Upgrading in the Indian garment industry: a study of three clusters

Saon Ray,[ξ] Prithvijit Mukherjee and Mishita Mehra

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Abstract: This paper examines the process of upgrading of the Indian garment industry through a survey of 100 firms in three clusters in Delhi NCR, Tirupur, and Mumbai, in 2012. Upgrading could be of three types: Process, Product or Functional. Product upgrading entails producing higher value added products and involves steps taken to upgrade product quality, introduction of new fabrics and raw materials, and reduction in reworking rates. Process upgrading occurs through the incorporation of more sophisticated technologies in production and /or re-engineering. Process upgrading takes place through use of new production machinery, workers training, reduction in delivery time, total quality programs, introduction of new organizational approaches, improvements in the production process and increased usage of computer programs for business purposes. Functional upgrading involves moving to higher value functions and occurs through design, marketing and branding. Moreover, most value addition occurs in this stage of production. Most firms surveyed reported upgrading. Product upgrading is reported to be the lowest, followed by functional and process. Process upgrading is highest in the category both (firms which are exporting and also sell domestically), in Mumbai and among the medium sized firms. Product upgrading is highest in the export category, in Delhi NCR and in the medium sized firms. Little or no upgrading is reported by domestic firms, mostly in Delhi NCR and in large firms. Functional upgrading is highest in exporters, in Delhi NCR and the medium sized firms. The governance structure of the value chain determines functional upgrading. Discriminant analysis has been used to identify the variables that differentiate between the three groups, clusters, size and orientation. Reduction in reworking rates, introduction or improvements in total quality programmes, increased use of computer programmes and internet for business purposes and new production machinery are the most important predictors of upgrading among Mumbai, Delhi and Tirupur. New production machinery is most important predictor of upgrading between firms catering to the Domestic market and Both (i.e. exporting as well as supplying to the export market).

[ξ] Corresponding author: email: saonray@gmail.com

1. Introduction

Garments[1] are a labour intensive sector and contribute to a country's industrialization efforts by helping diversification from resource based exports. In the past, countries such as Japan reaped the benefits of industrialization by exporting garments. Today, global exports in garments are dominated by countries like China, while Bangladesh and Vietnam have also emerged as important players.

The garment industry provides employment to several thousand people, and is an important foreign exchange earner for many countries. For India too, the textiles and garment industry is important since it is the second largest employer[2] (agriculture is the largest) and also contributes significantly to exports. In 2013, global textiles exports were worth US$ 772 billion, of which India's share was 5.2 percent. India's textile and apparel exports amounted to US$ 40.2 billion in 2013, in which the share of textiles was 57 percent, while the share of apparel was about 43 percent. Apparel exports in 2013 from India were US$ 17 billion, registering an impressive increase of 22 percent over the previous year (WTO, 2013).

The textile and apparel value chain is organised around five main segments (Pickles, 2012): raw material inputs (which includes cotton, wool, silk for natural fibres, as well as oil and natural gas for synthetic fibres), textiles (natural fibre based or synthetic fibre based), apparel manufacture, intermediaries (brand name, overseas buying offices, and trading companies), marketing and retail. In this paper, we focus on the process of apparel manufacture which has four main stages of production, that is, design, cutting, sewing, and embellishment.

The literature on the organization of the apparel value chains is extensive (Gereffi and Memedovic, 2003). It is now examining the mechanism through which firms and industries can upgrade[3] within global value chains to capture greater value added and hence profits. Upgrading

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[1] In this paper we use garments and apparel interchangeably.

[2] 45 million direct employment (Technopak, 2012).

[3] Upgrading has been defined in the literature as "innovation producing and increase in the value added" (Morrison et al. 2008), insertion into local and global value chains in such a way as to maximize value creation and learning" (Gereffi et al. 2001), shifts in activities that "increase the skill content of their activities and/or move into market niches which have entry barriers and are therefore insulated to some extent from these pressures" (Humphrey and Schmitz, 2002), and, "the capacity of 'a firm'to innovate to increase the value-added of its products and processes" (Giuliani et al. 2005).

has been classified into four types (Humphrey and Schmitz, 2002)[4] : functional, product, process, and chain. Functional upgrading involves moving to higher value functions and occurs through design, marketing and branding, while product upgrading entails producing higher value added products. Product upgrading entails producing higher value added products and involves steps taken to upgrade product quality, introduce new fabrics and raw materials, and reduce reworking rates. Process upgrading occurs through the incorporation of more sophisticated technologies in production and /or re-engineering, while chain upgrading leads to the leveraging of expertise gained in one industrial sector to enter another sector. Process upgrading takes place through use of new production machinery, worker training, reduction in delivery time, total quality programs, introduction of new organizational approaches, improvements in the production process and increased usage of computer programs for business purposes. Chain upgrading leads to the leveraging of expertise gained in one industrial sector to enter another sector.

This paper examines the process of upgrading of the Indian garment industry through a survey in three clusters in Delhi National Capital Region (NCR), Tirupur, and Mumbai. The survey was conducted on 100 firms in the three clusters in 2012. Most firms surveyed report upgrading.[5] Product upgrading is reported to be the lowest, followed by functional and then process upgrading. Functional upgrading is the highest in exporters, in Delhi NCR and the medium sized firms. Process upgrading is highest in the category both (firms which are exporting as well as selling domestically), in Mumbai, and among the medium sized firms. Product upgrading is highest in the export category, in Delhi NCR and in the medium sized firms. Little or no upgrading is reported by domestic firms, mostly in Delhi NCR and in large firms.

The paper is organized as follows: the next section discusses the concept of upgrading and associated literature. Section 3 discusses the Indian apparel industry. Section 4 presents the methodology used to survey the firms. Section 5 presents the findings of the survey and discusses results of the discriminant analysis. Section 6 concludes.

2. Literature survey

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[4] In this paper we focus only on the first three types: product, process and functional.
[5] Firms were asked to rate (on a scale of 1-5, where 1 is the lowest investment) their product, process and functional upgrading.

Sixty percent of world trade takes place through coordinated global value chains (GVCs) (UNCTAD, 2013). GVCs are highly structured networks where the flow of products, knowledge, and resources are coordinated and serve as outlets for developing country exports.

The concept of upgrading or making better products and making them more efficiently and moving into more skilled activities has been studied in the context of competitiveness (Kaplinsky, 2001; Porter, 1990). In the context of value chains, upgrading is defined as innovating to increase value added (Giuliani et al. 2005).[6] Upgrading has been defined by Humphrey and Schmitz (2002) as occurring through one of the four: product, process, functional and chain.[7]

Product upgrading entails producing higher value added products. Process upgrading occurs through the incorporation of more sophisticated technologies in production and /or re-engineering. Functional upgrading involves moving to higher value functions, while chain upgrading leads to the leveraging of expertise gained in one industrial sector to enter another sector. Product upgrading involves steps taken to upgrade product quality, introduction of new fabrics and raw materials, and reduction in reworking rates.

Process upgrading occurs by moving into more sophisticated product lines in terms of more unit value and takes place through use of new production machinery, workers training, reduction in delivery time, total quality programs, introduction of new organizational approaches, improvements in the production process and increased usage of computer programs for business purposes. Functional upgrading is acquiring new and superior functions in the chain such as design, marketing and branding. Hence, most value addition occurs in this stage of production. Chain upgrading involves a movement into new activities which may also imply higher skills and capital requirement, and value added. Upgrading implies going up the value ladder and moving away from activities that are of lower value and where entry barriers are low (Giuliani et al. 2005).

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[6] Innovation does not refer to discoveries of breakthrough, but rather to marginal improvements of the products and process that are new to the firm.
[7] In this paper we examine only product, process and functional upgrading.

There is evidence of East Asian garment firms moving from low end activities to high end activities such as designing and branding as documented by Gereffi in his studies in 1994 and 1999. However, as the literature suggests, upgrading is not automatic and even exporting through global value chains does not guarantee upgrading. Nor does it provide access to the whole range of activities needed for developing country firms to compete in the global economy. This brings in the issue of governance of such value chains and the kinds of governance structure that facilitate upgrading.

The issue of governance of GVCs has been examined by Gereffi (1999); Gereffi, Humphrey and Sturgeon, 2005; Humphrey and Schmitz (2000).[8] Chains often have governor or lead firms that largely determine production parameters and wield power over other firms in the chain. Chain governance is one of the factors likely to influence a firm's upgrading chances (Bair, 2009; Schmitz, 2004). Governance of value chains is important for developing countries as it defines their prospects for learning and earning (Schmitz, 2006). Also, some activities are better remunerated than others and it is in the interest of developing country firms to learn the skills to upgrade their positions in the GVCs. The ability to identify activities providing higher returns along value chains is the key to understanding the global appropriation of the returns to production (Giuliani et al. 2005).

Giuliani et al. (2005) discuss how differences in learning across sectors foster the role of global buyers in each of the sectors and may help or hinder upgrading. Based on this argument, they develop a sectoral classification of upgrading in the context of Latin America. The categories are: traditional manufacturing, natural resource based sectors, complex product industries and specialized suppliers. In the case of traditional manufacturing which includes textiles, footwear, etc., the sector is supplier dominated and major process innovations are introduced by the

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[8] Gereffi et al. (2005) have developed taxonomy that combines five governance categories based on combinations of a) complexity of inter-firm transactions, b) the ability of participating firms to codify such transactions, c) the capabilities of the supply base to fulfil the requirements of these transactions in an independent manner. These categories are: 1) Market – with low buyer and low producer concentration, buyer not involved in product definition, 2) Captive (quasi hierarchical) – one firm exerts a high degree of control over other firms, high buyer dependency, high buyer concentration, buyer's competence in essential chain activities is higher than producers, 3) Modular – similar to captive except capability in supply base is high, 4) Relational – complex interaction between buyer and seller, 5) Hierarchy – which involves vertical integration.

producers of inputs such as machinery and materials. Firms upgrade their product by developing or imitating new product designs, often interacting with large buyers who play an important role in shaping the design of final products and the specificities of the process of production. Giuliani et al. (2005) examine the endogenous and exogenous factors that influence firm upgrading and note that the degree of cumulativeness of knowledge, codification and complexity of the knowledge base influence the capacity and way firms upgrade.

Navas-Aleman (2011) suggests that it is rare for developing country manufacturers to design their own exports even when operating in GVCs and even rarer for them to own exports brands. As Keesing and Lall (1992) note, lack of design and marketing skills leaves firms from developing countries in a vulnerable situation in comparison with global buyers. In this paper, we highlight this aspect of the chain governance in the context of garment manufacturing in India. In particular, we examine the product, process and functional upgrading for firms surveyed in three clusters of India.

3. The Indian garment industry

The textile industry contributes about 14 per cent of the total industrial production in India, 4 per cent to the GDP and 13 per cent of the total export earnings.[9] The textile sector is the most important sector in terms of employment, after the agriculture sector. It provides employment directly to about 45 million and indirect employment to 60 million people (Technopak, 2012). India is among the world's top fifteen exporters of textiles and clothing.

While the exports of textiles by India increased from $ 8 billion in 1995 to 21 billion in 2009, exports of clothing (garments), increased from $ 8.6 billion in 2005 to 10.6 billion in 2010. While India doubled its exports of textiles between 2005 and 2010, in 2013 India's textile and apparel exports amounted to US$ 40.2 billion, of which the share of textiles was 57 percent and the share of apparel was about 43 percent. Apparel exports in 2013 from India were US$ 17 billion in 2013.

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[9] Textile Committee (2011) National Household Survey 2010: Market for Textile and Clothing, pg 23

The textile and clothing industry is a diverse and heterogeneous industry which covers a great number of activities, from the transformation of raw materials to fibres, yarns, and fabrics. These in turn, are used to make a number of products including garments. The textile and the clothing sector covers approximately 1500 tariff lines; while the textile sector comprises HS chapters 50 to 60 and 63 of the combined nomenclature, clothing comprises chapters 61 and 62 of the same classification. The clothing sector covers made-up products that are articles of apparel and clothing and accessories. The clothing products in chapter 61 are either knitted or crocheted while apparel products that are produced from woven textile fabrics fall under chapter 62. Hence the classification process distinguishes between products based on the underlying manufacturing process. The maximum value addition to textiles is done by the apparel sector, which is the last stage of the textile value chain.

The garment industry in India comprises the domestic market as well as exports. In 2008, it was estimated that while the size of the domestic apparel market was US$ 15 billion, apparel exports were US$ 9.7 billion (CITI). At current prices, the Indian textiles industry is pegged at US $ 55 billion, 64 percent of which services domestic demand (Ministry of Textiles). During the year 2010-11, garments accounted for 45 percent of total textile exports. Garments and cotton textiles nearly account for 70 percent of India's exports of textiles and clothing. *Textiles and Apparel Operations Outlook* (2012) places the domestic market at US $ 50 billion while approximately US $ 25 billion is exported.

The Annual Survey of Industries reports that there were 3760 garment manufacturing units in 2009-10 (going by the definition of Factory under the factories Act, 1948). In 2001-02, the same figure was 3273 and in 2006-07, it was 3627. The Annual Survey of Industries collects data only for registered manufacturing. The small and medium sector is surveyed by the Micro, Small and Medium sector (MSME) survey. The Fourth MSME Census reported 214,557 registered MSMEs in 2006-07. However, this covers only registered units meaning that unregistered small and medium units are not counted.

The industrial structure in the garment industry is rather complex: the bulk of the units are small and medium firms. Most of the production is organized in clusters. The major clusters are

located in Delhi NCR, Mumbai, Ludhiana, Kolkata, Tirupur, and Bangalore. A study by AEPC in 2009 estimated that 95 percent of the production is in the top 19 clusters, whose annual production is 890 crore pieces. Of this 680 crore pieces fulfill domestic demand and 210 crore pieces are exported. The total number of garment units in these 19 clusters is 33371. The market for textile and apparel is pegged at Rs. 3290 billion[10] in 2011 in India, out of which the market for apparel is pegged at Rs. 1540 billion, out of which 65 percent accounts for readymade garments, and rest consists of unstitched garments.

India's top readymade garments (RMG) exports in 2010 comprised Cotton T shirts (610910), Women's/Girls' Blouses, Shirts and Shirt Blouses of Cotton (620630) and Men's / Boys' Shirts of cotton (620520). These items were also the top three items in 2005. An assessment of the number of knitted versus woven garments shows that based on certain assumptions,[11] 47 percent of the garments in 2009 were in the knitted category and 53 percent in the woven category.

For the domestic market in 2009, 43 percent of the total production comprised men's wear amounting to Rs. 66300 crores, while women's wear stood at Rs. 57745 crores, and 37 percent of the total. Boy's and girl's wear stood at Rs. 15765 (10% of total) and Rs. 14190 (9% of total) crores, respectively (Indian Textile and Apparel Compendium, 2010 Technopak).

4. Methodology

The primary study for the study examined the nature of the garments value chain located in different clusters of the country. The objectives of the primary survey were the following:

(i)   To document the firm's engagement in different types of supply chains (global, regional and domestic) and its perspective on the nature of such chains in the industry.

(ii)   To examine different components of the supply chain

(iii) To examine the governance structures of the supply chain.

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[10] The Apparel Times – Vol. 7, No. 6, Nov- Dec 2011

[11] Kolkata and Howrah which have turnovers of Rs. 5000 crores make largely knitted products; while Metiaburz with a turnover of Rs. 7200 makes woven products. The share of knitted in total turnover is 40%. Mumbai which has 30 to 35 percent of the total production makes knitted garments.

(iv)   To understand strategies related to process efficiency, product upgrading and capacity to augment their functional position in the chain adopted by firms

(v)   To examine the impact of incentives and regulatory regimes on the firm's performance.

Design of the survey

Primary data was collected from firms making garments using a combination of quantitative and qualitative methods. Firms were selected randomly for participating in the survey, and a structured questionnaire was used with 100 firms who agreed to participate from three clusters. The questionnaires were administered to firms through face to face interviews during 2012.[12] Information was also collected from other key stakeholders including industry associations. A key informant survey was used to understand the difference in the behavior of the clusters with industry associations.

As mentioned earlier, upgrading could be of several types, – a) Process upgrading b) Product upgrading and c) Functional upgrading. In order to capture the differences, large, medium and small firms were surveyed. To get a sense of the different value chains in the country, firms with and without export orientation were surveyed. Questions related to the nature of the value chains in which firms operate were asked. This allowed us to construct value chains, both, global and domestic. Other questions were related to the nature of upgradation.   Some firms were interviewed repeatedly to understand the nature of the logistics of their operations. A few firms reported production linkages with Bangladesh, enabling us to capture the regional value chain. The questionnaire was designed to capture each aspect of upgrading. Following Navas-Aleman (2011), firms were asked to rate (on a scale of 1-5, where 1 is the lowest investment) their product, process and functional upgrading. The thirteen categories that they were asked to rate were: 1. New production machinery (Process upgrading), 2. Worker training and attainment of qualifications (Process upgrading), 3. Reduction in delivery time (Process upgrading), 4. Introduction or improvements in total quality programmes (Process upgrading), 5. Introduction of new organizational/ management techniques (Process upgrading), 6. Improvements in the production process (Process upgrading), 7. Increased use of computer programmes and internet

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[12] 40 questions were asked. The first few questions related to the nature of the firm and its operations. Firms were asked about their product, their markets and their exports. Finally, questions related to upgrading and ways to remove barriers to upgrading were also asked.

for business purposes (Process upgrading), 8. Steps taken to increase product quality (Product upgrading), 9. Introduction of new materials and fabric to enhance product range (Product upgrading), 10. Reduction in reworking rates (Product upgrading), 11. Design (Functional upgrading), 12. Marketing (Functional upgrading), and 13. Branding (Functional upgrading). The average product, process and functional upgrading index score was used to compare firms and clusters.

5. Findings

A. Validation of value chains
a. Global value chains

Based on discussions with firms and industry associations, we note the presence of several chains in the Indian garment industry. Firms cater to global value chains and also to the domestic market. Firms in the Mumbai cluster sell half their output to the domestic market. We discuss the domestic value chain below. The global value chain is of two types: the first, supplying to the US and EU, and, the second, supplying to the Middle East market (or countries in South America). Most of the medium and large firms cater to global value chains and the products of which are being sold in the markets of US and EU. There are some differences between the two value chains: while the products in the US market are low value added garments, which are sold in bulk, the products sold in the EU market are higher value added while the quantities are lower. The design, specification of inputs, standards of compliance and the supply chain are largely determined by the buyer. The GVC catering to the Middle East markets is different from the value chain in the US and the EU markets. Firms in Delhi NCR sell mostly to US/EU. Firms in Tirupur sell to the Middle East as well as to the US/EU. The design, specification of inputs and the supply chain is collaborative in case of US/EU. There is less importance attached to compliance and producers upply products under their own brand names. Other, newer markets that were being explored by the firms include Japan, South Korea, Singapore, Latin America, South America and East Africa. Some firms have production linkages with the South Asian countries, particularly Bangladesh, which we discuss below.

The coexistence of several value chains has also been found by Giuliani et al. (2005) in the case of Latin America. They suggest that different value chains coexist in the same cluster, with firms

participating in domestics as well as global value chains, especially in traditional manufacturing. Evidence of different chains dominated by US and EU buyers are also prevalent in the Sinos Valley footwear cluster, where US and EU buyers dominate the GVC but there are minor chains oriented towards Brazilian and Latin American markets (Bazan and Navas-Aleman, 2004). These different chains also have different governance structures: in the quasi-hierarchical chain, US buyers imposed their conditions concerning product design, marketing and branding on Brazilian producers (Giuliani et al. 2005). There is evidence also from two Mexican footwear clusters in Guadalajara and Leon, where firms participate in the domestic value chain (apart from the GVC dominated by the US and EU, where the design and product development is controlled by the US buyer), and in network chains (Giuliani et al. 2004). In the latter, there is cooperation among firms, where competencies are shared among firms with more or less equal power.

b. Difference in governance structures in global value chains

Raw materials:

In supplying to the EU/US, as regards source of raw materials, either of the following could prevail: a) The source and specification of the raw material are specified by the buyer – this is done usually when the firm is dealing with a buyer for the first time or the buyer has commissioned a mill for all the raw material required for production. In this case the producer has very low bargaining power.

b) The specification is provided for the raw material by the buyer and the producer negotiates the price with the mills.

c) The source and specification of accessories is always specified by the buyer. Usually they are imported from Hong Kong.

Raw materials are procured directly by producers and products sold under their own brand name in the Middle East market.

Design:

There are three models followed in supplying products to the EU/US:

a) the design, source and specification of raw material given by the buyer

b) The design is given by the buyer and the producer and buyer collaborates on the decision regarding the type of material which would suit the design the best. The producer then procures the raw materials.

c) The design is done by producer in collaboration with the buyer.

In the Middle East market, the seller sells under his own brand name and hence has greater control over the value chain.

Product:
a) US market – basic garments and large volume
b) EU market – high value added with smaller volume and high on fashion
c) Middle East – producers have spaces reserved in supermarkets and supplies vary with demand[13]

Production standards:
a) USA and EU market – there are various standards which the factory has to meet and there is a huge restriction on outsourcing of the production process. However, in the peak season, when production capacity is exhausted, outsourcing is allowed. Samples are approved by the buyer at every point of the production process (though this comes down with time as the firms have been dealing with each other) which considerably increases the time required for production. For example, after dyeing, tests are done on the fabric to check if they are azo-dye free, etc. Maintaining standards for production substantially increases costs.
b) Middle East – There are no such standards in these markets.

c. Domestic value chains

The domestic value chain is organized in a different manner from the global value chain. The domestic value chain has two segments; the first caters to the lower and middle income market in the country. The producers have a ready stock of different styles which are sold directly to wholesalers and multi brand outlets. In case of retail brands, the design is collaborative or

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[13] Products sold in the Middle East included children's wear and garments for men and women.

provided by the buyer. The buyer monitors the quality and delivery schedule of the garments. This segment is similar to that of the GVCs. Firms largely own brands in the domestic value chain – which are sold through own showrooms, multi brand outlets and retail brands. One of the most important differences in the domestic segment is that the credit cycle is different from that of the export market.[14] Apart from this, regulations regarding quality, etc., are more lax.

The infrastructure used to produce garments is common to the domestic and export markets. The export market's volumes are larger than those of the domestic market. The number of production cycles for the export market can go up to 4 in a year, while in the domestic market there are 2. The first is the festive season which extends from August to mid-January and which includes all the major festivals, and the second is the summer season between March and May. The transactions in the export market are done through defined contracts of design, payment, etc., while payments in the domestic market are a bit flexible.

d. Emergence of regional value chains

Some firms have reported that they have production linkages with Bangladesh.[15] There are two models of production in the regional value chain: own factory and sub contracting. There are also two models for distributing the final output: directly exporting goods to EU (taking benefits under GSP), and importing to India for sale in the Indian domestic market. Some of the advantages cited in the case of the regional value chain are:

- Lower labour costs
- Lower costs for sourcing inputs
- Lower energy costs
- Ease of availability of labour
- Lax labour laws vis-à-vis India

Goods that are produced in Bangladesh and then imported to India, are 5 to 7 percent cheaper than goods produced in India.

B. Upgrading

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[14] Some firms reported that recovery of dues from the domestic market is difficult while in the case of the exporting, payment is prompt if all the paperwork is in order.
[15] Products sold to Bangladesh included sherwani, jodhpuri, etc., as well as ladies T shirts.

The upgrading survey was conducted in Delhi NCR, Mumbai and Tirupur. One firm in Surat was also interviewed. Each firm surveyed was asked questions relating to the form of upgrading and were asked to score their response on a scale of 1-5, with 1 being the lowest score corresponding to little or no upgrading. While 100 firms were interviewed for this purpose, the response of 97 is reported (some firms had to be removed from the sample because of missing observations on location of the firms and other major variables). Firms were also asked about the problems they faced in upgrading. Appendix A shows the scores recorded by the firms for each category of upgrading. The table below provides a summary of the responses recorded by the firms. It shows the count of firms reporting upgrading in one form or other: a score of more than 3 counted as upgrading and a score less than 3 suggested little or no upgrading.

[Table 1 about here]

Several points emerge from the table: most firms report upgrading. Product upgrading is reported to be the lowest, followed by functional and process. Functional upgrading is highest in exporters, in Delhi NCR and the largest firms. Process upgrading is highest in the category exporting as well as selling domestically, in Tirupur, and among the medium sized firms. Product upgrading is highest within the domestic category, in Delhi NCR and in the large firms. Little or no upgrading is reported mostly by domestic firms, in Delhi NCR and in large firms. This should not be interpreted as domestic firms in Delhi NCR not upgrading since all the firms in our Delhi NCR sample were exporters. Rather, each of these categories should be seen as independent of the other. While the highest score of 5 was reported by a small Mumbai firm supplying to the domestic market, the lowest score was reported by a small exporter from Tirupur. The market to which the firm supplies are important, too, since low upgrading is reported in case firms of quasi-hierarchical structures (Humphrey and Schmitz, 2000). It is more fruitful to examine each category of upgrading, and that is described below.

a. Process upgrading

Process upgrading takes place through use of new production machinery, worker training, reduction in delivery time, total quality programs, introduction of new organizational approaches, improvements in the production process and increased usage of computer programs for business purposes. The lowest score was recorded for increased usage of computer programs

for business purposes, while the highest score was recorded for reduction in delivery time (see table in appendix). Seventeen firms reported that they did not use computer programs for business purposes, while all firms, except one, in the sample, reported reduction in delivery time. All except five firms reported introduction of new production machinery, and all except six reported worker training. Total quality programs were introduced by all firms except eight firms, while all except five reported improvements in production process, and all, except seven, had introduced new management techniques.

b. Product upgrading

Product upgrading involves steps taken to upgrade product quality, introduction of new fabrics and raw materials, and reduction in reworking rates. While introduction to new fabrics and raw materials scored the lowest, the highest rate was recorded by steps taken to improve the product quality by all the firms in our sample. Twenty two firms reported that they had not introduced any new fabrics while nine firms reported that they had not seen any reduction in reworking rates, and only three reported that they had not taken any steps to improve the product quality. India faces a particular problem with respect to material since its strength lies in cotton textiles. India's strength is in polyester[16] among the man-made fibres, while other manmade fibres are used the world over.[17]

c. Functional upgrading

Of all the forms of upgrading, the most difficult is functional upgrading. Functional upgrading involves upgrading through design, marketing and branding. However, most value addition occurs in this stage of production. Investing in functional upgrading can create valuable development options especially for firms that depend on finding new buyers for survival (Giuliani et al., 2005).

Our survey revealed that almost all the firms are involved in functional upgrading. The lowest score, as expected, was recorded by branding while the highest score was recorded by design. In

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[16] Ministry of Textiles, Government of India report
(http://texmin.nic.in/policy/Fibre_Policy_Sub_%20Groups_Report_dir_mg_d_20100608_2.pdf)

[17] Currently the global mix is 41% natural while 59% is manmade. In India, 70% of the mix is cotton based garments.

the sample, thirteen firms reported that they are not doing any branding. Eleven firms reported that they are not involved in marketing, and five of the firms reported that they are not involved in design. Most of the firms not doing any branding also reported that they were not involved in any marketing and many of them were not involved in designing as well. As has been discussed earlier, in the context of global value chains, certain buyers specify the design and the firm supplies according to the specifications. Contrary to expectation, the small and medium firms are engaged in design and branding. This has to be seen in the context of the value chain to which they are catering: branding and design is least in firms selling to the global value chain through direct contact. Most firms in the Delhi NCR (which are also exporting) reported that buyers specified the design.

The discussion on the organization of the domestic value chain and the global value chain (catering to the EU/ US and Middle East) needs to be highlighted here. As Humphrey and Schmitz (2000) point out, insertion in a quasi-hierarchical chain offers favourable conditions for product and process upgrading but hinders functional upgrading. Our survey suggests that designs are specified by the buyers mostly in the case of firms supplying to the EU or US (and hence functional upgrading is limited in these cases). While functional upgrading could be prevented by buyers in quasi-hierarchical chains, it can occur more easily in market based value chains (Giuliani et al. 2004). In the Sinos Valley case, functional upgrading in design, branding and marketing have been achieved by firms selling to buyers in the domestic and regional markets of Latin America (Bazan and Navas-Aleman, 2004). Functional upgrading has also been reported by the Mexican footwear producers selling in the domestic market (Rabellotti, 2009). In the Brazilian textile cluster of Valle de Itaji, functional upgrading has been experienced (Giuliani et al., 2005).

Hence the governance of the value chain has implications for functional upgrading and as suggested by Navas-Aleman (2011), firms functionally upgrade first in domestic value chains and then apply this knowledge when they start to export. The importance of domestic value chains also needs to be recognized in this context.

C. Discussion on differences and similarities between firms in upgrading

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a. Small firms vs. medium sized firms in upgrading

There are 52 medium sized firms, 39 small and 6 large in the sample. The small firms surveyed are firms catering to the domestic market as well as exporting. In addition to supplying to EU and US, small firms cater to the Gulf countries and South America. The small firms in our sample are more actively engaged in process upgrading than product and functional upgrading. Within functional upgrading, these firms reported a higher score for design compared to marketing and branding. The majority of the small firms surveyed were located in Mumbai. The average scores for the small firms is higher than the averages score for the large firms but lower than the average scores for medium sized firms. Interestingly, in comparison to large firms (table in appendix), small firms score lower than large firms in the introduction of new organizational/management techniques, reduction in reworking rates, and marketing, while recording a higher score than the large firms in all other categories of upgrading. The medium sized firms scores lower than the large firms only in introduction of new organizational/management techniques while scoring less than small firms in reduction in delivery times, introduction /improvement in total quality programs and steps to improve product quality. Over half of the medium size firms were exporting while they were mostly located in Tirupur, in our sample.

b. Differences within the clusters in upgrading

There are 35 firms in the sample from Tirupur, 35 from Mumbai, one from Surat and the rest from the Delhi NCR region. The highest average score was recorded by Mumbai, followed by Delhi and Tirupur. The highest score recorded by the Mumbai cluster was in improvements in the production process, while the lowest score was in marketing and branding. The highest score recorded by the Delhi cluster was in reduction in delivery time, which given that all the firms in the Delhi cluster were exporters, is not surprising. The lowest score was in steps taken to increase product quality. In Tirupur, the highest score was in increased use of computer for business purposes, as has been mentioned earlier, while the lowest score was in reduction in reworking rates and branding.

c. Policy implications from the above discussion

Firms were also asked about the problems they faced in upgrading. A majority of firms reported lack of skilled labour, access to technology and finance as the major obstacles in upgrading. Some firms observed that the duty drawback system needed to be more streamlined so that delays in receiving payments could be reduced. Logistics and inadequate infrastructure were cited as major a reason for delays in exporting.

D. Discriminant analysis

Discriminant analysis is used to predict membership in two or more mutually exclusive groups from a set of predictors, when there is no natural ordering for the groups. We use discriminant analysis to to identify patterns in the perceptions of firms of upgrading they undertake.

Discriminate analysis has been used extensively in the finance literature to predict bankruptcy (Altman, 1968). Aziz and Dar (2006) review alternative methodologies such as multiple discriminant analysis and logit models and conclude that the predictive power of these models is comparable.

a. Methodology

In our survey, each firm was asked to rank on a scale of 1 to 5, if they undertook any upgrading. Questions pertaining to three types of upgrading were asked: product, process and functional upgrading. The firms belong to three clusters, Mumbai, Tirupur and Delhi NCR, and can be divided into small, medium and large, and, by whether they exported or served the domestic market.

The dependent variable is upgrading with three categories: Group 1: cluster (Mumbai, Delhi NCR, or Tirupur). Group 2 relates to firm size (small, medium and large) and Group 3 relates to the orientation of firms determined by whether they are exporting, supplying domestically or doing both.

The independent variables are the thirteen perception variables:

PR 1: New production machinery

PR2: Worker training and attainment of qualifications

PR3: Reduction in delivery time

PR4: Introduction or improvements in total quality programmes

PR5: Introduction of new organizational/ management techniques

PR 6: Improvements in the production process

PR 7: Increased use of computer programmes and internet for business purposes

PC 1: Steps taken to increase product quality

PC2. Introduction of new materials and fabric to enhance product range

PC 3: Reduction in reworking rates

FUN 1: Design

FUN 2: Marketing

FUN 3: Branding

The purpose of this analysis is to identify the variable that do the best job of differentiating between the three groups, and hence the stepwise method of selecting variables is most appropriate.

b. Assumptions

The sample size: each of the dependent variable groups should have at least 20 cases each. In this case, information is available for 97 firms, with all firms reporting some upgrading. The independent variables should be distributed normally and there should not be a linear relationship among variables. In order to check the latter we have examined the scatterplot matrix for the variables. This is shown in Figure 1. The variables show a non linear pattern, ruling out interdependencies between the variables.

[Figure 1 about here]

Similar to multiple regression analysis, our first task is to determine whether or not there is a statistically significant relation between independent variables and the dependent variable. Table 2 shows the eigenvalues and Wilk's Lambda for Group 1 (clusters: Mumbai, Delhi or Tirupur). The maximum number of discriminant functions is equal to the number of groups in the dependent variable minus one, or the number of variables in the analysis, whichever is smaller. For Group 2 (size of the firm: small, medium or large), no variable qualified for Wilk's Lamba. For Group 3, the table 2 shows that there is one discriminant function.

[Table 2 about here]

In discriminant analysis, the best measure of overall fit is classification accuracy. The appropriateness of using the pooled covariance matrix in computing classifications is evaluated by the Box's M statistic. The Box's M statistic helps determines whether or not the assumption of equal dispersion of covariance matrices holds. The null hypothesis is equal population covariance matrices and we reject the null hypothesis for Group 1 and 3. Table 3 reports the Box's M statistics for Group 1 and Group 3. The chi-square statistic for this test is less than 0.0001, and from the table we note that since the significance is larger, the null hypothesis is rejected. Hence we note that there are two statistically significant discriminant functions to separate Group 1 and one discriminant function to separate Group 3.

[Table 3 about here]

c. Results for classification of the groups

We next present the results of the accuracy rate for the holdout sample to each of the by chance accuracy rates in Table 4 for Group 1, and in Table 5 for Group 2. From Table 4 we note that, for group 1, 65 percent of the original grouped cases are correctly classified. From table5 we note that for group 2, 45 percent of the grouped cases are correctly classified.

[Table 4 about here]

[Table 5 about here]

For the role of functions in differentiating categories of the dependent variable, we look at patterns of positive and negative values in the output. From Table 6, we note that the centroid (mean) for Delhi and Mumbai in Group 1, have negative values while Tirupur has a positive value. Hence discriminant function 1 separates Tirupur from the other two groups. For discriminant function 2, Delhi and Tirupur have negative values while Mumbai has a positive value. So the second discriminant function separates Mumbai from the other two. For Group 3,

we note that Exporting is negative while Domestic and Both are positive. Hence discriminant function 1 separates exporting from the other two groups.

[Table 6 about here]

d. Assessing the contribution of predictor variables

The summary table of variables entering and leaving the discriminant functions is shown in Table 7. From this table we see that PC 3 (reduction in reworking rates), PR 4 (Introduction or improvements in total quality programmes), PR 7 (Increased use of computer programmes and internet for business purposes) and PR 1 (New production machinery) are the most important predictors of upgrading between Mumbai, Delhi and Tirupur. PR1 (New production machinery) is most important predictor of upgrading between firms catering to the Domestic market and Both (i.e. exporting as well as supplying to the export market).

[Table 7 about here]

The summary for Group 3 is given in Table 8. PR1 (New production machinery) is the most important predictor of upgrading between firms catering to the Domestic market and Both (i.e. exporting as well as supplying to the export market).

[Table 8 about here]

E. Ordered Probit Analysis

Ordered probit analysis model has been used to capture the determinants of upgrading. This is more appropriate than a linear regression model for explaining the hypothesis of what predicts upgrading?[18] The basic notion underlying the model is the existence of an underlying the model is the existence of a latent or unobserved continuous upgrading variable, indicating the degree of upgrading by the firm. This latent variable id related to a set of explanatory variables by the standard linear relationship:

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[18] Ordered probit makes no assumption about the cardinality of the upgrading: hence the firms which have reported an upgrading score of 2 are not assumed to be two times more upgraded than the firms that have reported a score of 1.

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$$U_i^* = x_i\beta + \varepsilon_i \hspace{8cm} (1)$$

where x_i is the vector of explanatory variables and include firm, industry and cluster related factors influencing the level of upgrading. β is the associated parameter vector, and ε is a random error term drawn from a standardized normal distribution. U_i^* is unobserved and is related to U by the following relationship:

$U_i = 0$ *iff* $U_i^* < 0$

$U_i = 1$ *iff* $0 < U_i^* < \mu_1$

…

$U_i = J$ *iff* $U_i^* > \mu_{J-1}$

where μ_i are unobserved thresholds defining the boundaries between different levels of upgrading.

The dependent variable is the index of upgrading and each of the thirteen categories of upgrading has been included in the analysis.

a. Determinants of upgrading

Kaplinsky and Wamae (2010), identify four sets of factors that explain the extent to which firms upgrade: ownership, the nature of buyers, the country of production (Madagascar or Kenya, in their case) and the location of the final market. Patterns of ownership, whether national or foreign, matters significantly in the case of Madagascar. Also the nationality of the foreign investor matters: whether they are Asian or US owned.[19] The nature of the buyers and their role in upgrading has been discussed extensively in the GVC literature (and discussed above). The location of the final markets is also closely related to the nature of the buyers and has been discussed in Gibbons (2008). The difference in functional upgrading for firms catering to the US/EU vis-a-vis supplying to the Middle East market has been noted in our case.

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[19] There are very few MNCs in our sample, most of the firms are Indian.

Based on this, the determinants of upgrading includes firm level factors such as size of the firm, the sales turnover, investment in plant and machinery and the number of persons employed. The cluster to which the firm belongs to has been included, as well the markets to which the firms are catering to (Exporting, Domestic or Both).[20]

b. Results

The variables significant in explaining upgrading include the cluster, the orientation of the firm and size and sales turnover as can be seen from table 9.

[Table 9 about here]

6. Conclusion

This paper examines, firstly, the engagement of firms in global, regional and domestic supply chains in the apparel industry in India. Firms surveyed using a structured questionnaire were located in Delhi NCR, Mumbai and Tirupur. There are firms catering to global value chains, as well as selling to the domestic market. The global value chain is of two types: supplying to the US and EU and supplying to the Middle East market. There are some differences in the two value chains: while the products in the US market are low value added garments, which are sold in bulk, the products sold in the EU market are higher value added while the quantities are lower.

Second, we also try to understand the strategies adopted by firms relating process, product upgrading and capacity to augment their functional position in the chain. While most of the firms reported process and product upgrading, fewer showed functional upgrading. For process upgrading, the lowest score was recorded for increased usage of computer programs for business purposes, while the highest score was recorded by reduction in delivery time. In the case of product upgrading, introduction to new fabrics and raw materials scored the lowest, while the highest rate was recorded by steps taken to improve the product quality by all the firms in our sample. Our survey revealed that almost all firms are involved in functional upgrading. The lowest score, as expected, was recorded by branding, while the highest score was recorded by design. The nature of the governance structure affecting functional upgrading was also observed from our survey.

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[20] It was not possible to distinguish between firms catering to the US versus catering to the EU in our sample.

Discriminant analysis was carried out to identify the variable that does the best job of differentiating between the three groups, clusters, size and orientation. For the role of functions in differentiating categories of the dependent variable, we look at patterns of positive and negative values in the output. In case of classification of firms based on clusters, we observe that there are two discriminant functions. Discriminant function 1 separates Tirupur from the other two groups. Discriminant function 2, separates Mumbai from the other two. For the group classified on the basis orientation, the first discriminant function separates Exporting from the other two groups (Domestic and Both). The summary table of variables entering and leaving the discriminant functions reveals that PC 3 (reduction in reworking rates), PR 4 (Introduction or improvements in total quality programmes), PR 7 (Increased use of computer programmes and internet for business purposes) and PR 1 (New production machinery) are the most important predictors of upgrading between Mumbai, Delhi and Tirupur. PR1 (New production machinery) is most important predictor of upgrading between firms catering to the Domestic market and Both (i.e. exporting as well as supplying to the export market).

The ordered probit analysis confirmed the importance of cluster for all the types of upgrading. Export orientation, and size of the firm also mattered in a few cases.

The policy implications from the survey follow from the factors that firms felt impacted upgrading the most. Some of these factors have been noted above and are commonly cited in the literature. However, the most important conclusion that emerges is the nature of the chain matter – whether the domestic or the GVC. Also the export destination in case of GVC matters since that determines the governance structure within the chain. Export promotion strategies of the government generally tend to overlook this aspect and perhaps a more nuanced approach to GVC activity will help the industry more.

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Table 1: Summary of upgrading scores reported by firms

	Product upgrading	Process upgrading	Functional upgrading	Product and process upgrading	Functional, Product and Process Upgrading	Little or no product upgrading	Little or no process up	Little or no upgrading
Domestic	12/25 (48)	12/25 (48)	11/25 (44)	7/25 (28)	4/25 (16)	13/25 (52)	13/25 (52)	6/25 (24)
Exporters	18/44 (41)	28/44 (64)	22/44 (50)	14/44 (32)	12/44 (27)	26/44 (59)	16/44 (36)	10/44 (23)
Domestic & Exporter	10/28 (36)	23/28 (82)	12/28 (43)	9/28 (32)	3/28 (10)	18/28 (64)	5/28 (18)	4/28 (14)
Total	40/97 (41)	63/97 (65)	45/97 (46)	30/97 (31)	19/97 (19)	57/97 (59)	34/97 (35)	20/97 (21)
Delhi NCR	15/25 (60)	14/25 (56)	17/28 (61)	12/25 (48)	12/28 (42)	10/25 (40)	11/25 (44)	8/25 (32)
Mumbai	18/37 (49)	23/37 (62)	19/37 (51)	12/37 (32)	6/37 (16)	19/37 (51)	14/37 (38)	6/37 (16)
Tirupur	6/34 (18)	26/34 (76)	9/34 (26)	6/34 (18)	1/34 (3)	28/34 (82)	8/34 (23)	6/34 (18)
Total	39/96 (41)	63/96 (66)	45/96 (47)	30/96 (31)	19/96 (20)	57/96 (59)	33/96 (34)	20/96 (21)
Small	16/39 (41)	25/39 (64)	19/39 (49)	13/39 (33)	8/39 (20)	23/39 (56)	14/39 (36)	8/39 (20)
Medium	20/52 (38)	35/52 (67)	23/52 (44)	14/52 (27)	9/52 (17)	32/52 (61)	17/52 (33)	10/52 (19)
Large	4/6 (67)	3/6 (50)	3/6 (50)	3/6 (50)	2/6 (33)	2/6 (33)	3/6 (50)	2/6 (33)
Total	40/97 (41)	63/97 (65)	45/97 (46)	30/97 (31)	19/97 (19)	57/97 (59)	34/97 (35)	20/97 (21)

Source: Authors' compilation based on survey

Note: The table reports how many firms reported upgrading (score of 3 or more than 3 on a scale of 5) by the total number of respondents in that category. Figures in parentheses are the number of firms in each category.

Table 2: Overall significance of the discriminant function (s)

Group 1				
Function	Eigenvalue	% of Variance	Cumulative %	Canonical correlation
1	.402[21]	66.0	66.0	0.536
2	.207	34.0	100.0	0.414
Test of function(s)	Wilk's Lambda	Chi-square	df	Sig.

[21] First two canonical discriminant functions were used in the analysis

1 through 2	0.591	48.144	8	.000
2	0.828	17.215	3	.001

Group 3				
Function	Eigenvalue	% of Variance	Cumulative %	Canonical correlation
1	.100[22]	100.0	100.0	0.301
Test of function(s)	Wilk's Lambda	Chi-square	df	Sig.
1	0.909	8.923	2	.012

Source: Authors' calculations

Table 3: Box's M

Group 1	
Box's M	43.009
F Approx.	3.410
df1	12
df2	32193.527
Sig.	.000
Group 3	
Box's M	13.669
F Approx.	6.735
df1	2
df2	16809.872
Sig.	.001

Source: Authors' calculations

Table 4: Classification results [a,b,c] for Group 1

Upgrading				Predicted group membership			Total
				Delhi	Mumbai	Tirupur	
Cases selected	Original	Count	Delhi	12	11	2	25
			Mumbai	4	26	7	37
			Tirupur	2	8	24	34
			Ungrouped cases	0	1	0	1
		%	Delhi	48.0	44.0	8.0	100.0
			Mumbai	10.8	70.3	18.9	100.0
			Tirupur	5.9	23.5	70.6	100.0
			Ungrouped cases	0	100.0	0	100.0
Cross validated		Count	Delhi	11	12	2	25
			Mumbai	5	25	7	37
			Tirupur	2	8	24	34
		%	Delhi	44.0	48.0	8.0	100.0
			Mumbai	13.5	67.6	18.9	100.0
			Tirupur	5.9	23.5	70.6	100.0

Source: Authors' calculations

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[22] First 1 canonical discriminant functions were used in the analysis

Table 5: Classification results [a,b,c] for Group 3

Upgrading				Predicted group membership			Total
				Export	Domestic	Both	
Cases selected	Original	Count	Export	39	0	5	44
			Domestic	16	0	7	23
			Both	25	0	5	30
		%	Export	88.6	0	11.4	100.0
			Domestic	69.6	0	30.4	100.0
			Both	83.3	0	16.7	100.0
Cross validated		Count	Export	39	0	5	44
			Domestic	16	0	7	23
			Both	25	0	5	30
		%	Export	88.6	0	11.4	100.0
			Domestic	69.6	0	30.4	100.0
			Both	83.3	0	16.7	100.0

Source: Authors' calculations

Table 6: Functions at Group Centroids

Upgrading	Function	
Group 1		
	1	2
Delhi	-.885	-.333
Mumbai	-.064	.461
Tirupur	.720	-.256
Upgrading	Function	
Group 3		
	1	
Export	-.341	
Domestic	.285	
Both	.281	

Source: Authors' calculations

Table 7: Variables entered/removed for Group 1

Step	Entered	Min. D square					
		Statistic	Between group	Exact F			
				Statistic	df1	df2	Sig.
1	PC 3	0.098	Mumbai and Tirupur	1.732	1	93.00	0.191
2	PR 4	0.240	Mumbai and Tirupur	2.100	2	92.00	0.128
3	PR 7	0.897	Delhi and Mumbai	4.366	3	91.00	0.006
4	PR1	1.373	Mumbai and Tirupur	5.885	4	90.00	0.000

Source: Authors' calculations

Table 8: Variables entered/removed for Group 3

Step	Entered	Min. D square					
		Statistic	Between group	Exact F			
				Statistic	df1	df2	Sig.
1	PR1	0.17	Domestic and Both	.221	1	94.00	0.640

Source: Authors' calculations

Table 9: Results of the ordered probit regression

Independent variables → / Dependent variables ↓	Cluster	Export orientation	Size	Employment	STO
PR 1	0.46 (2.02)*** (M)			0.00 (2.19)***	
PR2		0.58 (2.02)***		0.00 (2.13)***	
PR3	2.02 (6.22)*** (D), 1.45 (4.53)*** (M), 1.07 (3.46)*** (T)				
PR4	0.62 (2.67)*** (M)				
PR5	0.39 (1.83)** (M)	0.39 (1.71)*			

PR 6	0.92 (3.39) *** (M)	0.60 (2.05) ***	1.31 (2.64)*** 1.22 (2.45) ***		
PR 7	0.51 (2.57) *** (T)				
PC 1	0.46 (1.88)** (M)		2.10E-06 (2.01)*		
PC2	0.71 (2.20)*** (D)				
PC 3	1.08 (3.40) *** (D), 0.49 (2.13)*** (M)		3.34E-06 (3.27)		
FUN 1	0.69 (2.39)*** (D)				0.00 (1.79)**
FUN 2	0.58 (1.79)* (D)				0.00 (2.66) ***
FUN 3	0.51 (1.67) (D)		3.46E-06 (1.99)*		

Source: Authors' calculations

Figure 1: Scatterplot matrix of independent variables
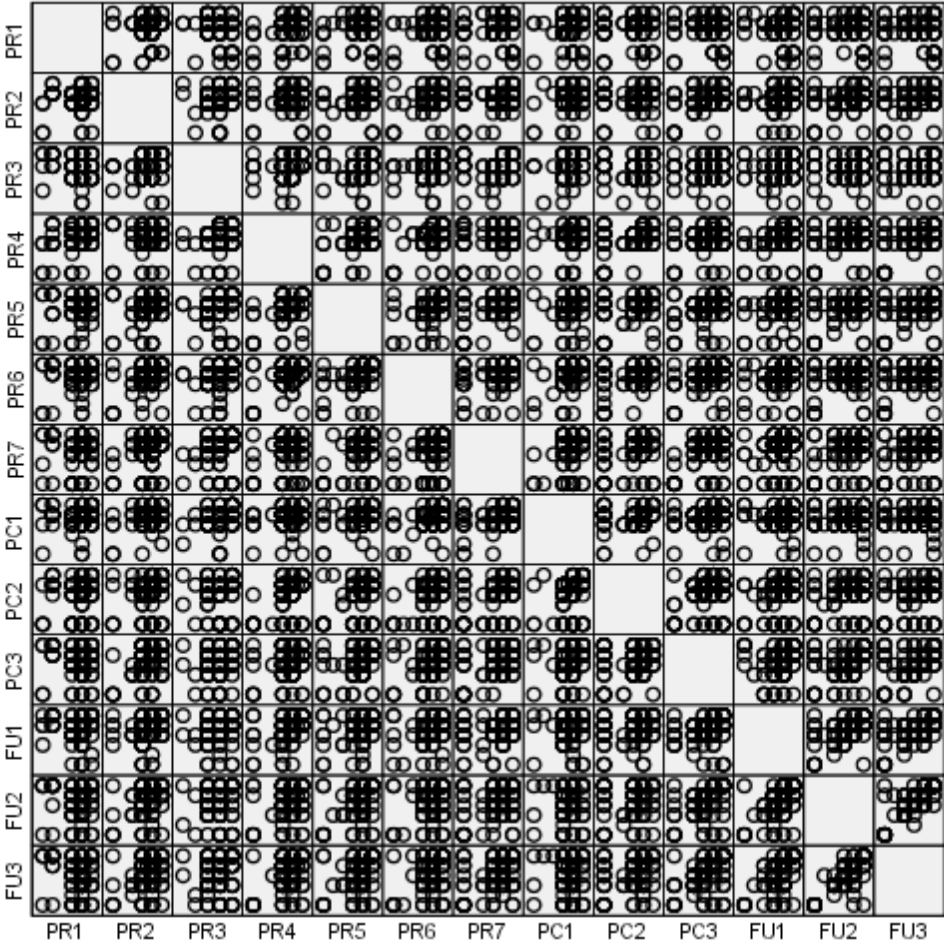
Appendix

Appendix A: Scores reported by firms in upgrading

Sl. No.	Cluster [*]	Size [**]	Exporter/ domestic [***]	New production machinery purchased in the recent past	Workers training	Reduction in delivery times	Introduction or improvements in total quality programs	Introduction of new organizational/management techniques	Improvements in the production process	Increased usage of computer programs and internet for business purposes	Steps taken to increase product quality	Introduction of new materials and fabric to enhance the product range	Reduction in reworking rates	Design	Marketing	Branding	Average score
	Firm characteristics			**Process upgrading**							**Product upgrading**			**Functional upgrading**			
1	M	S	D	5	5	5	5	5	5	4	5	5	5	5	5	5	4.9
2	T	S	B	5	4	3	4	3	4	2	3	0	2	4	4	2	2.8
3	T	M	B	4	3	4	3	4	4	4	4	3	4	2	3	4	3.5
4	D	M	E	5	4	3	4	4	5	4	3	4	3	5	4	5	4.0
5	T	M	E	4	3	4	3	3	4	4	3	4	3	3	4	3	3.5
6	T	S	E	4	3	4	3	4	4	5	3	4	3	3	3	4	3.6
7	T	M	B	3	4	3	4	5	3	3	3	3	4	3	4	4	3.5
8	T	M	E	4	5	4	3	4	4	4	4	0	2	3	3	3	3.1
9	M	L	B	3	4	3	4	4	4	3	3	4	4	3	3	3	3.5
10	M	S	D	5	3	3	3	3	4	3	5	4	5	0	0	0	2.7
11	M	L	B	3	4	4	5	5	5	3	4	4	3	4	4	4	4.1
12	M	S	D	5	5	5	5	5	5	5	5	5	5	5	5	5	5.0
13	D	S	E	3	4	5	0	0	3	0	4	0	3	0	0	0	1.4
14	T	M	E	4	5	4	3	3	4	5	4	0	5	3	4	2	3.4
15	M	S	B	4	2	4	5	1	4	5	5	5	3	4	2	2	3.6
16	D	M	E	4	3	4	3	5	4	3	4	3	5	4	5	3	3.9
17	D	S	E	1	4	5	3	5	5	5	4	4	5	4	5	5	4.5
18	M	S	D	3	4	4	5	4	4	2	4	0	5	5	3	3	3.5
19	M	M	B	4	4	5	4	4	5	0	3	3	3	4	0	0	2.8
20	T	S	B	4	3	3	4	3	3	4	4	3	3	4	4	4	3.5
21	D	S	E	4	3	4	5	4	4	3	4	4	5	4	5	5	4.3
22	T	S	E	4	2	2	3	3	3	3	4	4	2	3	4	1	2.9
23	M	S	E	4	4	5	4	4	5	5	5	4	4	0	0	0	3.3
24	T	S	B	4	2	3	4	4	3	4	3	3	2	3	2	2	3.0

25T	M	E	4	2	4	4	3	2	4	4	4	2	3	4	3	3.4
26T	S	B	3	4	4	3	4	3	4	3	4	3	3	3	3	3.4
27T	S	D	3	4	3	4	4	4	4	3	4	3	4	2	1	3.3
28D	L	B	4	0	4	5	5	0	0	3	0	0	3	0	0	1.8
29T	M	D	4	3	4	4	4	4	4	4	3	2	4	3	2	3.5
30T	S	E	0	0	2	0	0	0	2	3	0	0	2	0	0	0.8
31D	M	E	5	3	5	5	4	4	4	3	4	4	5	4	5	4.3
32M	M	B	4	3.5	4	3	4	3	4	4	3	3	3	4	4	3.5
33T	L	E	4	5	4	3	3	4	4	4	3	4	3	4	4	3.6
34T	S	E	4	3	3	4	4	3	4	3	4	4	2	3	4	3.5
35T	M	E	4	4	4	3	4	3	4	4	4	3	4	3	2	3.5
36M	M	B	4	0	4	5	5	5	3	0	4	4	4	2	2	3.5
37M	M	B	5	4	4	3	4	5	2	4	3	2	1	2	2	2.9
38M	M	D	4	3	3	3	2	3	0	3	2	0	2	2	2	2.0
39M	M	B	4	5	1	4	4	4	0	1	5	5	5	5	5	3.5
40D	M	E	1	5	4	5	3	5	4	4	4	5	5	5	5	4.5
41T	M	E	4	4	4	3	3	4	3	3	4	4	4	3	3	3.5
42M	M	B	4	3	3	3	3	4	3	4	3	3	4	3	2	3.2
43D	M	E	1	4	5	5	0	4	0	4	5	4	5	5	5	3.8
44T	M	E	5	3	3	3	2	4	4	4	3	3	5	4	4	3.5
45D	M	E	3	4	3	3	4	3	4	4	3	5	5	5	5	4.0
46M	S	D	3	3	4	5	3	5	3	4	4	3	4	3	5	3.9
47T	M	B	4	5	4	3	4	3	5	3	4	2	3	4	3	3.5
48T	M	B	3	4	4	3	4	4	3	4	3	4	3	4	3	3.5
49M	M	B	5	4	4	4	3	3	3	4	0	0	4	3	2	2.7
50D	S	E	3	4	5	3	0	3	0	5	0	0	3	0	0	1.7
51M	S	B	4	5	5	5	5	5	0	5	0	4	4	5	4	3.8
52M	L	E	3	3	3	4	4	3	3	4	4	4	3	5	5	3.8
53D	M	B	1	4	5	3	5	5	5	4	4	5	4	5	5	4.5
54T	M	E	4	3	4	3	3	4	3	4	4	2	4	2	2	3.2
55D	M	E	4	3	3	4	3	3	4	3	3	5	5	5	5	3.9
56M	S	B	5	4	4	4	4	5	4	4	0	4	4	5	4	3.8
57D	M	E	1	5	4	0	3	0	5	3	3	4	5	0	0	2.5
58D	M	E	1	4	5	3	5	5	5	4	4	5	4	5	5	4.5
59M	M	D	3	3	4	2	3	4	4	4	0	3	2	2	3	2.8
60M	M	B	4	5	5	4	4	5	4	5	5	4	5	4	4	4.5
61D	M	E	0	3	5	3	5	5	5	5	4	5	4	5	5	4.6
62T	M	E	4	5	3	4	4	4	5	3	4	2	4	4	2	3.5
63M	S	B	4	3	3	3	2	3	0	3	2	0	2	2	2	2.0

64	T	M	E	4	4	3	4	3	4	4	4	3	3	3	4	3	3.5
65	D	M	E	3	4	4	0	3	5	0	4	0	0	3	4	0	2.1
66	T	M	E	0	3	5	3	5	5	5	5	0	5	4	5	5	4.3
67	T	S	B	4	3	4	3	4	4	4	4	3	2	4	3	4	3.5
68	M	S	D	3	3	5	4	4	5	5	3	4	5	3	2	2	3.8
69	D	S	E	1	4	5	4	3	4	4	5	5	5	4	5	4	4.4
70	M	M	D	4	5	5	4	4	5	5	4	0	5	5	4	4	4.1
71	D	M	E	4	3	4	3	4	5	4	3	3	5	5	5	5	4.2
72	M	S	D	3	4	3	3	4	3	4	4	5	3	3	4	4	3.6
73	D	S	E	3	3	4	0	0	5	0	3	0	4	3	0	0	1.7
74	T	S	E	4	3	4	3	4	3	4	4	4	2	4	3	3	3.5
75	M	S	B	4	4	5	4	4	5	5	5	3	3	4	2	2	3.8
76	M	S	D	0	0	4	0	0	0	0	0	0	0	5	5	5	1.7
77	D	L	E	4	3	3	0	4	0	3	4	0	5	0	5	0	2.2
78	M	M	B	4	4	4	4	4	4	3	4	0	4	4	5	4	3.6
79	M	S	D	5	4	3	4	4	4	4	4	3	5	5	5	5	4.2
80	M	S	D	4	4	4	3	4	3	0	4	4	3	3	3	3	3.1
81	T	M	E	4	3	4	4	3	4	4	4	3	2	4	3	3	3.5
82	T	M	D	3	3	3	4	3	4	3	4	3	2	3	2	2	3.0
83	M	M	D	3	3	4	4.5	4	3.5	0	3.5	4	4	4	4	4	3.6
84	M	S	D	5	0	4	5	5	4	0	4	5	0	4	0	0	2.8
85	D	M	E	4	3	4	3	0	1	0	0	0	5	0	0	0	1.2
86	D	M	E	1	4	4	5	5	4	5	5	4	4	5	3	4	4.4
87	M	M	D	5	4	3	4	4	5	4	5	5	4	3	3	3	3.9
88	T	M	E	4	4	3	3	4	4	5	3	3	4	3	4	4	3.6
89	M	M	B	4	4	1	3	4	4	3	3	2	3	3	1	3	2.7
90	S	M	D	4	3	3	3	3	4	3	4	5	3	3	3	4	3.5
91	D	S	E	4	4	5	4	4	4	4	3	4	3	4	4	4	3.9
92	M	S	D	3	4	4	4	3	2	3	2	0	3	4	5	5	3.2
93	T	M	B	5	3	3	4	4	3	5	3	3	4	4	5	4	3.8
94	T	S	B	4	5	5	4	4	3	4	3	4	3	4	4	4	3.8
95	T	M	D	4	3	5	4	4	3	4	3	4	2	2	3	2	3.3
96	M	S	D	5	4	4	5	5	5	4	5	0	4	5	5	5	4.3
97	D	S	E	1	4	5	3	5	5	5	4	5	4	5	5	5	4.6
	Average score			3.5	3.5	3.9	3.5	3.5	3.8	3.2	3.7	2.9	3.3	3.5	3.3	3.1	

Note: [*]Cluster: M stands for Mumbai, D for Delhi, and, T for Tirupur
[**]Size: L: Large, M: Medium and S: Small (size of firms is defined in terms of sales turnover instead of plant and machinery since information on this has not been provided by most firms)
[***]Exporter/ Domestic: E stands for exporter, D for domestic and B for both