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Central Statistics Office
Industrial Statistics Wing
Government of India

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EDITORIAL

This journal is intended to provide a meaningful data-based picture of Indian Industry in relation to its various facets on which credible data have been available. Analysis of such data should not merely reveal the current state of affairs but also help us in making dependable projections about the future. Most of the papers published here have made use of data collected through the Annual Survey of Industries by the Central Statistics Office (Industrial Statistics Wing) and justifiably so. The Annual Survey of Industries is a document-based survey unlike many other response-based surveys.

However, credibility of data cannot always be ensured by the fact that these are compiled from relevant documents maintained by the organizations and accessed by the survey investigators. Firstly, such documents do not reveal the true facts and figures necessarily—because of intentional clubbing of some items and subjective dissection of some item into several sub-items as well as unintentional mistakes in recording the facts and figures. Secondly, figures appearing in the documents accessed do not always conform to standard definitions and calculations for some of the items of information.

Towards maintaining international comparability in reporting financial positions of companies, the International Financial Reporting Standards (IFRS) have been introduced in accounting and auditing practices. As of now, of course, not all organizations have so far been able to conform to the requirements of this Standard and that leads to lack of comparability of Balance Sheets across companies. Some information captured through Balance Sheets do not convey any real picture about certain equipments and facilities which are maintained at some costs but are not being fully or even partly utilized, e.g. we procure data on expenses on pollution control equipments, but do not get any information about how these are utilized and what have been the impacts on performance.

Given that the data as are being captured are reasonably error-free, the coverage and content of the Annual Survey are limited on several counts and for several reasons. As is well-known, the ASI does not cover service industries or plantation industries. While coverage limitations can be duly acknowledged, content limitations are being looked at and removed by steps. In fact, quite a few important considerations which have attracted the attention of analysts to get insights into Industry are surfacing recently. The author has pointed out some of these newly emerging considerations in the Editorial Notes in earlier issues of this journal. Problems likely to come up in our bid to overcome these limitations in content have also been discussed.

Somewhat unfortunate is the situation with analysis of available data for examining important relations and testing relevant hypotheses, using some available figures as proxies for some difficult-to—measure features of the industrial units. Some illustrations merit a mention. 'Research and Development Intensity' has been sometimes examined in terms of Expenditure on 'R & D' as a proxy and the latter, in many units, includes expenses on routine activities like Inspection and Testing on incoming materials, components and equipments as also on some routine data analysis and documentation, which by no stretch of imagination can be construed as 'R&D' activities. Even if these routine activities were taken out, expenditures on genuine R&D activities, wherever carried out, cannot reflect on the 'intensity of R&D

activity', since such activities involve costs and efforts which depend very much on the process and product profile of the unit and on the proposed objective(s) of the R&D work taken up.

Similarly, costs of compliance to regulatory requirements or to standards for Quality or /and Environmental Management Systems like ISO 9001 or ISO 14001 Standards cannot be assumed as good indicators of benefits accruing from effective implementation of such standards or requirements. And costs of compliance include costs on various activities which are directly related to various operations normally carried out by the concerned unit.

A growing tendency among research workers these days is to use as much statistical analysis of the data as they can, mostly with the help of softwares and without caring adequately for the assumptions implicit in the statistical procedures applied. In fact, the basic requirements of 'random' samples to validate the application of most of the procedures are not checked and the procedures are applied even on data from 'purposive samples'. One must remember that the substantive content of an empirical study is much more important than its technical content.

March 2015
Kolkata

S. P. Mukherjee
Editor-in-Chief

Note from the Editor-in-Chief

Earlier versions of the following two papers had been presented at the Ninth Annual Conference of the Forum for Global Knowledge Sharing, held at the National Institute of Advanced Studies, Bangalore, during October 27-29, 2014.

1. Foreign Investment in Indian Industrial Firms and Its Impact on Firm Performance by Biswanath Goldar and Akhilesh Kumar Sharma
2. FDI, Technology Acquisition and Labour Demand in an Emerging Market Economy: *A Firm-Level Exploration of Indian Manufacturing Industries* by Maitri Ghosh and Saikat Sinha Roy

Foreign Investment in Indian Industrial Firms and Its Impact on Firm Performance

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Abstract

There is a strong belief that foreign direct investment in industrial firms in developing countries has a positive productivity enhancing effect on the domestic firms. The objective of the present paper is to assess the impact of FDI in Indian manufacturing firms on their performance. The analysis is carried out using a panel data-set (unbalanced panel) on 775 manufacturing companies in India for the period 2000-01 to 2011-12. Growth, profitability and export intensity are considered as performance indicators for the analysis. The estimates obtained by using difference-in-difference estimator coupled with propensity score matching do not show a significant effect of FDI on growth and export performance. However, there is some evidence, though not strong, that FDI tends to raise profitability of Indian manufacturing firms after two or three years which is probably a manifestation of the productivity enhancing effect of FDI.

1. Introduction

1.1 There is a strong belief that foreign direct investment in industrial firms in developing countries has a positive productivity enhancing effect on the local firms receiving the investment. The reason for expecting such an impact primarily lies in the transfer of technological knowledge, management practices, etc. associated with foreign investment as well as the local firms getting increasingly more acquainted with global players and hence developing new business connections with them. There are empirical studies that have found evidence of such positive productivity enhancing effects of foreign direct investment. Arnold and Javorcik (2009), for instance, have found a significant positive effect of foreign investment on productivity of industrial plants in Indonesia.

1.2 Foreign direct investment (FDI) may not only enhance the productivity of firms in which the investment takes place, but it may also have a positive indirect effect on the productivity of other local firms belonging to the same industry and on the productivity of local firms in vertically connected industries (as supplier of inputs or users of the products). This is known in the literature as the spillover effects of FDI. There is a huge literature on the spillover effects of FDI including studies undertaken in the context of developing countries. A number of studies on the spillover effects of FDI has been carried out for Indian manufacturing firms and several of them, though not all, have found evidence of positive spillover effects (see, for instance, Siddharthan and Lal, 2004; Behera *et al*., 2012a, 2012b; and Mondol and Pant, 2014). This aspect is not discussed any further in this paper because the focus here is on the direct effect of FDI on performance indicators of the firms receiving the investment.

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1.3 Besides productivity, the impact of FDI on other performance indicators of firms has been studied empirically. These include wages and growth. A couple of studies have examined the impact of FDI on wages. Lipsey and Sjoholm (2004), for instance, have investigated this issue for Indonesia. They find that foreign-owned establishments in Indonesia pay a higher wage to their workers than domestically owned establishments, and the difference in wages is mostly attributable to ownership rather than plant characteristics. The impact of FDI on growth performance of firms has been studied by Petkova (2013) in the context of Indian manufacturing. She has found a significant positive effect of FDI on growth performance of firms.

1.4 Confining attention now only to the studies that have been undertaken on the impact of FDI of Indian manufacturing firms, a majority of the studies have tried to assess the spillover effects. But, an assessment of the direct effect of FDI on the performance of the firm receiving the investment has also been done as, for instance, in the study of Petkova (2013) mentioned above. The effect of FDI or foreign ownership on productivity of industrial firms in India has been examined by Goldar *et al*. (2004), Banga (2004) and Mishra (2011), among others. The effect of FDI on export performance has been examined by Banga (2006) and Ghosh and Roy (2013), among others. The effect of FDI on technological choices and technological efforts made by firms has been studied by Kathuria (2008) and Ghosh and Roy (2014).

1.5 The object of this paper is to assess the impact of FDI in Indian manufacturing firms on their performance. The analysis is carried out using a panel data-set (unbalanced panel) on manufacturing companies in India covering the period 2000-01 to 2011-12. Three performance indicators are considered for the analysis: growth, profitability and export intensity. The empirical approach adopted in this study, which is explained later in Section 2, is essentially similar to that in Petkova's study on the impact of FDI on Indian manufacturing firms. There are, however, certain differences. One important difference is that the period covered in this paper is more recent than that covered by Petkova. In the study of Petkova, the period considered is 2000-01 to 2008-09, whereas the period covered in this study is 2000-01 to 2011-12. Thus, a longer and more recent period is covered in this study.

1.6 The rest of the paper is organized as follows. Section 2 discusses the data and methodology utilized for the analysis. A preliminary analysis of the firm-level data is presented in Section 3. A more rigorous econometric analysis of the effect of FDI on firm performance is presented in Section 4. Finally, the key findings are summarized and some concluding remarks are made in Section 5.

2. Data and Methodology

2.1 This study makes use of the *Ace Equity* data-base. The period covered is 2000-01 to 2011-12. Data on 775 manufacturing companies are used for the study. It should be pointed out here that *Ace Equity* covers a much larger number of manufacturing companies. However, for the analysis presented here, detailed data are required on the pattern of equity holding in different years, particularly the holding of the foreign promoters, if any. Since such data are not available for many manufacturing firms in the *Ace Equity* data-base, these firms had to be excluded from the analysis.

2.2 To explain next the empirical strategy, the focus is on the change in ownership, from domestic to foreign, taking place in a firm. To make an assessment of the impact of the ownership change on the firm performance, the difference-in-difference (DID) estimator is used. Thus, the average change in a performance indicator of the acquired firms is compared with the average change in the performance indicator in respect of the firms that remain in domestic hands.

2.3 Let the change of ownership, from domestic to foreign, occurring in a particular year T, be called an event taking place in time T, and the firms that experience the event be called treated firms (i.e. the firms that get treated in that year). Also, let the firms that remain in domestic hands and do not experience the event be called control group firms. Thus, to judge the effect of foreign acquisition, the average change in a performance indicator (say logarithm of real sales) between years T and T-1 for treated firms could be compared with that for control groups firms. This is termed as the average treatment effect on the treated (ATT).

2.4 To make a valid comparison so as to isolate the treatment effect, the difference-in-difference (DID) estimator is combined with propensity score matching. This makes it possible to compare treated firms with non-treated firms having similar characteristics.[2] The central idea underlying the technique of propensity score matching is that there are a number of time varying and time invariant characteristics that could make a control group firm a suitable match for a treated firm. Since a large number of variables would be difficult to compare across firms to find suitable matches, an index may be formed on the basis of the relevant variables which may then be used for finding suitable matches. This index, known as propensity score, is formed by estimating a logit or a probit model which gives for each firm the probability of getting treated at time T.

2.5 When using panel data for the analysis, the year in which the event occurs and the industry affiliation of the treated are important pieces of information to be used for finding suitable matches for the treated firms. Arnold and Javorcik (2009) in their study have used a technique that ensures that for each acquired/treated firm, the match from the control group are assigned from the same year and same industry group/sector. In this study, the same technique has been applied.[3]

2.6 Following Arnold and Javorcik (2009), the standard error of ATT is computed by using bootstrapping procedure. While Arnold and Javorcik have considered two-digit level industrial disaggregation for finding matches for treated firms, the same procedure could not applied here because the number of treated firms is relatively smaller. Instead of considering individual two-digit industries separately, four broad groups have been formed: (a) food, tobacco, textiles, leather and other agriculture based industries, (b) chemicals, rubber, plastics, and non-metallic mineral products, (c) metals and metal products, and (d) machinery, transport equipment and other miscellaneous industries. Matching has been done by considering the year of treatment and the broad industry groups (out of the above four) to which the treated firm belongs.

[2] In a way, this creates a counterfactual. Thus, the observed change in a performance indicator in respect of a treated firm is compared with what the change would have been if the firm did not get the treatment, i.e. the firm had remained in domestic hands.

[3] We are thankful to Jens Matthias Arnold for sharing the programming codes to be used in STATA.

2.7 One important methodological issue is what threshold of foreign equity holding should be used to define a foreign firm or foreign acquisition. In studies undertaken on Indian manufacturing firms, the cut-off level has commonly been taken as 10 percent (see, for instance, Sasidharan and Ramanathan, 2007; Behera *et al*., 2012a, 2012b; and Mondol and Pant, 2014). Indeed, Petkova in her study (2013) of mentioned above has also used 10 percent foreign equity level for defining foreign acquisition. Arnold and Javorick (2009), by contrast, have used the cut-off level of 20 percent. One interesting empirical question this arises here is that defining foreign acquisition or treatment at 10 percent foreign equity may yield different results than the alternate option of defining foreign acquisition or treatment at 20 percent foreign equity. This issue has not been investigated in this paper and left for future research. For the analysis undertaken in this paper, the threshold level of foreign equity participation has been taken as 10 percent.

3. Trends in FDI and Preliminary Analysis of the Firm-level Data

This section is divided into two sub-sections. Section 3.1 gives a macro view of FDI inflows and discusses the trends in FDI in India in the 2000s and later. Section 3.2 presents a preliminary analysis of firm-level data relating to foreign (equity) investment in Indian industrial firms, covering the period 2000-01 to 2011-12.

Since the main object of the paper is to assess the impact of foreign investment in Indian manufacturing firms on certain performance indicators of those firms, covering the period 2000-01 to 2011-12, a brief discussion on the trends in FDI inflows in India in this period would obviously be useful, as a background to the analysis presented later. The preliminary analysis of the firm-level data serves the same purpose, providing an indication of the magnitude of foreign equity investment in Indian industrial firms and its distribution across industry groups and over time.

3.1 *Trends in FDI*

3.1.1 Table 1 presents data on India's FDI inflows in the years 2000-01 to 2012-13, showing inter-temporal changes in aggregate FDI inflows as well as foreign equity inflows. The table is based on DIPP (Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Government of India) data on India's FDI inflows. It is interesting to observe from the table that there was a sharp increase in FDI inflows in 2006-07 over the previous year, and another large increase in 2007-08. The increase in aggregate FDI inflows between 2005-06 and 2006-07 was by about 150 percent, and that in equity investment was by about 125 percent. Between 2006-07 and 2008-09, aggregate FDI inflows increased by about 84 percent and foreign equity inflows increased by about 150 percent. There is no clear trend in FDI inflows in the period after 2008-09. The inflows in 2010-11 were lower than those in 2008-09. However, there was a smart recovery the next year, i.e. 2011-12. In the year 2012-13, FDI inflows came down significantly from the levels reached in 2011-12 with the results that the FDI inflows in 2012-13 were lower than those in 2008-09.

3.1.2 It is important to note that the average annual FDI inflows of India in the period after 2005-06 were substantially higher than those during the period 2000-01 to 2005-06. This is true both for aggregate FDI inflows and foreign equity inflows. In the case of equity

inflows, for instance, the average inflow during the period 2000-01 to 2005-06 were about US$ 3.4 billion while that during the period 2006-07 to 2012-13 were about US$ 24.7 billion, i.e. more than seven times the figure for the first half of the 2000s.

3.1.3 Sector-wise breakup of FDI inflows is presented in Table 2. It is evident from the table that a substantial portion of the FDI inflows during the period April 2000 to March 2012 went to the services sector. The share of manufacturing in the total inflows of FDI in India in this period appears to be below the 50 percent mark. A careful analysis of the industry-wise division of FDI inflow undertaken by Chalapati Rao *et al.* (2014) brings out that the share of manufacturing in aggregate FDI inflows in India in the period 2000 to 2012 was about 30 percent, and it was relatively higher at about 40 percent in the more recent period, 2010-2012. The implication is that the huge increase in foreign equity inflows that took place in the second half of the 2000s was not confined to services, electricity and construction. Rather, a sizeable part of these equity inflows went to manufacturing firms. This point obviously has relevance for the analysis carried out later in this paper.

3.1.4 A more detailed industry-wise break up of FDI inflows into manufacturing during the period 2000 to 2012 is depicted in Figure 1. This is based on the estimates provided in the study of Chalapati Rao and associates (2014) mentioned earlier. It is evident from the figure that Drugs and Pharmaceuticals, Chemicals (other than fertilizers), Automobiles and Metallurgical industries dominate the FDI inflows into manufacturing. The combined share of these four industries during the period 2000 to 2012 was about 59 percent. Other industries that were important destinations of FDI inflows include Electrical equipment, Cement and gypsum products, Industrial machinery, Miscellaneous mechanical and engineering industries and Food processing, each accounting for about three percent of the inflow or a higher proportion.

3.1.5 Some observations on the nature of the foreign investors and the nature of foreign investment made in Indian manufacturing would be in order here. These observations are based on the analysis of this aspect undertaken by Chalapati Rao *et al.* (2014).

3.1.6 In the study of Chalapati Rao *et al.* (2014), a distinction has been made between 'realistic FDI" and other FDI inflows. Realistic FDI is defined as those investments where the foreign investor or its parent is engaged in manufacturing. The remaining part of the investments (about one quarter of the aggregate FDI inflows into manufacturing) is dominated by private equity, venture capital, hedge funds and sovereign wealth funds. Within the realistic FDI, a relatively large part appears to be accounted for by greenfield investment (see Figure 2). This is followed by acquisition of existing shares. Combining all realistic FDI in manufacturing where shares of a company are acquired or additional foreign equity inflows take place in an already acquired company, the total comes about 40 percent of the aggregate FDI inflows into Indian manufacturing. This is important to note because the empirical analysis presented later in the paper is essentially about this type of investment.

3.2 *Analysis of Firm Level Data*

3.2.1 As mentioned above, this study on the impact of FDI on firm performance in Indian manufacturing is based on firm level data for 775 manufacturing firms taken from *Ace*

Equity database covering the period 2000-01 to 2011-12. To study how foreign equity participation has changed over time, two threshold levels of foreign equity participation are considered, namely (a) foreign promoters' equity holding of 10 percent or more, and (b) foreign promoters' equity holding of 25 percent or more.

3.2.2 Table 3 shows the total number of manufacturing firms in the sample in various years during 2000-01 to 2011-12, and among them, the firms (in number and percentage) which meet the above mentioned two threshold levels of foreign equity participation in different years.

3.2.3 There are about 500 to 700 firms in the sample each year. In about 42 to 48 percent of the firms in different years, foreign equity participation is 10 percent or more, and in about 29 to 36 percent of the firms in different years, foreign equity participation is 25 percent or more. The sample seems to be somewhat biased towards the firms with foreign equity participation, as many firms with no foreign equity participation probably get excluded from the sample because certain importance pieces of information, particularly details on pattern of equity holdings, are missing.

3.2.4 The comparison between firms belonging to low technology industries and those belonging to medium and high technology industries shown in the table reveals that foreign equity participation is relatively lower in low technology industries. This is true whether one considers the threshold of 10 percent foreign equity holding or 25 percent foreign equity holding.

3.2.5 It is interesting to note from Table 3 that even though there was a huge increase in the foreign equity inflows in Indian manufacturing in the period after the mid-2000s (as indicated by Table 1), there was no clear upward trend in the proportion of firms that cross the specified threshold levels of foreign equity participation. This pattern is found for the proportion of firms with foreign equity participation of 10 percent or more, and the same holds true for the proportion of firms with foreign equity participation of 25 percent or more. These findings are obviously surprising given that there was a huge increase in foreign equity inflow in the second half of the 2000s as observed in Table 1 above. A closer examination of the data reveals that in 150 cases, the foreign equity participation in the firms has increased from a level below 10 percent to a level of 10 percent or more during the period under study, i.e. 2000-01 to 2011-12 (see Table 4). On the other hand, the reverse change i.e. the extent of foreign equity participation decreasing from a level of 10 percent or more to a level below 10 percent has occurred in 157 cases. Similarly, it is found that in 90 cases, the level of foreign equity participation has increased from a level below 25 percent to a level of 25 percent or more (see Table 4). The reverse change has occurred in 101 cases. It is evident from the examination of the data that while there has been considerable inflow of foreign investment in Indian manufacturing firms (companies), this has not led to any general increase in the share of foreign promoters in equity holding in the Indian industrial firms (companies). While the share of foreign promoters in equity has increased in a number of cases to the threshold levels or beyond, there has been a decrease to a level below threshold in an equally large number or a greater number of cases.

3.2.6 The opposing trends of rising foreign equity share in some firms and falling foreign equity share in some other firms seems to have, by and large, neutralized each other. Hence,

there has been no clear upward trend or downward trend in the overall share of foreign promoters in equity of Indian manufacturing companies. This may be seen from Figure 3 which shows the average foreign equity holding in the 775 sample companies considered for the study.

3.2.7 It may be mentioned in passing that in the study of Petkova (2013) on Indian manufacturing firms for the period 2000-01 to 2008-09, she identified 66 cases of foreign investment in Indian manufacturing, i.e. the cases in which foreign equity holding crossed the threshold limit of 10 percent. Also, she found 46 cases of disinvestment, i.e. the cases in which foreign equity holding came down from a level of 10 percent or above to a level below 10 percent. These findings are broadly consistent with the findings of this study. According to the assessment made by Petkova, the largest number of cases of foreign direct investment took place in 2006. This matches the pattern observed in Table 4. According to Petkova, this sharp increase in the number of cases of foreign investment in 2006 may have a lot to do with Clause 49 of the listing agreement for all Indian publically traded companies which became effective from January 1, 2006. This clause ensures greater transparency in various ways and thus encouraged foreign investment. It mandates 50 percent independent directors or one-third if the chairperson of the board is a non-executive director. Other requirements imposed include independent audit committee and disclosure of information on subsidiary companies.

3.2.8 Table 5 shows the distribution of sample firms according to two-digit industries to which they belong. A further sub-division of firms has been made according to the level of technology. Firms have been divided into two groups in terms of technology used: low, and medium and high. Out of the 775 firms covered in the study, 124 belong to chemicals and chemical products (medium technology firms), 66 belong to textiles (low technology firms), 55 firms belong to pharmaceuticals and 50 firms belong to computers, electronics and optical products (high technology firms). The following industries account for the dominant portion of the cases of foreign direct investment: textiles, chemicals and pharmaceuticals, non-metallic mineral products, basic metals, computer and electronics, and non-electrical machinery.

3.2.9 Before concluding this section, it should be pointed out that there are several cases in which a firm experiences a decline in foreign equity participation percentage below the threshold and an increase back to the threshold. An examination of the data reveals that out of the 150 cases of firms which experienced an increase in foreign equity participation from a level below 10 percent to a level of 10 percent or more, there are 11 cases which had experienced a reverse change within the previous three/four years. Similarly, out of the 90 cases, in which the increase in foreign equity participation percentage was from a level below 25 percent to a level of 25 percent or more, there are 8 cases where the reverse change had taken place in the previous three/four years.

4. Results of Econometric Analysis

4.1 *Differences between domestic and foreign firms*

4.1.1 To analyze differences in certain important firm characteristics between domestic and foreign firms, t-test for equality of means has been applied. Table 6 makes a comparison

of the mean values between domestic and foreign firms in respect of certain variables representing important firm characteristics. The table reports t-statistic for the test of equality of means. A comparison is made between the observations (firm by year) in which the foreign equity proportion is less than 10 percent (regarded as domestic firm) and the observations in which the relevant proportion is 10 percent or more (regarded as foreign firm).[4] It should be noted that categorization is not done by firm but by observation.[5] Thus, some firms are treated as a domestic firm in some observations and as a foreign firm in others. This occurs in those cases where a significant change takes place over time in the foreign equity holding proportion in the firm making foreign equity share cross over the 10% threshold in some year during the period under study. Therefore, these firms change from being a domestic firm to a foreign firm (or from a foreign to a domestic firm).

4.1.2 The comparison of means shown in Table 6 indicates that the foreign firms are bigger in size than domestic firms. Expenditure on royalty and technical fees in foreign exchange is relatively higher for foreign firms than domestic firms, which implies that the foreign firms are more technology oriented than domestic firms. Also, it may be inferred from the table that foreign firms have relatively higher intensity of imports of materials, stores and spares, and capital goods. On the other hand, foreign firms do not have higher export intensity than domestic firms. Rather, the opposite seems to be true. Another interesting finding is that the foreign firms have greater liquidity and are less leveraged. Indeed, there is a marked difference in the debt-equity ratio between the foreign and domestic firms; it is relatively lower in foreign firms.

4.1.3 The comparison of means presented in Table 6 has been followed-up by a discriminant analysis. The results of this analysis indicate that the two most important factors that distinguish between domestic firms and foreign firms are: (a) debt-equity ratio and (b) whether the firm belongs to a business house. The results indicate that a foreign firm is more likely to be a firm belonging to a business house than an independent private firm. Also, the debt-equity ratio in a foreign firm is likely to be lower than that in a domestic firm. Other important factors distinguishing between domestic and foreign firms are size of the firm, technology import intensity, import intensity and export intensity. In the case of the last factor, there is an inverse relationship, i.e. foreign firms are expected to have lower export intensity.

4.2 Probit Model for Explaining Foreign Investment

4.2.1 As mentioned earlier, a Probit model has been estimated to obtain the propensity scores to be used for matching. The estimates of the Probit model are presented in Table 7. The model explains the transition of firms from being domestically owned to foreign owned.

4.2.2 Since the model explains the transition of domestic firm to foreign firm, it is estimated from those observations in which the one-year lagged value of foreign equity proportion is

[4] In most cases, the variables representing firm characteristics have been winsorized at 2.5 percent level to take care of extreme variation in the values of the variables. This applies also to variables used for the estimation of the Probit model presented later.

[5] There are over 3500 observations for domestic firms and over 3000 observations for foreign firms, summing over observations for different years.

less than 10 percent. It should be noted further that the explanatory variables in the model are lagged by one year (to take care of possible simultaneity bias), except in the case of dummy variables such as membership of business house. The model includes year dummies and two-digit industry dummies. These dummy variables are intended to capture the inter-industry differences and incorporate the influence of time factor, for example, the effect of clause 49 that came into effect in 2006 (mentioned earlier).

4.2.3 The Probit model estimate indicates that the probability of transition of a domestic firm to a foreign firm is positively related to the rate of investment and negatively related to cash flow situation in the firm. Thus, an important reason for foreign equity inflow in a firm may be the financial requirements of the firm. The coefficient of the debt-equity variable in the model is negative, which is consistent with the pattern observed in Section 4.1. The coefficient is not strictly statistically significant, but the t-ratio is high enough to infer justifiably that high leverage discourages foreign direct investment in a manufacturing firm in India.

4.2.4 It appears from the model results that foreign equity participation is more likely to take place in new firms than in old firms. Also, firms belonging to business houses are more likely to attract foreign direct investment than firms not belonging to business houses.

4.3 Estimates of the Impact of Foreign Direct Investment

4.3.1 Three indicators of performance are considered for assessing the impact of foreign direct investment on the performance of manufacturing firms. These are: (a) growth in real sales measured by changes in logarithm of real sales,[6] (b) change in profitability measured by the ratio of profit before tax and exceptional items to gross sales, and (c) change in export intensity measured by the ratio of value of export to gross sales. The estimates of ATT (average treatment effect on the treated) obtained by the matching procedure of Arnold and Javorick (2009) are reported in Table 8.[7]

4.3.2 It is seen from Table 8 that none of the estimates of ATT for sales growth and change in export intensity are statistically significant. Also, the estimates are erratic. The estimate of ATT for sales growth is negative for years 0 and 1 and turns positive for later years. The estimate of ATT for export intensity is negative for years 0, 1 and 2 and turns positive for year 3. All these estimates of ATT for change in export intensity are rather low. Thus, it is difficult to judge whether foreign direct investment will have a positive or a negative effect on growth and export performance. Based on the results obtained, one may conclude that the estimates of ATT do provide any clear indication of a significant effect of foreign equity inflow in a firm on its growth or export performance.

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[6] Sales have been deflated by the wholesale price index of manufactured products.

[7] The estimates make use of PSMATCH2 run on STATA 12 along with MATCHCAT procedure developed by Arnold. While making matches, the firms that turned from foreign owned to domestically owned in one year and then turned again to foreign owned in the next year have been excluded. Also, while finding a match for a particular treated firm, the year of treatment is considered and the foreign equity proportion in other firms in that year is considered. Among the other firms, those in which foreign equity proportion is more than (or equal to) 10 percent in the year of treatment and also in the previous year are not considered as a possible control.

4.3.3 It should be noted that the results obtained here in respect of the impact of FDI on growth performance of Indian manufacturing firms are at variance with the findings of Petkova (2013) who has found a significant positive effect of FDI on growth of firms. One possible reason why the findings of this study differs from that of Petkova is that the period covered in this study includes the years of recent global economic crisis, which are not included in Petkova's study.

4.3.4 In the case of profit rate, the estimates of ATT are statistically insignificant for years 0, 1 and 2, and statistically significant for year 3. The estimates of ATT for years 2 and 3 are relatively large in numerical magnitude. The estimate for year 2 is greater than the standard error, and the estimate for year 3 is well above the standard error (see Figure 4 for a graphic presentation of changes in profitability among treated and control group firms). This is suggestive of a positive effect of FDI on profitability of manufacturing firms.

4.3.5 To examine further the effect of FDI on profitability, an alternate estimate of ATT has been made in which matching has been done simply on the basis of propensity scores without paying any attention to the timing of the treatment and industry affiliation of the treated firms. The results of this analysis are reported in Table 9. In this case, the estimates of ATT are statistically insignificant for all four years. However, the estimated ATT is positive in numerical value for all four years, and the estimate for year 3 is relatively big in numerical magnitude and greater than the standard error. Indeed, the t-ratio is only marginally less than the tabulated value for 10 percent level of statistical significance. Thus, considering the results reported in Tables 8 and 9, it may be inferred that there are indications of a positive effect of foreign direct investment on profitability of manufacturing companies by the third year.

5. Conclusion

5.1 The effect of foreign direct investment in Indian manufacturing firms on their performance has been studied in this paper using data on 775 manufacturing companies for the period 2000-01 to 2011-12. Three indicators of performance are considered for the analysis: growth, profitability and export intensity.

5.2 An interesting finding of the study is that while there was a huge increase in FDI inflows particularly foreign equity inflows from the mid-2000s, the foreign equity share in Indian manufacturing companies has not increased much. A close examination of the data revealed that while the foreign equity share increased beyond the 10 percent threshold in about 150 firms out of 775 firms studied, in another 157 firms, foreign equity share declined from a level of 10 percent or more to a level below 10 percent. Similarly, in 90 cases, the foreign equity share increased beyond the threshold level of 25 percent, and in another 101 cases, the reverse change took place.

5.3 Analysis of firm level data reveals that some of the most important factors that determine foreign direct investment in Indian manufacturing firms are: (a) debt-equity ratio, (b) whether the firm belongs to a business house, and (c) import orientation of the firms. Also, it appears that one important cause for foreign investment taking place in a firm may be connected with the financial requirements of the firm; a firm engaged in large investment

activity and not having sufficient resources of its own is more likely to go for foreign equity inflow. Thus, the underlying basis for the foreign investment decision in this case is more financial than strategic.

5.4 The main focus of the study is on the assessment of the impact of FDI on firm performance. The estimates obtained by using difference-in-difference estimator coupled with propensity score matching did not show a significant effect of FDI on growth and export performance. However, there is some evidence, though not strong, that FDI tends to raise profitability of Indian manufacturing firms after two or three years. This is probably a manifestation of the productivity enhancing effect of FDI. In this sense, the findings of this study are in agreement with the findings of the study of Arnold and Javorcik (2009) undertaken of manufacturing plants of Indonesia.

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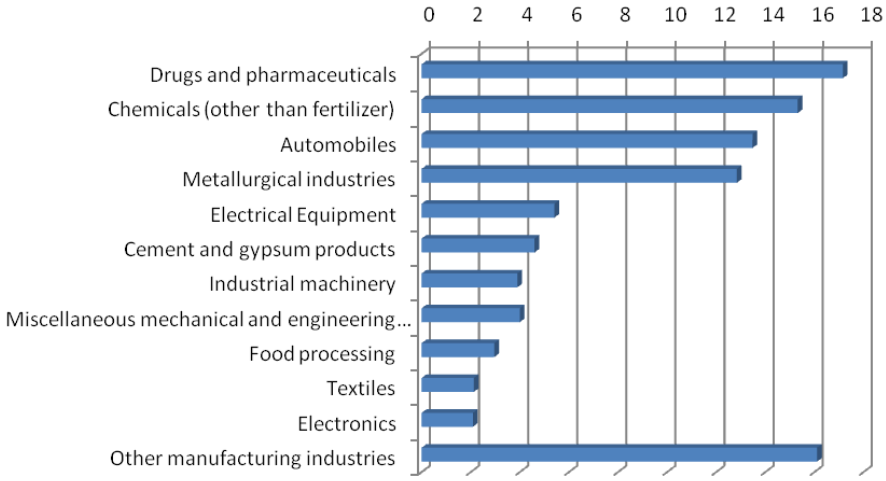
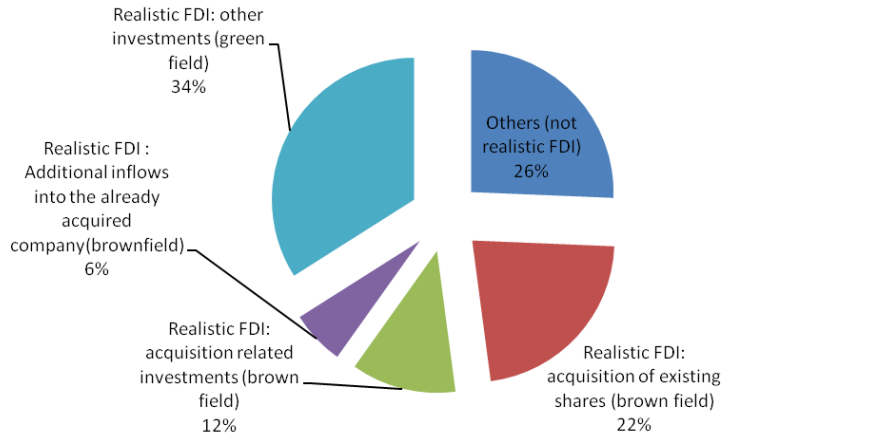
Fig. 1 : Share in FDI (%), manufacturing, during 2000-2012



Source: Prepared by Authors from FDI inflow data provided in Chalapati Rao *et al.* (2014).

Fig. 2 : FDI in Manufacturing, September 2004 to March 2013 (% share)



Source: Prepared by Authors based on estimates of category-wise FDI inflows into manufacturing made by Chalapati Rao *et al.* (2014).

Note: The sample covers only those manufacturing firms (companies) for which details of equity holding are available. Thus, many small firms in which there is no foreign equity participation get excluded as the details of equity holding are not available. The average level of foreign equity participation shown in the graph is therefore an over-estimate of foreign equity participation in all manufacturing companies in India.

Source: Authors' computation based on Ace Equity database.

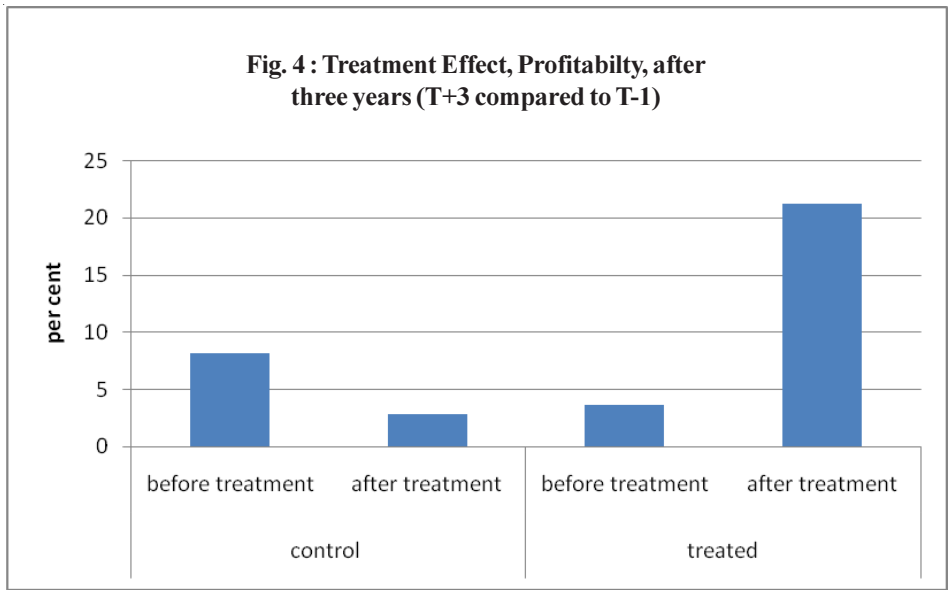


Table 1: India's FDI Inflows, 2000-01 to 2012-13

Financial Year	FDI Inflow (As per International Best Practices) (US $ Million)	% Growth over Previous Year	FDI equity inflow (US $ Million)	% Growth over Previous Year
2000-01	4029		2,463	
2001-02	6130	52	4,065	65
2002-03	5035	-18	2,705	-33
2003-04	4322	-14	2,188	-19
2004-05	6051	40	3,219	47
2005-06	8961	48	5,540	72
2006-07	22826	146	12,492	125
2007-08	34843	53	24,575	97
2008-09	41873	20	31,396	28
2009-10 (P)+	37745	-10	25,834	-18
2010-11 (P)+	34847	-8	21,383	-17
2011-12 (P)	46556	34	35,121	64
2012-13(P)+	36860	-21	22,423	-36

Source: Based on DIPP, "Fact Sheet on Foreign Direct Investment (FDI)", April2014.

"(P)" All figures are provisional; "+" Data in respect of 'Re-invested earnings' & 'Other capital' for the years 2009-10, 2010-11 and 2012-13 are estimated as average of previous two years.

Table 2: Sectors Attracting Relatively High FDI Equity Inflows, India, April 2000 to March 2012 [Amount, Rupees in crores (US$ in million)]

Ranks	*Sector*	*2009-10 (April-March)*	*2010-11 (April-March)*	*2011-12 (April-March)*	*Cumulative Inflows (April 00 - March 12)*	*% age to total Inflows (In terms of US$)*
1	SERVICES SECTOR (financial & non-financial)	19,945 (4,176)	15,053 (3,296)	24,656 (5,216)	145,764 (32,351)	19 %
2	TELECOMMUNICATIONS (radio paging, cellular mobile, basic telephone services)	12,270 (2,539)	7,542 (1,665)	9,012 (1,997)	57,078 (12,552)	7%
3	CONSTRUCTION ACTIVITIES (including roads & highways)	13,469 (2,852)	4,979 (1,103)	13,672 (2,796)	52,253 (11,433)	7%
4	COMPUTER SOFTWARE & HARDWARE	4,127 (872)	3,551 (780)	3,804 (796)	50,118 (11,205)	7%
5	HOUSING & REAL ESTATE	14,027 (2,935)	5,600 (1,227)	3,443 (731)	49,717 (11,113)	7%
6	CHEMICALS (OTHER THAN FERTILIZERS)	1,726 (366)	1,812 (398)	36,227 (7,252)	47,904 (9,844)	6%
7	DRUGS & PHARMACEUTICALS	1,006 (213)	961 (209)	14,605 (3,232)	42,868 (9,195)	5%
8	POWER	6,138 (1,272)	5,796 (1,272)	7,678 (1,652)	33,214 (7,299)	4%
9	AUTOMOBILE INDUSTRY	5,893 (1,236)	5,864 (1,299)	4,347 (923)	30,785 (6,758)	4%
10	METALLURGICAL INDUSTRIES	1,999 (420)	5,023 (1,098)	8,348 (1,786)	26,936 (6,041)	4%
	TOTAL FDI INFLOWS *	123,120 (25,834)	88,520 (19,427)	173,946 (36,504)	775,006 (170,407)	-

Source: Based on DIPP, "Fact Sheet on Foreign Direct Investment (FDI)", March 2012.

Note: (i) Cumulative Sector-wise FDI equity inflows (from April 2000 to March, 2012); (ii) FDI Sectoral data has been revalidated with that of RBI, and the comparison revealed only minor changes in the FDI figures(increase/decrease) as compared to the earlier published sectoral data.

Table 3: Foreign equity holding among firms in the sample, 2000-01 to 2011-12,by year

Year	Total number of firms in the sample	Firms in which foreign equity percentage is 10 percent or more		Firms in which foreign equity percentage is 25 percent or more		Among firms belonging to low technology industries		Among firms belonging to medium and high technology industries	
	No.	No.	Percent	No.	Percent	Percentage of firms with foreign equity>=10%	Percentage of firms with foreign equity >=25%	Percentage of firms with foreign equity >=10%	Percentage of firms with foreign equity >=25%
2000	528	248	47	189	36	37	21	49	39
2001	609	292	48	221	36	36	22	51	40
2002	638	292	46	217	34	35	21	49	38
2003	637	287	45	210	33	37	21	47	36
2004	649	287	44	202	31	36	18	46	35
2005	660	284	43	204	31	35	17	45	35
2006	690	329	48	220	32	39	19	50	35
2007	689	309	45	219	32	36	20	47	35
2008	695	311	45	223	32	33	20	48	35
2009	681	300	44	210	31	30	18	48	34
2010	653	286	44	195	30	30	19	48	33
2011	646	274	42	186	29	32	21	45	31

Source: Authors' computation based on Ace Equity data.

Table 4: Number of Sample Firms and Cases in which Foreign Equity Percentage in Firms Reached the Threshold Foreign Equity Holding Levels of 10 and 25 Percent, by year

Year	Number of firms in the sample	Cases in which foreign equity holding percentage in the firms has increased to reach the specified threshold level	
		Reached 10%+	Reached 25%+
2000-01	528	NC	NC
2001-02	609	8	6
2002-03	638	5	4
2003-04	637	10	6
2004-05	649	10	6
2005-06	660	12	10
2006-07	690	53	23
2007-08	689	8	6
2008-09	695	12	11
2009-10	681	11	5
2010-11	653	10	7
2011-12	646	11	6
Total		150	90

Source: Authors' computation based on Ace Equity data.NC= Not computed.

Table 5: Distribution of Sample Firms — Industry Group, Level of Technology and Foreign Equity

Two Digit NIC Code	Description	Number of Firms				
		Total	Level of Technology		Cases in which the foreign equity holding percentage has increased to reach specified threshold level	
			Low	Medium & High	Reached 10%+	Reached 25%+
10	Manufacture of food products	45	45	0	5	2
11	Manufacture of beverages	10	10	0	3	2
12	Manufacture of tobacco products	2	2	0	0	0
13	Manufacture of textiles	66	66	0	17	7
14	Manufacture of wearing apparel	12	12	0	3	2
15	Manufacture of leather and related products	2	2	0	0	0
16	Manufacture of wood and products of wood and cork, except furniture; Manufacture of articles of straw and plaiting materials	2	2	0	0	0
17	Manufacture of paper and paper products	19	19	0	2	3
19	Manufacture of coke and refined petroleum products	15	0	15	3	2
20	Manufacture of chemicals and chemical products	124	0	124	24	15
21	Manufacture of pharmaceuticals, medicinal chemical and botanical products	55	0	55	14	9
22	Manufacture of rubber and plastics products	52	0	52	8	5
23	Manufacture of other non-metallic mineral products	43	0	43	10	7
24	Manufacture of basic metals	68	0	68	18	9
25	Manufacture of fabricated metal products, except machinery and equipment	15	0	15	3	1
26	Manufacture of computer, electronic and optical products	50	0	50	9	7
27	Manufacture of electrical equipment	53	0	53	4	5
28	Manufacture of machinery and equipment n.e.c.	73	0	73	15	6
29	Manufacture of motor vehicles, trailers and semi-trailers	44	0	44	7	3
30	Manufacture of other transport equipment	3	0	3	0	0
32	Other manufacturing	20	8	12	5	5
33	Repair and installation of machinery and equipment	2	0	2	0	0
	All Manufacturing Firms	775	166	609	150	90

Source: Authors' computation based on Ace Equity data.

Table 6: Difference between Domestic and Foreign Firms, Important Firm Characteristics

Variable/firm characteristics	Mean value for Domestic firms	Mean Value for Foreign firms	t-statistics (P-value)
Age (years)	27.1	30.4	8.11(0.000)
Debt-equity ratio	6.44	4.13	-12.9 (0.000)
Export intensity	0.083	0.069	-3.5 (0.000)
Size (logarithm of gross fixed assets)	3.88	4.32	9.7 (0.000)
Investment rate (ratio of investment to gross fixed assets)	0.114	0.139	4.15 (0.000)
Ratio of capital goods imports to gross fixed assets	0.007	0.010	6.47 (0.000)
Ratio of imports of materials, stores and spares to gross sales	0.044	0.059	6.51 (0.000)
Ratio of payment for royalty and technical fees in foreign exchange to gross sales	0.0002	0.0018	15.3 (0.000)
Ratio of cash and bank balance to gross sales	0.073	0.089	4.45 (0.000)
Selling and distribution expenses to gross sales ratio	0.0427	0.0426	0.09 (0.92)
Cash-flow to sales ratio	0.016	0.038	4.2 (0.000)

Source: Authors' computations.

Table 7: Estimated Probit Model: Explaining Transition from Domestic to Foreign Ownership (threshold defined as foreign equity participation of 10%)

Explanatory variable	Coefficients
Royalty and technical fee/sales	-10.948 (-0.46)
Cash flow/sales	-0.359 (-2.43)**
Debt-equity ratio	-0.010 (-1.62)
Capital goods imports/gross fixed assets	-0.099 (-0.04)
Size (logarithm of gross fixed assets)	-0.009 (-0.32)
New firm (5 years of age or younger)	0.769 (2.36)**
Old firm (over 30 years of age)	-0.198 (-1.99)**
Firms not belonging to business groups (dummy)	-0.173 (-1.77)*
Foreign equity percentage (lagged)	-0.036(-2.57)***
Export intensity (exports/sales)	-0.107 (-0.43)
Ratio of imports of materials, stores and spares to gross sales	1.033 (2.02)**
Investment rate (investment/gross fixed assets)	0.353 (2.43)**
Industry dummies	Yes
Year dummies	Yes
Constant	-1.67
Pseudo R-squared	0.108
No. of observations	3707

t-ratios in parentheses. *, **, *** statistically significant at ten, five and one percent respectively.

Source: Authors' computations.

Table 8: Difference in Difference Matching Estimates of Average Treatment Effect (increase in outcome variables in comparison to one year before the change in ownership)

Time (year)	Change in logarithm of sales (Sales growth)	Change in profit rate	Change in export intensity
0	-0.061 (0.398)	-0.106 (0.255)	-0.004 (0.005)
1	-0.029 (0.545)	0.051 (0.472)	-0.002 (0.010)
2	0.043(0.913)	0.198 (0.131)	-0.018 (0.126)
3	0.017(0.697)	0.228 (0.064)*	0.004 (0.058)

Note: Figures in parentheses are standard errors obtained by bootstrapping procedure.

* statistically significant

Source: Authors' computations

Table 9: Difference in Difference Matching Estimates of Average Treatment Effect on Profitability

Time (year)	ATT (change in profitability)	Standard Error	t-statistics
0	0.032	0.085	0.38
1	0.021	0.086	0.25
2	0.048	0.110	0.44
3	0.203	0.129	1.57

Source: Authors' computations.

FDI, Technology Acquisition and Labour Demand in an Emerging Market Economy: *A Firm-Level Exploration of Indian Manufacturing Industries*

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Abstract

The paper investigates the impact of foreign direct investment on firm-level labour demand in India. FDI inflow and hence MNE participation in India during the post reforms period might have serious implications on the labour market. The evidence of inter-firm variations in labour demand across sectors is indicative of the existence of factors specific to firms. This paper estimates the impact of ownership, labour productivity and technology acquisition on firm-level employment across industries post 2000. Hausman Taylor estimation results show that foreign ownership does not play a significant role in determining firm-level labour demand in Indian manufacturing. In particular, technology acquisition by foreign firms is not labour displacing for major sectors. However productivity has a negative impact on firm-level employment.

1. Introduction

1.1 The developing economies integrate with the world with the process of liberalization. One of the critical issues in this process of integration which the governments need to address is the impact of such liberalization on labour market in terms of wages and employment (Banga, 2005). With major economic reforms since the 1990s, including reforms in the FDI policies, FDI inflows through MNE operations in India have witnessed a robust rising trend. Effect of such inflow of FDI on labour market particularly on employment and wages continues to be a very crucial issue for the labour surplus emerging market economies like India. This is one such issue which has not been explored much in the Indian context. With the MNEs operating, there has also been a rapid rise in the import of foreign technology both in embodied and disembodied form. FDI and imported technology might improve labour productivity in the developing economies but can have differential impact on wages and employment depending on the differences in the labour laws across countries. This issue of the impact of FDI and import of technology on labour market outcomes also deserves adequate attention. In specific, this paper investigates into the impact of FDI on firm-level employment across manufacturing industries in India. In this paper, post-2000 period has been chosen for analysis on account of quantum rise in export and technological intensities in conjunction with a sharp rise in FDI particularly in India after 2000. In the (econometric) analysis that follows, the study controls for factors including technology, productivity and foreign ownership in determining firm-level labour demand in Indian manufacturing enterprises. It is in this aspect where the study in particular, contributes to the existing literature. This analysis however, does not look into important issues including firm-level wage determination and wage inequality in the emerging market economies.

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1.2 The standard trade theory based on the Hecksher-Ohlin model would suggest that with trade liberalization there would be a favorable effect on the manufacturing employment of the developing countries. The H-O-S framework suggests that employment reduces with increased imports while it increases with increased exports. However, such implications are very industry specific. There can be a variety of factors by which liberalization might affect labour the most important being trade, FDI, international technology transfer and labour productivity. If FDI is concentrated in labour intensive industries, the positive impact of FDI on the level of employment would be substantial. FDI can also lead to increased employment amongst local firms as a result of backward and forward linkages. If an MNE firm makes long term commitment in the host country, it can provide stable employment (Jenkins, 2006). Theoretical literature suggests that the impact of FDI on total employment can be understood in two different ways. One argument is that with inflow of FDI there is an exogenous growth of output which in turn enhances employment opportunities. Apart from bringing in a package of productive resources in to the host country, FDI creates a significant possibility of job creation not only in the FDI intensive sectors but also in supporting domestic industries (Hill and Athukorola, 1998). Further, MNE affiliates facilitate access to foreign markets through exports which generate sources of employment. The benefits do not remain confined to the quantitative increase in employment but also improves the quality of the workforce in terms of skill and knowledge spillovers (Young et. al, 1988). One channel of such spillover is through turnover of employees (Fosfuri et. al, 2002; Glass and Saggi, 2002; Gorg and Strobl, 2005) and managers (Gershenberg, 1987; Pack 2001). As against this argument, the impact of Foreign Direct Investment on the labour market of the host economy can also be deduced from the Industrial Organization theory. As Hymer (1960), Kindleberger (1969), Caves (1971) argue that foreign firms possessing sophisticated technology, managerial and organizational skills, and marketing and distribution networks have some monopolistic advantage over the domestic firms. Thus varying labour market outcome can arise from the kind of technology employed by the foreign firms as compared to the local firms. The technology introduced by the MNEs is highly capital intensive and skill based. This might reduce employment potential as they are expected to have lower employment elasticity of output as compared to the domestic firms with labour intensive techniques of production (Pradhan and Sahoo, 2004). The idea that FDI may not bring in technology which is labour augmenting may lead to an absolute reduction in the overall employment (Nickel and Bell, 1996; Vivarelli and Pianta, 2000; Tayor and Driffield, 2000). This is typical to the developing market economies. Again, greater openness might affect employment by influencing the quantity and kind of labour required to produce a given output. Such effects are largely on account of changes in factor prices which arise out of changes in factor demand. As a result of competitive pressure, firms experience increased productivity influencing aggregate employment (Greenaway et al, 1999). Such trade-induced productivity effect can be a result of decrease in X-inefficiency (Chand and Sen, 2002) or trade-induced technological transfers (Jenkins and Sen 2006).

1.3 The experience of different countries has been varying with respect to the effect of trade liberalization and inflow of FDI on the level of employment. Nunnenkamp, Bremont and Waldkrich (2007) investigated the effect of FDI on the employment generation of Mexican manufacturing industries. A panel data analysis across 200 manufacturing firms reveals that FDI has a significant positive impact on the manufacturing employment of Mexico. Fu and Balasubramanyam (2005) found a strong linkage between FDI and

employment as well as FDI and exports in China. Craigwell (2006) investigates the impact of FDI on employment in the English and Dutch Speaking Caribbean. Empirical results following a panel data estimation technique reveal that FDI in a sample of Caribbean countries leads to an approximate one to one increase in employment. In a recent empirical study on Chinese manufacturing from the period 1998-2004, Karlsson, Lundin, Sjoholm and He (2009) conclude that FDI has contributed to employment in the Chinese manufacturing through its access to international markets and other firm characteristics which favour growth of employment. Liyan and Liu (2012) in an analysis exploring specific relationship between FDI and employment of three strata industries in China, indicate that in secondary and tertiary industries, growth of FDI in the long run promotes employment and this is particularly true for the tertiary industries. Based on a sample of Chinese state owned enterprises for the period 1999 to 2003, Gorg et.al (2006) examine the effect of privatization and foreign acquisition on employment. The results suggest that foreign acquisition increases employment.

1.4 A few studies recently have explored the labour market impact of international trade from a developing country perspective (Revenga 1997; Moreira and Najberg 2000; Sen 2009; Raj and Sen 2012). However, the results remain inconclusive. Sen (2009) concludes that Bangladesh and Vietnam experienced positive employment growth due to trade openness in contrast to Currie and Harrison (1997) who found no statistically significant impact of trade reform on employment in Morocco for private sector enterprises. Such absence of any impact of trade on employment has also been reported by Lang (1998) for New Zealand.

1.5 Goldar (2000) analyzed Indian manufacturing for the period 1980-81 to 1997-98 and found that trade liberalization raises labour demand elasticity. Pradhan et al. (2004) analysed the role of FDI in the labour market outcomes of wage and employment in the Indian manufacturing. The findings suggest that foreign firms do not have any adverse effects on the manufacturing employment in India as compared to their domestic counterparts. Banga (2005) examines the impact of FDI, trade and technology on employment and wages of the Indian organized manufacturing industries. The results show that FDI, trade and technological progress have differential impact on wages and employment. While higher extent of FDI in an industry leads to higher wage rate, it has no effect on employment. However, higher export intensity of an industry increases employment of the industry.

1.6 Empirical literature also provides studies which contradict the observation that FDI has a positive impact on employment (Machin and Van Reneen, 1998; Berman and Machin, 2000; Hanson, 2001). Onaron (2008) found that in Austrian manufacturing industries during 1990-2005, employment declined due to increased import penetration. Revenga (1992), Feenstra and Hanson (1996) concluded that increase in import competition or outsourcing has significant effect in terms of decrease in employment in the United States. Davis and Mishra (2007) however argued that such effects on employment depend on whether imports are substitutes or complementary to production in the host country. If imports are not substitutes but complementary inputs to what is produced domestically, then a positive effect on employment is possible. Revenga (1997) confirmed this complementary relationship between import of inputs and employment in Mexico during 1980s. Hasan, Mitra and Ramaswamy (2003, 2007) found that labour demand elasticities with respect to wages increased after trade reforms in India particularly in the states which have flexible labour

markets. Sen (2008, 2009) investigates the effect of international trade on India's manufacturing industries for the period 1975-1999. Using Generalized Methods of Moments, his results do not reveal any significant effect of export orientation and import penetration on employment. He concludes that international trade might not have impact on manufacturing employment. Similar results were revealed in the works of Chister, Kupets and Lehmann (2005) for Ukraine and Abdi and Edwards (2002) for South Africa.

1.7 Studies also reveal the impact of FDI on wages (Singh and Jun, 1997; Hatzius, 1997, Guha and Ray, 2000), firm productivity (Gorg and Greenaway, 2004; Lipsey and Sjoholm, 2005) and exports (Lipsey and Sjoholm, 2004b, Swenson, 2007). Elia, Mariotti and Piscitello (2008) in a slightly different angle investigate the effects of outward FDI on the home country employment and skill composition. Empirical evidence refer to an Italian case through the period 1996-2002 and shows that outward FDI has a significant negative impact on the demand for the low skilled workers in the parent company's "industrial region" , but this is true only for FDI in low wage countries. On the contrary, Navaretti, Castelleni and Disdier (2006) for France and Italy find no evidence of negative effect of outward investments to cheap labour countries on labour demand.

1.8 Any further research on the issue of FDI and labour market outcomes in an emerging country such as India thus has to investigate into the factors at a further disaggregate level as well as to understand the role of foreign ownership. This research work investigates into these dimensions of firm.

1.9 The paper is organized as follows. Section 2 provides some stylized facts on the trend of employment of the Indian manufacturing industries during 2001-2010. Section 3 discusses the analytical framework, the empirical model and method, and the database for analyzing the effect of FDI on aggregate firm level employment. Section 4 presents the empirical results. Section 5 summarizes the major findings of the paper following them by implications for policy.

2. An overview of employment across sectors (2001-2010)

2.1 Some facts on the trend of employment across sectors

2.1.1 As discussed in the earlier section, with FDI inflows and MNE operations, access to world-class technology became cheaper and easier for manufacturing firms in India. This encouraged dependence on technology imports particularly in the form of raw materials. Further, expenditure on indigenous R&D in some high-technology industries like chemical and machinery also increased post 2000 (Ghosh, 2014). Such technology choices across sectors might, on one hand, accelerate export and output growth, but on the other hand increase capital intensity in production. Here it will be relevant to look into employment implications of FDI inflows. Such observations can be posited against the phenomenon of 'jobless growth' as often observed in the Indian economy during post reforms.

2.1.2 Discussion on the trends of employment across sectors in Indian manufacturing as is done in this section has certain limitations. This is on account of non-availability of data on firm-level employment. Further, as observed in the Appendix I, firm-level employment data are estimated only for the period 2000-2010. Despite these limitations, we find that

variations in employment can be noticed across Indian manufacturing sectors post 2000. Table 1 reveals that there has been a sharp rise in employment till 2005, followed by a fall in all major sectors between 2006 and 2010. The fall in employment may be on account of the global economic recession.

3. Analytical framework

The effect of foreign direct investment on total employment works through two different channels. On one hand, with an inward investment, an increase in output can lead to an increase in labour demand, while on the other, capital-intensive technology introduced by FDI through MNE operations may reduce employment potentials. However, sector-biased technical progress increases demand and returns to skilled labour (Gottschalk and Smeeding 1997, Schmitt 1995, Taylor 1999). This leads to a decline in the demand for unskilled labour (Machin and Van Reneen 1998, Berman and Machin 2000, Hanson 2001). Thus, it is important to understand the impact of technology acquisition on net employment, evidence of which suggests ambiguity in the outcome (Krugman 2000, Xu 2001).

Further, with the growing literature on firm heterogeneity, it is evident that technology decisions are taken at the firm-level rather than at the industry level. Hence, the issue of impact on firm-level employment as a result of technology decisions by firms becomes very pertinent. Further, with inflow of FDI and MNE operations in the country, ownership patterns of firms assume importance while studying the firm-level employment patterns. Unfortunately, these issues remain largely unaddressed in the literature. This calls for an analysis of the effects of MNE ownership and technological acquisition on employment at the firm-level in India. This study attempts to fill in this gap in the existing literature by understanding the effect of ownership and technology acquisition on firm-level Indian manufacturing. In what follows is a brief delineation of the theoretical and the estimable models.

3.1 *The Theoretical Model*

Consider the Cobb-Douglas production function of a firm as:

$$Q = AL^{\alpha}K^{\beta} \tag{3.1}$$

where α and β are positive parameters, with $\alpha + \beta = 1$.

With cost minimization of the firm the objective function is:

$$Min\ C = w * L(Q) + r * K(Q); \text{ subject to } Q = AL^{\alpha}K^{\beta} \tag{3.2}$$

where, C = Cost

Q = Output

L = Labour

K = Capital; w and r are the input prices for L and K respectively.

Considering $MP_L/MP_K = w/r$, we have:

$$(\alpha/\beta)\,(Q/L) * K/Q = w/r \tag{3.3}$$

or, $\alpha/\beta * K/L = w/r$

or, $K = (\beta/\alpha)\,(w/r) * L$

Substituting in (3.1) we have:

$$Q = AL\alpha\{(\beta/\alpha)(w/r)\mathrm{L}\}\beta$$

$$\text{or, } Q = A\,L\alpha + \beta\{(\beta/\alpha)(w/r)\}\beta$$

Taking logarithm, we have:

$$logQ = log\,A + (\alpha + \beta)\,logL + \beta log\,(\beta/\alpha) + \beta log(w/r)$$

or

$$logQ = log\,A + (\alpha + \beta)\,logL + \beta(log\beta - log\alpha) + \beta(logw - log\,r)$$

or,

$$logL = log\,Q/(\alpha + \beta) - logA/(\alpha + \beta) - \beta(log\beta - log\alpha)/(\alpha + \beta) - \beta(logw - logr)/(\alpha + \beta) \quad (3.4)$$

3.1.1 The labour demand function thus can be written as: $L^* = f(Q,A,w,r)$. In Equation (3.4) 'A' stands for the productivity implying a parametric shift in this production function. The study also incorporates technology acquisition in the labour demand function. In this analysis labour productivity is used instead of total factor productivity.

3.1.2 However, a firms' ideal labour demand is different from its actual labour demand due to presence of rigidities and frictions in the labour market. Following Hasan, Mitra and Ramaswamy (2007), let us introduce labour market frictions in the framework. Let the actual labour demand in log terms be denoted by L^A and the ideal demand be denoted by L^*. We introduce a lagged expression by L^A_{-1}. Let $0 < \lambda < 1$ denote the extent of labour market frictions. Then we can write the actual labour demand as a weighted average of the ideal labour demand and lagged level of employment, the relative weight of lagged employment being an increasing function of labour market rigidity. Hence the actual labour demand function is written as:

$$L^A = \lambda L^A_{-1} + (1 - \lambda)\,L^* \quad (3.5)$$

3.1.3 This model is a partial adjustment model, (1-λ) being the speed of adjustment. The model is suggestive of the fact that only a part of the gap between desired and actual employment is met in every period and the proportion of the gap increases with labour market flexibility. Inserting the ideal labour demand function into the actual labour demand function we have the dynamic labour demand function as:

$$L^A = \lambda L^A_{-1} + (1 - \lambda)\{log\,Q/(\alpha + \beta) - logA/(\alpha + \beta) - \beta(log\beta - log\alpha)/(\alpha + \beta)$$

$$- \beta(logw - logr)/(\alpha + \beta) \quad (3.6)$$

3.2. *The Estimable model*

3.2.1 The impact of FDI on aggregate employment in Indian manufacturing industries can be analyzed using a dynamic labour demand function. A lagged employment term is introduced in dynamic labour demand function as employment slowly adjusts to the changes in wages and output. With FDI inflows, the MNEs operate in the host economy and can have substantial effect on labour demand. Further, this opens up the possibility to import

foreign technology as well as develop local research and development. Hence, in this model we have controlled for ownership and technology. Further, as labour demand is derived demand it is output constrained. Following Hasan, et al. (2007), the labour demand function is derived as follows:

$$L_{it} = f(L_{it-1}, w_{it}, r_{it}, pdtivity_{it}, Q_{it}, Tech_{it}, own) \tag{3.7}$$

where

L_{it} = Employment level of i^{th} firm in t^{th} time period

w_{it} =Average wage rate in i^{th} industry in t^{th} time period

r_{it} = Real user cost of capital in i^{th} firm in t^{th} time period

$Pdtivity_{it}$ =Labour productivity of the i^{th} firm in t^{th} time period

$Tech_{it}$ = Technology intensity (domestic and imported) of the i^{th} firm in t^{th} time period

Q_{it} = Total sales of the i^{th} firm in t^{th} time period

Own= Ownership

With linearization, the estimable labour demand equation is expressed as:

$$LogL_{it} = a_1 + b_0 LogL_{it-1} + b_1 Logw_{it} + b_2 Logr_{it} + b_3 Logpdtivity_{it} + b_4 LogQ_{it} + b_5 LogTech_{it} + b_6 own + \varepsilon_{it} \tag{3.8}$$

where $b_{i,\, i=1 \text{ to } 6} > 0$. Here, the variable 'own' is denoted by a dummy, which takes the value 1 for foreign ownership and 0 for domestic ownership.

3.3 *Estimation Method and Data Description*

3.3.1 This section of the paper delineates the estimation methodology and data description used for the analysis of impact of FDI and technology acquisition on firm-level employment. In order to understand the impact of FDI and foreign ownership on firm-level employment in Indian manufacturing, we use the Hausman-Taylor estimation method. As discussed earlier, the Hausman-Taylor estimator generates coefficients of time-invariant regressors, which in this case is ownership. This is the relationship of interest in this paper. On account of lack of exact data on production and non-production workers, labour demand elasticities are estimated for total labour employed in the sector. Productivity and lagged labour demand are considered to be endogenously determined within the system.

3.3.2 An empirical research work is largely contingent upon time comparable good database. In this paper, firm-level data from the PROWESS Database from the Centre for Monitoring Indian Economy (CMIE) have been used. PROWESS provides information from audited financial statements and thereby uses company balance sheets and income statements as sources of information. The database covers both listed and unlisted firms from a wide cross-section of manufacturing, services, utilities and financial industries

covering 60-70 per cent of organized sector in India, 75 per cent of corporate taxes and 95 per cent of excise duties collected by the Government of India (Goldberg et al., 2010).

3.3.3 In this study, information on only manufacturing firms is used. The industries chosen for the purpose of analysis are chemicals (including drug and pharmaceuticals), machinery, transport equipment, food and beverages, textiles and basic metals. The choice of these industries has been primarily guided by the fact that these industries cover approximately more than 70 per cent of Indian manufacturing sector. Further, FDI inflows in these sectors have been increasing during post reforms. Again, as these industries widely differ in terms of their technology intensities (ISIC Revision 2), the selected industries cover high/medium-high technology industries like chemicals, machinery and transport equipment as well as medium-low/low technology industries like basic metals, food and beverages and textiles.

3.3.4 The firms are identified according to ownership for finding the "FDI firms" as against "non-FDI firms". PROWESS provides data for foreign promoter's equity holdings. If for a company, equity holding of the foreign promoter exceeds 25 percent, it is classified as a foreign owned firm or a "FDI firm". PROWESS reports data on foreign promoter's equity holdings for post 2001 period. However numerous missing values of equity participation do not auger well with the empirical analyses being carried out. However, the database provides separate information on the ownership group of firm in the sense of whether a firm is 'Private Indian', 'Private Foreign' or a 'State-run' enterprise etc. This information is used in the study to identify domestic and foreign ownership of firms. We use a dummy variable indicating ownership taking the value one if the firm is foreign and the value zero if the firm is domestic. A total of 868 observations for the chemicals industry, 532 observations for the machinery industry, 266 observations for the transport equipments industry, 146 observations for the food & beverages industry, 368 observations for the textiles and garments industry and 98 observations for the basic metal industry are obtained after sifting for possible erroneous observations. The final set of observations includes both domestic and foreign owned firms. Panel structures for each of the six industries are constructed over a period of ten years.

3.3.5 Importantly, Prowess database does not provide data on number of employees. However, information on wages and salaries of a firm is available. We make use of the Annual Survey of Industries (ASI) database to construct the employment variable. For this purpose, 2-digit National Industrial Classification (NIC) 1998, 2004 and 2008 is considered (See Appendix I for Concordance).

4. The Empirical Results

4.1 The Hausman-Taylor estimation results of equation (3.8) showing the effect of FDI on firm-level employment are presented in Table 2. The Wald statistic justifies the overall significance of the model. The estimation coefficients signify elasticity of labour demand with respect to each independent variable. The results show that foreign ownership, measured in terms of a dummy variable, does not have any positive impact on firm-level employment across Indian manufacturing sectors. This result is in conformity with the findings of Banga (2005) that suggests that FDI does not have any significant role in generating employment in Indian manufacturing. The only exception to this pattern is food

and beverages. This can be largely on account of growing exports in this sector during post-reforms. Further, the composition of food and beverages in the export basket has changed from the traditional food items to more value-added items like marine products, processed and packaged food etc. during this period, which is suggestive of the possibility of employment expansion through diversification in this sector. Foreign ownership, thus, plays an important role in determining firm-level employment in this sector.

4.2 The lagged endogenous variable has significant positive impact on employment for all industries excepting chemicals and machinery industries. This arises out of labour market imperfections in terms of frictions and rigidities. This is observed particularly in the case of low and medium technology industries. Average wage has the expected result of a significant negative impact on the demand for firm-level labour for machinery, transport equipment, food and beverages, basic metals and textile industries. This implies that in these industries an increase in average wage leads to the displacement of firm-level labour. Interestingly this is not the case for chemicals where a significant positive relationship is found between average wage and labour demand. Purohit (1989) finds that the ratio of wage to the value of output is the lowest for certain industries including chemicals and engineering. Such low ratio is possibly because of low average wage rates and/or high average productivity of workers. Figure 1 suggests that the average wage rate in the chemical industry is the lowest followed by machinery and food and beverages. Hence, it is expected that these industries would also have high average firm-level labour productivity in the firms. This is suggestive of a favourable situation for the demand for labour. It is quite possible that under such circumstance, the entrepreneurs in the presence of growing output hire more labour and are likely to pay higher average wages. Hence, it is expected that the firms in such industry groups expand and thereby increase their demand for labour.

4.3 The user cost of capital has no statistically significant impact on demand for labour in most industries. The exceptions are chemicals and textiles, where a negative and significant relationship is found. This implies that capital and labour are complements for each other in these industries. With the phasing out of the Multi-Fibre Agreement (MFA) since 1995 the textile industry was exposed to international competition. Relaxation of restrictions on foreign technology and equipments were aimed at making the industry more efficient to face such international competition. However, this did not have an adverse effect on the firm level labour demand of the industry.

4.4 Table 2 also shows that technology acquisition by firms displaces labour significantly in the low technology textiles industry. This is in conformity with the findings of Das and Kalita, (2009) who find that labour intensity declined for the labour intensive industries during post reforms. With import liberalization in the early 1990s, Indian manufacturers acquired imported technology and adapted them in their production processes particularly in textiles and metals industries with a view to technology upgradation. Such technology acquisition gave these industries competitive edge both in terms of prices as well as in scale. This perhaps, has a negative impact on employment in textiles, despite growth and export growth. For other industries however, no significant effect on employment is noticed. Another important factor that determines firm-level employment significantly across sectors is firm level output. Estimation results suggest that as the output of firms expands the demand for labour rises significantly across all sectors. Importantly, labour productivity

has implications for labour market outcomes in Indian manufacturing. Increase in productivity significantly displaces labour across all major sectors barring food and beverages. This is an expected result as with increase in productivity, an increase in wage is expected. The firms thus are likely to employ less labour.

4.5 On the whole, the results show that ownership does not have any significant impact on firm-level employment across sectors in Indian manufacturing, except food and beverages. Barring chemicals and machinery, evidence of significant path dependence is noticed in case of employment. Increase in average wage is expectedly found to have negative impact on firm-level labour demand. However, chemical industry is an exception to this finding. The user cost of capital also has a significant negative impact on labour demand in chemicals and textiles industries implying complementarity between labour and capital in these sectors. Technology acquisition displaces labour only in the low technology textile industry. Employment significantly increases with output but is displaced with increase in productivity across sectors.

5. Summary of Findings

5.1 In this paper, impact of FDI on labour market outcome in terms of firm-level labour demand in Indian manufacturing is studied in the post reforms period. Evidence suggests that the average employment in Indian manufacturing as a whole shows an increasing trend since 2001 particularly in conjunction with rising FDI across sectors. However, there are variations across sectors. Such stylized facts led to inquire into, in particular, the impact of FDI on firm-level employment. Here FDI is accounted for in terms of foreign ownership. The Hausman-Taylor estimation technique is used for empirical estimation.

5.2 MNE operations, along with technology acquisition, have implications for labour demand. Foreign ownership however does not play any significant role in determining firm-level labour demand in Indian manufacturing. The only exception is the food and beverage industry. Estimation results suggest path dependence of employment for most manufacturing industries. An increase in the average wage leads to significant displacement of firm-level labour across all sectors barring chemicals. This is an interesting result which is suggestive of expansion in this sector leading to higher employment generation. The user cost of capital has differential impact on labour demand across sectors. The results suggest that capital and labour are complementary factors in textiles and chemicals. Though an increase in output significantly increases labour demand, technology acquisition by such firms does not have any impact on labour for most sectors. However, for textile industry, technology acquisition is labour displacing. Importantly, productivity has significant impact on employment across sectors. Increase in productivity is found to displace labour across sectors.

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Fig 1: Average Wage Rate across Sectors, 2001-2010

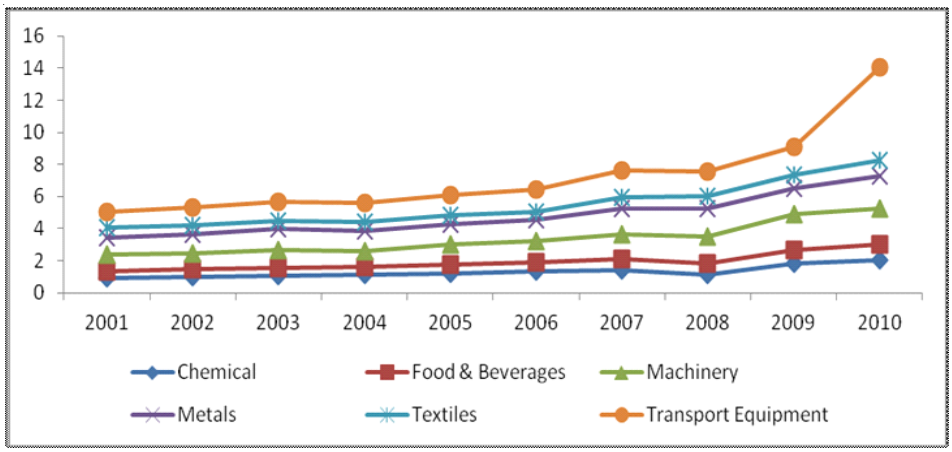

Table 1: Employment across Manufacturing Sectors (figures in crores)

Year	Chemical	Machinery	Transport Equipment	Metal	Food and Beverage	Textile
2001	638	1398	314	1654	1054	252
2002	508	1539	342	1560	1159	351
2003	923	1470	399	1355	1224	479
2004	1070	1706	471	1756	1188	654
2005	1259	1596	557	2265	1131	690
2006	1588	1453	663	2248	1216	977
2007	2001	1726	637	2565	1404	1124
2008	1887	1927	858	2569	1303	1227
2009	3391	1518	864	2954	1277	1090
2010	3834	2050	683	2606	1015	2163

Source: Calculations based on PROWESS and ASI database.

Table 2: Determinants of Firm-level Employment: Hausman-Taylor Estimation

	Chemical	Machinery	Transport Equipment	Food and Beverage	Textile	Basic Metal
Own (Time invariant exogenous variable)	.057 (0.54)	.15 (1.04)	.03 (0.63)	**1.83*** ** (1.71)	.36 (1.25)	-.37 (-0.89)
logq	**.93*** (62.92)	**.73*** (31.51)	**.98*** (88.83)	**.61*** (6.71)	**1.03*** (32.04)	**.90*** (18.39)
logw	**.00001*** (29.95)	**-.16*** (-3.87)	**-.97*** (-59.79)	**-.62*** (-3.08)	**-.96*** (-13.28)	**-.70*** (-3.72)
logr	**-3.04*** (-58.19)	-.24 (-1.62)	-.16 (-0.91)	**.**35 (0.57)	**-1.97*** (-18.71)	.13 (0.59)
logtech	.011 (1.42)	-.008 (-0.83)	.003 (1.03)	**-**.014 (-0.70)	**-.02**** (-2.39)	-.003 (-0.25)
logL_{t-1} (Endogenous)	.012 (1.60)	.037 (2.19)	**.02**** (2.46)	**.07**** (2.16)	**.17*** (8.82)	**.03***** (1.69)
logPdtivity (Endogenous)	**-.88*** (-38.67)	**-.69*** (-23.08)	**-.96*** (-46.88)	.024 (1.20)	**-.79*** (20.51)	**-.80*** (-14.96)
Wald Chi Square	183.37*	1788.81**	2307.19*	130.80*	1298.04*	1097.34*
Number of observations	868	532	266	146	368	98

Note: 1. z values are provided in parentheses

2. * denotes 1% level of significance, ** denotes 5% level of significance, *** denotes 10% level of significance.

3. L_{t-1} denotes labour with one year lag.

APPENDIX

A Note on variable construction

The variables constructed for the purpose of analysis are as follows:

Labour: Number of persons engaged in a firm is arrived at by dividing expenditure on salaries and wages of the firm by the average wage rate of the industry (at 2 digit level) to which the firm belongs. Average wage rate is calculated as Total emoluments/ Total persons engaged.

Wage: Average wage rate of the relevant industry.

Output: Total Sales of a firm is used as an indicator of output.

Real user cost of capital: This variable is constructed by deflating the nominal user cost of capital by industry specific WPI. Nominal user cost of capital is arrived at by multiplying WPI of machinery and machine tools with the sum of average prime lending rate and the rate of depreciation. Following Hasan et al. (2007), the rate of depreciation is considered at 10 per cent. Data on prime lending rate is obtained from Reserve Bank of India database. WPI data used in the study are availed from the Office of the Economic Advisor, Ministry of Industry, Government of India. The study period covers time points of indices with all the two base years. The indices with earlier base periods were converted to bring these time series to uniform base period, 2004-05=100.

Technology intensity: The ratio of the sum of expenditures on R&D, import of raw material, import of capital good and forex payment for technical know-how and royalty payments of firms to firm sales.

Productivity: Ratio of value of output to salaries and wages.

We use a dummy variable indicating ownership taking the value one if the firm is foreign and the value zero if the firm is domestic.

Table A.1: Average Wage Across Sectors (2001-2010)

Year	Chemical	Food & Beverages	Machinery	Metals	Textiles	Transport Equipment
2001	0.93	0.44	1.01	1.05	0.60	1.02
2002	1.00	0.45	1.02	1.18	0.53	1.11
2003	1.08	0.46	1.1	1.32	0.54	1.19
2004	1.13	0.47	1.01	1.23	0.56	1.23
2005	1.21	0.52	1.25	1.26	0.59	1.28
2006	1.32	0.56	1.35	1.31	0.52	1.35
2007	1.44	0.65	1.53	1.64	0.69	1.71
2008	1.11	0.73	1.66	1.76	0.74	1.58
2009	1.83	0.82	2.23	1.66	0.82	1.76
2010	2.06	0.95	2.24	2.02	0.96	5.81

Note: Calculations based on ASI Database; Figures in Rupees Crores.

Table A.2: Classification Concordance between NIC 1998, NIC 2004 and NIC2008

Description	**NIC 1998 2-digit**	**NIC 2004 2-digit**	**NIC 2008 2-digit**
Chemical and Chemical Products	24	24	20+21
Basic Metals	27	27	24
Food Products and Beverages	15	15	10+11
Motor Vehicles, Trailers and Semi Trailers+Other Transport Equipment	34+35	34+35	29+30
Textile Products+Wearing Apparel, Dressing and Dyeing of Fur	17+18	17+18	13+14
Machinery and Equipment NEC +Accounting and Computing Machinery	29+30	29+30	26+27+28

Relative Efficiency of Organized and Unorganized Segments of Indian Textile and Garments Industry: A Preliminary Exploration

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Abstract

Abolition of important protective measures in the Textile Policy of 2000 has exposed the decentralized sector of Textile and Garments (T&G) producers in India to increased competition. The post-reforms period also experienced increased linkages between the organized and unorganized units of this industry. Important observations from the analyses based on annual cross-section unit-level data from the Annual Survey of Industries (ASI) and the National Sample Survey (NSS) rounds respectively on the organized and unorganized sections for the period between 2001 and 2011, include: (i) an absolute decline in the average productivities for the unorganized segment and widening gap with the organized sector in this regard; (ii) a fall in relative efficiency of the former with respect to the other; and (iii) increased divergence from the national grand frontier even of the best performing firms in the unorganized T&G industry.

1. Introduction

1.1 During the pre-reforms years the decentralized small units of the Indian Textile and Garments industry (T&G hereafter) have been given policy support to realize its relatively high potential for employment generation (Little, Mazumdar and Page 1987; Roy 1996). However, average performance of such units did not improve much in this period. This raised concerns regarding the segment's continued dependence on protective policies as well as doubts on effectiveness of such policies (Roy, 1998b; Ganesh 2002). Withdrawal of major protective measures for the unorganized segment in the Textile Policy 2000 increased its dependence on the organized section for assured market access mainly via contract-work (Teewari 1999, 2000; Maiti, 2008; Maiti and Marjit 2009; Maiti and Sen 2010). Micro-level studies indicate that organized segment also relied increasingly on sub-contracting to the unorganized segment as part of the former's cost-cutting measures (Teewari 2000; Roy 1996, 2009). Under the presumption of same technological exposure, the unorganized segment is considered to be both less productive and less efficient due to its generally sub-optimal scale of operation than its organized counterpart (Seth 1995; Rani & Unni 2004; Perry et al 2007; Taymaz 2009). So, if the organized-unorganized linkage increases a few changes are expected in the structure, conduct and relative performance of these two segments.

1.2 Any actual improvement in unorganized segment's relative efficiency will point toward the complementary nature of organized-unorganized interaction. If the complementary relation grows in the post-reforms years, it is likely that the organized section will out-source the more labor intensive operations to the unorganized one where

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the latter has started enjoying some spillover technical upgradation; these two factors taken together will contribute favorably towards an enhancement of labor productivity as well as efficiency. However, a number of structural factors may come in between to obstruct such efficiency gains. For example, while increased spillover of improved production techniques and practices from the organized segment may create opportunity to raise the unorganized segment's efficiency, small suppliers' asymmetric bargaining power in value chain, traditionally dominated by intermediaries, may erect barrier in realization of such improvements. Available literature on T&G clusters (Teewari 2000; Singh & Sapra, 2007; Heyer, 2013 for example) indicates possibilities of effective intervention on the part of the policy makers to remove these structural weaknesses.

1.3 In this background it would be interesting to ask whether there has actually been any convergence in the performance of the two segments of the T&G industry. This paper seeks to explore the relative factor productivity, production efficiency in the organized vis-à-vis unorganized sector and its change over the reform period for T&G industry of India. Using unit-level annual cross-section data from the Annual Survey of Industries (ASI) for the organized part and National Sample Survey (NSS) data on the unorganized section for the study period 2001-11[2], this study poses the following research questions:

(i) Did the gap in factor productivities between the two sectors decrease during the study period?

(ii) Has the relative efficiency of the unorganized T&G industrial units increased with respect to the organized T&G firms over time?

There are two parts in this question: first, did the firm-level technical efficiency in both the sectors improve and grow as a result of the reforms? Secondly, did the best-performing firms of different groups come closer to each other and to the overall set of best-performers of the country?

1.4 The rest of the paper is organized in the following way: Next section (Section 2) lists the specific research questions while in section 3 the data sources and variables used in the analysis are described. Section 4 has three subsections, each explaining the methodologies applied for individual research exercises. Section 5 discusses the main findings. Section 6 concludes the paper.

2. Research Questions

2.1 This paper attempts to carry out the following exercises for the stated research questions:

(i) It explored the direction of gap between average productivities (labour & capital) of unorganized and organized T&G industry at two selected time points (Exercise I).

[2] We have combined NSS data for 2000-01 and ASI data for 2001-02 for the initial point and joined ASI 2009-10 with NSS 2010-11 data at the last point of our analysis. Following the style of referring to ASI data we have considered 2001 as the beginning and 2011 as the end of our study period – 2001 and 2011 being the two time-points considered.

(ii) In the second part of the analysis, we compared the relative efficiency of unorganized T&G sector (measured with respect to organized T&G sector) at two selected time points (Exercise II).

(iii) As the third exercise our aim was (a) to determine the firm-level and group-specific technical efficiency (TE) scores by constructing *group* frontiers and (b) to assess the closeness of different *group* frontiers to the *grand* frontier (Exercise III).

2.2 First two exercises are relatively straightforward. But the steps involved in the last one need elaboration. The specific group and grand analysis are explained below.

2.3 It is well-known that different groups of units in a particular industry may operate under different technological conditions. Available literature on the Indian T&G sector also indicates such possibilities[3] (Little, Mazumdar & Page op cit.; Roy 1998a; Ganesh op cit.). In such a context a *meta-frontier* approach to efficiency analysis (Rao, O'Donnell, Battese 2003; Bhandari & Ray 2011; Majumder, 2011) will be more appropriate.

2.4 In this study we take organized and unorganized segments at the two selected time-points as the relevant groups and derive *group* frontiers for each of them. The *group* efficiency scores enable us to compare the efficiency performances of firms within a group facing the same sets of financial and institutional constraints, while the average *group* scores evaluate the effect of producing in a particular segment – organized or unorganized.

2.5 A major part of existing literature on the unorganized manufacturing sector while recording its generally inferior performance relative to that of the organized units also predicted that withdrawal of state-support in the form of government policies protecting or directly promoting the small scale units will lead to decline of the sector (Seth op. cit.; Taymaz op.cit.). But other studies on the unorganized sector especially in the context of textile sector have emphasized on the segment's historically displayed ability to withstand competition by successful adjustments and innovations (Liebl and Roy 2001, 2003; Roy, 1998a; 2009). However, such adjustments have been accompanied by increasing differentiation within the sector. Thus most of these studies continue to observe growth and dynamism in certain sections of the unorganized T&G enterprises alongside decline for the others. In fact the intensifying competition in the post-reforms period creating both opportunities for expansion and threats for survival - may have increased such differentiation.

2.6 In this context, we may expect the group of relatively better performers even within the unorganized T&G segment to improve their average group TE over time. This may also reduce the gap between average TE for the growing segment of the unorganized T&G units with that of the relatively dynamic T&G units in the organized sector. So at the next stage we treat the best-performing units in each group as representative firms of the respective *group*-frontiers. Then we tried to evaluate the change in closeness of the relatively well-performing enterprises in all groups during the study period to a common benchmark technology set for all such units.

[3] The difference may arise because of varied technological capacities developed traditionally or due to the distinct nature of demand those units cater to.

2.7 Thus instead of constructing a grand-frontier from applying DEA on all observations, we cull out the units in each group operating on respective group-frontiers. An output-oriented DEA is run on the pooled data to derive a grand frontier[4]. Our approach provides a relative measure of efficiencies of different groups of best-performing firms also through a comparison of their average Technology closeness ratio (TCR hereafter).

3. Database and Variables:

3.1 Unit level data on the registered factories are available from the Annual Survey of Industries (ASI) database and the information on unorganized manufacturing units are provided by the successive rounds of National Sample Survey (NSS). We are proposing a framework to carry out an analysis of difference as well as integration by combining these two databases. As common time points we have matched NSS 56th Round Survey 2000-01 data on Unorganized Manufacturing Sector with the 2001-02 ASI data and 2010-11 NSSO Round (Survey of Unincorporated Non-agricultural Enterprises) with 2009-10 ASI data to assess the change in the comparative performance of the organized and unorganized segments of the T&G industry in the years following Textile Policy 2000. The choice of NSSO time points is obvious and that of ASI was constrained by our access and availability of unit level data.

3.2 Each observation in our data set collates information on a number of variables including those on input and output bundles for different individual industrial enterprises. Necessary adjustments were made to ensure comparability of categories representing the same variables, as is illustrated in Table 1.

3.3 Three types of enterprises were covered by the NSS rounds based on nature of operation in the reference year of the particular survey: perennial, seasonal and casual. As the ASI data have no counterpart for 'seasonal' or 'casual' enterprises in the organized segment, we have considered only the perennial enterprises in the unorganized sector which operate regularly throughout the year.

3.4 Labour-use pattern and choice of optimum techniques are likely to differ between enterprises mainly using own labour and those hiring labour on a regular basis. Thus, to make the comparison more meaningful we have only included unorganized firms hiring worker on a regular basis. Two full-time hired workers[5] were taken as the relevant cut-off to get the final set of observations. So our data set from the unorganized sector covers a part of the NDME (Non-Directory Manufacturing Establishments) and the entire DME (Directory Manufacturing Establishments) section.

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[4] As any particular firm typically faces varying technological and structural conditions at different time-points that influence their optimum decision-making, production-information in two periods, even if it refers to the same firm represent distinct observations.

[5] It has been empirically observed in the Indian context that except for the very small-sized enterprises such as own-account manufacturing enterprises (hiring no labour on a regular basis) or those hiring very few full-time workers, unorganized manufacturing enterprises with small size of employment such as NDMEs are more productive than the OAMEs and can also be more productive than much larger firms (Little, Mazumdar & Page 1987; NCAER 2009; Roy 2009 among others). So we excluded the OAMEs and the size-group immediately above that, while retaining a part of the NDMEs.

3.5 Both the data sets[6] were converted at 2004-05 prices by deflating with the help of wholesale price index (WPI) for 'Manufacturing Products'[7] (Table 2 gives the deflator series used here). The pre-reform analysis has been carried out on the basis of 10,058 unit level observations and the analysis of the later period uses 7265 observations[8].

4. Methodology Applied

4.1 *Productivity Analysis*: Using the firm-level input-output data at the two chosen time-points for unorganized and organized T&G segments we have determined the industry-level average of factor productivities (GVA per unit of labour and capital) and that of capital-labour ratio calculated for individual enterprises at 2004-05 prices (Exercise I). We have also reported the average productivity values along with the coefficient of variation for different size-groups of the unorganized sector constructed on the basis of size of employment - determined by number of total workers employed by an establishment.

4.2 For the second part of our analysis an m-input standard Cobb-Douglas production function with CRS was considered:

$$Y_i = A\Pi_j X_{ji}^{\beta_n} e^{\gamma_i}$$

where, $\Sigma_n \beta_n = 1$

A: the industry-specific technology

e^{γ_i} : efficiency-factor for the i^{th} firm;

i.e., Y_i may vary across firms with same technology and using same level of inputs due to variation in γ_i. The γ_i values can be generated for all constituent sectors of the industry (assuming no variation in firm-specific efficiency within each sector). The series can also be generated for the individual firms. In the first case we can estimate sector-specific relative efficiency (as in Exercise II) while firm-specific relative efficiency can be evaluated in the latter (Exercise III). The methods applied are explained in the following two sections.

4.3 Estimation of Relative Efficiency: Sector-specific

4.3.1 The most crucial assumption that allows for this estimation is that the technological opportunity set is the same for producers in all the sectors under consideration. Given the available dataset containing information on one output and three inputs (capital, labour and intermediate inputs), we have considered GVA[9] as the relevant output measure here

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[6] Given that capital stock and intermediate inputs generally used in T&G production are manufactured products, the same deflator series has been used for output as well as capital stock and intermediate inputs.

[7] To simplify we have not resorted to use of multiple indices although use of WPI for textile products and WPI for textiles machinery or that for general machinery to deflate output and fixed capital stock respectively would be more appropriate. However, this is a limitation of the measures used in this work.

[8] The final data set was obtained after excluding firms with non-positive values of output (the relevant measures-gross output or GVA) and/or inputs (capital, labour and material-fuel) to make it more reliable as well as amenable to DEA.

[9] Gross output in excess of energy and materials costs, as explained in Section 2.2

and capital and labour as the inputs. Then the i[th] firm's production function can be written as:

$Y_i = AL_i^{\beta} K_i^{1-\beta} e^{\gamma i}$ …….. (1)

where,

$\frac{Y_i}{L_i} = \mathrm{A}\left(\frac{K_i}{L_i}\right)^{1-\beta} e^{\gamma i}$

or, $lny_i = lnA + (1-\beta)lnk_i + \gamma i$ ……..... (2)

Where, $y_i = \frac{Y_i}{L_i}$ and $k_i = \frac{K_i}{L_i}$;

Substituting $\gamma i = \gamma i = \theta D_j\ D_{ji}$ being the dummy for the j[th] sector; j = organized, unorganized

we can apply an OLS method on the production function as in equation (2):

$lny_i = \alpha + \rho lnk_i + \theta\, D_{ji} + \varepsilon_{ij}$ …….. (3)

$\alpha = lnA$ + intercept-term in γi (if any),

$\rho = (1 - \beta)$;

θ estimates the pure efficiency-differential due to operating in a particular sector and ε_{ij} is the stochastic error term.

If $D_{ji} = 0$ for all enterprises in the organized segment and

= 1 for all firms in the unorganized segment of the concerned industry,

$\hat{\theta} = \gamma_{unorg} - \gamma_{org}$ (estimated)

and relative efficiency: $e^{\hat{\theta}} = e(\gamma_{unorg} - \gamma_{org}) = e^{\gamma unorg}/e^{\gamma org}$……(4)

4.4 Estimation of Firm-specific Relative Efficiency: Data Envelopment Analysis

4.4.1 Here we allow for variation in efficiency of firms even within a particular sector and our objective is to evaluate the relative efficiency of firms in a sector by applying Data Envelopment analysis (DEA). The DEA tries to generate the production frontier from the available observed data without making any specific assumption regarding the functional form of the production function. This method was first introduced into the Operation Research (OR) literature by Charnes, Cooper and Rhodes (CCR) in 1978. The model was developed under the assumption of constant returns to scale (CRS) and was subsequently extended to the case of variable returns to scale (VRS) by Banker, Charnes and Cooper (BCC) in 1984[10]. Non-parametric DEA generates a production frontier on the basis of only observed input-output data by applying linear programming (LP) technique and without considering the input and output prices.[11]

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[10] The two models are respectively known as first generation efficiency measurement model under the assumption of CRS and second generation model under the assumption of VRS.

[11] Being non statistical in nature the LP solution of DEA problem produces no standard error and makes no room for hypothesis testing, which is a limitation.

4.4.2 Under the standard assumptions of feasibility, convexity and free disposability, the DEA algorithm generates the frontier under the defined technology and measures technical efficiency from the calculated distance of an observed point from the generated frontier.

Suppose there are N firms in the system and we consider the t^{th} firm. The input output bundle of that firm is: $x^t = (x_{1t}, x_{2t}, ..., x_{nt})$ and $y^t = (y_{1t}, y_{2t}, ..., y_{mt})$.

The LP problem following BCC model becomes

Max: ϕ

Subject to: $\sum_{t=1}^{N} \mu_t y_{jt} \geq \phi y_{jt}; \forall j = 1,2,.....,m$

$$\sum_{t=1}^{N} \mu_t x_{it} \leq x_{it}; \forall i = 1,2,.....,n$$

$$\sum_{t=1}^{N} \mu_t = 1$$

$$\mu_t \geq 0; \forall t = 1,2,.....,N$$

The score generated from the expression $\frac{1}{\phi}$ is nothing but the output oriented technical efficiency of the t^{th} firm under VRS[12]. Notably, this is only a radial measure of (in) efficiency.

This technique was applied first to obtain group-specific frontiers (for a total of four groups – one for each segment at each time-point) in order to evaluate individual unit's *group* efficiency. It allowed us also to identify how operating in a particular segment influenced individual unit's performance as also how the performance in each segment has changed over time.

4.4.3 At the next stage, we applied a *meta-frontier* analysis proposed by Battese and Rao (2002) as illustrated in Rao, O'Donnell & Battese 2003 and also applied in Bhandari & Ray (2011). The objective was to evaluate the relative technological proximity of best-performing establishments of different groups to national frontier taking both the time-points into account. In this approach, a global or *grand frontier* is calculated by considering all firms in the sample and the efficiency of a firm belonging to a group is calculated also with reference to the *grand frontier*. For our purpose it was necessary to pool together the group-frontier units separated out from each group to derive the relevant *grand frontier*. This helped us to examine the technological proximity of any *group frontier* to the *grand frontier* with the help of group-average[13] of TCR (a ratio of global to local technical efficiency scores for every unit).

[12] The (in)efficiency measurement with additional constraint $\sum_{t=1}^{N} \mu_t = 1$ in the above model makes BCC model an extended version of the CCR model.

[13] Geometric mean of TCRs was used to get the average.

5. Findings

5.1 *Average Productivities*: At constant prices none of the changes in organized segment is statistically significant. However, unorganized part of the industry experienced sharp fall in average productivities and a considerable rise in capital-labour ratio (see Table 3). The productivity values for both the years also indicate that not only have the unorganized sector productivity indicators declined, the productivity-gaps between the organized and unorganized establishments of the T & G industry have actually widened (Table 4).

5.1.1 The deterioration in unorganized segment's performance may be due to unpreparedness or failure to adjust in the new situation. Reforms appear to have affected this section more adversely than its organized counterpart. Or it might be that capital accumulation and restructuring in the large organized units which were initiated after announcement of 1985 Textile Policy and accelerated after 1991-92 reforms have started paying off, so that there is not much market-space left for viable operation by the unorganized establishments anymore.

5.1.2 We tried to evaluate the above changes in various size-groups[14] defined on the basis of number of total workers employed by an unorganized firm (detail of this classification is given in Table 5) in the T & G industry.

5.1.3 First we compared the changes in average productivity values and capital-intensity (presented in Table 6) for all size-groups. We consider both mean and median AP_L and find out same direction of change in the sub-groups as those observed for the unorganized segment as a whole (detailed results of tests for statistical significance is given in Table 7). At both the time-points mean AP_L was higher in the larger size-groups. However this gap narrowed during the study period. For instance, the ratio of the mean AP_L in the largest size-group to that of the smallest one decreased at the second time-point. Coefficient of variation (CV) in AP_L also recorded a fall in the last year. Thus we notice some kind of uniformity and increasing homogeneity within each size-group and also between the size-groups. However, it is slightly higher among firms for the smallest group in both the years and the largest size-group in the last year.

5.1.4 AP_K was also relatively high in the higher size-groups. Although AP_K at the endpoint declined for all the size-groups the gap between the two extreme groups increased slightly. Except for the largest size-group, capital-labour ratio increased across the size-classes. Intra-group variation became higher in the last period as reflected by increased CV for every size-group.

5.1.5 We can sum up the discussion above by arguing that during the study period average productivity of labour in the unorganized T&G sector has fallen farther behind that of its organized counterpart while capital productivity somewhat improved vis-à-vis the values recorded by the organized firms.

5.2 Estimation of Relative Efficiency: Results of the estimation of relative efficiency of the unorganized sector of the T&G industry with respect to the organized sector there for

[14] Variation of productivity-change is examined by size-based classification here as size is considered as a crucial limiting factor in enhancing unorganized firms' productivity and efficiency.

both the selected years are presented in Table 8. Here, we have divided the states with a minimum presence[15] of organized and unorganized T&G production units into two groups. The first consists of states with relatively large number of such units ('high concentration states') and the second group contains the rest among those selected in the first stage i.e., states with relatively low presence of T&G units ('medium-concentration' states[16]).

5.2.1 It was observed that unorganized segment was relatively less efficient than the organized section of the T & G industry in both the years under consideration[17]. Notably, relative efficiency of the unorganized enterprises was little better in the medium-concentration states in both the years. Thus, higher agglomeration in the high-concentration states does not seem to have led to greater relative efficiency of the unorganized segment than in the medium-concentration states. Secondly, we also noticed an over-time decline in relative efficiency of the unorganized T&G segment with respect to the organized counterpart[18].

5.2.2 The same pattern was generally observed when the estimation was repeated individually for all the states in the two groups - the only exception being the state of Karnataka (Table10).

5.3 Analysis of Technical Efficiency: Before we sum up the results of the data envelopment analysis we present the summary statistics for output and inputs (Table 11). These serve to show the extent of difference in the average scale of operation between the organized and unorganized sector units considered in this study.

5.3.1 Next, selected descriptive statistics of the TE scores for firms in the two study-segments are presented in Table 12**.** Technical efficiency scores measured against the *group-frontiers* for the two segments at the selected time-points show that average *group* efficiency was the lowest in the organized segment in 2009-10 and highest for the organized units in 2001-02. Average group-efficiency has fallen in both the segments in the last year and the fall was much sharper in the organized part.

5.3.2 Notably, coefficient of variation in individual *group* efficiency within the organized sector has increased during the study period, while the same remained almost the same for its unorganized counterpart. Relatively high decline in average *group*-TE of the organized

[15] States with very low presence of T&G units (less than 100 - in either of the year) were not considered here. this list was cross-checked with available literature on Indian textiles sector and Annual Reports of Ministry of Textiles – different years;

[16] States with more than 5% of sample units in each in either of the two years fell in the 'high concentration' category while 'medium concentration states' included those with less than 5% of total but more than 100 T&G units – organized and unorganized taken together. Additional care was taken to ensure that each group has a balance in terms of number of observation belonging to organized and unorganized segments to enable the relative efficiency analysis. Details of this classification with number of observations in each group are given in Table 9.

[17] A part of this gap in relative efficiency may however be attributed to the different measures used to estimate fixed capital stock for the two segments under consideration. Since the value of the capital used by the organized segment is assessed on the basis of book-value alone and that for the unorganized segment is obtained on the basis of market value, hence there is a possibility of under statement for the former that may culminate into an overestimation of its performance-lead. However, no such applicable adjustment practice is available to make the two series compatible and the paper presents analysis with this limitation unattended.

[18] The conclusion remains the same when we perform the analysis for each state considered here (Table 10).

firms may be a reflection of increased heterogeneity in efficiency-performance of the constituent firms while a section of the segment may have actually improved their efficiency. Similarly, the observed small decline in average TE for the unorganized units may be a result of almost unchanged CV (and homogeneity) in average group-TE even in presence of somewhat uniform fall in firm-specific efficiency. Thus from this table we cannot directly infer that the decreased gap in technical efficiency between the two segments indicates an actual improvement in unorganized segment's relative performance. In fact, findings from the earlier analyses on firm-level productivity and segment-specific relative efficiency points to the contrary.

5.3.3 Thus we make use of the *meta-frontier* and compare TCR of the concerned groups to assess the extent of relative improvement in average performance of the two segments over time.

5.3.4 As explained in the subsection 4.4.3 on methodology, we have concentrated only on the best-performing units in each group. Measures of relative performance of these groups –consisting of the frontier units alone - are summed up in the Table 13. This table shows that the best-performing organized units have the greatest proximity to the national technology frontier in the last year. On the other hand, even the *group* frontier firms in the unorganized segment at the end of the study period exhibited the lowest average TCR among frontier firms of all groups taken together and the highest decline in the same during the study period. We arrive at a similar conclusion when we look at the percentage of the *group frontier* firms operating on the *grand frontier* (Table 14).

5.3.5 It is important to note that average TCR for best-performing units within unorganized segment was higher than that for the organized frontier firms at the initial time point. In fact TCR was the highest for the 2000-01 unorganized frontier units also having the highest proportional presence on the *grand frontier*. It seems plausible that burden of adverse effects of reforms especially in the post-2000 years has fallen disproportionately heavily on this sector and the decline was somewhat uniformly experienced by firms within the group. Thus even the relatively well-performing establishments appeared incapable of restructuring in an efficiency-enhancing way and could not benefit from the dynamism of the organized segment.

5.3.6 As a confirmatory exercise, we carried out the estimation of relative efficiency for the group of unorganized frontier firms with respect to the group of organized frontier units at both the time-points. The results summarized in Table 15 are self-explanatory and support our earlier observation of declining relative performance even among the best performing firms in the unorganized T &G sector.

6. Conclusion

6.1 Various empirical studies have reported much lower average labour productivity for units in the unorganized manufacturing sector as a whole or for some selected sectors in it than for those in their organized counterpart in India and other developing countries. De-reservation of the fast-growing garments subsector is likely to encourage entry of large-firms and greater outsourcing of labour-intensive activities to the smaller units. With

increased linkages of unorganized T&G units with the organized firms along the textile value-chain we may expect a convergence in the performance of the two segments.

6.2 In the light of above findings our study explored (i) the productivity-gaps between the sectors studied (ii) change in relative efficiency of relatively big unorganized T&G establishments with respect to organized part of the industry and (iii) change in relative position of different sections of the concerned industry in terms of firm-level and sector-specific efficiency in the post-reforms years. Findings of this paper suggest (a) a considerable and statistically significant decline even in the absolute levels of factor productivities in the unorganized segment; (b) their falling relative efficiency with respect to the organized section over time; and (c) increase in divergence of even the best-performing T&G units in the former sector from the national *grand* frontier for the T&G sector.

6.3 A few points emerge from the observation of all-round decline in relative performance of the bigger unorganized T&G establishments vis-à-vis the organized T&G units during the first decade of the present century. First, these results contrast sharply the findings of available studies that the unorganized powerlooms and the garments manufacturing units accounted for much of the textile sector growth in the 1990s (Liebl & Roy op cit.; Roy 2009; for example). In fact economies of scale are not expected to favour large organized units significantly in the dynamic garments sector which has exhibited a small-scale bias worldwide. Small unorganized powerlooms units also evidently performed well even without reservation. Secondly, the recorded performance of the segment was one of substantial improvement in certain aspects like productivity growth during the immediately preceding decade (Roy 1998b; Raj 2007). Thus, withdrawal of protective measures and other aspects of reforms seem to have reduced this section of producers into an extremely vulnerable state. Sub-contracting and increase in other linkages with the organized part of the industry also could not enhance the former's performance at least during the study period. Finally, this tendency is alarming when we note from the successive NSS reports that during the same time estimated number of T&G enterprises and the estimated number of workers engaged in those units increased respectively by 33.3% and 15.29% as barriers to entry in the unorganized T&G sector is almost non-existent. Thus we need to study the sector at a more disaggregated level while explicitly linking the changing structure with the changing performances by controlling selected firm-level characteristics in our subsequent works.

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Table 1
Variables used in the combined dataset and their definitional compatibility

Variable	ASI data	NSS data
Output (Rs.)	(i) **GVA**: Ex -factory value of output – Costs of materials and fuels consumed [19] (Exercise I & II) (ii) **Y**: Annual ex -factory value of output (Exercise III)	(i) **GVA**: Annual [20] value of total receipt [21] – Expenses on materials and fuels (Exercise I & II) (ii) **Y**: Annual value of total receipt (Exercise III)
Intermediate input (Rs.)	**INTER**: Expenses on materials and fuels consumed	**INTER**: Expenses on materials and fuels consumed = Annual value of (total expenses – other operating expenses + costs of electricity & fuel consumed)[22]
Capital (Rs.)	**K**: Book value of fixed asset on the opening date of the reference year	**K**: Market value of fixed assets (owned & hired) as on the closing date of the reference year – net addition to fixed assets during the reference year
Labour (number)	**L** = Total man-days worked (both manufacturing and non-manufacturing)	**L** = (Total number of FTE workers[23] * 30 * number of months operated * average hours worked[24])/8

Source: Authors' classification from the data used

[19] Information on Gross Value Added (GVA) is not directly available in the ASI database but it can be calculated by deducting expenditure on materials and fuels and other operating expenses from total output (ex-factory value of output and other receipts e.g. value of electricity produced and sold). However, to be consistent with the production framework used in this study GVA values were calculated by subcontracting only costs of materials and energy from ex-factory value of output. Similarly, a new series of value-added was computed from the given GVA data provided by the NSSO to arrive at a similar measure. Observations with negative GVAs were dropped to make the exercise meaningful.

[20] Annual values are obtained directly from NSSO 2000-01 data. But annual values of receipts (and other categories e.g. expenses) for the year 2010-11are computed by multiplying the given series with number of months operated.

[21] It is necessary to note: (a) this category includes receipts from other activities e.g. 'receipt from trade' as well as 'other receipts' – in addition to 'receipts from manufacturing activities'. More accurate values of production could be obtained by deducting the non-manufacturing component from total receipts. Due to the presence of considerable number of missing values (especially for NSS 67th round) this operation would have made the data series unreliable or a substantial number of data points would have been lost.

[22] As in the data for 'value of products & by-products' there are a very large number of missing entries in the series on 'expenses on raw materials' thus making its direct use unreliable.

[23] To make the labour-data comparable to the ASI data, we convert all workers (both full-time and part-time) into full-time equivalents (FTEs), by treating 1 full-time worker = 2 part-time workers.

[24] In the 56th round data, average number of hours worked daily is not given. We assume here that each day consists of an 8-hour block.

Table 2
Deflator series using WPI for 'Manufacturing Products'
(base year: 2004-05)

Year										
MP-dff	**1993-94**	**1994-95**	**1995-96**	**1996-97**	**1997-98**	**1998-99**	**1999-00**	**2000-01**	**2001-02**	**2002-03**
	0.60	0.68	0.73	0.75	0.77	0.80	0.83	0.85	0.87	0.89
Year										
MP-dff	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
	0.94	1.00	1.02	1.08	1.13	1.20	1.23	1.30	1.40	1.47

Note: 'MP-dff' – Manufacturing-Products Price Deflator

Source: Authors' calculation

Table 3
Change in Average Productivity (L & K) & Capital-labour ratio at 2004-05 prices:
Organized & Unorganized T & G Industry

Value/Segment	Organized	Unorganized
ΔAP_L	-83.33	-26.19***
ΔAP_K	-233.21	-0.32***
Δ(K/L)	83.18	5.09***
Number of Observations	6766	10557

'Δ'–change in value in 2011 over 2001-level; '***' significant at less than 1% level

Source: Authors' calculation

Table 4
Average Productivity (L & K) & **Capital-labour ratio at 2004-05 prices:**
Organized & Unorganized T & G Industry

Measure	Sector	2001				2011			
		Obs.	**Mean**	**Median**	**CV**	**Obs.**	**Mean**	**Median**	**CV**
AP_L	**Organized**	3068	1059.77	478.17	7.16	3698	976.44	591.91	2.01
	Unorganized	6990	163.35	104.39	2.22	3567	137.17	107.41	1.41
AP_K	**Organized**	3068	284.07	1.07	34.73	3698	50.86	1.07	53.04
	Unorganized	6990	1.68	0.99	2.15	3567	1.35	0.78	2.25
K/L	**Organized**	3068	1277.20	457.07	5.09	3698	1360.38	566.10	2.45
	Unorganized	6990	203.91	104.36	1.96	3567	351.78	135.30	4.50

Source: Authors' calculation

Table 5
Number of firms in size-groups defined on the basis of total number of FTE[a] workers

Size-group	Year	I	II	III	IV	V	VI
Workers (#)		3 - 5	5.5 – 7.5	8 - 10	10.5 - 15	15.5 - 20	> 20
Units (#)	2001	2223	2135	1419	755	272	186
Units (#)	2011	1726	793	490	238	96	224

Note: [a] : full-time-equivalent of all full-time and part-time workers

Source: Authors' calculation

Table 6
Change in average productivities and factor-intensities in different size-groups of the unorganized T&G Industry between 2000-01 & 2010-11

Values/Size-Groups		Size Group 1		Size Group 2		Size Group 3		Size Group 4		Size Group 5	
		2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
AP_L	Mean	150.98	133.22	157.50	139.91	168.20	141.62	168.21	144.50	234.32	137.12
	Median	101.25	108.25	104.76	110.02	111.46	107.27	101.64	108.29	102.93	114.17
	CV	2.41	1.44	1.59	1.46	1.38	1.17	1.65	1.27	4.30	0.74
AP_K	Mean	1.56	1.19	1.71	1.27	1.71	1.50	1.74	1.49	1.70	1.47
	Median	0.97	0.74	0.99	0.74	0.96	0.77	1.05	0.91	1.13	0.93
	CV	1.93	1.50	2.10	1.49	2.96	1.80	1.43	1.25	1.00	1.19
K/L	Mean	193.46	293.26	196.58	439.16	216.14	378.77	226.47	514.69	209.25	458.76
	Median	101.44	139.20	104.81	142.05	112.30	139.91	102.26	125.47	99.30	119.81
	CV	1.89	3.07	1.64	3.68	1.49	2.68	2.58	8.72	2.13	2.65
Observations (#)		2223	1726	2135	793	1419	490	755	238	272	96

Source: Authors' calculation

Table 7
Change in average productivity and capital-labour ratio across size-groups of Unorganized T&G Industry between 2001 & 2011

Values/Size-Groups	I	II	III	IV	V
ΔAP_L	-17.76	-17.59	-26.58	-23.71	-97.20
[t-value (significance)]	-1.84 (**)	-1.77 (**)	-2.33 (***)	-1.24	-0.94
ΔAP_K	-0.36	-0.44	-0.21	-0.25	-0.22
[t-value (significance)]	-4.41 (***)	-3.29 (***)	-0.87	-1.46	-1.11
Δ (K/L)	99.81	242.57	162.64	288.22	249.52
[t-value (significance)]	4.75 (***)	6.59 (***)	5.31 (***)	1.72 (**)	2.88 (***)
Observations (#)	3949	2928	1909	993	368

Note: 'Δ'–change in value in 2011 over 2001-level; '***' significant at less than 1% level '**' significant at less than 5% level; not marked: not significant

Source: Authors' calculation

Table 8
Estimation of Relative Efficiency for Groups of Indian states with different concentration of T&G Industry Establishments

States	Year	No. of Observations	Coefficient (Significance at less than 5%)			Relative Efficiency
			ρ	θ	α	e^{θ}
High Concentration States[1]	**2001**	6804	0.39 (**)	-0.98 (**)	3.86 (**)	0.37 (**)
	2011	4885	0.25 (**)	-1.33 (**)	4.78 (**)	0.26 (**)
Medium Concentration States[2]	**2001**	2287	0.37 (**)	-0.88 (**)	3.87 (**)	0.41 (**)
	2011	1693	0.25 (**)	-1.29 (**)	4.74 **)	0.28 (**)
All India[3]	**2001**	9091	0.38 (**)	-0.95 (**)	3.86 (**)	0.39 (**)
	2011	6578	0.25 (**)	-1.32 (**)	4.77 (**)	0.27 (**)

Note: '1' – includes Andhra Pradesh, Delhi, Gujarat, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal.
'2' – includes Haryana, Karnataka, Kerala, Madhya Pradesh, Punjab, Rajasthan.
'3' – Aggregate of the high-concentration and medium-concentration states (these 13 states cover around 90% of total T&G units); the result remains similar when we consider all states;

Source: Authors' calculation

Table 9:
Classification of States for Sector-specific Relative Efficiency Analysis
2001 & 2011

States	2001			2011		
	Organized	Unorganized	Total	Organized	Unorganized	Total
High Concentration States						
Andhra Pradesh	124	341	465	156	270	426
Delhi	173	235	408	120	290	410
Gujarat	225	452	677	262	237	499
Maharashtra	245	1040	1285	332	222	554
Tamil Nadu	878	1181	2059	1114	560	1674
Uttar Pradesh	162	990	1152	255	368	623
West Bengal	113	645	758	139	564	703
All High concentration states	1920	4884	6804	2378	2511	4889
Medium Concentration States						
Haryana	169	98	267	255	48	303
Karnataka	230	284	514	168	163	331
Kerala	130	354	484	84	173	257
Madhya Pradesh	65	144	209	42	80	122
Punjab	172	299	471	304	64	368
Rajasthan	161	181	342	202	110	312
All Medium concentration states	927	1360	2287	1055	638	1693

Source: Authors' classification

Table 10: Estimation of Relative Efficiency

States	Year	No. of Observations	Coefficient (Significance at less than 5%)			Relative Efficiency
			ρ	θ	α	e^{θ}
All India[3]	**2001**	10058	0.38 (**)	-0.94 (**)	3.88 (**)	**0.39** (**)
	2011	7264	0.26 (**)	-1.33 (**)	4.72 (**)	**0.27** (**)
Andhra Pradesh	**2001**	465	0.29 (**)	-0.77 (**)	4.03 (**)	**0.47** (**)
	2011	425	0.23 (**)	-1.00 (**)	4.57 (**)	**0.37** (**)
Delhi	**2001**	408	0.28 (**)	-1.92 (**)	5.55 (**)	**0.15** (**)
	2011	410	0.29 (**)	-2.04 (**)	5.38 (**)	**0.13** (**)
Gujarat	**2001**	677	0.30 (**)	-0.77 (**)	4.39 (**)	**0.46** (**)
	2011	499	0.32 (**)	-1.13 (**)	4.38 (**)	**0.32** (**)
Haryana	**2001**	267	0.25 (**)	-1.26 (**)	4.82 (**)	**0.28** (**)
	2011	303	0.16 (**)	-1.55 (**)	5.60 (**)	**0.21** (**)
Karnataka	**2001**	514	0.26 (**)	-1.02 (**)	4.42 (**)	**0.36** (**)
	2011	331	0.38 (**)	-0.85 (**)	3.78 (**)	**0.43** (**)
Kerala	**2001**	484	0.32 (**)	-0.56 (**)	3.60 (**)	**0.57** (**)
	2011	257	0.28 (**)	-0.62 (**)	4.08 (**)	**0.54** (**)
Madhya Pradesh	**2001**	209	0.27 (**)	-0.84 (**)	4.28 (**)	**0.43** (**)
	2011	122	0.07 (**)	-1.68 (**)	5.66 (**)	**0.19** (**)
Maharashtra	**2001**	1285	0.39 (**)	-0.70 (**)	3.80 (**)	**0.49** (**)
	2011	554	0.21 (**)	-1.43 (**)	5.18 (**)	**0.24** (**)
Punjab	**2001**	471	0.42 (**)	-0.79 (**)	3.58 (**)	**0.45** (**)
	2011	368	0.23 (**)	-1.50 (**)	4.88 (**)	**0.22** (**)
Rajasthan	**2001**	342	0.38 (**)	-0.89 (**)	4.05 (**)	**0.41** (**)
	2011	312	0.15 (**)	-1.56 (**)	5.56 (**)	**0.21** (**)
Tamil Nadu	**2001**	2059	0.40 (**)	-1.07 (**)	3.71 (**)	**0.34** (**)
	2011	1671	0.21 (**)	-1.22 (**)	4.97 (**)	**0.29** (**)
Uttar Pradesh	**2001**	1152	0.43 (**)	-1.14 (**)	3.71 (**)	**0.32** (**)
	2011	623	0.19 (**)	-1.89 (**)	5.39 (**)	**0.15** (**)
West Bengal	**2001**	758	0.31 (**)	-0.96 (**)	4.20 (**)	**0.38** (**)
	2011	703	0.28 (**)	-1.11 (**)	4.38 (**)	**0.33** (**)

Source: Authors' calculation

Table 11 Descriptive statistics for Output produced and Inputs used in Organized and Unorganized Segments of the T & G Sector

Measures	2001				2011			
	Real Y	Real Inter	Real K	L	Real Y	Real Inter	Real K	L
Organized T&G Segment								
Count	3068	3068	3068	3068	3697	3697	3697	3697
Mean	213008270.31	151646440.44	113785118.76	90314	331488118.23	243836983.71	161534701.07	114082
Median	67903464.00	45432890.00	12255130.00	28844	94607408.00	60621788.00	20477282.00	42479
Min.	33425.29	21998.85	3.45	56	66088.62	23633.33	0.81	155
Max.	17656537088	12912504832	18042640384	2723663	36462350336	32884074496	30694553600	10293525
SD	552206127.43	396777693.33	528665705.75	194289.97	1056506206.15	884552561.00	755965614.95	289872.91
CV	2.59	2.62	4.65	2.15	3.19	3.63	4.68	2.54
Skewness	14.00	14.42	18.36	5.97	16.05	19.32	23.22	16.13
Kurtosis	358.00	379.53	502.57	53.90	429.18	580.32	795.90	466.63
Unorganized T&G Segment								
Count	6990	6990	6990	6990	3567	3567	3567	3567
Mean	1068765.34	634111.02	505774.70	2755	979348.68	497122.30	938190.70	3526
Median	328341.17	49164.71	243764.70	2160	330461.53	27120.00	343076.90	2250
Min.	11011.76	56.47	776.47	105	6153.85	46.15	923.08	135
Max.	293764704	229411760	88117648	137520	109230768	70384616	62000000	54360
SD	5990352.16	4428718.82	1516642	2854.69	3734927.45	2511548.00	2707346.00	3925.77
CV	5.60	6.98	3.00	1.04	3.81	5.05	2.89	1.11
Skewness	37.27	39.30	33.46	22.56	18.42	14.64	11.54	4.75
Kurtosis	1698.31	1920.14	1710.76	878.85	462.65	298.91	183.57	35.87

Note: the concerned years are 2001-02 and 2009-10 for the organized firms and 2000-01 and 2010-11 for the unorganized section.
Source : Authors' calculation

Table 12
Descriptive Statistics for Group-Efficiency (TE) Scores in T & G Sector

Different Groups	Technical Efficiency Scores						
	Count	Mean	Median	SD	CV	Skewness	Kurtosis
Organized T&G							
2002	3068	0.42	0.38	0.19	0.46	0.93	3.65
2010	3698	0.19	0.16	0.12	0.64	3.28	17.61
Unorganized T&G							
2001	3567	0.29	0.24	0.18	0.64	1.72	6.48
2011	6990	0.25	0.20	0.16	0.65	1.93	7.65

Source: Authors' calculation

Table 13
Technology Closeness Ratio of different groups with Grand Frontier

Groups	Technology Closeness Ratio
Organized Frontier 2002	0.57
Organized Frontier 2010	0.68
Unorganized Frontier 2001	0.81
Unorganized Frontier 2011	0.48

Source: Authors' calculation

Table 14
Number & Percentage of different groups in Grand-Frontier units

Groups	No. of units with GTE=1	% share of the group among all units with GTE=1
Organized Frontier 2002	22	28.95
Organized Frontier 2010	14	18.42
Unorganized Frontier 2001	30	39.47
Unorganized Frontier 2011	10	13.16

Source: Authors' calculation

Table 15
Relative Efficiency of Unorganized Frontier units with respect to Organized Frontier Units in respective years

Year	No. of Observations	Coefficient (Significance at less than 5%)			Relative Efficiency
		ρ	θ	α	e^{θ}
2001	106	0.31 (**)	-0.98 (**)	5.75 (**)	**0.37 (**)**
2011	68	0.38 (**)	-1.85 (**)	5.58 (**)	**0.16 (**)**

Source: Authors' calculation

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

Does Industrial Activity Explain Regional Dispersion in Credit: Empirical Evidences from Indian States

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Abstract

This study explores whether credit inequality across Indian states can be explained by state specific factors representing credit demand and supply and industrial characteristics. While earlier studies have documented credit heterogeneity across states, this study contributes to the literature by exploring deeper into the factors responsible for such diversity. Our results indicate that after controlling for various state specific effects, credit differences are explained by deposit garnered from the state, share of industries in total output, share of gross fixed capital formation (GFCF) in all India GFCF and operational industries in the state. This indicates that states, which have been leaders in terms of garnering deposits have also earned lion's share of the credit; greater financial inclusion may be, at least in part, hold a key to breaking this low level equilibrium trap. A more robust dataset on state specific industrial characteristics will facilitate further research in this area.

1. Introduction

1.1 The phenomenon of heterogeneity of credit across regions is well researched in international literature. While the neo-classical theorists believed that capital flows from developed regions to underdeveloped regions in pursuit of higher returns, Myrdal (1957) and Prebisch (1962) challenged this belief. These authors argued that as the risk weighted return on capital is higher in developed regions, capital flows from underdeveloped regions to developed regions. In the Indian context, available literatures have documented existence of credit diversity across Indian states (Das and Maiti 1998, Tyagarajan and Saoji 1979 and Pai 1970**).** This paper however analyses this issue from a different angle. As the credit diversity and causality between growth and financial development has been adequately explored in the literature so far, this paper evaluates a different postulation. We ask a question, why does credit dispersion across states differ so much? A logical answer to this question would be the risk weighted returns associated with each state may be different which attracts capital to a particular state and dissuades capital from other states. This paper essentially evaluates the factors that characterise the risk weighted return profile of each state. We attempt to quantify the characteristic factors to draw conclusions from empirical study.

1.2 Among emerging market economies (EMEs), India provides a natural laboratory, given its heterogeneity across states in terms of geographic, economic, developmental and demographic characteristics. We attempt to use this rich spatial heterogeneity to address emerging issues relating to credit flow across regions. In particular, using a large panel of 22

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states and data for 9 year (2004-12), we analyse why does the rate of credit disbursal differ so much across Indian states and what are the determinants of credit off-take across regions? Using a large number of explanatory variables that could account for credit divergence across states and an array of alternative models we attempt to decipher the impact of industrial activity and industry aggregates on credit aggregates.

1.3 The rest of the study is organised as follows. Section II gives an overview of the international as well as Indian literature; it also underlines how our study adds to this strand of literature. The dataset are detailed in Section III, while Section IV describes the empirical results. The concluding section-V- apart from summarising the results also discusses the policy implications of the study.

II. Literature Survey

2.1 Empirical literature is rich in studies which analyse whether the causality runs from economic growth to financial development or *vice versa*. Authors like McKinnon (1973), King and Levine (1993) and Levine (2000) have argued that causality runs from financial development to economic growth, because greater financial development facilitates more efficient allocation of resources, which in turn gives a boost to economic growth. However others like Gurley and Shaw (1967), Goldsmith (1969), Jung (1966) have suggested the causality runs the other way round; as economic growth picks up due to structural factors, the demand for financial market products increases and the financial markets develop as a response. Evidence of bi-directional causality has also been documented (Blackburn and Huang 1998, Khan 2001 and Hassen et. al. 2011). In the Indian context, studies such as Demetriades (1996) and Chakraborty (2010) suggest that financial sector reforms helped in achieving higher economic growth.

2.2 From the welfare maximisation point of view, policymakers are interested in ensuring egalitarian distribution of credit across states. However, the neo-classical theory postulates that free movement of factors of production will automatically result in exodus of labour from underdeveloped region to the developed region, while the financial resources, in pursuit of higher returns will seek more profitable opportunities available in underdeveloped region. In such a system, banks may fail to allocate resources among different regions only due to imperfect or asymmetric information or due to barriers to interregional movement of financial flows like transaction costs or policy requirements.

2.3 This neoclassical postulation was challenged by Myrdal (1957) and Prebisch (1962). Both the 'cumulative causation theory' of Myrdal and 'dependence' theory' of Prebisch suggest that yields of productive factors may vary between regions and the risk adjusted profitability of capital is higher in developed regions. This results in the developed regions not only utilising and exhausting all their financial resources, but also in attracting capital from less developed regions. In such systems, financial intermediation and banking play only a limited role, which is confined to garnering deposits.

2.4 Later developments in theory of development phases of the financial system challenged this hypothesis (Chick and Dow, 1988; Dow, 1990). These theories indicate that as the banking system becomes more mature, it develops an ability to create credit in

certain regions without reducing it in others. In this development phase, the decisions of banking system to finance development activities in one region are independent of deposits at its disposal.

2.5 Samolyk (1992) developed a regional credit model and its empirical application for the USA, which suggested that local banking sector problems may constrain economic activity in financially distressed regions, whereas no such link was evident in financially sound regions.

2.6 Gonzalez and Sales (2001) added to this strand of literature by highlighting the role of expectations about the number and magnitude of investment projects, which in turn determine the demand for financing or credit availability. The authors also found that in Spain, introduction of regional banks resulted in relatively low inter-regional differences. Cuesta and Garcia-Verdugo (1998) study on the other hand, found that the preference for liquidity is greater in the relatively lesser developed regions and in those that have a less promising economic outlook, which results in relatively lesser creation of credit for the region and an outflow of capital to more advanced regions. Among the EMEs, Lima and Resende (2008) found evidence of inequality in deposits translating into local credit for Brazilian states; moreover their study indicated bank group-wise differences (public *vs.* private banks) in such inequality pattern.

2.7 Valverde and Fernandez (2004) using a sample of Spanish banks during 1993-99 found that at a regional level, economic growth predicted financial deepening. They also found that the bank-lending specialization to be a key issue in financing firms and households compared to other bank specializations. Banos et. al (2011) also found a positive relationship between economic development, measured by the contribution of industry and services in the real gross domestic product, and banking development across regions in Philippines.

2.8 Recent experience suggests that the relationship between credit and corporate profit is cyclical in nature. In periods of high economic growth, corporate profits are generally high for overwhelming number of enterprises, in an environment of general confidence and optimism (Bilych, 2012). However, when the cycle turns, profits hit rock bottom as business and consumer confidence is shaken. In a scenario where investment is financed primarily through bank credit, the corporate profit serves as a guarantee for repayment of loans. As corporate profits shrink, both the supply and demand for bank loans is affected adversely. On one hand, investment intentions of corporate go down, while at the same time the perceived riskiness of corporates increase, prompting banks to lend less. Even though we could not find any study which evaluates this relationship between corporate profit and bank credit across various regions within an economy, we can be postulated that the relationship may work through economic growth channel, with corporate profits affecting economic growth and that in turn affect the supply of bank credit to that particular region.

2.9 There are a few studies that address the spatial divergence in credit distribution in India and the empirical evidence is mixed. While Das and Maiti (1998) found no significant evidence of credit migration, Tyagarajan and Saoji (1979) observed that credit migration was largely restricted to four major metropolitan cities. Pai (1970) showed that for industrially developed states, the credit expansion is at a higher rate as compared to the deposit growth rate while the *vice versa* is true in case of industrially backward states. Chatterjee *et al*

(1997) observed that the migration of credit in the major states had become more uniform between 1974 and 1994. Singh and Srinivasan (2002) found that per capita bank credit is an important determinant of growth. They also observed that C-D ratios (a proxy for the internal movement of capital) have both become more varied across states and more closely related with SDP per capita over the period.

2.10 This study contributes to the literature in a number of ways: first, as is clear from the literature survey, though a number of studies have documented the credit heterogeneity across states, very few studies have explored deeper to analyse the factors that are responsible for such phenomenon. The basic hypothesis of the present study is that as the monetary policy and interest rates charged by banks are constant across states, factors that specifically characterise the state's risk return profile may be responsible for attracting credit to a particular state as compared to others. Though it is not possible to compile an exhaustive list of all such factors, the key factors could be: availability of deposits, state of financial developments, profitability of investment in the state, investment climate in the state, availability of infrastructure, transaction costs and ease of doing business so on and so forth. It is challenging to capture these factors through appropriate proxies for which state wise time series data may be available. This paper essentially tries to identify and quantify these factors to empirically evaluate whether it has any explanatory power over the credit heterogeneity across states.

2.11 Specifically, we have narrowed down to a set of key indicators which we think would adequately represent the unique characteristics of each state to carry out our analysis. These indicators can be divided into two groups: supply of funds (deposit ratios) and demand for funds represented by industrial factors (state specific factories in operation, fixed capital, share of industry in state domestic product, working capital).

2.12 Second, earlier studies relating to India on this subject selected bigger states, completely ignoring the smaller states. However since this study is about explaining asymmetry in credit distribution, it is important not to exclude small states out of the sample, as that could distort the analysis. We therefore use large number of states (22); only the union territories and certain states in the north-eastern region could not be covered in the study due to unavailability of consistent time series data.

III. Data

3.1 Our study has employed panel data on 22 Indian states[2] for the period 2003-04 to 2011-12. Data for this study have been culled from a variety of sources. State wise time series data on outstanding deposits and credit have been taken from the Basic Statistical Returns (BSR) dataset of the Reserve Bank of India (Table-I). Variables like gross share of industry in state domestic product, factories in operation, have been taken from the Centre for Monitoring Indian Economy (CMIE) States of India database. The Annual Survey of Industries (ASI) database has been used for state specific proxies for demand for credit from the corporate sector including fixed capital, working capital and gross fixed capital formation.

[2] The states include Andhra Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujarat, Goa, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal.

3.2 Credit growth across Indian states has varied substantially, with only a few states registering higher than average growth rate (Chart I). An analysis of share of states in all India credit also points to stark contrasts (Chart II). While a few select states dominated and bagged a lion's share in outstanding credit, majority of the states have only a marginal share of the credit pie. We considered a third variable, the credit to GSDP ratio to represent state credit distribution as a percentage of economic activity. Here again, only a few states showed high credit to GSDP ratio, but most of the states have low levels of the ratio (Chart III). Chart –V also essentially describe the same variability with both transformed dependent variables, explanatory variables and their distributions as indicated along the vertical axis. As evident from these Charts the variables representing credit distribution didn't follow similar path across states and their locus varied considerably over time.

3.3 Amongst the three sectors viz. agriculture, industry and services, the share of industry in non-food credit has always remained highest, mainly reflecting its high credit intensity. Thus size of the industrial sector in the state may be an important demand side factor which attracts credit as suggested by Kumar and Fransisco (2005) and Banos (2011). Smaller size of industrial sector in a region is likely to attract lesser credit due to a variety of reasons: greater informational asymmetry about their operations and profitability, lesser availability of collateral, shorter credit history, little known contracts with suppliers, customers or with labours etc. It is however necessary to normalise this explanatory variable taking into consideration the size of the state. A large state is likely to have a comparatively larger industrial sector and *vice versa*. In our analysis therefore, we have taken share of industrial sector in state domestic product as an explanatory variable.

3.4 Further, we have also taken fixed capital and working capital of industries as explanatory variables. Since the first half of 2000s, the banks have been increasingly providing finance not only for short term requirements of the industry but also medium to long term (RBI 2007). These essentially reflect the credit requirements of industries. Hence they have been taken as explanatory variables with suitable normalisation.

3.5 While the fixed capital is a stock concept, the gross fixed capital formation is a flow concept representing investment in the economy. In a state which has just begun to develop, the stock of capital may not be large, though the investments may be large which is likely to propel further growth in the economy and in anticipation of this higher return, more credit may allocated to these regions. This is in line with the argument of Gonzalez and Sales (2001).

3.6 Lastly, state specific deposit is taken as a proxy representing resources available to financial sector for its lending activities in line with the argument proposed by Beck et. al. (2009) and Resende (2008).

IV. Empirical Analysis

4.1 We employ a generic panel data model with credit (or its transformation) as dependent variable, and function(s) of state domestic product, share of industry in state output, deposit garner in the state, bank-centres, gross fixed capital formation (as a ratio of all India or state domestic products), factories operational, fixed capital as explanatory variable; and working capital; the generic equation is as follows:

$G(credit)_{it}=f(share\_industry_{it}, deposit_{it,}, Gfcf\_AI_{it}, factories\_operational_{it}, fixed\_capital_{it}, working\_capital)+ \alpha_i + \lambda_t + \varepsilon_{it}$

where G(.),f(.) are functions such as log, difference or ratios, while ε_{it} *follows normal distribution.*

4.2 Before analysing data for panel regression we consider evaluating their properties, by running Levin-Lin-Chu test (LLC), which tests the hypothesis H_0: each time series contains a unit root against H_1: each time series is stationary. The finding of this procedure is reported in Table-2.

4.3 In the following section we used different indicators of state wise outstanding credit (both in levels and in normalized form). We start with state credit (it was found stationary) as a ratio of all India credit and estimate the coefficients of deposit and other variables indicating industrial health of the state in a pooled specification. The regression result under different explanatory variable(s) is indicated in Table-3. We controlled for gross state domestic product (GSDP) for the size and cycles of economic activity in the state.

4.4 The estimated coefficient and their P-values suggest that state deposit mobilisation played a major role in credit disbursement of the state. It could be in line with Lima and Resende (2008), where authors investigated regional heterogeneities in financial flows in Brazil, that greater availability of deposit has facilitated disbursement in state levels. This is also in line with the findings of Gao and Stepanyan (2011). Turning to demand factor, share of industry in the state output has a positive impact on the state level credit disbursement, along with the share of gross fixed capital formation in the state. This finding corroborates the findings of Gonzalez and Sales (2001) and Banos et. al (2011) in the Indian context. The operational factories have positively influenced the disbursement of credit. In this context it may be mentioned that Pai (1970) showed that for industrially developed states, the credit expansion is at a higher rate as compared to the deposit growth rate while the vice versa is true in case of industrially backward states. However, the results also indicate that the fixed capital coefficient had a negative sign, and working capital had an insignificant coefficient. The model with cross-section and period fixed effect was chosen on the basis of the F-statistics and redundant fixed effect chi-square test statistics. The residual diagnostics confirmed normal distribution of the panel regression errors.

4.5 To evaluate the effect of industrial variables, we performed a redundant variable likelihood ratio tests for deposits, share of industry and factory operational variables; the F-statistics and the likelihood ratio rejected the null of redundancy of these variables. Similarly, we considered the joint redundancy of the industrial variable on credit disbursements; the LR test statistics however, rejected the redundancy of these variables and indicated the importance of these variables in credit disbursement.

4.6 While the pooled regression indicate overall trend in credit disbursement and its determinants, we further control for state specific effect through a *random effect* panel model. However, the Houseman test statistics strongly indicate that the random effects are correlated which suggest use of fixed effect panel model for appropriate interpretation. In

this vain we estimated different fixed effect models (with cross section dummies, time dummies and with both cross-section and time dummies), estimated parameters and P-values from these different specifications are reported in the Table-4. While the coefficient magnitude and their significance varied across models, overall result indicate that after controlling for the state specific factors, *share of states' gross fixed capital formation* and *operational factories* emerge as important determinants of credit disbursements. *Share of deposits* has positive sign in the panel model with time dummies, however, for panel specification with cross section dummies and both cross-section and time dummies the coefficient turned out to be statistically insignificant.

4.7 To evaluate the persistence of credit flows or lag dependence of the state credit factor, we included first lag of credit in the equation and estimated this dynamic panel model in Panel GMM framework, using *Arellano–Bond* two-step procedure. The estimation results indicate (table-4, Model-4) that the coefficient of the lag-credit variable is positive and significantly different from zero; generally coefficients of industry share, gross fixed capital formation (all India share) and operational factories had positive coefficient supporting our earlier observations, however the *J-Stat*, *Arellano Bond* second lag autocorrelation, indicating that the dynamic panel is not a good fit for period under consideration.

4.8 Secondly, we used different transformation of credit disbursement, which includes state credit as a ratio of to state GDP (credit_GSDP). Other variables, e.g. deposit, GFCF and FC were appropriately normalized; for instance, the estimate of Credit_GSDP we used state deposit to SDP ratio, GFCF to SDP ratio, FC to GSDP and WC to GSDP ratio.

4.9 In line with Table-4 dummies ratio, we controlled for state specific variables and estimated panel model with cross section, time series dummies and with both cross section and time series dummies. The result underlined the importance of deposit mobilisation (relative to SDP) and factories operational in the state. However in the alternative specification the share of gross fixed capital formation to SDP didn't have much explanatory power.
We also estimated random effect model, which broadly supports our findings. Finally, in an attempt to test the dynamic relationship between credit to SDP ratio, we included the lagged value of the same as a right hand side variable and estimated the model using GMM methodology. The regression outcome indicate that while the lagged value of credit to SDP was statistically significantly explained the contemporaneous variables, the coefficient of other variables were not statistically significant; moreover, the *J-statistics* and *Arellano Bond* second lag autocorrelation, suggest poor fit of dynamic panel specification.

4.10 Our study could emphasise a broad trend in spatial distribution of credit and its relation with the industrial variables e.g. operational factories, share of industries in the state, share of gross fixed capital formation in the state and on the states deposit mobilisation, there are certain factors, e.g. the negative coefficient of fixed capital or insignificance of working capital in influencing credit disbursements. In the context it may be useful to consider factors representing banking network, infrastructure facilities and state GPD. One of the variables that we would have liked to consider in our analysis is the state specific profitability measure. This variable however did not give any significant result and had to be dropped for model parsimony. Our analysis suggests that volatility in profit in ASI dataset could be one of the reasons affecting the result. A more robust dataset in this respect would facilitate further research.

V. Conclusions

5.1 Heterogeneity of credit distribution across regions has attracted considerable academic and policy attention. Policymakers are especially interested in understanding the factors that hinder or foster a more egalitarian spatial distribution of credit with a view to removing the obstacles and encouraging the enabling factors. In the Indian context, while earlier studies have documented credit heterogeneity across states, we take a step forward to identify and quantify the state specific factors that characterise their risk return profile which may attract capital to one particular state as compared to others. Specifically, we consider factors related to industrial activities that have not been explicitly addressed in the literature; for instance, share of industries in total output, gross fixed capital formation, fixed and working capital requirements. We consider India, an EME, which provides considerable regional (across state) difference in terms credit disbursement and industrial activities.

5.2 Using data from large number of Indian states from 2003-04 to 2011-12, after appropriately controlling for the general time specific effects across states, we found empirical evidence which suggests availability of funds (deposits) and share of industry in total output as important variables explaining heterogeneity of credit disbursement. Among other variables, share of gross fixed capital formation and factories operational as important factors that affect credit disbursement.

5.3 Our empirical results motivate a few important policy implications. First, our results show that building a robust domestic deposit base is important for sustained and stable credit growth. This indicates that states, which have been leaders in terms of garnering deposits have also earned lion's share of the credit. However the solution to the problem does not lie in administrative credit rationing rules specifying which state should get how much credit; that would be grossly distortive in nature. Greater financial inclusion may be, at least in part, hold a key to breaking this low level equilibrium trap. Recent policy initiatives by Reserve Bank of India such as setting up differentiated banks (such as payments banks) with primary focus on the provision of basic financial services using new technologies could be helpful in achieving greater financial inclusion. The Government's *Jan Dhan Yojana* to provide bank accounts for each poor Indian family, where each account would include a debit card, accident and life insurance coverage, and an overdraft facility is also a major step in this direction.

5.4 Second, high level of industrialisation in the state seems to be attracting greater credit to the state. In line with the earlier discussion, this factor also suggests inequality breeding further inequality amongst states. Possibly, a 'big push' in terms of initiating industrial activity in the state by the Government may address this problem effectively. This can be done most effectively by creating enabling environment for industrial activity such as building strong infrastructure network, improving the investment climate in the state by reducing bureaucratic interference, more clarity and transparency in respect of rules and regulations governing the industrial sector and speedy decision making process.

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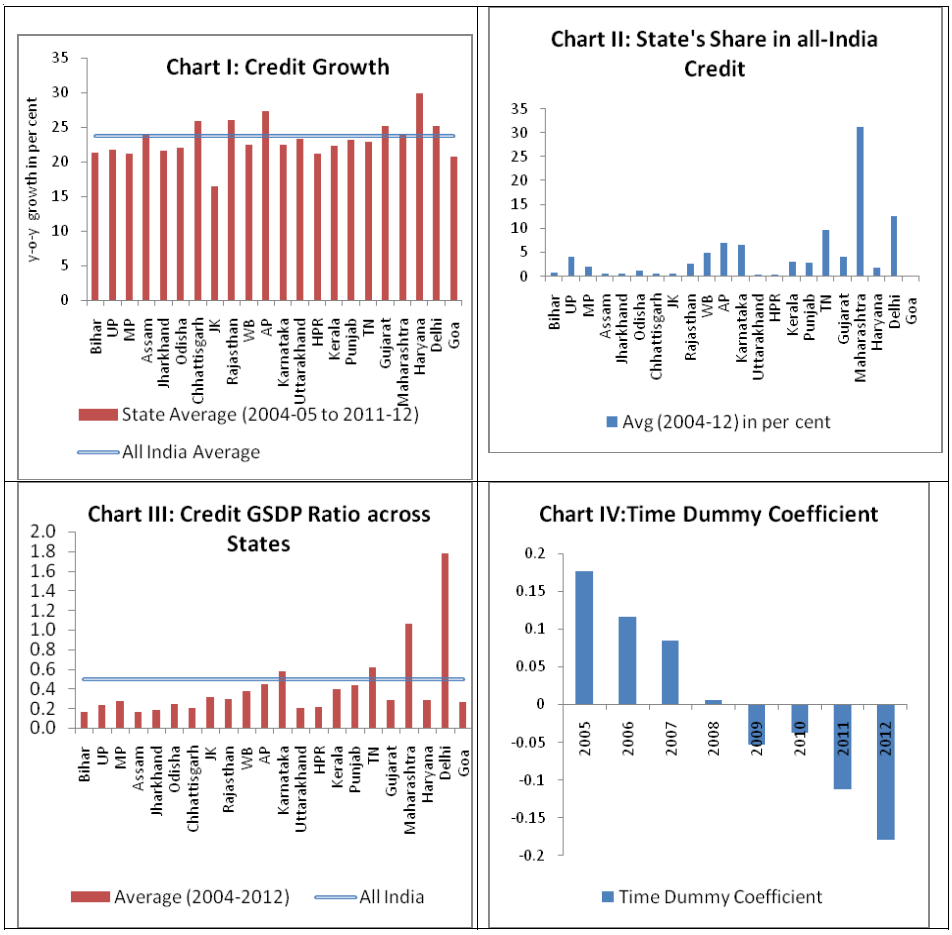
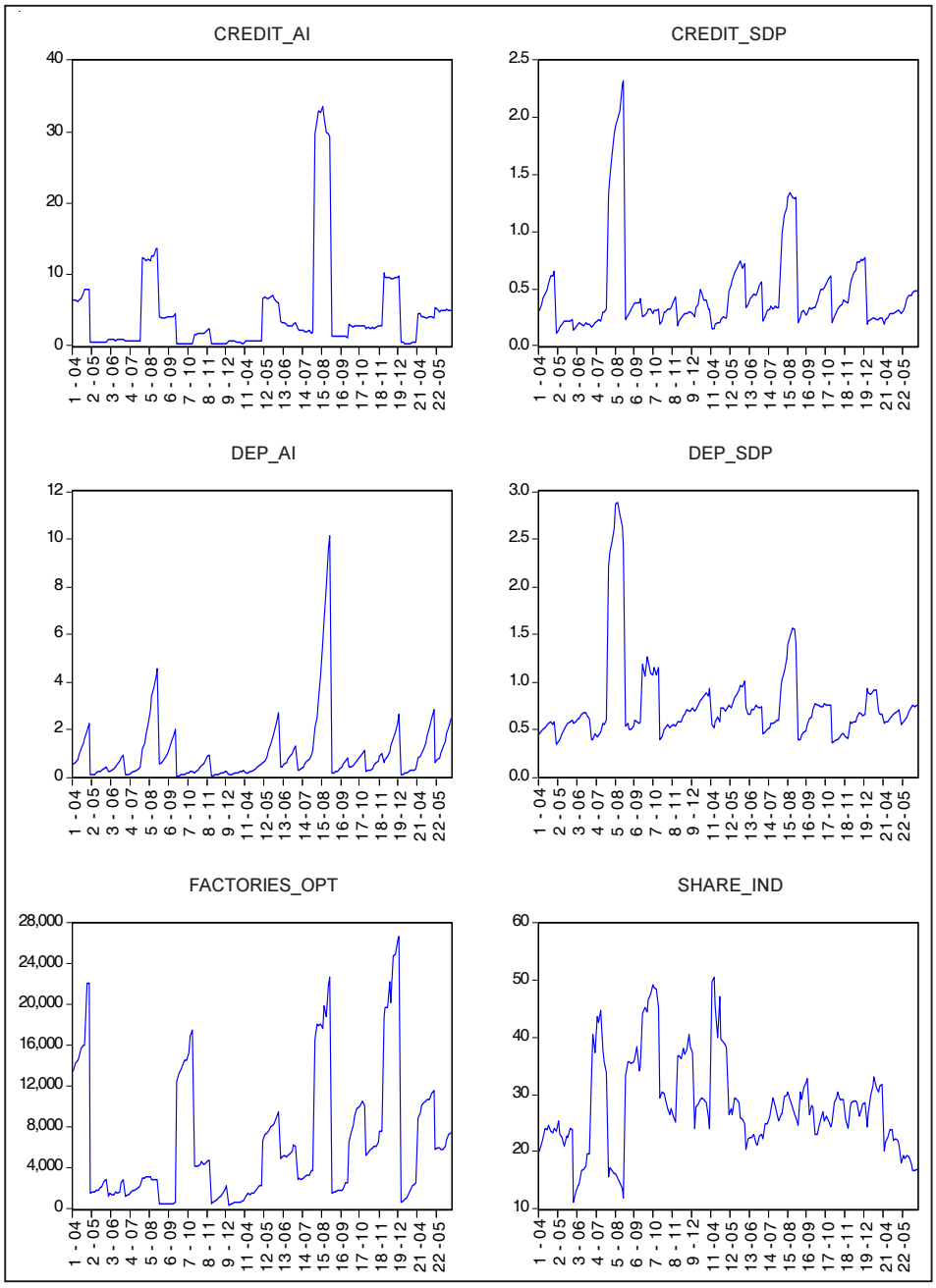


Note: In Charts I, II and III, the states have been arranged in ascending order of their average per capita GDP during the period under consideration.

Chart V: Variability of Credit Indicator and Major Macro Variables in India



Note: Horizontal axis indicate state-year (e.g. 1-2004 indicate state 1 year 2004) for each variable

Table 1: Variable Definition and Descriptive Statistics

Variable	Definition	Source	Mean	Median	Maximum	Minimum	Std. Dev.
CREDIT_AI	State credit to all India credit ratio	BSR-RBI	4.48	2.44	33.51	0.21	6.67
CREDIT_GSDP	State credit to state domestic product ratio	BSR-RBI and SoI- CMIE	0.46	0.33	2.31	0.11	0.39
DEP_AI	State deposit to all India deposit ratio	BSR-RBI	1.02	0.58	10.12	0.07	1.44
DEP_GSDP	State deposit to state domestic product ratio	BSR-RBI and SoI- CMIE	0.77	0.64	2.88	0.34	0.46
FACTORIES_OPT	Factories in operation in the state	ASI-GoI	6450.82	3942.00	26654.00	320.00	6412.03
FC_AI	State fixed capital to all India fixed capital ratio	ASI-GoI	4.52	3.07	19.70	0.08	4.73
FC_GSDP	State fixed capital to state domestic product ratio	ASI-GoI, SoI-CMIE	3.63	3.18	11.32	0.53	1.82
GFCF_AI	State gross fixed capital formation to all India gross fixed capital formation	SoI-CMIE	4.56	2.98	23.51	-0.02	4.58
GFCF_GSDP	State gross fixed capital formation to state domestic product ratio	SoI-CMIE	0.49	0.39	2.14	0.00	0.42
SHARE_IND	Share of industry in state domestic product	SoI-CMIE	28.08	26.86	50.61	11.22	8.24
WC_AI	State working capital to all India working capital ratio	ASI-GoI	4.45	3.19	18.21	-3.75	4.33
WC_GSDP	State working capital to state domestic product ratio	ASI-GoI	0.92	0.65	4.62	-0.71	0.88

Table-2: Panel Unit Root: Levin, Lin & Chu Test (Null: unit root)

	Statistic	Prob.	sections	Obs
Log(credit)	-8.89	0	22	154
log(deposit)	-3.91	0	22	154
Share of Industry in state*	-3.7	0	22	154
Factories Operational*	-8.8	0	22	132
Fixed Capital as ratio of all India	-2.18	0.01	22	154
Gross Fixed Capital Formation#	-5.52	0	22	153
Working Capital as ratio of all India	-5.85	0	22	154

*: variables found to be difference stationary; # as a ratio of all India

Table-3: Pooled Regression Explaining Spatial Credit Dispersion

	Coeff	P-value	Coeff	P-value	Coeff	P-value	Coeff	P-value	Coeff	P-value
C	0.20	0.54	-0.92	0.01	-1.36	0.00	-1.52	0.00	-1.64	0.00
DEP_AI	3.89	0.00	3.36	0.00	3.12	0.00	2.98	0.00	2.91	0.00
D(SHARE_IND)	0.27	0.04	0.24	0.04	0.22	0.05	0.20	0.07	0.20	0.07
GFCF_AI			0.37	0.00	0.32	0.00	0.62	0.00	0.55	0.00
FACTORIES_OPT					0.00015	0.00	0.00017	0.00	0.00017	0.00
LOG(FC_AI)							-1.28	0.00	-1.41	0.00
WC_AI									0.13	0.13
R-Squ	0.74		0.76		0.80		0.82		0.82	

Note: Independent Variabl is the share of state credit as a percentage of All India (AI) credit

Table-4: Static Fixed Effect Panel Model and Dynamic GMM Estimations

	Coeff	P-value	Coeff	P-value	Coeff	P-value	Coeff	P-value
C	3.93	0.00	-1.69	0.00	4.38	0.00		
CREDIT_AI(-1)							0.63	0.00
DEP_AI	-0.24	0.11	3.29	0.00	-0.31	0.07	-0.31	0.13
D(SHARE_IND)	0.00	0.88	-0.04	0.72	0.02	0.36	0.09	0.00
GFCF_AI	0.06	0.03	0.50	0.00	0.04	0.16	0.09	0.01
FACTORIES_OPT	0.00008	0.02	0.00017	0.00	0.00002	0.52	0.00014	0.08
LOG(FC_AI)	-0.09	0.63	-1.28	0.00	-0.01	0.94	-0.88	0.17
WC_AI	0.02	0.23	0.08	0.31	0.02	0.29	0.00	0.96
Fixed Effect	y				y		y	
Time Dummy			y		y		y	
							J-stat	5.06
R-Squ	0.86		0.97		0.99		Prob	0.75

Note: 1) Houseman test found correlated random effects, therefore fixed effect model results reported.
2) GMM estimates are given in the last two columns.

Table-5: Static and Dynamic Panel Models with State Credit to GDP as Dependent Variable

	Coeff	P-value	Coeff	P-value	Coeff	P-value	Coeff	P-value	Coeff	P-value	Coeff	P-value
C	0.29	0.00	-0.05	0.67	0.30	0.00	0.32	0.01	0.07	0.47		
CREDIT_GSDP(-1)											0.78	0.00
DEP_GSDP	0.64	0.00	0.55	0.00	0.63	0.00	0.34	0.00	0.61	0.00	-0.05	0.43
SHARE_IND	-0.01	0.00	0.00	0.94	-0.01	0.00	0.00	0.24	0.00	0.15	-0.01	0.22
GFCF_GSDP	0.00	0.96	-0.01	0.68	0.00	1.00	-0.06	0.02	-0.04	0.16	0.04	0.17
FACTORIES_OPT	0.00001	0.00	0.00002	0.00	0.00001	0.00	0.00000	0.55	0.00001	0.00	-0.00001	0.16
LOG(FC_GSDP)	-0.15	0.00	-0.04	0.01	-0.16	0.00	-0.01	0.38	-0.05	0.00	0.01	0.31
WC_GSDP	-0.01	0.57	0.01	0.64	-0.01	0.56	-0.01	0.37	0.00	0.95	-0.03	0.21
Fixed Effect			y				y		random		y	
Time Dummy					y		y		random		y	
											J-stat	6.31
R-Squ	0.87		0.97		0.87		0.97				Prob	0.61

Note: GMM estimates are given in the last two columns.

Investment Behaviour in Private Manufacturing Sector in India: An Empirical Analysis

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Abstract

This paper explores the investment behaviour of Indian private manufacturing industries at an aggregate level using the neoclassical theory of investment. Results indicate that the responsiveness of investment is higher with accelerator and profitability variables than financial liberalization and policy variables. In other words, industries consider the demand factors, internal liquidity and prior capital expenditure decisions than the policy variables as the major indicators of investment behaviour.

1. Introduction

1.1 Understanding the behaviour of investment provides an important insight into the process of economic development, where economic growth critically depends on capital accumulation and it stems from investment. "Industrial investment makes countries richer". This idea is commonly accepted among economists who argue that the speed of development closely depends on industrial investment level as well as on its structure, orientation and efficiency. In recent years, emphasis has been put on the development of the private sector to boost economic growth in developing countries. However, the idea of participation of the private sector as an alternative development strategy to boost growth in developing economies has started in latter part of 1980s. Recent theoretical and empirical studies on investment behaviour focused on the role of government policy and tried to derive an explicit relationship between the principal policy instruments and private investment (Blejer and Khan 1984, Greene and villaneuva 1991). More importantly, as evidenced, it is the private investment that plays a greater role than public investment in determining economic growth in developing countries. Henceforth the pace and pattern of business investment are central to the understanding of economic activity, where private investment is an important part of total investment.

1.2 Investment refers to increase in the total assets of a corporation, where new investment consists of addition to its assets, which enables it to produce more output. The growth in industrial output is primarily associated with new investment in plant and machinery. If firms are confident that demand will remain buoyant, they investment more in new plants and machineries which generate even more demand and increases productivity through the introduction of new technology which in turn accelerates economic growth.

1.3 In respect to India, it has been undergoing significant changes both in its structure and pattern owing to the policy changes. Since the early 1950s up until the early 1980s the evolution of manufacturing sector was guided by protected industrial and trade policies,

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which restricted the growth of the economy in general and manufacturing sector, in particular. Under old industrial and trade policy regime, manufacturing sector was characterized by extensive public sector participation, regulation of the private sector firms, restrictions on foreign investment, high tariff and non-tariff restrictions on imports, which held up the growth of the manufacturing sector. This has been replaced by a more liberal industrial and trade policy regime, through the inception of new economic policy in 1991. The major focus of these policies had been to dismantle the complex web of controls that severely constrained the emergence and operation of the private entrepreneurs. Investment performance has been a key emphasis in the policy debate following the reforms (Athukorala and Sen 1998). It is observed that new policies had tremendous effect on the industrial sector, in terms of creating conducive business environment for investment and for future growth process of industries. Besides these polices few more additional macroeconomic and structural adjustments, such as financial liberalization, development of securities market, boom in equity prices and growth of institutional investors have given rise to enhanced interest in the behaviour of investment and its link to growth.

2. An Outline of Investment Patterns in India

2.1 The capital formation in the country has been marked by some significant developments. The gross capital formation has gone up sizably since the 1950s with significant jumps during the 1980s. The rate of gross capital formation more than doubled by the 1980s and increased more than two and half times during the 1990s. However, for subsequent three years the rate of gross capital formation remained depressed and it fluctuated around 21% of GDP. The process of recovery started in 1994-95 and the gross capital formation rose to 25 percent in 1995-96 and it substantially increased to 34% of GDP in 2007-08. At present the rate of investment in the country is more than double the rate of investment in the early years of economic reforms. Figure1 presents the time series plots of private, public and total investment rates in percent to GDP. As evident, private investment rate surged in late 1980s, and increased at a rapid pace since reforms. Private investment as a percent of GDP is marginally high compared to public investment in pre reform period. It rose from 9.5 percent in 1980-81 to 13.6 percent in 1990-91 and during post reform period private investment amplified to 25.7% of GDP. However, total investment rate as a percent to GDP increased gradually over the years from 23% in 1990 to 34% in 2007. On the other side public investment declined gradually from its peak of 11.6% in 1986-87 to 9.8 % in 1991 and to abysmal of 8.2% in 2007.

2.2 Overall, as a consequence of economic liberalization it is the private corporate sector which performed well, due to the privatization of several industries. The escalating domestic demand and growing export orientation has brought an upsurge in the manufacturing sector. Phenomenal growth is registered in automobile sector, iron and steel, machinery and equipment, including transport and basic chemicals sector in recent years. However, concerning with private investment and its allocation among different sectors and factors that influence investment is central in theoretical macroeconomics. As adequate capital investment in industries is critical for accelerated industrial growth, forecasts of investment of the private sector assumes considerable significance in determining the performance of industrial sector, and it provides the necessary backdrop to gauge the impact of reform policies on private investment.

2.3 However, a number of empirical studies exist on the above issue, where few studies used pre-reform as well as post liberalization data on private investment in India. However, the current study is another attempt in a broader dimension, where it comprehensively evaluates the empirical determinants of private investment activity. The paper investigates three interrelated core issues: firstly, the role of accelerators and financial variables in influencing business fixed investment across various industrial groups and second, emphasis on the implications of financial sector reforms on manufacturing investment behaviour. Third, the role of equity finance in determining capital expenditure is examined for the post reform period. It is observed that an extensive volume of research works have emerged, both at the theoretical and empirical levels, to counter the above issues. Theoretically, in modeling the determinants of investment behaviour of a firm, five broad approaches are considered; which include the simple accelerator model, the liquidity theory, the expected profits theory and the neo classical theory of investment. One of the first theories of investment and the base for other approaches was the simple accelerator model, (Clarke, 1917) which maintains expected future sales as the main determinant of investment. This acceleration concept hypothesized a direct functional relationship between a rate of change in a flow and additions to a stock, (Meyer. J and Edwin Kuh,1955). Specifically, additions to the stock of physical capital were considered, as a simple function of the rate of change in output. This model was soon transformed into the flexible accelerator model of investment behaviour (Chenery, 1952 and Koyock, 1954), which states that, the adjustment of capital stock to the desired level is not instantaneous because of delivery lags and delayed responses to changes in the level of demand. They incorporated financial variables along with future sales as the determinant for investment decisions, where they assumed the level of desired capital to be proportional to output. There are other theories, which are propounded as alternatives to the rigid accelerator theory, i.e. Liquidity theory and Expected Profits theory. In the liquidity theory of investment behaviour, desired capital is proportional to liquidity (Jorgenson and Calvin D. Siebert 1968), whereas in expected profits theory desired capital is proportional to profits. The Profits theory holds that the amount of investment spending depends on the amount of profits that firms and industries are making i.e. profit expectations determine investment behaviour. As, against the above investment theories, the neo classical investment path, based on firm profit optimization, has been most dominant in applied research (Robert. S. Chirinko 1993). There are two major variants of this approach; one is the user cost of capital model, pioneered by Dale Jorgenson (1963), which postulates that output levels and user cost of capital are the two key determinants of investment. The theory of a profit maximizing firm, subject to a production function through which a technical relationship between inputs and outputs get defined is central in the neo classical model. The model assumes flexible accelerator prices and capital markets. The other variant of the optimizing approach is the q theory pioneered by Tobin (1969), which incorporates Keynes's analysis of share (stock) price instability into fixed investment volatility. According to Tobin, firm investment opportunities are summarized by the market value of its capital stock. In particular, firm investment expenditure is positively related to average q (also known as Tobin's q) defined as the ratio of the market value of the firm to the replacement cost value of its assets. The use of q is based on the idea that investment opportunities can be captured by equity market.

2.4 On the other hand, a vast literature suggests that in addition to real sales growth and the user cost of capital, financial factors are also imperative in explaining short run fluctuations in investment. However, firms first utilize internal funds for investment purposes

so as to maintain their control. But, the external finance is also sought for financing their investment plans if the desired rate of growth is higher than that permitted by the internal finance. According to financing hierarchy hypothesis, i.e. Myers(1984) "pecking order" theory of financing , the firm's capital structure will be driven by the desire to finance new investments, first internally, then with low-risk debt, and finally with equity only as a last resort. In contrast, transaction costs or information asymmetries induce a cost premium that makes external finance an imperfect substitute for internal finance. Therefore, in a world of heterogeneous firms, financing constraints would clearly influence the investment decisions of firms. In particular, investment may depend on financial factors, such as availability of internal finance, access to new debt or equity finance, or the functioning of particular credit markets. In the following empirical works we found contradictory views regarding investment determinants. The studies like Dhrymes, P. J. and M. Kurz (1967), Sachs, Reynolds and Albert. G. Hart (1968) investigated the determinants of fixed investment in a broader dimension, where they determined the structure underlying the dividend - investment – external finance triad of decision making process and found external finance activity of firms to be strongly affected by their investment policies. They indicated the considerable relevance of accelerator and profit theories in explaining the empirical behaviour of investment. Krishnamurthy. K and Sastry (1971, 1975), Bhattacharya.S (2008), also argued along similar lines, found the positive effects of accelerator, retained earnings and flow of external finance in determining investment behaviour of Indian manufacturing sector. These studies claim a significant support for the investment –accelerator relationship. Similarly, Bilsborrow E. Richard (1977) analyzed the determinants of investment in manufacturing firms with a different institutional and cultural context of a developing country, Colombian firms where along with the accelerator and financial variables he appraised the importance of foreign exchange as a significant influence on annual variation in investment. Recent empirical works, revealed the dependence of investment on financial factors. Hubbard. G (1998) emphasized on the contemporary models of capital market imperfection and the implications of these models in firm's investment process. The study considers the applications of these models to a range of investment activities including research on inventory investment, research and development, employment, business formation, survival, pricing and corporate risk management. However, identifying a specific channel (debt covenants) and the corresponding mechanism (transfer of control rights) through which financing frictions impact corporate investment, Chava. S and Michael. R. Roberts (2008), shows that capital investment declines sharply following a financial covenant violation, when creditors use the threat of accelerating the loan to intervene in management.

2.5 Further, the reduction in investment is concentrated in situations in which agency and information problems are relatively more sever, highlighting how the state contingent allocation of control rights can help mitigate investment distortions arising from financing frictions. On the other hand, Cava La, Gianni (2005), Bond. S and Costas Meghir (1994), explored the impact of financial factors on corporate investment, and indicated the severity of financing constraints of firms. The innovation of the study is that they distinguish financially distressed firms from financially constrained firms. The presence of financially distressed firms appears to bias downwards the sensitivity of investment to cash flow. The paper also explores the effects of cash flow on investment, where the availability of internal funding could significantly affect the investment of financially constrained firms. Real sales and the user cost of capital, which incorporates both debt and equity financing costs, also appears to be an important determinant. In contrast to their views, several studies

argued for government intervention in the allocation of investment finance. Emphasizing on the implications of the recent structural adjustment policy reforms of 1990s, on investment behavior Athukorala and Sen (1996) examined the determinants of private corporate investment in India. The results of their econometric analysis suggest that the net impact of the reforms on corporate investment has been salutary. The decline in real public sector investment brought about by the fiscal squeeze carried out as part of the reforms seems to have had a significant adverse impact on corporate investment. However, this adverse impact was outweighed by the salutary effects of the reform process on investment operating through the decline in real rental cost of capital and favorable changes in investor perception in the aftermaths of the reforms. Finally, they indicated the strong complimentary relationship of public investment with private corporate investment in India.

3. Theoretical Framework

3.1 In order to encompass sound theoretical underpinnings on the determinants of investment, we make use of neoclassical model of investment with appropriate consideration to the dynamic structural and institutional features of the Indian economy. The theory of a profit maximizing firm subject to a production function through which a technical relationship between inputs and outputs get defined is central in neoclassical model. This production function connects the capital stock to the relative price between capital and output. Jorgenson's basic assumption for a firm to maximize its present value is that the rate of change of the input of capital services is equal to the rate of net investment. This means that the provision of capital to a firm is derived function of the acquisition of investment goods by that firm. The neo classical model postulates that output levels and user cost of capital are the two key determinants of investment where the demand for capital is assumed to positively related to expected output (Y) and inversely related to the expected rental cost of capital (C). Assuming a conventional neoclassical model where a profit maximizing firm is subject to constant returns to scale and a constant elasticity of substitution production function, the function optimal capital stock (K*) can be represented as:

$$K_t^* = \alpha Y_t C_t^{-\sigma} \qquad (1)$$

Where, K_t^* is the desired capital stock, Y_t is the expected level of output in period t, C is expected cost of capital, in period t. The variable user cost of capital (Hebbel and Muller, 1992), is equal to $C_t = PK\,(r\,(1\text{-}t) + \delta - \pi^e)/P$. Where, PK = price of capital goods, r = bank lending rate, t= corporate tax, δ = depreciation rate, π^e = expected rate of change in capital goods price (inflation), and P= the general price level.

3.2 Similarly, if expectations are static, so that future changes in output are unanticipated, net investment can be represented as a distributed lag on past changes in desired capital stock.

$$I_t^n = \alpha \beta_j \sum_{j=0}^{N} \Delta K_{t-j}^* \qquad (2)$$

Assuming, that capital depreciates at a constant rate, the replacement investment (I_t^r) is given as:

$$I_t^r = \delta K_{t-1} \qquad (3)$$

By combining both net and replacement investment and adding a stochastic error term (u_t) we obtain the neo-classical investment model as:

$$I_t = \delta K_{t-1} + \sum_{j=0}^{N} \alpha \beta_j \Delta (Y_{t-j} C_{t-j}^{-\sigma}) + u_t \qquad (4)$$

3.3 For empirically estimating investment function we approximate K* linearly on the assumption that expectations of the output and rental cost terms are based on extrapolations of past values. Thus with inclusion of additional variables such as borrowings (BR_t), equity capital (EQ_t), Operating profit (OP_t), and Financial liberalization Index ($FlibDF_t$) the model can be written as:

$$I_t = C + \alpha K_t + \Sigma \Phi_{1j} Y_{t-j} - \Sigma \Phi_{2j} UCC_t + \Phi_3 OP_t + \Phi_4 BR_t + \Phi_5 EQ_t + \Phi_6 FlibDF_t + u_{it} \qquad (5)$$

Where the distributed lag co-efficient are an amalgam of the delivery lag, expectations and production parameters. The equation (5) provides a useful framework for examining the relationship between the macroeconomic stabilization programmes initiated in the early 1990s and the behaviour of private corporate investment in India.

4. Data, Methodology and Empirical Results

4.1 In order to examine the investment determinants the study uses two digit industries and for classification we have followed the Annual Survey of Industries, National Industry Classification (NIC) code 2004, which is regarded as benchmark for industry classification, prepared according to their economic activity. According to National Industry Classification (NIC), the manufacturing sector commences from NIC 15 and ends at NIC 36. In whole the manufacturing sector contains 22 two digit industries, out of it the study selected 15 major industries for time series analysis starting from 1990 to 2007 [see table 1].

4.2 In econometric theory it is generally found that, time series data are often encountered with the problem of Non-Stationarity and Autocorrelation. The study tested for these problems by employing Augmented Dickey Fuller (ADF) and Breusch Godfrey Serial Correlation LM (BGLM) test. The study makes use of Generalized Least Squares (GLS) technique for estimation of the regression model.

4.3 The study begins empirical analysis by carrying out unit root test for each of the variables across fifteen industries, the results of the unit root test both at level and difference along with the descriptive statistics results are reported in tables 4-4.1. According to the test results, the variables under consideration do not have the uniform order of integration, some variables are integrated of order one I (1) and some are integrated at order two I (2). Therefore the Stationarity problem is worked out by taking respective differences for all the variables. The results of the BGLM test are presented in table 3. If the test is significant null hypothesis is rejected indicating the presence of autocorrelation in the model. The results show that, the industries are significant at 1% and 5% level of significance, depicting the presence of autocorrelation in all the industries. Moreover, under the presence of autocorrelation the usual estimators of the covariance matrices of the OLS are not valid. Thus we need new estimation methods to handle regression models with error terms that are heteroskedastic and serially correlated or both. Therefore the study makes use of

Generalized Least Squares [GLS] technique for estimation, which is an efficient estimator where it satisfies the conditions of Gauss-Markov theorem. Finally, to examine the determinants of investment, the study followed Jorgensen's neoclassical theory of investment. The theory implies that investment is dependent on the level of output and the user cost of capital. The study along with output and user cost of capital as a determinants, considers other key determinants of investment such as operating profit, borrowing, equity and financial liberalization index.

4.4 The study hypothesizes that, sales affects investment with a lag i.e., previous period sales induces current investment. Additionally, current profitability of industries signal expected future profits that may affect investment expenditure, emphasizing the forward looking nature of investment decisions. The results of the estimated model displaying the contribution (coefficients) of the explanatory variables to capital formation are reported in table 2. The coefficient of sales lag is significant in Manufacture of Textiles (NIC 17), Manufacture of Paper and Paper Products (NIC 21), Manufacture of Rubber and Plastic Products (NIC 25), Manufacture of Fabricated Metal Products (NIC 28), Manufacture of Electrical Machinery and Apparatus (NIC 31), Manufacture of Radio, television and communication Equipment (NIC 32), Manufacture of Motor Vehicles trailers and Semi-trailers (NIC 34) and Manufacture of Transport Equipment (NIC 35). Meanwhile in industries such as, Manufacture of Food Products and Beverages (NIC 15), Manufacture of Tanning and Dressing of Leather (NIC 19), Manufacture of Coke, Refined Petroleum products (NIC 23), Manufacture of Chemicals and Chemical Products (NIC 24), Manufacture of Other non-metallic mineral products (NIC 26), Manufacture of Basic Metals (NIC 27), Manufacture of Machinery and Equipment (NIC 29), the coefficient is not statistically significant. In these industries the financial variables such as operating profit, capital stock and borrowings have a significant impact on investment. The results reveal that in half of the industries, the accelerator variable doesn't have greater influence on investment, where it is the financial variables which have a bigger influence in determining the level of investment.

4.5 On the other hand, capital stock is considerably influencing investment in few industries such as Manufacture of Food Products and Beverages (NIC 15) and also in heavy industries such as Manufacture of Other non-metallic mineral products (NIC 26), Manufacture of Basic Metals (NIC 27), Manufacture of Fabricated Metal Products (NIC 28), Manufacture of Machinery and Equipment (NIC 29), Manufacture of Motor Vehicles trailers and Semi-trailers(NIC 34), Manufacture of Transport Equipment (NIC 35), the coefficient is positive and significant at 1% and 5% level. Across the industrial sectors and within the industries, the mean value of capital stock [see table 5] is relatively higher compared to other variables, implying a greater amount of impact on capital formation. Meanwhile, in Manufacture of Textiles (NIC 17) and Manufacture of Chemicals and Chemical Products (NIC 24) the variable is significant with a negative coefficient values. Although these two industries have a higher mean value of capital stock but its influence on investment is negative, this is due to a larger control of sales and profitability respectively in determining capital expenditure in these two industries. On contrary to these findings, few industries for instance, Manufacture of Tanning and Dressing of Leather (NIC 19), Manufacture of Paper and Paper Products (NIC 21), Manufacture of Coke, Refined Petroleum products (NIC 23), Manufacture of Rubber and Plastic Products (NIC 25), and in two electrical and electronic industries such as Manufacture of Electrical Machinery and Apparatus (NIC 31),

Manufacture of Radio, television and communication Equipment (NIC 32), the variable capital stock is insignificant in explaining investment patterns. The descriptive statistics reveals that the mean value of capital stock is relatively less, implying a meager influence on investment spending in these six sectors.

4.6 The research finds internal sources of funds as a major source of financing investment. In fact, over the years operating profits increased in all the industries, in the sample out of fifteen industries, operating profits is a significant determinant in ten industries. Industries such as Manufacture of Textiles (NIC 17), Manufacture of Coke, Refined Petroleum products (NIC 23), Manufacture of Chemicals and Chemical Products (NIC 24), Manufacture of Other non-metallic mineral products (NIC 26), Manufacture of Fabricated Metal Products (NIC 28), Manufacture of Machinery and Equipment (NIC 29), Manufacture of Electrical Machinery and Apparatus (NIC 31), Manufacture of Radio, television and communication Equipment (NIC 32) and Manufacture of Transport Equipment (NIC 35) have positive and significant coefficients. The large and significant coefficient of the profit variable in these industries suggests the strong influence of operating profit in determining investment, a result which is consistent with earlier empirical works. On the other hand in, Manufacture of Paper and Paper Products (NIC 21) and Manufacture of Fabricated Metal Products (NIC 28), it is statistically significant with 5%and 10% level with negative coefficient estimates. Similarly, in contrast to these findings, operating profit is irrelevant in influencing investment in few industries such as Manufacture of Food Products and Beverages (NIC 15), Manufacture of Tanning and Dressing of Leather (NIC 19), Manufacture of Rubber and Plastic Products (NIC 25), Manufacture of Basic Metals (NIC 27) and Manufacture of Motor Vehicles trailers and Semi-trailers (NIC 34). The larger performance of accelerator, capital stock and borrowings led to irrelevance of this variable in determining investment patterns, it is evident from descriptive statistics.

4.7 The study also explores industry accessibility to external capital (Borrowings and Equity capital) and its relation to investment activities. Theoretically, the demand for external finance is influenced by growth objectives of industries, which determine the extent of borrowings. Industries resort to external finance if market opportunities warrant a faster rate of expansion than is permissible through internal resources. The results reveal that industries such as Manufacture of Food Products and Beverages (NIC 15), Manufacture of Tanning and Dressing of Leather (NIC 19), Manufacture of Chemicals and Chemical Products (NIC 24), Manufacture of other non-metallic minerals products (NIC 26) and Manufacture of Basic Metals (NIC 27), the coefficient of borrowings is positive and significant and in Manufacture of Rubber and Plastic Products (NIC 25) and Manufacture of Electrical Machinery and Apparatus (NIC 31) the coefficient is negative and statistically significant. The descriptive statistics reveals that in these industries the variable borrowings have marginally higher mean value compared to other variables in the model. Meanwhile, in remaining industries such as Manufacture of Textiles (NIC 17), Manufacture of Paper and Paper Products (NIC 21), Manufacture of Coke, Refined Petroleum products (NIC 23), Manufacture of Fabricated Metal Products (NIC 28), Manufacture of Machinery and Equipment (NIC 29), Manufacture of Radio, television and communication Equipment (NIC 32), Manufacture of Motor Vehicles trailers and Semi-trailers (NIC 34), Manufacture of Transport Equipment (NIC 35) borrowings is insignificant in determining investment.

4.8 Meanwhile, another important component of external finance is equity capital which also influences investment patterns in few high growth industries. The coefficient of equity capital is positively associated with the capital expenditure of industries such as Manufacture of Paper and Paper Products (NIC 21), Manufacture of Coke, Refined Petroleum products (NIC 23), Manufacture of Machinery and Equipment (NIC 29), Manufacture of Radio, television and communication Equipment (NIC 32) and Manufacture of Transport Equipment (NIC 35). In contrast to this, in few industries such as, Manufacture of Chemicals and Chemical Products (NIC 24) and Manufacture of Motor Vehicles trailers and Semi-trailers (NIC 34) the coefficient is negative with significant p values. Meanwhile in Manufacture of Food Products and Beverages (NIC 15), Manufacture of Textiles (NIC 17), Manufacture of Tanning and Dressing of Leather (NIC 19), Manufacture of Rubber and Plastic Products (NIC 25), Manufacture of Other non-metallic mineral products (NIC 26), Manufacture of Basic Metals (NIC 27), Manufacture of Fabricated Metal Products (NIC 28), Manufacture of Electrical Machinery and Apparatus (NIC 31) equity capital is insignificant in determining investment. Overall the results reveal that in majority of industries equity capital is not playing a significant part in determining investment.

4. 9 As for as the user cost of capital (UCC) is concerned, its influence on investment is negative and statistically insignificant implying that the long-run impact of the user cost of capital on investment is irrelevant and uninfluential in almost all the industries. This suggest that the tax and non-tax (economic depreciation rate of capital, interest rate and price level) incentive policies in India do not have a major impact on manufacturing investment. In this sense, the empirical results lend support to prior studies of developing countries where the user cost of capital doesn't surprisingly determine capital accumulation in the private sector.

4.10 Further, the study examined the impact of financial sector reforms on corporate investment patterns. The results reveal that the coefficient of financial liberalization defacto index is negative in all the industrial sectors except Manufacture of Fabricated Metal Products (NIC 28) and Manufacture of Motor Vehicles trailers and Semi-trailers (NIC 34). However, these two industries have positive coefficient but they are not statistically significant. In general, the result presents a low-key association between financial liberalization and corporate investment. Previous empirical studies (World Bank 1989, Harrigan and Mosley 1998, Nair.P 2005) evaluating the impact of reforms on private investment showed less impact in developing countries. Overall the results intend that the responsiveness of investment is higher with accelerator and profitability variables than the financial liberalization policy variables. In other words, industries consider the demand factors, internal liquidity and prior capital expenditure decisions than the policy variables as the major indicators of investment determinants.

4.11 By and large the results imply the greater relevance of accelerator as well as the profit theories in determining fixed investment. The study exposes the lesser power of accelerator in determining capital expenditure, but this should not be interpreted as a denial of the expediency of the accelerator variable.

5. Conclusion

"Business investment is ideally decided on the basis of anticipations of the future.... If our implicitly and explicitly assumed relations between past and future prove different from those of business decision makers, we can hardly expect to estimate a stable or reliable relation between business investment and past or current variables." quoted from Eisner [1978b. in pages 12 and 13].

5.1 However, there is ambiguity, regarding the theories and empirical works relating to the factors influencing investment, where different theories emphasized diverse factors as major determinants of investment namely accelerator, cash flow, liquidity, cost of capital etc. In this structure, the study examined the factors influencing investment behaviour in Indian industries. The investment analysis indicates the complex nature of manufacturing industries where the factors influencing investment are not uniform across the industries. In some industries accelerator variable plays a significant part whereas in some other industries financial factors such as operating profit and external finance have significant influence on investment. The results of the study indicate that the responsiveness of investment is more with profitability followed by accelerator and other determinants. Both accelerator hypothesis as well as profit theory have been found to be important in explaining investment behaviour. Numerous studies have established a positive relationship of investment with accelerator and profit theories, although in all cases the results were not robust. The fact that accelerator and profit theory functioned well as an explanation of investment for Indian industries lends additional support to it being considered as a crucial determinant of long-run investment. Meanwhile in few industries factors such as bank borrowings, equity capital and capital stock also found to be significant determinants. In majority of industries consistent with neo classical theory user cost of capital is inversely related to investment with negative coefficient value. Overall the empirical results upheld the importance of accelerator and profit theories of investment. As for as the impact of financial sector reforms is concerned, the results display a meager association between financial liberalization index and investment in Indian industries.

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Fig: 1 Public, Private and Total Capital formation in percent of GDP

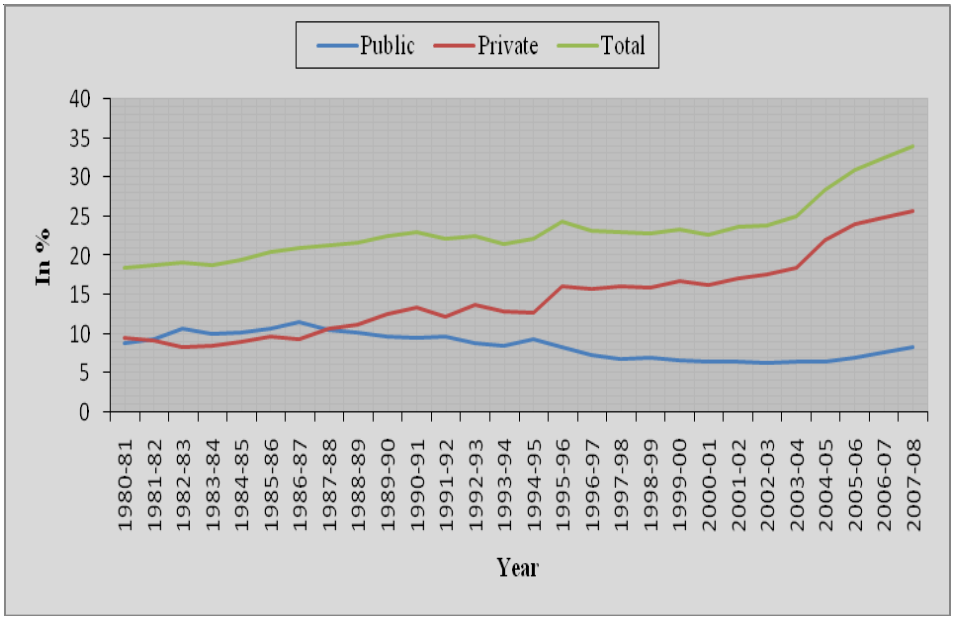

Table 1: Sample of Industries draw for empirical analysis

Industries selected by Economic Activity [NIC 2004]	CODE
Manufacture of food products and beverages	NIC 15
Manufacture of textiles	NIC 17
Manufacture Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	NIC 19
Manufacture of paper and paper products	NIC 21
Publishing, printing and reproduction of recorded media	NIC 22
Manufacture of coke, refined petroleum products and nuclear fuel	NIC 23
Manufacture of chemicals and chemical products	NIC 24
Manufacture of rubber and plastics products	NIC 25
Manufacture of other non-metallic mineral products	NIC 26
Manufacture of basic metals	NIC 27
Manufacture of fabricated metal products,	NIC 28
Manufacture of machinery and equipment	NIC 29
Manufacture of electrical machinery and apparatus	NIC 31
Manufacture of radio, television and communication equipment	NIC 32
Manufacture of motor vehicles, trailers and semi-trailers	NIC 34
Manufacture of other transport equipment	NIC 35

Table 2: Factors Influencing Investment Behaviour in Indian Manufacturing Sector

Dependent variable: *Investment (I_t)*

Industry / Variables	C	K_t	Y_{t-1}	UCC_t	OP_t	BR_t	EQ_t	$FlibDF_t$	R^2	DW
NIC15	130.302	0.246	0.054	-0.030	-0.093	0.111	-0.169	-242.990	0.91	1.95
t-statistics	1.688	2.700	1.884	-1.226	-0.615	3.411	-1.458	-1.505		
Prob	0.135	0.0307**	0.102	0.226	0.558	0.0113*	0.188	0.176		
NIC 17	559.575	-0.334	-0.348	-0.328	0.792	0.083	0.471	-1143.200	0.82	2.06
t-statistics	1.453	-2.553	-2.203	-1.389	3.204	0.799	1.144	-2.543		
Prob	0.184	0.0340**	0.0587**	0.202	0.0125*	0.448	0.286	0.0345**		
NIC 19	-18.681	-0.019	-0.063	-0.271	-0.135	0.323	0.079	-0.066	0.74	2.45
t-statistics	-0.388	-0.099	-0.600	-1.112	-0.430	1.897	0.492	-3.517		
Prob	0.708	0.924	0.565	0.298	0.679	0.099***	0.636	0.727		
NIC 21	378.210	0.088	0.195	-0.058	-0.188	-0.110	0.363	-34.826	0.89	2.18
t-statistics	10.303	1.406	5.577	-0.313	-1.978	-1.545	4.283	-0.859		
Prob	0.0000*	0.197	0.0005*	0.756	0.0833***	0.161	0.0027*	0.415		
NIC 23	34.854	-1.130	0.143	-0.029	1.235	0.336	0.388	-72.058	0.71	2.58
t-statistics	1.004	-1.741	1.314	-0.529	3.162	0.742	3.058	-2.118		
Prob	0.345	0.120	0.230	0.599	0.0159**	0.480	0.0184**	0.0720**		
NIC 24	-451.350	-0.294	0.053	-0.305	0.972	0.200	-0.662	-413.030	0.68	2.46
t-statistics	-0.445	-2.428	1.158	-2.455	2.276	1.942	-2.472	-1.087		
Prob	0.670	0.0456**	0.285	0.0438**	0.0569**	0.093***	0.0427**	0.313		
NIC 25	-28.368	-0.051	0.343	0.378	0.117	-0.145	0.079	-77.314	0.66	1.90
t-statistics	-0.349	-0.344	3.152	3.404	0.402	-2.272	0.213	-1.021		
Prob	0.736	0.740	0.0136**	0.0093*	0.698	0.0573**	0.837	0.337		
NIC 26	115.421	0.372	-0.085	-0.128	0.376	0.119	-0.204	-660.133	0.65	3.19
t-statistics	0.247	2.076	-0.545	-0.506	2.137	2.211	-0.477	-1.945		
Prob	0.812	0.0832**	0.603	0.629	0.0700**	0.069***	0.648	0.0923***		
NIC 27	-3961.070	0.289	-0.114	-0.093	0.091	0.949	-0.179	-1232.760	0.57	1.95
t-statistics	-0.718	3.293	-0.955	-0.738	0.668	3.833	-0.659	-0.820		
Prob	0.496	0.0133**	0.496	0.485	0.526	0.0064*	0.531	0.439		
NIC 28	-45.372	0.291	0.140	0.123	-0.237	-0.083	-0.103	35.245	0.85	2.26
t-statistics	-2.640	2.082	4.295	0.915	-2.409	-0.555	-0.912	1.744		
Prob	0.0297**	0.0709**	0.0026*	0.387	0.0527**	0.594	0.388	0.119		
NIC 29	278.856	0.846	0.269	-0.724	0.713	-0.015	1.682	-312.080	0.61	2.63
t-statistics	0.979	1.999	1.417	-1.522	2.660	-0.045	3.351	-0.765		
Prob	0.360	0.0857**	0.199	0.131	0.0325**	0.965	0.0122**	0.469		
NIC 31	110.580	0.104	0.238	-0.004	0.172	-0.190	-0.013	-31.322	0.72	2.25
t-statistics	2.284	1.517	2.891	-0.030	2.377	-2.295	-0.067	-0.457		
Prob	0.0517**	0.168	0.0233**	0.977	0.0491**	0.0508**	0.948	0.660		
NIC 32	455.690	-0.349	0.245	-0.524	1.367	0.366	0.518	-591.740	0.68	2.49
t-statistics	1.304	-1.169	3.103	-1.409	2.494	1.322	2.123	-0.754		
Prob	0.289	0.276	0.0173**	0.162	0.0469**	0.223	0.0780***	0.472		
NIC 34	248.350	0.474	0.949	0.030	0.301	-0.127	-0.780	180.306	0.84	1.99
t-statistics	0.745	3.579	3.833	0.182	1.234	-1.197	-2.244	0.484		
Prob	0.481	0.0090*	0.0064*	0.861	0.257	0.270	0.0598**	0.643		
NIC 35	69.816	-0.182	-0.061	-0.108	0.203	0.092	0.369	-33.351	0.86	1.94
t-statistics	2.671	-4.511	-2.650	-0.899	2.647	1.401	3.860	-0.549		
Prob	0.0283**	0.0020*	0.0293**	0.394	0.0294**	0.199	0.0048*	0.598		

* 1%, **5% and *** 10% level of significance.
Industries abbreviations are provided in [table 1]

Table 3: Breusch Godfrey Serial Correlation LM Test for Investment Determinants

		Breusch Godfrey Serial Correlation LM Test		
Industry	**F statistics**	**Prob F(2,7)**	**Obs*R-squared**	**Prob.Chi-Square (2)**
NIC 15	7.681090	0.0222	12.22521	0.0022*
NIC 17	6.138710	0.0289	10.82697	0.0045*
NIC 19	2.419051	0.1697	7.588758	0.0225**
NIC 21	1.118073	0.3969	5.253416	0.0723***
NIC 23	1.912286	0.2417	7.367806	0.0251**
NIC 24	5.683876	0.0516	11.80686	0.0027*
NIC 25	2.872194	0.1477	9.088893	0.0106*
NIC 26	3.855009	0.1483	10.07844	0.0065*
NIC 27	21.64789	0.0034	15.24001	0.0005*
NIC 28	11.60826	0.0087	12.71419	0.0017*
NIC 29	6.732296	0.0382	12.39659	0.0020*
NIC 31	1.494456	0.2974	5.320175	0.0699***
NIC 32	5.977336	0.0472	11.98663	0.0025*
NIC 34	2.617472	0.1668	7.672163	0.0216**
NIC 35	2.229391	0.2032	8.013643	0.0182**

* 1%, **5% and *** 10% level of significance

Table 4: Results of Unit Root (ADF) Test at Level for factors influencing Investment behavior in Indian Manufacturing Sector

Variables	Investment (I_t)		Sales lag (Y_{t-1})		Borrowing (BR_t)		Operating Profit (OP_t)		Equity (EQ_t)		NFA (K_t)		UCC (UCC_t)		$FlibDF_t$	
Industry	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob
NIC 15	3.757	1.000	4.431	1.000	1.257	0.997	2.603	1.000	-0.989	0.729	1.178	0.996	-1.359	0.575	2.375	1.000
NIC 17	-1.352	0.580	-1.014	0.721	-1.038	0.714	-0.077	0.938	-1.726	0.402	0.589	0.984	-1.270	0.616	2.375	1.000
NIC 19	-1.962	0.299	-0.724	0.813	-1.649	0.438	-0.300	0.902	-4.693	0.003	-1.780	0.377	-1.915	0.317	2.375	1.000
NIC 21	-3.046	0.051	0.375	0.974	-1.111	0.686	-0.451	0.879	-1.765	0.383	-0.659	0.832	-2.028	0.273	2.375	1.000
NIC 23	-2.611	0.110	-0.226	0.917	-1.962	0.299	-1.648	0.438	-1.909	0.320	-1.762	0.385	-1.844	0.348	2.375	1.000
NIC 24	4.079	1.000	2.339	1.000	-1.326	0.592	1.055	0.995	-2.734	0.089	-1.887	0.330	-3.273	0.035	2.375	1.000
NIC 25	3.485	1.000	0.286	0.969	-0.514	0.866	-0.169	0.926	-2.376	0.162	-1.627	0.447	-2.167	0.224	2.375	1.000
NIC 26	2.816	1.000	2.739	1.000	-0.586	0.850	3.428	1.000	-1.648	0.434	1.345	0.998	-1.620	0.450	2.375	1.000
NIC 27	1.539	0.998	2.787	1.000	-1.439	0.539	2.048	1.000	-1.237	0.631	-0.590	0.849	-3.086	0.051	2.375	1.000
NIC 28	4.029	1.000	2.259	1.000	-1.093	0.692	1.454	0.998	-1.485	0.515	-1.164	0.664	-1.222	0.638	2.375	1.000
NIC 29	-0.629	0.839	0.689	0.987	-2.460	0.142	-0.424	0.883	-1.418	0.549	-1.303	0.603	-2.379	0.163	2.375	1.000
NIC 31	1.675	0.999	0.398	0.974	-1.486	0.516	0.125	0.956	-1.738	0.396	-0.811	0.790	-1.435	0.539	2.375	1.000
NIC 32	-0.543	0.859	3.665	1.000	-0.299	0.906	-1.631	0.442	-1.346	0.583	-0.139	0.930	-1.727	0.400	2.375	1.000
NIC 34	1.791	0.999	2.385	1.000	-0.840	0.780	2.489	1.000	-1.264	0.619	-0.027	0.942	-0.999	0.727	2.375	1.000
NIC 35	-0.865	0.772	2.746	1.000	-1.925	0.314	0.704	0.988	4.699	1.000	2.296	1.000	-0.569	0.852	2.375	1.000

Table 4.1: Results of Unit Root (ADF) Test at difference for factors influencing Investment behavior in Indian Manufacturing Sector

Variables	Investment (I_t)		Sales lag (Y_{t-1})		Borrowing (BR_t)		Operating Profit (OP_t)		Equity (EQ_t)		NFA (K_t)		UCC (UCC_t)		$FlibDF_t$	
Industry	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob	t-stats	Prob
NIC 15	-4.111	0.009	-5.990	0.001	-5.534	0.001	-6.303	0.001	-5.231	0.001	-3.785	0.014	-3.915	0.011	-5.638	0.0034
NIC 17	-3.763	0.015	-4.708	0.003	-4.543	0.003	-5.380	0.001	-4.334	0.006	-2.809	0.081	-3.587	0.020	-5.638	0.0034
NIC 19	-4.762	0.002	-3.389	0.029	-3.285	0.033	-10.215	0.000			-3.909	0.010	-2.810	0.080	-5.638	0.0034
NIC 21			-5.741	0.000	-5.068	0.001	-4.142	0.009	-5.795	0.000	-4.877	0.002	-7.501	0.000	-5.638	0.0034
NIC 23	-5.225	0.001	-4.243	0.007	-3.585	0.019	-4.408	0.004	-10.228	0.000	-3.896	0.013	-4.356	0.005	-5.638	0.0034
NIC 24	-3.838	0.016	-5.261	0.001	-4.983	0.002	-3.231	0.037			-5.386	0.001			-5.638	0.0034
NIC 25	-3.173	0.041	-3.894	0.011	-2.879	0.075	-3.662	0.017	-3.998	0.009	-4.258	0.006	-5.956	0.000	-5.638	0.0034
NIC 26	-5.197	0.001	-4.742	0.003	-3.985	0.009	-5.138	0.001	-6.895	0.000	-2.815	0.083	-4.776	0.002	-5.638	0.0034
NIC 27	-4.760	0.003	-3.408	0.033	-2.927	0.064	-7.885	0.000	-6.397	0.000	-2.689	0.097			-5.638	0.0034
NIC 28	-4.137	0.008	-6.151	0.000	-5.380	0.001	-3.389	0.028	-6.765	0.000	-3.902	0.010	-5.581	0.001	-5.638	0.0034
NIC 29	-5.010	0.001	-3.714	0.017	-3.257	0.035	-3.260	0.036	-3.330	0.031	-6.357	0.000	-3.789	0.015	-5.638	0.0034
NIC 31	-3.370	0.029	-3.162	0.047	-3.659	0.017	-2.961	0.063	-3.076	0.049	-3.954	0.010	-3.667	0.017	-5.638	0.0034
NIC 32	-3.471	0.024	-3.451	0.029	-5.130	0.001	-5.023	0.002	-3.548	0.021	-4.871	0.002	-5.235	0.001	-5.638	0.0034
NIC 34	-3.030	0.053	-5.358	0.001	-3.910	0.011	-5.319	0.001	-3.769	0.015	-3.160	0.043	-3.874	0.012	-5.638	0.0034
NIC 35	-3.675	0.017	-3.315	0.034	-2.794	0.084	-3.579	0.020	-4.112	0.008	-3.499	0.024	-3.286	0.035	-5.638	0.0034

Descriptive Results for factors influencing Investment behavior in Indian Manufacturing Sector

Table 5: Mean

Industry/Variables	Investment (I_t)	Sales lag (Y_{t-1})	Operating Profit (OP_t)	NFA (K_t)	Borrowing (BR_t)	Equity (EQ_t)	UCC (UCC_t)	FlibDF$_t$
NIC 15	2570.242	35205.17	3440.385	13095.68	12303.85	3181.344	-24811.8	0.997607
NIC 17	3052.813	27261.87	22901.42	3466.211	4286.152	16466.83	-8668.65	0.997607
NIC19	109.81	1700.728	613.8561	147.3612	242.0011	562.1461	-285.052	0.997607
NIC 21	454.6472	6890.515	4349.488	1001.406	1829.908	5880.363	-3031.17	0.997607
NIC 23	116.7589	2587.492	325.0006	306.93	312.1278	467.25	-244.569	0.997607
NIC 24	5902.266	80003.44	45783.97	11537.08	51479.77	-27998.8	13784.48	0.997607
NIC 25	792.2994	7493.591	4739.334	930.5906	1318.58	4738.591	-2396.25	0.997607
NIC 26	2901.823	23478.29	16195.05	3957.981	3687.779	20316.69	-10548.9	0.997607
NIC 27	7307.086	75505.36	57047.68	13150.44	19334.41	69551.62	-37760.8	0.997607
NIC 28	237.6806	2918.002	1106.682	317.8165	415.0411	1114.487	-575.859	0.997607
NIC 29	1537.559	20697.08	6354.271	2455.686	2227.136	5619.641	-3105.78	0.997607
NIC 31	770.3078	11702.16	4172.656	1299.862	1194.497	-2162.02	4027.197	0.997607
NIC 32	1702.1	12246.86	5838.651	1000.311	1650.343	-2338.89	4760.224	0.997607
NIC 34	3614.029	41887.73	12128.96	4996.425	3572.271	-7448.71	14864.31	0.997607
NIC 35	858.3589	7996.381	1757.71	1036.458	631.8544	2267.186	-1063.53	0.997607

Table 5.1: Maximum

Industry/Variables	Investment (I_t)	Sales lag (Y_{t-1})	Operating Profit (OP_t)	NFA (K_t)	Borrowing (BR_t)	Equity (EQ_t)	UCC (UCC_t)	FlibDF$_t$
NIC 15	6976.51	72862.58	8244.29	27929.47	26814.06	5904.86	-1609.64	4.006385
NIC 17	6942.96	43019.7	38238.78	7584.8	6988.3	35255.08	-2267.8	4.006385
NIC19	205.64	2864.41	1002.3	276.78	373.2	895.41	-21.3119	4.006385
NIC 21	780.93	12936.27	7236.54	1920.03	3134.1	10190.24	145.0017	4.006385
NIC 23	245.2	4791.68	530.15	528.68	713.78	766.88	-57.3944	4.006385
NIC 24	16842.91	161236.6	71190.72	23331.14	77096.48	-8845.34	19227.09	4.006385
NIC 25	2602.54	14586.15	8832.32	1647.12	1997.22	7789.8	-211.561	4.006385
NIC 26	8763.5	49533.65	27282.36	9122.99	6332.56	42010.1	-3434.73	4.006385
NIC 27	26447.95	190915	90002.27	40442.78	28091.56	121241.6	-14243.7	4.006385
NIC 28	936.62	6988.05	1789.21	946.25	861.08	1911.74	-153.574	4.006385
NIC 29	4037.06	41056.1	8768.29	5778.62	3914.01	8838.9	-1239.45	4.006385
NIC 31	2135	25869.46	6186.45	3241.7	1869.79	-660.943	6854.26	4.006385
NIC 32	4155	26299.77	11367.47	1929.03	2919.13	869.4999	10842.95	4.006385
NIC 34	11779.58	109839.9	26375.3	13915.67	6649.55	-1722.72	32981.16	4.006385
NIC 35	2788.49	19926.92	2633.8	2835.21	1548.75	6383.65	-491.448	4.006385

Table 5.2: Minimum

Industry/Variables	Investment (I_t)	Sales lag (Y_{t-1})	Operating Profit (OP_t)	NFA (K_t)	Borrowing (BR_t)	Equity (EQ_t)	UCC (UCC_t)	FlibDF$_t$
NIC 15	239.49	7474.11	953.58	1686.92	1601.7	468.51	-39665.6	0.008617
NIC 17	190.43	8318.02	3490.45	889.74	514.65	2531.42	-13729.5	0.008617
NIC19	1.35	447.82	98.7	31.4	16.23	51.8	-538.009	0.008617
NIC 21	45.35	2129.27	847.6	389.27	400.95	1250.24	-4620.08	0.008617
NIC 23	4.75	484.91	107.35	47.72	29.82	92.37	-415.541	0.008617
NIC 24	551.11	22152.52	11822.31	3296.27	11839.17	-37903.1	4897.36	0.008617
NIC 25	8.21	1129.2	463.06	106.5	117.09	356.32	-3805.89	0.008617
NIC 26	522.25	6804.06	4305.14	975.39	877.59	4333.25	-15464.3	0.008617
NIC 27	1245.83	20755.84	14435.42	3636.8	7691.27	15689.32	-47471.2	0.008617
NIC 28	1.75	742.73	286.3	65.48	56.57	191.93	-867.052	0.008617
NIC 29	168.71	7100.3	1894.12	884.43	491.42	1497.27	-4353.09	0.008617
NIC 31	52.14	3404.95	1074.99	342.69	281.28	-3263.99	817.21	0.008617
NIC 32	38.65	2631.22	1066.94	342.35	248.15	-5648.27	635.82	0.008617
NIC 34	397.6	8039.94	2440.98	949.42	577.36	-12800.3	2115.12	0.008617
NIC 35	75.75	2061.46	1165.02	208.81	228.89	748.54	-2296.24	0.008617

Table 5.3: Standard Deviation

Industry/Variables	Investment (I_t)	Sales lag (Y_{t-1})	Operating Profit (OP_t)	NFA (K_t)	Borrowing (BR_t)	Equity (EQ_t)	UCC (UCC_t)	FlibDF$_t$
NIC 15	2008.755	20109.87	1838.863	7454.926	7351.914	1759.01	16219.08	0.980468
NIC 17	2141.147	11473.37	12677.72	1780.004	2310.725	8836.914	3447.292	0.980468
NIC19	76.78701	767.5248	311.3005	78.72816	126.1241	297.297	166.5223	0.980468
NIC 21	203.245	3368.192	1951.359	482.5338	886.4904	3120.916	1355.626	0.980468
NIC 23	72.99296	1414.038	122.2952	150.8152	222.4312	229.3612	110.1333	0.980468
NIC 24	5077.294	41265.34	19694.83	5549.479	23398.11	9194.36	4707.352	0.980468
NIC 25	831.0105	4141.854	2703.917	486.5442	676.0741	2607.127	1203.642	0.980468
NIC 26	2372.753	12574.02	7784.043	2215.28	2021.084	11542.87	3985.957	0.980468
NIC 27	6581.506	49378.72	21181.94	10955.94	5866.717	29246.09	10199.49	0.980468
NIC 28	254.3534	1691.644	545.5125	212.7799	256.1776	583.3132	239.7845	0.980468
NIC 29	1061.475	9052.074	2190.695	1133.948	1114.935	2212.493	915.3966	0.980468
NIC 31	606.8371	5921.285	1803.947	691.5225	556.9989	886.5196	2014.445	0.980468
NIC 32	1562.998	7793.953	3201.208	447.979	897.2594	1418.745	3118.387	0.980468
NIC 34	3242.188	29932.1	7010.209	3718.675	2416.027	3977.379	9566.909	0.980468
NIC 35	998.2336	5857.59	432.2233	890.886	422.2432	1771.598	571.0085	0.980468

Table 5.4: Industries Share of Investment in Total Manufacturing Investment

Industry	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
NIC 15	5.87	7.29	7.74	8.65	8.27	7.78	8.00	7.71	6.96	8.24	8.86	7.81	8.21	8.24	7.39	7.21	7.11	7.11
NIC 16	1.70	1.90	2.18	2.63	2.44	2.08	2.15	2.15	3.81	4.49	3.66	3.21	2.91	4.29	5.62	6.44	5.53	3.89
NIC 17	4.67	4.81	6.48	8.72	12.15	12.24	14.26	13.22	11.87	10.90	10.89	9.84	7.84	8.33	10.37	9.29	8.85	4.43
NIC 18	.0002	.0002	.0184	.0010	.0348	.0238	.0358	.0345	.0308	.0241	.0492	.0525	.0606	.0507	.0287	.0240	.0696	.0715
NIC 19	0.03	0.23	0.26	0.24	0.28	0.19	0.94	0.96	0.77	0.48	0.50	0.28	0.13	0.43	0.24	0.18	0.24	0.18
NIC 20	0.06	0.07	0.02	0.06	0.03	0.11	0.13	0.13	0.21	0.09	0.08	0.08	0.13	0.13	0.08	0.11	0.14	0.10
NIC 21	1.11	4.60	4.59	4.80	3.38	2.80	3.42	3.76	0.85	2.37	2.13	1.78	1.32	1.46	0.72	0.61	0.54	0.34
NIC 22	.0002	.0002	.0002	.0002	.0001	.0001	.0099	.0241	.0227	.0216	.4000	.2544	.2011	.0057	.1439	.1134	.0764	.0541
NIC 23	0.12	0.38	0.48	0.80	1.05	1.02	0.69	0.39	0.41	0.50	0.40	0.06	0.42	0.52	0.18	0.32	0.25	0.15
NIC 24	13.51	20.42	22.43	18.38	14.33	13.79	14.35	15.29	13.99	17.41	18.37	18.39	18.08	17.72	17.93	18.68	18.17	17.15
NIC 25	0.20	0.33	0.34	0.98	1.46	1.07	1.30	1.57	1.29	1.87	2.29	2.49	3.18	2.63	2.28	2.45	3.08	2.65
NIC 26	12.80	12.62	13.05	11.84	11.08	11.74	8.16	7.55	7.57	7.82	6.03	7.56	9.26	8.78	8.37	8.14	8.45	8.92
NIC 27	36.85	27.41	22.47	22.90	23.33	22.56	20.66	20.46	19.54	18.99	19.93	20.07	19.51	21.22	20.55	19.84	20.17	26.94
NIC 28	0.04	0.11	0.17	0.19	0.15	0.16	0.58	0.73	0.51	0.69	0.82	0.64	0.70	0.79	0.70	0.66	0.79	0.95
NIC 29	4.14	3.91	4.07	5.49	6.03	5.53	5.36	5.52	12.20	6.55	5.81	5.03	4.63	4.70	2.46	3.05	3.31	4.11
NIC 30	0.02	0.01	0.01	0.01	0.13	0.16	0.15	0.30	0.08	0.26	0.34	0.38	0.47	0.60	0.60	0.93	0.47	0.52
NIC 31	1.40	0.99	1.25	1.40	2.03	2.63	2.51	2.66	2.69	2.86	2.95	2.58	2.51	2.32	1.85	1.74	2.41	2.17
NIC 32	1.14	3.83	0.70	4.71	5.24	4.28	3.31	4.21	3.26	2.80	2.53	8.30	9.98	6.97	5.56	5.07	4.06	4.11
NIC 33	0.01	0.00	0.01	0.06	0.07	0.07	0.14	0.18	0.18	0.21	0.16	0.19	0.17	0.10	0.13	0.16	0.15	0.13
NIC 34	13.70	8.98	12.13	6.79	7.11	10.59	12.79	11.95	12.61	11.75	11.87	9.00	7.34	6.97	11.21	10.84	11.50	12.00
NIC 35	2.61	2.09	1.56	1.29	1.14	0.95	0.79	0.99	0.87	1.40	1.64	1.68	2.62	3.33	3.16	3.56	3.41	2.84
NIC 36	0.03	0.02	0.02	0.05	0.26	0.22	0.24	0.22	0.24	0.28	0.30	0.30	0.34	0.41	0.44	0.59	1.24	1.18
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 6: Industries Share of Sales in Total Manufacturing Sales

Industry	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
NIC15	7.64	8.49	8.59	8.59	9.06	8.85	8.87	8.83	9.40	10.04	9.40	9.17	10.56	10.40	9.55	8.42	8.76	8.32
NIC16	2.96	2.97	3.09	3.17	2.93	2.69	2.24	2.51	2.69	2.72	2.54	2.52	2.74	2.64	2.36	2.26	2.37	2.32
NIC17	8.50	8.46	8.10	7.98	8.47	8.54	8.54	8.67	8.72	8.06	8.05	7.85	7.17	7.08	5.92	5.49	5.17	4.77
NIC 18	0.02	0.02	0.02	0.01	0.04	0.11	0.12	0.13	0.14	0.12	0.14	0.15	0.17	0.18	0.16	0.12	0.13	0.12
NIC 19	0.46	0.43	0.43	0.40	0.57	0.56	0.58	0.58	0.53	0.55	0.52	0.43	0.42	0.42	0.40	0.33	0.34	0.28
NIC 20	0.16	0.19	0.15	0.18	0.23	0.25	0.25	0.26	0.23	0.24	0.21	0.21	0.20	0.17	0.13	0.14	0.14	0.17
NIC 21	2.18	2.46	2.36	2.11	1.96	1.88	2.09	1.96	1.34	1.79	1.61	2.11	1.97	1.91	1.74	1.55	1.56	1.33
NIC 22	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.05	0.06	0.06	0.04	0.01	0.02	0.03	0.02	0.02
NIC 23	0.50	0.50	0.54	0.60	0.69	0.70	0.72	0.73	0.78	0.74	0.83	0.78	0.68	0.67	0.67	0.62	0.58	0.54
NIC 24	22.65	22.08	23.84	23.36	21.83	21.92	21.14	20.96	21.95	21.93	22.03	21.41	21.57	21.32	20.49	18.81	19.39	17.02
NIC 25	1.15	1.50	1.50	1.64	1.96	2.15	2.16	2.29	2.08	2.36	2.12	2.10	2.09	1.99	1.87	1.82	1.75	1.65
NIC 26	6.96	7.21	6.83	6.48	6.65	6.17	6.17	6.11	6.17	6.23	6.01	6.24	6.51	5.74	6.09	5.97	5.96	6.99
NIC 27	21.22	19.71	20.00	19.88	19.86	20.12	19.76	18.11	17.92	17.45	17.16	17.64	17.62	18.77	20.31	23.58	22.95	25.06
NIC 28	0.76	0.82	0.73	0.74	0.78	0.83	0.69	0.74	0.78	0.81	0.72	0.81	0.79	0.79	0.67	0.72	0.84	0.81
NIC 29	7.26	7.42	7.19	6.91	6.59	6.48	6.21	6.61	6.31	5.74	5.51	4.93	4.95	4.55	4.47	4.71	4.94	5.06
NIC 30	0.35	0.35	0.38	0.69	0.77	0.75	0.94	1.22	0.90	1.04	0.98	1.11	0.95	0.89	0.96	0.81	0.79	0.74
NIC 31	3.48	3.26	3.13	3.62	3.57	3.54	3.64	3.23	3.12	3.09	3.11	3.31	3.46	2.68	2.42	2.59	3.11	3.60
NIC 32	2.69	2.78	2.05	3.00	3.11	2.78	2.75	2.76	2.97	3.38	3.20	3.50	3.10	4.28	3.81	3.54	2.59	2.08
NIC 33	0.26	0.20	0.27	0.38	0.43	0.34	0.41	0.42	0.28	0.42	0.42	0.44	0.49	0.44	0.35	0.26	0.32	0.34
NIC 34	8.22	8.61	8.52	7.83	7.99	8.71	9.94	11.55	10.10	9.42	11.24	10.92	10.63	10.58	12.13	12.97	13.21	13.84
NIC 35	2.11	2.04	1.74	1.83	1.65	1.59	1.59	1.41	1.89	2.26	2.20	1.60	1.80	2.23	2.66	2.61	2.40	2.57
NIC 36	0.46	0.47	0.50	0.56	0.82	1.02	1.15	0.89	1.66	1.57	1.94	2.70	2.08	2.26	2.82	2.63	2.68	2.34
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7: Industries Share of Profits in Total Manufacturing Profits

Industry	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
NIC15	7.04	7.39	6.54	6.55	8.03	6.32	5.84	6.07	7.34	7.66	7.32	6.72	7.45	5.81	5.13	4.75	5.11	5.06
NIC16	1.31	1.58	2.04	2.23	2.20	1.91	1.41	1.59	2.47	2.79	3.43	3.99	4.57	4.14	3.63	3.54	3.31	2.90
NIC17	6.57	7.70	7.05	7.07	8.63	8.63	7.38	8.01	6.89	6.13	6.62	7.05	6.31	6.33	7.62	4.95	6.21	4.93
NIC 18	0.03	0.03	0.03	0.01	0.04	0.09	0.10	0.01	0.07	0.02	0.11	0.11	0.09	0.10	0.05	0.05	0.09	0.06
NIC 19	0.23	0.24	0.26	0.23	0.53	0.41	0.29	0.20	0.32	0.42	0.42	0.25	0.19	0.27	0.32	0.25	0.21	0.17
NIC 20	0.16	0.16	0.12	0.19	0.27	0.31	0.32	0.34	0.34	0.30	0.30	0.21	0.18	0.17	0.12	-0.08	0.15	0.13
NIC 21	2.87	3.12	2.81	2.36	2.19	1.77	2.65	2.10	0.92	1.71	1.58	2.63	3.11	2.01	1.66	1.46	1.57	1.36
NIC 22	0.01	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.07	0.12	0.08	-0.01	-0.02	-0.01	0.01	0.02	0.01
NIC 23	0.35	0.46	0.56	0.64	0.64	0.65	0.71	0.74	0.80	0.93	0.89	0.66	0.40	0.65	0.51	0.48	0.37	0.30
NIC 24	24.33	23.41	24.27	26.02	25.03	25.14	23.02	23.07	24.31	26.24	24.55	21.70	25.86	23.18	21.28	18.14	19.12	15.05
NIC 25	0.79	1.15	1.34	1.39	2.14	2.23	2.07	2.08	1.94	2.07	2.04	1.94	2.42	2.31	1.87	1.27	1.35	1.22
NIC 26	7.20	9.83	9.84	7.27	7.38	7.55	8.17	7.20	7.05	7.77	6.56	8.63	9.32	7.75	7.73	7.01	7.48	10.79
NIC 27	27.37	22.11	23.61	23.46	20.78	22.95	25.10	21.78	22.46	19.13	19.38	23.00	16.61	22.88	27.90	36.92	31.25	34.90
NIC 28	0.48	0.51	0.56	0.63	0.65	0.66	0.65	0.74	0.63	0.38	0.61	0.51	0.73	0.68	0.58	0.49	0.78	0.67
NIC 29	6.53	7.00	6.92	6.69	5.68	5.55	5.39	6.12	6.05	5.53	5.01	4.81	3.91	3.46	3.11	3.57	4.73	4.29
NIC 30	0.33	0.33	0.39	0.65	0.64	0.62	0.64	0.64	0.50	0.33	0.67	1.00	1.02	0.89	1.03	0.60	0.63	0.58
NIC 31	2.53	2.36	2.51	3.12	3.15	3.14	3.12	2.87	2.51	2.60	3.04	3.70	2.85	1.89	1.41	1.75	2.66	2.57
NIC 32	2.53	2.78	1.93	3.24	3.50	2.36	1.57	2.15	2.35	2.50	2.83	2.76	2.48	2.97	1.68	0.87	0.35	1.64
NIC 33	0.22	0.17	0.18	0.33	0.43	0.26	0.36	0.37	0.18	0.48	0.54	0.38	0.54	0.32	0.04	0.05	0.19	0.20
NIC 34	7.01	7.52	7.23	6.05	6.60	7.63	9.33	11.23	10.32	9.29	10.34	7.22	9.14	9.80	10.85	11.04	11.40	10.15
NIC 35	1.70	1.68	1.25	1.33	0.73	0.90	0.96	2.10	1.40	2.45	2.33	1.19	1.73	3.42	2.80	2.25	2.32	2.18
NIC 36	0.41	0.44	0.54	0.51	0.73	0.88	0.90	0.58	1.13	1.21	1.29	1.47	1.09	0.99	0.68	0.63	0.70	0.82
	100.	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SECTION II

- Selected Economic Indicators of Manufacturing Sector of India: Table 1
- All India ASI Data Based on Units with 100 and more Employees: Table 2
- Employment by Industry Division in Manufacturing Sector: Table 3
- Employment by Industry Group in Manufacturing Sector: Table 4
- 2-digit NIC Division and Description

Table 1: Selected Economic Indicators by 2-digit Industry Div. based on ASI 2011-12 and 2012-13

All India

NIC-2008	Description	Labour Productivity (Rs. Lakh)		Capital Productivity	
Div.		2011-12	2012-13	2011-12	2012-13
01	Crop and animal production, hunting and related service activities	2.56	4.00	0.77	0.84
08	Other mining and quarrying	2.31	3.57	0.72	0.98
10	Manufacture of food products	3.60	3.63	0.48	0.42
11	Manufacture of beverages	7.71	8.66	0.51	0.49
12	Manufacture of tobacco products	2.23	2.87	2.72	2.26
13	Manufacture of textiles	2.13	3.32	0.26	0.39
14	Manufacture of wearing apparel	1.67	1.89	0.92	0.72
15	Manufacture of leather and related products	1.87	1.99	0.80	0.78
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2.64	2.87	0.42	0.47
17	Manufacture of paper and paper products	3.22	3.19	0.22	0.18
18	Printing and reproduction of recorded media	4.26	4.81	0.51	0.58
19	Manufacture of coke and refined petroleum products	48.16	113.11	0.29	0.70
20	Manufacture of chemicals and chemical products	13.12	12.10	0.66	0.52
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	10.59	10.45	0.82	0.80
22	Manufacture of rubber and plastics products	4.56	4.71	0.43	0.42
23	Manufacture of other non-metallic mineral products	4.53	4.83	0.34	0.21
24	Manufacture of basic metals	13.17	7.81	0.30	0.16
25	Manufacture of fabricated metal products, except machinery and equipment	4.53	5.10	0.64	0.69
26	Manufacture of computer, electronic and optical products	7.17	8.39	0.77	0.83
27	Manufacture of electrical equipment	6.63	7.20	0.83	0.76
28	Manufacture of machinery and equipment n.e.c.	8.13	8.96	1.02	0.97
29	Manufacture of motor vehicles, trailers and semi trailers	6.50	7.46	0.49	0.46
30	Manufacture of other transport equipment	7.10	7.54	0.71	0.50
31	Manufacture of furniture	2.49	4.04	0.52	0.42
32	Other manufacturing	4.36	4.86	1.29	1.24
33	Repair and installation of machinery and equipment	6.67	5.76	0.93	0.57
38	Waste collection, treatment and disposal activities; materials recovery	3.61	3.13	0.44	0.22
58	Publishing activities	9.26	11.60	0.58	0.74
Others	Other Industries	11.68	9.27	0.20	0.13
Total		**6.23**	**6.58**	**0.43**	**0.39**

Labour Productivity: Net Value Added / Total Number of Persons Engaged
Capital Productivity: Net Value Added / Fixed Capital

Table 1 (cntd.): Selected Economic Indicators by 2-digit Industry Div. based on ASI 2011-12 and 2012-13

All India

NIC-2008 Div.	Description	Ratio of Total Output to Total Inputs		Output per Person Engaged (Rs. Lakh)	
		2011-12	2012-13	2011-12	2012-13
01	Crop and animal production, hunting and related service activities	1.06	1.09	53.56	55.58
08	Other mining and quarrying	2.87	1.98	4.09	7.87
10	Manufacture of food products	1.11	1.11	41.80	45.13
11	Manufacture of beverages	1.33	1.38	36.14	36.80
12	Manufacture of tobacco products	1.59	1.64	6.19	7.67
13	Manufacture of textiles	1.17	1.23	20.21	22.02
14	Manufacture of wearing apparel	1.28	1.27	8.45	9.80
15	Manufacture of leather and related products	1.22	1.19	11.78	14.46
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	1.18	1.16	20.79	24.23
17	Manufacture of paper and paper products	1.20	1.18	26.63	29.12
18	Printing and reproduction of recorded media	1.39	1.39	18.05	20.34
19	Manufacture of coke and refined petroleum products	1.08	1.14	824.19	1056.73
20	Manufacture of chem icals and chemical products	1.28	1.23	68.87	74.64
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	1.55	1.48	33.05	35.77
22	Manufacture of rubber and plastics products	1.21	1.19	32.22	36.02
23	Manufacture of other non -metallic mineral products	1.41	1.38	19.13	21.90
24	Manufacture of basic metals	1.25	1.15	76.58	75.54
25	Manufacture of fabricated metal products, except machinery and equipment	1.23	1.29	27.02	25.53
26	Manufacture of computer, electronic and optical product s	1.25	1.25	41.84	48.72
27	Manufacture of electrical equipment	1.23	1.23	39.88	42.60
28	Manufacture of machinery and equipment n.e.c.	1.32	1.35	36.60	37.93
29	Manufacture of motor vehicles, trailers and semi-trailers	1.20	1.22	48.15	52.07
30	Manufactur e of other transport equipment	1.22	1.23	43.63	45.13
31	Manufacture of furniture	1.18	1.25	19.19	22.55
32	Other manufacturing	1.10	1.10	51.04	59.09
33	Repair and installation of machinery and equipment	1.46	1.32	23.10	27.35
38	Waste collection, treatme nt and disposal activities; materials recovery	1.07	1.08	65.28	56.29
58	Publishing activities	1.77	1.82	24.10	28.96
Others	Other Industries	1.26	1.24	70.70	67.18
Total		**1.20**	**1.20**	**43.01**	**46.53**

Ratio of Total Output to Total Inputs: Total Output / Total Inputs
Output per Person Engaged: Total Output / Total Number of Persons Engaged

Table 1 (cntd.): Selected Economic Indicators by 2-digit Industry Div. based on ASI 2011-12 and 2012-13

All India

NIC-2008	Description	Wage Rate (Rs.)			
		Direct Workers		Contract Workers	
Div.		2011-12	2012-13	2011-12	2012-13
01	Crop and animal production, hunting and related service activities	44826	60156	39910	54079
08	Other mining and quarrying	49750	67816	50063	52098
10	Manufacture of food products	73854	84221	64037	72414
11	Manufacture of beverages	108501	126262	79411	85886
12	Manufacture of tobacco products	46859	60771	24404	27143
13	Manufacture of textiles	79789	90264	84236	84814
14	Manufacture of wearing apparel	67186	82158	68062	74691
15	Manufacture of leather and related products	69376	77329	68575	80167
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	64769	81951	68961	81879
17	Manufacture of paper and paper products	102013	112952	78269	88591
18	Printing and reproduction of recorded media	116657	138319	66478	89665
19	Manufacture of coke and refined petroleum products	396487	458864	179405	164672
20	Manufacture of chemicals and chemical products	133435	151922	81200	94856
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	148463	164286	83623	92215
22	Manufacture of rubber and plastics products	97812	110322	79208	103320
23	Manufacture of other non-metallic mineral products	89563	101503	53951	65207
24	Manufacture of basic metals	174474	208229	86805	110898
25	Manufacture of fabricated metal products, except machinery and equipment	118464	131121	85255	93002
26	Manufacture of computer, electronic and optical products	143236	165576	97444	112676
27	Manufacture of electrical equipment	143791	167342	87828	94626
28	Manufacture of machinery and equipment n.e.c.	147273	172302	90402	115515
29	Manufacture of motor vehicles, trailers and semi-trailers	168425	190880	87455	97859
30	Manufacture of other transport equipment	146872	160359	99284	109738
31	Manufacture of furniture	111940	122636	80248	94777
32	Other manufacturing	104574	116781	90825	94109
33	Repair and installation of machinery and equipment	201045	248033	94625	116839
38	Waste collection, treatment and disposal activities; materials recovery	89633	97378	82063	90496
58	Publishing activities	192806	200898	118545	116658
Others	Other Industries	99272	122851	82785	101804
Total		**106846**	**123216**	**74510**	**85590**

Wage Rate (Direct Workers): Wages & Salary to Direct Workers / No. of Direct Workers

Wage Rate (Contract Workers): Wages & Salary to Contract Workers / No. of Contract Workers

Table 2: Selected Characteristics of Factory Sector (100 and more employees) by 2-digit Industry Div. (NIC-2008) for all-India based on ASI 2012-13

(Values in Rs. Lakh unless otherwise mentioned)

Characteristics		Total ASI	2-Digit Industry Div: NIC-2008						
			All	01	08	10	11	12	13
1	Number of Factories (no.)	222120	28751	197	19	3707	393	503	2987
2	Fixed Capital	218026022	191814733	239826	26574	10200996	2100714	458640	10288247
3	Physical Working Capital	96385193	79005438	286924	6663	11119165	649870	498592	5035570
4	Working Capital	60341107	44937113	176068	3220	3864547	833783	475404	3055826
5	Invested Capital	314411215	270820171	526749	33237	21320161	2750584	957233	15323816
6	Gross Value of Addition to Fixed Capital	49720435	44301765	45225	2639	2055048	493511	198715	1705846
7	Rent Paid for Fixed Assets	1642164	1355529	1200	2059	76493	12553	4363	23019
8	Outstanding Loan	107224700	86219319	128906	32811	5165744	877996	128470	6249562
9	Interest Paid	13807327	11045528	18399	3206	1068067	90757	24966	992965
10	Rent Received for Fixed Assets	353968	221764	235	52	27241	9713	1794	21302
11	Interest Received	1930026	1590493	4121	291	132990	9049	6848	66225
12	Gross Value of Plant & Machinery	193619136	176645799	181476	20522	9056045	1723241	498559	12306894
13	Value of Product and By-Product	528558114	439312467	917115	37906	39074042	4273447	2391567	22905529
14	Total Output	602594536	488518941	1041756	53954	43884934	4623551	2484843	25799401
15	Fuels Consumed	26754523	21856060	26829	2591	1173314	191864	28541	2150479
16	Materials Consumed	392949410	322066852	669797	3640	31955699	2521763	1079881	15857986
17	Total Inputs	501866586	402255182	838404	25490	39280692	3319855	1368353	20727385
18	Gross Value Added	100727950	86263759	203352	28464	4604242	1303697	1116490	5072016
19	Depreciation	15533081	13202911	24764	1870	731514	180193	45508	959578
20	Net Value Added	85194869	73060847	178589	26594	3872728	1123503	1070982	4112438
21	Net Fixed Capital Formation	20219540	18038164	14505	185	769540	227266	76336	466698
22	Gross Fixed Capital Formation	35752621	31241076	39269	2055	1501054	407459	121844	1426277
23	Total workers (no.)	10051626	7550846	29948	5011	826008	95271	365778	998401
24	Total Persons Engaged (no.)	12950025	9573905	38455	5440	1039896	119388	379972	1153311
25	Wages to Workers	11089620	9110647	19555	2767	738119	103618	130747	913557
26	Emoluments to Employees	23805727	19666290	43724	3882	1513740	218813	175971	1424055
27	Gross Capital Formation	44673315	38079737	64268	2108	3127062	454326	211036	1932914
28	Income	71928627	62407137	163303	21671	2882177	1036376	1050017	3182802
29	Profit	44426292	39508737	114911	17283	1148087	786985	847228	1564765

Table 2 (cntd.): Selected Characteristics of Factory Sector (100 and more employees) by 2-digit Industry Div. (NIC-2008) for all-India based on ASI 2012-13

(Values in Rs. Lakh unless otherwise mentioned)

	Characteristics	2-Digit Industry Div: NIC -2008							
		14	15	16	17	18	19	20	21
1	Number of Factories (no.)	2501	799	118	485	530	163	1399	1140
2	Fixed Capital	1979473	529424	295312	3521343	870809	15703275	12836137	6144561
3	Physical Working Capital	1626157	586942	190739	852172	308210	10004636	5115772	3237083
4	Working Capital	1109249	265782	117261	394026	327828	2751695	3880032	3344034
5	Invested Capital	3605631	1116366	486051	4373515	1179020	25707911	17951909	9381644
6	Gross Value of Addition to Fixed Capital	782658	141842	92598	752084	151387	1944528	3153715	1330531
7	Rent Paid for Fixed Assets	67273	12104	2921	9344	23913	34737	63146	42076
8	Outstanding Loan	990786	217306	157099	1403938	388181	2565105	3716846	2124160
9	Interest Paid	179760	60053	26975	176747	56308	645500	805535	301314
10	Rent Received for Fixed Assets	6151	4347	85	2287	4932	1459	18753	15158
11	Interest Received	21851	26820	2519	14315	16488	62647	85470	64206
12	Gross Value of Plant & Machinery	862317	358753	240634	3729656	880481	19625384	18184794	4800139
13	Value of Product and By -Product	6191893	2397097	765750	4581420	1221856	1.03E+08	34544402	14254725
14	Total Output	7033855	3162132	873793	4815807	2098289	1.04E+08	38087909	16452882
15	Fuels Consumed	150009	56446	37473	608191	52137	1411179	2950556	562616
16	Materials Consumed	3651778	1679227	516137	2965213	1042083	87664980	23451321	7324282
17	Total Inputs	5447108	2652927	721373	4054557	1514100	91144948	30779236	10784109
18	Gross Value Added	1586747	509205	152420	761249	584190	12430229	7308673	5668773
19	Depreciation	134476	56735	23970	246115	87875	1301175	1105870	503913
20	Net Value Added	1452271	452470	128450	515134	496314	11129054	6202803	5164860
21	Net Fixed Capital Formation	593662	59389	21635	338560	-6117	123003	1432400	551661
22	Gross Fixed Capital Formation	728138	116125	45605	584675	81759	1424178	2538271	1055574
23	Total workers (no.)	687119	199403	25266	113635	49680	59126	339774	274312
24	Total Persons Engaged (no.)	790153	228334	32739	142990	92872	79030	456607	447108
25	Wages to Workers	559001	157803	24436	142151	72230	216276	503465	377584
26	Emoluments to Employees	888998	248247	53673	288293	253893	472853	1279949	1322568
27	Gross Capital For mation	1101711	186305	67227	627205	108480	1383101	3044050	1551296
28	Income	1232843	411283	101103	344052	437038	10512627	5428454	4889780
29	Profit	234316	127993	42818	5324	150039	9876406	3897013	3387955

Table 2(cntd.): Selected Characteristics of Factory Sector (100 and more employees) by 2-digit Industry Div.(NIC-2008) for all-India based on ASI 2012-13

(Values in Rs. Lakh unless otherwise mentioned)

	Characteristics	2-Digit Industry Div: NIC-2008							
		22	23	24	25	26	27	28	29
1	Number of Factories (no.)	1229	1852	1744	1492	478	1189	1525	1579
2	Fixed Capital	4553313	18744851	45882234	3191347	1872340	3803617	5047228	11357087
3	Physical Working Capital	1976650	2752604	12210082	2232192	1748013	2889180	3985159	4167611
4	Working Capital	2289127	-4123643	9285517	2322642	2574668	3240614	3945253	1723839
5	Invested Capital	6529963	21497455	58092316	5423539	3620353	6692798	9032386	15524698
6	Gross Value of Addition to Fixed Capital	1071223	2733799	9657257	708541	281470	772676	1304932	3941118
7	Rent Paid for Fixed Assets	34832	79773	78031	22806	96493	59792	66754	350994
8	Outstanding Loan	2123331	4000200	23818516	1261611	1707594	2591646	1935426	4219575
9	Interest Paid	311090	522535	2233671	256629	203269	627868	410407	490825
10	Rent Received for Fixed Assets	6733	4425	13837	19605	7432	5154	14600	13127
11	Interest Received	36401	69186	320403	38712	48274	58345	98192	143330
12	Gross Value of Plant & Machinery	5062192	12674027	36436975	2658999	2444171	3462752	4524533	12589075
13	Value of Product and By -Product	12848337	13855031	56216620	9147501	7198064	15270450	19022663	34584094
14	Total Output	14068450	14748670	62184588	10906790	9699926	16942229	21338396	37605554
15	Fuels Consumed	626914	3221869	5984534	327820	114072	269765	287583	735082
16	Materials Consumed	9622942	5525218	39683076	6138424	5203639	10923792	12155285	25960472
17	Total Inputs	11798983	10370954	52795585	8392019	7770812	13580268	15535778	30878159
18	Gross Value Added	2269467	4377716	9389003	2514771	1929115	3361962	5802618	6727395
19	Depreciation	416489	908544	2114281	272722	241948	355763	504154	1293238
20	Net Value Added	1852978	3469172	7274722	2242050	1687166	3006198	5298464	5434157
21	Net Fixed Capital Formation	273268	988965	4768459	191478	-20304	269022	263698	1694090
22	Gross Fixed Capital Formation	689757	1897509	6882740	464199	221644	624786	767852	2987328
23	Total workers (no.)	289192	378874	647169	318222	119769	282033	329612	527834
24	Total Persons Engaged (no.)	360993	472646	832942	397380	175544	376170	480041	676899
25	Wages to Wo rkers	346355	385730	1189527	397276	190374	432404	576100	845812
26	Emoluments to Employees	659478	843852	2312495	789667	655800	1051074	1597975	1861491
27	Gross Capital Formation	772103	2299360	7929072	487952	387513	800763	735709	3235779
28	Income	1548192	2939694	5292578	2017412	1440269	2380262	4931151	4746895
29	Profit	784803	1962446	2558012	1130139	690649	1143829	3043499	2512610

Table 2 (cntd.): Selected Characteristics of Factory Sector (100 and more employees) by 2-digit Industry Div.(NIC-2008) for all-India based on ASI 2012-13

(Values in Rs. Lakh unless otherwise mentioned)

	Characteristics	2-Digit Industry Div: NIC-2008						
		30	31	32	33	38	58	Others
1	Number of Factories (no.)	451	188	702	91	35	102	1153
2	Fixed Capital	4090556	554813	875723	255062	104988	313951	25972291
3	Physical Working Capital	1331116	176567	2614921	95395	40352	59189	3207910
4	Working Capital	532727	158935	2486458	100712	25443	-243194	19261
5	Invested Capital	5421672	731379	3490645	350458	145340	373140	29180201
6	Gross Value of Addition to Fixed Capital	2047105	53986	282932	83618	41373	39050	8432359
7	Rent Paid for Fixed Assets	21149	8894	27727	7305	115	6906	118755
8	Outstanding Loan	1749529	114750	942695	107054	78892	96200	17325390
9	Interest Paid	212811	20905	173300	11247	8324	30002	1082093
10	Rent Received for Fixed Assets	3284	2004	1078	2548	35	1659	12732
11	Interest Received	45802	1629	27067	2985	4807	2761	178758
12	Gross Value of Plant & Machinery	2587702	158170	607440	133422	67152	266047	20504247
13	Value of Product and By-Product	11105736	1029727	11763791	135127	111268	168043	10639678
14	Total Output	11894358	1195908	13295653	549208	159322	628817	19312788
15	Fuels Consumed	194574	21517	58964	11574	9190	10101	580278
16	Materials Consumed	8341525	771160	10308418	127640	101009	214302	6606162
17	Total Inputs	9609200	965512	12028671	407889	127156	322271	15013387
18	Gross Value Added	2285158	230395	1266982	141318	32165	306546	4299401
19	Depreciation	244289	21529	76406	20881	9143	30666	1289301
20	Net Value Added	2040869	208867	1190576	120437	23022	275880	3010099
21	Net Fixed Capital Formation	1433779	29161	137773	57777	6445	4998	3270830
22	Gross Fixed Capital Formation	1678069	50689	214179	78659	15588	35664	4560132
23	Total workers (no.)	209284	34892	175064	14050	4914	9503	141703
24	Total Persons Engaged (no.)	255303	46573	220767	19785	6117	20278	226174
25	Wages to Workers	295562	41954	203472	36139	4980	15927	187727
26	Emoluments to Employees	572807	105093	378593	82248	8131	81291	477637
27	Gross Capital Formation	1739360	45405	692356	84249	8764	33391	4966873
28	Income	1855272	182653	1017580	105302	19425	243391	1993536
29	Profit	1189336	68907	599410	10636	10464	152796	1450079

Table 3: Estimates and Proportions of the Employed by Type of Employment at 2-digit Industry Div. (NIC-2008) based on ASI 2012-13 (All India).

NIC-2008	Total Persons Engaged (no.)	Total Workers (no.)	Directly Emp. Workers (no.)	Contract Workers (no.)	Total Workers (%)	Direct Workers (%)	Contract Workers (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
01	104729	81457	52336	29121	77.78	64.25	35.75
08	8625	7662	1504	6159	88.83	19.63	80.38
10	1547183	1206076	859261	346815	77.95	71.24	28.76
11	141992	111524	54719	56805	78.54	49.06	50.94
12	428550	406795	108673	298121	94.92	26.71	73.29
13	1408669	1199293	1030555	168739	85.14	85.93	14.07
14	922950	790975	693307	97668	85.70	87.65	12.35
15	285393	244243	196236	48007	85.58	80.34	19.66
16	76897	57839	42608	15231	75.22	73.67	26.33
17	235558	184362	135729	48633	78.27	73.62	26.38
18	167152	102024	87520	14504	61.04	85.78	14.22
19	99774	74141	37399	36742	74.31	50.44	49.56
20	633659	463645	286397	177248	73.17	61.77	38.23
21	532015	328437	174707	153730	61.73	53.19	46.81
22	539155	420824	283582	137242	78.05	67.39	32.61
23	891917	723955	304227	419728	81.17	42.02	57.98
24	1017218	782970	442810	340161	76.97	56.56	43.44
25	636411	494113	277224	216889	77.64	56.11	43.89
26	219235	147694	97687	50007	67.37	66.14	33.86
27	501158	370163	228596	141567	73.86	61.76	38.24
28	671284	461223	310262	150961	68.71	67.27	32.73
29	764515	591627	356222	235406	77.39	60.21	39.79
30	293983	237576	123069	114507	80.81	51.80	48.20
31	65357	47341	29023	18318	72.43	61.31	38.69
32	266858	207818	167196	40622	77.88	80.45	19.55
33	33073	22370	15197	7173	67.64	67.93	32.07
38	12555	9539	5815	3724	75.98	60.96	39.04
58	25331	12354	7580	4774	48.77	61.36	38.64
Others	418829	263586	198767	64819	62.93	75.41	24.59
Total	**12950025**	**10051626**	**6608207**	**3443419**	**77.62**	**65.74**	**34.26**

Table 4: Estimates and Proportions of the Employed by type of Employment at 3-digit Industry Group (NIC-2008), based on ASI 2012-13 (All India).

NIC-2008	Total Persons Engaged (no.)	Total Workers (no.)	Directly Emp. Workers (no.)	Contract Workers (no.)	Total Workers (%)	Direct Workers (%)	Contract Workers (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
016	104729	81457	52336	29121	77.78	64.25	35.75
089	8625	7662	1504	6159	88.83	19.63	80.38
101	22130	17932	8918	9014	81.03	49.73	50.27
102	36773	30258	17448	12810	82.28	57.66	42.34
103	55090	43851	18721	25130	79.60	42.69	57.31
104	111218	86089	47336	38753	77.41	54.98	45.02
105	135108	93159	54197	38962	68.95	58.18	41.82
106	322849	241893	152684	89210	74.92	63.12	36.88
107	825285	664379	539921	124458	80.50	81.27	18.73
108	38730	28515	20037	8478	73.63	70.27	29.73
110	141992	111524	54719	56805	78.54	49.06	50.94
120	428550	406795	108673	298121	94.92	26.71	73.29
131	1153497	990046	858144	131901	85.83	86.68	13.32
139	255173	209248	172410	36837	82.00	82.40	17.60
141	662166	568404	487551	80853	85.84	85.78	14.22
142	890	731	604	127	82.13	82.63	17.37
143	259894	221840	205152	16688	85.36	92.48	7.52
151	91406	76439	52759	23680	83.63	69.02	30.98
152	193987	167803	143477	24326	86.50	85.50	14.50
161	9041	6504	6074	430	71.94	93.39	6.61
162	67855	51335	36534	14801	75.65	71.17	28.83
170	235558	184362	135729	48633	78.27	73.62	26.38
181	166588	101754	87252	14502	61.08	85.75	14.25
182	564	270	268	2	47.87	99.26	0.74
191	29924	24029	15865	8164	80.30	66.02	33.98
192	69850	50112	21535	28577	71.74	42.97	57.03
201	273513	189415	102450	86965	69.25	54.09	45.91
202	334248	253349	167366	85983	75.80	66.06	33.94
203	25899	20881	16581	4300	80.62	79.41	20.59
210	532015	328437	174707	153730	61.73	53.19	46.81
221	181152	143218	100769	42449	79.06	70.36	29.64
222	358003	277606	182813	94793	77.54	65.85	34.15
231	65081	52707	29989	22718	80.99	56.90	43.10
239	826836	671248	274238	397010	81.18	40.85	59.15
241	679869	522503	286107	236397	76.85	54.76	45.24
242	107310	82321	48159	34162	76.71	58.50	41.50
243	230040	178146	108544	69602	77.44	60.93	39.07
251	246197	186402	87605	98796	75.71	47.00	53.00
252	1791	1243	765	478	69.40	61.54	38.46
259	388423	306468	188854	117614	78.90	61.62	38.38
261	71793	49994	38544	11450	69.64	77.10	22.90

Table 4 (cntd.): Estimates and Proportions of the Employed by type of Employment at 3-digit Industry Group (NIC-2008), based on ASI 2012-13 (All India).

NIC-2008	Total Persons Engaged (no.)	Total Workers (no.)	Directly Emp. Workers (no.)	Contract Workers (no.)	Total Workers (%)	Direct Workers (%)	Contract Workers (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
262	29778	19073	8917	10156	64.05	46.75	53.25
263	40062	26151	15009	11142	65.28	57.39	42.61
264	22368	15536	10143	5393	69.46	65.29	34.71
265	43947	28867	19138	9729	65.69	66.30	33.70
266	8388	5935	4131	1804	70.76	69.60	30.40
267	2659	1919	1585	334	72.17	82.60	17.40
268	240	221	221	0	92.08	100.00	0.00
271	219281	153075	97888	55186	69.81	63.95	36.05
272	48058	37325	23022	14303	77.67	61.68	38.32
273	85569	66284	39553	26731	77.46	59.67	40.33
274	45593	37217	20533	16684	81.63	55.17	44.83
275	49249	38029	25277	12752	77.22	66.47	33.53
279	53407	38234	22322	15912	71.59	58.38	41.62
281	340325	234511	155389	79123	68.91	66.26	33.74
282	330959	226712	154874	71838	68.50	68.31	31.69
291	148523	110273	91360	18913	74.25	82.85	17.15
292	54587	41973	19088	22885	76.89	45.48	54.52
293	561405	439381	245773	193608	78.26	55.94	44.06
301	41188	35402	7139	28263	85.95	20.17	79.83
302	30391	23363	13284	10079	76.87	56.86	43.14
303	16027	11792	9630	2161	73.58	81.67	18.33
304	1158	827	491	336	71.42	59.37	40.63
309	205220	166193	92525	73668	80.98	55.67	44.33
310	65357	47341	29023	18318	72.43	61.31	38.69
321	155236	121379	100033	21346	78.19	82.41	17.59
322	427	341	321	20	79.86	94.13	5.87
323	9103	6994	6609	385	76.83	94.50	5.50
324	2665	1935	1910	25	72.61	98.71	1.29
325	38226	27917	22120	5797	73.03	79.23	20.77
329	61202	49252	36203	13050	80.47	73.51	26.50
331	27379	18346	12527	5819	67.01	68.28	31.72
332	5694	4024	2670	1354	70.67	66.35	33.65
381	564	450	34	416	79.79	7.56	92.44
382	5553	4179	1827	2352	75.26	43.72	56.28
383	6438	4910	3954	956	76.27	80.53	19.47
581	25302	12335	7561	4774	48.75	61.30	38.70
Others	418858	263605	198786	64819	62.93	75.41	24.59
Total	**12950025**	**10051626**	**6608207**	**3443419**	**77.62**	**65.74**	**34.26**

For NIC 2008 detailed description, may visit the URL given below:

http://mospi.nic.in/Mospi_New/site/inner.aspx?status=2&menu_id=129

http://www.csoisw.gov.in/CMS/En/1026-national-industrial-activity-classification.aspx

2-digit NIC Division and Description

NIC-2008	Description
01	CROP AND ANIMAL PRODUCTION, HUNTING AND RELATED SERVICE ACTIVITIES
02	FORESTRY AND LOGGING
03	FISHING AND AQUACULTURE
05	MINING OF COAL AND LIGNITE
06	EXTRACTION OF CRUDE PETROLEUM AND NATURAL GAS
07	MINING OF METAL ORES
08	OTHER MINING AND QUARRYING
09	MINING SUPPORT SERVICE ACTIVITIES
10	MANUFACTURE OF FOOD PRODUCTS
11	MANUFACTURE OF BEVERAGES
12	MANUFACTURE OF TOBACCO PRODUCTS
13	MANUFACTURE OF TEXTILES
14	MANUFACTURE WEARING APPAREL
15	MANUFACTURE LEATHER AND RELATED PRODUCTS
16	MANUFACTURE OF WOOD AND OF PRODUCTS OF WOOD AND CORK, EXCEPT FURNITURE; ARTICLES OF STRAW AND PLAITING MATERIAL
17	MANUFACTURE OF PAPER AND PAPER PRODUCTS
18	MANUFACTURE OF PRINTING AND REPRODUCTION OF RECORDED MEDIA
19	MANUFACTURE OF COKE AND REFINED PETROLEUM PRODUCTS
20	MANUFACTURE OF CHEMICALS AND CHEMICAL PRODUCTS
21	MANUFACTURE OF BASIC PHARMACEUTICAL PRODUCTS AND PHARMACEUTICAL PREPARATIONS
22	MANUFACTURE OF RUBBER AND PLASTICS PRODUCTS
23	MANUFACTURE OF OTHER NON-METALLIC MINERAL PRODUCTS
24	MANUFACTURE OF BASIC METALS
25	MANUFACTURE OF FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT
26	MANUFACTURE OF COMPUTER, ELECTRONIC AND OPTICAL PRODUCTS
27	MANUFACTURE OF ELECTRICAL EQUIPMENT
28	MANUFACTURE OF MACHINERY AND EQUIPMENT N.E.C.
29	MANUFACTURE OF MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS
30	MANUFACTURE OF OTHER TRANSPORT EQUIPMENT
31	MANUFACTURE OF FURNITURE
32	OTHER MANUFACTURING
33	REPAIR AND INSTALLATION OF MACHINERY AND EQUIPMENT
35	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY
36	WATER COLLECTION, TREATMENT AND SUPPLY
37	SEWERAGE
38	WASTE COLLECTION, TREATMENT AND DISPOSAL ACTIVITIES; MATERIALS RECOVERY
39	REMEDIATION ACTIVITIES AND OTHER WASTE MANAGEMENT S ERVICES
41	CONSTRUCTION OF BUILDINGS
42	CIVIL ENGINEERING
43	SPECIALIZED CONSTRUCTION ACTIVITIES
45	WHOLESALE AND RETAIL TRADE AND REPAIR OF MOTOR VEHICLES AND MOTORCYCLES

2-digit NIC Division and Description (cntd.)

NIC-2008	Description
46	WHOLESALE TRADE, EXCEPT OF MOTOR VEHICLES AND MOTORCYCLES
47	RETAIL TRADE, EXCEPT OF MOTOR VEHICLES AND MOTORCYCLES
49	LAND TRANSPORT AND TRANSPORT VIA PIPELINES
50	WATER TRANSPORT
51	AIR TRANSPORT
52	WAREHOUSING AND SUPPORT ACTIVITIES FOR TRANSPORTATION
53	POSTAL AND COURIER ACTIVITIES
55	ACCOMMODATION
56	FOOD AND BEVERAGE SERVICE ACTIVITIES
58	PUBLISHING ACTIVITIES
59	MOTION PICTURE, VIDEO AND TELEVISION PROGRAMME PRODUCTION, SOUND RECORDING AND MUSIC PUBLISHING ACTIVITIES
60	BROADCASTING AND PROGRAMMING ACTIVITIES
61	TELECOMMUNICATIONS
62	COMPUTER PROGRAMMING, CONSULTANCY AND RELATED ACTIVITIES
63	INFORMATION SERVICE ACTIVITIES
64	FINANCIAL SERVICE ACTIVITIES, EXCEPT INSURANCE AND PENSION FUNDING
65	INSURANCE, REINSURANCE AND PENSION FUNDING, EXCEPT COMPULSORY SOCIAL SECURITY
66	OTHER FINANCIAL ACTIVITIES
68	REAL ESTATE ACTIVITIES
69	LEGAL AND ACCOUNTING ACTIVITIES
70	ACTIVITIES OF HEAD OFFICES; MANAGEMENT CONSULTANCY ACTIVITIES
71	ARCHITECTURE AND ENGINEERING ACTIVITIES; TECHNICAL TESTING AND ANALYSIS
72	SCIENTIFIC RESEARCH AND DEVELOPMENT
73	ADVERTISING AND MARKET RESEARCH
74	OTHER PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES
75	VETERINARY ACTIVITIES
77	RENTAL AND LEASING ACTIVITIES
78	EMPLOYMENT ACTIVITIES
79	TRAVEL AGENCY, TO UR OPERATOR AND OTHER RESERVATION SERVICE ACTIVITIES
80	SECURITY AND INVESTIGATION ACTIVITIES
81	SERVICES TO BUILDINGS AND LANDSCAPE ACTIVITIES
82	OFFICE ADMINISTRATIVE, OFFICE SUPPORT AND OTHER BUSINESS SUPPORT ACTIVITIES
84	PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY
85	EDUCATION
86	HUMAN HEALTH ACTIVITIES
87	RESIDENTIAL CARE ACTIVITIES
88	SOCIAL WORK ACTIVITIES WITHOUT ACCOMMODATION
90	CREATIVE, ARTS AND ENTERTAINMENT ACTIVITIES
91	LIBRARIES, ARCHIVES, MUSEUMS AND OTHER CULTURAL ACTIVITIES
92	GAMBLING AND BETTING ACTIVITIES
93	SPORTS ACTIVITIES AND AMUSEMENT AND RECREATION ACTIVITIES
94	ACTIVITIES OF MEMBERSHIP ORGANIZATIONS
95	REPAIR OF COMPUTERS AND PERSONAL AND HOUSEHOLD GOODS
96	OTHER PERSONAL SERVICE ACTIVITIES
97	ACTIVITIES OF HOUSEHOLDS AS EMPLOYERS OF DOMESTIC PERSONNEL
98	UNDIFFERENTIATED GOODS - AND SERVICES -PRODUCING ACTIVITIES OF PRIVATE HOUSEHOLDS FOR OWN USE
99	ACTIVITIES OF EXTRATERRITORIAL ORGANIZATIONS AND BODIES

Obituary

Mr. K. Sankaranarayanan

Full many a gem of purest ray serene,
The dark unfathom'd caves of ocean bear:
Full many a flow'r is born to blush unseen,
And waste its sweetness on the desert air.[1]

These are the words that best describe the person that Mr. K. Sankaranarayanan was: modest and humble, known for his skills, knowledge, intelligence and efficiency in work only among the small coterie of people who worked with him. Born in a small hamlet called Varavoor in the district of Thrisshur of Kerala, in the year 1933, he went on to join the prestigious Madras Christian College for his Intermediate course, Kerala Varma College for his B. A. Statistics and Kerala University for his M. Sc in Statistics. He retired as a Joint Director of the Survey Design and Research Division (SDRD) of the National Sample Survey Organization in the year 1991.

Mr. K. Sankaranarayanan became a part of National Sample Survey (NSS), then a Section of the Indian Statistical Institute, handling planning and designing of surveys, data processing and report writing in the year 1955. In the year 1968, as part of the Colombo Plan, Mr. Sankaranarayanan visited Canada. In the meantime, there were fundamental changes in the set up of NSS Unit of ISI. On the advice of Prof. P. C. Mahalanobis and based on the recommendations of the High Level Committee under the Chairmanship of Prof. V. M. Dandekar, all activities of NSS including Planning and Designing of Surveys and Data Processing being done in ISI and Field Operations carried out by Directorate of NSS within the Government were combined and brought a single entity called National Sample Survey Organisation (NSSO) in 1970, in the Ministry of Planning. With this, the NSS Unit in ISI became part of the NSSO in the Government in 1972, with its four Divisions, Survey Design and Research Division (SDRD), Field Operations Division (FOD), Data Processing Division (DPD) and Economic Analysis Division (EAD). NSSO was made responsible for conducting

[1] Gray, Thomas, 'Elegy Written in a Country Churchyard' http://www.poetryfoundation.org/poem/173564, accessed on 19th March 2015

large scale sample surveys for gathering statistics relating to household socio economic characteristics, crop area and production and industrial statistics. As one of the three sampling experts, Mr. Sankaranarayanan was responsible for the planning of surveys, formulation of sample design and the drawing up of schedules of inquiry, and was involved in it right from the tenth round to the forty-fifth rounds of the NSS.

Meanwhile, in 1980, the Royal Statistical Society published a paper on 'A Note on the Admissibility of some Non-negative Quadratic Estimators' authored by Mr. Sankaranarayanan. In May 1990, Mr. Sankaranarayanan also visited Beijing, China as a representative of India for a Seminar on Design and Evaluation of Household Sample Surveys. He was one of the few statisticians who got an extension of service after his retirement in 1991. Following this, he was appointed as a consultant of the Indian Institute of Management, Kolkata and was responsible for a survey on education conducted in Assam in the years 1992-1993.

Mr. K. Sankaranarayanan was also one of the few statisticians who used the computer right from the first generation one (first IBM computer in India set up in Indian Statistical Institute, Kolkata) to the fifth generation personal computer.

Being a voracious reader interested in research, Mr. K. Sankaranarayanan spent a great deal of time in the ISI library. He was greatly involved in improving the NSSO library housed in the Nepal Raja's palace on Shakespeare Sarani.

Besides being a statistician, Mr. K. Sankaranarayanan was a linguist and a lover of music and literature. Not only did he know the English and the four South Indian languages, Sanskrit, Bengali and Hindi (Pragya), he also learnt French and Chinese (Mandarin). He found links between Malayalam and English poetry and even between Tagore's works and those of eminent Malayalam poets like Kumaran Asan. He has also translated articles in Malayalam to English. All his acquaintances became aware of his erudition and intelligence when this mild and reserved person opened up.

His demise is mourned by all those who knew him. He believed that everybody is good and the creed that helped him be calm in life was never to be upset by any kind of criticism and not to be vain on being praised. The good memories of moments shared with him are a lesson on how to lead one's life: be honest and doing anything that is worth doing in the best way possible. May his soul rest in peace!

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- The Journal of Industrial Statistics is meant for original articles on industrial statistics based on data, mainly on Indian context. Government officials, business houses, individual researcher, entrepreneurs, research organization can contribute articles in the journal.
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