Examining the Relation of Productivity and Competitive Factors with Market Sales and R&D: A Study of Selected Agri-Biotech Firms of Punjab

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Abstract

The present study covers empirical research on selected Agri-Biotech firms of Punjab. The sample has been chosen from state of Punjab covering sectors Food Process Industry, Fertilizer and Pesticides Industry. The study tries to identify factors influencing productivity. These factors are Internal and External Environment; Cost Efficiency; Production Planning and Control; Technological Advancement. On the basis of factor analysis the study has also identified key factors influencing competitiveness. These are Threat of new competition; Threat of substitute products or services; Bargaining power of suppliers; Intensity of competitive rivalry; Bargaining power of customers; Rivalry among existing firms. The study also tries to evaluate the findings on the basis of author-factor matrix.

Index terms— production planning and control, bargaining power, internal and external environment, agri-biotech.

1 Introduction

io-technology has become one of the emerging spheres and technologies in India as well on a global level. Indian economy is going through a transition phase where the restructuring of industries and firms are taking place in the form of privatization, globalization, and liberalization. Along with the global economic integration, there has been a marked acceleration in the pace of technological and scientific progress. Advances in technology have created new opportunities for businesses. Technology plays a vital role in the development of any Economy. Modern industry is driven by technology, and lack of access to technology can stunt economic growth. Technology played an important role in the rapid economic growth observed in the late twentieth century in Korea, Taiwan, and Singapore. The World is changing fast and the world of business is changing faster. In the new millennium, business corporations will have to deal with entirely new challenges to meet customer demands, move from competition to collaborative reconfiguration, dovetail supplier and subcontractor processes to the corporate goals and empower employees to be able to meet and surpass customer expectations. Due to global competitiveness now companies are taking more effective steps to improve overall productivity and efficiency.

To attain a place in the competitive market, companies have to reduce the cost price of their product. It can only be possible if production of goods is increased by applying same input or by reducing time wastage. Past experience shows that Indian firms took decades to be able to catch up with global productivity levels. There is a strong need to evaluate available technological options to overcome new challenges and become top performers. At the strategic level, the main challenge is to become globally competitive by adopting collaborative manufacturing strategies. The process of acquiring a production capability is initiated by importing a plant from another country or having a new plant built with the help of a technology provider.

2 II.

3 Review of Literature

One of the perquisites for developing a wellstructured hypothesis is Review of literature that enables the Researcher to avoid pit falls and difficulties experienced by predecessors and help them to draw a well-designed plan in the area of his interest. To have a proper perspective of the subject, it is essential to have bird's eye view of the findings of other academic researchers. Thus the planning and execution of any research study should be preceded by thorough Review of Literature in related fields since it helps to familiarize with the work that has been done in that area, eliminates the possibility of unnecessary duplication of efforts and provides valuable information on research techniques. Many explanatory and interesting studies have been undertaken in India as well as in other countries of the world to analyse the productivity and competitiveness in different sectors.

According Lall (2001), a complete competitiveness analysis must define what competitiveness means and how it is to be measured and identify the most important factors influencing it. It should also highlight the interactions between these factors and how they affect the competitiveness. **??**uckley et al. 1988 opines that Competitiveness is synonymous with a firm's long-run profit performance and its ability to compensate its employees and provide superior returns to its owners.

Productivity comprises of capital productivity as well as labour productivity but according to Hassan Arif et al. **??**2006) successful organizations in today's business environment are those who manage along with their technological resources their human resources also well. Organizations perform better when they are making investment in training their employees and broaden their skills (Hollbeche, 1998). Employee's creativity and innovation skills can increase only by giving them appropriate recognition and reward for their creative work (Koning, 1998). Sheel (2002) states that for technological advances new infrastructures, mainly telecommunication, information technology, new strategic thinking practices are needed for hyper competitive environment. Sethi et al. (2007) highlight that various factors may be quite important to manufacturing firms trying to compete with flexibility competence and technological capabilities. Human factor in term of their skills, technical expertise, training involvement, and attitude has been found to be the most significant for achieving flexibilities. For gaining competitive advantage and developing firm's internal capabilities, Technology adoption and adaptation are considered to be among the most critical elements for a firm (Khamba and Singh, 2001). The study by Lee et al. (2007) compares the real output and labour productivity of Chinese and Indian manufacturing from 1980 to 2002. The analysis shows that since 1980, real value added and labour productivity growth for Chinese manufacturing has been well above Indian levels. The study explores the impact of trade policy reforms on TFP growth in the Indian manufacturing sector. The three-digit estimates for each year over the pre and post-reform period shows that for the whole pre-reform period, the majority (0.53) of three digit industries experienced TFP regression, while for the post-reform, the majority (0.69) of industries experienced TFP growth. There have been a lot of studies focusing on using patents as indicators of innovation, but there are certain pitfalls associated with measuring innovation outcomes with patent data (Griliches 1990). One widely accepted notion is that patents only capture a part of the innovation output. Moreover, there exist remarkable differences in what Scherer (1983) called the propensity to patent across sectors or firms. Thus the present study shall try to cover all the aspects of competitiveness.

Limited work has been done on analyzing the impact of new policy regime on the productivity and competitiveness in biotech sector. Most studies cover the overall manufacturing sector of Punjab. A few studies covering some aspects of the Punjab manufacturing have been discussed below: Singh (1987) has calculated the partial and total factor productivity for the manufacturing sector of Punjab. The time period covered by the study is 1967-68 to 1981-82. The study is based on the ASI data. The author has studied the manufacturing sector (census sector as reported in ASI) and has calculated both the partial and total factor productivity indices. While the labour productivity and the capital intensity showed a rising trend, the capital productivity showed a falling trend. Total factor productivity as measured by Kendrick, Solow and Translog indices showed a declining trend. Bhardwaj (1990) studies the structure and growth of hosiery industry in Punjab over the period 1975-76 to 1980-81. The industry had growing demand for its products both in domestic and international markets. The small scale units have been engaged in solving the problem of unemployment, increasing the level of per capita income, national income and exploration of natural resources. The study suggests a great need to develop the industry on modern lines with expansion of units, modernization of spinning and knitting units etc. Singh (2004) studies the impact of economic reforms on productivity growth in manufacturing sector of Punjab covering the period 1983-84 to 1998-99. In this study total factor productivity is calculated by the three indices that are: a) Kendrick Index b) Solow Index and c) Translog Index. Growth rates of labour productivity, capital productivity and capital intensity have also been calculated in this study. Period from 1983-84 to 1990-91 is descripted as pre-reform period and 1991-92 to 1998-99 as post-reform period. The findings of the study show that labour productivity increased in the manufacturing sector of Punjab. It is found that the growth rate of labour productivity is more pronounced in the post-reform period. The average annual growth rates of capital productivity reveals that it shows a declining trend in the manufacturing sector of Punjab for the entire study period. But growth rate of capital productivity is positive in post-reform period and negative for the pre-reform period. The results suggest that efficiency of capital input had declined in the manufacturing sector of Punjab in the pre-reform period but post-reform period shows some increase in efficiency of capital input.

The estimates of average annual growth rates of capital intensity reveal that it has increased. This result indicates that the process of capital deepening has taken place in the manufacturing sector of Punjab during both pre and post-reform period. The comparative analysis of average annual growth of Kendrick, Solow and Translog indices suggests that the overall factor use efficiency in the manufacturing sector of Punjab has declined during the post-reform period, which shows that there emerged technological retrogression in Punjab. Banerji (1975) analyzed partial productivity indices of labour and capital and total productivity index during the perod 1946-64. The trend in the study shows that the performance of the manufacturing secto was sluggish over this period. While labour productivity showed up significant up trend, no evidence was found to indicate the presence of technical progress in the sector. Mehta (1980) in a comprehensive study has calculated partial and total factor productivity indices for large scale industries. This study for Indian manufacturing shows that overall efficiency of the industrial sector declined during the period under study. According to Stuart Smyth et.al while most innovations commonly enter the marketplace with little notice or fanfare, this cannot be said for products of agricultural biotechnology. The commercialization of innovative new transgenic crops and the resulting food products have resulted in some products entering the market that are not desired by some consumers. It is argued that these new products are creating a new class of socioeconomic liabilities in the marketplace. The global agri-food industry has reoriented itself in the past decade around technological change and innovation. Both farmers and the rest of the agrifood supply chain have recognized that the long-term threat to their livelihoods is other local and regional demand for land, labor, and capital. Ultimately, the sector will need to achieve productivity gains at least equal to those in other domestic sectors, which will require significant technological and institutional change. Change creates risk, which can, if not anticipated and managed, create liabilities for someone. Biological control of liabilities, either through contemporary technologies described above or those yet to be devised, is the science side of the story. The human, institutional element is the complementary other side. Ultimately, these two parts must fit together in a discussion of the relative costs (risks) and benefits of alternative options. Similarly, control mechanisms are not cheap. Incomplete institutional approaches can lead to millions of dollars of losses when technologies are widely dispersed. Governments tend to have a larger role in defining, managing, and adjudicating liability because we live in an imperfect world, where individual market actions do not lead to socially acceptable outcomes. In a world characterized by perfect, costless information, governments could simply define rights and then allow adjudication institutions to operate. If those systems did not impose any transaction costs on those who chose to enter into a transaction, the existence of the threat of liability would lead to an efficient market outcome. The existence of legal liability would act as a perfect deterrent, as the full costs of any transaction would have to be accounted for by those entering into the transaction.

According to Jeremy Hall et.al Many argue that transgenic technology will have wide-ranging implications for farmers in developing nations. A key concern is that competencies may be destroyed by predominantly foreign multinational transgenic technologies, exacerbating problems of social exclusion in the case of subsistence farmers. Conversely, those that fail to adopt the technology may become uncompetitive, particularly in commodity-based export markets. Drawing on interview data conducted in Brazil and supporting data collected in North America, Europe and China, we found that the impact of transgenic technology varies. It has less impact on farmers that adapt the products to their crop systems and environment, and greater negative implications for less formally educated subsistence farmers in consequence of both complexity and compatibility. Agriculture plays a major economic and social role in these countries, for domestic consumption, employment and acquisition of foreign exchange through exports. Countries that fail to adopt the technology may become uncompetitive in international markets. Conversely, traditional breeding competencies, ecosystem diversity and crop knowledge may be destroyed by predominantly foreign transgenic technologies, thus widening the gap between developed and developing nations. A key challenge for companies promoting transgenic technology is to recognize socioeconomic differences amongst regions and reconcile these often conflicting pressures and needs, most of which are beyond the boundaries of their firm, the extended value chain and other key primary stakeholders.

Coming to the studies related with competitiveness different studies have used different parameters. IPRs are emerging as important factors to enhance competitiveness and give an edge to firm possessing more IPRs. **??**ornish and Lewelyn (2003) used the term IP to describe the various forms of intangible property that include trade mark, patent, copyright. Maskus (2000) talked of two contrasting views of intellectual property, the natural-rights view that sees ownership of mental creations as a natural right of the creator, and the public-rights view which deems all information to be in public domain, since free access to information is vital to social well-being and cultural growth. Intellectual property is the term that describes the ideas, inventions, technologies, artworks, music and literature that are intangible when first created, but become valuable in tangible form as products. Intellectual property is not the product itself, but the special idea behind it, the way the idea is expressed and the distinctive way it is named and described (Idris, 2002).

According to Kavida et al. (2008), India is emerging as the hub of 'knowledge economy' in south Asia. India has proved her strength in information technology. Davis (2004) A intellectual property rights (IPRs), tracing four recent, inter-related trends in the IP landscape: the growing prominence of intangible assets as sources of competitive advantage, the globalization of business activities, advances in digital technologies and changes in the legal framework governing the strength and scope of IPRs. The researcher analyzed the implications of these trends for firm strategy by considering the 'overall value' and effectiveness of patents for firms. In order to be

competitive in today's world of globalization and liberalization Indian organizations have to use of advanced technology, technical manpower, and innovative research and development (Narain et al., 2004).

According to Lalitha (2004) showed that patenting in biotechnology is foreigndominated with nearly 75% of the patents owned by foreigners. Predominantly, patents related to the pharmaceutical sector covered processes for the preparation of antibiotics, vitamins, enzymes, antibodies and vaccines, although patenting also covers chemicals such as alcohols and polysaccharides. In the agricultural sector, it covers plant growth regulators, veterinary vaccines, plant cells and tissue culture. In the food industry, dairy and fish products, yeast and food additives, starch products, glucose and fructose syrups are covered by the biotechnology patents. However, what is significant is that biotech patents are marked by a shift towards newer areas employing gene manipulation techniques. Huge resources are spent on introducing new traits in plants through GMOs, and all over the world, the field of transgenic crops has been expanding ever since such products were introduced in1996. It is considered that use of transgenic crops results in sustainable and resourceefficient crop management practices, aside from reducing the use of pesticides in crop production, and thus impact positively on biodiversity (James, 2001). Because of these advantages, the total land area used for transgenic crops increased from 1.7 million ha in 1996 to 58.7 million ha in 2002. In the United States alone, the total land area used for these crops increased from 1.5 to 39 million ha (majority under transgenic cotton), where patents and UPOV 1991 protect innovations in plant varieties.

In 2000, a total of 13 countries, 8 industrial and 5 developing countries, grew GM crops. Although plant biotechnology is considered to provide solution to the growing food insecurity among developing countries, lack of appropriate and concrete answers to the concerns raised relating to the environment have induced the developing countries to tread cautiously in the area of transgenic crops. One reason for the slow spread of transgenic crops in developing countries is that governments in many developing countries are with-holding approval for the release of GM crops due to their insufficient technical, financial and infrastructure capacities to assess GM crops for biological safety. In some developing countries, even if the technical capacity to regulate for bio-safety is strong, approvals for GM crops have been delayed because of political pressures from local and international anti-GM activist groups and uncertainty regarding consumer acceptance of GM products in international markets. GM crop technologies created by private companies restrict technology transfer to poor farmers in poor countries because of the privately held intellectual property rights. Lack of protection for intellectual property rights in developing countries demotivates the entry of the private sector. Gupta (2006) observes that, in comparison with the plant protection in more than 30 countries, the protection offered to the extent and farmer varieties to protect the land races by the Indian Act is a bold attempt and has not been tried by any other country. However, some modifications in the following lines perhaps will be more useful for the farmers and the breeders. While it is appreciable that the Indian Act provides for the registration of extant and farmers varieties, the condition that such varieties will have to meet the criteria of distinctiveness, uniformity and stability (DUS) may not be realized, at least in the case of local land races and wild relatives of economic plants. Although it appears relatively easy and inexpensive to obtain plant variety right than a patent, still the local communities cannot exercise such rights.

The uniformity and stability requirements imply that only commercial breeders of genetically uniform varieties can benefit from the system (Dutfield, 2000).

He points out that 'local communities whose land races (or traditional cultivars) may be rich in intra-varietal genetic diversity (due in part to the preference of communities for versatility and adaptability) are unable to acquire protection because of this genetic diversity'. Hence, in view of this, the DUS requirement may be modified in the case of extant and farmers varieties. A related issue is that in order to provide effective protection to the local land races, cooperation of local communities having knowledge about such varieties and village organisations is very essential. This would be useful in (a) creating and updating a national database of such varieties and (b) benefit sharing whenever such varieties are exploited for further development. Furthermore, the period of protection provided by the Indian Act is shorter than the period of protection offered by other types of plant protection. Taking into account the role of plant bio-technology in agriculture and pharmaceutical sector, it is essential to protect the extant and farmers varieties for a longer period, so that the local communities can also benefit from research or developments that are based on local land races. The Indian Act provides for the farmer's rights to save, use, sow, re-sow, ex-change share or sell his farm produce including a protected seed variety, although a farmer cannot sell the protected seeds as a branded seed.

The other area where intellectual property rights become very essential is in protecting traditional resources from bio-piracy resulting from bioprospecting. Increasingly, plants and plant-based resources are used in pharmaceutical preparations. Whereas over 90% of genetic resources are estimated to be found in the tropical regions of Africa, Asia and South America, which are economically resource-poor countries, the countries which rely on such resources for industrial production and research, however, are in the North and are economically rich (Biber, 2000). With the increase in outsourcing of biotechnology production and re-search by western countries, developing countries are demanding that the country of origin of genetic resources should also benefit by the larger research and subsequent commercialization of the research. Although Article 15 of the Convention of Biodiversity says that the benefits of the research should be shared 'in a fair and equitable' manner with the country providing those resources, in the absence of effective international arbitration and without specific

regulations at the national level to fix the level of fairness and equitability, currently the benefits are shared by mutually agreed contract arrangements.

Although the Indian Act incorporates the concept of benefit sharing so as to benefit the local communities, the methodology to arrive at a formula that will be acceptable for both the local community and the researcher is yet to be laid down. Nevertheless because benefit sharing can take financial, conservation, social and scientific forms, they must therefore be resolved during the prior-informed-consent process before any bio-prospecting permits are issued (Moran, 2000). As case studies demonstrate, opportunities for financial compensation include upfront payments and mediumterm benefit sharing as research progresses. Many companies offer stakes in equity, profit sharing and joint venture opportunities. In the case of drugs produced from plant resources, royalties occur only if and when a drug is marketed. The researcher concluded that Innovations in biotechnology have several useful applications in agriculture and are useful for developing countries like India. However, current resources for such innovations have nevertheless resulted in their protection by way of appropriate intellectual property rights. While patents prevent further research, a sui generis system adopted by India benefits both the farmers and the breeders, and diffusion is possible. Although plant protection rights will check unlawful bioprospecting, to protect the interests of farmers and breeders, large databases that document the existing varieties need to be undertaken. This paper highlighted some of the issues that emerge from the context of extending protection to extant and essentially derived varieties, and the implications for agricultural research in the context of adopting transgenic technology. While protection may encourage the private sector to go for research in commercial crops, it may also divert the resources of the public sector from investing in research on food crops to regulating and monitoring the research in private sector. The task that confronts developing countries like India is in focusing on developing the physical and scientific infrastructure to provide plant protection effectively.

According to Clemente (2006) Pharmaceutics, biodiversity and ethnic knowledge are critical areas of impact. 'Trade-relating' intellectual property might allow developing countries to be compensated, but incentive implementation of optimal compensation in the legislatures seems infeasible. Scientific communities in developing countries are particularly vulnerable to limitations of cooperation and access to information, resulting from stronger intellectual property rights protection, as their efforts to obtain normal science results must be considerable. Developing countries' policies and academic debate on intellectual property have followed a pendulum-like movement. Soon after the Second World War, a new perspective on the importance of technology in trade and development was created by the work of United Nations programmes (such as the Economic Commission for Latin America) and independent economists from developing countries. These analyses, which centred on technology transfer issues, concluded that developed and developing countries should take a different stance concerning the protection of intellectual property. He stressed that situations of monopoly and oligopoly in world technology markets prevented developing countries from having fair access to technology. Penrose (1951) maintained that developing countries could not expect any advantage from protecting IPR, for these were concentrated in the hands of residents of developed countries. From the point of view of global welfare, it was argued, industrialized countries would not lose much from the lack of protection in those countries and, overall, welfare would improve with low protection. Between the 1950s and the middle of the 1980s, developing countries succeeded in maintaining a special status in the international intellectual property system. Regional organizations such as the Latin America Free Trade Association (LAFTA), the Andean Pact and others advanced common intellectual property policies along these lines. In 1970, India adopted a patent law with considerable restrictions on patent holders. The choice of this country in favour of process patents rather than product patents allowed local production of imported products whenever the use of a different process was demonstrated.

In the mid-1980s, a shift in this scenario began to occur on the initiative of the United States Government. Responding to the concerns of US-based firms, and sometimes in agreement with other advanced countries, the United States pursued what David (1993) views as "a direct, unilateral course of action", that was chosen instead of renegotiating international intellectual property agreements (Paris or Berne Conventions). First introduced in bilateral agreements, this shift in intellectual property regulation was finally enacted multilaterally in the Uruguay Round of the 1990s, as part of the conditions to join the World Trade Organization. Four major changes in the global regime of intellectual property rights and trends related to it appear to be affecting the ways scientific and technological research is conducted in developing countries: (1) the already mentioned Uruguay Round of the General Agreement on Tariffs and Trade, that resulted in the 1994 agreement on trade-related aspects of intellectual property rights (TRIPs) and in the establishment of specific conditions for access to the World Trade Organization, (2) the extension of patent protection to the pharmaceutical sector in most developing countries, following the TRIPs agreement, (3) the 1980 Bayh-Dole and Stevenson-Wydler Acts in the USA, permitting universities, non-profit organizations in general and SMEs to appropriate knowledge resulting from research financed with public Federal funds, and the more recent 1999 Research and Innovation Law in France which seeks the same purpose, and (4) the patenting of research tools and databases.

Mei-Fang Chen et al used DEA (data envelopment analysis) and Mamlquist models to evaluate the efficiency and productivity of Taiwan's biotech industry. Moreover, we use the two-stage approach to find the effects of environmental variables on efficiency and productivity scores. A panel data set is used composed of 31 listed or over-the-counter biotechrelated firms during 1998-2001. The DEA results show that the proportion of biotech firms with inefficient returns to scale rose during this period. The results from the Tobit regression further indicate that food-related firms have higher scale efficiencies than others. Mamlquist indices reveal that food-and

chemicalrelated firms have lower technical efficiencies than others, and their total factor productivities (TFP) grew from 1998 to 2000 but fell in 2001. Obviously, technical changes constitute the main source of biotech TFP changes in Taiwan. In addition to maintaining competitive advantage in technology improvements, the managers in Taiwan's biotech industry have to put more efforts into efficiency improvement.

According to Kiran et.al the study analyzes the trends in value added , labour, capital as well as trends in labour, capital and total factor productivity for sixteen industrial groups on the organized manufacturing sector for the period 1980-81 to 2002-03. The present study tries to examine the trends in partial productivities as well as total factor productivity. In this study, the focus is on the empirical measurement of (a) growth of output, capital and labour (b) capital productivity (c) labour productivity and (d) total factor productivity. Partial factor productivity measures the ratio of output to one of the inputs setting aside interdependence of use of other output. Labour productivity (V/L) is the ratio of value added to total no of persons employed. Capital Productivity (V/K) is the ratio of value added to gross fixed capital.

Studies by Ahluwalia (1985Ahluwalia (,1991)) for the period 1959 to 1985 examines total factor productivity. The studies show that during the two decades of the sixties and seventies total factor productivity in the manufacturing sector declined. However there is also a finding that in the first half of eighties productivity growth improved. The dominant source of the acceleration in total factor productivity has been growth of value added.

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Volume XV Issue XI Version I Year ( ) Many explanatory and interesting studies have been undertaken in the world to analyse the productivity and competitiveness in different sectors. The satisfaction of the customers can be measured by the quality provided by the firms. Different companies have used various factors for judging the quality factor. Table 1 shows factor analysis for competitiveness, Table 2 shows factor analysis for productivity. On the basis of factor analysis results six factors that emerged are:A

1) Threat of new competition 2) Threat of substitute products or services 3) Bargaining power of suppliers 4) Intensity of competitive rivalry 5) Bargaining power of customers (buyers) 6) Rivalry among existing firms These six factors account for 96.208 percent of total variation. Threat of new competition emerged as an important factor explaining 20.452 percent of total variation. All the variables in this factor account for loadings in the range of 0.821 to 0. 891. The item industry profitability had item loading of 0.663.The second factor viz. threat of substitute products or services had variables accounting for 19.958 percent of variation. Here the item buyer propensity to substitute had item loading of 0.660 while the variables buyer switching costs, perceived level of product differentiation, number of substitute products available in the market, quality had item loading of 0.787,0.930,0.738 and 0.922 respectively.

The next perceived factor is bargaining power of suppliers which accounts for 17.144 percent of variation. The items supplier switching costs, supplier concentration to firm concentration had item loading of 0.863, 0.764 whereas the item ability to forward vertically integrate had item loading of 0.591. The fourth factor is intensity of competitive rivalry which explains 16.906 percent of total variation. The items sustainable competitive advantage through innovation, competition between online and offline companies, level of advertising expense, powerful competitive strategy, flexibility through customization, volume and variety had item loading of 0.938,0.951,0.760,0.631,0.778 respectively.

The fifth factor bargaining power of customers explains 11.231 percent of variation. It has items viz. buyer concentration having item loading of 0.678, bargaining power having item loading of 0.769, buyer information availability having item loading of 0.886, products uniqueness having item loading of 0.813. The last factor is rivalry among existing firms accounts for 10.518 percent of variation. It has three items competitor products, existence of labor unions, competitive position having item loadings of 0.933, 0.636, and 0.625.

5 a) Factors Influencing Productivity

The study has taken four factors influencing productivity. These are: Internal and External Environment; Cost Efficiency; Production Planning and control; and Technological advancement.

Production Planning and control emerges as a factor with highest mean score, followed by Internal and external environment as depicted through figure **??**. Technological advancement has the lowest mean score. Thus there has to be focus on this factor as this seems to be a neglected factor. Similar trend is reflected by large scale sector with Technological advancement reflecting the lowest score of 3.47. The trend is slightly different for medium and small scale as the highest mean score for these two sectors has been for Internal and External Environment, followed by Production Planning and control. The least mean score for these two sectors has been recorded by Technological advancement (Figure **??**V). These four factors account for 90.669 percent of total variation. Internal and External Environment emerged as an important factor explaining 31.208 percent of total variation. The items education and training and Govt regulations had very high item loadings of 0.992 and 0.963. Other items like trends of the past years for new technology, consider consequential changes and availability of better technology due to globalization had high item loadings of 0.710, 0.709 and 0.718 whereas the item participation of engineers had item loading of 0.556.

The second factor is cost efficiency which accounts for 24.600 percent of total variation. The items threats, cost of training and education, lack of finance had item loading of 0.806, 0.961, 0.824 whereas the item alternate processes cost effective, economic viability study had item loading of -0.975 and -0.639.

The third factor is production planning and control which explains 18.685 percent of total variation. The items opportunities due to globalization, cost of new technology and increased maintenance expenses had item loading of 0.756, -0.647, -0.807respectively. The fourth factor is technological advancement which accounts for 16.176 percent of total variation. The items adopting new technology, attitude of employees towards adoption, availability of professional consultants, production management skill deficiency, problem of compatibility of equipment had item loading of -0.821, -0.632, 0.623, 0.946 and 0.973.

7 III.

8 Conclusion

The factors of productivity are Internal and External Environment; Cost Efficiency; Production Planning and Control; Technological Advancement. The factors of competitiveness are Threat of new competition; Threat of substitute products or services; Bargaining power of suppliers; Intensity of competitive rivalry; Bargaining power of customers; Rivalry among existing firms. The result of factor analysis has been validated through the author-factor matrix. There are a number of studies where the individual factors have been identified. The present study adds upon that literature by the aggregative analysis. Some of the factors identified for competitiveness have been related to Porter model which has been used as a base. Empirical results through factor analysis have helped in identifying their importance.

IV.

9 Future Work

This study has identified factors influencing competitiveness and productivity in Indian scenario. For future work case-study analysis can be done to validate the factors identified in the study. [1] [2]

Figure 1:

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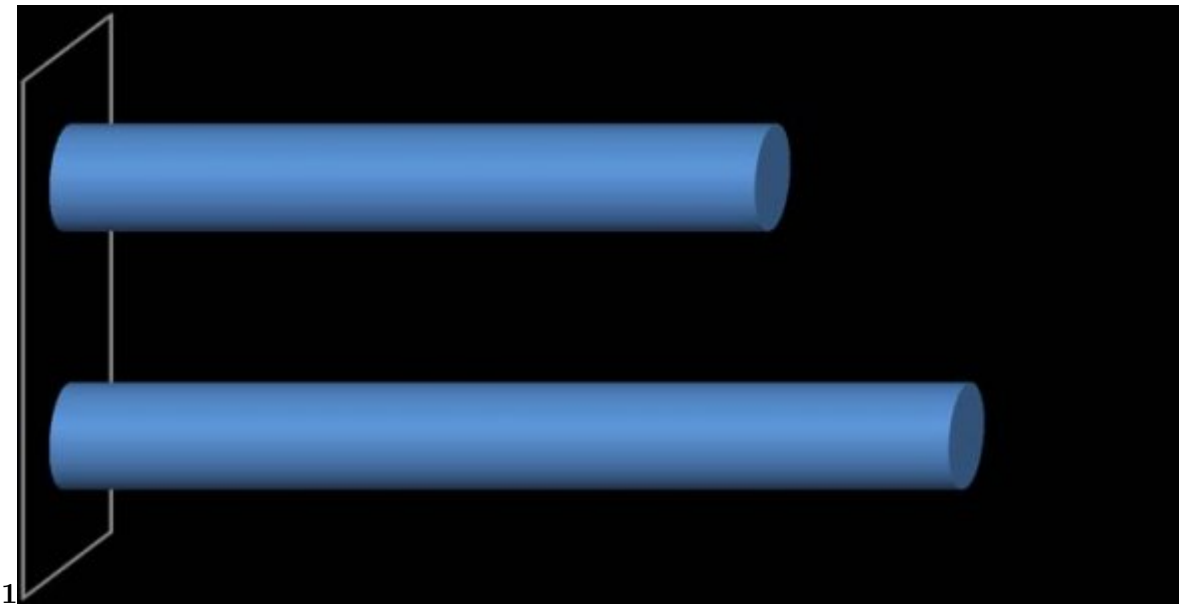

Figure 2: Figure 1 :

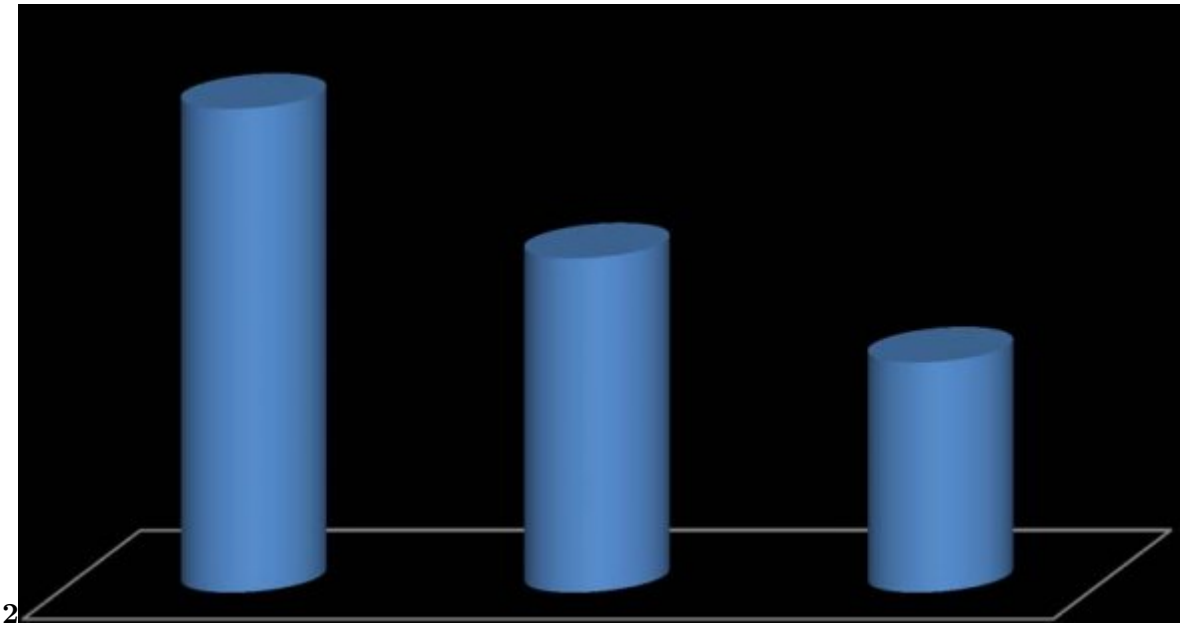

Figure 3: Figure 2 :

facilities for maintenance of cell lines, acquisition of research biological at a central point and distribution was created. Under DBT's guardianship, financial institutions started encouraging investments in BT commercialization by entrepreneurs. An interface organisation called Biotech Consortium of India was established to serve as a link between research organisations and industry located either in India or abroad. A survey of Indian patents in biotechnology during 1972-1988 carried out for the Department of Biotechnology and subsequently updated until 1991

Figure 4:

1

Factor Name	Items	Factor Loading	Eigen Value	% of Var anc
1) Threat of new competition	? Barriers to entry	0.821	5.113	20.4
	? Economies of product differences	0.891		
	? Absolute cost Industry profitability;	0.663		
2) Threat of substitute products or services	? Buyer propensity to substitute	0.660	4.989	19.9
	? Buyer switching costs ? Perceived level of product differentiation	0.787		
		0.930		
	? Number products available in the of substitute market ? Quality	0.738		
		0.922		
3)Bargaining power of suppliers	? Supplier switching costs	0.863	4.286	17.1
	? Supplier to firm concentration concentration	0.764		
	? Ability to forward vertically integrate	0.591		
4) Intensity of competitive rivalry	? Sustainable competitive advantage through innova tion	0.938	4.227	16.9
	? Competition online and between offline companies ? Level	0.951		
		0.760		
	of advertising expense ? Powerful competitive strategy	0.631		

Figure 5: Table 1 :

2

Year
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( )
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[Note: A]

Figure 6: Table 2 :

[Cornish and Llewelyn (ed.) ()] , William Cornish , David Llewelyn . Intellectual Property, Sweet & Maxwell London (ed.) 2003. (5th Edn)

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