Proceedings of International Conference on Strategies in Volatile and Uncertain Environment for Emerging Markets
July 14-15, 2017
Indian Institute of Technology Delhi, New Delhi
pp. 47-59

Role of Patents in Driving Differential Innovation and Firm Performance: A Study of Bengaluru High-tech Manufacturing Cluster

Deepak C[1] and M H Bala Subrahmanya[2]

Abstract

Of late, patenting as a phenomenon has been gaining the traction of researchers and policy makers given the economic benefits that patents offer to firms in general. Failing to withstand the intense market competition, imitator firms tend to misuse the unintended knowledge diffusions in a cluster, especially in a high-tech cluster, to their advantage. This has prompted the leader firms in a cluster to protect their inventions from imitation, by going for obtaining patents. However, the role of patents in further strengthening the innovation propensity of these firms, and enhancing their firm performance has not be adequately explored. It is in the context of Bengaluru (erstwhile Bangalore) high-tech cluster which houses densely interconnected network of high-tech manufacturing firms that this paper probes the role of patents in driving differential innovation and firm performance among firms in a cluster.

Keywords: Bengaluru, Cluster, Firm Performance, High-tech firm, Innovation, Manufacturing, Patent

1. Introduction

Of late, with the emergence of knowledge intensive industries, the intellectual capital of a firm has been increasingly garnering the attention of researchers and practitioners world-wide as it develops competitive advantage to the firm. Intellectual capital of firms refer to intangible assets including human capital, social capital and intellectual property (Smedlund, 2004). It is the ability of a firm to create intellectual capital that differentiates it from others. It is here that industrial clusters play a vital role in providing conducive environment to firms to create their intellectual capital.

Further, there is increasing in focus on the collaborative relationships, especially in high-tech clusters that are characterized by complex technologies or innovations, in order to gain and sustain a competitive advantage (Zhou, 2009; Rao and Klein, 2013). However, these collaborative relationships promoted industrial clusters pose a threat for intellectual capital of firms by providing scope for its misuse by other opportunistic/imitator firms in a cluster to their advantage (Solitander and Tidstrom, 2010). Hence, there is a growing need for firms in a cluster to strike a delicate balance between openness and appropriability (Arora, 2016). It is here that the patents assume a key role in protecting the inventions of a firm that are the outcomes of its intellectual capital. However, firms can reap the benefits of patents to a great extent if they can transform these

1. Department of Management Studies, Indian Institute of Science, Bangalore, India
E-mail: deepakc@mgmt.iisc.ernet.in
2. Department of Management Studies, Indian Institute of Science, Bangalore, India
E-mail: bala@mgmt.iisc.emet.in

inventions protected by patents into innovations that cater to the unique and customized needs of users (Kakati, 2003; Macdonald, 2004). In addition, firms that obtain patents are entitled to various economic benefits that enhance their firm performance (OECD, 2004; Haeussler *et al*., 2014; Torrisi *et al*., 2016). Given this, it is appropriate to explore the role of patents in furthering the innovation propensity of firms in a cluster and enhancing their firm performance.

Although Bengaluru cluster is predominantly known for its vibrant IT sector, it also encompasses other high-tech industries, specifically in manufacturing such as electronics, pharmaceutical, machine tools and electrical industries (Nadvi, 1995; GoK, 2006). With reference to high-tech manufacturing cluster of Bengaluru, this paper examines the role of patents in driving differential innovation and firm performance of firms in a cluster.

This paper has been structured to comprise five sections. Section 2 deals with a review of literature related to the key constructs considered in our study. Section 3 proposes the research objectives, scope, sampling and methodology employed in our study to address the identified research gaps. Section 4 delineates the results with discussion. Section 5 presents the conclusions derived from our study.

2. Literature Review

2.1 Industrial Cluster and Patents

Industrial clusters, regarded as the proponents of innovation, are geographically proximate groups of firms and associated institutions in related industries, linked by economic and social interdependencies (Porter, 1990). They provide conducive environment for firms to acquire or create intellectual capital through collaborative networks. However, with the increasing focus on collaborative relationships facilitated by industrial clusters, opportunistic behaviour exhibited by the partners in the cluster to secure market advantage unethically, (Solitander and Tidstrom, 2010) demands firms to protect the outcomes of their intellectual capital from being misused. Further, in a high-tech cluster characterized by a complex innovation or technology, the intense market competition on the one hand, and constantly changing frontiers of technology on the other hand, have put immense pressure on firms to innovate (Zhang, 2012; Blazsek and Escribano, 2016). It is in this context that the follower firms tend to imitate leader firms which are innovative and technically superior to them by misusing the unintended knowledge diffusions in a cluster (Arora, 2016). Therefore, there is a pressing need for firms in a cluster to strike a delicate balance between the sharing and protection of knowledge. It is here that the notion of patenting assumes cardinal importance in the protection of innovative outcomes of the firms. In addition, patenting also offers various economic benefits to firms.

Having understood that the environment of cut-throat competition among firms in a cluster put pressure on firms to innovate and, subsequently prompt them to patent their inventions to protect from imitation, now the question is, do patents further strengthen the innovation propensity of firms and improve their firm performance? Before answering this question, at first, the literature related to innovation and firm performance has been reviewed in the next section.

2.2 Innovation and Firm Performance

The ultimate objective of a firm is to succeed in economic terms. The firm performance which is the reflection of firm's growth was defined as the total value created by a firm through its activities, which is the sum of the utility created for each of a firm's legitimate stakeholders (Harrison and Wicks, 2013). In particular, it is a testament of how well a firm has been able to address the constantly changing needs of customers (Steinle and Schiele, 2002; Kakati, 2003; Kostopoulos *et al*., 2011). Further, it is a measure of productivity of a firm in addition to its

profitability (Loecker and Goldberg, 2014). Ultimately, it is the productivity of a firm which provides a firm with competitive advantage over others. Innovation is a critical factor which drives productivity in firms (Porter, 1990).

Schumpeter (1934) regarded innovation as the driving force of economic development. He asserted that innovation takes five forms viz. - introduction of new methods of production, new products, the opening of new markets, new sources of supply, and new forms of organization. At a firm-level, researchers have defined innovation in many ways. Innovation in general has been defined as the creation, development and introduction of new product/service or product/service components, or a new procedure or process for the benefit of the stakeholders in an organisation (Birchall *et al*., 1996). In the context of India, NKC (2007) defined innovation as a process by which varying degrees of measurable value enhancement is planned and achieved, in any commercial activity. This process may be radical or incremental, and it may occur continuously or intermittently in a company; it may be achieved by: (i) introducing new or improved goods and services and/or, (ii) implementing new or improved operational processes and/or, (iii) implementing new or improved organizational/managerial processes (NKC, 2007).

Innovations can be categorized into four types based on Schumpeterian classification. They are product, process, marketing, and organizational innovations. However, in the context of a manufacturing firm, the emphasis is laid on technological innovation which yields superior product or process as a result of technical improvements. Technological innovation is unavoidable for firms which want to gain and sustain a competitive advantage and/or gain entry into new markets (Becheikh *et al*., 2006).

With an understanding of importance of innovation and firm performance along with the definitions, it is now appropriate to explore the influence of patents on firm-level innovation and performance.

2.3 Patents, Innovation and Firm Performance

There are two alternate schools of thought elucidating the role of patenting in innovation. One school of thought argues that patent gives an exclusive privilege to the firm for a limited period of time, thereby conferring monopoly to the firm and protecting from imitation by other firms at a considerably lower cost (Sweet and Maggio, 2015). In addition, patents enable firms to secure the future technological space to develop and market new products internally (Blind *et al*., 2009; Hu 2010; Burhan *et al*., 2016; Torrisi *et al*., 2016). This enhances the ability of the firm to lock in returns from its R&D investment through higher margins and incentive to innovate.

The patent grant entitles a firm with certain economic benefits that enhance its firm performance. These benefits are complementary to those that arise due to superior innovation performance of a firm. Primarily, patent contributes to firm performance by reducing the transaction costs of a firm in the market for information by facilitating a firm to trade (sell or licence) its own proprietary technology and other intangible assets (Torrisi *et al*., 2016). It also helps a firm to establish corporate identity as a technology leader, and improve the market value of a firm (OECD, 2004; Haeussler *et al*., 2014). In the context of a firm in a cluster, the inter-firm cluster linkages that were previously based on the ascribed trust (socio-economic ties) steadily and gradually transforms into earned trust (reputation) (Schmitz, 1999). It is here that the patent which is a reflection of technical supremacy, and reputation and credibility of a firm comes in handy to establish connections with other firms (generally suppliers and customers). Further, patents also serve as the bartering chips for patented firms to enter into licensing collaborations with other firms in order to earn additional revenue (Blind *et al*., 2009). However, intensively patenting the inventions above certain threshold may also negate the positive effects of patenting on firm performance in firms, especially in those firms which are constrained by internal resources, as the costs of patenting shoot up overweighing the benefits derived from patenting.

In a nut shell, patents strengthen the propensity of a firm to innovate further, and subsequently it translates it in to improved firm performance. However, there are certain advantages of patenting that do not directly impact the firm-level innovation, yet they drive the firm performance among the firms in a cluster.

An alternate school of thought propounds that patents are only a means to innovation but not an end (Macdonald, 2004). Patents only reflect inventions capturing the explicit side of technological innovations resulting out of accumulation of tacit as well as explicit knowledge (Sweet and Maggio, 2015). Though every patent may not materialize into innovated products for various reasons including lack of market for patented technology, low applicability of patented technology to solve industry problems. (Basberg, 1987; Torrisi, 2016). In most cases, patents are used offensively with an intent to neither use it internally nor sell/license it externally but just use it to block the competitors by denying them the freedom to operate beyond the product and technology space occupied thereby supressing a healthy competition (Blind *et al*., 2009; Hudson and Minea, 2013; Torrisi *et al*., 2016). Hence, patents merely a corporate strategy not leading to any market worthy innovative product development (Sweet and Maggio, 2015).

Further, other firms may choose not to patent their inventions due to costs involved in application, grant, maintenance, litigation involving enforcement of patent rights (Hall *et al*., 2014).

To recapitulate, patents will neither enhance firm-level innovation nor firm performance unless it translates into products meeting the unique and customized requirements of users. Hence, patents are largely viewed as a cost to the company.

2.4 Gaps in the Literature

Researchers have made both theoretical and empirical contributions in determining the factors that influence the decision of a firm to obtain patents (Macdonald, 2004; Blind *et al*., 2009; Hu, 2010; Zheng, 2012; Huang and Cheng, 2015; Sweet and Maggio, 2015). However, besides theorizing the phenomenon of patenting, considerable efforts have not been put in to adequately explore the role of patents in furthering the innovation propensity of firms, especially firms in a cluster, and enhancing their firm performance. It is against this backdrop that research objective has been proposed in the next section.

3. Objective, Scope, Sampling and Methodology

3.1 Research Objective

To ascertain the role of patents in driving differential innovation and firm performance among firms in a cluster.

3.2 Scope

This study is limited to Bengaluru high-tech cluster. Bengaluru is the highest ranked hub in Asia among the 46 global hubs of technological innovations (UNDP, 2001). In addition, recently Bengaluru has been named among the top 8 technology innovation clusters in the globe by MIT Technology Review (oneindia, 2013). It is also a haven for innovation intensive firms belonging to high-tech industries (Nadvi, 1995; GoK, 2006; Okada and Siddharthan, 2007; Bala Subrahmanya, 2011; Bala Subrahmanya, 2013). Further, among the high-tech industries in Bengaluru, electronics, pharmaceutical, electrical and machine tools industries have gained the attention of global investors given the prospect these industries offer (GoK, 2006). The cross-sectional study includes firms of all sizes (measured by investment in plant and machinery above Rs. 25 lakhs) across high-tech manufacturing industries such as electronics (EC), electrical (EE), machine tools (MT) and pharmaceutical (P) industries.

3.3 Sampling and Specifics of Data Collection

The list of firms belonging to industries under consideration was sourced from multiple industry associations and government agencies. For a population of 186 high-tech manufacturing firms whose at least one of the manufacturing units are located in Bengaluru, with a confidence interval of 10 at 95% confidence level, the required minimum sample size is 64 firms. Further, four strata corresponding to each of the industry sectors under consideration were identified. Stratified Random Sampling technique was adopted to choose sample firms from our population. Based on the population size of each of the strata, total sample size and total population size, the minimum sample size required for each of the strata (20 for EC, 20 form MT, 13 for P and 12 for EE) was determined. Finally, 31, 30, 20 and 20 firms belonging to EC, MT, P and EE respectively, were chosen from the population.

Primary data collection method was employed to gather data from identified sample firms through semi-structured questionnaires and in-depth interviews with the top level management of these firms. Further, PROWESS Centre for Monitoring Indian Economy (CMIE) database was used to validate the firm-specific financial data (for the year 2015-16) which were collected through primary data collection method.

3.4 Dimensions, Variables and Measures

1. Propensity of a firm to obtain a patent:

Based on the propensity of a firm to patent its inventions, the sample firms have been classified into three distinctive groups viz. - (1) firms that have been granted with a patent (2) firms that have just filed a patent application, and (3) firms that have not filed a patent application.

2. Innovation Performance of a firm:

The two dimensions capturing both the range of unique products produced and sales obtained from these unique products are used to build an Innovation Index (INI) which is presented in Table 3:

Table 3: Dimensions of Firm-level Innovation

Sl. No.	Dimension	Variable
1	Innovated products (D_1) (Bala Subrahmanya, 2011; Sweet and Maggio, 2015)	Proportion of innovated products to total products (v_1)
2	Innovation sales (D_2) (Li *et al.*,2012; Bala Subrahmanya, 2013)	Proportion of innovation sales to total sales (v_2)

All the variables were measured on a ratio scale. In addition, the weighted score for each dimension was computed using standardized weights derived from the importance rating and the actual score of the innovation dimension. The weighted average for each dimension was computed using following equation:

(1) Weighted average for each dimension:

$$w_p = \sum_{k=1}^{m} \frac{W_k X_{kp}}{n}$$

Where,

w_p is the weighted average of p^{th} dimension, W_k is the weight of k^{th} importance rating, X_{kp} is the number of responses of k^{th} importance rating for p^{th} dimension, p is the number of dimensions, m is the total number of importance rating, and n is the total number of respondents.

Subsequently, the index number of innovation (INI) for each firm was calculated using the following equation:

$$INI = (w_1^* v_1) + (w_2^* v_2)$$

Two step process was followed to validate the index number of innovation (INI) calculated. At first, Cluster Analysis was carried out to cluster the sample firms using a K-Means algorithm into three distinct groups – Low INI, Moderate INI and High INI Clusters based on the cluster variable INI (Table A3). Further, to ascertain whether the distinct clusters differ based on the underlying constituent factors of INI (such as innovated products and innovation sales), ANOVA was employed. The results of ANOVA indicate that both the underlying constituent factors of INI varied across the cluster groups (Table A4). This signifies that both the underlying factors of absorptive capacity contributed to the variance of INI. Secondly, INI was correlated with other established measures (number of patents, R&D expenditure, and proportion of innovation sales to total sales) of innovation performance of a firm. The results indicate that INI established a statistically significant positive correlation with all the measure except R&D expenditure (Table A5). However, R&D expenditure is a poor measure of innovation. This is because how effectively a firm transforms the investment made in R&D to innovation depends on the individual competence of a firm (Sweet and Maggio, 2015). There are evidences in literature that R&D expenditure only accounted to minuscule proportion of total product innovation expenditure (Sweet and Maggio, 2015). In addition, although number of patents has established a low positive correlation with INI, it is still statistically significant. However, in the context of developing economy like India, the number of patents granted is a weak measure of innovation. This is because the culture of patenting has not evolved completely which can be largely attributed to lack of awareness about patenting and the costs involved in patenting and enforcement of patent laws (Hall *et al*., 2012; Sweet and Maggio, 2015).

3. Firm Performance:

Annual sales turnover/revenue is a preferred measure of firm performance due to easy its accessibility compared to other financial indicators such as profit and ROI (Kakati, 2003; Subrahmanya, 2011). Further, the annual sales turnover values of firms were normalized with respect their firm sizes in terms of number of employees.

3.5 Method of Analysis

To examine the varying levels of INI and FP across the groups of firms considered, the Multivariate ANOVA was carried out. This was followed by Univariate ANOVAs corresponding to each of the dependant variables (INI and FP). Further, Post Hoc (Tukey's HSD) test was employed to ascertain the extent of difference in the means of INI between the groups of firms.

4. Results and Discussion

Table 1: MANOVA Results: Box's Test of Equality of Covariance Matrices and Multivariate Tests

	F Statistic	P-value
Box's Test of Equality of Covariance Matrices	2.220	.038
Pillai's Trace	3.548	.008***
Wilks' Lambda	3.543	.008***
Hotelling's Trace	3.538	.008***
Roy's Largest Root	5.453	.008***

Between two dependent variables viz. - INI and FP, FP is normally distributed across the groups of firms considered based on propensity of a firm to patent. However, overall F test is very robust to non-normality. Further, the Box' Test of Equality of Covariance Matrices used to test the homogeneity of covariance across the groups of firms is not significant (p<.001) (Table 1). Proceeding further, the results of multivariate tests indicate that all the four statistical tests (Pillai's Trace, Wilks' Lambda, Hotelling's Trace and Roy's Largest Root) are significant (p<.01) (Table 1). This signifies that there are significant differences among the groups of firms on a linear combination of the two dependent variables (INI and FP). Furthermore, to explore the contribution of propensity of a firm to patent to varying levels of INI and FP, two univariate ANOVAs were carried out.

Table 2: Univariate ANOVA Results: INI and FP Across the Groups of Firms based on the Propensity of a Firm to Patent (firms that have been granted with a patent, firms that have just filed a patent application, and firms that have not filed a patent application so far)

Dependent Variable	F Statistic	P-value
INI	4.610	.012**
FP	3.029	**.183**

**p< (0.05/2=0.025)

Note: The test for equality of means was preceded by the test for Equality of Variances. In case the variances are equal, the regular F-Statistic values have been reported; otherwise Welch-F-Statistic values have been reported. **P-values** of results are marked in **bold**.

The one-way ANOVA results indicate that there is a significant difference [p<.025 (.05 divided by number of ANOVAs conducted or number of dependent variables] in the means of INI across the groups of firms under consideration (Table 2). However, there is no statistically significant difference in the means of FP across the groups of firms. This signifies that patents have no significant role in enhancing the firm performance of firms (Table 2).

Table 3: Post Hoc (Tukey's HSD) Test Results: INI across

Firm Group No. (I)	Firm Group No. (J)	Mean Difference (I-J)	P-value
1 *(Patent(s) Granted)*	2 *(Patent Application Filed)*	Negative	.993
	3 *(Patent Application Not Filed)*	Positive	.060*
2 *(Patent Application Filed)*	1 *(Patent(s) Granted)*	Positive	.993
	3 *(Patent Application Not Filed)*	Positive	.061*
3 *(Patent Application Not Filed)*	1 *(Patent(s) Granted)*	Negative	.060*
	2 *(Patent Application Filed)*	Negative	.061*

***p<.01, **p<0.05, *p<0.1

Further, to understand the extent of differences in the means of INI, Post Hoc test (Tukey's HSD) was carried out. It can be inferred from the test results that (Table 3)

(a) The mean of INI for the group of firms that have been granted with a patent is significantly higher than that of group of firms that have not filed a patent application, and is not significantly lower than that of group of firms that have just filed a patent application.

(b) The mean of INI for the group of firms that have just filed a patent application is significantly higher than that of group of firms that have not filed a patent application, and is not significantly higher than the group of firms that have been granted with a patent.

(c) The mean of INI for the group of firms that have not filed a patent application is significantly lower than those groups of firms that have been granted with a patent and that have just filed a patent application.

This signifies that there is no statistically significant difference in the innovation performance of firms that have been granted with a patent and firms that have just filed a patent application. Further, regardless of whether firms have just filed a patent application or granted with a patent, they exhibit superior innovation performance. This drives to a point that the propensity of a firm to patent its inventions is an indicative of superior innovation performance of a firm.

Despite the superior innovation performance of firms that have either just filed a patent application or granted with a patent over non-patented firms, there is no statistically significant difference in the firm performance between them. This is because- (1) In the context of a transitional economy like India, the culture of patenting has not emerged completely. Due to lack of awareness about patents and their strategic use, firms have not been able to derive economic value out of them (Sweet and Maggio, 2015; Burhan 2016), and (2) not all firms are innovative, even they are innovative not all firms launch patentable inventions, and if at all they launch patentable inventions, not all firms patent their inventions.

Although firms in general and Small and Medium Enterprises (SMEs) in particular innovate intensively they opt not to file patent applications because they fear that the innovation information disclosures made during the patenting process may be revealed and therein it poses a threat of rival firms using those information to their advantage (Zhang, 2012). Further, given the high costs of patent application, grant and maintenance, the firms stay away from patenting

their inventions (Hall, 2014; Sweet and Maggio, 2015). Furthermore, Imperfections in the patent protection caused by weak Intellectual Property Rights (IPRs) regimes raise concern over the enforcement of patent laws in case of patent infringements/violations by firms (Zhang, 2012). In the context of high-tech industries, technology changes at a rapid pace and there are chances that by the time a patent is granted, the patented technology would have been obsolete (Basberg, 1987; Torrisi, 2016). Thus a patent obtained may not find a place in the market.

The process of obtaining a patent is considered to be time consuming, tedious and an expensive affair (Burhan et al., 2016). Even though a patent application is filed, there is no certainty that it gets translated into a grant at the end. Even if granted, the granted patent may be ruled invalid through litigation (Zheng, 2012). Hence, patents are regarded as a cost to a firm.

5. Conclusions

This paper has probed the varying levels of innovation and firm performance across the groups of firms that have been granted with a patent, the group of firms that have just filed a patent application, and the group of firms that have not filed a patent application.

The findings suggest that the propensity of firms to obtain patents no matter whether they have just filed a patent application or have been granted with a patent is an indicative of superior innovation performance of these firms over other firms which have not ventured into patents. However, patents have no direct role in enhancing the firm performance. This can be primarily attributed to the inability of patented firms to derive economic value out of patents. Further, in the context of a developing economy, not all innovative firms tend to patent their inventions due to high costs associated with obtaining and maintaining patents.

This paper has made a key contribution to the existing literature by examining the varying levels of innovation and firm performance of firms in a cluster.

References

- Arora, A., Athreye, S., and Huang, C. (2016) The Paradox of Openness Revisited: Collaborative Innovation and Patenting by UK Innovators, Research Policy, 45, 1352-1361.
- Bala Subrahmanya, M. H. (2011) Technological Innovation and Growth of SMEs in Bangalore: Does Innovation Facilitate Growth of Firm Size? The Asian Journal of Technology Management, 4(1), 41-55.
- Bala Subrahmanya, M. H. (2013) External Support, Innovation And Economic Performance: What Firm Level Factors Matter For High-tech SMEs? How?, International Journal of Innovation Managment, 17(5), 1-26.
- Basberg, B. L. (1987) Patents and Measurement of Technological Change: A Survey of the Literature, Research Policy, 16, 131-141.
- Becheikh, N., Landry, R., and Amara, N. (2006) Lessons from Innovation Empirical Studies in the Manufacturing Sector:A Systematic Review of the Literature from 1993–2003, Technovation, 26 (5-6), 644-664.
- Birchall, D. W., Chanaron, J. J., and Soderquist, K.(1996) Managing Innovations in SMEs: A Comparison of Companies in the UK, France, and Porugal, International Journal of Technology Management, 12(3).
- Blazsek, S., and Escribano, A. (2016) Patent Propensity, R&D, Market Competition: Dynamic Spillovers of Innovation Leaders and Followers, Journal of Econometrics, 191, 145-163.
- Blind, K., Cremers, K., and Mueller, E.(2009) The Influence of Strategic Patenting on Companies' Patent Portfolios, Research Policy, 38, 428-436.
- Burhan, M., Singh, A. K., and Jain, S. K.(2016) Patents as Proxy for Measuring Innovations: A Case of Changing Patent Behavior in Indian Public Funded Research Organizations, Technological Forecasting

& Social Change, XX: XXXX-XXXX, Article in Press.

- GoK (2006) New Industrial Policy 2006-2011, Department of Industries and Commerce: Bangalore.
- Haeussler, C., Harhoff, D., and Mueller, E. (2016) How Patenting Informs VC Investors: A Case of Biotechnology, Research Policy, 43, 1286-1298.
- Hall, B., Helmers, C., Rogers, M., and Sena, V. (2014) The Choice between Formal and Informal Intellectual Property: A Review, Journal of Economic Literature, 52(2), 1–50.
- Harrison, J. S., and Wicks, A. C. (2013) Stakeholder Theory, Value and Firm Performance, Business Ethics Quarterly, 23(1), 97-124.
- Hu, A. G. (2010) Propensity to Patent, Competition and China's Foreign Patenting Surge, Research Policy, 39, 985-993.
- Huang, K. F., and Cheng, T. C. (2015) Determinants of Firms' Patenting or Not Patenting Behaviors, Journal of Engineering and Technology Management, 36, 52-77.
- Hudson, J., and Minea, A. (2013) Innovation, Intellectual Property Rights, and Economic Development: A Unified Empirical Investigation, World Development, 46, 66–78.
- IPO UK. (2013) Innovation, Patenting and Licensing in the UK: Evidence from the SIPU Survey, Intelluctual Property Office: Newport.
- Kakati, M. (2003) Success Criteria in High-Tech New Ventures, Technovation, 23, 447-457.
- Kostopoulos, K., Papalexandris, A., Papachroni, M., and Loannou, G. (2011) Absorptive Capacity, Innovation, and Financial Performance, Journel of Business Research, 64(12), 1335-1343.
- Lin, Y., and Wu, L. (2014) Exploring the Role of Dynamic Capabilities in Firm Performance under the Resource-Based View Framework, Journal of Business Research, 67, 407-413.
- Loecker, J. D., and Goldberg, P. K. (2014) Firm Performance in a Global Market, Annual Review of Economics, 6, 201-227.
- Macdonald, S. (2004) When Means Become Ends: Considering the Impact of Patent Strategy on Innovation, Information Economics and Policy, 16(1), 135–158.
- Nadvi, K. (1995) Industrial Clusters and Metworks: Case Studies of SME Growth and Innovation, UNIDO, Small Medium Enterprises Programme.
- NKC (2007) Innovation in India, Government of India.
- OECD. (2004) Networks, Partnerships, Clusters and Intellectual Property Rights: Opportunities and Challenges For Innovative Smes in a Global Economy, (p. 78) Istanbul, OECD: Turkey.
- Okada, A., and Siddharthan, N. (2007) Industrial Clusters in India: Evidence from Automobile Clusters in Chennai and the National Capital Region, Institute for Studies in Industrial Development, JETRO, Chiba, Japan.
- Oneindia. (2013) Retrieved from http://www.oneindia.com/2013/08/02/bangalore-listed-among-top-8-tech-clusters-in-mit-review-1274110.html
- Porter, M. E. (1990) The Competitive of Nations, Harvard Business Review.
- Rao, P., and Klein, J. A. (2013) Inter-Firm Technology Tranfers and Collaboration, In P. Rao, and J. A. Klein, Strategies for High-Tech Firms (pp. 107-120), M.E. Sharpe: New York.
- Schmitz, H. (1999) From Ascribed to Earned Trust in Exporting Clusters, Journal of International Economics, 48(1), 139-150.
- Schumpeter, J. A. (1934) The Theory of Economic Development: An Inquiry Into Profits, Capital, Credit, Interest, and the Business Cycle, Transaction Publishers.
- Smedlund, A. P. (2004) Assessing Intellectual Capital Creation in Regional Clusters, Journal of Intellectual Capital, 5(3), 351-365.
- Solitander, M., and Tidstrom, A. (2010) Competitive Flows of Intellectual Capital in Value Creating Networks, Journal of Intellectual Capital, 11(1), 23-38.
- Steinle, C., and Schiele, H. (2002) When do Industries Cluster? A Proposal on How to Assess an

Industry's Propensity to Concentrate at a Single Region or Nation, Research Policy, 31(6), 849-858.

- Sweet, C. M., and Maggio, D. S. (2015) Do Stronger Intellectual Property Rights Increase Innovation? World Development, 66, 665-677.
- Torrisi, S., Gambardella, A., Giuri, P., Harhoff, D., Hoisl, K., and Mariani, M.(2016) Used, Blocking and Sleeping Patents: Empirical Evidence from a Large-scale Inventor Survey, Research Policy, 45, 1374-1385.
- UNDP. (2001) Human Development Report, Oxford University Press: New York.
- Zhang, S. (2012) Patenting in the Shadow of Independent Discoveries by Rivals, International Journal of Industrial Organization, 30, 41-49.
- Zhou, Y. (2009) High-tech Industry, International Encyclopedia of Human Geography, 120-127.

Annexures

Table A1: Weighted Averages and Standardised Weights for the Variables of Innovation

Variable	Weighted Average	Standardized Weights
Proportion of innovated products to total products (v_1)	4.7525	0.5074
Proportion of innovation sales to total sales (v_2)	4.6139	0.4926

Table A2: Descriptive Statistics of INI

	N	Minimum	Maximum	Mean	Std. Deviation
INI	100	.10000000	1.00000000	.5501635216	.25378442003
Valid N (listwise)	100				

Table A3: Cluster Analysis Results- INI

	Cluster 1 Low INI	Cluster 2 Moderate INI	Cluster 3 High INI
Number of Observations	39	38	24
Percentage of Observations	38.61%	37.62%	23.76%
Cluster Variables	**Final Cluster Centers**		
INI	.3066	.5683	.9235

Table A4: ANOVA- Constituent Factors of INI across INI Cluster Groups

Dependent Variable	F-statistic	Significance
Innovated Products	184.835	.000***
Innovation Sales	241.776	.000***

***p-value<0.01

Note: The test for equality of means was preceded by the test for Equality of Variances. In case the variances are equal, the regular F-Statistic values have been reported; otherwise Welch-F-Statistic values have been reported. P-values of significant results are marked in **bold**.

Table A5: Correlation between INI and Other Measures of Innovation Performance of a Firm

	Number of Patents	R&D expenditure	Proportion innovation sales to total sales
Correlation	.192	.069	.951
P-value	.055*	.494	.000***

***p-value<0.01

Table A6: Tests of Normality- INI and FP across the Groups of Firms

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual for INI	.076	101	.157	.964	101	.008***
Standardized Residual for FP	.187	101	.000	.748	101	.000

***p<.01, **p<0.05, *p<0.1

Table A7: Levene's Test of Equality of Error Variances- INI and FP across the Groups of Firms

	Levene's Statistic	P-value
INI	2.061	.133
FP	2.985	.055*

***p<.01, **p<0.05, *p<0.1