Efficiency of the Indian Garments Manufacturing Units in the post MFA period

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Abstract

The paper attempts a state level analysis using Data Envelopment Analysis (DEA) to find out how technical efficiency of Indian apparel firms has changed in the post Multi Fibre Agreement (MFA) period. Overall Technical Efficiency is sub divided into Pure Technical Efficiency and Scale Efficiency to identify the causes behind low Overall Technical Efficiency scores of Indian apparel firms. It is found that a major factor constraining the efficiency of the sector in the post MFA period is non optimal input output mix. The analysis of the relationship between size and age and technical efficiency suggest the older and bigger firms are more efficient. The meta frontier analysis carried out to rank the major garment producing states according to their Technology Closeness Ratio (TCR) suggests that technological gap between the technologically superior and backward states is increasing over time.

1. Introduction

1.1 The complete phasing out of the Multi Fibre Agreement (MFA) in 2005 has initiated a new era of free trade in textiles. The global apparel market is characterized by monopolistic competition with a large number of firms supplying similar but differentiated products. While the dismantling of the MFA quotas has opened up new opportunities for the apparel firms in developing countries like India it has also exposed them to intense competition. Garment is one of the leading sectors in the Indian economy in terms of output, employment and foreign exchange earnings. The Indian government has undertaken a through restructuring of the policies towards this sector to prepare it for the changed market environment. Earlier, the government policy of reservation of the garments sector to small scale resulted in fragmentation of the industry and hindered modernization and realization of economies of scale. The Textile Policy 2000 has taken major steps towards removing the policy constraints facing the sector. A number of important measures like de reservation of the garments sector from the small scale, inclusion of garments in the list of industries for automatic approval of FDI has been undertaken to improve the competitiveness of the sector. India also has a natural competitive edge in the garment industry over other countries because of the easy availability of cheap labour and steady supply of inputs from the well established textile industry in the country. As is apparent from Table-1, India's total garments exports has more than doubled between 2003 and 2013 while India's export share in the total world export of garments has increased from less than 3% to more than 4% during the same period suggesting that the phase out of MFA quota has favourably influenced India's garment exports. However, there is little room for complacency since India's share in world garment exports is still much lower than that of China (WTO, 2013).

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1.2 Hence, in the changed global scenario India needs to continuously improve her competitiveness in order to sustain and improve her share in the world apparel market. India's competitiveness in the global market will largely depend on the efficiency of the Indian firms. Hence, an interesting question to explore is how the efficiency of the Indian apparel firms has changed in the post MFA period.

1.3 Empirical studies addressing the issue of efficiency of Indian textile or garments firms are relatively few. Bhandari and Maiti (2007) use firm level ASI data for the years 1985-86, 1990-91, 1996-97, 1998-99 and 2001-02 to estimate the Technical efficiency (TE) of the Indian textile firms. To check how liberalization has affected the TE of the firms they estimate the average TE of the firms for each of the years under consideration but found no distinct trend of the average TE of the textile firms over the years under consideration. In another separate study, Bhandari and Ray (2007) use meta frontier analysis to identify how locational, proprietary and organization characteristics of the firms affect their performance. Bandopadhyay & Majumder (2013) attempt to estimate the impact of domestic reforms on the performance of the Indian garments industry. They use Annual Survey of Industries data and carry out their analysis for four alternative years viz 1999-00, 2001-02, 2003-04 and 2004-05. Interestingly, they also like Bhandari and Maiti (2007) could not find any significant impact of liberalization on the efficiency scores of the garment firms. Gopalan and Shannnugam (2010) employs Stochastic Frontier Approach to estimate the overall and input specific efficiency values for 215 sample firms during 1993-94 to 2005-06 and concludes that the average efficiency of the textile firms have declined over the years. The present study supplements these small numbers of studies and attempts to evaluate the effect of the phasing out of MFA on the efficiency of the Indian garment firms.

1.4 The paper is organized as follows: Section 2 outlines the objectives of the study. Section 3 explains in brief the methodology of Data Envelopment Analysis and also explains the concept of meta frontier. Results and policy prescriptions are discussed in section 4. Section 5 concludes the paper.

2. Objective

2.1 Given the above background the basic objective of the paper is to investigate the changes if any in the efficiency of the Indian garment firms in the post MFA period, identify the factors affecting technical efficiency of these firms and suggest policies to improve their efficiency levels. Since, Indian states are heterogeneous in nature a state level analysis is conducted. Data Envelopment Analysis (DEA) is used to find firm level technical efficiency. Data Envelopment Analysis (DEA) is a Linear Programming technique that utilizes observed input output data of the decision making units (DMUs) or firms to obtain scalar measure of efficiency for each DMU relative to its competing DMUs. The Overall Technical Efficiency (OTE) scores of the DMUs are derived. The Overall Technical Efficiency (OTE) scores are then decomposed into Pure Technical Efficiency (PTE) and Scale Efficiency (SE) to find out whether low OTE scores are due to the choice of wrong input output mix (i.e. pure technical inefficiency) or choice of inappropriate scale (i.e. scale inefficiency). An analysis of input slacks is also undertaken to investigate whether underutilization of certain inputs is contributing towards low efficiency. The identification of the sources of inefficiency in the units provides useful insights regarding the policy reforms that are required to improve the efficiency of the firms.

2.2 In the changed market environment larger and established firms are expected to assume an important role. Hence the relationship between size and age of the firms and technical efficiency is studied to identify which type of firms are more suitable to meet the new challenges and suggest suitable policies to encourage growth of such firms.

2.3 It is possible that the level of technology differs across the major garment producing states. Hence, a meta frontier analysis is undertaken to find out the extent of technological heterogeneity among the Indian states. Technology Closeness Ratio (TCR) is calculated at the state level and the major garment producing states are ranked in terms of their TCR. This helps in identification of technologically backward states, so that effective policies may be designed to induce technological modernization of these states.

2.4 In order to investigate the above objectives the following three exercises are undertaken:

- DEA is used to find OTE, PTE and SE scores of the garment producing units for the years 2003-04, 2005-06, 2007-08 and 2009-10. Analysis of input slacks for the units is also undertaken for the above mentioned years.
- Classify the firms according to their size and age and check the relationship between size and age of the firms and technical efficiency.
- Calculate the Technology Closeness Ratio (TCR) at the state level and rank the major garment producing states in terms of their TCR.

3. Data & Methodology:

3.1 In this paper Data Envelopment Analysis (DEA) is done to find output oriented technical efficiency scores of the garment firms using firm level ASI data at 5-digit level of disaggregation for the years 2003-04, 2005-06, 2007-08 and 2009-10. Data Envelopment Analysis (DEA) is a Linear Programming technique that derives a benchmark technology from a sample of observed input output data. The Decision Making Units (DMUs) or firms performing best relative to its competing DMUs (peers) are assigned an efficiency score of 1 and they form the best practice envelope or frontier. The technical efficiency (TE) scores are derived as the ratio of the actual output to ideal output specified by the generated frontier.

3.2 The first DEA model was proposed by Charnes et al (1978) also known as CRS DEA model. The CRS model finds overall technical efficiency and the model cannot be used to distinguish between pure technical efficiency and scale efficiency. The overall technical efficiency measures inefficiencies due to input output mix (pure technical efficiency) as well as scale of operation (scale efficiency). The CRS specification of the production technology implicitly assumes that the DMUs operate on an optimal scale. Since, this assumption might not hold in practice Banker et al (1984) developed a VRS DEA model that can be used to decompose overall technical efficiency into pure technical efficiency and scale efficiency. The measure corresponding to the VRS assumption represents pure technical efficiency. Overall technical efficiency (OTE) is the product of pure technical efficiency (PTE) and scale efficiency (SE). Thus, scale efficiency of a firm can be derived as:

$$\text{Scale Efficiency} = \frac{\theta_{CRS}^{*}}{\theta_{VRS}^{*}}$$

Where θ_{CRS}^{*} is the TE score of the firm under the assumption of CRS technology and θ_{VRS}^{*} is the TE score of the firm under the assumption of VRS technology. In the following paragraph the VRS DEA model used to obtain the output oriented technical efficiency scores is briefly explained.

Let $(x_{j,}\ y_j)$ be the observed input-output bundle of an individual firm j in a sample of N firms in the data. Then given the assumptions of convexity of the production possibility set along with free disposability of both inputs and outputs, the production possibility set under the assumption of VRS technology can be empirically constructed as

$$T = \{(x, y) : x \geq \sum_{j=1}^{N} \lambda_j x^j \ ; y \leq \sum_{j=1}^{N} \lambda_j y^j ; \sum_{j=1}^{N} \lambda_j = 1; \lambda_j \geq 0.(j = 1,2,.....N)\}$$

The output-oriented measure of technical efficiency of firm j is obtained from the solution of the following program:

$$\max \phi$$

$$\text{s.t.} \ \sum_{\text{j=1}}^{N} \lambda_{\text{j}} \text{x}_{ij} \ \leq x_{ij} : \forall i = 1,2,.....n$$

$$\sum_{\text{j=1}}^{N} \lambda_{\text{j}}\, y_{rj} \geq \phi\, y_{rj} \ ; \forall r = 1,2,....m$$

$$\sum_{\text{j=1}}^{N} \lambda_{\text{j}} = 1 ;$$

$$\lambda_{\text{j}} \geq 0 \ (\ \text{j} = 1\ ,\ 2\ ,...,\ N)\ .$$

The score $\theta^{*} = \frac{1}{\phi}$ obtained by solving the above Linear Programming Problem gives the output oriented technical efficiency of the j th firm under VRS. The CRS DEA model can be derived simply by deleting the restriction $\sum_{\text{j=1}}^{N} \lambda_{\text{j}} = 1$.

3.3 The VRS DEA calculates only radial in (efficiency). For radial and slack calculation the following model which is an extension of the VRS DEA model is used:

$$\text{Max}\,\bar{\phi} = \phi + \varepsilon\left(\sum_{r=1}^{m} s^{+}{}_{r} + \sum_{i=1}^{n} s^{-}{}_{i}\right)$$

$$\text{Subject to } \sum_{j=1}^{N} \lambda_j y_{rj} - s^{+}{}_{r} = \phi y_{rj} \quad \forall r = 1,2,.....m$$

$$\sum_{j=1}^{N} \lambda_j x_{ij} + s^{-}{}_{i} = x_{ij}; \forall i = 1,2,.....n$$

$$\lambda_j, s^{+}{}_{r}, s^{-}{}_{i} \geq 0; \forall j = 1,2,.....N, \forall r = 1,2,.....m; \forall i = 1,2,.....n$$

where ϕ is free. $s^{+}{}_{r}, s^{-}{}_{i}$, indicates the output and input slack and ε is any pre assigned positive number, however small. Positive sign means output should be increased and negative sign means input should be decreased (Ray, 2004).

3.4 The firms which are not scale efficient are either operating at decreasing returns to scale or at increasing returns to scale. Following Zhu and Shen (1995) the returns to scale of units can be computed with the help of the CRS TE and VRS TE scores and the $\lambda_j s$ corresponding to their CRS TE scores:

i) If CRS TE score = VRS TE score then CRS prevails.

ii) If CRS TE score ≠ VRS TE score and $\sum_{j=1}^{N} \lambda_j < 1$ then increasing returns to scale prevail.

iii) If CRS TE score ≠ VRS TE score and $\sum_{j=1}^{N} \lambda_j > 1$ then decreasing returns to scale prevail.

3.5 In the new expanding global market larger and older firms are expected to have an advantage since larger firms can adopt modern technology and enjoy economies of scale in production while the older firms have better market presence. Hence, size and age of the firm can play a significant role in determining the efficiency and competitiveness of the firms. In a recent study, Bandopadhyay and Majumder, use unit level ASI data for alternate years starting from 1999-2000 till 2005-06 to show that in the Indian apparel sector the bigger and older firms are more efficient (Bandopadhyay and Majumder 2013). The present paper extends their analysis for the years 2007-08 and 2009-10. Following Bandopadhyay and Majumder, the firms are divided into four categories according to size and three categories according to age for the years 2007-08 and 2009-10. The efficiency scores for each year are then arranged in a two way table to study the relationship between age and efficiency within each size class.

3.6 In India substantial heterogeneity exists among the states. Each state has its unique geographical, political, socio economic and infrastructural peculiarities which might significantly affect the level of technical efficiency of the firms in these states. Hence, it is possible that the benchmark or the frontier technology varies across states. So, constructing

a single frontier on the basis of all the data points might result in an inappropriate benchmark technology (Bhandari and Ray 2007). To address the possibility of state level heterogeneity separate frontiers (group frontier) are constructed for the major garment producing states and these group frontiers are then compared with the frontier constructed with all the firms in all the states (meta frontier). If for a firm the group and meta frontier scores are close then at the corresponding data point the state frontier is close to the meta frontier. Instead of assessing the proximity of the two frontiers at individual data points it is useful to construct an overall measure of proximity by considering the average TE scores of all the firms belonging to a particular state measured against the state (group) frontier relative to their TE scores measured against the meta frontier. The average technical efficiency of the firms in state relative to the state frontier (i.e. the frontier consisting of only the firms belonging to the particular state in question in any particular year) is given by the geometric average of their technical efficiencies w.r.t. the state frontier: $TE_s = \left(\prod_{k=1}^{n} TE_s^{\,k} \right)^{\frac{1}{n}}$. Similarly, the average technical efficiency of the firms in the state relative to the meta frontier (i.e. the frontier constructed with all the firms in all the states in the year under consideration) is calculated as: $TE_{sM} = \left(\prod_{k=1}^{n} TE_{sM}^{\,k} \right)^{\frac{1}{n}}$, where *k = 1 ...n.,* are the firms belonging to state *s.* It may be noted that $TE_s \geq TE_{sM}$ as the firms cannot be more efficient when evaluated against the meta frontier than when evaluated against the state frontier. Hence, for state s an overall measure of the proximity of the state frontier to the meta frontier is given by the technology closeness ratio: $TCR = \frac{TE_{sM}}{TE_s}$. The value of TCR increases if the state frontier moves towards the meta frontier. The TCR attains the maximum possible value of unity when the state frontier coincides with the meta frontier.

4. Results & Policy Prescriptions:

The percentage of firms with Overall Technical Efficiency (OTE) score of one is low both at the state level as well as at the all India level (Table-2). At the all India level the percentage of firms with OTE is less than 2% for all the years under consideration. The only state where more than 2% firms have obtained OTE score of one in all the four years is Maharashtra. The average OTE scores are also surprisingly low (Table-3). At the all India level the average OTE score is less than 0.4 for all the years in question implying that in any of these years an average Indian apparel firm could increase its output by more than 60% without altering the amount of inputs used by it, by adopting the best technology available in the country in that particular year. There has been some improvement in the average OTE score at the all India level between 2003-04 and 2009-10. However, the average overall efficiency scores for the country as a whole as well as for the individual states are still extremely low. Hence, an average Indian garment firm needs to improve its efficiency to catch up with the best practice frontier. In the following section the OTE score is decomposed into Pure Technical Efficiency (PTE) and Scale Efficiency (SE) to identify the underlying causes of inefficiency of the Indian apparel firms.

4.1 Decomposition of OTE: PTE & SE

4.1.1 As discussed earlier, Overall Technical Efficiency (OTE) captures Pure Technical Efficiency (PTE) as well as Scale Efficiency (SE). Thus, firms which have an OTE score of less than one either have pure technical inefficiency or scale inefficiency or both. As is apparent from Table-2, the percentage of firms which demonstrate Pure Technical Efficiency is quite low in all the years under consideration suggesting that improper input output mix is a major cause behind low OTE in this sector. Among the major ten garment producing states the only state where more than 5% of the firms have obtained a perfect PTE score in all the four years is Maharashtra (Table-2). The average PTE score is again unsatisfactory both at the all India level as well as across the states (Table-3). The average PTE score at the all India level has actually fallen between 2003-04 and 2005-06. While pure technical efficiency scores have remained unsatisfactory scale efficiency has improved over the years. At the all India level the percentage of scale efficient firms has increased from below 2% to above 15% between 2003-04 and 2009-10 (Table-2). All major garment producing states have also recorded an increase in the percentage of scale efficient firms. The average SE score has also improved between 2003-04 and 2009-10 at the all India level as well as across the states (Table-3). Earlier, reservation of the apparel sector to small scale led to low level of operation and prevented technological up gradation (Hasim 2004). With the de reservation of the apparel sector from small scale the scale efficiency of the firms seems to have gradually improved over the years.

4.2 Analysis of Input Slacks:

4.2.1 Firms which have PTE score of less than one are using inappropriate input output mix. The input slacks reported by the Data Envelopment Analysis Program gives interesting insights regarding the changes in input mix that are required to improve an inefficient firm's efficiency. The efficiency score of a firm indicates the proportional or radial improvement in output that can be achieved without requiring extra inputs. However, even after the required proportional improvement (radial adjustment) in outputs the firm may not be Pareto efficient if it operates on the horizontal section of the efficient frontier. To project the firm to a Pareto efficient point further slack adjustments are necessary. The presence of non zero input slacks for a firm implies that the firm in question can improve beyond the level implied by the estimate of technical efficiency. Hence, both the efficiency scores and any non zero output or input slacks should be taken into account to obtain an accurate estimate of technical efficiency (Cooper et al 2000, Saranga 2009, Kumar and Gulati 2008).

4.2.2 It is observed that at the all India level slacks in capital have fallen over the period of our analysis (Table-4). At the state level too slacks in capital have fallen for most states. The slack in intermediate input is negligible for all the years under consideration and it has also fallen over the years. One of the major factors constraining the efficiency of the units seems to be underutilization of labour. At the all India level the labour slack fell between 2003-04 and 2005-06 but increased in all the later years under consideration. The slacks in labour have also increased in all the states between 2007-08 and 2009-10. In 2003-04 the percentage of firms with capital slack was more than those with labour slack. In 2009-10 the percentage of firms with labour slack exceeded those with capital slacks. The increase in slack in labour may be due to introduction of modern relatively capital intensive technology. The reason behind the failure of the firms in reducing the labour slacks seems to be rigid labour laws that do not allow firms to retrench labour.

4.3 Analysis of Returns to scale:

4.3.1 Economies of scale in production is an important source of efficiency gain and cost competitiveness. The garment sector suffered from diseconomies of scale in production as the scale of operation was restricted until recently due to the policy of reservation of the sector to small scale. The Textile Policy 2000 de reserved the garment sector from small scale. As is apparent from the earlier discussion the policy of de reservation of the garment sector from small scale seems to have a positive effect on scale efficiency since the scale efficiency of the sector has improved during the period of our analysis. However, still a substantial percentage of the firms are operating at non optimum scale in all four years (Table-5). At the all India level in all the years under consideration except 2007-08 the percentage of firms operating under DRS exceeds the percentage of firms operating under IRS. At the state level too in most cases the percentage of firms operating under DRS exceeds the percentage of firms operating under IRS. In 2003-04, at the all India level more than 74% of the total firms were operating under DRS. In 2009-10 the percentage of firms operating under DRS has dropped but still more than 40% of the firms are operating under DRS. Thus, majority of the inefficient firms are operating under DRS implying that these firms are over utilizing their existing capacity and increase in production for these firms will lead to lesser returns per unit of production. The firms operating under IRS on the other hand have excess capacity and can save costs by increasing production volume.

4.4 Effect of Size and Age on Technical Efficiency Scores:

4.4.1 In India majority of garment producing firms are small in size. Low scale of operation prevents adoption of modern technology and realization of economies of scale. Hence, decreasing returns to scale is expected to set in quickly in firms which are small. Integration of global trade in textiles means larger markets and firm size becomes increasingly important to establish presence in expanding global market. Hence, size of the firm may significantly affect the efficiency of the firms. In a recent study, Bandopadhyay and Majumder (op. cit) use unit level ASI data for alternate years starting from 1999-2000 till 2005-06 to show that in the Indian apparel sector the bigger and older firms are more efficient. The present paper extends their analysis for the years 2007-08 and 2009-10. Table-6 reports the results for 2007-08 and 2009-10. The results for 2003-04 and 2005-06 from the study by Bandopadhyay and Majumder are also reported. It is apparent from the table that very large and very old groups of firms have high Technical Efficiency scores for all the years. The very small and young group on the other hand have much lower efficiency scores. Larger firms are more efficient because higher scale of operation not only reduces average costs, but also aids modernization (Roy 2010). The older firms on the other hand seem have an edge over the younger ones as the former has the benefit of more secure market access. Hence, an increase in the capacity of the existing firms might improve their efficiency by allowing them to enjoy economies of scale in production through adoption of modern technology.

4.5 Technology Closeness Ratio:

4.5.1 In order to check whether there exist differences between the different Indian states in terms of technology, meta frontier analysis is undertaken. The results are reported in Table-7. Ten major garment producing states are identified namely: Delhi, Gujarat, Haryana, Karnataka, Maharashtra, Punjab, Rajasthan, Tamil Nadu, UP, West Bengal and the

Technology Closeness Ratios are calculated for each of these states. As discussed earlier the maximum value of TCR is unity. A TCR value of one for any state suggest that the maximum output producible from any given input bundle in the state is at least as high as what it could have produced if the firm was located anywhere else in the country. Thus, a high value of TCR implies that the state in question does not face any technological constraint that affect the productivity of the firms in the state relative to the nation as a whole. The state level Technology Closeness Ratios suggest that the five states: Delhi, Haryana, Maharashtra, Tamil Nadu and UP are technologically superior states and they occupy the first five positions in the all the post MFA years under consideration. These states also account for a high percentage of frontier firms and the shares of these states in total frontier firms have improved between 2003-04 and 2009-10. All these states except Delhi have also recorded improvement in TCRs between 2003-04 and 2009-10.The Technology Closeness Ratios indicate that there exists substantial technological heterogeneity across the states. The TCRs of most of the technologically weaker states have either deteriorated or remained constant between 2003-04 and 2009-10, suggesting that the technological gap between the technologically superior and weaker states is increasing over time. Another important point to note is that average efficiency scores of the firms relative to the meta frontier are low for most of the states suggesting that an average firm's performance is well below the benchmark. This is true even for the technologically superior states. For example in 2009-10 the GM of efficiency scores of the firms with respect to the grand frontier in Delhi which has the highest average (grand) efficiency score among states in that year, is only 0.48 (Table-7). This perhaps points towards the fact that the benchmark technology is determined by a few frontier firms which use modern technology and hence have higher efficiency scores. Most of the firms operating below the frontier seem to use inferior technology and hence have much lower efficiency scores. Previous studies on the garment sector have reported that a major hindrance behind growth in productivity and efficiency in this sector is the use of primitive technology by a majority of the garment producing units. According to a study by NIFT (1999) only 17% of the manufacturers used world class technology. The Technology Upgradation Fund Scheme[2] (TUFS) was launched in April 1999 to help the textile and garments sector overcome technological obsolescence and create economies of scale. However, though the scheme was effective in encouraging investments for modernization and capacity building the full potential for technological modernization was not realized in the garments sector (Apparel Export Promotion Council and Office of the Textile Commissioner, 2007). The Revised Restructured Technology Upgradation Fund Scheme (RR-TUFS) launched in April 2013 recognizes the importance for technological modernization of the garments sector. Proper targeting of the technologically backward units under the scheme can improve the overall efficiency of the sector by enabling the firms operating below the frontier to reach the frontier.

[2] It would be interesting if further analysis could be done to study the impact of technological upgradation attempted through support under TUFS on the TE of the firms. However, this is not possible with the present dataset since data on technological upgradation or data on support received by the units under TUFS is not available. The alternative is to study the relationship between investment in fixed assets and TE scores. However, since investment in fixed assets is expected to affect TE after a gestation lag such an analysis requires panel data and is not possible with the ASI unit level data used in the study since the data set does not identify individual firms.

5. Conclusion

5.1 The paper tries to investigate the changes if any that have taken place in the levels of technical efficiency of the garment manufacturing units in India in the post MFA period and identify the major causes of inefficiency in those units. Since, the Indian states are heterogeneous in nature a state level analysis is conducted. It is found that the percentage of firms which demonstrate Overall Technical Efficiency (OTE) is low at the all India level as well as across the major states in all the years under consideration. The average OTE scores are also low at the state level as well as for the country as a whole. The firms which have an OTE score of less than unity are either scale inefficient or suffer from pure technical inefficiency. The scale efficiency of the firms has improved steadily during the period of analysis. The average scale efficiency as well as the percentage of scale efficient firms has improved at the all India level as well as across the major garment producing states. The improvement in scale efficiency seems to be the effect of recent changes in policy which has removed the constraint on scale of operation by dereserving the garment sector from small scale. The factor that has depressed the OTE scores of the firms seem to be the use of non optimal input output mix. This is apparent from the fact that pure technical efficiency at the all India level has not shown any improvement between 2003-04 and 2009-10. An analysis of the input slacks reveal that the slack in capital and intermediate inputs has fallen between 2003-04 and 2009-10 at the all India level as well as across most states. At the all India level the slack in labour has decreased between 2003-04 and 2005-06 but increased in all the later years under consideration. The labour slacks have also gone up in all the major garment producing states between 2007-08 and 2009-10. Inflexible labour laws which prohibit retrenchment of labour seem to the reason behind existence of widespread slack in labour. Hence, labour market reforms to ensure greater flexibility of labour laws are required to increase the efficiency of the sector.

5.2 In the post MFA period larger and older firms is expected to play a very important role as these firms have superior technology and better market presence. The analysis of the relationship between size and age and technical efficiency suggest the older and bigger firms are more efficient and hence a capacity expansion of the existing firms can improve the efficiency of the sector.

5.3 The meta frontier analysis conducted to identify the extent of technological heterogeneity across the states, suggests that five states namely Delhi, Haryana, Maharashtra, Tamil Nadu and UP are technologically superior states as they have relatively high TCRs in all the years under consideration. While TCRs of the technologically superior states has improved the TCRs of the technologically weaker states have fallen or remained constant, suggesting that the technological gap between the technologically superior and the technologically disadvantaged states is increasing in the post MFA period. Another discouraging sign is low average technical efficiency of the firms in the states including the technologically superior states. Lack of technological progress in the technologically disadvantaged states and operation of the average firms well below the technological frontier can seriously restrict the competitiveness of the sector in the international market. Hence, proper incentives towards technological modernization of the firms is an essential pre requisite to improve the efficiency and competitiveness of the sector.

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Table-1: India's Garments Exports

Year	**India's Total Garments Exports** (in constant $ million)	**India's share in World Garments Export**
2003	6269.98	2.87
2004	6621.35	2.78
2005	8200.65	3.33
2006	8746.27	3.25
2007	8857.70	3.00
2008	9481.02	3.12
2009	10405.36	3.94
2010	9635.98	3.34
2011	12237.42	3.66
2012	11279.10	3.66
2013	13532.00	4.08

Source: WITS database COMTRADE at HS 2-digit level

Table-2: State-Wise Percentage of OTE, PTE and SE firms

STATE	**CRITERION**	**2003-04**	**2005-06**	**2007-08**	**2009-10**
DELHI	OTE FIRMS (%)	1.34	1.47	2.29	3.06
	PTE FIRMS (%)	2.01	5.15	3.82	4.08
	SE FIRMS (%)	1.35	2.94	5.34	20.41
GUJRAT	OTE FIRMS (%)	NIL	NIL	3.23	NIL
	PTE FIRMS (%)	3.57	0.00	3.23	0.00
	SE FIRMS (%)	0.00	0.00	12.90	6.38
HARYANA	OTE FIRMS (%)	NIL	NIL	0.56	1.40
	PTE FIRMS (%)	0.00	0.78	2.25	2.80
	SE FIRMS (%)	0.00	0.00	6.18	16.78
KARNATAKA	OTE FIRMS (%)	0.62	NIL	0.00	NIL
	PTE FIRMS (%)	2.47	1.91	1.95	0.79
	SE FIRMS (%)	0.62	1.27	5.84	19.69
MAHARASHTRA	OTE FIRMS (%)	4.17	3.06	3.80	2.78
	PTE FIRMS (%)	5.21	7.14	6.33	10.19
	SE FIRMS (%)	4.17	3.06	6.33	10.19
PUNJAB	OTE FIRMS (%)	NIL	NIL	NIL	0.68
	PTE FIRMS (%)	15.38	0.00	10.00	0.68
	SE FIRMS (%)	0.00	0.00	10.00	13.51
RAJASTHAN	OTE FIRMS (%)	NIL	2.94	NIL	NIL
	PTE FIRMS (%)	0.00	2.94	3.13	0.00
	SE FIRMS (%)	3.13	2.94	9.38	23.40
TN	OTE FIRMS (%)	NIL	1.29	0.60	0.73
	PTE FIRMS (%)	1.94	2.16	2.41	1.47
	SE FIRMS (%)	0.00	1.29	9.04	14.43
UP	OTE FIRMS (%)	1.32	2.80	1.57	0.67
	PTE FIRMS (%)	1.32	2.80	3.15	2.01
	SE FIRMS (%)	1.32	4.20	11.02	17.45

Table-2: State-Wise Percentage of OTE, PTE and SE firms (Contd.)

STATE	CRITERION	2003-04	2005-06	2007-08	2009-10
WB	OTE FIRMS (%)	NIL	NIL	8.33	NIL
	PTE FIRMS (%)	0.00	0.00	8.33	3.45
	SE FIRMS (%)	7.69	0.00	8.33	20.69
ALL INDIA	OTE FIRMS (%)	1.18	1.49	1.59	1.02
	PTE FIRMS (%)	2.69	2.98	3.58	2.47
	SE FIRMS (%)	1.40	2.05	7.56	15.11

Source: Calculated from ASI data

Table-3: State-Wise Average OTE, PTE and SE Scores

STATE	CRITERION	2003-04	2005-06	2007-08	2009-10
DELHI	OTE	0.40	0.45	0.52	0.48
	PTE	0.48	0.55	0.55	0.51
	SE	0.85	0.81	0.95	0.95
GUJRAT	OTE	0.28	0.25	0.39	0.32
	PTE	0.40	0.32	0.42	0.34
	SE	0.74	0.77	0.95	0.94
HARYANA	OTE	0.28	0.28	0.38	0.36
	PTE	0.43	0.42	0.43	0.40
	SE	0.70	0.69	0.90	0.91
KARNATAKA	OTE	0.24	0.20	0.24	0.32
	PTE	0.39	0.31	0.33	0.37
	SE	0.67	0.71	0.82	0.89
MAHARASHTRA	OTE	0.38	0.39	0.48	0.45
	PTE	0.42	0.46	0.51	0.49
	SE	0.88	0.86	0.94	0.93
PUNJAB	OTE	0.27	0.25	0.36	0.34
	PTE	0.44	0.33	0.45	0.36
	SE	0.76	0.80	0.84	0.95
RAJASTHAN	OTE	0.35	0.30	0.36	0.32
	PTE	0.41	0.38	0.40	0.33
	SE	0.87	0.77	0.92	0.95
TN	OTE	0.25	0.24	0.26	0.34
	PTE	0.37	0.34	0.33	0.37
	SE	0.72	0.74	0.87	0.94
UP	OTE	0.33	0.34	0.39	0.39
	PTE	0.40	0.41	0.44	0.42
	SE	0.84	0.82	0.92	0.95

Table-3: State-Wise Average OTE, PTE and SE Scores (Contd.)

STATE	CRITERION	2003-04	2005-06	2007-08	2009-10
WB	OTE	0.42	0.42	0.45	0.38
	PTE	0.47	0.48	0.47	0.41
	SE	0.88	0.87	0.95	0.94
ALL INDIA	OTE	0.31	0.30	0.36	0.36
	PTE	0.41	0.40	0.42	0.39
	SE	0.77	0.77	0.89	0.93

Source: Calculated from ASI data

Table-4: State-Wise Percentage of Firms with Input Slacks

STATE	CRITERION	2003-04	2005-06	2007-08	2009-10
DELHI	LABOUR SLACK	39.86	12.50	10.69	30.61
	CAPITAL SLACK	58.11	23.53	14.50	21.43
	INT. INPUT SLACK	2.03	0.00	0.00	0.00
GUJRAT	LABOUR SLACK	39.86	12.50	10.69	30.61
	CAPITAL SLACK	58.11	23.53	14.50	21.43
	INT. INPUT SLACK	0.00	0.00	0.00	0.00
HARYANA	LABOUR SLACK	58.97	14.06	17.42	34.27
	CAPITAL SLACK	73.08	51.56	11.80	37.06
	INT. INPUT SLACK	3.85	2.34	0.56	0.00
KARNATAKA	LABOUR SLACK	80.25	50.32	48.70	69.29
	CAPITAL SLACK	35.80	38.22	36.36	12.60
	INT. INPUT SLACK	0.62	0.64	0.00	0.00
MAHARASHTRA	LABOUR SLACK	32.29	11.22	13.92	19.44
	CAPITAL SLACK	52.08	35.71	30.38	25.00
	INT. INPUT SLACK	0.00	0.00	0.00	0.00
PUNJAB	LABOUR SLACK	7.69	6.90	0.00	19.59
	CAPITAL SLACK	53.85	17.24	30.00	18.92
	INT. INPUT SLACK	0.00	0.00	0.00	2.03
RAJASTHAN	LABOUR SLACK	15.63	8.82	15.63	42.55
	CAPITAL SLACK	81.25	47.06	59.38	38.30
	INT. INPUT SLACK	0.00	0.00	0.00	0.00
TN	LABOUR SLACK	77.18	29.74	39.16	51.59
	CAPITAL SLACK	38.35	31.03	36.75	24.69
	INT. INPUT SLACK	0.49	0.86	0.00	0.24
UP	LABOUR SLACK	28.95	13.29	14.17	41.61
	CAPITAL SLACK	75.00	27.97	30.71	26.17
	INT. INPUT SLACK	1.32	0.00	0.79	0.00
WB	LABOUR SLACK	38.46	0.00	8.33	17.24
	CAPITAL SLACK	30.77	10.00	8.33	31.03
	INT. INPUT SLACK	0.00	0.00	0.00	0.00
ALL INDIA	LABOUR SLACK	54.95	22.60	23.98	40.23
	CAPITAL SLACK	51.72	34.14	34.73	25.85
	INT. INPUT SLACK	1.40	0.56	0.30	0.22

Source: Calculated from ASI data

Table - 5: State-Wise Percentage of DRS and IRS Firms

STATE	CRITERION	2003-04	2005-06	2007-08	2009-10
DELHI	DRS	66.89	88.24	21.37	35.71
	IRS	26.35	5.88	69.47	40.82
GUJRAT	DRS	82.76	83.33	22.60	51.06
	IRS	10.34	11.11	45.16	29.79
HARYANA	DRS	91.03	99.22	19.10	63.64
	IRS	6.41	0.00	27.53	15.38
KAR	DRS	84.57	85.99	50.00	46.46
	IRS	11.73	3.18	32.47	29.13
MAHA	DRS	54.17	70.41	7.59	37.04
	IRS	40.63	20.41	79.75	47.22
PUNJAB	DRS	38.46	89.66	30.00	33.11
	IRS	61.54	6.90	60.00	45.27
RAJASTHAN	DRS	62.50	88.24	9.38	55.32
	IRS	34.38	5.88	71.88	14.89
TN	DRS	86.89	90.52	39.76	40.59
	IRS	10.68	5.17	38.55	36.43
UP	DRS	61.84	88.11	20.47	38.93
	IRS	34.21	3.50	57.48	34.90
WB	DRS	69.23	80.00	16.67	44.83
	IRS	23.08	20.00	66.67	24.14
ALL INDIA	DRS	74.62	87.07	30.25	42.85
	IRS	21.18	6.60	52.74	34.93

Source: Calculated from ASI data

Table-6: Size-Age-Wise Average of Technical Efficiency

YEAR		Young	Old	Very Old
2003-04	Very small	0.25	0.27	0.31
	Small	0.37	0.41	0.39
	Large	0.43	0.42	0.47
	Very Large	0.54	0.55	0.59
2005-06	Very small	0.26	0.29	0.30
	Small	0.38	0.37	0.34
	Large	0.43	0.39	0.48
	Very Large	0.56	0.54	0.56

Table-6: Size-Age-Wise Average of Technical Efficiency (Contd.)

YEAR		Young	Old	Very Old
2007-08	Very small	0.31	0.30	0.42
	Small	0.37	0.33	0.36
	Large	0.42	0.44	0.47
	Very Large	0.53	0.56	0.59
2009-10	Very small	0.34	0.29	0.35
	Small	0.39	0.38	0.38
	Large	0.38	0.38	0.43
	Very Large	0.46	0.48	0.48

Source: Results for 2003-04 and 2005-06 in Table-6 are reported from Bandopadhyay and Majumder (2013). Results for 2007-08 and 2009-10 are derived from author's own calculation using ASI unit level data.

Table 7: State-Wise TCR

State	Criterion	Year			
		2003-04	2005-06	2007-08	2009-10
DELHI	% of Firms	16.02	12.65	13.03	7.12
	GRAND AVERAGE EFFICIENCY (GM)	0.44	0.44	0.48	0.48
	GROUP AVERAGE EFFICIENCY (GM)	0.59	0.63	0.67	0.72
	% of FRONTIER FIRMS	12	21.88	13.89	11.76
	TCR	0.74	0.71	0.72	0.66
	TCR RANK	1	3	2	3
GUJRAT	% of Firms	3.01	3.35	3.08	3.41
	GRAND AVER AGE EFFICIENCY (GM)	0.36	0.27	0.35	0.29
	GROUP AVERAGE EFFICIENCY (GM)	0.74	0.61	0.71	0.73
	% of FRONTIER FIRMS	4	0	2.78	0
	TCR	0.48	0.44	0.49	0.4
	TCR RANK	6	6	6	9
HARYANA	% of Firms	8.39	11.91	17.71	10.38
	GRAND AVERAGE EFFICIENCY (GM)	0.39	0.36	0.38	0.37
	GROUP AVERAGE EFFICIENCY (GM)	0.71	0.75	0.59	0.55
	% of FRONTIER FIRMS	none	3.13	11.11	11.76
	TCR	0.55	0.49	0.64	0.67
	TCR RANK	4	5	3	2
KARNATAKA	% of Firms	17.42	14.6	1.45	9.22
	GRAND AVERAGE EFFICIENCY (GM)	0.31	0.21	0.25	0.31
	GROUP AVER AGE EFFICIENCY (GM)	0.55	0.51	0.6	0.61
	% of FRONTIER FIRMS	16	9.38	8.33	2.94
	TCR	0.56	0.41	0.41	0.52
	TCR RANK	3	8	10	6

Table 7: State-Wise TCR (Contd.)

State	Criterion	Year			
		2003-04	2005-06	2007-08	2009-10
MAHARSHTRA	% of Firms	10.32	9.12	7.86	7.84
	GRAND AVERAGE EFFICIENCY (GM)	0.35	0.34	0.42	0.41
	GROUP AVERAGE EFFICIENCY (GM)	0.56	0.39	0.71	0.48
	% of FRONTIER FIRMS	20	21.88	13.89	32.35
	TCR	0.62	0.86	0.6	0.84
	TCR RANK	2	1	4	1
PUNJAB	% of Firms	1.4	2.7	1	10.75
	GRAND AVERAGE EFFICIENCY (GM)	0.38	0.3	0.42	0.33
	GROUP AVERAGE EFFICIENCY (GM)	0.94	0.85	0.92	0.74
	% of FRONTIER FIRMS	8	none	2.78	2.94
	TCR	0.4	0.35	0.45	0.45
	TCR RANK	10	9	8	7
RAJASTHAN	% of Firms	3.44	3.16	3.18	3.41
	GRAND AVERAGE EFFICIENCY (GM)	0.38	0.32	0.33	0.31
	GROUP AVERAGE EFFICIENCY (GM)	0.83	0.75	0.69	0.83
	% of FRONTIER FIRMS	none	3.13	2.78	none
	TCR	0.47	0.42	0.47	0.37
	TCR RANK	8	7	7	10
TN	% of Firms	22.15	21.58	16.52	29.7
	GRAND AVERAGE EFFICIENCY (GM)	0.32	0.27	0.26	0.32
	GROUP AVERAGE EFFICIENCY (GM)	0.64	0.36	0.32	0.49
	% of FRONTIER FIRMS	16	15.63	11.11	17.65
	TCR	0.51	0.76	0.8	0.65
	TCR RANK	5	2	1	4
UP	% of Firms	8.17	13.3	12.64	10.82
	GRAND AVERAGE EFFICIENCY (GM)	0.34	0.34	0.38	0.37
	GROUP AVERAGE EFFICIENCY (GM)	0.71	0.62	0.66	0.69
	% of FRONTIER FIRMS	4	12.5	11.1	8.82
	TCR	0.48	0.54	0.58	0.54
	TCR RANK	7	4	5	5
WB	% of Firms	1.4	0.93	1.19	2.11
	GRAND AVERAGE EFFICIENCY (GM)	0.38	0.46	0.43	0.38
	GROUP AVERAGE EFFICIENCY (GM)	0.91	0.99	0.95	0.91
	% of FRONTIER FIRMS	none	none	2.78	2.94
	TCR	0.42	0.46	0.45	0.42
	TCR RANK	9	10	9	8

Source: Calculated from ASI data