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Analysis of the Structural Decomposition of the Textile-Clothing Industry in Bangladesh

Md. Masum[1] Md. Mourtuza Ahamed[2] and Mohammad Sayedur Rahman[3]

Abstract

Purpose*: This paper aims to introduce the technology's role and the final demand in the textile-clothing industry's growth path (TCI) of Bangladesh.*

Methodology*: This study applies structural decomposition analysis in the input-output framework to measure Bangladesh's textile–clothing industry structural changes. Structural decomposition analysis is also known as growth accounting in literature.*

Findings*: This paper finds that, from 1975 to 1995, the TCI has grown due to huge domestic demand, from 1995 to 2015, this industry has grown due to export expansion. The technology was never a key factor over low–cost labor for the development of TCI in Bangladesh.*

Implications*: For the sustainable development of the TCI in Bangladesh, domestic demand expansion is significant. Private and public policies should reflect this expansionary (domestic demand expansion) strategy.*

Originality*: Previous studies on the TCI were mainly descriptive; there was no decomposition analysis in the input-output framework. Moreover, this paper decomposes the growth of the TCI into technical effect and final demand effect, which are new in the ready-made garment industry of Bangladesh.*

Keywords: Textile–clothing industry; Bangladesh; Structural decomposition analysis; Growth accounting

Introduction

The export-oriented textile-clothing industry (TCI[4]) in Bangladesh started its journey in the late 1970s as a small non-traditional sector of export. Bangladesh exported garments worth only US$ 69,000 when Reaz Garments exported its first consignment to the USA in 1978 (Bhattacharya et al., 2002). By the year 2019, within about four decades, exports have gone up to US$ 35 billion, holding the second position in exports of garments after China. The sector registered an annual growth rate of 15 percent, an exceptionally high growth rate for an emerging sector any where globally. The industrial base which sustained such high growth also enjoyed a robust expansion, from less than 50 factories in 1983 to more than 4,500 in 2019, with the number of TCI workers reaching approximately 4 million out of which 3.6 million is women. Bangladesh is a developing country, and its economy is mainly dependent on agriculture. However, the TCI has been placed the most considerable export earnings of Bangladesh. The textile industry, pharmaceuticals, agribusiness, jute, leather, tea, and food processing contribute to Bangladesh's national economic development. However, TCI has secured the first position to earn foreign currency (Rahman & Siddiqui, 2015).

Moreover, TCI has created strong backward and forward linkages, which are the growth factor for other industries, e.g., TCI is taking input from the chemical industry, water industry, transport industry. These input supplying industries are contributing a lot to the economy. In addition to directing contribution to the economy, the textile industry is also stimulating other industries (Masum & Inaba, 2015). As a result of such direct and indirect contributions, it has become essential to analyze the growth contributors of TCI. This paper attempts to do so. TCI

[1] *Associate Professor, Department of Textile Engineering Management, Bangladesh University of Textiles, Tejgaon, Dhaka, Bangladesh, Email: masum@butex.edu.bd*
[2] *Associate Professor, Business Administration Discipline, Khulna University, Khulna-9208, Bangladesh, Email: amm203@gmail.com*
[3] *Department of Management, Dhaka College, Dhaka, Bangladesh, Email: msr_shohag@yahoo.com*

[4] TCI is defined as a processing industry in this paper. The finished output of TCI is apparel/clothing. The backward linkage of the apparel sub sector is fibre, yarn and fabric sub sectors. As the input–output table has consolidated fibre, yarn, fabric and apparel sub sectors into only one sector, i.e., TCI, we consider TCI as one sector throughout this paper.

of Bangladesh is the economic backbone of Bangladesh. This industry empowers women, brings social equity, earns foreign currency, and contributes the lion's share to Bangladesh's Gross Domestic Product (Masum & Inaba, 2018). This industry is a labor-intensive industry, and cheap labor is considered the primary competitive weapon. Many entrepreneurs in this industry of Bangladesh are thinking about replacing labor with technology because they claim that labor is also the source of unrest in the textile sector and a significant cause of low productivity. The Bangladesh government is also encouraging all sectors to be digitized; there is a dilemma as to whether the labor-intensive textile industry should be pushed into the capital-intensive industry. There is little research, analysis of the application of technology in this prime sector of Bangladesh. At the same time, it is unknown whether the growth of this sector is technology-driven or demand-driven. In addition to this introduction, this paper has four other sections. The second section gives a review of the literature. Section 3 discusses the methodological aspects, including the input-output table (IOT) framework and structural decomposition analysis (SDA) framework. In section 4, this paper discusses the results of the decomposition analysis. Finally, section 5 provides the concluding remarks.

Literature Review

TCI of Bangladesh is the labor-intensive, low-tech manufacturing industry and the first rung on the ladder of industrialization of Bangladesh (Kabeer &Mahmud, 2004). Bangladesh inherited some big industrial enterprises in jute, textile, and steel from East Pakistan after independence. Older industries have become extinct, and export-oriented industries have grown. The textile industry has become the single largest source of export earning sector afterward (Muhammad, 2011). Bangladesh's world export market was opened through the sale of textile products and clothing (Rock, 2001). Labor has become the boon for the growth of the TCI in Bangladesh. However, labor price is inferior compared to other manufacturing sectors in Bangladesh (Rock, 2003). The production, distribution, and consumption of textiles and clothing had epitomized the uneven development of the world economy since the beginning of industrial capitalism in the eighteenth century, when the high quality, handicraft-based Indian textile industry was destroyed by the output of Lancashire's mills. In its turn, Lancashire gave way to the United States, Germany, and Japan. At the same time, today, South Korea, Taiwan, Hong Kong, and, latterly, China, challenge the older established locations (Elson, 2002). The Bangladesh government took an early initiative to declare the textile sector as a thrust sector. The increasingly crucial role the export-oriented TCI of Bangladesh has come to play in Bangladesh's economy and society(Bhattacharya et al., 2002). Thus, the industry is growing in a new fashion today in Bangladesh and other underdeveloped countries.

TCI of Bangladesh has grown since its inception as an export item in the early 1980s (Masum & Islam, 2014; Masum, 2016). The average output growth rate for the last two decades is around 20%. Each time the country is criticized for its high level of corruption and conflicting politics, its garment industry is booming. The reality is that the growth in TCI has been mainly due to China's Western nations' restrictions (Uddin & Jahed, 2007). The main drivers of the TCI in Bangladesh are exports of finished goods following the abolition of the quota system. Both national and international quotas did provide Bangladesh garments with access to guaranteed international markets. However, as shown by the rising export volumes and market shares of Bangladesh's TCI products over the period 2005-06, the quota system's withdrawal did not impede the further development of Bangladesh's industry (Ahmed, 2009). The sources of competitiveness of TCI of Bangladesh are a market force represented by the low wage of labor, expansionary government policy, and dynamism inside the industry (Yunus & Yamagata, 2012).Previous studies suggest that the increase in TCI is responsible for exports (Ahmed, 2013; Bow, 2001; Dowlah, 1999; Khan, 2004; Mottaleb & Sonobe, 2011; Quddus & Rashid, 2000; M. Rahman, 2005; S. Rahman, 2004; Razzaque, 2005; Rhee, 1990; Siddiqi, 2004; Sonobe et al., 2018; Spinanger, 2001; Yamagata, 2006; Yang & Mlachila, 2007).Nevertheless, in today's world, technology is considered a competitive and growth tool (Clemons, 1986; Ives & Learmonth, 1984; McFarlane, 1984; Parsons, 1983; Porter & Millar, 1985).Whether the technology has any role in the growth of Bangladesh's TCI is not investigated yet. This study aims to gain insight into the contribution of technology and final demand for the ICT growth pathway in Bangladesh. More specifically, the paper's research question is–*Is the growth of the TCI in Bangladesh technology-driven or final demand-driven?* To answer the research question, we use input-output (IO) based structural decomposition analysis on the TCI of Bangladesh's output growth. Although the SDA is similar to growth accounting (GA) (Crafts, 2009; Denison, 2010; Kendrick, 1973; Solow, 1970), the focus is different. The focus of GA is productivity analysis mainly. The SDA's focus is to decompose the output growth into the technical effect, final demand effect, domestic demand effect, value-added effect, export effect, import effect, energy effect. The IOT based SDA has become a research issue since the 1930s (Leontief, 1936, 1941, 1951). Chenery et al., (1962) applied SDA in Japanese economic growth analysis; Carter (1970) used SDA for investment and technological change analysis; Sterner (1985) applied the concept for structural change and technology choice in Mexican manufacturing industry; Feldman et al., (1987) and Blair & Wyckoff (1989) used the idea for the US economy; Urata (1988) analyse the economic growth and structural change in the Soviet economy; Skolka (1989) has extended SDA to Austrian economy; Barker (1990) analyse sources of structural change for the UK service industries; Buccellato (1990) applied SDA to estimate technological progress; Dewhurst (1993) has quantified changes in the intermediate transaction flows using SDA; Siegel, Alwang, & Johnson (1995) used SDA as a means of identifying instability of supply–demand sources; Guilhoto, Hewings, Sonis, & Guo (2001) has applied SDA in Brazilian economy; Pei, Dietzenbacher, Oosterhaven, & Yang (2011)has extended the idea to China's import growth analysis. These are some applications of SDA among other major studies. Thus, during the last two decades, SDA has become a popular methodology (Sonis, Guilhoto, Hewings, & Martins, 1995; Rose & Casler, 1996).

The number of translog and Cobb-Douglas frontier production models were estimated for the Bangladesh handloom textile industry to investigate its production technology and technical efficiency in production. It finds that the industry's technical efficiency in producing cloth is 41% (Jaforullah, 1999). The technical efficiencies for the textile industry of Bangladesh have been estimated by Samad &Patwary (2003). A translog stochastic frontier production function model has been used for this purpose. The overall average technical efficiency is estimated to be 0.80 for Bangladesh's textile industry under consideration, which implies that only 80% of the potential output is currently being realized in this sector. Findings of other similar studies corroborate this result. Goedhuys et al., (2013) examine the importance of various sources of knowledge to explain productivity using firm-level data from five developing countries, including Bangladesh. The result shows that level of development affects the effectiveness of knowledge sources and technology. Capital-intensive textile firms raise productivity. Descriptive analysis by Ali & Habib (2012) shows that technology plays a useful role in the textile industry's supply chain aspects in Bangladesh. Technologies are used in the textile industry's waste water treatment, but not for expanding textile production in Bangladesh (Miah, 2012). However, SDA has never been applied for technical efficiency analysis of the TCI in Bangladesh.

Methodology

This paper has applied IOTs from 1975 to 2015. This paper calculated the changes in every five-year gap. There are eight periods (1975–1980, 1980–1985, 1985–1990, 1990–1995, 1995–2000, 2000–2005, 2005–2010, and 2010–2015). This paper used the Asian Development Bank’s (ADB) Multi-Regional Input-Output Tables (MRIOTs). ADB’s MRIOTs are available from 2000 to 2011 at the time of analysis for this paper. For the missing years (1975 to 1995), GRAS methodology has been applied in MATLAB. All the GRAS approach details under the MATLAB environment are described in Temurshoev, Miller, & Bouwmeester (2013). The ABD’s MRIOTs are open source and available at *http://www.wiod.org/otherdb#ADB*. The primary source of data in this paper is the IOTs of Bangladesh. The national IOTs of Bangladesh are not readily available from a reliable source. The national IOTs are compiled from the MRIOT of the ADB. The following is the method to compile the national IOTs from the MRIOT.

The following equation (1), the demand-supply integration for country P, is the representation of output in the MRIOTs, where $IntP + IntQ + \cdots + IntR$ is the intermediate output for countries $P, Q \ldots R$, respectively, and $fP + fQ + \cdots + fR$ is the final output of countries $P, Q \ldots R$, respectively.

$$x_i(MRIOT) = (IntP + IntQ + \cdots + IntR) + (fP + fQ + \cdots + fR) \qquad (1)$$

We develop the output for national input-output tables (IOTs) for country P from the MRIOTs using the equation (2) below, where $IntP$ is the intermediate output of country P, fP is the final output of country$P$, and eP is exported (summation of all intermediate and final outputs from country P to other countries).

$$x_i(IOT) = (IntP + fP + eP[(IntQ + \cdots + IntR) + (fQ + \cdots + fR)] \qquad (2)$$

Here, the subscript i indicates output sectors or row vectors.

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The equation (3), Income–expense integration for country P, is the representation of the input in the MRIOTs, where $kP + kQ + \cdots + kR$ is the intermediate input for countries $P, Q \dots R$, respectively, and $vP + vQ + \cdots + vR$ is the primary input of countries $P, Q \dots R$, respectively.

$$x_j(MRIOT) = (kP + kQ + \cdots + kR) + vP + vQ + \cdots + vR) \qquad (3)$$

The input for national IOTs for country P is derived from the MRIOT using the equation (4) below, where kP is the intermediate input of country P, vP is the VA input of country P, and mP is imported (summation of all intermediate inputs and VA to country P from other countries).

$$x_j(IOT) = (kP + vP + mP[(kQ + \cdots + kR) + (vQ + \cdots + vR)] \qquad (4)$$

Here, the subscript j indicates input vectors or column vectors.

The SDA model applied in this paper is based on the IO model. The general idea of the IO model is explained here before discussing the SDA model. The Leontief inverse of the IO model for SDA is the core of the analysis shown in this paper. Leontief inverse is calculated using the input-output table (IOT)[5]. The IOT represents the total amount of inputs ($\boldsymbol{x_j = \sum_{i=1}^{n} z_{ij} + v_j + m_j}$) required to produce the total amount of outputs ($\boldsymbol{x_i = \sum_{j=1}^{n} z_{ij} + \acute{f}_i + E_i}$), and there is an equilibrium of total inputs and total outputs, i.e., $\boldsymbol{x_j = x_i}$ as represented in the following Table 1, which is a two-sector hypothetical national economy.

Table 1: The IoT framework

		Intermediate (Sector j)		**Final demand (f)**		**Total Output (x)**
		Sector 1	**Sector 2**	**Domestic demand (ḟ)**	**Export (E)**	
Intermediate (Sector I	Sector 1	z_{11}	z_{12}	$\acute{f}_1$	E_1	x_1
	Sector 2	z_{21}	z_{22}	$\acute{f}_2$	E_2	x_2
Value-added (v́)		v_1	v_2			
Import (ḿ)		m_1	m_2			
Total Input (x́)		x_1	x_2			

Source: Based on Miller & Blair (2009)

Here, Table 1 denotes2×2 intermediate IO matrix as Z (elements are z_{ij}), $f$as the total demand column vector, $\acute{f}$ as the domestic final demand column vector, E as the export column vector, x as the output vector, $\acute{v}$ as the value-added row vector, $\acute{x}$is the total input row vector and $\acute{m}$ as the import row vector. The representation of the above Table 1 in matrix format can be as below:

$$Z = \begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix}, \ \acute{f} = \begin{bmatrix} \acute{f}_1 \\ \acute{f}_2 \end{bmatrix}, E = \begin{bmatrix} E_1 \\ E_2 \end{bmatrix}, \ x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}, \acute{m} = [m_1 \quad m_2], \ \acute{v} = [v_1 \quad v_2], \text{and } \acute{x} = [x_1 \quad x_2]$$

To know the Leontief inverse coefficients, we need to know the *direct input coefficients*. We define $a_{ij} = \frac{z_{ij}}{x_j}$As the *direct input coefficients are* representing the input of sector i from sector j. So,a_{11}The following equation (5) represents the input required to produce one production unit of sector one from sector 1. Similarly, the expression a_{21} represents the number of raw materials that sector 1 takes from sector 2 to produce one product unit. This paperdefines$A$ as the *direct input coefficient* matrix. So, $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}$Moreover,the economy's representation in a matrix format can be shown in the following equation (5).

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} \acute{f}_1 \\ \acute{f}_2 \end{bmatrix} + \begin{bmatrix} E_1 \\ E_2 \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \qquad (5)$$

The above equation (1) can be rewritten as

[5] See Miller & Blair (2009) for more details.

$$Ax + \underbrace{\acute{f} + E}_{f} = x$$

$$\rightarrow x = (I - A)^{-1} f \qquad (6)$$

This inverse matrix, in equation (6), is known as Leontief inverse as Leontief invented this calculation and referred to as L. So,

$$L = (I - A)^{-1} \qquad (7)$$

Where I is the identity matrix. As explained above that A represents the *direct input coefficients*, whereas L represents the *total input coefficients* (direct and indirect). This resulting coefficient table indicates how much production will be ultimately induced (direct and indirect) in what industry by a demand increase of one unit in a particular industry. Once the inverse matrix coefficients are calculated, the simultaneous equations in (5) do not need to be solved independently. When the final demand in a sector is given, total production in each sector, corresponding to the final demand, can be immediately calculated using equation (7). The essence of *indirect effect* is noted here. For the example economy, suppose the demand for sector one has increased by one unit. Sector 1 will require raw materials to generate one unit of production (direct effect). Sector 1 will thus generate intermediate demands of a_{11} and a_{21} Units of raw materials in sector one and sector 2, respectively, by the *direct input coefficients*, which is the primary production repercussion (direct effect). Receiving the demands, sector one and sector two will further generate the secondary production repercussions (indirect effect) by the respective input coefficients to produce a_{11} and a_{12} units. This series of production repercussions continue infinitely until production levels for the respective sectors can ultimately be calculated to summarize all production repercussions. In this manner, input coefficients are crucial to measuring how much production can be ultimately induced at each sector when certain levels of final demand are generated in an industrial sector. However, it is impossible and unfeasible to trace and calculate each process of production repercussion occurrences. The *inverse matrix coefficients*, introduced by Leontief, are prepared to simplify such production repercussion calculations (Director-General for Policy Planning, 2009; Miller & Blair, 2009). The variables used in the paper are almost similar to the variables used in Frank et al., (1975); Dietzenbacher & Los (1998); and Magacho, McCombie, & Guilhoto (2018). The variables are given in the following Figure 1. The technical effect (TE) in this analysis indicates the effect of technology that affects the intermediate consumption, including inter-industry transfers. Final demand (FD) indicates the effect of personal consumption, government consumption, investment, and net exports. Domestic demand indicates the locally created demand that affects the growth of the industry. Export expansion corresponds to the foreign demand that helps to grow the industry. Import substitution gauges the replacement of imports by local production. Here, the TE and FD equal one, and the sum of DD, EE, and IS are equal to FD. TE has not been decomposed further.

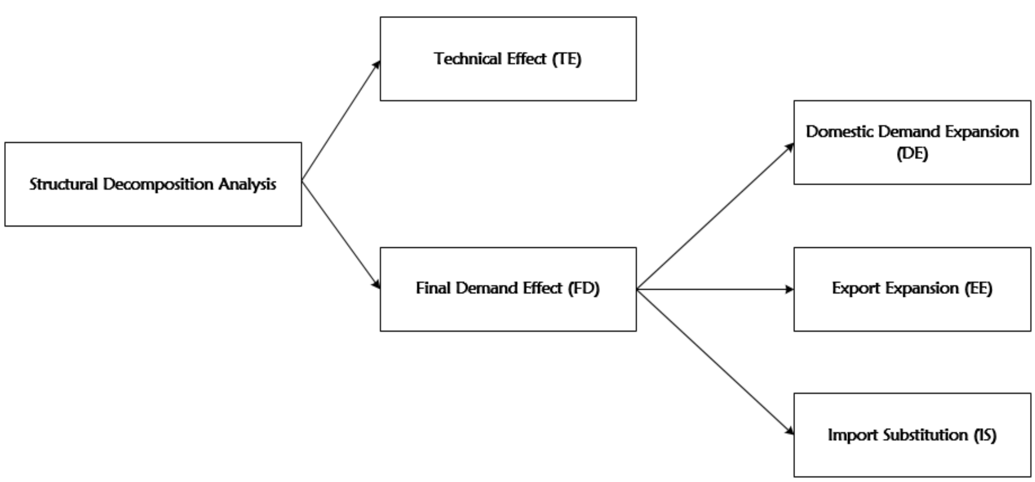

Figure 1 : Variables of structural decomposition analysis.

Frank et al., (1975) used the SDA to measure the South Korean economy's structural changes subdividing output growth into domestic demand growth effect, export growth effect, and import substitution effect. The model of Frank et al., (1975)is given here in equation (8):

$$\Delta x = \underbrace{(1-\tilde{m}^0)\times\Delta\acute{f}}_{Domesticdemaneffect} + \underbrace{\Delta E}_{Exporteffect} - \underbrace{\Delta\tilde{m}\times\acute{f}^1}_{Importsubstitutioneffect} \qquad (8)$$

Here,$\Delta x$is the changes in output, $\tilde{m}$is the ratio of imports (m) to domestic demand ($\acute{f}$), $\Delta\acute{f}$ is the changes in domestic demand, ΔE is the changes in exports, and $\Delta\tilde{m}$are the changes in $\tilde{m}$. Superscript 0 and1indicate the base year and current year, respectively.

Afterward, Dietzen & Los (1998) added technical effect (the number of changes that are not due to final demand changes) on output changes under the IO framework. The basic model of Dietzenbacher & Los (1998) is given hereunder in equation (9).

$$\Delta x = \underbrace{\tfrac{1}{2}(\Delta L)(f^0+f^1)}_{Technicaleffect} + \underbrace{\tfrac{1}{2}(L^0+L^1)(\Delta f)}_{Finaldemandeffect} \qquad (9)$$

Here, x is the output column vector, L is the $n \times n$ Leontief inverse matrix, f is the final demand column vector, including exports. The superscript *0* and *1* indicate the base year and current/subsequent year respectively. Magacho, McCombie, & Guilhoto (2018) extended the decomposition of output growth into technical effect, domestic demand effect, and export effect as below in equation (10).

$$\Delta x = \underbrace{\tfrac{1}{2}(\Delta L)(f^0+f^1)}_{Technicaleffect} + \underbrace{\tfrac{1}{2}(L^0+L^1)(\Delta\acute{f})}_{Domesticdemandeffect} + \underbrace{\tfrac{1}{2}(L^0+L^1)(\Delta E)}_{Exporteffect} \qquad (10)$$

Here, x is the output column vector, L is the $n \times n$ Leontief inverse matrix, $\acute{f}$ is the domestic demand column vector, f is the final demand column vector, including exports. The superscript *0* and *1* indicate the base year and current/subsequent year, respectively. Magacho, McCombie, & Guilhoto (2018) defined the production structure's technical changes as the changes in Leontief's coefficients weighted by final demand. Leontief's coefficients weight the domestic demand effect and export effect. It is the latest SDA innovation, which applied in materializing the impact of trade liberalization in the Brazilian economy. This paper applies this model, as in equation (10), for Bangladesh's economy to measure the structural changes in the TCI of Bangladesh, i.e., the effect of technology, export effect, and the domestic effect demand TCI's output growth.

Results and Discussion

The result summarized in Table 2; equation (10) is used for calculation. Table 2 indicated that in the early stage, domestic demand had played a growing role. In the later stage, significantly since the 1990s, the growth role has changed from domestic orientation to export orientation, prevailing stillness now. However, the technical effect was not a growth factor for the textile industry of Bangladesh.

Table 2: The Result of Structural Decomposition Analysis

Period	Technical Effect	Domestic Demand Effect	Export Effect
1975–1980	–19%	119%	1%
1980–1985	7%	80%	13%
1985–1990	0%	64%	37%
1990–1995	1%	47%	53%
1995–2000	–1%	31%	70%
2000–2005	–9%	41%	68%
2005–2010	5%	25%	70%
2010–2015	2%	26%	72%

Source: Authors' calculation based on equation

The textile industry has started its growth in the early 1980s, a post-liberation war period in Bangladesh. At that time clothes for the local people were very scared. That is why, in addition to smaller-scale exports, a vast volume of output growth was due to domestic demand with inferior technology, especially handloom technology. Nevertheless, in the later stage, export is leading to the growth of the industry. The government has initiated many measures to increase exports. The textile sector's strategic measures were effective because Bangladesh had immense uneducated labor, especially illiterate women. The women had contributed a lot to the expansion of the TCI. Moreover, Bangladesh was, still now, import-dependent for even daily essentials. The source of foreign currency was only jute exports. However, jute has become unpopular in the world market. This unpopular theme also gave impetus to the growth of TCI. Given that no other export-oriented industry has evolved in the Bangladeshi economy; TCI uses government incentives and supports to compete globally. Besides, international policies were also favourable for the TCI of Bangladesh. After the Multi-Fibre Agreement (MFA) phase, the textile exports have enhanced significantly due to some international tariff facilities. Bangladesh is enjoying the relaxation of Rules of Origin (RoO) and the Generalized System of Preferences (GSP) for exporting to developing countries. Bangladesh is also enjoying export facilities from Europe under the Everything but Arms (EBA[6]) policy. The technology has never been useful for the growth of Bangladesh's TCI.

Technology is significant for any business in the current world. Nevertheless, there are some controversies regarding the application of technology in the light of labor-intensive manufacturing industries like TCI. There are some sub sectors of TCI where high technology is not useful, e.g., sewing. Without physical labor, sewing cannot be practical and defect-free. Bangladesh is the 2nd largest exporter of clothing globally, with a 5.1% market share[7]. The industry in Bangladesh is known as the cutting–making–trimming (CMT) industry. This CMT is the lowest value-added part of the clothing marketing network (Fernandez-Stark, Frederick and Gereffi, 2011). The application of technology in the CMT workflow is a proven mistake. Many former manufacturers in the UK, USA, Japan, Korea, Germany and France applied technology in the TCI, but they all lost the market for higher production costs[8]. Even in countries that abandoned the textile industry and migrated to more sophisticated industries, technology has never been a growth factor. The United Kingdom, European countries, the United States, newly industrialized countries (Korea, Taiwan, Singapore and Hong Kong) tried to apply technology. However, they failed to stop shifting the industry to developing countries. Now the same experience is facing by China. China is trying to apply technology to TCI; the result is a shift of TCI to other low-tech countries. That is why the former manufacturers have shifted the CMT part of the value chain to under developed countries like Bangladesh. The higher value-added the developed countries still control parts like their own designing, own branding[9]. The application of technology is useful for the higher value-added activities in the value chain of the TCI. The higher value-added activities include designing, demand forecasting, reaching the finished products to the ultimate consumers, branding. The result of structural decomposition analysis shows that the technical effect was negative in Bangladesh's early period of independence. Bangladesh achieved its independence in 1971. The industrial structure, after nine months long independence war, was devastating. The domestic demand for clothing was high, but the supply was scarce. The export was almost nil before 1980. The revolution of TCI in Bangladesh begins in 1977 from a Korean company's foreign direct investment (FDI)[10]. The initiation of technology in the TCI of Bangladesh begins after receiving the FDI from Korea. The Korean company transferred some technology to Bangladesh. That is why, during 1980–1985, the technical effect in Bangladesh's TCI is the highest. Afterward, until early 2000, there was almost no technical change. The effect of changes in the early 1980s continues till 2000. Until 2005, Bangladesh's TCI was governed by the World Trade Organization (WTO) quota system, which was discontinued in 2005. There is a great fear that

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[6]EBA is an initiative of the European Union (EU) under which all imports to the EU from the Least Developed Countries are duty-free and quota-free, apart from armaments. EBA entered into force on 5 March 2001.

[7] Market share of China, Bangladesh, Italy, Germany, Hong Kong, and Vietnam are 38.6%, 5.1%, 5.1%, 4.1%, 4.2%, and 4.0% respectively in 2015.

[8] The trend analysis of TCI shows that it was important industry for USA, UK, Japan, Asian NICs, etc., but now the industry is prevailing in the developing countries in Asia and Africa due to higher production cost (Masum, 2017).

[9] Demand is created in developed countries, but supply is coming from low–income, labour–abundant countries like Bangladesh. The demand–supply statistics shows that the consumers or buyers of TCI are from EU, US, Australia, Japan, Canada, etc., whereas, the sellers are mainly from China, India, Indonesia, Bangladesh, Viet Nam, among countries in Asia. And the nature of these sellers is different. These sellers are supplier of finished goods to middlemen. The branded retailers, also called middlemen, sell the clothing to the ultimate consumers and enjoy the lion share of profit. All branded retailers are from developed countries like Walmart, Tesco, Uniqlo, Zara, etc.

[10] Daewoo of Korea in a joint venture with Desh Garments Limited in 1977 made an investment in the TCI of Bangladesh, which also trained 130 Bangladeshi people in Korea. The journey was expedited by Young ones Bangladesh Limited in 1980, another Korean firm (Yunus and Yamagata, 2012). A total of 115 out of 130 initial workers trained in Korea left Daewoo to set up either new firms or joined newly set–up local firms (UNCTAD, 1999).

Bangladesh's TCI will not compete with low–cost manufacturers like China. That is why the investment was stagnant until 2005, and as a result, technological change was negative. However, phase-out of Multi–Fibre Agreement (MFA) and full implementation of WTO's multilateral trading system brought boon for the TCI of Bangladesh (Majmudar, 1996; Khan, 2004; Razzaque, 2005; Kelegama, 2005; Rahman, 2005; Chowdhury et al.,2006; Joarder et al.,2010; Alam, 2012; Rahman et al.,2012; Ahmed, 2013; Moazzem & Sehrin, 2016). Because of the increasing success of TCI after quota abolition, investors' confidence was increased manifold. Much investment, after 2005, was made in the TCI of Bangladesh. That is why positive technical changes are after that MFA phase-out in Bangladesh. The effect was minimal, up to 5%, because Bangladesh's TCI is a labor-intensive industry where labor contributes much to its existence[11]. In the early stage of the growth of the TCI, domestic demand contributed much. After independence, clothing was so scarce in Bangladesh that having only one additional dress was massive. The satisfaction of domestic demand was a challenging issue. The industry was domestic-oriented until 1990. Since 2000, the per capita income has started to grow in Bangladesh, which continues till today. Even in the early 20th century, the import of clothing has increased much to satisfy domestic demand (Masum, 2016).

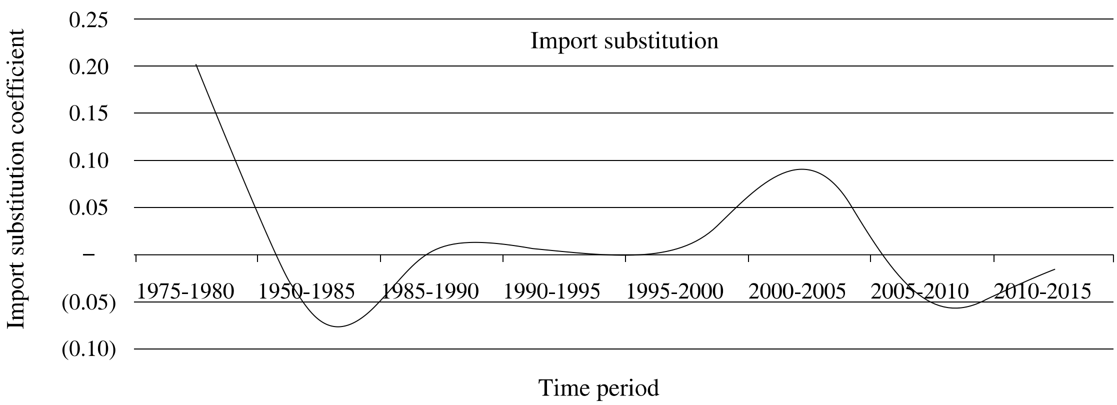

Figure 2 : Import substitution of the TCI.

Source: Authors' calculation based on equation

Bangladesh's trade policies and economic policies were never targeting the substitution of imported textile and clothing items. After the post-liberation period (1975-1980) in Bangladesh, there was no significant import substitution in the industry, as shown in Figure 2. We are still exporting clothing; simultaneously, we import textile and clothing items from the international market. So, our policy has not been designed to meet domestic demand through local generation. Instead, the objective was still to expand exports. The government of Bangladesh has declared the industry export-oriented from the beginning. The firm producing only for export will receive many incentives, including cash incentives, duty drawback, export order as a financing instrument, extra privileges to the shipment ports, and a bonded warehouse facility (Ahmed, 2009; Latifee & Kabir, 2015; Masum, 2016). These incentives and the low-cost labor force led to the growth of the TCI, prevailing in the industry still today. The problem that remains in the industry is that the laborer is low paid, which is the most important competitive factor (Bakht et al., 2006; Uddin, 2009; Mottaleb & Sonobe, 2011; Shahidul & Shazali, 2011; Taplin, 2014). In the TCI of Bangladesh, there is no such alternative to penetrate the low-cost labor. However, stakeholders should concentrate on the nourishment of labor. The well-being of the laborer is the well-being of the TCI.

Conclusion

We can conclude that the TCI of Bangladesh is the final demand-driven industry, not a technology-driven industry. We subdivided the final demand as domestic demand and export demand. Domestic demand played growth roles in the early stage, and export demand is still playing growth roles since 1990.

[11] There are five million workers are working in this industry, out of which 80% are women. So, TCI is also a women empowering industry.

The role of technology in the output growth of the TCI is minimal. The role of export is so intense in today's TCI industry of Bangladesh that if there is no export, the industry will die. In 2016, around 84% of total export earnings in Bangladesh were coming from TCI. Thus, national dependency on textile–clothing exports is much higher. The expansion of domestic demand can make the TCI more sustainable. So, it is also essential to concentrate on the domestic market. Although technology is essential for a modern production system, technology is not cost-effective in the TCI. If the low cost labor is available, the industry should rely more on labor than technology. The experience of technology application in the TCI is not favourable. Due to the unavailability of labor, developed countries replaced the labour-intensive production process with technology, which led to the loss of market competitiveness in the international consumer market. This competitive weakness forces the developed countries to relocate production process to labor abundant countries. This paper's findings and results of the related previous studies suggest not applying technology in the low value-added part (CMT) of the TCI production. Technology may be appropriate for higher value-added production stages like own design, manufacturing, or own-brand manufacturing.

References

Ahmad, M. (2007) *Impact of Origin Rules for Textiles and Clothing on Developing Countries*. International Centre for Trade and Sustainable Development (ICTSD).https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.550.7619&rep=rep1&type=pdf

Ahmed, N. (2009) 'Sustaining ready-made garment exports from Bangladesh,'*Journal of Contemporary Asia*,Vol. 39, No. 4, pp. 597–618.

Ahmed, R. (2013) 'An analysis of the change and volatility in Bangladesh's apparel industry after MFA era,'*Journal of Textile and Apparel Technology and Management*,Vol. 8, No. 1, pp.1-11.

Samsul, A.M., 2012. The garment industry's competitive factors during the post-multi-fiber arrangement (MFA) period: Empirical evidence from Bangladesh. Ritsumeikan Asia Pacific University. Available at: http://r-cube.ritsumei.ac.jp/bitstream/10367/4725/1/51210605.pdf.

Ali, M. and Habib, D. M. (2012) 'Supply chain management of textile industry: A case study in Bangladesh,'*International Journal of Supply chain Management*, Vol.1, No.2, pp. 35-40.

Bakht, Z., Salimullah, M., Yamagata, T. and Yunus, M., 2006. Competitiveness of a labor-intensive industry in the least developed country: A case of the knitwear industry in Bangladesh. *Mimeographed, Chiba, Japan: Institute of Developing Economies.*

Barker, T. (1990) 'Sources of structural change for the UK service industries 1979–84', *Economic Systems Research*, Vol. 2, No. 2, pp. 173–184.

Bhattacharya, D., Rahman, M., and Raihan, A. (2002) 'Contribution of the RMG sector to the Bangladesh economy,'*CPD Occasional Paper Series*, Vol. 50, No. 6, pp. 150-170.

Blair, P.D. and Wyckoff, A.W., 1989. The changing structure of the US economy: an input-output analysis. *Frontiers of input-output analysis*, pp.293-307.

Bow, J.J., 2001. *Bangladesh's Export-apparel Industry: Into the 21st century: the Next Challenges*. Asia Foundation.https://www.worldcat.org/title/bangladeshs-export-apparel-industry-into-the-21st-century-the-next-challenges/oclc/57391819

Buccellato, C., 1990. Input-Output Analysis, Technological Change, and Relations between Industry and Services. *Economic Systems Research*, Vol. 2, No. 1, pp.53-63.

Carter, A.P., 2013. *Structural change in the American economy*. Harvard University Press.https://www.hup.harvard.edu/catalog.php?isbn=9780674493629

Chenery, H.B., Shishido, S. and Watanabe, T., 1962. The pattern of Japanese growth, 1914-1954. *Econometrica: Journal of the Econometric Society*, Vol. 30, No.1, pp.98-139.

Chowdhury, M.A.M., Ali, M.M. and Rahman, R., 2006. WTO, post-MFA era and the Bangladesh RMG sector: An assessment of performance and challenges. *South Asian Journal of Management*, Vol.13, No. 1, pp.76-90.

Clemons, E.K., 1986. Information systems for sustainable competitive advantage. *Information & Management*, Vol.11, No. 3, pp.131-136.

Crafts, N., 2009. Solow and growth accounting: A perspective from quantitative economic history. *History of Political Economy*, Vol. 41, No.1, pp.200-220.

Denison, E.F., 2010. *Accounting for slower economic growth: the United States in the 1970s*. Brookings Institution Press.Massachusetts Avenue, NW,Washington, DC 20036https://academic.oup.com/ej/article/91/364/1044/5219933

Dewhurst, J.H.L., 1993. Decomposition of changes in input-output tables. *Economic Systems Research*, Vol. 5, No. 1, pp.41-54.

Dietzenbacher, E. and Los, B., 1998. Structural decomposition techniques: sense and sensitivity. *Economic Systems Research*, Vol.10, No. 4, pp.307-324.

Bureau, S. and Center, S., 2005. Input-output tables for Japan. *http://www. Stat. go. jp/data/io/index.*

Dowlah, C.A.F., 1999. The Future of the Readymade Clothing Industry of Bangladesh in the Post- Uruguay Round World. *World Economy*, Vol. *22, No.* 7, pp.933-953.

Elson, D., 1994. Uneven development and the textiles and clothing industry. *Capitalism and development*, Vol. 12, No. 2, pp.189-210.

Feldman, S.J., McClain, D. and Palmer, K., 1987. Sources of structural change in the United States, 1963-78: an input-output perspective. *The Review of Economics and Statistics*, Vol.69, No.3, pp.503-510.

Fernández-Stark, K., Frederick, S. and Gereffi, G., 2011. The apparel global value chain. Duke Center on Globalization. *Governance and competitiveness*, p.13.

Frank Jr, C.R., Kim, K.S. and Westphal, L.E., 1975. Exports and the Growth and Structure of the Economy. In *Foreign Trade Regimes and Economic Development: South Korea* (pp. 77-100). NBER.

Goedhuys, M., Janz, N. and Mohnen, P., 2014. Knowledge-based productivity in "low-tech" industries: evidence from firms in developing countries. *Industrial and Corporate Change*, Vol.23, No.1, pp.1-23.

Guilhoto, J.J., Hewings, G.J., Sonis, M. and Guo, J., 2001. Economic structural change over time: Brazil and the United States compared. *Journal of Policy Modeling*, Vol. 23, No. 6, pp.703-711.

Ives, B. and Learmonth, G.P., 1984. The information system is a competitive weapon. *Communications of the ACM*, Vol. 27, No. 12, pp.1193-1201.

Jaforullah, M., 1999. Production technology, the elasticity of substitution, and technical efficiency of the handloom textile industry of Bangladesh. *Applied Economics*, Vol.31, No. 4, pp.437-442.

Joarder, M.A.M., Hossain, A.K.M. and Hakim, M.M., 2010. Post-MFA performance of Bangladesh apparel sector. *International Review of Business Research Papers*, Vol.6, No. 4, pp.134-144.

Kabeer, N. and Mahmud, S., 2004. Rags, riches and women workers: export-oriented garment manufacturing in Bangladesh. *Chains of fortune: Linking women producers and workers with global markets*, pp.133-164.

Kelegama, S. ed., 2005. *South Asia After the Quota System, Impact of the MFA Phase-out*. Institute of Policy Studies.Srilanka.

Kendrick, J.W., 1973. Frontmatter, Postwar Productivity Trends in the United States, 1948–1969. In *Postwar Productivity Trends in the United States, 1948–1969* (pp. 24-40). NBER.

Khan, S., 2004. Textile and Clothing Sector in Bangladesh: Post MFA Challenges and Action Plan. *Dhaka: Ministry of Commerce*.

Leontief, W., 1936. Quantitative Input-output Relations in The Economic System of The United States. *Review of Economy and Statistics*, Vol.18, No. 3, pp.105-125.

Leontief, W.W., 1941. The Structure of the American Economy, 1919–1929 Harvard University Press. *Cambridge (new, enlarged edition, Oxford University Press, New York, 1951)*.

Leontief, W.W., 1951. *The American economy structure, 1919-1939: an empirical application of equilibrium analysis* (No. HC106. 3 L3945 1951).

Magacho, G., McCombie, J. and Guilhoto, J., 2018. Impacts of trade liberalization on countries' sectoral structure of production and trade: A structural decomposition analysis. *Structural Change and Economic Dynamics*, Vol.46, No. C, pp.70-77.

Majmudar, M. (1996) 'Trade Liberalization in Clothing: the MFA Phase- Out and the Developing Countries, *Development Policy Review*, Vol.14, No. 1, pp. 5–36.

Masum, M. (2016) 'The Bangladesh Textile-Clothing Industry: A Demand-Supply Review,'*Social System Studies*, Vol. 33, No. 5, pp. 109–139.

Masum, M. (2017) 'Demand-Supply Direction of the Textile-Clothing Industry of Asian Newly Industrialized Economy South Korea and Bangladesh,'*The Ritsumeikan Economic Review*, Vol. 65, No. 4, pp. 691–735.

Masum, M. and Inaba, K., 2015. A comparative input-output analysis of the textile-clothing industry in Bangladesh and some Asian countries. In *10th RICA Conference, Bangkok, Thailand*. pp. 101–116.

Masum, M. and Inaba, K. (2018) 'A role of textile-clothing industry in Bangladesh's economic structure: An input-output analysis,'*The Ritsumeikan Economic Review*, Vol. 67, No.3, pp. 1–20.

Masum, M. and Islam, M. M. (2014) 'Analyzing job security of lower and lower-middle-class employees of textile sector of Bangladesh,'*Journal of Textile Science and Engineering*, Vol. 1, No.1, p. 27—34.

McFarlane, F.W., 1984. *Information technology changes the way you compete* (pp. 98-103). Harvard Business Review, Reprint Service.

Miah, M.S., 2012. Cost-effective treatment technology on textile industrial wastewater in Bangladesh. *Journal of Chemical Engineering*, Vol. 27, No. 1, pp.32-36.

Miller, R.E. and Blair, P.D., 2009. *Input-output analysis: foundations and extensions*. Cambridge university press. London.

Moazzem, K. G. and Sehrin, F. (2016) 'Economic Upgrading in Bangladesh's Apparel Value Chain during the Post-MFA Period: An Exploratory Analysis,'*South Asia Economic Journal*, Vol. 17, No. 1, pp. 73–93.

Mottaleb, K. A. and Sonobe, T. (2011) 'An inquiry into the garment industry's rapid growth in Bangladesh,' Economic Development and Cultural Change, Vol. 60, No. 1, pp 67–89.

Muhammad, A., 2011. Wealth and deprivation: Ready-made garments industry in Bangladesh. *Economic and Political Weekly*,Vol.46, No.34, pp.23-27.

Parsons, G.L., 1983. Information technology: a new competitive weapon. *Sloan Management Review (pre-1986)*, Vol. 25, No. 1, pp.3-20.

Pei, J., Dietzenbacher, E., Oosterhaven, J. and Yang, C., 2011. Accounting for China's import growth: A structural decomposition for 1997–2005. *Environment and Planning A*, Vol. 43, No. 12, pp.2971-2991.

Porter, M.E. and Millar, V.E., 1985. How information gives you a competitive advantage.Harvard Business Review. 60 Harvard Way Boston, MA 02163 USA.

Quddus, M. and Rashid, S., 2000. *Entrepreneurs and Economic Development: the remarkable story of garment exports from Bangladesh*. University Press.Dhaka, Bangladesh.

Rahman, M., 2005. Bangladesh after MFA phases out. *South Asian Journal*, Vol. *8, No.* (April–June), pp.124-134.

Rahman, M., Bhattacharya, D., and Moazzem, K.G., 2012. *Bangladeshâ€™ s Apparel Sector in Post-MFA Period: A Benchmarking Study on the Ongoing Restructuring Process* (No. 23152).

Rahman, M. H., and Siddiqui, S. A. (2015) 'Female RMG worker: economic contribution in Bangladesh,'*International Journal of Scientific and Research Publications*. Citeseer, Vol. 5, No. 9, pp. 1–9.

Rahman, S. (2004) 'Global shift: Bangladesh garment industry in perspective,'*Asian Affairs*, Vol. 26, No.1, pp. 75–91.

Razzaque, A., 2005. Sustaining RMG export growth after MFA phase-out: An analysis of relevant issues concerning trade and human development. *UNDP, Bangladesh*.

Rhee, Y.W., 1990. The catalyst model of development: Lessons from Bangladesh's success with garment exports. *World Development*, Vol.*18, No.* 2, pp.333-346.

Rock, M., 2001. Globalization and Bangladesh: The case of export- oriented garment manufacture. *South Asia: Journal of South Asian Studies*, Vol. 24.No. 1, pp.201-225.

Rock, M. (2003) 'Labour conditions in the export-oriented garment industry in Bangladesh,'*South Asia: Journal of South Asian Studies*, Vol. 26, No. 3, pp. 391–407.

Rose, A. and Casler, S. (1996) 'Input-output structural decomposition analysis: a critical appraisal,' *Economic Systems Research*, Vol. 8, No.1, pp. 33–62.

Samad, Q. A., and Patwary, F. K. (2003) 'Technical efficiency in the textile industry of Bangladesh: an application of frontier production function,' *International journal of information and management sciences*, Vol.14, No. 1, pp. 19–30.

Shahidul, M. I. and Syed Shazali, S. T. (2011) 'Dynamics of manufacturing productivity: lesson learned from labor-intensive industries,' *Journal of Manufacturing Technology Management*, Vol. 22, No. 5, pp. 664–678.

Siddiqi, H. G. A. (2004) *The Ready-made garment industry of Bangladesh*. University Press Limited. Dhaka, Bangladesh.

Siegel, P. B., Alwang, J. and Johnson, T. G. (1995) 'A structural decomposition of regional economic instability: a conceptual framework,' *Journal of Regional Science*, Vol. 35, No. 3, pp. 457–470.

Skolka, J. (1989) 'Input-output structural decomposition analysis for Austria', *Journal of Policy Modeling*, Vol. 11, No.1, pp. 45–66.

Solow, R.M., 1970. Growth theory. An exposition. In *Growth theory. An exposition*. Oxford: Clarendon Press.

Sonobe, T., Mottaleb, K.A. and Amin, M.N., 2018. The Miraculous Development of the Garment and Pharmaceutical Industries in Bangladesh. In *Economic and Social Development of Bangladesh* (pp. 27-51). Palgrave Macmillan, Cham.

Spinanger, D. (2001) *The WTO, ATC and textiles and clothing from a global perspective: What is in it for Bangladesh?* Centre for Policy Dialogue (CPD).

Sterner, T. (1985) 'Structural change and technology choice: energy use in the Mexican manufacturing industry, 1970–1981', *Energy Economics*, Vol. 7, No.2, pp. 77–86.

Taplin, M. I. (2014) 'Who is to blame? A re-examination of fast fashion after the 2013 factory disaster in Bangladesh', *critical perspectives on international business*, Vol.10, No.1/2, pp. 72–83.

Temurshoev, U., Miller, R. E. and Bouwmeester, M. C. (2013) 'A note on the GRAS method', *Economic Systems Research*, Vol. 25, No. 3, pp. 361–367.

Uddin, G.S., 2008. Wage productivity and wage income differential in the labor market: evidence from RMG sector in Bangladesh. *Asian Social Science*, Vol. *4*, No. 12, pp.92-101.

Uddin, M. S., and Jahed, M. A. (2007) 'Garments industry: a prime mover in the socio-economic development of Bangladesh,' *The Cost and Management*, Vol.35, No. 1, pp. 59–70.

United Nations Conference on Trade and Development (Geneva), 1999. World Investment Report: Foreign Direct Investment and the Challenge of Development. 1999. UN.https://unctad.org/system/files/official-document/wir2010_presentation_en.pdf

Urata, S. (1988) 'Economic growth and structural change in the Soviet economy, 1959-72', *M. Ciaschini (comp.), input-output analysis. Current Developments, Londres y Nueva York, Chapmand and Hall*.

Yamagata, T. (2006) 'Two dynamic LDCs: Cambodia and Bangladesh as garment exporters', *Economic Review*, Vol. 3, No.3, pp. 8–12.

Yang, Y. and Mlachila, M. (2007) 'The end of textile quotas: A case study of the impact on Bangladesh,' *The Journal of Development Studies*, Vol. 43, No.4, pp. 675–699.

Yunus, M. and Yamagata, T. (2012) 'The garment industry in Bangladesh,' in Fukunishi, T. (ed.) *Dynamics of the Garment Industry in Low-Income Countries: Experience of Asia and Africa.* Tokyo: IDE-JETRO.