Analysis of Technical Efficiency and Total Factor Productivity of the Indian Textile Industry using Hicks-Moorsteen and Fare-Primont Productivity Indices

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Abstract: *This paper examines the change in technical efficiency and total factor productivity of the Indian textile industry at the firm level for the period 2005 to 2016, covering the post-Multi Fibre Agreement (MFA) regime. The study draws on data from the Centre for Monitoring Indian Economy (CMIE) Prowess database for 30 selected companies and for the industry as a whole. Two productivity indices, namely the Hicks-Moorsteen index and the Fare-Primont index, are employed to evaluate the technical efficiency and total factor productivity of the industry. The findings reveal mixed results in terms of input-oriented technical efficiency (ITE) and total factor productivity (TFP) over the study period. While some of the selected firms recorded an improvement in TFP and ITE, others experienced a decline in TFP. The study also estimates TFP and ITE for the industry as a whole, and the results indicate an improvement in TFP but no change in the level of ITE throughout the study period.*

Keywords: Total factor productivity, technical efficiency, textile industry, productivity indices

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Introduction

The textile industry, being labour-intensive and requiring a relatively low level of investment, holds great significance for the development of developing countries such as India. It has been an important industry within India's manufacturing sector, serving basic human needs by providing cloth to the masses and raw materials to other industries. Owing to its labour-intensive nature, the industry has been a major source of employment generation, offering entry-level opportunities to the unskilled labour force in developing countries. It also allows developing countries to adopt modern technology at relatively low investment costs compared with developed countries. This feature provides a basis for industrialization in developing countries, particularly in Asia, some of which have experienced high output growth rates in this sub-sector (Nordas, 2004). The textile industry has also been considered instrumental in initiating the process of industrialization in many developing countries. It has been identified as a vehicle for transformation under strategic industrial policies of export promotion and import substitution. It has the potential to invigorate a stagnant industrial environment in developing countries if resources are properly utilized, and it offers these countries a comparative advantage in benefiting from growing global trade (UNCTAD, 2004).

Historically, the textile industry has been one of the most important industries for India's overall economic development, a significance reflected in its contribution to national income, industrial output, employment generation, and foreign exchange earnings. The industry has been subject to various trade restrictions over time, particularly after 1960, the most notable of which was the Multi-Fibre Agreement (MFA), which regulated trade in the industry from 1974 onwards. Under the MFA, developed countries benefited from a system of quotas that restricted textile and clothing exports from developing countries: no country was permitted to export beyond the quota assigned to it, which gave developed countries a competitive edge by protecting their domestic textile industries. The MFA effectively exempted trade in textiles and clothing from the discipline of the General Agreement on Tariffs and Trade (GATT). A significant development in the Indian textile trade occurred in 2005 with the removal of the MFA, following the decision taken during the Uruguay Round of trade negotiations to phase it out through the Agreement on Textiles and Clothing (ATC). The ATC provided for the elimination of quotas in four stages over a transitional period that ended in 2005. Thereafter, from 1 January 2005 onwards, trade in textiles and clothing became quota-free and fully integrated into the GATT system.

Following the implementation of the ATC, India was widely expected to be one of the biggest beneficiaries of the global textile and clothing trade. However, apart from a few initial years, India was unable to fully capitalize on the changed trade landscape. Although the Indian industry possessed certain advantages, including a strong production base, the ability to meet high-value orders, and relatively better designer resources than its competitors, these competitive strengths could not offset the industry's various weaknesses. Among other factors, technological backwardness across almost all segments of the industry has been a major reason it has lagged far behind its main global competitors. Despite India being one of the largest producers of cotton yarn and fabrics, the productivity of its cotton industry remains extremely low compared with its competitors. Following the removal of quotas and the onset of liberalization, the Indian unorganized sector has faced stiff competition from the domestic power-loom sector, mill-made fabrics, and cheap imports (Kothari & Gupta, 2009). In this changed trade scenario, the survival of India's textile industry depends, to a considerable extent, on its ability to strengthen its overall competitiveness in the international market by improving productivity and efficiency. Against this backdrop, the present study aims to evaluate the levels of technical efficiency and productivity of the Indian textile industry for the period 2005 to 2016, that is, the post-quota period.

Review of Literature

A considerable body of research has examined the technical efficiency and productivity of the Indian manufacturing sector, with most studies focusing on the organized manufacturing sector. The present review, by contrast, focuses primarily on studies of the impact of liberalization on efficiency and productivity in the textile industry. The empirical literature offers conflicting evidence on the relationship between trade liberalization and productivity. It is generally argued that liberalizing trade by removing barriers leads to improved efficiency, as firms are compelled to adjust to changing market conditions. This hypothesis rests on the argument that the expansion of output creates economies of scale, encourages specialization in production, and fosters an environment favourable to innovation, all of which contribute to higher levels of growth, efficiency, and productivity. In the Indian context, studies by Das (1998), Krishna and Mitra (1998), and Unel (2003) have found a positive relationship between trade liberalization and the efficiency and productivity of the manufacturing sector. By contrast, studies by Trivedi et al. (2000), Balakrishnan et al. (2000), Goldar (2002), Goldar and Kumari (2003), Goldar (2004), and Prakash (2006) have found a decline in the growth rate of total factor productivity in Indian industries during the post-reform period.

Subramanian (1992) analysed the change in total productivity of the textile industry in Tamil Nadu during 1975-76 to 1985-86 and found a decline in the productivity of both capital and labour over the study period. The decline in capital productivity was attributed to reduced capacity utilization stemming from workers' strikes and severe power shortages, while the overall decline in the total factor productivity index was attributed to frequent workers' strikes, which caused heavy losses in man-days, power cuts, and the rising cost of raw cotton, labour, and electricity inputs. Hashim (2004) analysed the competitiveness of the Indian textile industry in terms of unit cost and productivity during 1989-97 and found an inverse relationship between the two, that is, companies with higher productivity levels experienced lower unit costs of production. Sarma and Reddy (2006) analysed productivity growth across 14 major states and the Indian textile industry as a whole for the pre- and post-liberalization periods. Their Divisia total factor productivity index revealed that most states exhibited lower TFP growth in the pre-liberalization period and negative TFP growth in the post-reform period; the study also found that the coefficient of relative concentration was a significant determinant of productivity across states. Jajri and Ismail (2006) evaluated the levels of technical efficiency, technological change, and TFP growth in the Malaysian manufacturing sector using Data Envelopment Analysis (DEA), based on data from the Industrial Manufacturing Survey (1985-2000) collected by the Department of Statistics, Malaysia. Their results showed an increasing trend in TFP growth over the study period, driven largely by technical efficiency change, alongside a rising trend in technological change. Chemical, food, wood, and iron products emerged as the industries with the highest technical efficiency scores, while the textile industry, though it exhibited greater technical progress than technical efficiency, recorded values below unity for both measures.

Bhandari and Ray (2007) examined technical efficiency in the Indian textile industry at the firm level using nonparametric analysis for the period 1985-86 to 2001-02. The study found that firms in West Bengal performed at higher average levels of technical efficiency, relative to both their state frontier and a grand frontier applicable to firms across all states, and that significant technological differences existed across states. However, firms in states with more productive technologies often operated at low efficiency, as evidenced by Gujarat in 1990-91, while there was some evidence that states with less productive technologies were gradually catching up with the national benchmark. The study also found that private-sector firms were both more efficient and technologically superior to their public-sector counterparts, and that technical efficiency tended to increase with firm size.

Joshi and Singh (2010) analysed the change in total factor productivity (TFP) among Indian garment-producing companies during 2002-2007 to identify its determinants and to suggest measures for firms to improve their productivity levels. The study found that the Indian garment industry achieved a moderate average TFP growth rate of 1.7 per cent per annum over the study period, with medium and large-scale companies found to be more productive than small-scale firms; productivity growth was attributed largely to technical efficiency change rather than technological change. Murugeshwari (2011) analysed the impact of liberalization on total factor productivity in the Indian textile industry and found that the industry recorded improvements in TFP and technological progress during the pre-liberalization period, suggesting that competition subsequently reduced both the productivity performance and the technological progress of the industry.

Saricam and Erdumlu (2012) examined the efficiency of textile and apparel companies using an input-oriented DEA model under the variable returns-to-scale assumption. Textile and apparel companies listed on the Istanbul Stock Exchange between 2003 and 2008 were evaluated for efficiency, providing a framework for calculating input excesses and output shortfalls. The analysis revealed that the average efficiency score of the apparel industry was higher than those of both the textile industry and the two industries combined, suggesting that apparel companies need to increase export levels, whereas textile companies need to increase gross value added to become more efficient.

Pal and Soriya (2012) analysed the association between intellectual capital efficiency and financial performance for 105 pharmaceutical companies and 102 textile companies drawn from the CMIE Prowess database. Their results indicated a positive association between profitability and intellectual capital, but no significant relationship between intellectual capital and either productivity or market valuation.

The studies reviewed above shed light on changes in the productivity of the textile industry at both the firm and industry levels. However, none has attempted to analyse the impact of liberalization on the technical efficiency and productivity of the Indian textile industry over the entire period following the Agreement on Textiles and Clothing (ATC). Against this background, the present study analyses the levels of technical efficiency and total factor productivity of the Indian textile industry. The remainder of the paper is organized as follows: Section III presents the research questions, Section IV the objectives of the study, Section V the significance of the study, Section VI the methodology and data, Section VII the empirical analysis, and Section VIII the conclusion.

Research Questions

- The study aims to analyse the technical efficiency and total factor productivity of the Indian textile industry in light of the following research questions:
- How can the levels of technical efficiency and TFP of Indian textile firms be measured?
- What is the current level of TFP and competitiveness of firms in the industry?
- What are the factors that determine the efficiency and productivity of firms in the textile industry?
- What measures can be undertaken to improve the technical efficiency and productivity of the industry?

Objectives of the Study

The study seeks to employ quantitative methods on secondary data to analyse the factors affecting the technical efficiency, total factor productivity, and competitiveness of the Indian textile industry. Building on this general objective, the study focuses on the following specific objectives.

- To assess the potential and strategic importance of the textile industry for the country's development
- To evaluate the trends and growth of the Indian textile industry
- To analyse the technical efficiency and total factor productivity of Indian textile firms

Significance of the Study

The goal of this study is to analyze firm-level technical efficiency and total factor productivity, both of which are crucial for strengthening competitiveness. An assessment of the industry's productivity levels can inform policy options that help the government adopt trade and industrial policies favourable to the development of the sub-sector, and can assist Indian textile producers in addressing the challenges and opportunities presented by trade liberalization. Further, the study aims to provide policymakers with critical insights into the prevailing situation of the industry, enabling them to take the necessary steps to address the operational and policy-related issues that have hindered the technical efficiency, productivity, and competitiveness of the textile industry.

Methodology and Data

The analysis of technical efficiency and total factor productivity has attracted considerable attention in the economic literature over the last few decades, in both developed and developing countries (Battese and Coelli, 1995; O'Donnell, 2012). Productivity growth is vital for firms seeking to survive and compete against newly emerging domestic firms as well as foreign multinationals from the developed world; by enhancing productivity, both the firm and the industry can sustain their competitiveness in the international market. Several productivity indices are available in the literature for computing total factor productivity (TFP), including the Tornqvist index, the Fisher index, the Fare-Primont index, the Hicks-Moorsteen index, and the Malmquist index, all of which have been extensively used in empirical research. However, both the Tornqvist and Fisher indices satisfy neither the transitivity nor the identity axioms, which renders them unsuitable for multilateral or multi-temporal comparisons (O'Donnell, 2012). The Malmquist productivity index, by contrast, is one of the standard approaches in the productivity literature and can be exhaustively decomposed, particularly in nonparametric specifications (Bjurek, 1996). More recently, two further indices, the Hicks-Moorsteen TFP index (Moorsteen, 1961; Bjurek, 1996) and the Fare-Primont index (O'Donnell, 2011), have been used to construct productivity indices. These indices are considered more reliable, as they can be decomposed into several components without requiring price data or restrictive assumptions concerning statistical noise. Accordingly, the present study employs both the Fare-Primont index and the Hicks-Moorsteen index to compute the change in TFP and to decompose this change into measures of technical change, technical efficiency change, and scale efficiency change for the Indian textile industry over the period 2005 to 2016.

Productivity Indices and Measurement of Productivity of Firms

The TFP change can be measured as changes in the ratio of aggregate output index to the aggregate input index. For constructing a ratio of an index of all outputs over all inputs, first we need to aggregate the inputs together and the output measures together. Suppose there is a dataset on N firms over T time periods and let $x_{\text{it}} = (x_{1\text{it}},\ldots,x_{\text{kit}})'$ and $\text{y}_{\text{it}} = (y_{1\text{it}},\ldots\ldots,y_{\text{kit}})'$ denote the input and output quantity vectors of firm i in period t. Then the TFP of the firm is,

$$TFP_{it} = \frac{Y_{it}}{X_{it}} \quad \text{...(6.1)}$$

Where, $Y_{it} = Y(y_{it})$ is an aggregate output, $X_{it} = X(x_{it})$ is an aggregate input and (.)Y and (.) X are non-negative, non-decreasing and linearly homogeneous aggregator functions. The associated index number that measures the TFP of firm i in period t relative to the TFP of firm j in period m is (O’Donnell, 2011),

$$TFP_{jm,it} = \frac{TFP_{it}}{TFP_{jm}} = \frac{Y_{it} / X_{it}}{Y_{jm} / X_{it}} = \frac{Y_{jm,it}}{X_{jm,it}} \quad \text{...(6.2)}$$

Where $Y_{jm,it} = Y_{it} / Y_{jm}$ and $X_{jm,it} = X_{it} / X_{jm}$ are output quantity index and input quantity index respectively. Thus, this equation shows that TFP growth can be expressed as a measure of output growth divided by a measure of input growth. This measure of relative productivity is said to be multiplicatively complete (O’Donnell, 2012).

Fare-Primont Productivity Index

The Fare-Primont index, proposed by O'Donnell (2012), is the only total factor productivity index that can be constructed from distance functions without violating the important transitivity and identity axioms of index theory. It also has the important property that it can be exhaustively decomposed into various measures of technical change and efficiency change without any residual effects. Moreover, it can be computed using quantity data alone, that is, price data are not required to compute the index. The present study uses the Fare-Primont index to compute and decompose total factor productivity into a measure of technical change and several measures of efficiency. The Fare-Primont index belongs to a class of "multiplicatively complete" productivity indexes that employs the following non-negative, non-decreasing, and linearly homogeneous aggregator function:

$$Y(y) = D_0(x_{it}, y, t_0)$$

$$X(x) = D_1(x, y_0, t_0)$$

Where $D_0(x_{it}, y, t_0)\ and\ D_1(x, y_0, t_0)$ are Shephard (1953) outputs and input distance functions representing the production technology available in period t, respectively. Then the Fare-Primont index takes the following form (O'Donnell, 2011):

$$TFP_{jm,it} = \frac{D_0(x_0, y_{it}, t_0)}{D_0(x_0, y_{jm}, t_0)} \frac{D_1(x_{jm}, y_0, t_0)}{D_1(x_{it}, y_0, t_0)} \qquad \text{... (6.3)}$$

Productivity growth (decline) is indicated by values smaller (larger) than unity. However, production technologies represented as Shephard output and input distance functions maintain following measures of efficiency,

Measures of Efficiency

Following O'Donnell (2012), this section defines several input-oriented measures of efficiency in terms of aggregate outputs and inputs. The efficiency measures that feature in an input-oriented decomposition of TFP change are as follows:

$$TFPE_{it} = \frac{TFP_{it}}{TFP^*_t} \leq 1 \qquad \text{(TFP efficiency)}$$

$$ITE_{it} = \frac{Y_{it} / X_{it}}{Y_{it} / \bar{X}_{it}} = \frac{\bar{X}_{it}}{X_{it}} = D_1(x_{it}, y_{it}, t)^{-1} \leq 1 \qquad \text{(Input Oriented Technical Efficiency)}$$

$$\text{ISE}_{it} = \frac{Y_{it} / \bar{X}_{it}}{Y_{it} / X_{it}} \leq 1 \qquad \text{(Input Oriented Scale Efficiency)}$$

Where, $Y_{it}\ and\ X_{it}$ are the aggregate output and input quantities and $\bar{X}_{it}$ is the maximum aggregate input quantities that is technically feasible to produce a scalar multiple of y_{it} using x_{it}. Technical change measures the movements in the production frontier; technical efficiency change tells about movements towards or away from the frontier; and the scale efficiency change measures the movements around the frontier surface to capture economies of scale.

Hicks-Moorsteen Productivity Index

The Hicks-Moorsteen TFP index is a multiplicatively complete index that can be computed without price data, defined as the ratio of the Malmquist output and input quantity indexes. Its advantage over the more popular Malmquist productivity index is that it is free from any assumptions concerning firms' optimizing behaviour, market structure, or returns to scale. It is, however, fair to say that it is less widely used in applied research than the Malmquist productivity index, having been introduced partly to avoid the latter's indeterminacy problem. A Hicks-Moorsteen (or Malmquist TFP) productivity index for the base period t is defined as the ratio of a Malmquist output quantity index and a Malmquist input quantity index, both evaluated at the base period t, as follows:

$$HM_{T(t)}\{(x^t, y^t),(x^{t+1}, y^{t+1})\} = \frac{E^O{}_{T(t)}(x^t, y^t) / E^O{}_{T(t)}(x^t, y^{t+1})}{E^I{}_{T(t)}(x^t, y^t) / E^I{}_{T(t)}(x^{t+1}, y^t)} \quad ....(6.4)$$

Where $E^O{}_{T(t)}$ and $E^I{}_{T(t)}$ refer to the output and input oriented Farrell measures of efficiency respectively. Clearly $y^t < y^{t+1}$ entails $E^O{}_{T(t)}(x^t, y^t) > E^O{}_{T(t)}(x^t, y^{t+1})$ and thus numerator in the above equation becomes greater than unity. Likewise $x^{t+1} < x^t$ makes $E^I{}_{T(t)}(x^t, y^t) > E^I{}_{T(t)}(x^{t+1}, y^t)$ and thus the denominator in the above equation become lesser than unity. In other words, when the Malmquist output quantity index (ratio in numerator) is greater (smaller) than unity, then more(less) outputs were produced in period t+1 than in period t from a given level of inputs. Similarly, when the Malmquist input quantity index (ratio in denominator) is larger (smaller) than unity, then less (more) inputs were needed in period t+1 than in period t to produce a given level of output. When the Hicks-Moorsteen productivity index is larger (smaller) than unity, then it indicates productivity gain (loss).

Similarly, for a base period t+1, the Hicks-Moorsteen productivity index is defined as follows:

$$HM_{T(t+1)}\{(x^t, y^t),(x^{t+1}, y^{t+1})\} = \frac{E^O{}_{T(t+1)}(x^{t+1}, y^t) / E^O{}_{T(t+1)}(x^{t+1}, y^{t+1})}{E^I{}_{T(t+1)}(x^t, y^{t+1}) / E^I{}_{T(t+1)}(x^{t+1}, y^{t+1})} \quad .... (6.5)$$

The interpretation of this equation is similar to that given above.

Data and Input-Output Specifications for the Productivity Analysis

To compute the productivity of Indian textile firms, the necessary data were obtained from CMIE for the period 2005 to 2016. The study conceptualizes a single-output, four-input production technology. The output considered in the model is total income, while the inputs are labour (measured as wages and salaries paid to workers), material inputs (measured as companies' expenditure on raw materials), energy (measured as expenditure on power and fuel), and capital (measured as the book value of plant, machinery, and buildings).

Empirical Analysis

Analysis of Results of Hicks-Moorsteen Productivity Index

Table 1 presents the results of the Hicks-Moorsteen index for the total factor productivity (TFP) and input-oriented technical efficiency (ITE) of the selected firms in the Indian textile industry for the years 2005, 2010, and 2016. Although TFP and ITE were calculated for each year from 2005 to 2016, only the results for these three years are reported here owing to space constraints. The results of the Hicks-Moorsteen index show that all selected firms exhibited an improvement in TFP and ITE over the period 2005 to 2016, with the exception of CLC Industries Ltd, which recorded a decline in both measures, from a score of 1 to 0.7 (TFP) and 0.8 (ITE) respectively. Among all the selected companies, Sintex Industries Ltd emerged as the best performer in terms of TFP and ITE, with values rising from 0.29 and 0.54, respectively, in 2005 to 1.67 and 1.00 in 2016.

Table 1: Results of Hicks-Moorsteen Productivity Index

Companies Name/Years	2005			2010			2016		
	TFP	TFPE	ITE	TFP	TFPE	ITE	TFP	TFPE	ITE
A Y M Syntex Ltd.	0.35	0.59	0.59	0.89	0.72	0.89	0.90	0.84	0.91
Alok Industries Ltd.	0.38	0.61	0.61	0.30	0.49	0.75	0.70	0.25	0.64
Arvind Ltd.	0.20	0.45	0.45	0.50	0.60	0.67	0.56	0.36	0.73
Bombay Dyeing & Mfg. Co. Ltd.	0.42	0.65	0.65	0.60	0.75	0.90	0.63	0.28	0.65
C L C Industries Ltd.	1.00	1.00	1.00	0.51	0.64	0.71	0.70	0.75	0.80
Century Enka Ltd.	0.33	0.57	0.57	0.68	0.64	0.78	0.77	0.53	0.94
Eastern Silk Inds. Ltd.	1.00	1.00	1.00	1.40	0.80	1.00	1.06	0.51	1.00
Eskay K'N'It (India) Ltd.	1.00	1.00	1.00	1.13	0.90	1.00	1.24	0.40	0.69
Ester Industries Ltd.	0.30	0.55	0.55	0.85	0.75	0.85	0.74	0.72	0.83
Garden Silk Mills Pvt. Ltd.	0.34	0.58	0.58	0.90	0.88	1.00	0.74	0.77	0.83
Gokaldas Exports Ltd.	1.00	1.00	1.00	1.05	0.98	1.00	1.07	0.72	1.00
Grasim Industries Ltd.	0.41	0.64	0.64	0.95	0.99	1.00	0.55	0.28	0.72
Hooghly Mills Co. Ltd.	0.39	0.62	0.62	0.65	0.63	0.70	0.98	0.68	1.00
Indian Acrylics Ltd.	0.56	0.75	0.75	1.06	0.80	1.00	1.00	0.83	0.96

Indo Rama Synthetics (India) Ltd.	0.77	0.88	0.88	0.86	0.82	0.91	0.93	0.84	0.93
J C T Ltd.	0.34	0.58	0.58	0.47	0.63	0.69	0.75	0.82	0.89
Jindal Poly Films Ltd.	0.67	0.82	0.82	0.93	0.91	1.00	1.15	0.66	1.00
Loyal Textile Mills Ltd.	0.20	0.45	0.45	0.57	0.71	0.76	1.02	0.48	1.00
Malwa Cotton Spg. Mills Ltd.	0.25	0.50	0.50	0.59	0.65	0.72	0.27	0.19	0.33
Nahar Industrial Enterprises Ltd.	0.16	0.40	0.40	0.39	0.55	0.61	0.48	0.66	0.73
Nahar Spinning Mills Ltd.	0.16	0.40	0.40	0.46	0.58	0.65	0.49	0.34	0.73
Pasupati Acrylon Ltd.	0.64	0.80	0.80	0.99	0.77	1.00	1.09	0.99	1.00
R S W M Ltd.	0.32	0.57	0.57	0.56	0.68	0.75	0.69	0.78	0.84
S Kumars Nationwide Ltd.	0.40	0.63	0.63	1.11	0.93	1.00	0.18	0.15	0.41
Sangam (India) Ltd.	0.24	0.49	0.49	0.43	0.60	0.65	0.62	0.75	0.80
Sintex Industries Ltd.	0.29	0.54	0.54	0.31	0.51	0.57	1.67	0.49	1.00
Siyaram Silk Mills Ltd.	0.88	0.94	0.94	1.04	0.93	1.00	1.06	0.52	1.00
Trident Ltd.	0.18	0.42	0.42	0.43	0.64	0.68	0.47	0.33	0.62
Vardhman Textiles Ltd.	0.22	0.47	0.47	0.38	0.55	0.61	0.61	0.37	0.79
Welspun Living Ltd.	0.23	0.48	0.48	0.44	0.58	0.68	0.68	0.40	0.84

Source: Authors' own calculations.

Analysis of Results of Fare-Primont Productivity Index

Table 2 presents the results of the Fare-Primont index for total factor productivity (TFP) and input-oriented technical efficiency (ITE) of the selected firms in the Indian textile industry for 2005, 2010, and 2016. As with the Hicks-Moorsteen index discussed in the previous section, TFP and ITE were calculated for each year from 2005 to 2016, but only the results for these three years are reported here owing to space constraints. The results of the Fare-Primont index reveal a mixed pattern, with some firms exhibiting an improvement in both TFP and ITE over the period 2005 to 2016; for example, A Y M Syntex Ltd recorded an increase in TFP and ITE from 0.17 and 0.59, respectively, in 2005 to 0.19 and 0.91 in 2016. By contrast, firms such as Arvind Ltd, Century Enka Ltd, and Eastern Silk Inds. Ltd recorded a decline in TFP alongside an improvement in ITE over the same period.

Table 2: Results of Fare-Primont Productivity Index

Companies name /Years	2005			2010			2016		
	TFP	TFPE	ITE	TFP	TFPE	ITE	TFP	TFPE	ITE
A Y M Syntex Ltd.	0.17	0.46	0.59	0.15	0.47	0.89	0.19	0.58	0.91
Alok Industries Ltd.	0.17	0.46	0.61	0.13	0.39	0.75	0.13	0.39	0.64
Arvind Ltd.	0.12	0.32	0.45	0.14	0.41	0.67	0.15	0.44	0.73
Bombay Dyeing & Mfg. Co. Ltd.	0.16	0.42	0.65	0.21	0.65	0.90	0.16	0.47	0.65
C L C Industries Ltd.	0.38	1.00	1.00	0.14	0.43	0.71	0.12	0.37	0.80
Century Enka Ltd.	0.17	0.46	0.57	0.13	0.40	0.78	0.13	0.37	0.94
Eastern Silk Inds. Ltd.	0.36	0.93	1.00	0.32	0.99	1.00	0.17	0.50	1.00
Eskay K'N'It (India) Ltd.	0.18	0.48	1.00	0.15	0.46	1.00	0.17	0.51	0.69
Ester Industries Ltd.	0.18	0.48	0.55	0.19	0.57	0.85	0.16	0.47	0.83
Garden Silk Mills Pvt. Ltd.	0.20	0.51	0.58	0.17	0.52	1.00	0.16	0.48	0.83
Gokaldas Exports Ltd.	0.33	0.86	1.00	0.30	0.92	1.00	0.34	1.00	1.00
Grasim Industries Ltd.	0.12	0.31	0.64	0.14	0.42	1.00	0.10	0.31	0.72
Hooghly Mills Co. Ltd.	0.16	0.43	0.62	0.19	0.58	0.70	0.20	0.60	1.00
Indian Acrylics Ltd.	0.15	0.40	0.75	0.14	0.42	1.00	0.14	0.43	0.96
Indo Rama Synthetics (India) Ltd.	0.22	0.57	0.88	0.16	0.48	0.91	0.17	0.52	0.93
J C T Ltd.	0.13	0.33	0.58	0.11	0.34	0.69	0.12	0.36	0.89
Jindal Poly Films Ltd.	0.16	0.42	0.82	0.14	0.43	1.00	0.17	0.50	1.00
Loyal Textile Mills Ltd.	0.17	0.45	0.45	0.13	0.41	0.76	0.17	0.51	1.00
Malwa Cotton Spg. Mills Ltd.	0.13	0.35	0.50	0.12	0.38	0.72	0.07	0.22	0.33
Nahar Industrial Enterprises Ltd.	0.13	0.33	0.40	0.10	0.32	0.61	0.12	0.35	0.73
Nahar Spinning Mills Ltd.	0.14	0.36	0.40	0.11	0.35	0.65	0.12	0.34	0.73
Pasupati Acrylon Ltd.	0.17	0.45	0.80	0.17	0.53	1.00	0.19	0.55	1.00
R S W M Ltd.	0.16	0.41	0.57	0.13	0.40	0.75	0.14	0.43	0.84
S Kumars Nationwide Ltd.	0.17	0.45	0.63	0.20	0.62	1.00	0.07	0.20	0.41
Sangam (India) Ltd.	0.15	0.38	0.49	0.12	0.36	0.65	0.14	0.41	0.80
Sintex Industries Ltd.	0.18	0.48	0.54	0.17	0.51	0.57	0.28	0.85	1.00
Siyaram Silk Mills Ltd.	0.33	0.86	0.94	0.33	1.00	1.00	0.28	0.85	1.00
Trident Ltd.	0.14	0.37	0.42	0.14	0.44	0.68	0.13	0.39	0.62
Vardhman Textiles Ltd.	0.14	0.36	0.47	0.11	0.33	0.61	0.13	0.40	0.79
Welspun Living Ltd.	0.15	0.40	0.48	0.14	0.43	0.68	0.16	0.49	0.84

Source: Authors' own calculations.

Analysis of Results of TFP and ITE for Overall Industry using both Fare-Primont and Hicks-Moorsteen Productivity Indices

Table 3 presents the results of both the Fare-Primont index and the Hicks-Moorsteen index for the total factor productivity (TFP) and input-oriented technical efficiency (ITE) of the textile industry as a whole for the years 2005 to 2016. The results of both indices show a mixed trend in TFP over the study period, whereas the level of ITE calculated by both indices remained the same throughout 2005 to 2016.

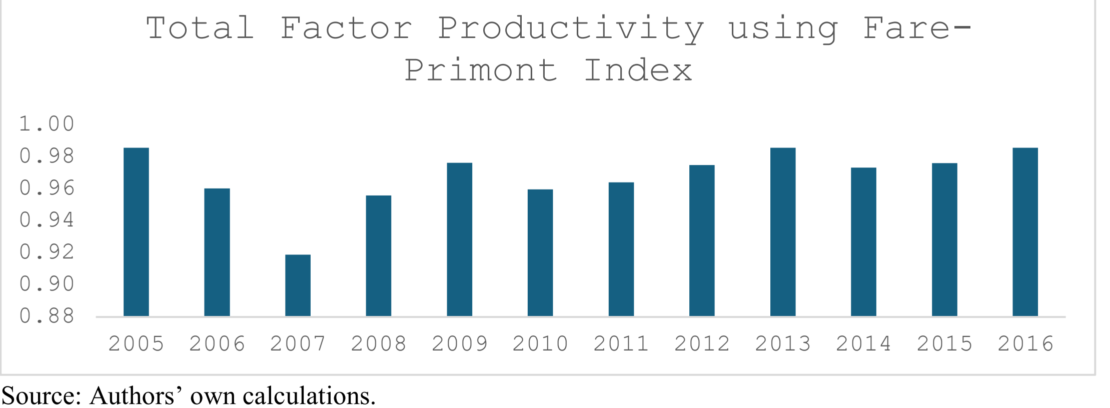
Table 3: Results of Hicks-Moorsteen and Fare-Primont Productivity Indices for the industry

Period	Fare-Primont Index			Hicks-Moorsteen Index		
	TFP	TFPE	ITE	TFP	TFPE	ITE
2005	0.99	1.00	1.00	1.00	1.00	1.00
2006	0.96	1.00	1.00	1.07	1.00	1.00
2007	0.92	1.00	1.00	1.04	1.00	1.00
2008	0.96	1.00	1.00	1.09	0.99	1.00
2009	0.98	1.00	1.00	1.03	0.98	1.00
2010	0.96	1.00	1.00	1.07	1.00	1.00
2011	0.96	1.00	1.00	1.13	0.91	1.00
2012	0.97	1.00	1.00	1.01	0.99	1.00
2013	0.99	1.00	1.00	1.06	1.00	1.00
2014	0.97	1.00	1.00	1.15	1.00	1.00
2015	0.98	1.00	1.00	1.06	1.00	1.00
2016	0.99	1.00	1.00	1.11	1.00	1.00

Source: Authors’ own calculations.

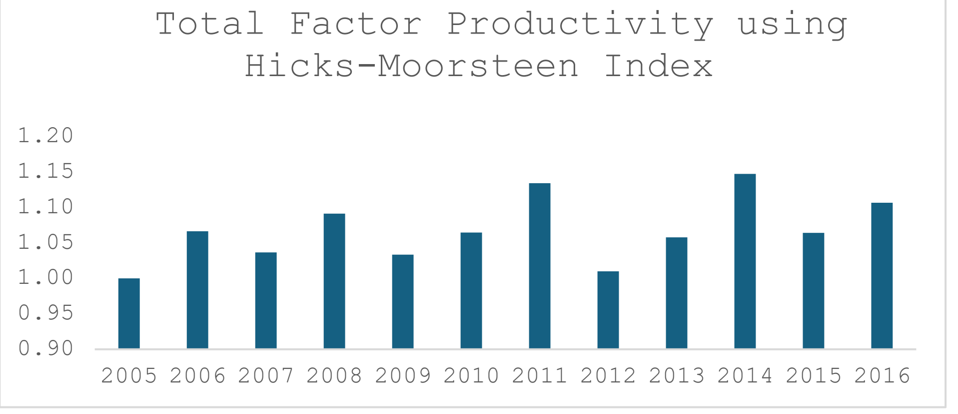
Figures 1 and 2 show the trend in TFP, calculated using both the Fare-Primont and Hicks-Moorsteen productivity indices, for the Indian textile industry over the period 2005 to 2016. The results of both indices show fluctuations in the industry's total factor productivity.

Figure 1: Trend of TFP of the India Textile Industry using Fare-Primont Index



Source: Authors’ own calculations.

Figure 2: Trend of TFP of the India Textile Industry using Hicks-Moorsteen Index



Source: Authors' own calculations.

Conclusion

The Indian textile industry has come a long way since independence, when multinational corporations dominated the sector. Over the years, despite an unfavourable policy regime imposed by the MFA from 1974 to 2005, the industry has grown and consolidated its position in an increasingly competitive environment. The present study has analysed firm-level technical efficiency and total factor productivity, along with their various components, for Indian textile firms over the period 2005 to 2016, given that efficiency and productivity are considered crucial to strengthening the competitiveness of this sub-sector. The study finds that the industry has experienced rapid technical progress, opening new production possibilities; however, most firms have failed to fully appropriate the benefits of this technological change. The study further reveals that, although overall productivity change shows an increasing trend, this increase is not driven mainly by technical change alone. In addition, the study computes the total factor productivity (TFP) and input-oriented technical efficiency (ITE) of the textile industry as a whole for the years 2005 to 2016, using both the Fare-Primont index and the Hicks-Moorsteen index. The results of both indices show a mixed trend in TFP over the study period, whereas the ITE level calculated by both indices remained the same from 2005 to 2016.

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