What explains India's poor performance in garments exports: evidence from five clusters?

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Abstract

In this paper, we examine the Indian apparel industry to examine the effect of clusters on the sales of this industry. The data has been collected through a primary survey in five garments clusters in India. The variable that is significant in explaining sales in most equations is technology proxied by imported machinery. It has been argued that inter-firm linkages and linkages between firms, service providers and institutions are crucial for competitiveness and this is best achieved through a cluster. Studies on clusters have shown that some clusters have been able to deepen their inter-firm division of labour, raise their competitiveness and break into international markets. Agglomeration may arise from the specialization of a region in a particular industry where firms share common inputs or knowledge. We argue that the main reason for India's poor performance in garments (compared to other South Asian countries such as Bangladesh) is the lack of proper clusters. The development of the cluster in India has followed the 'top down' approach and the natural process through which linkages are developed are yet to occur in most clusters.

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1.   Introduction

The apparel industry was central to the industrialization process of many developed countries (like Japan) and Newly Industrializing Countries (Dickerson, 1999). Short term effects of engaging in this sector come from employment, income and foreign exchange while long term effects include export diversification. In 2013, the global clothing exports accounted for USD 378 billion, making this one of the most traded manufactured products. Exports in this sector are dominated by developing countries. In 2015, the top 10 exporters of clothing included eight developing countries (China, Bangladesh, Viet Nam, Hong Kong, India, Turkey, Indonesia and Cambodia). However, India has been losing its share of the world apparel trade; in 2016 it was 3.5%, compared to 6% in 2013.

Competitiveness in exports can be achieved in increase in productivity. According to Porter (1990), competitiveness can be achieved through a mix of endowments, factors price and policies. While it may be possible to increase competitiveness in the short run through low costs, in the long run increase in productivity is necessary to sustain competitiveness. Pietrobelli (2007) argues that inter-firm linkages and linkages between firms, service providers and institutions are crucial for competitiveness and this is best achieved through a cluster. Upgrading of local firms is often enhanced through horizontal linkages and collective efficiency in local clusters (Pietrobelli and Rabellotti, 2007).

In this paper, we examine the Indian apparel industry to examine the effect of clusters on the sales of this industry. We examine the effect of South Asian competition on Indian garment industries and conclude that it is negligible. We also argue that the main reason for India's poor performance in garments exports is the lack of proper clusters.

 The structure of the paper is as follows: in the next section we discuss the literature with respect to clustering and why it assumes importance in the context of certain industries. Section 3 discusses the competiveness of the South Asian countries with respect to garments. Section 4 discussed the Indian garments[1] industry. Section 5 sets out the empirical exercise used in this paper. Section 6 presents the results of the empirical exercise. Section 7 concludes with policy implications.

2.   Literature Survey

Agglomeration of related economic activity is a central feature of economic geography (Marshall, 1920; Porter 1990; Krugman 1991; Ciccone and Hall, 1996). In his *Principles of Economics*, Marshall (1920) showed why clustering would especially help small enterprises compete. While he noted that agglomeration of firms engaged in similar or related activities generated a range of localized external economies that lowered costs for clustered producers, subsequent work has focused on deliberate effects of collective action (Brusco et al., 1990; Tendler and Amorin, 1996 etc.). Clusters are defined as sectoral and spatial concentration of firms.

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[1]   Garments, apparel and clothing have been used interchangeably in this paper.

Agglomeration economies arise from interdependencies across complementary economic activities that give rise to increasing returns. The literature has tended to contrast two potential types of agglomerating forces: localization (increasing returns to activities within a single industry) and urbanization (increasing returns to diversity at the overall regional level). Agglomeration may arise from the specialization of a region in a particular industry where firms share common inputs or knowledge (localization economies). On the other hand, agglomeration may be the result of exploiting the overall diversity of industries in a regional economy (urbanization economies).

Economists have tended to highlight at least three drivers of agglomeration: input-output linkages, labour market pooling and knowledge spillovers. Each of these mechanisms is associated with cost or productivity advantages to firms that result in increasing returns to geography. Another agglomeration driver that has emerged in the literature is the role of local demand, structure of regional business and social networks (Porter, 1990, 1998; Saxenian 1994; Markusen 1996).

Delgado et al. (2010) move beyond the issues of localization and urbanization and examine the agglomeration forces arising among closely related and complementary industries. Industries within a cluster benefit by sharing common technologies, knowledge, inputs and cluster specific institutions. They evaluate the impact of clusters on regional economic performance, which includes growth in employment, wages, business creation and innovation. Although there have been many studies on clusters in the context of developed countries, the studies in the context of developing countries are more recent and have grown out of the role of small scale industry to industrialization (Schmitz, 1989). Summarizing the literature on clusters in the context of developing countries, Schmitz and Nadvi (1999) point out that industrial clustering is significant in developing countries.

Clusters are common in a wide range of countries and sectors (Nadvi and Schmitz, 1994). However, the growth experiences of clusters widely vary. Studies on clusters have shown that some clusters have been able to deepen their inter-firm division of labour, raise their competitiveness and break into international markets (Nadvi, 1999; Schmitz, 1995). Clustering is particularly relevant in the early stages by helping small enterprises grow. However, clusters could also be mature and comprise of large and medium firms. Internal heterogeneity is pronounced (Knorringa, 1996; Rabelotti and Schmitz, 1997). Except in rudimentary clusters, medium and large firms have emerged and play an important role in the governance of these clusters. In this respect while the developed country experiences (especially the Italian experience) were widely different from the developing countries experiences in the 1970s and 1980s, it was not so different in the 1990s (Rabelotti, 1997).

Development of clusters can take either of two routes: spontaneous and policy driven. Policy driven clusters are set up by the actions of the government, and particularly followed the success of well known industrial clusters such as Silicon Valley (Richardson, 2010). Wallsten (2004) observes that very little is known about the effectiveness of policy interventions on industrial clusters. Richardson (2010) studies the ways in which policy driven clusters affect internationalization in the context of Malaysia. His findings point out (in the context of the

clusters he studied) that exchange of knowledge between firms (which is regarded as key to the success of a cluster) may be limited in a policy driven cluster, at least in the short run.

Rodriguez-Clare (2007) argues that if a developing country has a comparative advantage in a sector with Marshallian externalities (due to which firms benefit from the production and innovation activities of neighbouring firms in the same or related industries) temporary import substitution can work. However, Marhsallian externalities are not intrinsic to any sector but depend on the way production is organized, and in that case import substitution does not work. He develops a theoretical model to show that the best policy in such a case is not import substitution but the direct promotion of clustering in a sector in which the country has a comparative advantage.

Many of the studies in the context of clusters are based on case studies and help identify the differences between success and failures. The ability of clusters to cope with global competitive pressures has been examined in the context of India by Tewari (1999) and in the case of Mexico by Rabelotti (1999). Tewari examined the experience of the Ludhiana cluster in surviving the loss of its largest export market and the simultaneous opening of the domestic to free trade. In both cases, the cluster recovered within a short time and moved to more competitive export markets. The process of adjustment was however uneven for firms but provide lessons for coping with the pressures of adjustment.

Rabelotti (1999) examines the impact of trade liberalization on cooperative behavior of the Mexican cluster of Guadalajara. The empirical exercise showed that cooperation increased among the firms and cooperation positively affected the firms' performance. This along with a favorable market environment contributed to the cluster's recovery. We turn to the issue of competitiveness in the next section.

3.   South Asia's garments competitiveness

Apparel is one of the most important industries for countries in South Asia. South Asia accounts for 12% of global exports of apparel, compared to 43% of China (Lopez-Acevedo and Robertson, 2016). Gereffi and Frederick (2010) characterize the exporters into four groups: steady growth suppliers (China, Bangladesh, India Vietnam, and Cambodia), spilt market suppliers (Indonesia and Sri Lanka), pre MFA suppliers (Canada, Mexico, EU 12 etc.) and past prime suppliers (Hong Kong, South Korea, Taiwan and Malaysia). They also note that leading exporters such as China, India and Turkey have witnessed a slowdown in their exports as they concentrate on their domestic market. South Asian countries have seen an increase in their exports to EU, particularly due to the GSP scheme.

The nature of the GVC in garments, according to Gereffi and Frederick (2010) comprises of four outsourcing arrangements: assembly/Cut-Make-Trim (CMT), Original Equipment

Manufacturing (OEM)[2]/ Free On Board (FOB)[3]/ Package Contractor, Original Design Manufacturing (ODM)[4]/ Full Package and Original Brand Manufacturing (OBM).[5] In the CMT,[6] the firms are involved only in the manufacture of the garment, as in the OEM. In the latter, the firm also provides all the production services, finishing and packaging for delivery to the retail outlet. In case of the ODM, the entire process from sourcing to delivery to the retail outlet is undertaken by the firm. OBM is a business mode that focuses on branding rather than on design or manufacturing. The nature of the outsourcing model is important, because not all South Asian countries are using the same arrangement: India qualifies as ODM,[7] while Bangladesh follows the OEM model and is a preferred supplier. Sri Lanka is a niche supplier with an OEM model.

Lopez- Acevedo and Robertson (2016) benchmark the South Asian countries apparel export performance in terms of product diversity, and end markets and note that exports for Pakistan and Bangladesh exports are concentrated in three categories. Between 2005 and 2012, South Asian countries have become less dependent on the EU and the US, with Sri Lanka becoming most diversified among the South Asian countries.

Tewari (2008) observes that there is a clear division of labour in the region's sectoral composition and specialization in the textiles and clothing sector. Bangladesh's exports is dominated by clothing while Pakistan's exports by textiles. India is in the middle with share of clothing in exports at 43% while share of textiles is 57% in 2103 (Ray et al., 2016). The import intensity of T&C in the region is low, especially imports of clothing (Tewari, 2008). This is not surprising since all the South Asian countries have strong comparative advantage in clothing (though not in the same items) and are net exporters of clothing. While Bangladesh and Sri Lanka are net importers of fabric, yarn, and textiles, India and Pakistan are net exporters of textiles. India and Pakistan do not compete in the same textile categories (Taneja et al. 2017).

4.   The Indian garment industry

The process of manufacturing a garment comprises of several steps: cutting, stitching, embroidery, fixing of accessories, dyeing etc. The maximum value addition to textiles is done

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[2]   Original Equipment Manufacturing (OEM)/FOB/Package Contractor: A business model that focuses on the manufacturing process. In the clothing industry, OEMs typically manufacture according to customer specifications and design, and in many cases use raw materials specified by the customer.

[3]   Free on Board (FOB) is whereby goods are delivered on-board a ship or to another carrier at no cost to the buyer.

[4]   Original Design Manufacturing (ODM)/Full Package: A full package garment supplier carries out all steps involved in the production of a finished garment—including design, fabric purchasing, cutting, sewing, trimming, packaging, and distribution.

[5]   Original Brand Manufacturing (OBM): A business model that focuses on branding rather than on design or manufacturing; this is a form of upgrading to move into the sale of own brand products. For many firms in developing countries, this marks the beginning of brand development for products sold in the home or neighboring countries.

[6]   Assembly/CMT: CMT stands for "cut, make and trim" or CM (cut and make) and is a system whereby a manufacturer produces garments for a customer by cutting fabric provided by the customer and sewing the cut fabric into garments in accordance with the customer's specifications.

[7]   India is a full package provider which means that it can carry out all the steps involved in the production of a garment. This includes design, fabric purchasing, cutting, sewing, trimming, packaging and distribution (Gereffi and Frederick. 2010.).

by the apparel sector, which is the last stage of the textile value chain (Ray and Miglani, 2018). The structure of the garment industry in India is rather complex with the bulk of units being small and medium firms.[8] The Annual Survey of Industries reports that there were 3760 garment manufacturing units in 2009-10 (using the definition of 'Factory' in the Factories Act, 1948). In 2001-02, it was 3273, and in 2006-07, it was 3627. 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,[9] and this covers only registered units and unregistered small and medium units are not counted.[10]

The garment industry in India caters to both, the domestic market and exports. The garments industry in India was worth $ 30 billion of which 10 billion was exported (AEPC Study, 2009). In 2008, it was estimated that while the size of the domestic apparel market was worth USD 15 billion, apparel exports were USD 9.7 billion (Confederation of Indian Textile Industry) (CITI). In 2008, AEPC Study (2009) pointed out that India produced 8900 million pieces of which 2100 million pieces were exported. India is among the world's top fifteen exporters of textiles and clothing.[11] In 2013, exports from India were USD 19 billion, and its share in the world was 6.2% (Ray and Miglani, 2018),[12] while it imported USD 4 billion worth of textiles in 2013.[13] India's clothing exports were worth USD 17 billion and its share was 3.7% of the world's exports of clothing in 2013. While the exports of textiles by India increased from USD 2.1 billion in 1990 to 19 billion in 2013, exports of clothing (garments), increased from USD 2.3 billion in 2000 to 18 billion in 2014. The top items exported by India are 'T- shirts, Singlets, vests, etc.' (HS 6109), and 'Women's or Girls Suits, Ensembles, Jackets, Blazers, etc.' (HS 6204) in 2015-16.[14] The readymade garment segment contributes to 43% of the Indian textile exports, which includes cotton garments and accessories, manmade fibre garments and other textile clothing (Ministry of Textiles, 2016.).

The garment industry was one of the most protected industries (Gereffi and Frederick, 2010). However, with the removal of quotas in 2005, the international restrictions on apparel trade is now limited. India has followed an inward looking policy till the 1980s. The trade policy followed by India was one of import substitution (Bhagwati, 2003) with import controls and high tariffs. Subsequent to 1991, India has dismantled its protective regime with a reduction in its tariffs, phasing out its non tariff barriers and allowing the imports of most goods barring a

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[8]   According to Roy. 2009., the gross value-added of the Annual Survey of Industries (ASI) sector is 80% for the garment industry while the Directory Manufacturing Establishment (DME) accounts for 20% (Based on data from National Sample Survey Organization (NSSO), data for (ASI) for 2004-05 while for DME for 2005-06. The employment of the ASI sector is 64% while that of the DME sector is 36%. This is based on information from eight major garment-producing states. West Bengal is the only exception which has a larger share of the DME sector.

[9]   The employment provided was 0.901 million in 2006-07. Source: Ministry of Micro, Small, Medium and Enterprises. 2016.

[10]   The number of unregistered units was 2.952 million which provided employment to 5.105 million in 2006-07.

[11]   The top exporters include China, EU 27, Bangladesh, and Turkey (Gereffi and Frederick. 2010.)

[12]   WTO, https://www.wto.org/english/res_e/statis_e/its2014_e/its14_merch_trade_product_e.htm (accessed on July 13, 2017).

[13]   The major consumption of garments is in US, EU and Japan.

[14]   Based on information from the Export Import data from the Ministry of Commerce and Industries, Government of India.

few. However, India still follows a protectionist approach in its regional trading arrangements and continues to maintain a large number of items on its sensitive list. This is particularly true of the South Asian Free Trade Agreement (SAFTA) where India maintained a negative list of 480 items for least developed countries (LDCs) and 868 items for non-least developed countries (NLDC). The negative list maintained by India for all the three countries has a large number of items in the textiles. This is not surprising since all the countries have competencies in the textiles sector. India has subsequently given concessions on readymade garments to Sri Lanka under its bilateral agreement with Sri Lanka. Similarly, Bangladesh has also been given a concession of 164 items (Taneja et al. 2011).

Based on data provided by the Textile Commissioner (Technopak. 2012) estimates suggest that that the contribution of the textiles and garments sector to employment is significant. It is the second largest employer in the country, providing 19 percent of the industrial workforce in 2013. The garments industry provides a quarter of the jobs in this sector.[15]

The AEPC 2009 Study estimated that 95% of the production is in the top 19 clusters, whose annual production is 8900 million pieces. The total number of garment units in these 19 clusters is 33371. Nearly 80 percent of the national production of garments is concentrated in ten clusters: Kolkata, Mumbai, Tirupur, Ludhiana, Indore, Bellary, Jaipur, Bangalore, Chennai and Okhla. [16] The clusters are specialized in terms of type of garments (either woven or knitted) and the variety of the products (men's, women's or children's). For the domestic market in 2009, men's wear comprised forty three percent of the total production amounting to INR 663,000 million, and women's wear stood at INR 577,450 million, and thirty seven percent of the total. Boy's and girl's wear stood at INR 15765 (ten percent of total) and INR 141,900 (nine percent of total) million, respectively (Indian Textile and Apparel Compendium, 2010 Technopak).

Ray and Miglani (2018) discuss the details of the nineteen major manufacturing clusters in terms of the products made in the various clusters, along with the raw material used and the principal market for the products based on the AEPC study. The domestic market is a category with products of a lower quality than those exported, and mass produced items. The segment can be subdivided into items that are branded and sold through organized retail and those that are not branded. The prices of the unbranded segment are significantly lower than those in the branded segment (for a comparable product). The branded segment faces competition from imports while in the latter there is competition from Bangladesh. The unstitched segment produces saris, dhotis, and dress material mainly for the domestic segment (with some export to countries like Bangladesh and the Middle East). 55 to 60 percent of the cost of production of a garment is incurred in the raw materials which include fabric, accessories, sewing thread etc.

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[15]   It is unclear whether the employment provided in the Micro, Small and Medium Enterprises (MSME) sector is covered in this estimate.

[16]   A description of these clusters is provided in the AEPC report 2009.

A brief description of each cluster surveyed is given[17]:

1. **Kolkata:** This cluster is the oldest knitting cluster of India catering primarily to the domestic market with limited exports to the Middle East. The production consists mainly of traditional items like undergarments and kids wear. It is the birthplace of hosiery industry of India and the principal hub for interlock fabric. Additionally, it is the only centre for production of work wear. This cluster has a turnover of Rs. 12,200 crores.

2. **Bangalore**: It is one of the oldest and the most organized apparel hub of India with a turnover of more than Rs. 50,000 crore. It contributes extensively towards domestic market as well as exports. Its main strength lies in its close proximity to the sources of raw material, rendering to its strong supply chain link. The production is organized on a unique model of outsourcing operations on FOB basis and consists of mainly cotton based menswear and daily wear garments.

3. **Tirupur**: Tirupur is the leading export hub of India for knitted garments. It is well integrated with units specializing in different activities like fabricating, dyeing, knitting etc. The local availability of raw material and skilled labour force are the biggest strengths of the cluster. Production is concentrated in menswear, kids wear and undergarments.

4. **Ludhiana**: This cluster has a rich heritage in production of a wide variety of winter wear garments using a range of raw materials. Total annual production of the cluster is 14 lakh pieces and the turnover is estimated to be Rs. 7000 crore. Majority of the goods are meant for domestic consumption with exports estimated as only 20 percent. The products manufactured include sweaters, cardigans, jackets, mufflers, t-shirts & polo shirts, and gloves.

5. **Delhi**: Around 70% of production in this cluster is of fashionable ladies wear like blouses, tops, skirts, dresses, etc. Apart from this, several units are also engaged in manufacturing shorts, skirts, frocks, etc for children and trousers and shirts for men. The Okhla cluster has an annual turnover of approximately Rs. 800 crore with an annual production of 3.20 crore pieces. A large share of products manufactured in the cluster is exported to EU and USA with buying houses playing a crucial role in sourcing the products.

Roy (2009) discusses examined how the phasing out of the multi fibre agreement affected the growth and size distribution of two garment clusters (Delhi NCR and Tirupur) in India. He argues that while there are some trends towards vertical integration in these two clusters, there are differences in the two clusters as regards outsourcing. The Delhi NCR cluster is diverse in terms of its activities and the backward and forward linkages are thin.

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[17] Source: AEPC (2009). Though dated, the brief description of the cluster presented below pertains to the period when the survey was done.

5. Empirical exercise

(a) Data collection and sample

In order to examine the extent of competition to India from products manufactured in the other South Asian countries we conducted a survey of apparel manufacturers in India. Tirupur, Kolkata, Ludhiana, and Bangalore emerge as the leading centres while the combined sales of the NCR region make it one of the top business centres for apparel products. The survey of these clusters of the apparel industry of India was conducted over a span of 30 days in September to October 2010. While Kolkata specializes in kid's garments and men's inner wear and shirts, the Delhi cluster manufactures products mainly for women. Both Bangalore and Tirupur are largely export oriented while the Kolkata cluster caters largely to the domestic market. Ludhiana specializes in winter wear. The clusters are categorized in terms of 2 aspects: (a) type of garments (i.e. knitting or woven) and; (b) variety of products (men, women, kids wear).

(b) Data analysis

127 firms were interviewed with approximately 25 respondents in each cluster. Table 1 shows the number of firms surveyed per cluster.

Table 1: Cluster Coverage

Cluster	Number of respondents per cluster
Kolkata	28
Bangalore	25
Tirupur	27
Ludhiana	25
Delhi	22
Total	**127**

Source: Author's calculations based on survey

In terms of the product categories surveyed, Table 2 shows the share of firms producing men's, women's and kids wear in the surveyed firms. Some firms manufacture all three types of garments.

Table 2: Category Coverage

	Men's Wear	Women's Wear	Kid's Wear
Total number of firms making	143	174	45
Share in Sample (%)	40	48	12

Source: Author's calculations based on survey

Table 3 shows the kind of firms interviewed in terms of their turnover, whether they were producing for the domestic market or were exporting, how many of them were using imported

machinery and whether there was a size correlation with this technology usage, and the age of the firms in terms of the number of years in operation. We have categorized the sample in terms of size which has been captured through sales turnover.

Table 3: Key Characteristics of the Sample

Firm Size (*in terms of Turnover for 2009*)	Frequency	Market Segment			No. of Firms Importing Machinery	Age (years)	
		Domestic	Export	Domestic and Export		<10	>10
Small (Up to Rs. 30 crore)	105 (83.3%)	38 (36.2%)	40 (38.1%)	27 (25.7%)	67 (64.8%)	35 (33.34%)	70 (66.7%)
Large (> Rs. 30 crore)	21 (16.7%)	0 (0.0%)	10 (47.6%)	11 (52.4%)	20 (95.2%)	5 (23.8%)	16 (76.2%)
Total	**126**	**38**	**50**	**38**	**87**	**40**	**86**

Source: Author's calculations based on survey. Figures in parenthesis are as a percentage of firm size.

*The total size of the sample is 127. However, one firm refused to give details of its turnover and hence, could not be categorised in terms of size.

The small scale sector is defined in India either in terms of the number of employees or in terms of investment in plant and machinery. There are problems categorizing size in terms of both of the above criteria. While we have information on the number of employees in our sample, firms use contractual labour as well and such employees are not usually counted as the formal employees of the firm. On the other hand most firms typically outsource a large part of their production to 'job workers' and the only employees they report are administrative personnel who are not production workers.[18] This presents a problem in enumerating the firm size based on the number of employees. The second relates to the use of plant and machinery in defining the size of the firm. Again due the practice of outsourcing by firms, investment in plant and machinery is low for typically small firms. Some of the respondents have said that only stitching is done in house while the rest of the activities are outsourced. Hence we have used the sales turnover as a measure of the size of the firm.[19]

The categorization of the firms (shown in Table 3) in terms of large and small has been done in the following manner: a firm with sales turnover of more than Rs. 30 crore has been categorized as large while a firm with sales turnover of less than 30 crore has been defined as small. This definition should then be interpreted with the caveat that this is strictly not the definition used by the Annual Survey of Industries and we will us the terms 'larger' and 'smaller' to highlight this aspect. We notice from the table that larger firms are not catering to the domestic market exclusively – all of them are also exporting. A significant proportion of the smaller firms are producing only for the domestic market and a large number of these firms belong to the Kolkata cluster. A very significant number of firms are using imported

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[18]   108 firms out of 120 firms in our sample outsource some part of their production activity.
[19]   A variant of the regression exercise was also tried using the full time workers as the dependent variable. Though this has not been reported in the table on results, due to reasons discussed above, the broad results conform to those obtained with sales turnover as the dependent variable.

machinery, though the proportion is higher for the large firms. We examine this issue in greater detail in the regression exercise below. Looking at the age of the firms in terms of the number of years in operation, we see that most of the firms are more than ten years old.

Turning to the nature of competition faced by the Indian firms we find most firms said that they face no competition from the South Asian countries. This is important since India is losing ground in the garments exports and if not to the South Asian countries, who is it losing ground to? As shown in the table 4, we have categorized firms by the market segment, to which they are catering, as domestic, export and both. None of the larger firms are catering to the domestic segment only – they are either exporting or serving both the domestic and export market as already mentioned above. Firms that are exporting only, face very little competition from the South Asian countries. This is mainly due to the fact that Indian products involve a higher value addition such as embroidery etc. vis-à-vis products of other South Asian countries and lie somewhere in between the products manufactured by Turkey and other South Asian countries in terms of quality. They are thus, catering to different segments of the export market. As far as the domestic market is concerned, the competition is not coming from South Asia but mainly from other countries such as China, Cambodia, and Vietnam etc. This is evident from the table below: the number of firms reporting facing any competition from South Asia (comprising of Bangladesh, Sri Lanka and Pakistan) is 23 against 40 from other countries. Moreover, most of the competition faced by the firms in the domestic segment is coming from other firms in the domestic segment. This implies that the domestic market in itself is highly competitive and does not face any significant competition from South Asian products.

Table 4: Competitiveness of all firms

Market Segment	No. of Firms	Firm Size (in terms of Turnover for 2009)		No. of Firms Facing Competition from		No. of Firms Facing Competition from	
		Small (<= Rs. 30 crore)	Large (> than Rs. 30 crore)	Large Firms	Small Firms	South Asia	Other Countries
Domestic	38	38	0	23	32	5	10
Export	50	40	10	0	0	2	7
Domestic and Export	38	27	11	28	28	16	23
Total	**126**	**105**	**21**	**51***	**60***	**23***	**40***

Source: Author's calculations based on survey

*Note: *does not add up due to overlapping responses.*

There is a distinction that has to be made, however, in the nature of the competition faced by the firms from South Asia. This is shown in Table 5. The smaller firms have reported that some of them do face competition from the South Asian countries, especially in some products like swimwear from Sri Lanka. From the table below we see that of the firms catering to the domestic sector and as well as exporting, 64 of them are smaller while 11 of them are larger. A smaller number of firms in the 'smaller' category report competition from abroad and mainly from China: 26 out of 64 while for the 'larger' group it is 7 out of 11. Competition from South Asia was similar: 7 out of 64 for the smaller group against 4 out of 11 for the larger group.

Table 5: Competitiveness of Firms Catering to Domestic and Domestic-Export Market

Sl. No.	Firm Size *(in terms of Turnover for 2009)*	No. of Domestic and Domestic-Export Firms	No. of Firms Facing Competition from		No. of Firms Facing Competition from	
			Large Firms	Small Firms	South Asia	Other Countries
1	Small (Up to Rs. 30 crore)	64	42	50	7	29
2	Large (Greater than Rs. 30 crore)	11	8	9	4	3
	Total	75	50	59	11	32

Source: Author's calculations based on survey

In the case of increased competition, how should the firms cope with the increased imports? Technology is the key to facing the challenge of greater imports and competition. Turning to the role of imported machinery we note that, 8 of the 38 domestic segment firms use imported machinery, while the corresponding figure for the export segment is 42 out of 50. 37 of the 39 firms belonging to the both domestic and export segment use imported machinery. This is not surprising since export product are of better quality than domestic products and the values addition using imported machinery can be far greater. 67 of the 105 smaller firms use imported machinery while 20 of the 21 larger firms use imported machinery. This is due to the fact that imported machines are far costlier than the corresponding domestic machines, and hence, are unaffordable by the smaller firms. Most of the imported machines were imported from Japan, Taiwan, China, Singapore and EU for the processes of dyeing, knitting, cutting and stitching.

Table 6: Technology

Sl. No.	Imported Machinery Proportion Range (%)	Frequency	Small Firms	Large Firms	Domestic Market Firms	Export Market Firms	Both Domestic and Export Market Firms
1	1-20	1	1	0	1	0	0
2	21-40	6	5	1	1	1	4
3	41-60	31	27	4	5	11	15
4	61-80	30	22	8	0	18	12
5	81-100	19	12	7	1	12	6
	Total	87	67	20	8	42	37

Source: Author's calculations based on survey

Using the data obtained from the primary survey we have tried to capture whether the South Asian countries are exerting any influence on the Indian firms. One problem encountered in understanding clusters is that statistical significance in industrial production is hard to determine as economic regions do not respect administrative boundaries and industrial classifications often fail to capture the existing specialization (Krugman, 1991). Thus the design of the empirical exercise has to be done with caution keeping the nature of data in mind.

The dependent equation in the regression is sales of the firm. The independent variables are the age of the firm (Age), the cluster to which the firm belongs (Cluster), whether the firm is selling exclusively to the domestic market (Market), foreign market or the both, the effect of

competition from South Asia (Competition from SA), and the technology used by the firm (Technology (imported)). Complete information on all the variables was available for 126 firms. Table 7 presents the descriptive statistics of the data used for the survey in terms of each cluster. The data point is available only for one year: 2009. Hence the OLS regression has been run for the cross section of firms on which the survey was conducted.

Table 7: Descriptive Characteristics

Variables	Kolkata	Bangalore	Tirupur	Ludhiana	NCR
Total Number of Firms	28	25	27	25	22
Age					
Less than-equal to 10 years	9	14	9	6	6
More than 10 years	19	11	18	19	16
Technology					
Domestic	16	10	5	4	1
Imported		1			12
Domestic and Imported	8	14	22	21	9
Market Segment					
Domestic	17	6	1		17
Export	3	8	21	10	2
Domestic and Export	4	11	5	15	3
Competition from South Asia					
Yes	6	3	3	0	3
No	22	22	24	25	19

Source: Author's calculations based on survey

We note several points from the table: the number of older firms is greater in Kolkata and Ludhiana. The number of firms using domestic technology only is largest in Kolkata. As also noted earlier, the garments manufactured by the Kolkata cluster are mainly for the domestic market and require very little value addition. From the table we see from the table above, the number of firms catering only to the domestic segment is highest in Kolkata. None of the firms surveyed in the Ludhiana cluster were exporting and also none of them are facing any competition from South Asia.

(c) Empirical specification:

Hence the regression equation can be written as:

S$_i$ = f {Age, Cluster, Market, SA Comp, Tech} + ε$_I$ **(i= 1,…, 126)**

Variables:

Sales: this variable measures the performance of the firms. The objective of the regression exercise is to see whether this measure of performance has been affected by competition from South Asia. Rabelotti (1999) has used sales as one measure of performance in her analysis of the Mexican cluster. We do not have information on the other variable used in her exercise: profits, or production. We do have information on the employees. However, as discussed earlier the data on employees may not be reflecting the actual number of workers used in the production since a large part of the production is outsourced. We have tried a version of the regression exercise with employees as the dependent variable. This also tests the robustness of the regression model. In another variant, we have used domestic sales and export sales as the dependent variable: this is reported in equation 4 and 5 in Table 8.

Age of the firm: this variable captures the effect of older or younger firms on the ability to sell in the market. A positive sign is expected since it would mean that older firms are able to effectively sell in the market through established networks. However the ability to sell in an export market may depend on variables other than age.

Competition from South Asia: this variable is a dummy based on the responses of the firm as to whether they face any competition from South Asia, or from any other country. The expected sign of this variable is negative since competition from South Asia (or from any other country) should adversely affect sales. The result reported in the table below is based on the firms' response to whether they faced competition from Bangladesh.

Cluster: As discussed previously, the survey was conducted in five clusters of India. The effect of the cluster has been examined in two ways: first we have tried running the regression on each cluster separately. The degree of freedom is very low in each case. All the respondents of the Ludhiana cluster reported that they did not face any competition from South Asia. Hence, we have also tried controlling for the effect of clusters in general by including four dummies for the five clusters in the regression exercise (reported in equation 1-3 in the table 8). The Kolkata cluster has been taken as the benchmark. The results of this exercise should be interpreted as compared to the benchmark (Kolkata cluster), did belonging to any of the other cluster, affect the sales? The variable cluster should reflect the fact that the linkages in the cluster are aiding or hampering sales. We should thus expect a positive sign if the cluster linkages are aiding the sales. The cluster dummies are not significant by themselves but as interaction terms with competition from Bangladesh (South Asia) or with import of raw materials.

Market: this variable is a dummy variable capturing the effect of selling in the domestic or export market or both. According to Tewari (1999) who surveyed the Ludhiana cluster in 1998, reported that there was a strong simultaneous presence in the exports and the domestic market. In her paper she has found that this simultaneous presence of firms in the export and the domestic markets has helped the firms to spread risks more broadly across the two markets, has served as a market enlarging capacity and also as a learning strategy. We have run the market variable taking zero for domestic, and one for exports. This variable is also not significant by itself. We have also run the regression separately for each of the two categories: export, domestic or both. This has been discussed below.

Technology: this variable captures the role of domestic or imported machinery in the performance of the firms surveyed (Table 6). The expected sign of this variable is positive. As reported in the discussion of the survey, EU and US markets have stringent quality norms. As a result, the exporters are obliged to invest in better quality machines which are generally imported. (this is contrary to that reported by Tewari (1999) in the context of the Ludhiana cluster). However, as noted also by Tewari, the usual assumption that exports generally are of higher quality holds in our case.[20] Moreover, to meet the growing demands of Indian consumers and compete with imports, the firms catering to domestic market also employ latest technology and frequently engage in technical up gradation. To examine the role of imported machinery in the sales, ideally the value of the imported machinery should be used. However, we do not have information on that. Alternatively, we have tried looking at whether the proportion of imported machinery has any significant effect on the sales. This variable is significant.

We do not have information on the value of the raw materials used by the firms. However, as noted before raw materials constitute a significant cost.[21] In recent times, there has been a huge increase in the raw material costs especially due to the increase in the price of cotton. The descriptive statistics related to the variables is reported in table 7. This variable is significant and has been reported in Table 8, in equation 4 where the dependent variable is export sales. It is also significant in other variants of the dependent variable.

6. Results

The results of the regression exercise are presented in Table 8. Equation 1 uses the age of the firm, competition from South Asia, use of imported raw material and source of technology employed (whether imported, domestic or both) as independent variables. From the table, we note that age, use of imported raw material and imported technology are significant.

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[20] The sign of the technology variable will be interesting to observe in the context of the Ludhiana cluster and whether the reversal in the role of the exports and the domestic still holds good in that case.

[21] Birnbaum (2014) points out that India's inability to import raw materials particularly heavier weight manmade fibres and wool, has restricted its production to one season, namely spring. The rest of the garment exporting countries produce for two seasons.

Table 8: Results of the regression

Independent Variables	Equation 1	Equation 2	Equation 3	Equation 4$^£$	Equation 5^Σ
Constant	-454.20 (-0.39)	1082.67 (0.59)	2048.12 (1.06)	930.45 (0.53)	754.28 (1.05)
Age	85.08 (2.00)***	84.98 (1.98)***	76.14 (1.79)*	16.57 (0.66)	-21.57 (-0.77)
Competition from SA	2032.57 (0.93)	1032.56 (0.43)	-2447.57 (-0.19)	496.51 (0.71)	-670.77 (-1.12)
Cluster (Bangalore)		-1976.97 (-0.61)	-1894.87 (-0.56)	-406.56 (-0.20)	889.87 (0.65)
Cluster (Tirupur)		-4000.07 (-1.30)	-5238.34 (-1.58)	-1229.56 (-0.58)	844.51 (-0.86)
Cluster (Ludhiana)		- 6333.24 (-1.70)	- 64867.00 (-1.66)	-1238.06 (-0.62)	-2260.66 (-2.41)
Cluster (Delhi)		- 4640.89 (-1.04)	- 6320.11 (-1.40)	1088.94 (0.30)	-560.79 (-0.30)
Raw material				477.37 (10.36)***	
Technology (imported)	36.79 (2.71)***	67.75 (2.06)**	69.62 (2.06)***	4.69 (0.32)	9.43 (0.68)
Market	117.93 (0.08)	702.59 (0.32)	30.51 (0.01)		
Interaction Comp from SA Cluster (Bangalore)			-606.64 (-0.24)		-2216.37 (-1.14)
Interaction Comp from SA Cluster (Tirupur)			7434 (2.18)***		5932.09 (2.07)***
Interaction Comp from SA Cluster (Ludhiana)			2236.66 (0.95)		443.38 (0.71)
Interaction Comp from SA Cluster (Delhi)			7867.52 (1.14)		5025.80 (0.89)
Interaction Age Technology					1.66 (2.32)***
Interaction Raw material Cluster (Bangalore)				-377.63 (-4.77)***	
Interaction Raw material Cluster (Tirupur)				-1405.32 (-2.85)***	
Interaction Raw material Cluster (Ludhiana)					
Interaction Raw material Cluster (Delhi)				-495.48 (-8.15)***	
Adjusted R^2	0.07	0.15	0.17	0.51	0.29
Number of observations	116	116	116	115	115

Note: * significance at 5%, ** significance at 10 %, *** significance at 1%

Dependent variable: Sales of the firm in equation (1) to (3)

$^£$ Dependent variable: Export sales = Sales of firm*export share

^{Σ} Dependent variable: Domestic sales = Sales of firm*domestic share

White Heteroskedasticity – Consistent Standard Errors and Covariance

The market variable is insignificant in most versions of the equation and implies that sales are not affected by the market to which the firm caters. The Indian domestic market is increasing at a phenomenal rate which has made it as attractive as the export market. We have run the

regressions separately for the domestic or both, and export market and is reported in equation 5 and 4 in Table 8.

Imported Technology

This variable is significant, and has revealed the role of the cluster in the context of technology. We have also tried an interaction term with the age of the firm and the imported technology – this is also significant with a positive sign.

Age

The variable Age also has the right sign and is significant in most versions of the equation.

Cluster

The cluster (location of firm with each cluster represented as a dummy), has been used as an independent variable in equation 2. None of the cluster variables in equation 2 are significant. The variable cluster should reflect the fact that the linkages in the cluster are aiding or hampering sales. We should thus expect a positive sign if the cluster linkages are aiding the sales.

The variable cluster, however, is very interesting. The coefficient of the variable is negative but insignificant for all clusters (except Ludhiana) suggesting that there is no effect of clusters on sales of a firm. The firms interviewed pointed out that the proximity of their production unit with other processing units leads to cost efficiency and hence, allows them to sell their product at a competitive price. This also does not conform to the literature which states that agglomeration results in better firm performance. The variable 'cluster' must be interpreted with a caveat that the results depend on how the variable is modeled in the equation. The cluster dummies are not significant by themselves but as interaction terms with competition from Bangladesh (South Asia) or with import of raw materials.

The variable competition from South Asia is not significant by itself, but as an interaction term with the cluster dummy. The coefficient of this variable is positive and significant for Tirupur but insignificant for Ludhiana and Delhi, and negative and insignificant for Bangalore. The interaction term of cluster with competition from South Asia is significant for Tirupur. This indicates that (compared to the benchmark cluster Kolkata), the effect of competition from South Asia, increases as the cluster is considered. Thus, at least in the case of Tirupur, belonging to the cluster is adding sales.

Competition from South Asia

From table 8, we observe that the variable competition from South Asia is insignificant in all versions of the regression. This corroborates with our findings of the survey that each of the South Asian country specializes in different categories of apparel products and hence, do not pose a threat to each other. While Bangladesh manufactures simple apparel such as t-shirts, shirts and alike in bulk, Sri Lanka is engaged in production of swimwear and ladies

undergarments. Pakistan is primarily a supplier of fabrics especially denims and manufactures bed linen and other household apparels. India, on the other hand, manufactures superior quality woven and knitted products. The firms usually take up small orders and deliver products with value additions such as embroidery, sequencing, printing, etc. One of the interviewees pointed out that to meet the changing demands of the Indian buyer, large retail stores like Shoppers Stop and Pantaloon replace their old stock every 15-20 days with new designs and cuts. This given an edge to the domestic manufacturers who can meet this requirement of value added apparel more easily as compared to South Asian manufacturer.

We have also run the above equations with employees as the dependent variable. We have information on full time workers, and contractual workers. We have run the regressions separately on the full time, contractual and total workers. However from our data we do not have information on the number of production workers. The results from this exercise broadly confirm the results obtained in the exercise with sales as the dependent variable, though most of the variables except technology are insignificant. This confirms the importance of productivity in improving competitiveness.[22] We have also used sales as another explanatory variable in the employees' regression. Sales also captures the size of the firm and in the version of the regression with employees as the dependent variable, the effect of size on the performance of firms is being controlled. However, with the inclusion of the sales in the equation, technology becomes insignificant.

The main reason for India's poor performance (compared to Bangladesh) is the lack of proper clusters. This is in line with Roy (2009), who discusses the Delhi NCR and the Tirupur cluster and argues that while the Delhi NCR agglomeration appears like a cluster, it is not what an industrial cluster should be: it more of an estate than a cluster. The development of the cluster in India has followed the 'top down' approach and the natural process through which linkages are developed are yet to occur (at least in Delhi NCR). Others like Martin et al. (2008) point out that policies promoting agglomeration are unnecessary. Using data from French firms, they show that while clusters do bring economic benefits, such as productivity gain, there is a bell shaped curve between productivity gains and agglomeration. They argue that policies that attempt to foster more dispersion of economic activities to reduce regional inequalities also have efficiency costs.

Shirley (2005) says that informal institutions influence the ways of functioning of a democracy that are not often examined. Kennedy (2014) has argued that in India, the emergence of sub national state spaces, which is a historical process, has changed the institutional framework of the country. These state spaces provide examples of governance mechanisms such as rules and policies for industrial development, and regulatory tools for promoting new clusters. She argues that economic policy making has to be viewed from this perspective, since the 'reworked institutional context and sub national scales are crucial for understanding emerging patterns of economic governance.'

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[22]   Sala-i-Martin et al. (2007).

7.   Conclusion and policy implications

In this paper, we examine the Indian apparel industry to examine the effect of clusters on the sales of this industry. We argue that the main reason for India's poor performance (compared to Bangladesh) is the lack of proper clusters. The natural process through which linkages are developed are yet to occur in most clusters studied in this paper. This naturally leads to the question that what policies should be followed to encourage cluster formation or should that be left to firms too? While there is a lot of extant literature on this issue, the linkage between trade and industrial policies along with land acquisition, access to other inputs etc. has been emphasized often. What has not been discussed is that sometimes the 'top down' approach of policy driven clusters will not work and other alternatives need to be explored. Notably, the discussion on how sub national state spaces in India, has changed the institutional framework of the country is also missing.

References

AEPC Study (2009) *Indian Apparel Clusters: An Assessment*. AEPC.

Bhagwati, J. (1993) *India in Transition: Freeing an Economy*, Oxford University Press, Oxford.

Birnbaum, D. (2014), Benchmark Study India: Part II – Operational Problems v Structural Obstacles and Systemic Barriers,
http://www.birnbaumgarment.com/2014/07/15/benchmark-study-india-part-ii-operational-problems-v-structural-obstacles-and-systemic-barriers/

Brusco, S. et al. (1996), The idea of the industrial district: its genesis, in Pyke, F., G. Becattini, and W. Sengenberger (eds.) *The Evolution of industrial districts and inter-firm cooperation in Italy*, International Institute for Labour Studies, ILO, Geneva.

Ciccone, A. and R. Hall (1996) Productivity and the Density of Economic Activity, *American Economic Review*, 86, 1, 54-70.

Delgado, M., M. E. Porter, and S. Stern (2010) Clusters, Convergence and Economic Performance, CES working paper 10-34.

Dickerson, K .G. (1999) *Textiles and garments in the Global Economy*, Upper Saddle River. NJ: Merrill.

Gereffi, G. and S. Frederick (2010) The Global Apparel Value Chain, Trade and the Crisis – Challenges and Opportunities for developing Countries, Policy Research Working paper No. 5281, World Bank.

Kennedy, L. (2014) *The Politics of Economic restructuring in India; Economic Governance and State Spatial Rescaling*, Routledge, Special Indian edition, Oxford and New York.

Knorringa, P. (1996) *Economics of Collaboration: Indian Shoemakers between Market and Hierarchy*, Sage, New Delhi and London.

Krugman, P. (1991) *Geography and Trade*, MIT Press, Cambridge MA.

Lopez-Acevedo, G. and R. Robertson (2016) (Eds.) *Stitches to Riches? Apparel employment, trade and economic development in South Asia.* Washington: IBRD/ World Bank.

Markusen, A. (1996) Sticky Places in Slippery Space: A typology of Industrial Districts, *Economic Geography*, 72, 3, 293-313.

Marshall, A. (1920) *Principles of Economics*, 8th edition, Macmillan, London.

Martin, P., Mayer, T., and F. Mayneris (2008) Natural Clusters: Why Policies promoting agglomeration are unnecessary, VOX CEPR.

Nadvi, K. (1999) The cutting edge: Collective Efficiency and International competitiveness in Pakistan, *Oxford Development Studies*, 27, 1, 81-107.

Nadvi, K. and H. Schmitz (1994) Industrial clusters in less developed countries: Review of experiences and research agenda. Discussion paper no. 339, Institute of Development Studies, University of Sussex, Brighton.

Pietrobelli, C. (2007) Private sector development: concepts and practices. In: *Business for development: Fostering the Private Secto*r, Paris: OCED.

Pietrobelli, C. and R. Rabellotti (2007) *Upgrading to Compete. Global value chains, SMEs and Clusters in Latin America*. Cambridge: MA: Harvard University

Porter, M. (1990) *The Competitive Advantage of Nations*, Macmillan, London.

Porter, M. (1998) Clusters and the New Economics of Competition, *Harvard Business Review*, November-December, 77-90.

Rabelotti (1999) Recovery of a Mexican cluster: Devaluation Bonanza or Collective Efficiency? *World Development*, 27, 9, 1571-1585.

Rabelotti, R. and H. Schmitz (1999) The internal heterogeneity of industrial districts in Italy, Brazil and Mexico, *Regional Studies*, 33, 97-108.

Ray, S., Mukherjee, P., and M. Mehra (2016) Upgrading in the Indian garment industry; A study of Three clusters, ADB South Asia Working Paper Series, No. 43.

Ray, S. and S. Miglani (2018) Integration in the Garments Value Chain: In Ray, S. and S. Miglani (2018) *Global Value Chains and Missing Links: Cases from Indian Industry*, London and New York: Routledge.

Richardson, C.J. R. (2010) The Internationalisation of Firms in a Policy-Driven industrial cluster: The Case of Malaysia's Multimedia Super Corridor. Thesis submitted to the University of Manchester for the doctoral degree. Link: https://www.research.manchester.ac.uk/portal/en/theses/the-internationalisation-of-firms-in-a-policydriven-industrial-cluster-the-case-of-malaysias-multimedia-super-corridor(392e5f1d-98cc-47d8-a9c4-cca1025a64ed).html

Rodriguez-Clare, A. (2007) Clusters and Comparative Advantage: Implications for Industrial Policy, *Journal of Development Economics*, 82, 43-57.

Roy, S. (2009) Garments Industry in India: Lessons from two clusters, ISID Working paper no. 2009/01.

Sala-i-Martin, X. Blanke, J., Drzeniek Hanouz, M., Geiger, T., Mia, I., and F. Paua (2007) The Global Competitiveness Report: Measuring the Productive Potential of Nations, The Global Competitiveness Report 2007-08, World Economic Forum.

Saxenian, A. (1994*) Regional Advantage: Culture and Competition in Silicon Valley and Route 128,* Cambridge, MA: Harvard University Press.

Schmitz, H. (1989) Flexible Specialization: A New paradigm of small scale industrialization, Discussion paper No. 261, Institute of Development Studies, University of Sussex, Brighton.

Schmitz, H. (1995) Collective efficiency: Growth Paths for small-scale industry. *Journal of Development Studies*, 31, 4, 529-66.

Schmitz, H. and K. Nadvi (1999) Clustering and Industrialization: An Introduction, *World Development*, 27, 2, 1503-14.

Shirley, M. M. (2005) 'Institutions and development'. In: C. Menard and M. M. Shirley (eds.): *Handbook of New Institutional Economics*. Springer: The Netherlands, pp. 611–638.

Tendler, J. and M. Amorin (1996) Small firms and their helpers: Lessons on demand. *World Development*, 24, 3, 407-26.

Taneja, N., S. Ray, N. Kaushal and D. Roy Chowdhury (2011) An Approach to Prune India's Sensitive Lists under SAFTA. *Economic and Political Weekly*, Vol. XLVI, No. 11, March 12, 15-18.

Taneja, N., Ray, S. and D. Pande (2017) Exploring the Trade in textiles and Clothing between India and Pakistan, In Taneja, N. and I. Dayal (Eds.) India-Pakistan Trade Normalisation: The unfinished Agenda, Springer, Singapore.

Tewari, M. (1999) Successful Adjustment in Indian Industry: The Case of Ludhiana's Woolen Knitwear Cluster, *World Development*, 27, 9, 1651-1671.

Tewari, M. (2008) Deepening Intraregional Trade and Investment in South Asia: The Case of the Textiles and Clothing Industry, ICRIER Working paper no. 2013.

Wallsten, S.J. (2004) 'The role of government in regional technology development: the effects of public venture capital and science parks'. In; T. Bresnahan and A. Gambardella (eds.) *Building High-tech Clusters: Silicon Valley and Beyond.* Cambridge, Cambridge University Press.