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IPR scenario and factors for promoting IPR culture: a post-TRIPS period analysis of selected pharmaceutical firms in North India

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ABSTRACT

Different shades of World Trade Organization (WTO) agreement on trade-related intellectual property rights (TRIPS) are reflected in the Indian pharmaceutical industry, but small and medium-scale pharmaceutical firms are slowly increasing their product innovation, process innovation and research and development (R&D) intensity. Analysis of variance results highlight a significant difference in performance of sole proprietorship/partnership, private limited and public limited firms vis-à-vis product innovation, process innovation, increased range of goods and services, R&D intensity, new technology adoption and adaptation. Factor analysis results indicated that developing intellectual property rights (IPR), technological measures and marketing practices explained 80.256% of variation. Policy initiative factor is dominating and SMEs are still relying heavily on support from government.

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1. Introduction

Is World Trade Organization (WTO) agreement on trade-related intellectual property rights (TRIPS) the key international agreement for promoting the harmonisation of national intellectual property right (IPR) regimes or does it merely guarantee minimum standards more than harmonisation? There are different viewpoints. The present study is a small attempt to gauge the impact of TRIPS on pharmaceutical small and medium enterprises (SMEs). The purpose of TRIPS, as stated in the preamble, is to introduce new rules and disciplines for global trade concerning the provision of adequate standards and principles concerning the availability, scope and use of TRIPS, for effective and appropriate means for the enforcement of TRIPS and for effective and expeditious procedures for the multilateral prevention and settlement of disputes between governments. The present study tries to analyse the IPR scenario and factors for promoting IPR culture in the post-TRIPS period through a survey of pharmaceutical firms.

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A brief reflection of the Indian pharmaceutical industry (IPI) is necessary to understand the changing scenario and relevance of TRIPS for IPRs. The IPI has been largely affected by various options and strategies available in Indian Patent Act 1970 focusing on the process patents. Thus, the domestic firms were able to introduce products patented by multinational corporations (MNCs) by making some minor changes in the manufacturing process. This act also restricted import of finished formulations and imposed high tariff rates.

The liberalisation of Indian economy has been the driving force for new technology and new products. Predominantly technology was imported, and only some scattered examples of firms investing in R&D to add their own value to the existing products were visible. Signing of TRIPS under WTO on 15 April 1994 changed the scenario. As part of this agreement, India has implemented product patent with effect from January 2005 implying a stringent IP environment. Thus, on account of liberalisation of the Indian economy and on account of new obligations undertaken by India under the TRIPS agreement, the adoption of new technology has become crucial for long-term growth of pharmaceutical industry. The Indian pharmaceutical sector grew by legally reverse-engineering internationally patented drugs. These changes at the global platform and at the national level have induced the pharmaceutical industry to adopt the rigour to enhance its competitiveness and productivity. Before adoption of TRIPs, patent act of 1970 was a key driver in the growth of the generics market in particular, and many companies were set up to reverse engineer new drugs patented in other counties and develop a new method of production. The drugs could be produced at lower prices.

India's patent protection was weak and had adverse effects on international pharmaceutical and chemical firms. It is estimated that annual losses to the US pharmaceutical industry are $450 million, but Indian authorities have a different perspective. Processes for making drugs were patentable, but the patent term was limited to the five years from the grant of patent or seven years from the filing date of the patent application, whichever was shorter. Product patents in other areas were granted for 14 years from the date of filing. As per the obligations under WTO agreement, the Patents (Amendments) Act 1999 was passed in March 1999 to provide for exclusive marketing rights. The Patents (Second Amendment) Bill 1999 to further amend the patent Act 1970 and make it compliant with the TRIPS agreement to push towards product patenting and India introduced a comprehensive system of product patents in Jan, 2005.

Earlier focus of publish or perish is now on patent or perish (Bhanot & Kiran, 2013). Patents thus provide incentives for private sector investors to enhance their investments and thus help in their growth and development. The intangible nature of intellectual property and the worldwide inconsistency of standard practices create challenges for those businesses wishing to protect their inventions, brands, and business methods in foreign markets. Patents are equally useful for small manufacturing enterprises (i.e. SMEs). Patents, it is generally felt benefits the owner of the IP and adds value to business concerns. Hence, all business corporations, whether SMEs or large, should have independent research and development (R&D) units. Providing free R&D facilities must be avoided. Proper documentation and maintenance of secrecy are considered as prime issues.

In this change, there is a need to understand the technology management strategies adopted by small and medium pharmaceutical firms in India to gear up for tougher patenting regime. It is equally important to identify the factors for promoting IPR environment. Under Section 7 of the Micro, Small and Medium Enterprises Development (MSMED) Act,

2006, the Indian government defined a small enterprise is where the investment in plant and machinery is more than 25 lakh rupees but does not exceed 5 crore rupees; and a medium enterprise is where the investment in plant and machinery is more than five crore rupees but does not exceed ten crore rupees. There are many studies covering implications of TRIPs on large pharmaceuticals, but strategies adopted by small and medium firms need to be analysed to gain more insights on the impact of TRIPS on Pharmaceutical sector as a whole. The present study is a step in this direction covering up the following research questions.

i. Is there a difference in patenting scenario of drugs and pharmaceutical industry in comparison to other sectors in post-TRIPs period?
ii. Is there a shift towards adoption of technology management strategies after implementation of TRIPs by small and medium pharmaceutical firms?
iii. What are the factors that promote IPR culture in small and medium pharma firms?

2. Review of literature and hypotheses development

It is pertinent to review implications of TRIPs on the IPI.

2.1. Implications of TRIPs on the IPI

There are diverse opinions regarding implications of strong patent regime on performance of the IPI. Dhar and Gopakumar (2006) reveal that the patent provisions in the TRIPS Agreement strengthened the existing trade monopolies and adversely pressurise technology diffusion between the north and the south. Kumar (2002) apprehends that strengthening of the IPR regime is likely to affect the prices of a large number of important drugs adversely and he opines that the strengthening of the IPR regime may limit the access of technology by developing country enterprises. Introduction of product patents is likely to increase drug prices and a strengthened IPR regime may actually slow down the pace of technological development by stifling the flow of R&D spill overs that are important inputs in research.

On the other hand, Lanjouw (1998) expressed that adherence to strong IPRs is good. Stronger IPRs may make the Indian environment more appealing to MNCs as a location for R&D. Mascus (2010) opines that strengthening the patent regime in developing countries with technologically imitative country such as India, would result in net expansion of OECD exports. Smith (2000), with more dissimulative industry-wise export data at state-level, has confirmed the substantial export expansion effect in the case of the US economy. Salazar, Falconi, Komen, and Cohen (2000) also strengthened the views expressed by Lanjouw (1998) and opine it would help research institutions to develop the means of protection and commercialisation of their technologies and products. The study by Grace (2004) reveals that one third of all FDA applications came from India in 2003 and would grow further.

Tancer (1999) feels that the intellectual property environment in a country affects the flow of foreign investment, particularly in those industries heavily dependent on intellectual property protection. Following the TRIPS agreement, India is obligated to provide patent protection to the Pharmaceutical Industry by 2005. Gupta (2000) emphasises that in post-WTO patenting activity in U.S.A the private sector firms in the area of drugs and pharmaceuticals have shown the maximum interest to obtain patents. Smith (2000) has

argued that India has now reached a stage in pharmaceutical production where stronger IPRs would induce greater innovation by local firms. Athreye and Kapur (2009) also endorse this argument.

The study by Lalitha (2002) reveals that the much applauded IPI's expertise in process development skills were achieved by positive amendments made to the Indian Patents Act 1970. This strength should be utilised to the get to the benefit from opportunities that arise from vertical disintegration of research, clinical trials and manufacturing by the multinationals. Kiran and Mishra (2009) report that the protection of IPR plays a dominant role in enhancing invention and innovation in the economy. The researchers analyse the patent scenario in India especially after the TRIPS agreement. The study also examines the patenting in India in the period of the 1990s and discusses that India still has to a long way to go and catch up with China and the US.In the light of these findings, the following hypothesis is proposed:

H_1: Patent filing in drugs and pharmaceutical sector is higher as compared to other sectors in the post-TRIPS period

2.2. Firm size, type of organisation and firm performance

Ramanna (2002) highlights that from 1995 to 1998, India did not revise its patent laws as required by TRIPS. It was only the changing interest of industry groups by 1998–99, that were ultimately instrumental in forcing the government to implement full compliance to TRIPS and in evolving a pro-IPR constituency in India. Pradhan (2003) indicates that the observed R&D intensity of domestic firms is 2.6% and is three and half times than that of foreign firms, which is only 0.74%. Although with the implementation of TRIPS, the competitive pressure has worked efficiently in pushing Indian pharmaceutical firms into R&D activity, however its impact is likely to be limited to a few large and medium sized firms, as the large segment of small size firms lacks the huge resources that are required for product development.

Fink (2000) expresses that given India's favourable cost structure, well-educated scientists, English-speaking doctors who can supervise drug trials, India may well emerge as an attractive location for the conduct of R&D. Such a development would lead to additional long-term gains from strengthened patent protection. According to Dhar and Gopakumar (2006) the R&D spending of some of the leading firms has shown increase in Post- TRIPS period and hence R&D intensities of the firms have improved significantly. Sunil (2006) opines that the TRIPS compliance of the IPR regime has not reduced the innovation capacity of the domestic pharmaceutical industry which has visualised an increase in both research budget and patenting.

Chaturvedi and Chataway (2006) highlight that Indian firms are investing in R&D not only for new drug discovery but for developing capabilities to assimilate and exploit knowledge available externally. They are also positioning themselves as a partner of choice for technology savvy national and multinational firms. As Srinivas (2004) reports, industrial Drugs and Chemical increased their share in global exports; therefore, the observed decline in value added and employment remains unexplained. SMEs employ more than 100 employers and generate employment. Gupta (2000) suggests that the IPI has stimulating opportunities in the post-TRIPS period. Indian companies are accelerating their rate of DMF filings every quarter. IPRs have protected the innovation and products of the pharmaceuticals and

ANDA (abbreviated new drug application) filings with US FDA (United States Food and Drug Administration) are also increasing in the post-TRIPS period.

Aggarwal (2004) expressed that most of the R&D in Indian pharmaceutical firms is by large firms, supporting the suggestion that firm size bears a positive relationship with R&D. Chaudhuri (2007) further supported this view and opined that SME industries were primarily engaged with the development of new processes for manufacturing drugs, but now they are also involved in R&D for new chemical entities (NCE).

In the views of Chadha (2006), Indian firms are spending maximum resources to secure non-infringing process patents in foreign countries, especially of the growth of SME. According to Reddy (2006) the growth in R&D for SME and large scale pharmaceuticals is greater than the growth for the general pharmaceutical sector. Pharmaceuticals have huge resources to devote more investment for R&D and can afford to think about the future.

Further, Pandey and Shivesh (2007) highlight the fact that the performance of SME pharmaceutical firms in the Indian economy in terms of absolute growth in number of enterprises, employment, production and exports in the TRIPs period has improved. Pradhan and Sahu (2008) highlighted that the growth of SMEs plays an important role in structuring the Indian pharmaceutical market. Khalil Darwish and Singh (2013) highlight that the strong support for the involvement of human resource functions in business and corporate strategy reduces employee turnover rate and enhances financial performance. Belwal, Belwal, and Al-Jabri (2014) opine that the training needs of employees should be kept in mind for better productivity. As highlighted by Tehseen and Ramayah (2015), external integration moderates the influence of entrepreneurial competencies on success of SMEs business which enhances the need for entrepreneurs to be competent enough to manage their relationships with their customers and suppliers to get competitive advantage.

Thus, this calls for a need to analyse the relation between firm size and organisation type on performance in the post-TRIPS Period. Size-wise the study focused on small and medium size and in organisation types, Sole proprietorship/ Partnership, Private limited and Public limited firms were analysed. The related hypotheses are:

H_2: There is a relation between size of the firm and performance indicators: viz. sales, turnover, market share; profit; productivity; product cost; competitiveness; capital investment; and technological skills

H_3: There is a relation between organisation form and performance indicators: viz. sales, turnover, market share; profit; productivity; product cost; competitiveness; capital investment; and technological skills

2.3. Adoption of technology management strategies

The next objective of the study was to understand the adoption of technology management strategies by selected pharmaceutical firms in the post-TRIPS period. Firms' sustainable competitive advantage requires that the firms continuously differentiate their products and services from competitors (Chen, Hwa, Lee, Yu, & Wu, 2008; Koellinger, 2008). They proposed that if an idea has not been developed and transformed into a product, process, or service, or if it has not been commercialised, then it would not be classified as an innovation. This provides an effective method of investigating the link between innovation and firm performance (Gopalakrishnan, 2000). Smith (2000) predicts that although the new patent regime has the potential to reward multinational corporations at the expense of

Indian firms, even then, the local firms are likely to benefit from stricter laws. The process of liberalisation (1991) has helped the domestic pharmaceuticals to develop policies that are focused on attracting domestic as well as international market and turn Indian market a global based industry, which has further transferred the Indian pharma industry in the pace of growth and increased competitiveness of Indian industry. They also examine that India is slowly moving into the global markets with international quality standards and prices and the future of the IPI hinges on patent protection. Technological collaboration is seen as a strategic mechanism to achieve certain objectives as highlighted (Bayona, García-Marco, & Huerta, 2001; Hagedoorn, Link, & Vonortas, 2000): (1) to increase the technological capabilities of the firm; (2) to gain access to new markets and to exploit new business opportunities; (3) to have access to public funding; and (4) to complete the innovation process.

The process of liberalisation (since 1991) has helped domestic pharmaceutical firms to develop policies that are focused on attracting domestic as well as international market and turn Indian market a global based industry, which has further transferred the Indian pharma industry in the pace of growth and increased competitiveness of Indian industry. They also examine that India is slowly moving into the global markets with international quality standards and prices and the future of the IPI hinges on patent protection. Zacharias and Faraias (2002) have observed that the IPI is a successfully growing and high technology based industry. As opposite to this, Walker (2001) contends that TRIPS fails to help build 'innovative, ethical and sustainable societies'.

Kubo (2004) has examined the factors behind the observed patterns of R&D expenditure and patenting by Indian pharmaceutical companies after the signing of TRIPS agreement. He found that R&D intensity and the patent to R&D ratio have increased after 1995. The firms that produce both the bulk drugs and formulations are filing the majority of product patent applications as well as a large share of process patents than the firms specialising in bulk drugs only.

A study by Haakon (2004) suggests that as trade becomes more global the need for IPRs has increased in countries. Haakon mentioned the TRIPS perspective to encourage protection of new ideas in trade. It also highlights R&D on uniqueness, prompt creativity, innovation and invention. According to Chadha (2006), Indian firms are spending maximum resources to secure non-infringing process patents in foreign countries, especially for the growth of SMEs. Developing countries place more emphasis on drug master filings (DMFs) for bulk actives supply and ANDAs for formulations. Kavida and Sivakoumar (2008) express the view that innovation and IPRs can play a vital role in the acquiring new techniques of production in the economy with developments in information technology.

Brouwers, Silverstein, and Wolff (2004) similarly find that if countries imposing price controls were to remove them, R&D expenditures would increase by $17–22 billion, and between 10 and 13 new compounds a year would be introduced to the market. Srinivasan (1999) reports that industrial drugs and chemicals increased their share of global exports; therefore, the observed decline in added value and employment remains unexplained. According to Ullrich (2007), the settlement of patent infringement disputes is only to be considered under the ambit of cartel law in so far as the validity or the substantive scope of a property right is seriously in doubt. As highlighted by Mascus (2010) widespread violations of an innovator's IPRs in developing countries have become a major international issue. Thus, these need to be tackled to encourage patents. SMEs employ more than 100 employers and generate employment. In light of this, it is pertinent to propose the next hypothesis:

H_4: There is a shift towards adoption of technology management strategies after implementation of TRIPs by small and medium pharmaceutical firms

2.4. Factors for promoting IPR Environment

The last step of research was to identify factors for promoting an IPR environment. The next research question is to understand which factors are important for promoting the IPR environment. The results of a research study (2007) by EXIM Bank's Occasional Paper Series found that favourable government policies along with industry/firm level initiative have helped the industry to increase growth rates over the years. As highlighted in the study by Jain and Kiran (2012), the factors promoting IPRs could be either organisational factors or policy factors. Policy factors are prevalent more in developing countries, like in India we have TIFAC, patent facilitating centres which provide assistance at state or central level to promote IPR culture. Like in Punjab, we have a patent facilitating centre. We have Punjab state council of science and technology in Chandigarh to assist in patent search and literature review. Second type of measures could be those initiated by the organisations themselves.

The related hypothesis is:

H_5: Policy initiative factors are more important than organisational factors

3. Design and methodology

3.1. Data collection

The sample was collected from north-east India. North-west region mainly comprises excise free zones and non-excise free zones ever since the central government announced the excise free zones in 2003 with the objective to help the development of backward and hilly areas of northwest India. The present research covers the excise free zones of Badi and Kala Amb in Himachal Pradesh and non-excise free zones of Mohali, Dehra Bassi, Lalru in Punjab. A questionnaire has been developed to study the post-TRIPS scenario in the pharmaceutical industry of India with reference to states Punjab, Haryana and Himachal Pradesh. The items along with author details are presented in Table 1. A random stratified sampling method has been adopted for the selection of the pharmaceutical companies. The firms with an annual sales turnover of between 100 and 300 crores as medium-scale firms and with an annual sales turnover of less than Rs. 100 crores have been classified as small-scale firms. Such firms are approximately 1000 in number. Thus, the survey covers 1% of the firms. These SMEs have been chosen from northern India, a growing region of India. The reason for taking these enterprises is that most of them are export oriented units and must be innovators and it is good to understand their technology management strategies and know if they are investing in IPRs as well.

The pharmaceutical industry has gone through many phases. The IPI progressed with process innovation before 1991. This led to low prices for Indian drugs. The period 1995–2008 (i.e. the post-TRIPS period) saw many changes in the IPI on IPR and Innovation front.

Around 300 firms were approached and 120 firms returned the questionnaire, out of which 100 complete in all respects have been taken up for analysis. The response rate is 40%. The study covers the major areas in northwest India, where pharmaceutical firms are located viz. Mohali, Dehra Bassi, Lalru in Punjab; Baddi, Kala Aamb in Himachal Pradesh; and Ambala in Haryana. This has been depicted in Table 2.

Table 1. Scale items with author details.

Scale items	Authors
Technology management strategies	
Investment in R&D	Blundell et al. (1999); Hagedoorn et al. (2000); Bayona et al. (2001); Jain and Kiran (2012); Koellinger, P. (2008).
Increased range of goods and services	Blundell et al. (1999); Jain and Kiran (2012)
Nature of the firm	Blundell et al. (1999); Koellinger, P. (2008).
Market share	Tehseen and Ramayah (2015); Blundell et al. (1999); Koellinger, P. (2008).
Quality	Gunasekaran et al. (1996)
Product flexibility	Gunasekaran et al. (1996); Reddy (2006)
Reduced labour costs	Khalil Darwish and Singh (2013); Chen et al.
Reduced environment costs	Brouwers et al. (2004).
Status of IPRs	Kumar (2002); Hagedoorn and Cloodt (2003)
Factors for promoting IPR environment	
Internal training programme for R&D personnel on knowledge related to IPRs	Belwal et al. (2014).
Reward the employee who has helped in acquiring IPRs	
Get associated with Indian Pharmaceutical Alliance	Kumar (2002)
Expanding distribution network	Modell (2003);
Franchise manufacturing	Modell (2003)
Filing of IPRs (patents, trademarks, copyrights, trade secrets)	Haakon (2004);
Pool patenting	Modell (2003); Bayona et al. (2001)
Reduction of taxes and fees	Ullrich (2007)
Faster registration process	Modell (2003)
Government assistance for facilitating patent filing	Kiran and Misra (2009)
Support for entrepreneurial and managerial development	Belwal et al. (2014)
Severe penalty for IPR violation	Ullrich (2007)

Source: Author Created.

Table 2. Sample pharmaceutical firms from northwest region.

	Place of pharmaceutical firm	State	No. of units
Excise free zones	Baddi	Himachal Pradesh	27
	Kala Amb	Himachal Pradesh	25
	Total		52
Non-excise free zones	Lalru	Punjab	8
	Mohali	Punjab	8
	Dehra Bassi	Punjab	6
	Ambala	Haryana	26
	Total		48
	Grand Total		100

Source: Authors' calculations'.

3.2. Validity and reliability of the questionnaire

Table 3 depicts the section-wise reliability. The questionnaire is based on theory and empirical research. The item-wise details of the questionnaire along with an author index has been added through Table 3. The questionnaire was pretested for 20 firms. In case of technology management three questions were deleted on the basis of item-wise reliability. Thus, after deletion the reliability score for the constructs were greater than 0.70. The questionnaire had also been validated by the peers and has validation score of 3.75. Some questions were deleted and the changes suggested were incorporated in the questionnaire. The final questionnaire has been segmented into five sections. Section A covers the overall performance of the firms. Section B covers the status of IPR. Sections C and D deal with impact of TRIPS. Section C covers technology management strategies and has 21 items. Section D has four items related with exports. Section E covers measures for developing an IPR culture. It has 12

items with a reliability score measured by Cronbach Alpha of .801. The overall reliability of the questionnaire has been .842. Face and content validity has been used for questionnaire.

4. Firm-wise analysis

4.1. Status of IPRs

IPRs are playing a very important role in the pharmaceutical sector. The status of IPRs of drugs and pharmaceuticals with other sectors, as shown through Table 4, highlights that the chemical sector has shown a highest growth of 4.81% and 4.17% while electrical has lowest growth of 3.81%. The growth of food is 4.11%, of mechanical is 4.01% and general is 4.09%. This is indicative of the fact that drugs and pharmaceutical sector is a growing sector of the Indian economy. Thus the related hypothesis:

H_1: Patent filing in drugs and pharmaceutical sector is higher as compared to other sectors in the post-TRIPS period

has been accepted.

In addition to this firm-wise analysis has also been done through primary data collected through questionnaire for various forms of IPR. The IPRS considered in the present study are: patents, copyrights, trademarks and trade secrets. As shown in Table 5, the results highlight that in terms of mean score the status of IPRS as reported by respondent firms is lower than that of medium firms, but one positive aspect is that in terms of trade marks the performance is better for both small and medium firms. Similarly for trade secrets the situation is better for medium scale firms. There is still much more effort needed by SMEs to improve their performance in terms of patents and copyrights. But one thing can be said that the situation is improving even for SMEs. Status of IPRs has improved and even SMEs are now indulging in the

Table 3. Item-wise reliability.

S No	Items	No. of items	Cronbach alpha
1.	Overall performance of the firms	10	.802
2.	Status of intellectual property rights	08	.745
3.	Technology management strategies	21	.889
4.	Status of exports	4	.712
5.	Measures for developing IPR culture	12	.801
	Overall		.842

Source: Authors' calculations'.

Table 4. Patents granted scenario.

Year	Chemical	Drug	Food	Electrical	Mechanical	General
1995–96	470	132	34	56	159	682
1996–97	282	71	18	54	142	340
1997–98	503	291	58	177	381	434
1998–99	609	150	35	138	462	406
1999–00	516	307	250	147	569	92
2000–01	353	276	72	142	254	221
2001–02	483	320	36	139	311	302
2002–03	399	312	67	118	228	255
2003–04	609	419	110	396	539	396
2004–05	573	263	67	245	414	349
2005–06	1140	508	140	451	1448	633
2006–07	1989	887	244	787	2526	1106
2007–08	4071	1783	554	1078	3230	5011
Growth rates	4.81**	4.17**	4.11**	3.81**	4.01**	4.09**

Source: Growth rates authors' calculations'.

pace of innovation and inventions of new products and technology and trying to grab greater market share. With the new technology and product SMEs are now becoming an integral part of the supply chain for large pharmaceutical industries. Since there are many studies expressing concern over implementation of TRIPs, there is a need to study whether the performance of sample firms in terms of IPRs has improved in post- TRIPs scenario. A simple analysis on the basis of mean score reflects improvement in IPRS in Post-TRIPS scenario. This is reflection of simple numbers, while commercial aspects of IPRs are not covered in the current study.

4.2. Performance indicators

The results of the study shown in Table 6 highlight that small-scale pharmaceutical industries have performed well in terms of productivity, product cost, competitiveness, capital investment and technological skills. On the other hand medium scale pharmaceutical firms performed well in all other parameters. Thus results do reflect an improvement in performance with size as medium scale performed well on all parameters. These results have been corroborated by Pandey and Shivesh (2007) and Pandey and Dixit (2009). This is an initial analysis which needs to be tested through t-test or analysis of variance (ANOVA). Thus, the next hypothesis:

> *H_2: There is a relation between size of the firm and performance indicators: viz. sales, turnover, market share; profit; productivity; product cost; competitiveness; capital investment; and technological skills*

has been accepted.

To gauge the organisation-wise results for performance ANOVA test was done. ANOVA helps to understand whether there has been a significant difference in the mean performance indicators on the basis of the three organisational forms, viz. sole proprietorship/partnership; private limited and public limited companies. The results of ANOVA have been depicted in Table 7.

ANOVA results shown through Table 7 highlight that '*p*-value' is significant for sales, turnover, market share and profits. Thus, there is a significant difference in performance vis-à-vis sales,

Table 5. Status of intellectual property rights.

Type of firm	Small	Medium	Total
Patents	2.36	2.50	2.64
Copyrights	1.86	2.17	2.20
Trademarks	3.07	3.17	3.20
Trade secrets	2.57	3.00	2.80

Source: Authors' calculations'.

Table 6. Firm-wise performance indicators.

Firm size/performance indicators	Small	Medium
Sales	2.00	3.33
Turnover	2.07	3.00
Market share	1.43	2.00
Profit	2.00	2.17
Productivity	3.93	3.83
Product cost	3.43	3.00
Competitiveness	4.00	3.67
Capital investment	3.17	3.00
Technological skills	3.36	3.17

Source: Authors' calculations'.

Table 7. ANOVA: organisational form and performance indicators.

Organisational factors		Sum of squares	df	Mean square	F	Sig.
Sales	Between groups	17.707	2	8.853	3.948	.034*
	Within groups	49.333	22	2.242		
	Total	67.040	24			
Turnover	Between groups	20.431	2	10.216	5.093	.015**
	Within groups	44.129	22	2.006		
	Total	64.560	24			
Market share	Between groups	28.411	2	14.206	8.626	.002***
	Within groups	36.229	22	1.647		
	Total	64.640	24			
Profit	Between groups	15.327	2	7.663	4.577	.022*
	Within groups	36.833	22	1.674		
	Total	52.160	24			
Productivity	Between groups	2.731	2	1.366	1.402	.267
	Within groups	21.429	22	.974		
	Total	24.160	24			
Product quality	Between groups	1.998	2	.999	.595	.560
	Within groups	36.962	22	1.680		
	Total	38.960	24			
Product cost	Between groups	1.131	2	.566	.505	.610
	Within groups	24.629	22	1.119		
	Total	25.760	24			
Competitiveness	Between groups	.827	2	.413	.323	.727
	Within groups	28.133	22	1.279		
	Total	28.960	24			
Capital investment	Between groups	.640	2	.320	.409	.669
	Within groups	17.200	22	.782		
	Total	17.840	24			
Technological skills	Between groups	.512	2	.256	.160	.853
	Within groups	35.248	22	1.602		
	Total	35.760	24			

***Sig. at 0.01% level; **Sig. at 1% level; *Sig. at 5% level.
Source: Authors' calculations'.

turnover, market share and profits on the basis of form of organisation, viz. sole proprietorship/partnership, private and public limited firm. In case of other parameters the mean scores are not significantly different. Thus on the basis of productivity, product quality, product cost, competitiveness, capital investment and technological skills impact of organisational form is not visible in the sample firms. This supports the next hypothesis. Thus,

> *H_3: There is a relation between organisation form and performance indicators: viz. sales, turnover, market share; profit; productivity; product cost; competitiveness; capital investment; and technological skills*

has been accepted.

Overall results show that SMEs have started adopting patents, copyrights, trademarks, and trade secrets and mark their significance in the pharmaceutical market. The situation is improving. Kubo (2004) has also established that R&D intensity and the patent to R&D ratio have increased after 1995. Gupta (2007) has also expressed that the IPI has stimulating opportunities in post-TRIPS period. The present study supports this increasing trend of patent filing in the post-TRIPS period in comparison to other sectors,. Earlier literature showed that MNCs and large firms were more active in filing IPRs, But current data is suggesting that patents are being filed by SMEs and this trend is indicative of better status.

Next step of research was to get an insight into technological status of sample firms by asking them to rate product, process or R&D intensity on a scale of 1–5, with 5 reflecting

Table 8. Status of technology management strategies.

Firm size/technology management strategies	Small	Medium	Total
Increase in product innovation	1.14	1.5	1.64
Increase in process innovation	2.71	2.67	2.98
Increased range of goods and services	2.5	3.17	3.06
R&D intensity	3.21	3.24	3.08
New technology adoption	2.86	2.67	2.52
New technology adaptation	2.71	2.33	2.32

Source: Authors' calculations'.

Table 9. ANOVA: technology management strategy and pharmaceutical firms.

		Sum of squares	df	Mean square	F	Sig.
Increase in product innovation	Between groups	15.746	2	7.873	9.615	.001***
	Within groups	18.014	22	.819		
	Total	33.760	24			
Increase in process innovation	Between groups	11.570	2	5.785	6.563	.006***
	Within groups	19.390	22	.881		
	Total	30.960	24			
Increased range of goods and services	Between groups	10.867	2	5.433	6.977	.005***
	Within groups	17.133	22	.779		
	Total	28.000	24			
R&D intensity (the ratio of a company's investment in R&D to its sales)	Between groups	7.850	2	3.925	3.322	.050*
	Within groups	25.990	22	1.181		
	Total	33.840	24			
New technology adoption	Between groups	5.992	2	2.996	1.723	.202
	Within groups	38.248	22	1.739		
	Total	44.240	24			
New technology adaption	Between groups	8.450	2	4.225	5.470	.012**
	Within groups	16.990	22	.772		
	Total	25.440	24			

***Sig. at 0.01% level; **Sig. at 1% level; *Sig. at 5% level.
Source: Authors' calculations'.

high priority. The results reflected in Table 8 highlight that small- and medium-scale pharmaceutical firms are slowly increasing their product innovation, process innovation, and R&D intensity. While for increased the of goods and services, medium scale firms have an edge over small scale, for new technology adaptation small firms have in fact a little higher mean score than medium scale firms. This reflects that size of the firm does lead to increase in the range of goods and services produced.

ANOVA was also applied and results (Table 9) are significant for product innovation, process innovation, increased range of goods and services, R&D intensity and new technology adoption and technology adaptation. Thus there is a significant difference in performance of sole proprietorship/partnership and private and public limited firms vis-à-vis product innovation (0.001), process innovation (0.006), increased range of goods and services (0.005), R&D intensity (0.050), new technology adoption (0.202) and new technology adaptation (0.012). Difference in technology parameters is visible on the basis of sole proprietorship/partnership; private limited and public limited companies.

4.3. Technology management strategies and pharmaceutical firms

Factor analysis was undertaken on technology management strategies to classify them into smaller number of factors. Factor analysis clubs similar variables into same factor and facilitates further analysis. The related hypothesis is:

Table 10. Technology adoption strategies.

Product attributes/factor	Developing IPR	Technological measures	Marketing practices
1. Product innovation	.834		
2. Material and energy	.780		
3. Process invention	.751		
4. Enhanced collaborations (R&D)	.699		
5. Managing practices	.699		
6. Production flexibility	.613		
7. R&D expenditure	.513		
Eigenvalue	2.094		
% of variance	14.955		
Cumulative variance	55.005		
8. New products		.807	
9. Labour costs		.799	
Eigenvalue		1.887	
% of variance		13.476	
Cumulative variance		68.481	
10. Increased range of goods			.868
11. Price strategy			.832
Eigenvalue			1.649
% of variance			11.775
Cumulative variance			80.256

Source: Authors' calculations'.

H_4: There is a shift towards adoption of technology management strategies after implementation of TRIPs by small and medium pharmaceutical firms

Technology management strategies have been classified into three factors. The results are depicted through Table 10.

These strategies are:

i. Developing IPR
ii. Technological measures
iii. Marketing practices

These three factors explain 80.256% of variation. The details of these along with sub-items are shown in Table 10. Developing IPR has emerged as most important factor with eigenvalue 2.094 and explaining 55.005% of variation.

Developing IPRs and technological measures are two important strategies reporting 68.481 percent of total variation. Marketing practices strategies have reported lower variance as compared to other strategies. On the whole these three strategies explain 80.256% of variation. Thus, the next hypothesis:

H_4: there is a shift towards adoption of technology management strategies after implementation of TRIPs by small and medium pharmaceutical firms

has been accepted.

4.4. Factors for developing IPR culture

Factor analysis was performed on variables influencing IPR culture. These included 12 variables. The results are shown in Table 11. These were classified into two factors:

i. Organisational factors
ii. Policy factors

Table 11. Factors for promoting IPR environment.

Factor	Eigen value	% of var.	Cum. %	Items	Factor loading	Mean	SD	Rank
Organisational factors	3.54	36.79	36.79	Internal training programme for R&D personnel on knowledge related to IPRs	.822	4.23	.45	4
				Reward the employee who has helped in acquiring IPRs	.701	4.36	.67	9
				Get associated with Indian Pharmaceutical Alliance	.801	4.32	.68	7
				Expanding distribution network	.695	4.34	.55	11
				Franchise manufacturing	.697	4.56	.70	10
				Filing of IPRs (patents, trademarks, copyrights, trade secrets)	.841	4.84	.72	3
				Pool patenting	.704	4.62	.68	8
Mean of organisational initiatives						4.46		
Policy initiatives	2.12	30.08	76.86	Reduction of taxes and fees	.899	4.84	.48	2
				Faster registration process	.901	4.56	.54	1
				Government assistance for facilitating patent filing	.817	4.67	.62	5
				Support for entrepreneurial and managerial development	.802	4.65	.70	6
				Severe penalty for IPR violation	.655	4.31	.77	12
Mean of policy factors						4.61		
Overall mean						4.53		

Source: Authors' calculations'.

The related hypothesis is:

H_5: Policy initiative factors are considered more important than organisational factors in developing IPR culture

For understanding IPR environment factor analysis was performed on this construct. On the basis of factor analysis, two factors namely policy initiatives and organisational factors have been identified.

Organisational factors cover the following:

i. Internal training programme for R&D personnel on knowledge related to IPRs
ii. Reward the employee who has helped in acquiring IPRs
iii. Get associated with Indian Pharmaceutical Alliance
iv. Expanding distribution network
v. Franchise manufacturing
vi. Filing of IPRs (patents, trademarks, copyrights, trade secrets)
vii. Pool patenting

In the organisational factors, filing of IPRs (patents, trademarks, copyrights, trade secrets) got highest loading and pool patenting the lowest loading. We are yet to develop a culture for pool patenting.

Policy initiative factors cover the following items:

i. Reduction of taxes and fees
ii. Faster registration process
iii. Government assistance for facilitating patent filing
iv. Support for entrepreneurial and managerial development
v. Severe penalty for IPR violation.

Policy initiative factors had higher mean score and higher loadings, signifying that the firms are yet not focusing on organisational policies to enhance their competitiveness and still relying upon government policies. Thus, the hypothesis that

H_5: Policy initiative factors are considered more important than organisational factors in developing IPR culture

has been accepted.

5. Major findings of the study

The results depict that small- and medium-scale pharmaceutical firms are slowly increasing their product innovation, process innovation and R&D intensity. These results are corroborated by Kiran and Mishra (2010) and Nair (2008). ANOVA results indicate a significant difference in product innovation, process innovation, increased range of goods and services, R&D intensity and new technology adoption and technology adaptation on the basis of forms of business organisation, viz. sole-proprietorship/partnership, private limited and public limited companies. This study indicates that even small-scale firms are into patent filing and they are competing with others in trademarks. Earlier literature supports this as is eminent from earlier studies (Chaudhuri, 2007; Grace, 2004). Blundell, Griffiths, and Van Reenen (1999) find a robust and positive effect of market share on observable headcounts of innovations and patents although increased product market competition in the industry tends to stimulate innovative activity. Furthermore, the impact of innovation on market value is larger for firms with higher market shares. According to Hanel (2006), as a patent-friendly environment is now prevalent in India, patents are increasingly used for protecting innovations from imitation. But the results of the present study highlight the low filing of IPRs by manufacturing SMEs. These viewpoints are a contrast to those of Mosey, Clare, and Woodcock (2002) who suggest that the larger organisation manages knowledge and information more systematically.Developing IPRs, technological measures and marketing practices explained 80.256% of variation. Out of these, developing IPRs has emerged as the most important factor that explains maximum variation. Though technological measures need to be focused more to improve productivity as this will reduce cost of production and enhance competitiveness of firms. These thoughts are reverberated by Salazar et al. (2000) and Nair (2008).Policy initiative factors had higher mean score and higher loadings, signifying that the firms are yet not focusing on organisational policies to enhance their competitiveness and still relying upon Govt. Policies. In the organisational factors, filing of IPRs (patents, trademarks, copyrights, trade secrets) got highest loading and pool patenting the lowest loading. SMEs are yet to develop a culture for pool patenting.

The outcome of research has been presented through Figure 1. The study used respondents from small scale and medium scale to find out factors essential for developing IPR Conducive environment. These stakeholders helped in understanding technology management strategies followed by SMEs. These three strategies identified are: (i) developing IPRs; (ii) technological measures and (iii) marketing practices.

Regarding factors for promoting IPR culture, two factors are: (i) policy measures and (ii) organisational measures.

The results reflect that SMEs are still relying more on policy measures and regarding organisational measures, some initiatives have been started, like organising IPR training programmes, but these measures are still in nascent stage. Stage is not yet set for interdisciplinary

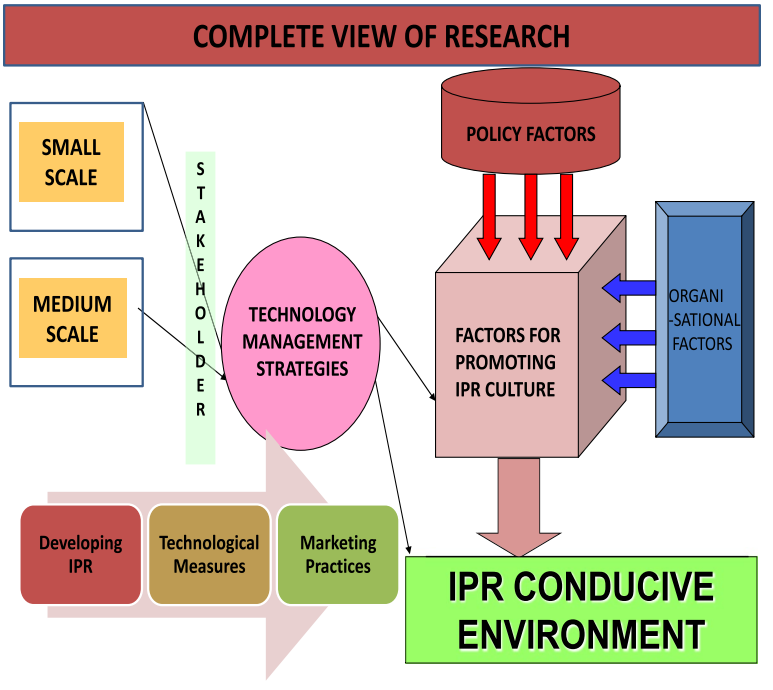

Figure 1. Complete view of research. Source: Authors' creation.

and inter-organisational sharing is still low. Pool patenting could be a solution, but it has not emerged as important factor for sample SMEs.

6. Recommendation for further research

Future research should be focused on in-depth study of patenting activity, R&D and exports by taking case studies of some selected pharmaceutical companies. Case studies of successful firms can be of great help for the policy makers as well as for the pharmaceutical firms.

In this competitive environment the Pharmaceutical Industry of India is passing through various phases. Firms like Dr. Reddy's lab are into innovative drug manufacturing and are actively filing up IPRs. The generics market is passing through difficult phase and even big companies like Ranbaxy had suffered the consequences of this. There is an emergence of Tax free zones in North-western region of India. Baddi (Himachal Pradesh) and Kala Amb (Haryana) are being flooded by new pharmaceutical firms. Baddi in Himachal Pradesh is being quoted as the new pharma capital. All pharma firms are into Drug manufacturing filings and ANDA filings have also improved in the post-TRIPS period. Thus the pharmaceutical industry of India is facing a lot of challenges in view of these changes. A time has come for them to indulge in filing more IPRs for enhancing global competitiveness.

Disclosure statement

No potential conflict of interest was reported by the author.

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