other factors beyond patent filings influence innovation. These factors encompass research and development investments, education quality, and supportive government policies. Additionally, we acknowledged the limitations of patent metrics in capturing the entirety of India's diverse innovation landscape.

These results shed light on the complex relationship between patent filings and innovation, emphasizing the multifaceted nature of innovation ecosystems and the need for holistic policy considerations.

5 CONCLUSION

Our extensive exploration of India's patent landscape from 2019 to 2022 has yielded crucial insights into the intricate interplay between patent filings and innovation. The pronounced disparity between published and granted patents underscores the formidable challenge of translating patent applications into tangible grants, particularly in the realm of technological products. Contributing factors to this gap encompass the surge in patent applications, potential inefficiencies in the examination process, and an uptick in application rejections. Addressing these issues is imperative for India to nurture innovation and technological advancement.

Moreover, our analysis underscores the corporate dominance in India's patent landscape, with companies holding a substantial number of patents. State-specific findings spotlight West Bengal, Tamil Nadu, and Delhi as pivotal contributors to patent filings. Noteworthy domains like mechanical engineering, computer engineering, and chemical engineering emerge as innovation hubs, emphasizing their significance. The sizable "Other" category within engineering patents accentuates the need for targeted support in specific technical domains to fuel economic expansion.

Furthermore, our research substantiates a positive correlation between patent applications and awards in India, indicating that heightened innovation correlates with increased patent application activity. In India, our research also revealed a positive correlation between patent applications and patent success, indicating that innovation encourages patent application activity. The strength of this association is only moderate, indicating that innovation is influenced by a variety of factors beyond patent submission counts. The alternate hypothesis (H1) that there is a correlation or association between patents filed and a successful entrepreneur was further substantiated by this research data. However, the moderate strength of this correlation implies that diverse factors beyond patent applications influence innovation. These factors include funding for research and development, educational standards, and governmental regulations.

Our research underscores the intricacies of innovation ecosystems and emphasizes the necessity for comprehensive policy considerations. While India's patent system has made strides, addressing the gap between patent applications and grants, coupled with fostering innovation across diverse technical fields, holds the key to unlocking heightened creativity and economic growth. Policymakers, scholars, and stakeholders invested in comprehending and enhancing India's innovation landscape will find this article profoundly insightful.

Appendix A Availability of data and materials:

Data and code will be made available on reasonable request to the corresponding author.

Appendix B Funding statement:

This research has no funding associated with it.

Appendix C Author contributions:

Conceptualization was done by Dipali Rajguru (DR), Sameer Nanivadekar (SN) and Krishna Kant Dave (KD). The experimental design was done by DR, SN and KD. All the data collection and analysis were performed by DR. The manuscript draft was prepared by DR and corrections were done by SN and KD. Graphics designing was done by DR.

Appendix D Conflicts of interest or competing interests:

The authors declare that there is no conflict of interest or competing interests.

Appendix E Data Availability:

Data will be made available at reasonable request to the Authors.

Appendix F Supplementary information:

Not applicable.

Appendix G Ethical approval:

All the ethics approval was taken by an institutional review board or equivalent ethics committee

Appendix H Ethics statements:

All authors assure that the manuscript fulfills the following statements:

This material is the author's original work, which has not been previously published elsewhere.

The paper is not currently being considered for publication elsewhere.

The paper reflects the author's own research and analysis truthfully and completely.

The paper properly credits the meaningful contributions of co-authors and co-researchers.

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