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EDITORIAL

Manufacturing is the prime mover for industrialization and industrialization is the front engine to drive economic growth. Of course, this growth has to be pushed further by a back engine in terms of constitutional safeguards and state policies to make it more 'inclusive' and to achieve reduction in poverty and in income inequality, thereby ensuring a better quality of life for an increasing section of the entire population.

The nature and structure of manufacturing industry and its contribution to national income have changed a lot across countries and over the recent years. There have been resource transfers from and to manufacturing in developing as well as in developed economies. In many developing countries, services sector has seen significant growth accompanied by an expanding share in gross domestic product. Further, the recent emphasis on environmental concerns has altered the profile of manufacturing industries. At the same time, scientific and technological advances have thrown up new materials that need be processed through new and novel technologies by workers possessing requisite skills opening up possibilities for better performance.

Manufacturing embraces a wide spectrum, covering labour-intensive, low-technology, dwindling-market traditional industries like jute on the one end to capital-intensive, advanced-technology industries like electronics and communication devices with markets opening up with economic growth. There are manufacturing units which are pursuing the path of innovation quite ardently, while there are others which do not currently realize the urgency for innovation in order to survive and even to grow. We have industries which invest considerably on their employees to enhance their knowledge and skill, their motivation and job satisfaction, their safety and security, and their quality of life. Some industries extend the net of such activities to cover their business partners — customers, suppliers and investors. Emphasis on Corporate Social Responsibility implies increasingly greater roles of industries in the over-all development of the socio-cultural-economic environment within which they operate.

Traditional analysis of efficiency or effectiveness or productivity of manufacturing industries in terms of different measures or co-efficients which can be derived from data available from dependable sources has not generally reflected the impact of management styles and priorities on the performance of such industries. One of the reasons could be non-availability of relevant data, caused partly by difficulties in coming up with 'operational definitions' of the concepts involved and partly by an apathy of industrial units to provide adequate information required for the purpose. This apathy is sometimes a consequence of a lurking apprehension

that disclosure of specific and 'sensitive' information in the public domain would invite some problems of non-compliance with some regulatory norms or standards or could adversely affect competitive strength.

While steps to allay such apprehensions — not always unfounded in the course of administration of different policies and checks and balances — have to be put in place, industrial units, particularly in the micro-, small and medium industries, have to be assisted — beyond being advised — to keep proper records relating to different facets of their performance. Equally important are the efforts of data-collecting agencies including those in the government to expose people involved in data collection and scrutiny to the nuances of 'level of technology' or 'level of competence of people on different tasks,' or 'environmental management', or 'investment in people', or 'international financial reporting system'. And we must ensure international comparability in measuring and reporting performance of an industry sector or even an industry unit, so that appropriate policies and plans could be put in place to stimulate higher performance. Incidentally, to speak of 'performance' we should move away from the earlier single bottom line of 'profit' to the emerging concept of triple bottom lines viz. profit, people and planet.

As more comprehensive data become available, we look forward to a better insight into performance of industry, in general, and manufacturing industry, in particular.

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S. P. Mukherjee
Editor-in-Chief

Efficiency Comparison between Formal and Informal Firms – Evidence from Indian Manufacturing

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Abstract

The majority of firms in developing countries are located in the informal sector. Whether informal firms are more or less efficient than formal firms is a matter of empirical scrutiny. We investigate this by using unit record data for the informal and formal manufacturing sectors combined from four repeated cross-sections over the period 1989-2005 for the Indian economy. We apply stochastic frontier analysis to these firms to calculate absolute and relative technical efficiency, correcting for selection bias in the firm's decision to be in the informal or in the formal sector using a recent technique proposed by Greene (2010). Our selection results indicate that the likelihood of the firm being in the formal sector is positively linked to its size, less stringent labour regulation, the availability of power supply and priority sector lending to small-scale firms. After accounting for selection bias, we find that formal firms are significantly more efficient than informal firms. The results hold irrespective of their location - rural or urban. This suggests that policy-makers should relax regulations that may allow more informal sector firms to relocate to the formal sector.

1. Introduction

1.1 The informal sector is a large part of economic activity in most developing economies. Typically the manufacturing sector in many developing economies has a large informal sector, where most firms reside, along a relatively small formal sector, comprising fewer firms (WTO 2009). Conventional wisdom about the informal manufacturing sector takes it that firms in this sector are generally less productive than firms in the formal manufacturing sector (Dabla-Norris *et al.* 2005). Under this view, since firms in the informal sector tend to remain small to escape the attention of government inspectors, they are not able to reap economies of scale, nor have access to credit from formal financial institutions to expand operations due to their lack of registration with government authorities. This view often underscores the policy concern about a burgeoning informal sector in the face of a shrinking or stagnant formal sector and is the basis of the oft repeated policy recommendation that entry of firms from the informal to the formal sector should be eased and that the overall policy aim with respect to the informal sector would be to reduce its size over time (World Bank 2005). However, this view is not without its critics – others argue that informal firms may well be more efficient than formal firms and this could be the reason why the informal sector does not seem to contract in size with economic growth and rapid modernization of the economy (De Soto 1989). Under this view, informal

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firms are inherently more entrepreneurial and dynamic than formal firms as they are unlikely to face the high degree of regulations faced by formal firms. Therefore, the policy prescription here would be to provide stronger support to the informal sector through access to credit and training in skills to make it grow, rather than attempt to shift firms from the informal to the formal sector.

1.2 There has been little systematic analysis of efficiency differentials between informal and formal manufacturing firms which can provide support to either of the above two propositions.[2] In great part, this has been due to lack of available data that can allow for such comparisons at the firm level. Data on output and capital stock are difficult to obtain for micro and small enterprises in the informal sector of developing countries as by definition, informal enterprises are not registered with the government and therefore, not required to submit production data to official statistical agencies. Furthermore, there are methodological problems in the comparison of efficiency between informal and formal firms which does not take into account the selection bias inherent in the choice that firms around a threshold size may prefer to be either in the informal or formal sector. Theoretical models predict that firms choose whether to be in the informal or formal sector depending on government regulations, access to formal sector credit and the ability to gain from the spillover effects of certain types of infrastructure which are mostly available to the formal sector (Dessy and Pallage 2003, Straub 2005, Ulyssea 2010, Fajnzylber *et al.* 2011). If being located in the formal sector is not random but depends on firm choice, a comparison of efficiency levels between firms in the informal and formal manufacturing sectors without addressing the endogeneity of firm location is not correct. Such a comparison would bias upwards the efficiency levels of formal manufacturing firms if these levels depended on the firm being located in the formal sector.

1.3 In this paper, we estimate the efficiency of informal and formal manufacturing firms using an unique data-set of such firms for a developing country and using stochastic frontier analysis that corrects for selection bias. We ask the question: are informal manufacturing firms less efficient than formal manufacturing firms? The country we study is India, where about 80 per cent of manufacturing employment and 17 per cent of manufacturing output is in the informal sector (NCEUS 2007), and where we have large cross-sections of firm-level data-set for both the informal and formal manufacturing sectors for four years, beginning in 1989-90 and ending in 2005-06.[3] We look at both absolute and relative efficiency, and find that formal firms are more efficient than informal firms, both for absolute and relative efficiency. Our findings support the policy concern about the high proportion of firms in the informal sector, as our results imply such a phenomenon may be one important reason for the low levels of productivity witnessed in the manufacturing sectors of developing countries.

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[2] There have been a limited number of empirical studies that have investigated whether small firms are more efficient than larger firms (see Taymaz 2005, and Yang and Chen 2009). However, these studies do not investigate the difference in efficiency between informal and formal firms.

[3] The formal sector in India is taken to be definitionally equivalent to the organized sector, which comprises firms which are registered under the Indian Factories Act of 1948. Firms have to register under the Factories Act if they employ ten or more workers if the firm uses electricity or twenty and more workers if the firm does not use electricity. Registration under the Factories Act implies that the firm will need to comply with a wide range of government regulations that are exclusively applicable to the formal sector.

1.4 The rest of the paper is in four sections. In Section II, we describe our econometric methodology. In Section III, we discuss the empirical specification. Section IV describes the data and presents the results of the empirical analysis. Section V concludes.

2. Econometric Methodology

2.1 We use stochastic frontier analysis (SFA) to analyse firm efficiency.[4] We are interested in determining the technical efficiency of the firm – the maximum possible output that a firm can produce, given its inputs. The standard approach to SFA is the one proposed by Aigner *et al*. (1977). Under this approach, a single-equation cross-sectional stochastic production frontier model is estimated, with the assumption that firm i uses the input vector x_i to produce a single output y_i based on the following equation:

$$y_i = x_i b + (v_i - u_i)$$

$$\textbf{where } u_i = |\sigma_u U_i| = \sigma_u |U_i|. U_i \sim N[0,1] \quad \text{——————————} (1)$$

$$y_i = \sigma_v, v_i \sim N(0,1)$$

The model is estimated using the maximum likelihood method. However, the model does not account for selection bias.

2.2 Correcting for Selection Bias

2.2.1 The method proposed by Heckman (1976) is the conventional one used in the literature to correct for the selectivity bias. It involves two steps. In the first stage, the probit model is fit to the data and estimate the sample selection equation. In the second stage, the model (either Ordinary Least Squares or Weighted Least Squares) is fit to the selected sample data by adding the inverse Mills ratio obtained from the first step as an independent variable to correct for selectivity bias and test its significance.

2.2.2 As is argued by Greene (2006), this approach is not appropriate for models that are non-linear in nature such as probit, tobit.[5] As an alternative, Greene (2006) proposed an internally consistent method of incorporating 'sample selection' into a stochastic frontier framework. He proposes the following analytical approach:

$$d^* = \alpha' z + w, d = 1, d^* > 0 \quad \text{——————————} (2)$$

$$y = \beta' x + v - u \quad \text{——————————} (3)$$

$$u = |U|, with\ U \sim N[0, \sigma_u^2]$$

[4] For an early application of SFA to the estimation of firm efficiency in developing countries, see Taymaz and Saatci (1997).

[5] The reasons as stated by Greene (2006) include: a) the impact of the conditional mean of the estimated model may not always take the form of an inverse Mills ratio; b) though the inclusion of the inverse Mills ratio in the second step is justified based on the bivariate normality assumption, it does not generally appear in the model; and c) the dependent variable, conditioned on the sample selection, is unlikely to have the distribution described by the model in the absence of selection. Refer Greene (2006, 2010) for details.

$$(v.w) \sim bivariate\ normal\ with\ [(0,0),(\sigma_u^2,\rho\sigma_v,1)]$$
$$(y,x) only\ observed\ when\ d=1$$

where d is a probit selection equation (with adoption depending on a host of price and non-price factors) and y is the stochastic frontier function, specified only for the adopting firms.

The estimator is developed as follows:

w is conditional on v as: $\frac{w}{v} = \rho v + h\ where\ h \sim N[(0,(1,p^2)]$ and h is independent of v.

Therefore,

$$d^*|v = \alpha' z + \rho v + h, d = 1, \qquad d^* > 0|v$$

Then,

$$prob\ [d = 1\ or\ 0|z,v] = \varphi\left[(2d-1)\left(\frac{\alpha' z+\rho v}{\sqrt{1-\rho^2}}\right)\right] \text{ ——————— (4)}$$

The estimation is divided into two parts. For the selected observations, d=1, conditioned on v, the joint density for y and d is the products of the marginals as conditioned on v, y and d are independent

$$f(y,d=1|x,z,v) = f(y|x,v)prob\ (d=1|z,v)$$

This is the second part. For the first part,

$$y|x,v = (\beta' x + \sigma_v v) - \sigma_u u$$

where u is the truncation at zero of a standard normal variable. The conditional density is given by:

$$f(y|x,v) = \frac{2}{\sigma_u}\emptyset\left(\frac{(\beta' x+\sigma_v v)-y}{\sigma_u}\right), (\beta' x+\sigma_v v) - y \geq 0 \text{ ——————— (5)}$$

Therefore, the joint conditional density is given by:

$$f(y,d=1|x,z,v) = \frac{2}{\sigma_u}\emptyset\left(\frac{(\beta' x+\sigma_v v)-y}{\sigma_u}\right)\varphi\left(\frac{\alpha' z+\rho v}{\sqrt{1-\rho^2}}\right) \text{ ——————— (6)}$$

We obtain the unconditional density by integrating v out of equation (6). The integral does not exist in a closed form and hence, Greene (2006) proposes computation by simulation. The final simulated log likelihood is given by (for details see Greene 2006):

$$\log L_s = \sum_i \log \frac{1}{R}\sum_{r=1}^{R}\left\{d_i\left[\frac{2}{\sigma_u}\emptyset\left(\frac{\beta' x+\sigma_v v_{ir}-y}{\sigma_u}\right)\varphi\left(\frac{\alpha' z+\rho v_{ir}}{\sqrt{1-\rho^2}}\right)\right] + (1-d_i)\left[\varphi\left(\frac{-\alpha' z+\rho v_{ir}}{\sqrt{1-\rho^2}}\right)\right]\right\} \quad (7)$$

The model is estimated using NLOGIT version 4.

3. Empirical Specification

3.1 As is clear from the discussion above, the implementation of SFA with correction for selection bias involves two stages – in the first stage, estimation of a probit equation which models the selection of firms into the informal and formal sectors, and in the second stage, estimates for the production function and for technical efficiency are obtained, conditioned on the sample selection. Once we obtain the efficiency estimates, we estimate regressions where the firm level measure of efficiency is the dependent variable and the key explanatory variable is the firm's location in the formal or informal sector, along with other controls.

3.2 *First Stage Analysis*

3.2.1 We assume that firms can choose between being in the formal or informal sector subject to a set of variables that capture the benefits and costs of formalization. To obtain the set of explanatory variables which determine the benefits and costs of formalization, we draw from recent theoretical literature on why firms formalize. We also exploit the fact that there are important differences in institutions relating to labour regulation, access to credit and the provision of infrastructure across Indian states and over time. A key factor that has been highlighted by both the theoretical and empirical literature is the degree of regulation faced by the firm if it chooses to be in the formal sector (Fajnzylber *et al*. 2011, Ulyssea 2010, Taymaz 2009). While the regulatory framework relating to product market entry and exit are the same across states in India, labour regulations have differed greatly across Indian states. Industrial relations in India fall under the joint jurisdiction of the central and state governments. A particular piece of labour legislation that has particularly detrimental to the growth of the formal manufacturing sector in India, and has encouraged informality, is the Industrial Disputes Act (IDA) of 1947, which sets out the conciliation, arbitration and adjudication procedures to be followed in the case of an industrial dispute. The IDA applies only to formal sector firms and imposes significant restrictions on employers regarding layoff, retrenchment and closure (Ahsan *et al*. 2008). Since labour laws are both within the jurisdiction of state and central governments, the IDA has been extensively amended by state governments during the post-independence period. Besley and Burgess (2004) have coded each state amendment to labour laws as neutral, pro-worker or pro-employer for the period 1947-1997. We extended the Besley-Burgess variable till 2005 and then normalized it between 0 and 1 such that the more pro-worker labour law amendments in a state would result in lower value for that state. We would expect that more pro-employer labour law amendments *(Labour Laws*) as seen by a higher value of our variable would have a positive effect on the firm's decision to formalize.

3.2.2 A second factor highlighted by the theoretical literature is access to formal sector credit (Straub 2005). The higher the likelihood for a firm to obtain formal sector credit, which are usually on more favourable terms than informal sector credit and at lower interest rates, the more likely that the firm will choose to be in the formal sector. This is because registration as a formal sector unit is often a precondition for firms to access credit from specialized formal sources such as commercial banks and development finance institutions. In India, government regulations made it mandatory for commercial banks to lend a large

proportion of their funds to small and medium enterprises in the formal manufacturing sector (which are mostly the units that are making the transition from the informal sector) along with farmer-households in the agricultural sector – these regulations were called priority sector lending requirements (Sen and Vaidya 1997). Access to priority sector lending depended a great deal on the level of financial development in a given state, and this differed from state to state and across time (Burgess and Pande 2005). We capture differential access to formal sector credit for small and medium enterprises across Indian states and over time by the share of bank lending going to priority sectors (*Priority Sector Lending*) for 1989-90, 1994-1995, 2000-01 and 2005-06.

3.2.3 Our third variable to explain the decision of a firm to formalize is the provision of a productive public good to formal sector firms which creates a strong incentive to formalize (Dessy and Pallage 2003). We take the public good to be electricity, which has been found to be a binding constraint for formal manufacturing growth in India (World Bank 2004). Indian states have differed widely in their ability to provide electricity to manufacturing firms, in part due to the very different performance of State Electricity Boards, the main agency responsible for transmission and distribution, across Indian states (Krueger and Chinoy 2002, Panagariya 2008). We measure the electricity constraint on a firm's decision to formalise by the real price of power supply (*Cost of Power Supply*), which is less subject to endogeneity concerns in comparison to measures of electricity infrastructure such as the degree of electrification (Cali and Sen 2011). A higher price of electricity would reflect better quality of electricity provision (for example, less frequent power outages) and provide an incentive for firms to move from the informal to the formal sector to take advantage of electricity provision by the state or the private sector to registered firms, but it could also deter informal firms to move into the formal sector as the cost of production in the formal sector increases. Which of the two impacts dominates is an empirical issue.

3.2.4 Finally, we assume that the larger the firm (in terms of employment) (*Firm Size*), the more likely it will be that the firm is in the formal sector as it will be difficult for the firm not to be noticed by regulators (and state agents such as tax and labour officials) if it remains in the informal sector (Taymaz 2009).

We estimate probit model of the following type:

$$F = f(LABOUR\ LAWS,\ PRIORITY\ SECTOR\ LENDING,\ COST\ OF\ POWER\ SUPPY,\ FIRM\ SIZE) \qquad \text{———————-(8)}$$

where F is 1 if the firm is in the formal sector, 0 otherwise. We expect that the signs of the *Labour Laws*, *Priority Sector Lending* and *Firm Size* will be positive. The sign on *Cost of Power Supply* will be indeterminate.

We estimate the probit equation for each industry separately, but for all four years combined. We explain below why we estimate the probit model separately for each industry.

3.3 Second Stage Analysis

3.3.1 The production behaviour of formal and informal sector firms is modeled using a simple Cobb Douglas function. Thus, we have:

$$\ln(Y_{iT}) = b_0 + b_1\ln(K_{iT}) + b_2\ln(L_{iT}) + (v_{iT} - u_{iT}) \quad \text{——————————(9)}$$

Where T=1989-90. 1994-95, 2000-01 and 2005-06 and i is the firm. Y is gross value added, K is capital stock, L is labour, and bs are the parameters to be estimated. The v_{iT}s are random variables independent of the u_{iT}s and purport to capture the random shocks that are beyond the control of firms. The u_{iT}s capture technical inefficiency and are the combined outcome of non-price and organizational factors that constrains a firm from achieving their maximum possible output from the given set of inputs and technology. The u_is are non-negative and assumed to be identically distributed at truncations at zero, $u = |U|$ with $U \sim N [0, ó^2_u]$.[6] Thus technical efficiency (TE_i) is measured as the ratio of the observed output of the firm to the potential output derived by the frontier function. We examine both the absolute and the relative technical efficiency of firms in our sample, where the latter is defined as the difference between the maximum absolute efficiency obtained in a given industry for a given year, and the actual absolute technical efficiency relative to the maximum absolute efficiency in that industry and year.

3.3.2 Instead of estimating the same production function for the entire set of firms, irrespective of industry, we estimate equation (9) industry by industry and for each of the two groups – formal and informal separately, at the National Industrial Classification (NIC) 2 digit industry level (broadly corresponding to the ISIC 3 digit level of industrial classification used by the United Nations Industrial Development Organization). There are twenty-two industries in our data-set (we provide the list of industries along with the industry codes in Appendix A). By estimating the production function separately for formal and informal firms at the industry level, we not only allow the parameters for capital and labour in the firm-level production function to differ across industries but also across the two groups. This is a reasonable assumption to make when a) the industries differ so widely in their production technology and in characteristics relating to export orientation and market structure (e.g., leather versus electrical machinery); and b) even within the same industry, production coefficients may be different for labour-intensive informal firms and capital-intensive formal firms.

3.3.3 Once we have estimated efficiency at the firm level, we regress firm-specific technical efficiency on whether the firm is in the formal or informal sector as follows:

$$TE_{ijt} = á + â*FORMAL_{ijt} + ä_j + ã_t + å\text{-}_{ijt} \quad \text{——————————(10)}$$

Where TE_{ijt} is technical efficiency of firm i in industry j and year t, *FORMAL* is a dummy which takes the value one if the firm is in the formal sector, and zero if the firm is in the

[6] The inefficiency term can be modeled using truncated normal, half-normal or exponential distributions. We assume that the inefficiency term follows the truncated normal distribution though we have also estimated efficiency using the half-normal distribution without any change in our results.

informal sector, ä$_j$ are industry fixed effects, ã$_t$ are year effects and å-$_{ijt}$ is the error term. If â is greater than zero (and statistically significant), formal firms are more efficient than informal firms and vice versa. We estimate the above equation using Ordinary Least Squares – we do not need to use instrumental variable methods as our first stage analysis precludes the possibility that firms with higher technical efficiency tend to move to the formal sector, and therefore, of simultaneity bias. We use our estimates of absolute and relative technical efficiency alternately as our dependent variable in the estimation of equation (10).

4. Results

4.1 We use unit level data for the formal and informal manufacturing sectors for four years, 1989-90, 1994-95, 2000-01 and 2005-06.[7] The choice of years is governed by the fact that the data on informal sector firms are only available for these years. Data on the formal manufacturing sector is drawn from the Annual Survey of Industries (ASI), undertaken by the Central Statistical Organization (CSO), which is the annual census-cum-sample survey of all the formal manufacturing units for all the industries across all the states. For the informal sector, we use the National Sample Survey Organization (NSSO) surveys on the informal manufacturing sector, which are undertaken quinquennially using a stratified sampling procedure.[8] It is to be noted that during the sixteen years of our analysis period, industrial classification has undergone some changes. For instance, ASI data for 2005-06 uses NIC 1998 codes, whereas 1994-95 and 2000-01 data uses NIC 1987 codes. Similarly, NSSO data for 1989-90 and 1994-95 are based on NIC 1987, whereas 2000-01 data is based on NIC 1998 and 2005-06 data is based on NIC 2004. We harmonized the whole data at NIC 1998 codes. The average number of firms in the formal sector that we use in our empirical analysis is 25,000 and for the informal sector, 28,000.

Labour regulation data till 1997 comes from Besley and Burgess (2004), and we have updated it using similar coding procedures till 2005. Data on priority credit share for the selected states are drawn from Burgess and Pande (2005) till 1995, and we have updated it for the years 2000-01 and 2005-06 from an annual publication titled Statistical Tables Relating to Banks in India published by the Reserve Bank of India (RBI). The data on the cost of power supply comes from the Indian Planning Commission (2002).

We first present the results for the first stage estimation followed by the results for the second stage estimation.

4.2 First Stage Estimation

4.2.1 Table 1 presents the descriptive statistics for the main variables that we use in our first stage probit model estimation. On average, priority sectors such as small-scale industries, services and agriculture together received about 31 per cent of the total bank

[7] Data are in the form of repeated cross-sections, and not in panel form. This is because the Indian statistical agencies do not reveal the identity of the firm/plant in the unit level data, and for the informal sector, the same firms may not be surveyed in each round.

[8] We limit our analysis of informal firms to only those which hire outside labour, as there are serious limitations on the quality of data for household enterprises.

lending for the period 1989-90 to 2005-06. It is clearly evident from the Table that average value added per employee is considerably higher for firms in the formal sector as compared to their counterparts in the informal sector. Evidence also points to significant differences in the level of input use between firms in the formal and informal sector. The capital-labour ratio computed for both the sectors suggest the highly capital intensive nature of production process employed in the formal sector vis-à-vis the informal sector. The labour regulation variable suggests that, on average, labour laws in India have been pro-worker.

4.2.2 We present the results of the first stage probit equation estimation in Table 2. The chi-square test statistic in the probit selection equation is significant at the 1 per cent level in all the industries except three industries, namely medical, precision and optical instruments, office machinery and basic metal industries. As expected, the likelihood of the firm being in the formal sector is positively correlated with firm size. We also find that weaker labour regulation significantly and positively influences the firm's decision to be in the formal sector. By and large, wherever the variable is significant in the industry by industry results, there seems to be a positive relationship between the availability of power supply and the firm's decision to be in the formal sector. This suggest that the greater the quality of the electricity supplied in a given state, the more likely is it that firms in that state will be formalized. In most industries, greater availability of priority sector lending from commercial banks seems to have a greater likelihood of firms to be in the formal sector.

4.3 Second Stage Estimation

4.3.1 Table 3 gives the summary statistics for variables used in estimating stochastic production frontier for formal and informal firms separately. As is evident from the table, the informal firms on an average use less labour and capital and produces less, though the variation is smaller for the group. Is the use of labour and capital relatively more inefficient for informal firms? This is investigated next.

4.3.2 The maximum likelihood estimates of the parameters of the model obtained from estimating the stochastic production frontier model separately for 22 industries are presented for 1989-90, 1994-95, 2000-01 and 2005-06 in Tables 4 and 5 respectively.[9] The models estimated by the maximum likelihood method are highly significant as shown by the large likelihood values. The coefficient of the selectivity variable ($\tilde{n}_{w,v}$) is significantly different from zero at the 5% level in most of the industries especially for 2000-01 and 2005-06, which confirms that serious selection bias exists, thereby supporting the use of a sample-selection framework in the stochastic frontier model. The results of the stochastic

[9] The variables for the stochastic frontier model are real value added and real capital stock at 1993-94 prices and employment. We omitted observations for which real value added, real capital and the labour variables are less than or equal to zero. Real value added is obtained by deflating nominal value added using the wholesale price index (WPI) for manufactured products at the four digit industry level. Labour is measured as total number of persons engaged in the production activity, which include production workers as well as employees. Real capital stock is constructed by deflating gross fixed assets by WPI for machine and machinery tools. To ensure that the empirical analysis is not sensitive to the inclusion of outliers, we have dropped all firms where real capital stock, employment or real output are more than two standard deviations from the industry means of these variables.

production frontier models show that as expected in a labour surplus economy, labour is a more important input than capital in the production function. The coefficient of labour is higher than that of capital for most industries and for most years irrespective of the group suggesting that labour is a more important input than capital in the production function, which is a quite plausible finding for a labour surplus economy like India. For informal sector, we find elasticity of labour or capital is negative in some industries. This could be because of two reasons – first, some of these industries are highly capital intensive, thereby having less scope for informal firms (for example, Petroleum); and second, the estimates for these industries are not consistent due to less degrees of freedom as these industries consist of only few informal firms (for example, Office Machinery). We also examine whether there has been any changes in the estimated parameters of the industry production functions over time. Our results preclude any such possibility in the formal sector as the t-ratio for differences in coefficients is found to be insignificant for most industries and most years. However, the t-test for differences in coefficients do suggest changes in estimated parameters over time for the informal sector with the sector reporting increasing returns to scale for the later period.

4.3.3 Figure 1 gives the estimated technical efficiency and relative technical efficiency of formal and informal groups. We observe that formal firms, on average, are more efficient and closer to the frontier than informal firms. We next examine whether this observation is supported by regression analysis. We first pool our efficiency estimates for both formal and informal firms in one data-set. We then use Ordinary Least Squares in this combined data-set, regressing the efficiency estimates on the formal sector dummy, as in equation (10). To take into account that efficiency may be impacted by macro shocks and that efficiency may be correlated with unobserved industry characteristics, we see how robust our results are to the inclusion of year and industry effects. We present our results in Table 6. We present estimates for both absolute and relative technical efficiency. Cols (1) to (2) present the results for absolute technical efficiency while Cols (3) to (4) present the results for relative technical efficiency. In Col. (1) and (3), we present the results without industry effects but with year effects, and in Cols (2) and (4), with both industry and year effects. Our regression results clearly show that formal firms are more efficient than informal firms, – as the coefficient on the formal sector dummy is statistically significant at the 1 per cent level. This is independent of year- and sector-effects. However, the informal firms are closer to the frontier.

4.4 Does Location Matter for Efficiency?

4.4.1 In order to see, whether this higher efficiency of formal firms holds true irrespective of their location (LOCATION) – we use an interaction term with FORMAL in the following manner.

$$TE_{ijt} = \acute{a} + \hat{a}_1 * FORMAL_{ijt} \times Z_{ijt} + \ddot{a}_j + \tilde{a}_t + \mathring{a}\text{-}_{ijt} \qquad \text{——————————(10)}$$

Where TE_{ijt} is technical efficiency of firm i in industry j and year t, , Z is the location variable, $\ddot{a}_j$ are industry fixed effects, $\tilde{a}_t$ are year effects and $\mathring{a}\text{-}_{ijt}$ is the error term. If $\hat{a}_1$ is greater than zero (and statistically significant), formal firms are more efficient than informal firms for that characteristic.

4.4.2 For location, we have information about whether firm is located in Rural or Urban area. We expect that firms in urban areas to be more efficient due to greater access of public goods and also having more access to information, labour market pooling and market for other components and allied services. However it is not clear which category of firms - formal or informal would make use of their location better. This would be interesting to see.

4.4.3 We measure location as a dummy having two values – RURAL and URBAN having value of one if the firm is located in rural area and urban areas respectively.

$$TE_{ijt} = \acute{a} + \hat{a}_1 * FORMAL \text{ x } \text{RURAL}_{ijt} + \hat{a}_2 * FORMAL \text{ x } \text{URBAN}_{ijt} + \ddot{a}_j + \tilde{a}_t + \mathring{a}\text{-}_{ijt} \quad \text{— (11)}$$

We expect b_1 to be positive if formal firms are more efficient. However, if formal firms make use of their location better, b_2 will not only be positive but also greater than b_1. The results are given in Table 7. Before we discuss results, we give kernel density plot (Figure 2) that compares efficiency of formal and informal firms with respect to their location.

4.4.4 From the figure we can make following inferences – a) formal more efficient than informal – irrespective of whether in Rural or urban areas; b) Formal firms on an average becoming more efficient in both rural and urban areas (Figure 2).

4.4.5 To see whether these differences are statistically significant or not we estimate equations 11 for which results are given in Table 7. From the table, we can make following inferences: formal firms more efficient whether located in Rural or Urban area; whereas, informal firms are more closer to their frontier. Based on the results, we can say that formal firms are more efficient irrespective of their location.

5. Conclusion

5.1 Whether formal firms are more efficient than informal firms is a matter of empirical inquiry. In this paper, we use unit record data for the informal and formal manufacturing sectors combined from four repeated cross-sections over the period 1989-2005 and use stochastic frontier analysis applied to twenty-two industries to calculate absolute and relative efficiency at the firm-level for the Indian economy to examine whether formal firms are more efficient than formal firms. We use a recent econometric methodology proposed by Greene (2010) to correct for selection bias in the firm's decision to be in the informal or formal sectors in the estimates of efficiency using stochastic frontier analysis. To do this, we estimate probit equations in the first stage to capture the likelihood of the firm being in the formal or informal sector. Our first stage results indicate that except three industries, namely medical, precision and optical instruments, office machinery and basic metal industries, there exists selection bias. The likelihood of the firm being in the formal sector is positively linked to its size, less stringent labour regulation, the availability of power supply and priority sector lending to small-scale firms from commercial banks.

5.2 We then use stochastic frontier analysis to estimate firm-level estimates of efficiency in the second stage of our empirical analysis, correcting for selection bias. We use the

firm-specific estimates of absolute and relative technical efficiency and pooled Ordinary Least Squares methods to examine whether formal firms are more efficient than informal firms. We find that formal firms are more efficient than informal firms, both for absolute and relative efficiency – the coefficient on the formal sector dummy is statistically significant at the 1 per cent level, controlling for year and industry effects.

5.3 In next stage we find that the results hold irrespective of their location - rural or urban. We find that formal firms in urban areas are more efficient. This suggests that there are clear benefits of easing the transition of informal firms to the formal sector. The paper thus provides empirical support for the proposition that policy-makers should relax regulations that may allow more informal sector firms to relocate to the formal sector.

References

Ahsan, A., C. Pages and T. Roy (2008), "Legislation, enforcement and adjudication in Indian labour markets: Origins, consequence and the way forward", in D. Mazumdar and S. Sarkar (eds.), Globalization, Labour Markets and Inequality in India, UK: Routledge.

Aigner, D.J., C.A.K. Lovell, and P. Schmidt (1977), "Formulation and estimation of stochastic frontier production function models", *Journal of Econometrics*, 6: 21-37.

Besley, T. and Burgess, R. (2004), "Can Labour Regulation Hinder Economic Performance? Evidence from India", *The Quarterly Journal of Economics*, 119(1) 91-134.

Burgess R. and R. Pande (2005), "Do Rural Banks Matter? Evidence from the Indian Social Banking Experiment", *American Economic Review,* 95(3): 780-795.

Cali, M. and K. Sen (2011), "Do effective state-business relations matter for economic growth? Evidence from Indian states", World Development (forthcoming)

Dabla-Norris, E., Gradstein, M. and Inchauste, G. (2005), "What Causes Firms to Hide Output? The Determinants of Informality", IMF Working Paper No. 05/160, IMF, Washington DC.

De Soto, H. (1989), "The Other Path: the Invisible Revolution in the Third World", Harper and Row, New York.

Dessy, S. and Pallage, S (2003), "Taxes, inequality and the size of the informal sector", *Journal of Development Economics*, 70: 225-233.

Greene, W. (2006), "A General Approach to Incorporating 'Selectivity' in a Model", Working Paper EC-06-10, Stern School of Business, New York University.

Greene, W. (2010), "A stochastic frontier model with correction for sample selection", *Journal of Productivity Analysis*, 34: 15-24.

Heckman J. J. (1976), "The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models", *Annals of Economic and Social Measurement*, 5: 475–492.

Fajnzylber, W.F. Maloney and G.V. Montes-Rojas (2011), "Does formality improve micro-firm performance? Quasi-Experimental Evidence from the Brazilian SIMPLES program", *Journal of Development Economics,* 94(1): 262-276.

Krueger, A.O. and S. Chinoy (2002), "The Indian Economy in a Global Context", in A.O. Krueger (ed.), Economic Policy Reforms and the Indian Economy, Chicago: University of Chicago Press.

National Commission for Enterprises in the Unorganised Sector (NCEUS), Government of India (2007), "Conditions of Work and Promotion of Livelihood in the Unorganised Sector". Report, Government of India, N.Delhi.

Panagariya, A (2008), India: The Emerging Giant, New York: Oxford University Press.

Planning Commission (2002), Annual Report on the Working of State Electricity Boards and Electricity Departments, Government of India, N.Delhi.

Sen, K. and R.R. Vaidya (1997), "The Process of Financial Liberalization in India", Delhi: Oxford University Press.

Straub, S. (2005), "Informal sector: the credit channel", *Journal of Development Economics*, 78: 299-321.

Taymaz, E. and G. Saatci (1997), "Technical change and efficiency in Turkish manufacturing industries", *Journal of Productivity Analysis*, 8: 461-475.

Taymaz, E. (2005), "Are Small Firms Really Less Productive?", *Small Business Economics*, 25: 429-445.

Taymaz, E. (2009), "Informality and Productivity: Productivity Differentials between Formal and Informal firms in Turkey", ERC Working Papers, 0901, Economic Research Centre,Middle,East,TechnicalUniversityAnkara (http://www.erc.metu.edu.tr/menu/series09/ 0901.pdf accessed in December 2010).

Ulyssea, G. (2010), "Regulation of entry, labor market information and the informal sector", *Journal of Development Economics,* 91: 87-99.

WTO (2009), "Globalization and Informal Jobs in Developing Countries", Geneva: World Trade Organization and International Labour Office.

World Bank (2004), "India Investment Climate Assessment2004:Improving Manufacturing Competitiveness", Washington D C; The World Bank.

World Bank (2005), "World Development Report 2005: A Better Investment Climate For Everyone", Washington D C: The World Bank.

Yang, C-H. and J-H. Chen (2009), "Are small firms less efficient?", *Small Business Economics,* 32: 375-395.

Table 1: Descriptive statistics at the aggregate level: 1989-2006 (N = 219,393 – ASI = 110,014, NSSO = 109,369)

	Mean	Standard deviation
Labour regulation index (pro-worker: +1; pro-employer: -1)	0.576	0.235
Cost of power supply, state level, (Rs./Kwhr)	5.323	0.5422
Share of priority sector lending, state-level (percent)	31.457	9.883
Firm size (log (ln) employment)	2.652	1.557
Ln formal manufacturing value added per employee	10.719	1.126
Ln informal manufacturing value added per employee	8.920	1.199
Ln formal manufacturing capital labour ratio	10.454	1.727
Ln informal manufacturing capital labour ratio	9.821	1.341
Ln formal manufacturing employment (No.)	3.893	1.211
Ln informal manufacturing employment (No.)	1.404	0.529

Notes: The data are for the 15 major sates for the period 1989-2006. Since Bihar, MP and UP were bifurcated in 2000 to form the new states, Uttarakhand, Chhattisgarh and Jharkhand, we have merged these three states with their parent states so as to have consistent data for the study period.

Table 2: Parameter Estimates of the Probit Selection Equation, Industry Level, All Years

Industries	Cons-tant	Size	Labour regu-lation	Power	Priority -sector lending	Log likeli hood	Ma Fadden R-square	N	Chi squared
Food	-7.54*	2.45*	0.89*	0.33*	-0.01*	-5072.35	0.81	38978	154.53
	(0.21)	(0.03)	(0.07)	(0.03)	(0.002)				
Tobacco	-9.32*	1.31*	-1.43*	0.92*	0.07*	-1064.94	0.65	4449	28.70
	(0.48)	(0.04)	(0.14)	(0.07)	(0.01)				
Textiles	-10.22*	2.84*	0.38*	0.43*	0.01*	-3955.03	0.83	35138	203.86
	(0.26)	(0.04)	(0.07)	(0.04)	(0.001)				
Apparel	-23.90*	11.60*	0.14	-0.41	0.001	-98.57	0.98	12320	
	(2.96)	(1.21)	(0.48)	(0.26)	(0.01)				
Leather	-7.79*	2.90*	1.26*	0.07	0.01*	-490.19	0.82	4035	16.90
	(0.68)	(0.12)	(0.18)	(0.11)	(0.005)				
Wood	-6.10*	2.48*	0.18*	0.10*	0.01*	-1930.47	0.66	9400	149.49
	(0.32)	(0.06)	(0.11)	(0.05)	(0.003)				
Paper	-5.92*	2.42*	0.65*	0.09	0.0003	-661.49	0.67	3692	10.53
	(0.60)	(0.09)	(0.19)	(0.09)	(0.004)				
Publishing	-7.76*	2.88*	0.27*	0.17*	0.01*	-973.04	0.80	7122	30.49
	(0.47)	(0.08)	(0.14)	(0.07)	(0.004)				
Petroleum	-4.94*	1.52*	1.79*	0.23	0.01	-208.23	0.57	1259	17.50
	(0.89)	(0.11)	(0.36)	(0.14)	(0.01)				
Chemicals	-5.44*	1.93*	-0.74*	0.24*	0.01*	-2044.35	0.62	11649	12.55
	(0.33)	(0.05)	(0.11)	(0.05)	(0.002)				
Rubber	-7.83*	2.31*	0.59*	0.40*	0.01*	-1459.21	0.67	6848	24.91
	(0.41)	(0.06)	(0.13)	(0.06)	(0.003)				
Minerals	-4.12*	1.51*	0.77*	-0.02	0.01*	-5131.86	0.54	16634	44.73
	(0.21)	(0.02)	(0.07)	(0.03)	(0.002)				
Basic metal	-5.73*	2.30*	0.83*	0.21*	-0.01*	-970.82	0.69	7594	3.46
	(0.47)	(0.07)	(0.15)	(0.07)	(0.003)				
Metal products	-8.32*	2.83*	0.32*	0.33*	0.01*	-2585.47	0.78	17146	153.99
	(0.30)	(0.05)	(0.09)	(0.04)	(0.002)				
Machinery	-7.40*	2.42*	1.05*	0.36*	-0.004*	-2386.36	0.73	13571	88.99
	(0.30)	(0.05)	(0.10)	(0.05)	(0.002)				
Office machinery	-2.55*	2.08*	-0.46	-0.57	0.04*	-34.98	0.69	294	1.38
	(2.18)	(0.38)	(0.76)	(0.38)	(0.02)				
Electrical machinery	-5.91*	2.39*	0.52*	0.005	0.02*	-874.18	0.73	5281	24.94
		(0.50)	(0.08)	(0.17)	(0.08)	(0.004)			
Radio & Television	-7.00*	2.40*	1.50*	0.05	0.03*	-134.77	0.74	1353	3.75
	(1.23)	(0.19)	(0.43)	(0.19)	(0.009)				
Medical, precision & optical instrmnts	-5.71*	2.40*	1.60*	0.05	-0.009	-196.34	0.74	1427	0.62
	(0.99)	(0.16)	(0.35)	(0.15)	(0.007)				
Motor vehicles	-4.14*	2.14*	0.03	-0.09	0.001	-527.59	0.67	3162	8.71
	(0.72)	(0.10)	(0.23)	(0.11)	(0.005)				
Transport equipment	-4.58*	2.02*	1.24*	0.11	-0.02*	-647.97	0.65	3241	34.60
	(0.56)	(0.08)	(0.23)	(0.09)	(0.004)				
Furniture and nec.	-5.90*	2.28*	0.77*	-0.04	0.01*	-1850.72	0.71	14843	96.01
	(0.33)	(0.05)	(0.12)	(0.05)	(0.003)				

Notes: a) N is the total number of firms; b) * and ** indicates level of significance at 5 per cent and 10 per cent respectively; c) Figures in parenthesis are standard errors.

Table 3: Summary Statistics for Second Stage Estimation – average over 1989-90 to 2005-06

Industry	Informal Sector			Formal Sector		
	Y	K	L	Y	K	L
Food	9.96 (6.93-13.04)	10.99 (7.36-14.50)	1.24 (0.69-2.48)	14.52 (10.68-18.54)	14.32 (9.39-19.30)	4.01 (1.39-6.73)
Tobacco	9.63 (6.99-12.26)	10.18 (7.07-13.12)	1.39 (0-3.18)	13.85 (9.37-18.44)	11.77 (3.58-18.92)	4.21 (0.69-7.95)
Textiles	10.37 (7.44-13.20)	10.93 (7.40-14.32)	1.57 (0.69-2.71)	15.10 (11.12-19.15)	15.12 (9.96-20.21)	4.34 (1.61-7.36)
Apparel	9.84 (6.72-13.11)	11.14 (8.80-13.53)	1.14 (0.69-2.20)	15.38 (12.19-18.40)	14.90 (10.67-18.89)	4.69 (2.08-7.21)
Leather	10.51 (7.43-13.57)	11.02 (7.81-14.15)	1.40 (0.69-2.56)	14.74 (11.32-18.08)	14.64 (10.49-18.69)	4.01 (1.39-6.73)
Wood	10.19 (7.26-12.96)	10.90 (6.96-14.59)	1.27 (0.69-2.30)	12.98 (10.13-16.04)	12.63 (8.27-16.87)	2.88 (1.10-5.07)
Paper	11.07 (7.89-14.17)	12.12 (8.82-15.14)	1.63 (0.69-2.83)	14.55 (11.00-18.35)	14.60 (10.19-19.36)	3.63 (1.39-6.34)
Publishing	10.28 (7.10-13.29)	11.92 (8.43-15.05)	1.34 (0.69-2.40)	14.23 (10.63-17.93)	14.01 (9.01-18.93)	3.62 (1.39-6.14)
Petroleum	10.43 (7.21-13.51)	11.71 (8.12-15.04)	1.63 (0.69-2.71)	14.72 (10.41-19.71)	14.99 (9.97-20.38)	3.73 (1.10-6.66)
Chemicals	11.04 (7.51-14.54)	12.06 (8.43-15.50)	1.82 (0.69-3.14)	15.15 (11.00-19.57)	14.91 (9.58-20.44)	4.14 (1.61-6.98)
Rubber	11.25 (7.82-14.54)	12.47 (8.76-15.82)	1.64 (0.69-2.77)	14.64 (11.26-18.27)	14.64 (10.64-18.92)	3.55 (1.39-6.13)
Minerals	10.59 (7.45-13.73)	11.42 (7.60-15.08)	1.83 (0.69-3.56)	13.75 (10.20-17.87)	13.36 (8.84-18.57)	3.65 (1.39-6.25)
Basic metal	10.76 (7.31-14.27)	11.86 (8.23-15.43)	1.55 (0.69-2.77)	14.97 (11.10-19.18)	14.98 (10.15-20.13)	3.97 (1.39-6.86)
Metal products	10.54 (7.44-13.55)	11.52 (8.13-14.66)	1.35 (0.69-2.40)	14.23 (10.87-17.89)	13.83 (9.67-18.19)	3.50 (1.39-6.11)
Machinery	10.79 (7.56-13.93)	11.91 (8.23-15.29)	1.41 (0.69-2.56)	14.54 (10.98-18.44)	14.20 (9.94-18.74)	3.60 (1.10-6.38)
Office machinery	12.43 (9.73-14.57)	12.96 (10.97-15.88)	1.85 (0.69-3.00)	16.11 (11.84-20.35)	15.66 (11.20-19.47)	4.27 (1.79-6.69)
Electrical machinery	10.77 (7.17-14.52)	11.98 (8.32-15.20)	1.46 (0.69-2.77)	15.02 (11.24-19.20)	14.51 (9.99-19.34)	3.75 (1.39-6.59)
Radio & Television	11.70 (7.74-15.42)	12.33 (8.79-15.32)	1.70 (0.69-3.00)	15.70 (11.60-20.08)	15.37 (10.49-20.32)	4.19 (1.61-7.02)
Medical, precision inst.	11.17 (7.85-14.48)	11.87 (8.61-14.90)	1.49 (0.69-2.77)	15.08 (11.40-18.76)	14.63 (10.11-19.11)	3.79 (1.39-6.44)
Motor vehicles	11.38 (8.33-14.29)	12.53 (9.81-15.10)	1.72 (0.69-2.89)	15.33 (11.27-19.59)	15.30 (10.49-20.34)	4.18 (1.39-7.26)
Transport equipment	11.05 (7.94-14.10)	12.18 (1.38-8.28)	1.58 (0.69-2.71)	14.82 (10.95-19.08)	14.37 (9.72-19.40)	3.84 (1.10-7.13)
Furniture	10.24 (7.18-13.30)	10.96 (7.68-14.03)	1.28 (0.69-2.56)	14.07 (10.32-18.14)	13.38 (8.17-18.59)	3.39 (1.10-6.10)

Note: Figures in the parentheses show the ranges for the respective variables; Y, K and L represent log of real gross value added, real fixed capital stock and number of workers respectively.

Table 4a: Estimated production parameters, industry level, 1989-90 and 1994-95 (Formal Firms)

Industry	1989-90						1994-95					
	Constant	Ln K	Ln L	Log L	Rho	N	Constant	Ln K	Ln L	Log L	Rho	N
Food	7.57* (0.15)	0.35* (0.01)	0.61* (0.02)	-4356.28	-0.08 (0.09)	3597	6.73* (0.12)	0.38* (0.01)	0.67* (0.01)	-9955.52	0.04 (0.04)	6766
Tobacco	8.59* (0.65)	0.19* (0.02)	0.72* (0.06)	-771.78	-0.10 (0.19)	477	8.26* (0.33)	0.24* (0.01)	0.76* (0.04)	-1340.60	0.02 (0.11)	840
Textiles	6.96* (0.17)	0.32* (0.01)	0.82* (0.02)	-2932.03	0.20* (0.08)	2103	7.26* (0.10)	0.34* (0.01)	0.66* (0.02)	-6103.41	0.13* (0.05)	4432
Apparel	8.03* (0.79)	0.35* (0.03)	0.50* (0.06)	-375.97	0.10 (0.65)	306	8.06* (0.33)	0.37* (0.02)	0.44* (0.03)	-1366.52	-0.35 (0.60)	1012
Leather	7.91* (0.59)	0.30* (0.05)	0.67* (0.07)	-492.13	-0.45 (0.29)	350	7.56* (0.49)	0.27* (0.02)	0.77* (0.04)	-977.52	0.01 (0.21)	759
Wood	7.96* (0.60)	0.23* (0.03)	0.73* (0.08)	-740.03	0.26* (0.15)	535	8.07* (0.22)	0.24* (0.02)	0.75* (0.05)	-1394.81	0.12 (0.12)	1025
Paper	8.08* (0.31)	0.33* (0.02)	0.63* (0.06)	-612.75	-0.12 (0.48)	492	7.11* (0.21)	0.35* (0.02)	0.77* (0.04)	-1147.83	0.20 (0.25)	926
Publishing	7.20* (0.21)	0.30* (0.02)	0.85* (0.04)	-961.20	0.09 (0.16)	779	7.42* (0.20)	0.28* (0.01)	0.92* (0.03)	-1278.57	0.03 (0.14)	1061
Petroleum	4.47* (0.82)	0.46* (0.04)	0.85* (0.07)	-286.72	0.28 (0.53)	194	4.55* (0.75)	0.55* (0.03)	0.60* (0.05)	-524.74	-0.82* (0.13)	357
Chemicals	5.75* (0.21)	0.51* (0.01)	0.61* (0.03)	-2716.27	-0.22 (0.20)	1861	6.08* (0.14)	0.45* (0.01)	0.67* (0.02)	-4612.17	0.12 (0.13)	3289
Rubber	7.86* (0.31)	0.33* (0.02)	0.71* (0.05)	-1116.25	0.37* (0.20)	802	6.90* (0.19)	0.35* (0.01)	0.84* (0.05)	-1947.59	0.48* (0.15)	1586
Minerals	6.43* (0.17)	0.30* (0.01)	0.85* (0.03)	-2471.65	0.61* (0.09)	1977	6.46* (0.13)	0.34* (0.01)	0.82* (0.02)	-4351.07	0.31* (0.10)	3395
Basic metal	6.51* (0.39)	0.46* (0.03)	0.47* (0.06)	-1831.99	0.44 (0.42)	1268	6.65* (0.27)	0.34* (0.01)	0.77* (0.02)	-2753.51	0.14 (0.14)	2231
Metal products	7.59* (0.19)	0.24* (0.01)	0.95* (0.03)	-1805.86	0.43* (0.13)	1422	6.97* (0.24)	0.30* (0.01)	0.85* (0.02)	-2952.08	0.13 (0.09)	2443
Machinery	7.18* (0.16)	0.30* (0.01)	0.94* (0.03)	-2183.91	0.48* (0.13)	1771	7.51* (0.13)	0.30* (0.01)	0.85* (0.02)	-3507.10	0.15* (0.08)	2878
Office machinery	6.97* (1.07)	0.31* (0.08)	1.10* (0.12)	-77.46	1.00 10.25)	65	5.87* (1.35)	0.51* (0.09)	0.64* (0.13)	-151.07	-0.68 (1.11)	99
Electrical machinery	6.55* (0.52)	0.35* (0.02)	0.85* (0.04)	-933.50	-0.17 (0.26)	712	7.16* (0.34)	0.31* (0.02)	0.88* (0.03)	-1565.09	0.02 (0.20)	1247
Radio & Television	7.03* (0.76)	0.33* (0.06)	0.77* (0.10)	-276.47	0.60 (0.62)	195	7.43* (0.38)	0.34* (0.03)	0.81* (0.07)	-691.09	-0.32 (0.40)	502
Medical, precision inst.	8.67* (0.58)	0.26* (0.05)	0.81* (0.10)	-259.45	0.00 (0.42)	193	7.80* (0.43)	0.30* (0.03)	0.84* (0.06)	-420.35	0.96* (0.24)	328
Motor vehicles	6.18* (0.69)	0.35* (0.03)	0.85* (0.05)	-358.00	-0.18 (0.54)	329	6.76* (0.39)	0.32* (0.02)	0.87* (0.03)	-764.52	0.27 (0.18)	702
Transport equipment	8.01* (0.76)	0.22* (0.03)	0.89* (0.05)	-547.11	0.22 (0.30)	401	7.53* (0.23)	0.29* (0.02)	0.85* (0.03)	-1135.97	0.32* (0.14)	894
Furniture	7.29* (0.35)	0.28* (0.03)	0.87* (0.07)	-681.00	0.07 (0.19)	450	6.98* (0.47)	0.29* (0.02)	0.91* (0.05)	-1283.84	0.12 (0.10)	771

Notes: a) Ln K and ln L are natural logarithms of capital stock and labour respectively; b) Log L is the value of the log likelihood function, Rho is selection parameter; and N is the total number of firms; d) * indicates level of significance at 5 per cent; e) Figures in parenthesis are standard errors.

Table 4b: Estimated production parameters, industry level, 2000-01 and 2005-06 (Formal Firms)

Industry	2000-01						2005-06					
	Constant	Ln K	Ln L	Log L	Rho	N	Constant	Ln K	Ln L	Log L	Rho	N
Food	6.11* (0.11)	0.44* (0.01)	0.66* (0.02)	-9055.74	0.11* (0.06)	4137	6.66* (0.11)	0.43* (0.01)	0.56* (0.01)	-6533.19	-0.08 (0.06)	5676
Tobacco	7.58* (0.68)	0.24* (0.02)	0.81* (0.05)	-659.94	-0.11 (0.16)	402	7.23* (0.50)	0.27* (0.01)	0.87* (0.04)	-1067.91	-0.09 (0.12)	656
Textiles	7.55* (0.13)	0.38* (0.01)	0.56* (0.02)	-3889.29	-0.15* (0.06)	2648	7.76* (0.10)	0.38* (0.01)	0.62* (0.01)	-4861.61	-0.25* (0.05)	3680
Apparel	8.30* (0.29)	0.33* (0.02)	0.61* (0.03)	-893.34	0.48* (0.20)	770	8.85* (0.22)	0.28* (0.01)	0.61* (0.02)	-1098.24	-0.39* (0.22)	1042
Leather	8.39* (0.40)	0.26* (0.03)	0.78* (0.05)	-529.66	-0.16 (0.20)	405	7.27* (0.59)	0.38* (0.02)	0.52* (0.03)	-710.77	-0.01 (0.12)	559
Wood	7.23* (0.35)	0.28* (0.02)	0.90* (0.09)	-847.22	0.21 (0.15)	469	7.75* (0.30)	0.29* (0.01)	0.79* (0.09)	-1083.45	-0.08 (0.14)	627
Paper	7.67* (0.29)	0.34* (0.02)	0.64* (0.04)	-681.14	-0.41* (0.12)	575	7.89* (0.21)	0.36* (0.02)	0.62* (0.04)	-1013.39	-0.21* (0.10)	831
Publishing	6.40* (0.54)	0.35* (0.02)	0.80* (0.05)	-757.13	-0.10 (0.13)	528	6.98* (0.40)	0.34* (0.01)	0.74* (0.04)	-963.62	-0.11 (0.10)	714
Petroleum	4.76* (0.96)	0.49* (0.03)	0.69* (0.06)	-318.56	-0.46* (0.22)	203	3.96* (0.76)	0.47* (0.03)	1.00* (0.05)	-425.10	0.52* (0.18)	277
Chemicals	6.51* (0.19)	0.42* (0.01)	0.67* (0.03)	-2957.92	0.24* (0.12)	1974	7.61* (0.16)	0.39* (0.01)	0.58* (0.02)	-3769.07	-0.13 (0.09)	2492
Rubber	7.14* (0.29)	0.40* (0.02)	0.60* (0.04)	-1127.65	-0.40* (0.11)	829	8.08* (0.19)	0.35* (0.01)	0.65* (0.03)	-1776.14	-0.11 (0.10)	1334
Minerals	6.24* (0.19)	0.40* (0.01)	0.70* (0.03)	-2822.38	-0.10 (0.10)	1779	7.07* (0.16)	0.37* (0.01)	0.70* (0.03)	-4946.57	-0.30* (0.06)	3122
Basic metal	7.54* (0.20)	0.35* (0.02)	0.68* (0.03)	-1503.30	-0.47* (0.13)	1164	8.19* (0.17)	0.35* (0.01)	0.64* (0.03)	-2387.69	-0.62* (0.07)	1823
Metal products	7.99* (0.18)	0.31* (0.01)	0.73* (0.03)	-1691.65	-0.26* (0.08)	1142	8.30* (0.15)	0.34* (0.01)	0.56* (0.02)	-2533.25	-0.40* (0.05)	1825
Machinery	7.66* (0.17)	0.31* (0.01)	0.82* (0.02)	-2273.62	0.03* (0.09)	1687	7.74* (0.14)	0.34* (0.01)	0.74* (0.02)	-2853.54	-0.20* (0.06)	2299
Office machinery	5.71* (1.68)	0.57* (0.14)	0.55* (0.17)	-60.18	0.99* (0.53)	49	11.08* (1.43)	0.16* (0.14)	0.93* (0.23)	-61.70	-0.99 (0.002)	43
Electrical machinery	7.92* (0.26)	0.34* (0.02)	0.76* (0.04)	-1073.98	-0.22 (0.14)	750	8.32* (0.25)	0.33* (0.02)	0.74* (0.04)	-1318.18	-0.12 (0.13)	944
Radio & Television	7.49* (0.53)	0.38* (0.04)	0.74* (0.06)	-292.97	-0.72* (0.32)	248	10.71* (0.64)	0.21* (0.05)	0.71* (0.09)	-333.99	-0.45* (0.18)	238
Medical, precision inst.	8.53* (0.46)	0.32* (0.04)	0.69* (0.06)	-386.39	-0.53* (0.20)	290	9.74* (0.52)	0.28* (0.04)	0.63* (0.08)	-428.31	-0.61* (0.19)	306
Motor vehicles	7.00* (0.24)	0.37* (0.02)	0.76* (0.04)	-744.36	-0.18 (0.18)	621	7.96* (0.27)	0.34* (0.02)	0.70* (0.04)	-1096.71	-0.28* (0.16)	882
Transport equipment	7.44* (0.38)	0.34* (0.03)	0.71* (0.05)	-596.37	-0.09 (0.17)	475	7.98* (0.22)	0.36* (0.02)	0.62* (0.03)	-724.00	-0.32* (0.12)	610
Furniture	8.33* (0.35)	0.28* (0.02)	0.88* (0.06)	-830.08	-0.29* (0.14)	420	9.61* (0.25)	0.22* (0.02)	0.77* (0.04)	-1131.41	-0.40* (0.09)	647

Notes: a) Ln K and ln L are natural logarithms of capital stock and labour respectively; b) Log L is the value of the log likelihood function, Rho is selection parameter; and N is the total number of firms; d) * indicates level of significance at 5 per cent; e) Figures in parenthesis are standard errors.

Table 5a: Estimated production parameters, industry level, 1989-90 and 1994-95 (Informal Firms)

Industry	1989-90						1994-95					
	Constant	Ln K	Ln L	Log L	Rho	N	Constant	Ln K	Ln L	Log L	Rho	N
Food	7.66* (0.267)	0.16* (0.01)	0.21* (0.06)	-6301.2	-0.27 (0.53)	4146	6.67* (0.12)	0.33* (0.01)	0.54* (0.04)	-6791.8	-0.27 (0.10)	4993
Tobacco	8.65* (0.81)	0.04 (0.035)	-0.13 (0.16)	-558.7	0.78* (0.12)	386	9.1* (0.46)	0.036 (0.026)	0.007 (0.045)	-1570.9	0.55* (0.1)	1063
Textiles	7.63* (0.25)	0.17* (0.01)	0.13* (0.05)	-5712.5	0.99* (0.05)	4046	5.91* (0.06)	0.34* (0.005)	0.74* (0.02)	-8915.0	0.09 (0.08)	8969
Apparel	7.13* (0.84)	0.31* (0.07)	0.28* (0.23)	-462.51	-0.98 (10.65)	283	8.47* (0.38)	0.16* (0.04)	0.84* (0.1)	-411.32	0.64 (0.88)	371
Leather	7.78* (0.92)	0.17* (0.04)	0.25 (0.23)	-435.70	-0.44 (1.30)	292	6.98* (0.38)	0.35* (0.03)	0.77* (0.11)	-719.86	-0.60* (0.25)	551
Wood	7.94* (0.43)	0.15* (0.02)	0.35* (0.17)	-2009.27	-0.05 (0.65)	1323	7.98* (0.13)	0.21* (0.01)	0.73* (0.06)	-1853.07	0.36 (0.23)	1639
Paper	9.51* (1.79)	-0.004 (0.8)	0.90* (0.44)	-175.62	-0.52 (0.83)	113	6.09* (0.51)	0.32* (0.05)	0.95* (0.18)	-219.89	0.11 (0.38)	171
Publishing	7.26* (0.69)	0.18* (0.03)	0.31* (0.19)	-1075.93	0.14 (1.12)	708	7.29* (0.25)	0.27* (0.02)	0.74* (0.09)	-1074.20	0.12 (0.28)	979
Petroleum	-	-	-	-	-	0	6.54* (1.25)	0.32* (0.07)	0.72 (0.48)	-70.01	-0.12 (0.70)	48
Chemicals	6.84* (1.30)	0.22* (0.06)	0.49 (0.40)	-411.48	-0.28 (0.94)	268	5.33* (0.44)	0.44* (0.03)	0.99* (0.16)	-937.06	-0.57 (0.22)	541
Rubber	8.14* (1.11)	0.16* (0.05)	0.61* (0.30)	-500.14	-0.27 (1.13)	308	6.50* (0.36)	0.33* (0.03)	0.83* (0.15)	-819.11	0.15 (0.35)	566
Minerals	8.20* (0.64)	0.11* (0.03)	0.10 (0.22)	-850.93	-0.003 (0.75)	586	6.72* (0.18)	0.35* (0.01)	0.41* (0.06)	-2252.83	0.52* (0.11)	1435
Basic metal	8.48* (1.90)	-0.01 (0.09)	1.49* (0.68)	-288.10	-0.39 (1.01)	162	7.93* (0.49)	0.20* (0.04)	0.94* (0.29)	-377.65	0.13 (0.46)	223
Metal products	7.19* (0.45)	0.21* (0.02)	0.43* (0.11)	-2383.10	-0.04 (0.75)	1565	7.18* (0.12)	0.28* (0.01)	0.82* (0.04)	-2819.40	0.18 (0.16)	2546
Machinery	8.27* (0.43)	0.15* (0.03)	0.48* (0.18)	-1522.37	-0.09 (0.82)	1002	6.99* (0.18)	0.28* (0.02)	0.93* (0.07)	-1788.85	0.28 (0.18)	1527
Office machinery	28.27 (18.93)	-1.42 (8.85)	-0.34 (8.44)	-15.36	0.86 (6.52)	7	25.32 (32.73)	-0.96 (2.94)	1.03 (7.96)	-15.22	0.68 (12.00)	6
Electrical machinery	8.60* (0.91)	0.16* (0.06)	0.27 (0.36)	-309.33	0.001 (0.96)	192	7.38* (0.36)	0.24* (0.03)	1.03* (0.15)	-426.28	0.09 (0.30)	310
Radio & Television	11.30* (1.80)	0.09* (0.13)	-1.18 (0.83)	-57.40	0.96 (0.85)	35	5.35* (0.59)	0.45* (0.05)	0.94* (0.15)	-52.99	-0.99* (0.15)	39
Medical, precision inst.	10.49* (1.78)	0.01 (0.14)	0.99* (0.56)	-75.21	-0.50 (3.96)	56	6.28* (1.85)	0.31* (0.12)	1.01* (0.61)	-104.92	0.12 (0.73)	69
Motor vehicles	9.37* (3.33)	0.05 (0.31)	0.96 (0.60)	-23.94	-0.59 (4.14)	22	6.06* (0.77)	0.41* (0.06)	0.79* (0.21)	-138.08	-0.77 (0.73)	98
Transport equipment	10.09* (0.53)	0.12* (0.04)	0.28* (0.20)	-213.43	-1.00* (0.001)	144	7.83* (0.63)	0.23* (0.05)	0.92* (0.21)	-447.88	-0.01 (0.48)	300
Furniture	6.90* (0.37)	0.18* (0.02)	0.59* (0.10)	-3554.82	-0.22 (0.73)	2358	7.85* (0.10)	0.22* (0.10)	0.79* (0.04)	-3194.97	0.17 (0.17)	2992

Note: Shaded Industry is having very small number of informal firms; the estimates thus are not efficient. Hence the industry has not been considered for further analysis.
* Indicated level of significance at 5 per cent.

Table 5b: Estimated production parameters, industry level, 2000-01 and 2005-06 (Informal Firms)

Industry	2000-01						2005-06					
	Constant	Ln K	Ln L	Log L	Rho	N	Constant	Ln K	Ln L	Log L	Rho	N
Food	6.61* (0.01)	0.34* (0.01)	0.74* (0.03)	-7842.5	-0.46* (0.07)	6188	4.19* (0.24)	0.26* (0.01)	1.27* (0.06)	-5097.98	0.08 (0.09)	3475
Tobacco	7.22* (0.36)	0.31* (0.03)	0.18* (0.10)	-889.47	0.7* (0.18)	538	3.99* (0.87)	0.33* (0.07)	0.78* (0.33)	-116.47	-0.36 (0.64)	87
Textiles	5.79* (0.13)	0.37* (0.005)	0.93* (0.02)	-6995.6	-0.75* (0.03)	7482	3.82* (0.26)	0.33* (0.01)	0.74* (0.05)	-1991.68	0.08 (0.15)	1778
Apparel	7.07* (0.08)	0.27* (0.01)	0.96* (0.18)	-4435.96	-0.86* (0.17)	5582	3.97* (0.16)	0.27* (0.01)	0.94* (0.03)	-2437.32	0.45 (0.42)	2954
Leather	8.07* (0.35)	0.17* (0.02)	0.85* (0.06)	-794.31	-0.26 (0.17)	807	4.18* (0.65)	0.32* (0.04)	0.85* (0.14)	-370.79	-0.16 (0.24)	312
Wood	8.05* (0.08)	0.20* (0.01)	0.82* (0.05)	-2390.10	0.25 (0.19)	2638	5.69* (0.32)	0.14* (0.02)	1.09* (0.10)	-1311.09	0.13 (0.24)	1144
Paper	6.55* (0.27)	0.38* (0.02)	0.43* (0.10)	-448.97	-0.63* (0.20)	389	-0.51 (1.93)	0.64* (0.12)	1.65* (0.63)	-435.45	-0.04 (0.39)	195
Publishing	5.87* (0.17)	0.35* (0.01)	0.80* (0.05)	-1507.07	-0.01 (0.19)	1672	4.00* (0.58)	0.24* (0.04)	1.24* (0.14)	-979.56	0.14 (0.23)	681
Petroleum	14.49* (2.96)	-0.38* (0.18)	0.64 (0.89)	-90.43	0.50 (0.62)	46	2.56 (2.91)	0.42 (0.15)	1.01 (0.92)	-104.88	0.54 (0.59)	39
Chemicals	5.23* (0.37)	0.49* (0.02)	0.68* (0.16)	-1244.32	-0.36 (0.27)	691	-0.10 (1.05)	0.69* (0.05)	0.85* (0.30)	-1328.28	0.18 (0.20)	533
Rubber	6.59* (0.22)	0.35* (0.02)	0.78* (0.09)	-1035.66	0.09 (0.21)	912	1.66* (1.07)	0.46* (0.05)	1.71* (0.33)	-1089.19	-0.07 (0.23)	511
Minerals	7.33* (0.13)	0.32* (0.01)	0.42* (0.05)	-3629.75	0.41* (0.11)	2486	5.09* (0.47)	0.25* (0.02)	0.92* (0.13)	-4946.57	-0.07 (0.15)	1854
Basic metal	6.31* (0.27)	0.35* (0.02)	0.93* (0.12)	-568.39	-0.35* (0.25)	456	2.52* (1.30)	0.37* (0.07)	1.44* (0.47)	-630.86	0.16 (0.27)	267
Metal products	7.76* (0.08)	0.24* (0.01)	0.79* (0.02)	-3437.30	0.38* (0.04)	4184	4.25* (0.30)	0.28* (0.02)	1.07* (0.07)	-2629.71	0.14 (0.13)	2019
Machinery	6.49* (0.18)	0.31* (0.01)	0.99* (0.06)	-1812.91	-0.001 (0.15)	1662	2.61* (0.74)	0.35* (0.04)	1.71* (0.18)	-1355.56	0.17 (0.16)	745
Office machinery	5.37 (18.89)	0.42 (1.86)	1.51 (4.52)	-10.33	-0.71 (13.19)	11	16.96 (11.12)	-0.52 (0.95)	2.05 (1.64)	-30.72	0.57 (4.87)	14
Electrical machinery	6.44* (0.29)	0.35* (0.03)	0.98* (0.10)	-622.26	-0.20 (0.28)	524	3.02* (0.85)	0.33* (0.04)	1.97* (0.21)	-1140.86	-0.11 (0.18)	602
Radio & Television	3.15* (1.56)	0.92* (0.14)	-0.57 (0.35)	-105.72	0.99* (0.001)	56	3.31 (2.87)	0.39 (0.25)	2.82* (0.74)	-90.48	-0.10 (1.13)	40
Medical, precision inst.	8.57* (1.13)	0.27* (0.10)	0.38* (0.22)	-155.70	-0.99* (0.08)	120	1.33 (3.14)	0.52* (0.14)	1.61 (1.02)	-130.96	-0.03 (0.74)	65
Motor vehicles	6.62* (0.49)	0.28* (0.03)	1.08* (0.11)	-409.80	-0.38 (0.24)	358	3.91* (1.71)	0.28* (0.08)	1.53* (0.72)	-300.95	-0.25 (0.55)	150
Transport equipment	5.25* (0.66)	0.46* (0.04)	0.58* (0.17)	-330.74	-0.63* (0.13)	254	4.98* (1.64)	0.23* (0.11)	1.27* (0.47)	-338.44	0.12 (0.35)	163
Furniture	7.72* (0.08)	0.24* (0.01)	0.80* (0.02)	-3732.66	0.45* (0.10)	4624	5.27* (0.23)	0.22* (0.01)	0.91* (0.04)	-2763.44	0.09 (0.19)	2581

Note: Shaded Industry is having very small number of informal firms; the estimates thus are not efficient. Hence the industry has not been considered for further analysis

* Indicates level of significance at 5 per cent.

Table 6: Regression Results: Absolute and Relative Technical Efficiency

Variables	Absolute Technical Efficiency		Relative Technical Efficiency	
	(1)	(2)	(3)	(4)
Constant	0.285*** (0.00220)	0.347*** (0.00302)	57.32*** (0.145)	60.42*** (0.183)
Formal	0.0597*** (0.00159)	0.0408*** (0.00178)	-6.291*** (0.105)	-7.290*** (0.105)
Industry Fixed Effects?	No	Yes	No	Yes
Year Effects?	Yes	Yes	Yes	Yes
Number of observations	169507	169507	169507	169507
R-squared	0.057	0.112	0.230	0.321

Note: *** indicates level of significance at 1 per cent. Figures in parenthesis are standard errors.

Table 7: Are formal firms more efficient irrespective of their location (Rural and Urban)?

	(1)	(2)
VARIABLES	TE	RTE
FORMAL*RURAL	0.164*** (0.00282)	-14.51*** (0.171)
FORMAL*URBAN	0.138*** (0.00225)	-15.81*** (0.140)
Industry dummy	Yes	Yes
Year_1994	0.368*** (0.00280)	-40.67*** (0.157)
year_2000	0.228*** (0.00237)	-34.36*** (0.144)
Year_2005	0.0153*** (0.00253)	-10.87*** (0.174)
Constant	0.261*** (0.00308)	66.94*** (0.175)
Observations	144825	144825
R-squared	0.202	0.434

Note: *** indicates level of significance at 1 per cent. Figures in parenthesis are standard errors.

Figure 1a: TE differentials between Informal and Formal firms

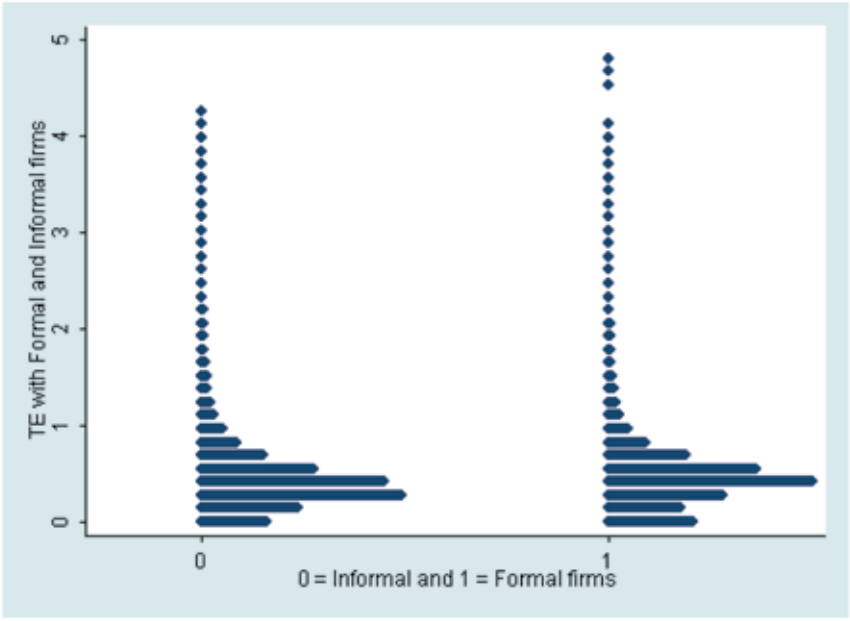


Figure 1b: Relative TE differentials between Informal and Formal firms

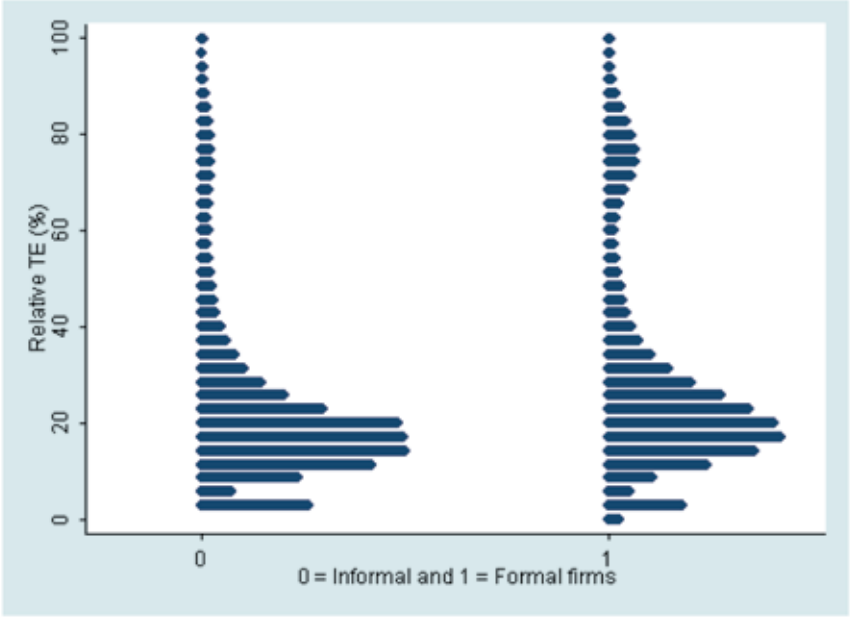
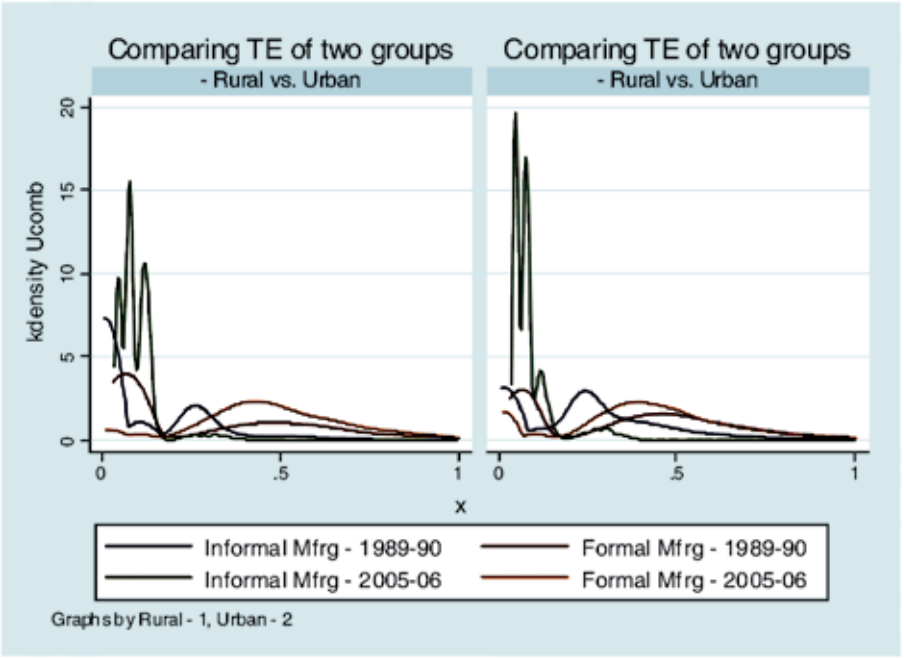


Figure 2: Location-wise comparison TE of formal and informal firms



The Extent of Processing of Agricultural products: Towards creating a Statistical database in India

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Abstract

The absence of a data protocol on the agro-processing activities in India is a serious impediment to public policy for promoting the food processing sector. Available data supporting the government is based on perceptions and insider information rather than on any scientific study and uniform methodology and product classification. This paper is an attempt to initiate the process of building up data on processing of agricultural products using methods open to deliberation and further development. Unit level data collected from registered factories by the Central Statistics Office under the Annual Survey of Industries (ASI) are analysed with considerable attention being placed on data validation through cross-checking. Overcoming the inadequacy in the dataset by using the multiple sources of official information, estimates of the extent of processing of a large number of agro-products are worked out and presented.

1. Introduction

1.1 The wide range of topography, soil quality, bio-diversity and climatic conditions prevailing in India makes agriculture advantageous for producing a large number of crops and non-crop products. The possibility of processing some of these products to value added items creates a significant potential for the development of the agricultural sector in India as also for generating employment within and outside agriculture. Food processing industries in India in particular have been accorded the status of a sunrise sector[2] in the recent period.

1.2 A policy focus on the agro-processing sector to strengthen the links between agriculture and industry will require effective monitoring and reformulating of the existing schemes for which it is vital to maintain reliable data relating to production, processing and other aspects of the sector. Unfortunately no systematic and scientific data pertaining to food processing activities based on 'harmonised concepts, definitions and classifications' is apparently available (MOFPI, 2012). The available data supporting the government policy-making process is sourced from different functional departments, business/industry associations, research institutions and NGOs. The data produced by these sources is not

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[2] The Ministry of Food Processing Industries (MOFPI) created in 1988 is implementing a number of programmes to provide the necessary stimulus to the food processing sector. A National Mission on Food Processing (NMFP) is due for implementation soon in order to maintain synergy between the agricultural Plans of the states and development of food processing sector and to decentralize the implementation of the Central schemes to invite state participation.

mutually comparable for lack of uniformity of methodology and product classification. Moreover, the Industry Associations and export groups often rely on insights, subjective projections, and insider information. These methods make it difficult to validate the data and present them in public domain.

1.3 Thus the lack of comprehensive and reliable data base on agro-processing industries, especially the food processing industry and indeed the absence of a unified data protocol is a constraint on research, policy formulation and decision making. Developing a reliable, systematic and official database relating to critical parameters on the food processing sector will be of vital importance as the sector evolves. This paper is an attempt to initiate this process in order to support the Ministry of Food Processing Industries and the Ministry of Agriculture.

2. Agro-processing to Develop Indian Agriculture

2.1 Agro-processing enterprises are seen to have a strategic developmental role in countries where farming and fishing are major productive activities (Abbot, 1994). In India agriculture remains even today the key source of livelihood, supporting more than 50 per cent of the population. Food processing is where business meets agriculture. Agro-processing being a crucial linkage between the large unorganized agriculture on the one hand and the formal industrial sector on the other can be seen as a way to integrate farming with the processing to enhance farm incomes[3]. Delivery of desired quality, quantity, nutritive value, packaging, and the convenience of shopping and of home-preparation to the downstream users are the motley of challenges facing an organized food processing sector. It is foreseen that the growth and development of the processing sector will improve the realization of the Farmers, enhance agricultural production, productivity, elongate shelf-life of products, reduce the wastage of farm products[4], provide diversified food options at competitive prices to consumers and better employment opportunities to communities. High industrial growth attained in the aftermath of liberalization and deregulation (Nagraj, 2004) even as agriculture and the food processing sector is mired by constraints suggests that the development of the agro-processing sector as industry is an unfinished task.

2.2 As farmers move from subsistence oriented to market driven production, shifts in cropping patterns away from conventional food grains are likely. At the same time, emphasis will move towards productivity and quality of output. Income earning capacity of the farm sector will take precedence over the traditional importance placed on food production as a way to food security. A close positive relation observed between the agricultural growth and reduction of poverty by World Bank's the World Development

[3] Agricultural and fish products need to be processed so that they may be stored, transported conveniently over distances, and presented in forms appealing to consumers to extend the markets in which these products can be sold through scientific marketing techniques, enable producer to access markets not otherwise accessible, and to permit sales at higher prices and in larger quantities.

[4] A study undertaken by the Central Institute of Post Harvest Engineering and Technology (CIPHET, 2010), Ludhiana has estimated the wastage in various produce, cereals (3.9 to 6 %), pulses (4.3 to 6.1 %), oilseeds (6 %), fruits and vegetables (5.8 to 18 %).

Report (2008) has vested agriculture with a significance that transcends its conventional role as a food provider and an evolving study by IFPRI (Gulati et. al, 2011) shows a strong and significant relation between agricultural performance on one hand and income, under-nutrition and women's status on the other.

2.3 While processing of agricultural products is generally seen as an essential process that separates production from consumption, much of this is conducted in the domestic domains (kitchen). The informal sector traditionally also takes up a major role where basic and semi-basic processing takes place. However, in this frame of operation, there are large compromises on quality, quantity, nutritive value and efficiency. Lack of standard norms, transparency on the inputs used and social protection of the workers involved in processing in the unorganized sector undermines product quality and production standards with adverse implications for health of the consumers and the welfare of the workers. Increasing health consciousness among consumers emanating from scientific understanding on food and nutrition and transformation of gender roles in household and professional domains create immense market demand[5] for processed food that can be harnessed to benefit farmers as well as the informal processors.

3. Objective

3.1 Agro-processing is done mostly in the unorganized sector in India, estimated to be accounting for about 99% of the units, 80 % of the employment and 21% of the total value of output in the food processing sector in 2004-05. The data on the extent of these activities are recorded by means of sample surveys conducted by the National Sample Survey Office (previously Organisation) (NSSO) in its periodic reports on the unorganized sector. With India's food production especially in emerging subsectors growing phenomenally in the new millennium (Kumari et. al, 2012, Gokarn et. al 2006), the organized sector, though small particularly in terms of number of units and employment, is also growing fast. Many of these products especially animal based products, horticultural products and also some of the traditional crop based products are available for processing into food products or other end uses. Agro-processing, especially in the organized sector has also received little coverage in literature and data protocols.

3.2 In this study we address agro-processing in general with an emphasis on food processing in the organized sector only. The extent of processing of agricultural products is worked out with a view to explore the options, complexities and constraints on data use. Primarily, we use unit level data collected from registered factories by the Annual Survey of Industries (ASI). This source is preferred because the ASI data is based on systematic sampling methodology that is comparable with international standards and has the potential to develop further to meet the data needs of the future. Considerable attention has been been given to data and its validation based on inter-temporal consistency checks and cross-checking with information collected by other official departments.

[5] It is estimated that 300 million, upper and middle class Indian families consume processed food. Ministry of food processing in its Vision 2015 document: has projected that the size of processed food sector will treble its present size. The processing level of perishable food products may increase from 6% to 20 and India's share in global food trade will increase from 1.5 % to 3%.

3.3 Major items under cereals, pulses, oilseeds, milk, fruits, vegetables, spices and animal based products including fish, meat, milk and egg are covered[6]. Food processing is the major user group among agro-processors but certain other industries also have small shares in the consumption of these inputs. We have therefore covered user industries under the categories of tobacco, chemicals, pharmaceuticals, agriculture and animal husbandry besides food processing. A major issue surrounds the specification of the agro-inputs which in reality enters the processing activity in different stages of basic level processing already conducted in the unorganized sector. While this issue merits greater consideration, for simplicity in the present analysis we have specified agro-processing with a reasonably broad perspective but exclusive of any basic minimum processing that may be essential for consumption.

4. Data, Definition and Methodology

4.1 The data used in the study is primarily taken from the Annual Survey of Industries (ASI) which is the major source of industrial statistics published by Central Statistics Office (CSO) under Ministry of Statistics and Programme Implementation (MOSPI). The survey is conducted annually[7] under the statutory provision of Collection of Statistics Act, 1953 that replaced the earlier schemes Census of Manufacturing Industries (CMI) and Sample Survey of Manufacturing Industries (SSMI) in 1960. We have used both summarised data in published form and unit level panel data. The sample period covered in this study is 2001-02 to 2009-10 starting with more vigorous reforms in the food sector and limited by the availability of the most recent data.

4.2 Agro-processing is the transformation of raw materials sourced from agriculture so that their original physical or chemical property is changed and the transformed product has commercial value. Alternatively, agro-processing is defined as a 'set of techno economic activities carried out for conservation and handling of agricultural raw materials (food and non-food) and to make it usable as food, feed, fibre, fuel or industrial raw material and which has storability/nutritive value' (Kachru, 2006). These transformations are not simply the manufacturing processes but include other ways of value addition through increased shelf life, cleaning, grading, dehydrating, shelling, dehusking or rehusking and greater preparedness (semi-cooking) for consumption[8].

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[6] Only agricultural food products will be covered and widely processed products such as cotton, tea and jute are excluded from our study.

[7] Extending to the entire country the ASI covers all factories registered under the Factories Act, 1948, that is employing 10 or more workers using power and those employing 20 or more workers without using power. The frame is based on the list of registered factory/units maintained by the Chief Inspector of Factory and is regularly updated. Thus the primary unit of enumeration is the factory. The data is presented in Volumes I and II in published and electronic forms in recent times.

[8] The ASI reports manufacturing process in the factory sector (defined in the Factories Act, 1948) as any process for: (i) Making, altering, ornamenting, finishing, packing, oiling, washing, cleaning, breaking up, demolishing or otherwise treating or adapting any article or substance with a view to its use , sale, transport, delivery or disposal; or, (ii) pumping oil, water or sewage; or, (iii) generating, transforming or transmitting power; or, (iv) composing types of printing by letter press, lithography, photogravure or other similar process or book binding; or, (v) constructing, reconstructing, repairing, refitting, finishing or breaking up ships or vessels, (vi) preserving or storing any article in cold storage.

4.3 Agro-processing is applicable to various groups of commodities raw or semi-processed but trade classification even at the international level remains highly inadequate (FAO, 1996) till today. Moreover, many of the processes are conducted outside the ambit of the organized industrial sector and part of the products already partially processed in this way feed into the organized factory sector as inputs for further processing. Further, some of the basic processing activities are essential for most consumption purposes making the most inclusive definition trivial and the estimation nearly irrelevant. For instance milling of paddy to rice and crushing sugarcane to sugar are possible activities that can be visualised to be the basic minimum. The coverage of activities under agro-processing thus poses a challenge for analysis.

Select Agro-items for Study

4.4 As already mentioned specification of items as inputs for processing is far from easy especially because in certain cases a basic minimum of processing becomes essential for consumption[9]. We have tried to minimize the chances of both over-estimation and underestimation by following a middle path. In other words the items chosen for examination are allowed to incorporate some degree of basic processing but such transformations as are minimally required for consumption are not considered as processing in our specification. The inputs and outputs of production activities are identified by Annual Survey of Industries Commodity Classification (ASICC) codes.

4.5 Some of the major agro-items amenable to processing include rice, wheat, coarse cereals, pulses, milk, fruits and vegetables, spices and animal products like egg, fish, chicken and fish. Based on data availability and time constraint we have selected the items given in Table A. To exclude cultivation as a processing activity cereals as seeds are not considered[10] as inputs. To avoid triviality of estimates and minimise chances of over-counting items products that enter as inputs after minimum basic processing are also included in the item list such as milled cereals, pulses, crushed sugarcane and powdered spices. Unmilled paddy and wheat not used as (excluding) seeds are not considered among the items.

Coverage of User Industries

4.6 The coverage of activities in this study transcends not only food processing, but also transformation of a product in form. Value added services such as cleaning, polishing and packaging would also enter the coverage. The major organised sub sectors in which the agricultural products are processed (Table B) are identified using NIC codes 1998, 2004 and 2008. Production in primary activities such as crop cultivation and animal husbandry is the first group given in serial 1 to allow for possibility of organized corporate farming

[9] This creates the undesirable possibility of obtaining trivial estimates of close to 100% processing in the entire economy.

[10] It is possible that grains as seeds enter as inputs in the organized sector where corporate or contract farming of crops and dairy take place.

that may require the agricultural products as inputs but not as seeds. Food processing is included in the groups given serial numbers 2 to 6. Crushing of sugarcane to manufacture sugar is excluded as a basic minimum processing activity. Similarly processing and blending of tea and coffee are left out of the processing ambit.

4.7 Although grain milling is included in the activities, milling of wheat into atta, maida and other products and paddy into rice is effectively left out of consideration through specification of items as discussed in the preceding sub-section. Grain milling however covers preparation of breakfast cereals, manufacture of starch products and animal feed under the NIC classification that effectively would be included in our specification. Crushing of oilseeds to fat has been retained in the coverage treating this not as an essential processing because groundnuts and soyabean are amenable to consumption in forms other than oil. We also chose to include tobacco and pharmaceuticals industries as possible users of agro-products.

5. Data Sources

5.1 We subject the unit level data to scrutiny for inter-year consistency and also for consistency with the corresponding data wherever reported by the Ministry of Agriculture. The data on agricultural production is collected from Directorate of Economics and Statistics, Ministry of Agriculture (MOA, website). While production of most food grains and oilseeds have been traditionally reported for a very long time, it may be pertinent to note that the reporting for most horticultural products and animal based products are a relatively recent initiative.

5.2 Data on wholesale prices for dominant crops especially foodgrains and oilseeds are reported by major markets or 'mandis' by the ministry of Agriculture (MOA, 2010). We computed state level price as the average of prices prevailing in the major mandis consideration being given to consistency in the price data to take care of qualitative differences in products. The all India level wholesale price average is computed taking production as weights. In other cases where no such all India level data on wholesale prices can be methodically computed by using disaggregate data, we have deflated the value of output of product reported by the Central Statistical Office (CSO website) by the production to obtain estimates of the wholesale prices. This is specifically the case for spices where the price information is weak. For fruits and vegetables, the averages of prices in growing states are computed where ever Ministry of Agriculture data is available. Similar average price is considered for milk. In a few cases like mango and papaya we had to resort to data imputed by Food and Agricultural Organization of the UN (FAO, website).

Validating Quantity Data

5.3 ASI collects data on various aspects of the factories including both the quantity and the value of the quantity of various materials consumed by the industries as inputs. The value of output and input reported by ASI has been subjected to larger academic review as a large volume of literature on industrial performance (Goldar, 2004, Neogi and Ghosh, 1998) grew out of this data. However the ASI reported data on quantity of inputs

consumed requires intense validation. An assessment of the inter-temporal consistency, suggests that use of alternate sources be considered as an option.

5.4 Deflating the purchase value of inputs by the quantities we can derive implicit prices of inputs consumed based on ASI data. This is the imputed price and signifies the average price at which the factories procure the different agro-inputs. We compare the price data so imputed with the Wholesale Price data (Table 1). The two series are largely convergent but as already indicated by the inspection of quantity data, instances of severe mismatch are not uncommon. While we do expect that the two set of prices would not differ significantly given that processors would rationally purchase at wholesale rates, there are reasons to expect variations also.

5.5 Firstly, processing companies in reality buy at different points of time for storage or from different points in the value chain rather than only from the wholesale markets. Besides the wholesaler, the sellers could be retailing vendors and are more likely to be certain middlemen in the chains. With liberalization direct purchase from farmers is also becoming common in many states. Second, in most cases prices can be pre-decided by contract, reflecting the bargaining strengths and sensitivity to the quality, more relevant in the case of horticultural crops. Thirdly, the average wholesale prices hide regional variation and more significantly quality differences. Fruits and vegetables procured for processing are usually of certain specific grades while the remaining products are sold to final customer to be consumed fresh. The wholesale prices are spot prices and reflective of its average quality only.

The extent of processing is estimated by the formula

Extent of processing = *Processed quantity (derived) /Production in agriculture*

Processed quantity (derived) = *Value of purchased input (ASI)/Wholesale price*

6. Results

6.1 Figure 1 depicts the extent of processing of products in the most recent triennium. Soyabean is the most processed products. Among others, pulses followed by milk and spices lead in their extents of processing, while fruit and vegetable processing is extremely poor at 1.7% and 2.4% respectively. The estimates for horticultural products are not at great variance from some of the conjectures made for policy making and citing but fall considerably short in the case of milk. It may be noted that a large part of grain and oil milling takes place outside the organised factories.

A Disaggregated Picture

6.2 A more disaggregated view is available in table 2 which provides the share of processed product for four different periods as averages of three years. Among the Coarse cereals Maize is the most processed one varying from 19% to 25% and Bajra the least between 0.63% and 1.80%. The processing of Jowar is also trivial. Coarse cereals can be processed into various health foods (nutrient-mix), biscuits, malt for beverages and snacks

after popping or flaking. Animal feed is a major end use. All the three items under the sub-groups Pulses are subject to moderate processing, the highest share being recorded by Arhar (tur) dal followed by Moong and Gram. The three pulses Arhar, Moong and Gram respectively are processed to the extent of 30%, 24% and 15% in triennium ending 2009-10. Pulses are daily items in Indian food habit, eaten cooked with cereals or as sprouted. Processing mostly involves, loosening of husk, preserving, oiling, cleaning, drying and packaging for final home use though many salted snacks (namkeens) also have different pulses as ingredients. Groundnut undergoes moderate processing of 5% mostly as crushing into oil.

6.3 Of the four fruits we considered, 2% of each of three fruits grapes, mango and orange is processed. In the case of papaya, the extent is less than 1%. Of the four vegetable crops only tapioca is processed to any significant extent. Certain fruits are more tasty and nutritious when eaten fresh. The same fruit or vegetable may be suitable both for processing and fresh consumption but at different stages of the ripening period. Although mostly cooked domestically, it is possible to process many vegetables. Potato is becoming popular ingredient for many snack foods like chips and bhujias and dehydrating potato has seen technical advancements. Tapioca is widely used for making traditional health product sago. Tomato juice, sauce and pastes are popular for which pulping is an essential step. Spices are processed to the extent of nearly 30% and all the spices considered in this study have high rates of processing especially turmeric. Hygienic handling and ways to avoid adulteration are part of the process. Traditionally, milk is one of most widely processed agro-products.

7. Concluding Remarks

7.1 Food processing creates linkages between the farmers and the consumers via the organized industry. As government promotes the sector, development of systematic data base for monitoring and understanding the growth of the sector will be crucial. This study is a step to move beyond subjective judgment based estimates to create the necessary statistics but given the complexity and the hierarchical processes involved, further refinements are possible. Greater attention also needs to be given towards the improving the quality of data in tandem with stronger statistical systems for agricultural prices and production.

References:

Abbott John C. (1994), "Agricultural Processing Enterprises: Development Potentials and Links to the Smallholder", International food Policy research institute.

Food and Agricultural Organisation (FAO), (1996), "Definition and classification of commodities", Draft report.

Gokarn Subir & Gunjan Gulati (2006), "India: Country Growth Analysis", Asian Development Bank.

Goldar, Bishwanath (2004). "Indian Manufacturing: Productivity Trends in Pre- and Post-Reform Periods," *Economic and Political Weekly,* November 20: 5033-42.

Gulati, Ashok, Kaveri Ganguly, Ganga Shreedhar (2011),"*Food and Nutritional Security in India*", International Food Policy Research Institute, New Delhi.

Kachru, R. P, (2006), "Agro-Processing Industries in India—Growth, Status and Prospects", Indian Council of Agriculture Research, New Delhi.

Kumari Anita, Nilabja Ghosh and Rajeshwor M (2012)," Structural Changes in Indian Agriculture: Using the Theil-Tornquist price Index", Un-publish paper, Institute of Economic Growth, New Delhi.

Majumdar, Kakali, (2012)," Foreign Direct Investment in India Food Processing Industry", *Asian Journal of Research in Business Economics and Management*, Vol.2 Issue 4, April, ISSN 2249 7307.

Ministry of Agriculture (2010), "*Agricultural Prices in India*, Directorate and Economic and Statistics", Department of Agriculture and Cooperation, Government of India.

Ministry of Agriculture, Directorate and Economic and Statistics, Department of Agriculture and Cooperation, Government of India. http://eands.dacnet.nic.in/Default.htm.

Ministry of Food Processing Industries (2012), "Data Bank on Economic Parameters of the Food Processing Sector", New Delhi. http://mofpi.nic.in/images/File/DataBank_SectoralDatabaseFPIs_140212.pdf.

Nagaraj, R. (2000),"Organised Manufacturing Employment," *Economic and Polictical Weekly*, September 16, Pp-3445-3448.

National Sample Survey Organization (various) Unorganized Manufacturing Sector in India: input, output and value added.

Neogi, Chiranjib and Buddhadeb, Ghosh, (1998), "Impact of Liberalisation on Performance of Indian Industries: A Firm Level Study," *Economic and Political Weekly*, Vol. 33, No. 9 (Feb. 28 - Mar. 6), Pp. M16-M24.

Radhakrishna, R. and C.Ravi (1992), "Effects of Growth, Relative Price and Preference on Food and Nutrition", *Indian Economic Review*, 27(Special Number), Pp.303-303.

World Development Report, (2008), "Agriculture for Development". worldbank.org/INTWDR2008/.../WDR_00_book.pdf.

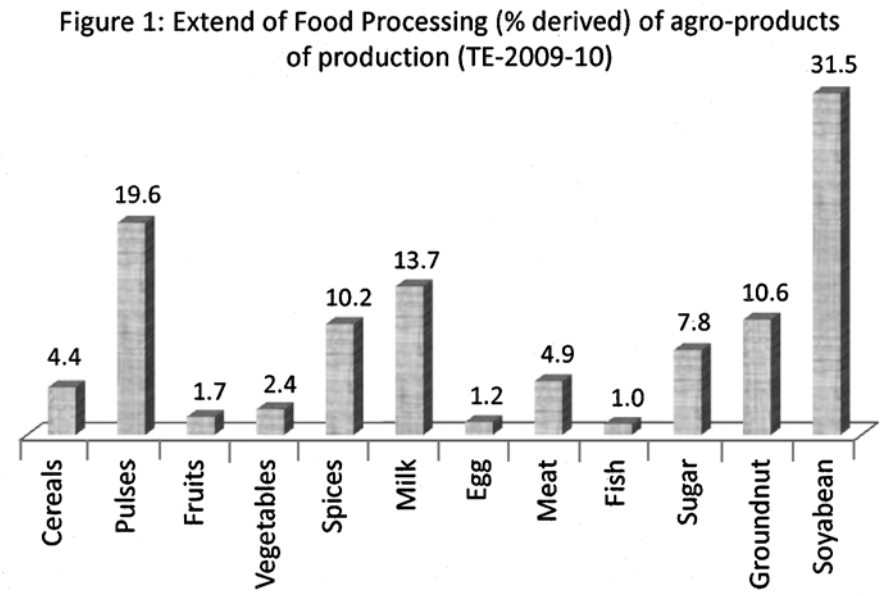

Table A: Selected agricultural products amenable to processing under study

Serial No	Group	Agricultural products
1	Cereal	Rice (raw, parboiled, basmati, broken, powdered, puffed, flakes)
2	Cereal	Wheat (Atta, maida, broken)
3	Coarse cereals	Maize, Jowar, Bajra (milled and unmilled)
4	Pulses	Gram, Arhar, Moong (Milled and unmilled)
5	Fruits	Grapes, Mango, Papaya, Orange,
6	Vegetables	Onion, Green peas, Potato, Squash, Tapioca, Tomato,
7	Spices	Chilli_dry, Turmeric fresh, Coriander (Dhaniya) seed, Cumin seed, Peppper,
8	Milk	Fresh Milk

Table B: Major User industries that process agricultural products and their NIC codes (2004)

Serial No.	NIC Codes - 3 digit	Description
1	014	Agricultural and animal husbandry service activities, except veterinary activities.
2	151	Production, Processing and Preservation of meat, fish, fruit, vegetables, oils and fats.
3	152	Manufacturing of Dairy Products.
4	153	Manufacture of Grain Mill Products, Starches and Starch Products, and prepared animal feeds.
5	154	Manufacture of other food products. (Bakery sugar, noodles, chocolates, confectionary etc). Manufacture of sugar and gur from sugarcane and processing of tea and coffee is excluded.
6	155	Manufacture of Beverages
7	160	Manufacture of tobacco products
8	242	Manufacture of pharmaceuticals, medicinal chemicals and botanical products.

Table1: Prices derived or obtained from alternative sources (Rs/Kg)

Crops	2001-2002		2004-05		2009-10	
	ASI imputed purchase prices	Wholesale prices	ASI imputed purchase prices	Wholesale prices	ASI imputed purchase prices	Wholesale prices
Rice	7.91	9.21	10.79	9.62	13.21	15.11
Wheat	6.79	6.21	6.27	6.85	12.14	11.34
Coarse Cereals						
Maize	5.24	4.78	5.76	5.52	6.76	7.37
Jowar	4.70	5.60	6.36	6.30	9.54	8.12
Bajra	9.69	4.56	5.68	5.81	5.96	10.19
Pulses						
Gram	18.20	17.42	14.17	14.06	19.93	18.54
Arhar	14.56	14.08	17.67	17.37	28.37	39.24
Moong	19.03	19.97	18.24	18.66	32.66	43.93
Oilseeds						
Groundnut	10.65	14.91	17.81	18.45	18.68	30.10
Soyabean	4.55	9.70	8.17	12.80	5.66	21.90
Fruits						
Grapes	9.21	14.71	12.55	17.90	17.32	25.84
Mango	4.93	15.52	8.00	18.89	5.40	27.26
Papaya	1.41	7.84	5.00	9.54	4.89	13.76
Orange	1.14	8.14	14.38	13.24	1.33	19.45
Vegetables						
Onion	3.36	4.19	4.28	4.74	8.98	6.73
peas_green	11.04	12.69	11.90	14.37	15.20	13.62
Potato	6.94	2.99	6.89	3.63	12.94	3.39
Squashes	6.79		76.92		8.14	
Tapioca	4.44	2.22	2.53	3.67	6.23	5.17
Tomato	4.24	6.92	5.41	7.83	4.47	11.18
Spices						
chilli_dry	33.14	35.24	33.38	38.35	61.40	63.65
seed_dhanya	17.58	24.17	27.18	22.99	42.89	76.41
Pepper	68.50	140.82	80.01	79.51	66.46	115.82
Turmeric Fresh	16.87	23.91	34.00	29.46	71.14	42.8
Fish	**32.70**	**77.46**	**41.20**	**86.22**	**32.62**	**46.89**
Milk fresh		**11.86**	**10.50**	**13.18**	**0.08**	**19.55**
Sugarcane*	0.78	0.58	1.27	0.65	0.24	0.89
Egg	23.56	25.32	31.40	25.84		40.63
Meat	34.42	110.42	96.92	122.30	63.89	224.10

Note: For Egg, year 2002-03 is taken instead of 2001-02. *Sugarcane as refined sugar input. Wheat price is for Wheat broken, Rice is for raw rice.

Table 2: Extent of processing of agro-products as percentage of production (%)

Triennium averages	T.E 2003-04	T.E 2005-06	T.E 2007-08	T.E 2009-10
Rice	0.91	1.00	1.40	0.97
Wheat	3.64	3.51	3.44	5.39
Maize	19.12	22.05	21.79	24.87
Jowar	1.32	2.51	2.59	3.61
Bajra	1.80	0.63	0.93	1.22
Gram	7.72	8.94	11.66	14.99
Arhar	29.47	28.22	32.71	30.04
Moong	14.11	20.59	19.01	24.07
Groundnut	6.69	7.11	5.19	5.67
Soyabean	31.66	23.44	14.13	31.49
Grapes	1.48	3.24	4.54	2.24
Mango	0.75	1.03	1.71	1.76
Papaya	0.15	1.04	1.13	0.62
Orange	0.08	0.02	0.01	1.99
Onion	5.46	2.86	2.39	1.31
Potato	0.47	1.00	1.71	1.52
Tapioca	5.03	5.88	6.22	8.59
Tomato	0.51	0.57	0.39	0.24
chilli_dry	6.73	6.53	8.11	13.02
Seed_dhanya	16.25	15.76	26.25	22.21
Pepper	4.36	7.28	18.05	27.04
Turmeric fresh	6.95	8.56	9.71	10.27
Fish	0.61	1.23	2.89	1.89
Milk fresh	11.56	11.99	13.69	13.69
Sugarcane	6.63	12.98	13.78	15.65
Meat	1.40	2.84	5.67	4.94
Egg	2.09	1.91	2.26	1.69

Note: Sugarcane as Sugar and gur only, Rice and wheat as exclusive of bran, meat including chicken.

Study on Seasonal Adjustment of IIP Using X-12 ARIMA

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Abstract

Index of Industrial Production (IIP) is a very important economic indicator of the Indian Economy, which depicts the growth picture in key sectors of Indian Economy – manufacturing, mining and electricity. Published monthly, IIP covers as many as 399 items (item groups). Some of these items are seasonal in nature. This study attempts to identify the seasonal items first and then adjust the corresponding item indices seasonally. Finally, the seasonally adjusted item indices are combined with the (unchanged) non-seasonal item indices to arrive at the general IIP and other higher order indices. X-12 ARIMA, robust software developed by US Census Bureau has been used extensively in this paper to compile seasonally adjusted IIP. It may be noted that United Nations (UN) also recommends X-12 ARIMA for seasonal adjustment of indices and many countries worldwide are using this tool for seasonal adjustment. Comparison of the growth rates obtained from the present series of IIP (unadjusted) and seasonally adjusted IIP reveals that growth rates are more stable in case of the latter. Except for intermediate goods, which have the least percentage of seasonal items within a use-based category, volatility in growth rate for all other categories reduces significantly in case of a seasonally adjusted series.

1. Introduction

1.1 Index of Industrial Production (IIP), compiled and published monthly by Central Statistical Office (CSO), is an important indicator of short-term economic development and is used to measure the industrial growth in the economy and hence assumes great importance to all – analysts, economists, statisticians, planners and policy makers. The present series of IIP with base 2004-05 covers 399 item (item groups) across three broad sectors of the economy viz. Mining, Manufacturing and Electricity with weights 141.6, 755.3 and 103.2 respectively, in a scale of 1000. The index is calculated in stages using a fixed base Laspeyre's formula, initially for items, then major groups (NIC-3digit), divisions (NIC-2digit), sectors (mining, manufacturing, electricity) and finally for all sectors combined (general index). At each stage, the index is a weighted average of the indices calculated at immediately lower stage. Apart from the general and sectoral indices, CSO also publishes indices at 2-digit divisions of NIC-2004 and for five use- based categories viz. Basic goods, Capital goods, Intermediate goods, Consumer durable and Consumer non-durable goods. Among all these use-based categories, capital goods sector is often considered as the barometer of the economy and high fluctuation in growth rate of capital goods in IIP has remained a major concern to all the stakeholders.

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1.2 High frequency time series data on economic statistics in general and industrial production in particular, including the IIP, are often characterized by seasonal fluctuations that mask the relevant short and long term movements of these series and impede a clear understanding of the underlying economic phenomena. A proper and well-known solution is to identify and remove these effects, thus relying on the seasonally adjusted data. In this paper an attempt has been made to seasonally adjusted IIP using X-12 ARIMA, a seasonal adjustment software package developed by the US Census Bureau and used extensively by many countries world-wide for this purpose. This is also one of the software packages recommended by the United Nations Statistics Division for seasonal adjustment of IIP[2]. The seasonally adjusted indices are then compared with the unadjusted original series. Finally, the seasonally adjusted series is tested for presence of residual seasonality.

1.3 The organization of the study is as follows: Section 2 discusses about the seasonal adjustment and its advantage. The theory of ARIMA modeling is outlined in Section 3. Section 4 gives a detail framework of X-12 ARIMA for seasonal adjustment. Features and diagnostics checks given in X-12 ARIMA seasonal adjustment process is described in Section 5 and Section 6 respectively. Data analysis and the findings of the study are given in Section 7 while Section 8 offers some concluding remarks.

2. Seasonal Adjustment

2.1 ***Objective***: The main aim of seasonal adjustment is to filter out seasonal fluctuations of the time series in order to uncover the important features of the series in relation to its evolution, i.e. direction and magnitude of changes that have taken place. Usual seasonal fluctuations mean those movements, which recur with similar intensity in the same season each year and which, based on the past movements of the time series, can under normal circumstances be expected to occur.

2.2 ***Advantage:*** Seasonal adjustment supplies users and analysts with the necessary inputs for business cycle analysis, trend-cycle decomposition and turning points detection. It provides a more smooth and understandable series hence revealing the "news" contained in the time series of interest. Seasonal adjustment facilitates the comparison of long-term and short-term movements among industries, sectors and countries. However, the seasonally adjusted data and the estimated trend/trend-cycle complement the original data, but, they cannot replace the original data for the following reasons: i) unadjusted data are useful in their own right. While the non-seasonally adjusted data show the actual economic events that have occurred, the seasonally adjusted data and the trend-cycle estimate represent an analytical elaboration of the data designed to show the underlying movements that may be hidden by the seasonal variations. Thus, compilation of seasonally adjusted data, exclusively, represents a loss of information; ii) no unique solution exists on how to conduct seasonal adjustment and; iii) seasonally adjusted data are subject to revisions as future data become available, even when the original data are not revised.

[2] *International Recommendations for the Index of Industrial Production (IRIIP), 2010, UNSD*

2.3 *Need for Seasonal Adjustment:*

2.3.1 Seasonal upswing or downswing can often be confused with upward or downward trend. This fact can be a matter of concern for short-term (monthly) time series like IIP. Hence, one should focus on the smoothed indices.

2.3.2 Seasonality of a time series can add to the overall volatility of the series. In recent times, volatility in the growth rate of IIP has been a point of discussion. Seasonal adjustment to IIP can reduce the volatility, specially, in the MoM growth rates.

2.3.3 However, one must not ignore the plausibility of distortion of the quality of the seasonal estimates. For this, some interventions is necessary to detect the outliers and effects like Additive Outlier (AO), Trend Breaks or Level Shift (LS), Temporary Change (TC) etc. In other words, the seasonal adjustments should not be made on a series which has these effects. Instead, these effects should be adjusted from the time series before seasonal factors are derived finally.

2.4 ***Quality of seasonal adjustment:*** The most fundamental requirement of seasonal adjustment quality is that there is no estimable seasonal effect still present in the seasonally adjusted series. The presence of estimable seasonal effects in either the seasonally adjusted series or the de-trended seasonally adjusted series (i.e. the irregular component) is, generally, what is referred to as residual seasonality. To detect whether the seasonally adjusted time series contains residual seasonality, a special "spectral diagnostic" should be carried out for monthly data.

2.5 ***Direct and Indirect seasonal adjustment:*** A seasonally adjusted value of an aggregate series can be derived either as seasonally adjusting the series itself (direct adjustment), or as summing (or combining) the seasonally adjusted values of its component series (indirect adjustment). Under most circumstances, the direct and indirect adjustments for an aggregate series are not identical. There are some very limited situations in which the two types of adjustment coincide, particularly if the adjustments are additive. Whether direct or indirect adjustment is more appropriate for a given set of series will largely depend on the set of series under consideration. As a practical rule generally indirect seasonal adjustment should be preferred when the component series that make up the aggregate series have quite distinctively different seasonal patterns and have adjustments of good quality. The indirect seasonal adjustment in this case is of better quality than the direct adjustment. Direct seasonal adjustment should be preferred when the component series have similar seasonal patterns and summing the series may result in noise cancellation.

2.6 *Principles of seasonal adjustment*

2.6.1 Let , Y be a time series and C, S and I are respectively the trend-cycle, seasonal and irregular components of the time series. Following are two types of time-series models:

Additive model : $Y = C + S + I$

Multiplicative model: $Y = C \times S \times I$

The seasonally adjusted series is formed by estimating and removing the seasonal component.

For the additive model: Seasonally adjusted series $= Y - S\hat{} = C + I$

For the multiplicative model: Seasonally adjusted series $= Y / S\hat{} = C \times I$.

S^ is the estimate of seasonal factor.

2.6.2 In a multiplicative decomposition, the seasonal effects change proportionately with the trend. If the trend rises, so do the seasonal effects, while if the trend moves downward the seasonal effects diminish too. In an additive decomposition, the seasonal effects remain broadly constant, no matter which direction the trend is moving in.

3. Theory of ARIMA Modeling

3.1 Auto Regressive Integrated Moving Average (ARIMA), developed by Box-Jenkins, is a very familiar econometric modeling technique that deals with non-stationary time series. This non-stationarity is observed with respect to mean of the series. The package X-12 ARIMA uses ARIMA extensively. Following is a brief account of ARIMA modeling.

3.2 Auto Regressive Moving Average (ARMA) models are frequently used to model stationary time series. Thus ARMA(p,q) on a time series y_t may be defined as

$$\Phi(B)\, y_t = \theta(B)\, a_t \qquad \longrightarrow \qquad (1)$$

where, B = Backshift Operator i.e. $By_t = y_{t-1}$

$\Phi(B) = (1 - \Phi_1 B - \Phi_2 B - \ldots\ldots\ldots\ldots\ldots\ldots \Phi_p B)$ is the non-seasonal AR operator.

$\theta(B) = (1 - \theta_1 B - \theta_2 B - \ldots\ldots\ldots\ldots\ldots\ldots \theta_q B)$ is the non-seasonal MA operator

a_t is the white noise process i.e. $\{ a_t \}$ is a sequence of independently and identically random variables with zero mean and variance σ^2.

3.3 But, most time series in real life are non-stationary in nature. That is the general level or the mean level of the series changes with respect to time. In such case, one may apply ARMA on the differenced series (i.e. on the series ($\Delta y_t = y_t - y_{t-1}$)). This is ARIntegrated(I)MA model. So a ARIMA(p,d,q) model looks like:

$$\Phi(B)\, \Delta^d y_t = \theta(B) a_t \qquad \longrightarrow \qquad (2)$$

3.4 ARIMA takes into account the trend component of the time series. But, often time series possess a seasonal component that repeats every s observations. For monthly observations s = 12 (12 in 1 year), for quarterly observations s = 4 (4 in 1 year). In order to deal with seasonality, ARIMA processes have been generalized to Seasonal ARIMA or SARIMA which has then been formulated as

$$\Phi(B)\Delta^{D}y_{t} = \theta(B)\alpha_{t}$$

where α_t is such that

$$\Phi(B^{s})\Delta_{s}^{D}\alpha_{t} = \theta(B^{s})\, a_{t}$$

Where, s is the seasonal frequency; 12(for monthly data), 4(for quarterly data) etc.

D = Order of seasonal differencing

$\Phi(B^s) = (1 - \Phi_1 B^s - \ldots\ldots\ldots\ldots\ldots \Phi_P B^{Ps})$ is the seasonal AR operator.

$\theta(B^s) = (1 - \theta_1 B^s - \ldots\ldots\ldots\ldots\ldots \theta_Q B^{Qs})$ is the seasonal MA operator.

Hence, $\Phi(B)\Phi(B^{s})\Delta_{s}^{D}\Delta^{d}y_{t} = \theta(B)\theta(B^{s})a_{t}$ ⟶ (3)

This is the SARIMA or ARIMA(p,d,q) x $(P,D,Q)_s$ model.

4. Framework of X-12 ARIMA for Seasonal Adjustment

4.1 The great strength of X-12 ARIMA is that it first models the seasonality using suitable econometric series and then the obtains the seasonal factors for the seasonal period. Two broad functionalities are performed in two major steps. First, the package uses Regression-ARIMA technique to model the underlying time series. The main essence of using Regression-ARIMA is that of prior adjustment and modeling to the data. This fitted model can be used for the purpose of forecasting and backcasting, so that the forecasted and the backcasted values can be utilized for the seasonal adjustment process. Second, after this prior adjustment the actual seasonal adjustment process is executed.

4.2 Prior Adjustment Process

4.2.1 In the regression part, the package uses linear function of suitable regressors that impacts the dependent time series variable. Then the errors of the time series are modeled as SARIMA. In other words, we can think of the following model:

$$y_{t} = \Sigma \beta_{i} x_{it} + z_{t} \longrightarrow (4)$$

Here, z_t is modeled by SARIMA as discussed in earlier section. x_i 's are the regressors and the β_i 's are the regression coefficients. Here the regressors are concurrent in nature. That is x_{it} goes with y_t with respect to same time point t only.

4.2.2 In standard regression technique z_t is modeled as white noise i.e. $\{Z_t\}$ is a sequence of independently and identically distributed random variables with zero mean and variance a^2. This assumption can be grossly invalid for a time series, where the residuals are supposed to be auto correlated. But modeling z_t as SARIMA helps to capture the covariance structure of the residuals.

4.2.3 The specialty of the regression part is that it contains such variables which should not be part of the series when the seasonal adjustment process is executed. Hence, the Regression-ARIMA model first estimates the regression effects and then the regression effects are subtracted from y_t to get the zero mean series z_t, which is assumed to follow the SARIMA model.

4.2.4 There are many regressors like, Trend Constant, fixed Seasonal effect, Trading day, Leap Year etc. that can be incorporated to the model. But, most importantly there are built in regression variables to deal with abrupt changes in the level of a series: additive outliers (AOs), level shifts (LSs), temporary changes (TCs), and ramps. AOs affect only one observation in the time series, LSs increase or decrease all observations from a certain time point onward by some constant amount, TCs allow for an abrupt increase or decrease in the level of the series that returns to its previous level exponentially rapidly, and ramps allow for a linear increase or decrease in the level of the series over a specified time interval. These four regressors are interventions to tackle seasonal outliers. This is, indeed, a crucial step to adjust seasonal outliers before the seasonal adjustment process starts.

4.3 Seasonal Adjustment Process

4.3.1 Once the prior adjustment is completed the seasonal adjustment process starts. It is evident that by now, the system has identified a suitable model for the time series, the necessary forecasted and backcasted values (using that fitted model) have been generated and the necessary interventions, if necessary, have been detected and applied.

4.3.2 X-12 ARIMA performs the following algorithm in 3 iterations to derive the seasonal factors. Let us consider a multiplicative model.

(i) Moving average (MA) over Y to get the preliminary estimate of trend component (C) of the time series, say C^

⬇

(ii) Estimate of the S*I = Y/ C^

⬇

(iii) Identify the outliers based on estimate of S*I's .

⬇

(iv) S*I values are modified (weighted average of S*I values are considered to get the adjustment) for outliers. The weight is assigned in accordance with to the extremity of the outliers in the S*I series.

⬇

(v) MA over the modified S* I values = Preliminary Estimate of Seasonal factor(S), say S^

⬇

(vi) Divide Y by S^ to get preliminary seasonally adjusted series , say, $Y^{/}$

⬇

(vii) Improve S^ by repeating (i) – (vi). But all the operations are carried out on $Y^{/}$. This is followed for 2 more iterations.

⬇

(viii) The final seasonally adjusted series is obtained by dividing the **original series Y** by the latest S^.

5. Features of X-12 ARIMA Seasonal Adjustment Process

5.1 X-12 ARIMA provides flexibility over to the transformation (example log transformation) to be used to the data series and the mode (additive/multiplicative) during the prior adjustment process. X-12 ARIMA zeroes down on a particular additive or multiplicative model if it has the lower Akaike's Information Criteria (AIC).

5.2 ***Advantage of forecasting and backcasting:*** Suppose we have data on a time series from April, 2000 to January, 2012. If the series is seasonal, then, the April, 2004 and April, 2006 will have more impact on April, 2005 value. But we do not have the value on April, 2004. Here, X-12 ARIMA backcasts (extends the time series backwards) to get value of April, 2004 and makes the estimate of April, 2005 more sensible based on April, 2004. Similarly, X-12 ARIMA will forecast (extends the time series in forward) for Jan, 2012 to get data for Jan, 2013 and generate reliable estimate of Jan, 2012.The model fitted by the prior adjustment process is used extensively for the purpose of forecasting and backcasting.

5.3 Because of the capability of backcasting and forecasting, X-12 ARIMA is capable of using symmetric moving average. This also makes sure less revision of the earlier seasonal estimates when the actual future series data is available.

5.4 X-12 ARIMA produces a set of diagnostics that can be easily used to identify whether a series is seasonal or not and also the stability of the seasonal estimates.

6. Diagnostics of X-12 ARIMA

6.1 *Tests for adequacy of the fitted model:*

6.1.1 As already has been pointed out, that as part of prior adjustment X-12 ARIMA fits different ARIMA model to the series so that it can be used for forecasting and backcasting. But it is necessary to find if the fitted model is adequate or not. In other words, the fitted model must not have autocorrelation in the residuals of the fitted series.

6.1.2 Autocorrelations for the sample residuals have been used for this. A fitted model has been considered adequate for forecasting and backcasting if all the p-values for the sample autocorrelations up to lag 24 (because of monthly data) are greater than 0.05 (for 5% level of significance).

6.2 ***Tests for checking seasonality:*** It has been already pointed out that IIP is a derived index. It covers 399 different items. So, the study has a major focus on the identification of seasonal items (5 digit NIC). To check whether a series is seasonal or not the following diagnostics measures (as generated by X-12 ARIMA has been used).

6.2.1 Let,

σ_T^2 = Total variance of S*I ratios (differences)

σ_M^2 = Between Months variance to measure the extent of stable seasonality

= Sum of Squares of the difference between the average for each month of SI and the total average, adjusted by correction factor.

σ_Y^2 = Between Years variance to measure the extent of moving seasonality

= Sum of Squares of the difference between the annual average of SI and the total average, adjusted by correction factor.

σ_R^2 = Residual Variance due to irregulars

$= \sigma_T^2 - \sigma_M^2 - \sigma_Y^2$

Now, to test the presence of stable seasonality a F-statistic F_s is constructed using σ_M^2 and σ_R^2 and tested as F-test. To test the presence of moving seasonality another F statistic F_m is constructed using σ_Y^2 and σ_R^2 tested as F-test.

Since, several assumptions regarding F-test may be violated; a non-parametric Kruskal-Wallis test is also conducted to test the presence of stable seasonality.

A series is identified as seasonal only if all the three tests indicate presence of seasonality.

6.2.2 Another diagnostics M7 is constructed as a function of the Fs and F_m. It measures the presence of moving seasonality relative to stable seasonality. If the moving seasonality is too much than compared to stable seasonality, the seasonal adjustment could be effective. Hence those item indices have been seasonally adjusted for which M7 is very small, preferably between 0 and 1. Smaller the M7 better is the seasonal adjustment.

6.2.3 The spectrum of the original series also serves good purpose to detect seasonality. Spectrum graphs of a monthly series tend to have peaks around seasonal frequencies i.e. at 1/12,2/12,3/12 etc. This condition has also been imposed on the item indices for the sake of testing seasonality.

6.3 *Checking of Suitability of Seasonal Adjustment*

6.3.1 Even if a time series is seasonal, the seasonal adjustment may not be appropriate if the residual of the seasonally adjusted series displays presence of seasonality. So, the residuals of all the seasonally adjusted item indices are checked for seasonality using the Spectrum plot (as mentioned in 6.2.3).

6.3.2 Same checking is applied on the higher order derived indices also to detect if there is still residual seasonality after the indirect adjustment.

7. Data Analysis and Major Findings

7.1 ***Data set:*** The 399 item level (5 digit NIC code) production indices for the present IIP series (with base 2004-05) has been used for the paper. All the item level (5 digit NIC code) monthly production indices from April, 2005 to Jan, 2012 have been used.

7.2 ***Why indirect seasonal adjustment:*** As discussed in Section 2.5, generally indirect seasonal adjustment is preferred over the direct adjustment when the component series that make up the aggregate series have distinctively different seasonal pattern. As the item indices exhibit quite different pattern of seasonality, in this paper indirect seasonal adjustment has been attempted. Also, as at each higher (2/3/4 digit NIC or sectoral or general) the index is a weighted average of indices at immediately lower stage and hence may contain seasonal as well as non-seasonal components, direct adjustment at an aggregate level may interfere with the originality of the non-seasonal items, which is undesirable.

7.2.1 *Seasonal items:* For this study, a particular item has been diagnosed as a seasonal item only if all the three tests mentioned in Sections 6.2.1, 6.2.2 and 6.2.3 indicate seasonality. Following this criterion, 148 out of 399 item indices were diagnosed as seasonal. Use-based category-wise and NIC-2 digit-wise total number of items, number and percentage of items exhibiting seasonality along with their corresponding weights are shown in Table 1 and Table 2 respectively.

7.2.2 It can be seen from Table 1 that highest number of seasonal items are from consumer non-durable sector followed by capital goods sector. In percentage term, highest percentage (46.6%) of seasonal items within a use-based category comes from capital goods, closely followed by consumer durable (46.5%) and consumer non-durable items (about 45%). Only 28.4% of the basic goods and 27.4% of intermediate goods are seasonal. Total weight of seasonal items is, however, highest for basic goods (with weight 302.34 i.e. more than 66% of the total weight of this sector) followed by consumer non-durable goods (98.14, i.e. 46% of the total weight of this sector) and capital goods (54.52, i.e. 62% of the total weight of capital goods). Figure 1 shows the seasonal items belonging to different use-based categories.

7.2.3 It is observed from Table 2 that highest number (31) of seasonal items belong to the NIC division 15 i.e. food products and beverages (67% of all items in that division), followed by NIC division 24 i.e. chemical and chemical products (24) and NIC division 29 i.e. machinery and equipment n.e.c. In percentage term, highest percentage of seasonal items within a NIC division (2-digit) is observed in wearing apparel (NIC div. 18), where both the items are seasonal. This is followed by motor vehicles, trailers and semi-trailers (NIC div.34) with 80% (4 out of 5) items from this group being seasonal. No item from the NIC division 16 i.e. tobacco products showed seasonality which is quite obvious. Weight-wise the seasonal items capture more than 78% weight in food products and beverages, 100% of the weight of wearing apparel, 99.8% of the weight of the motor vehicles, trailers and semi-trailers and 80% of the weight of other transport equipment. In total, 146 out of 397 item indices (about 37%) of manufacturing sector with total weight of more than 38% of the weight of manufacturing sector were identified as seasonal.

7.2.4 Apart from this, both the mining and electricity indices were found to be seasonal. Collectively, 37% of the item indices in general IIP exhibited seasonality having combined weight of 533 (out of 1000). the presence of such huge number of seasonal items having more than 50% weight fully justifies compilation of a seasonally adjusted IIP for a better understanding of the trend.

7.2.5 After identifying the item indices having seasonality, the same are seasonally adjusted by using software package X-12 ARIMA, as discussed in earlier sections.

7.3 Index Comparisons

7.3.1 The original (unadjusted) and the seasonally adjusted general IIP are plotted against months for the period April 2005 to January 2012 in Figure 2. Clearly, the the seasonally adjusted IIP is smoothed well. It may be noted that in the original series some regular peaks could be found around March in some years. Those peaks could be attributed to the branching that occur in March due to the closure of financial year. This point also adds to seasonality of the series and after the adjustment it is taken care of.

7.3.2 Comparison of the original (unadjusted) and seasonally adjusted series for manufacturing, mining and electricity sectors are given in Annexure-I. In all these cases, the seasonally adjusted series is a more smoothed one than the corresponding original series, which justifies the seasonal adjustment.

7.4 Growth Rate Comparisons – Year-on-Year (YoY) growth vs. Month on Month (MoM) growth

7.4.1 Growth rates can be computed either year-on-year or month-on-month basis. The YoY growth rate is computed as the percent change with respect to the corresponding month in the previous year (e.g. April 2009 over April 2008), while the MoM growth rate is computed as the percentage change with respect to the preceding month (e.g. April 2009 over March 2009). Hence in a YoY comparison, the seasonality factor gets somewhat nullified as one can expect that under normal circumstances, same seasonal factors would govern the seasonality of say April 2008 and April 2009. The two figures (Figure 3 and Figure 4) show the monthly growth rates observed in the original series and the seasonally adjusted series of general IIP on YoY and MoM basis respectively.

7.4.2 The monthly growth rate on YoY, show more or less the same pattern for the adjusted and unadjusted series, both with respect to direction and magnitude of growth. However, the real improvement in the volatility of the growth rate due to seasonal adjustment can be noticed if we compare the monthly growth rate on Month to Month basis (fig.4). In MoM comparison, the divergence of growth rates from the mean growth rate seems to be much lesser in case of a seasonally adjusted IIP. Hence, in the subsequent part of the paper all the growth rates have been computed on MoM basis so as to highlight the wide divergence in the growth rate in the original and the seasonally adjusted series.

7.4.3 Although the YoY growth rate very crudely adjust some seasonality, it is interesting to compare the YoY growth rate of the original (unadjusted) series with the seasonally adjusted series for the same months, as one adjusts for seasonality in a very crude way and the other adjusts for seasonality in a robust scientific way. The results are given in Annexure-II. It can be seen from this Annexure, that these two growth rates differ significantly for many months not only in magnitude, but also in direction (some such cases are highlighted in the table). This further emphasizes the need to do a proper seasonal adjustment of the IIP series.

7.4.4 The MoM growth rates of the original and adjusted series have been compiled for all the NIC 2-digit divisions, for all the three sectors (mining, manufacturing, electricity) as also for all the use-based categories. Such comparison of growth rates for the use-based categories are given in Annexure-III, while that for the sectoral indices are given in Annexure-IV and for selected 2-digit industries (where either the weight of seasonal items is more or the percentage of seasonal item is more or both) is given in Annexure-V. In all these Annexures, there are a number of cases where there exists a significant difference in the growth rates of the two series, some of which cases have been highlighted.

7.4.5 It may be observed from Annexure-III, that among the use-based categories most significant change in the MoM growth rate is observed in capital goods, which has often been criticized for its erratic behavior. The seasonally adjusted series of capital goods show a much less volatile growth as against its unadjusted counterpart. One important observation is made in case of capital goods – Almost for all the years the MoM growth for the month of March in the original series shoots up and then declines sharply in the month of April, which indicates presence of a marked seasonality in the March index. The seasonally adjusted series of capital goods, on the other hand, shows a much less growth (decline) figure for the same months of the corresponding year. Table 3 highlights this observation.

7.4.6 For all other use-based categories except for intermediate goods, the seasonal adjustment results in a much stable growth in comparison to the unadjusted series. Only in case of intermediate goods, the seasonally adjusted and unadjusted series reveal a similar kind of growth in magnitude and direction in most of the cases, which is probably because of lesser number of seasonal items in this category (only 27% of the intermediate goods were found to be seasonal). The seasonal adjustment seems to improve the consumer non-durable index to a large extent. This is consistent with the fact that we have already pointed, that most of seasonal items come from this category only.

7.4.7 In case of sectoral indices again (see Annexure-IV), the seasonally adjusted series significantly reduces the volatility in growth rate in comparison to the original series. Among the sectoral indices, the mining index exhibits a typical 'March syndrome' as manifested by the capital goods, but in a relatively smaller magnitude.

7.4.8 In case of NIC 2-digit divisions, a distinct pattern of seasonality is observed for NIC-2 digit divisions 15 (Food Products and beverages) and 18 (Wearing apparel). In case of NIC division 15, there is a peak in the months of November and December every year in the original (unadjusted) series which may be due to increased sugar production around that time in the year. Total weight of sugar is more than 21% of the total weight of the entire NIC division 15 and hence seasonality in sugar production significantly contributes to the seasonal fluctuation of the entire food industry, which is also clear from the M-O-M growth rates of these months for seasonally adjusted and unadjusted series. In case of NIC division 18, a peak is observed in the month of December. The main reason for this is probably the seasonality in production of leather garments and also woolen garments, which are produced in huge volume in the winter as the two items under this NIC division (18) are 'Apparel' and 'Leather garments' with the later having about 27% of the weight of the entire NIC-2 digit division 18. Both these items show marked seasonality.

7.4.9 In general it may be seen that the seasonally adjusted series is well smoothed for divisions 15, 18, 19, 20, 24, 25, 26, 28, 29, 30, 33, 34 and 35.Volatility in MoM growth rate also gets reduced for all these divisions. The reduction in fluctuation in growth is most profound in NIC division 15 i.e. food products and beverages, which, quite expectedly, has maximum number of seasonal items (seasonal items in this division account for more than 78% weight of the total weight for the entire division). The indices and the growth rate in NIC 15 are given in Figure 5.1 and Figure 5.2.

7.4.10 As already mentioned, the NIC division 16 contains the tobacco products viz. biri, cigarette, panmasala, gutka, zarda etc, which are non-seasonal in nature and hence no seasonal adjustment has been done on this group.

7.4.11 However, it seems that for certain NIC divisions like NIC-17, 21, 22, 23, 27, 31, 32 and 36 the seasonal adjustment does not produce a very significant improvement in reducing the fluctuation in growth rate. However, for most of these divisions also, the growth rate observed in the adjusted series is more stable than the original series. The reason is, however, understandable. NIC divisions 17, 21, 22 and 36 respectively contain only 2, 1, 1 and 1 seasonal items. For NIC divisions 23 and 32, total weight of the seasonal items are 7.6 and 5.5 respectively (with respect to total weight of 1000). For NIC-27 out of 30 items, 21 are non-seasonal basic items.

7.5 Appropriateness of Seasonal Adjustment

7.5.1 It has been already pointed that a seasonal adjustment process will be incomplete and unstable if it does not remove residual seasonality from the adjusted series. Hence, every seasonally adjusted series must be tested for presence of residual seasonality. As mentioned earlier, the spectrum function of the adjusted series has been observed to detect if there are any peaks at the major seasonal frequencies at (1/12), (2/12), (3/12) etc.

7.5.2 The seasonally adjusted index for IIP does not show any indication of seasonality. The seasonally adjusted indices for Basic Goods, Capital Goods, Consumer–Durable Goods and Consumer Non-durable Goods also do not show any indication of seasonality. This means the indirect adjustment works fine for these categories. However, very interesting result is obtained in case of intermediate goods. The seasonally adjusted series for intermediate goods, quite surprisingly, exhibits presence of seasonality. The indirect method of seasonal adjustment does not seem to work fine in case of intermediate goods.

7.5.3 It has been pointed out earlier that, while testing for individual item indices of intermediate categories for seasonality, smaller number of items tested to be seasonal. It may be noted that this test for seasonality is a bit stringent one in the sense that the test has to pass 3 tests [2 (1 parametric and 1 non-parametric) for presence of stable seasonality and 1(parametric) test for presence of moving seasonality]. May be, for intermediate goods the test could be little relaxed such that one could take an intermediate item as seasonal if the particular test accepts at least one form of seasonality- moving or stable. Alternatively, one can think of applying direct seasonal adjustment to intermediate goods.

8. Concluding Remarks

8.1 Seasonality is an important aspect in any high frequency economic data and IIP is no exception. Presence of seasonality often masks the short and long term movements of the series, which, in turn, hampers the proper analysis of the series. Seasonal adjustment of IIP is thus a necessity for proper study of the series. In the IIP in India, 148 out of 399 item indices exhibit seasonality. NIC-2 digit-wise, Sector-wise and Use-based category-wise series of seasonally adjusted IIP in most cases present a more stable series with much less volatility in growth rate in comparison to the original series. This is more profiund in case of capital goods and consumer durable goods among the use-based category and food and beverages and automobile industries among others in the NIC division level. The results strongly recommend for seasonal adjustment of IIP in India which would help a host of stake holders to have a better understanding of the series and would also help in reducing the increasing doubt about its quality.

References

Pindyck Robert S. and Rubinfeld Daniel L. (1991), Econometric Models and Economic Forecasts, McGraw-Hill Publications.

Chatfield C. (1995), The Analysis of Time Series: An Introduction, CHAPMAN & HALL/ CRC Publications.

George E.P. Box, Jenkins G.M. and Reinsel G.C. (2006), Time Series Analysis: Forecasting and Control (Fourth Edition), Wiley Series Publication in Probability and Statistics.

X-12-ARIMA Reference Manual Version 0.3 (2009),Time Series Research Statistical Research Division, U.S. Census Bureau, Washington.

Catherine C. Hood and Brian C. Monsell (2002), Getting Started with X-12-ARIMA Input Files on Your PC- DRAFT, U.S. Census Bureau, Washington.

Table 1: Use-based category-wise total number of items, number and percentage of items exhibiting seasonality along with their corresponding weights

Use-based category	Total No. of items	Weight of all items	No. of seasonal items	Weight of seasonal items	% of seasonal items	% of weight belonging to the seasonal items
Basic Goods	88	456.82	25	302.34	28.41	66.18
Capital Gods	73	88.25	34	54.52	46.58	61.78
Intermediate Goods	106	156.86	29	31.39	27.36	20.01
Consumer Durable Goods	43	84.60	20	46.56	46.51	55.04
Consumer Non-durable Goods	89	213.47	40	98.14	44.94	45.97
All	399	1000.00	148	532.95	37.09	53.30

Table 2: NIC-2-digit-wise total number of items, number and percentage of items exhibiting seasonality along with their corresponding weights

NIC-04	Industry Description	Total No. of items	Weight of all items	No. of seasonal items	Weight of seasonal items	% of seasonal items	% of weight belonging to the seasonal items
15	Food products and beverages	46	72.76	31	56.95	67.39	78.27
16	Tobacco products	5	15.70	0	0.00	0.00	0.00
17	Textiles	23	61.64	2	2.73	8.70	4.42
18	Wearing apparel; dressing and dyeing of fur	2	27.82	2	27.82	100.00	100.00
19	Tanning and dressing of leather luggages, handbags etc.	6	5.82	2	2.79	33.33	48.00
20	Wood and products of wood & cork except furniture;	4	10.51	1	5.11	25.00	48.58
21	Paper and paper products	8	9.99	1	0.90	12.50	9.01
22	Publishing, printing & reproduction of recorded media	2	10.78	1	0.70	50.00	6.47
23	Coke, refined petroleum products & nuclear fuel	16	67.15	5	7.61	31.25	11.34
24	Chemicals & chemical products	89	100.59	24	26.61	26.97	26.45
25	Rubber and plastics products	25	20.25	9	7.54	36.00	37.23
26	Other non-metallic mineral products	14	43.14	2	24.96	14.29	57.86
27	Basic metals	30	113.35	7	16.66	23.33	14.70

Table 2: NIC-2-digit-wise total number of items, number and percentage of items exhibiting seasonality along with their corresponding weights (Contd.)

NIC-04	Industry Description	Total No. of items	Weight of all items	No. of seasonal items	Weight of seasonal items	% of seasonal items	% of weight belonging to the seasonal items
28	Fabricated metal products, except machinery and equipment	13	30.85	8	13.59	61.54	44.06
29	Machinery and equipment n.e.c.	42	37.63	23	21.41	54.76	56.91
30	Office, accounting and computing machinery	4	3.05	1	2.33	25.00	76.37
31	Electrical machinery and apparatus n.e.c.	27	19.80	10	6.77	37.04	34.19
32	Radio, TV and communication equipment & apparatus	8	9.89	3	5.48	37.50	55.35
33	Medical, precision and optical instruments, watches & clocks	10	5.67	2	0.77	20.00	13.63
34	Motor vehicles, trailers and semi-trailers	5	40.64	4	40.56	80.00	99.80
35	Other transport equipment	12	18.25	7	14.64	58.33	80.21
36	Furniture; manufacturing n.e.c.	6	29.97	1	2.35	16.67	7.85
Total	**Manufacturing**	**397**	**755.27**	**146**	**288.28**	**36.78**	**38.17**

Table 3: Table highlighting the wide difference in growth rates for capital goods in the original and seasonally adjusted series in the months of March and April.

Year	Growth rate in original series of capital goods in the months of (March, April)	Growth rate in seasonally adjusted series of capital goods in the months of (March, April)
2006	(32.3, -33.2)	(10.0, -6.5)
2007	(28.2, -32.7)	(7.1, -7.0)
2008	(25.2, -25.5)	(9.7, -5.3)
2009	(27.8, -20.5)	(6.5, 6.4)
2010	(36.3, -27.5)	(9.0, -2.1)
2011	(65.5, -32.5)	(30.2, -7.7)

Figure 1:Pie Chart of Seasonal Items belonging to differdnt Use Based Categories.

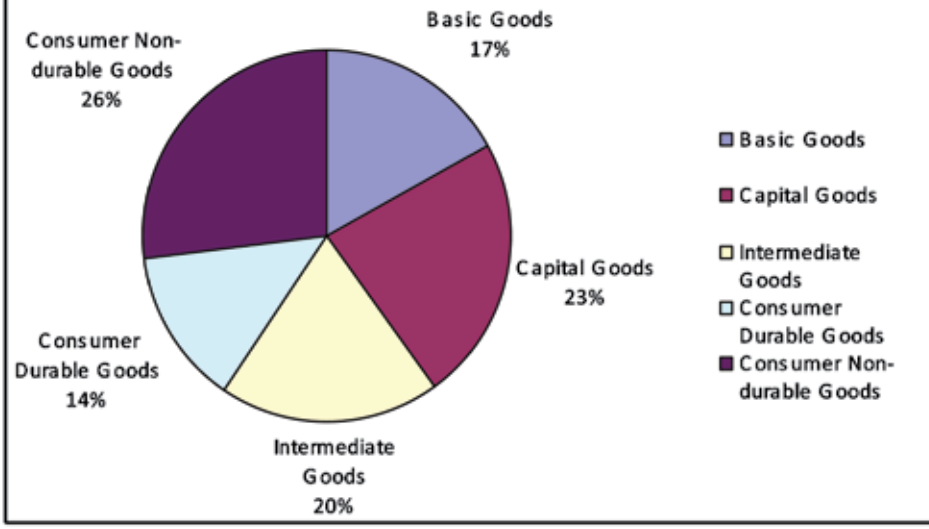
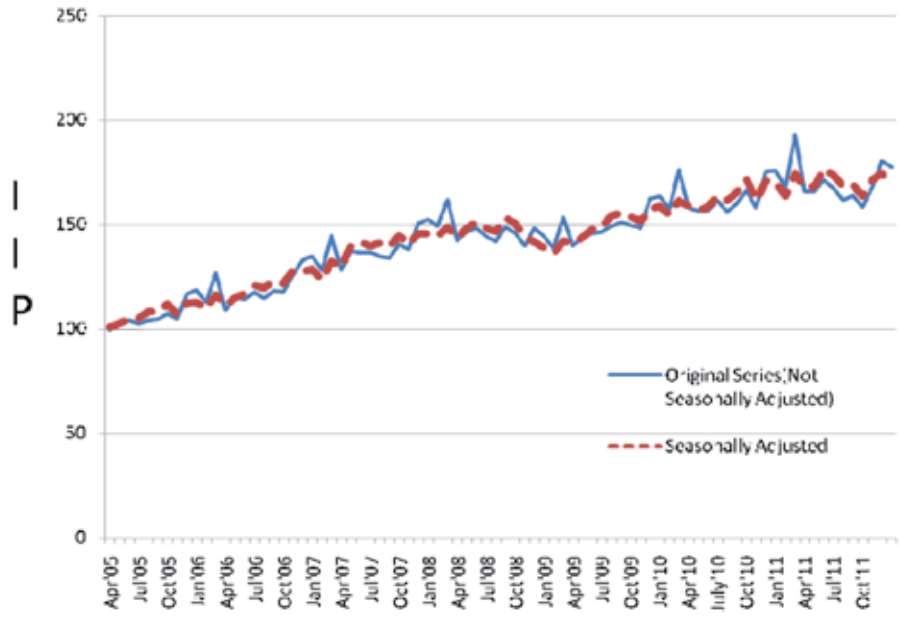


Fig 2: Comparison of General Index



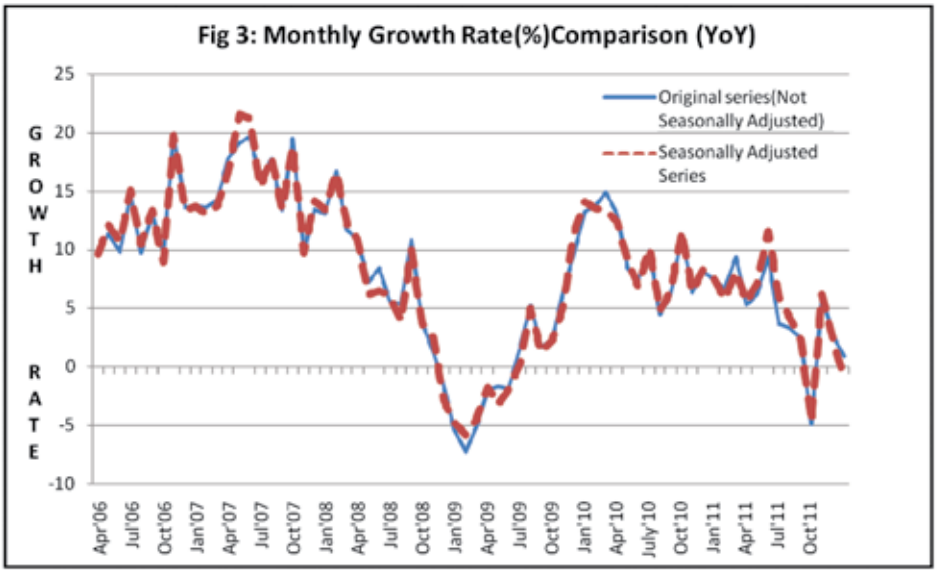


Fig 3: Monthly Growth Rate(%)Comparison (YoY)
GROWTH RATE
25
20
15
10
5
0
-5
-10
Original series(Not Seasonally Adjusted)
Seasonally Adjusted Series
Apr'06
Jul'06
Oct'06
Jan'07
Apr'07
Jul'07
Oct'07
Jan'08
Apr'08
Jul'08
Oct'08
Jan'09
Apr'09
Jul'09
Oct'09
Jan'10
Apr'10
July'10
Oct'10
Jan'11
Apr'11
Jul'11
Oct'11

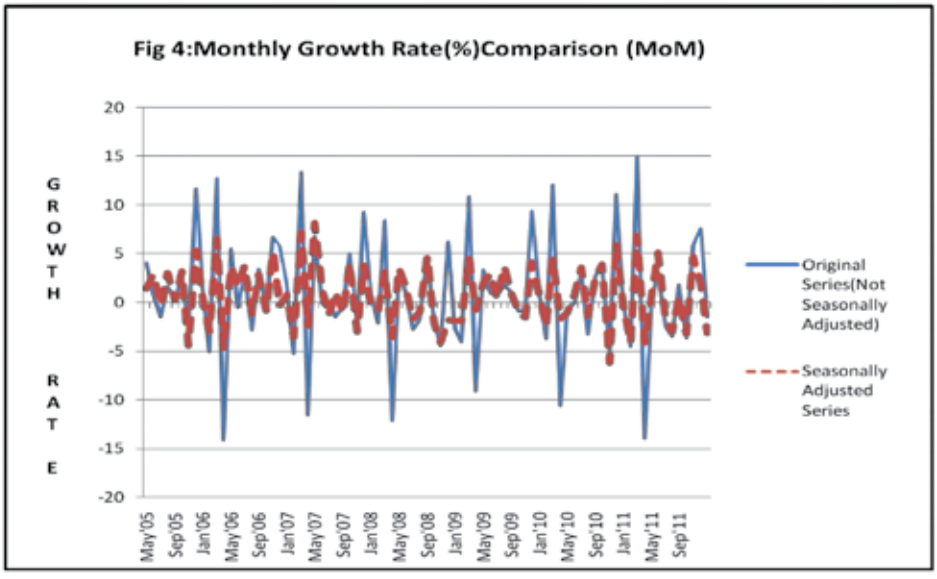


Fig 4:Monthly Growth Rate(%)Comparison (MoM)
GROWTH RATE
20
15
10
5
0
-5
-10
-15
-20
Original Series(Not Seasonally Adjusted)
Seasonally Adjusted Series
May'05
Sep'05
Jan'06
May'06
Sep'06
Jan'07
May'07
Sep'07
Jan'08
May'08
Sep'08
Jan'09
May'09
Sep'09
Jan'10
May'10
Sep'10
Jan'11
May'11
Sep'11

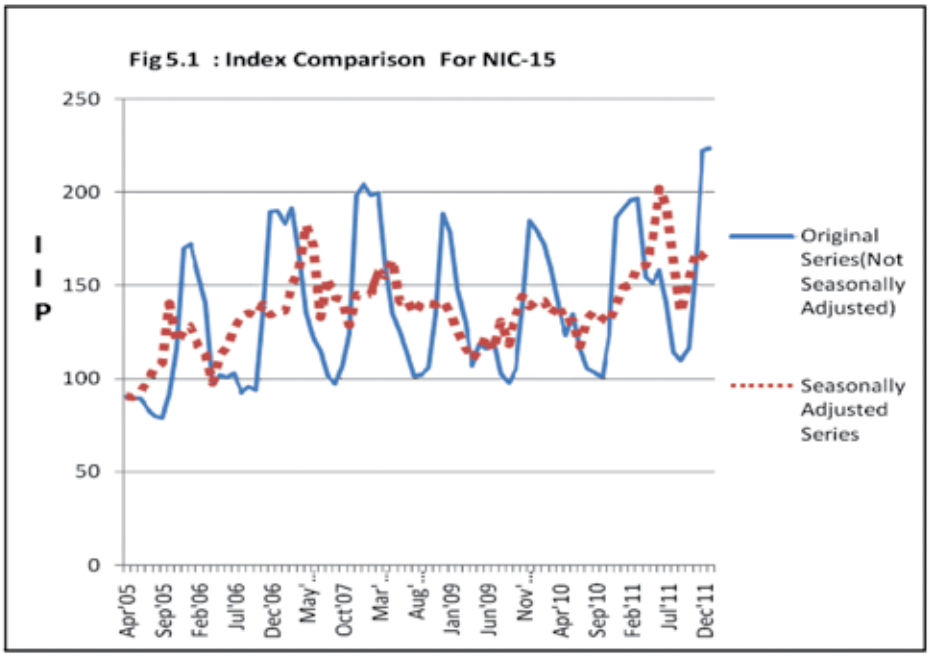


Fig 5.1 : Index Comparison For NIC-15
IIP
250
200
150
100
50
0
Apr'05
Sep'05
Feb'06
Jul'06
Dec'06
May'...
Oct'07
Mar'...
Aug'...
Jan'09
Jun'09
Nov'...
Apr'10
Sep'10
Feb'11
Jul'11
Dec'11
Original Series(Not Seasonally Adjusted)
Seasonally Adjusted Series

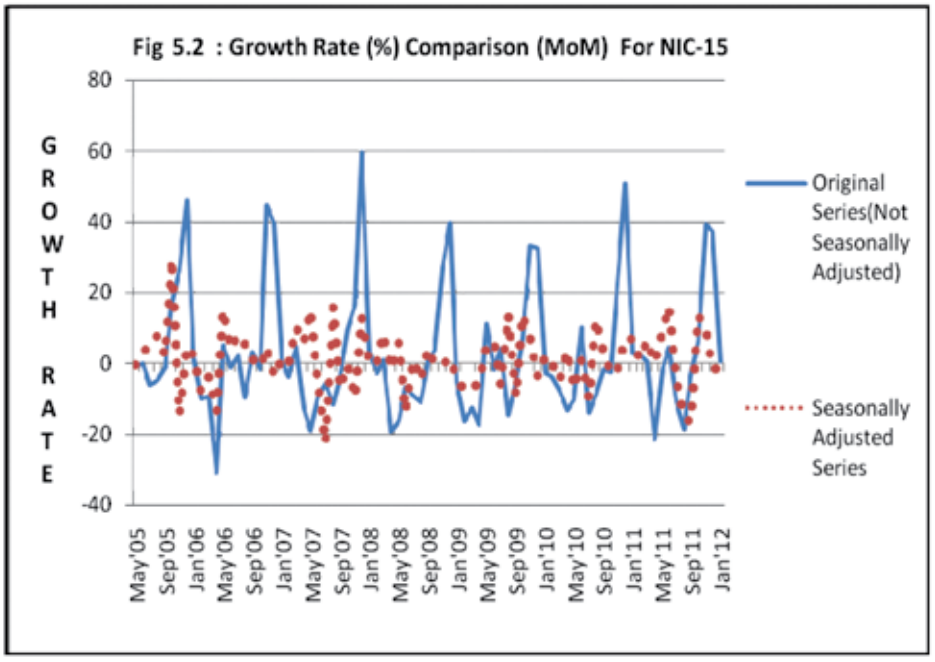
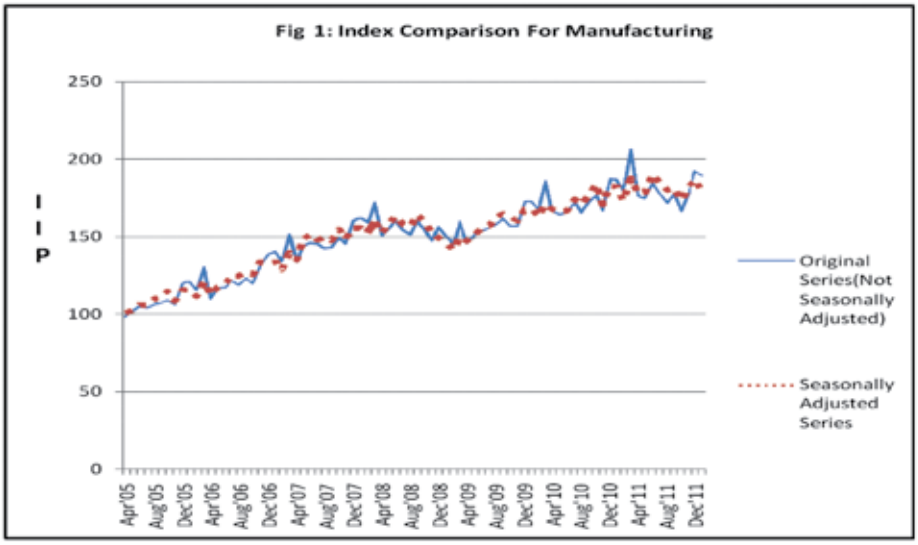
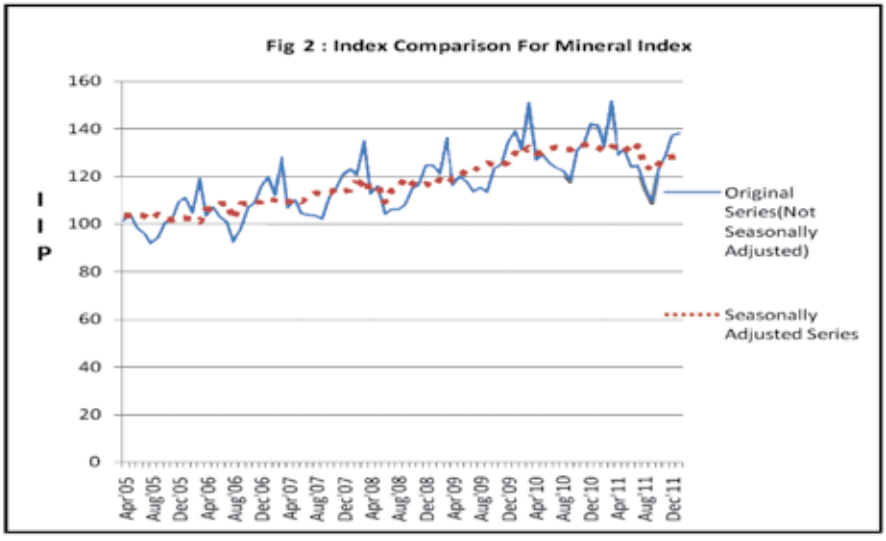


Fig 5.2 : Growth Rate (%) Comparison (MoM) For NIC-15
GROWTH RATE
80
60
40
20
0
-20
-40
May'05
Sep'05
Jan'06
May'06
Sep'06
Jan'07
May'07
Sep'07
Jan'08
May'08
Sep'08
Jan'09
May'09
Sep'09
Jan'10
May'10
Sep'10
Jan'11
May'11
Sep'11
Jan'12
Original Series(Not Seasonally Adjusted)
Seasonally Adjusted Series

Annexure – I

Comparison of Indices between original (unadjusted) and seasonally adjusted series of IIP





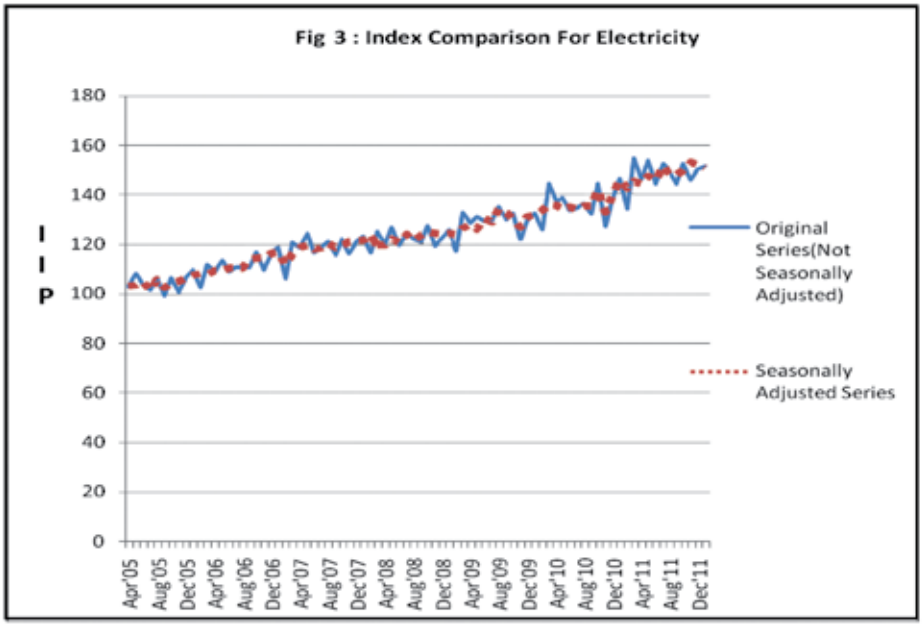


Fig 3 : Index Comparison For Electricity
IIP
180
160
140
120
100
80
60
40
20
0
Apr'05
Aug'05
Dec'05
Apr'06
Aug'06
Dec'06
Apr'07
Aug'07
Dec'07
Apr'08
Aug'08
Dec'08
Apr'09
Aug'09
Dec'09
Apr'10
Aug'10
Dec'10
Apr'11
Aug'11
Dec'11
Original Series(Not Seasonally Adjusted)
Seasonally Adjusted Series

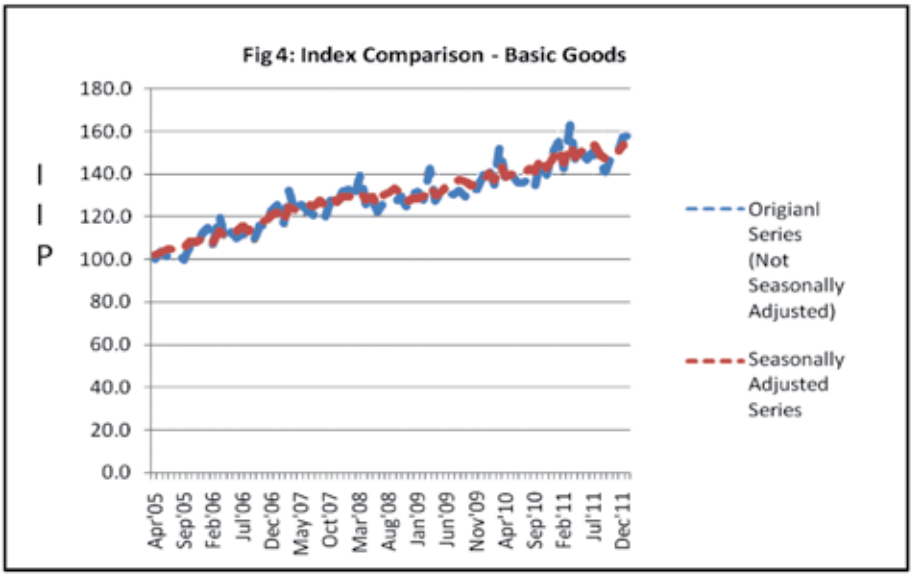


Fig 4: Index Comparison - Basic Goods
IIP
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Apr'05
Sep'05
Feb'06
Jul'06
Dec'06
May'07
Oct'07
Mar'08
Aug'08
Jan'09
Jun'09
Nov'09
Apr'10
Sep'10
Feb'11
Jul'11
Dec'11
Origianl Series (Not Seasonally Adjusted)
Seasonally Adjusted Series

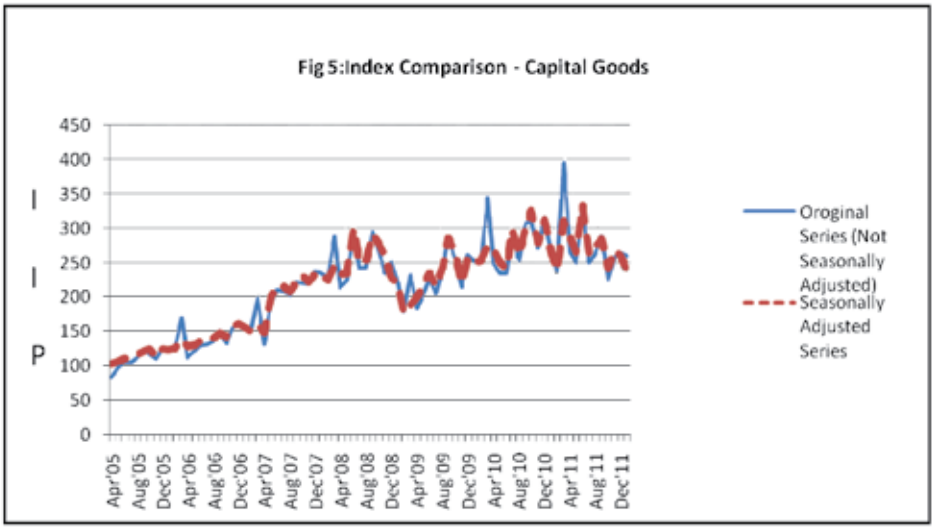


Fig 5:Index Comparison - Capital Goods
IIP
450
400
350
300
250
200
150
100
50
0
Apr'05
Aug'05
Dec'05
Apr'06
Aug'06
Dec'06
Apr'07
Aug'07
Dec'07
Apr'08
Aug'08
Dec'08
Apr'09
Aug'09
Dec'09
Apr'10
Aug'10
Dec'10
Apr'11
Aug'11
Dec'11
Oroginal Series (Not Seasonally Adjusted)
Seasonally Adjusted Series

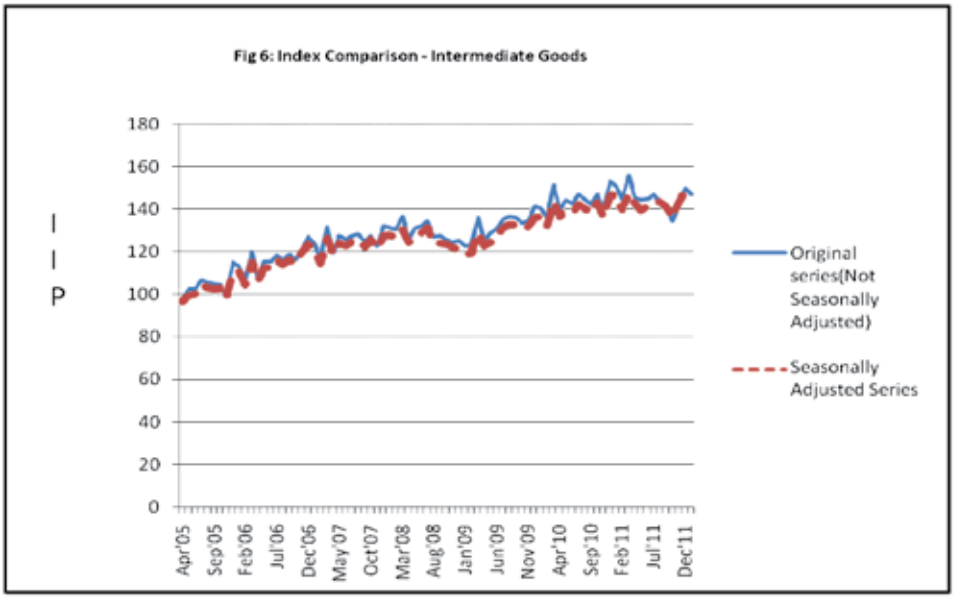


Fig 6: Index Comparison - Intermediate Goods
IIP
180
160
140
120
100
80
60
40
20
0
Apr'05
Sep'05
Feb'06
Jul'06
Dec'06
May'07
Oct'07
Mar'08
Aug'08
Jan'09
Jun'09
Nov'09
Apr'10
Sep'10
Feb'11
Jul'11
Dec'11
Original series(Not Seasonally Adjusted)
Seasonally Adjusted Series

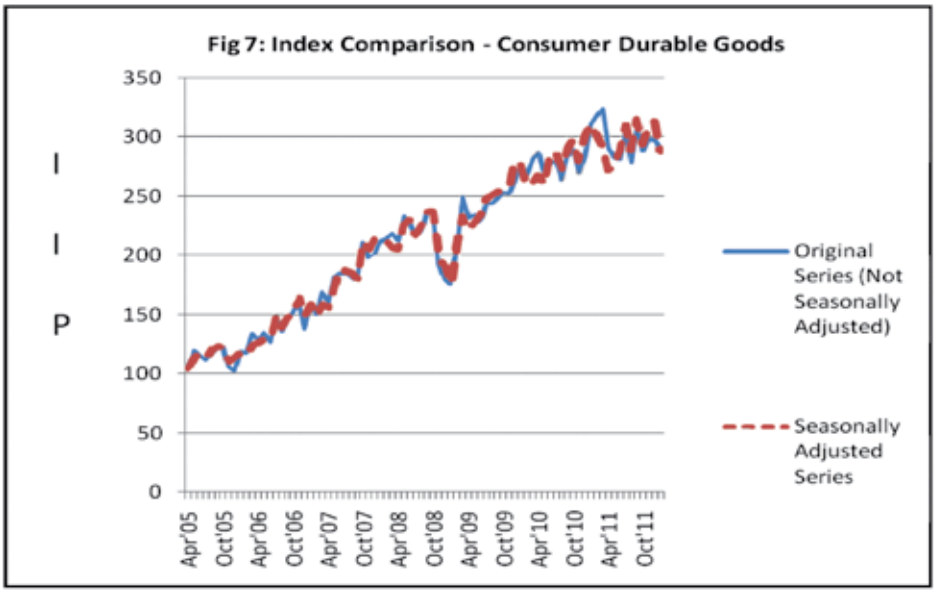


Fig 7: Index Comparison - Consumer Durable Goods
IIP
350
300
250
200
150
100
50
0
Apr'05
Oct'05
Apr'06
Oct'06
Apr'07
Oct'07
Apr'08
Oct'08
Apr'09
Oct'09
Apr'10
Oct'10
Apr'11
Oct'11
Original Series (Not Seasonally Adjusted)
Seasonally Adjusted Series

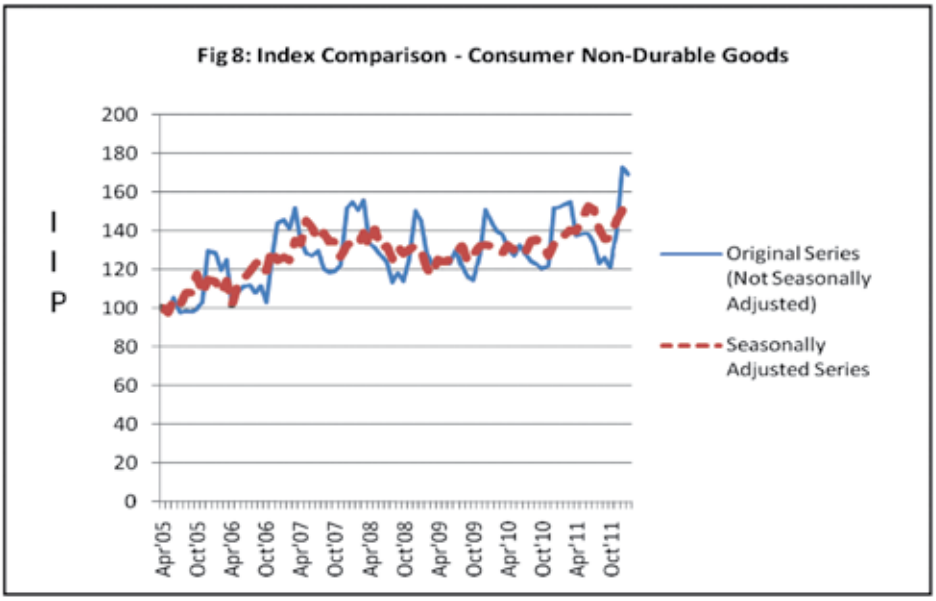


Fig 8: Index Comparison - Consumer Non-Durable Goods
IIP
200
180
160
140
120
100
80
60
40
20
0
Apr'05
Oct'05
Apr'06
Oct'06
Apr'07
Oct'07
Apr'08
Oct'08
Apr'09
Oct'09
Apr'10
Oct'10
Apr'11
Oct'11
Original Series (Not Seasonally Adjusted)
Seasonally Adjusted Series

Annexure – II

Month	YoY Growth rate observed in the Original series of IIP	MoM Growth rate observed in the Seasonally Adjusted series of IIP
Apr'06	9.85	-4.77
May'06	11.39	3.61
Jun'06	9.86	1.55
Jul'06	14.80	3.69
Aug'06	9.76	-1.16
Sep'06	13.18	2.78
Oct'06	9.65	-0.90
Nov'06	19.97	5.08
Dec'06	13.65	-0.37
Jan'07	13.84	0.71
Feb'07	13.69	-3.60
Mar'07	14.33	7.06
Apr'07	17.79	-2.44
May'07	19.19	8.09
Jun'07	19.72	1.29
Jul'07	16.19	-1.33
Aug'07	17.80	0.99
Sep'07	13.37	-1.12
Oct'07	19.58	3.90
Nov'07	9.87	-3.02
Dec'07	13.53	3.66
Jan'08	13.10	0.02
Feb'08	16.83	-0.91
Mar'08	11.74	3.07
Apr'08	11.02	-3.58
May'08	7.22	3.45
Jun'08	8.51	1.59
Jul'08	5.60	-1.74
Aug'08	5.40	-1.03
Sep'08	10.90	4.63
Oct'08	3.87	-2.02
Nov'08	1.25	-4.13
Dec'08	-1.62	-1.82
Jan'09	-5.34	-1.88
Feb'09	-7.24	-2.02

Month	YoY Growth rate observed in the Original series of IIP	MoM Growth rate observed in the Seasonally Adjusted series of IIP
Mar'09	-5.16	4.53
Apr'09	-1.92	-0.85
May'09	-1.69	1.95
Jun'09	-1.78	2.90
Jul'09	1.68	0.45
Aug'09	5.33	3.60
Sep'09	1.63	0.95
Oct'09	2.38	-0.99
Nov'09	6.33	-1.61
Dec'09	9.50	4.03
Jan'10	13.33	0.63
Feb'10	13.73	-2.49
Mar'10	14.94	4.40
Apr'10	13.08	-1.72
May'10	8.51	-1.07
June'10	7.42	0.84
July'10	9.94	3.50
Aug'10	4.47	-1.45
Sep'10	6.15	2.51
Oct'10	11.33	3.88
Nov'10	6.40	-6.21
Dec'10	8.14	5.90
Jan'11	7.51	-0.08
Feb'11	6.65	-4.11
Mar'11	9.42	6.76
Apr'11	5.29	-4.13
May'11	6.17	0.50
Jun'11	9.48	5.01
Jul'11	3.66	-1.75
Aug'11	3.40	-3.01
Sep'11	2.50	0.53
Oct'11	-4.92	-3.25
Nov'11	6.08	4.55
Dec'11	2.68	1.93
Jan'12	0.97	-3.14

Annexure – III

Month	Basic Goods		Capital Goods		Intermediate		Consumer Durable		Consumer Non-Durable	
	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed
May'05	3.2	1.1	16.8	2.6	4.6	2.6	11.4	9.1	-2.1	-2.6
Jun'05	-2.0	1.1	6.2	3.6	0.1	1.0	-3.7	3.0	7.7	7.3
Jul'05	-0.8	0.0	0.8	1.5	4.1	3.9	-2.9	-3.2	-7.1	-3.1
Aug'05	1.2	2.1	6.1	4.6	-0.9	-1.2	5.4	5.9	0.9	6.3
Sep'05	-1.9	-0.9	10.5	4.5	-0.8	-0.6	3.7	2.5	-0.5	-0.2
Oct'05	6.9	2.3	-5.4	2.1	-0.2	0.3	0.7	-1.3	1.5	9.3
Nov'05	-1.2	-0.3	-6.0	-8.9	-4.9	-4.4	-14.0	-9.1	3.6	-8.8
Dec'05	6.2	1.8	14.7	9.1	15.1	12.5	-2.8	2.9	25.6	6.8
Jan'06	1.9	0.9	-1.4	-0.5	-1.2	-0.3	15.2	3.7	-0.9	-0.9
Feb'06	-6.3	-2.5	1.8	1.8	-5.6	-5.4	-0.7	-1.4	-6.9	-5.1
Mar'06	12.4	4.6	32.3	10.0	12.0	9.9	13.9	6.7	4.5	5.8
Apr'06	-9.5	-2.0	-33.2	-6.5	-10.7	-7.3	-4.1	1.5	-19.4	-10.6
May'06	3.2	1.3	9.1	0.6	7.8	5.4	4.9	2.1	7.6	10.0
Jun'06	-2.3	0.7	6.3	5.3	0.0	0.6	-5.7	0.5	2.3	2.8
Jul'06	1.7	2.4	0.6	1.3	2.7	2.8	16.5	15.4	1.0	3.1
Aug'06	-3.2	-2.3	3.6	1.2	-1.8	-1.8	-7.8	-7.1	-3.5	3.4
Sep'06	1.5	2.4	9.7	4.4	1.9	2.0	7.8	6.2	3.3	1.7
Oct'06	5.4	1.0	-11.1	-2.8	-1.9	-1.4	3.0	2.0	-7.4	-4.8
Nov'06	-0.1	1.0	16.0	10.2	3.6	4.3	5.3	9.4	21.2	9.6
Dec'06	6.3	2.1	5.6	2.1	5.4	3.2	-13.6	-9.2	14.9	-4.4
Jan'07	1.8	0.8	-3.5	-2.6	-2.4	-1.6	14.9	6.0	1.1	1.5
Feb'07	-6.8	-3.3	-2.3	-4.2	-5.8	-5.6	-5.0	-5.8	-3.3	-1.4
Mar'07	13.2	5.8	28.2	7.1	12.7	10.2	12.3	6.4	7.7	7.8
Apr'07	-8.0	-1.0	-32.7	-7.0	-9.0	-5.7	-5.0	-1.8	-11.1	-1.1
May'07	3.3	1.9	44.4	34.6	6.2	4.2	13.0	12.0	-4.6	8.8
Jun'07	-2.5	0.3	9.7	7.0	-1.3	-0.9	2.0	7.6	-1.3	-1.8
Jul'07	-1.5	-1.1	-0.5	0.7	1.5	1.4	0.1	-0.3	2.0	-5.3
Aug'07	1.5	2.1	-3.8	-4.0	0.8	1.0	-1.9	-1.2	-7.2	3.3
Sep'07	-2.4	-1.2	10.2	5.8	-2.8	-2.9	-1.3	-2.5	-1.3	-3.4
Oct'07	6.5	2.3	-0.8	5.0	2.2	2.7	17.9	17.3	0.7	0.0
Nov'07	-2.3	-1.3	-0.5	-3.8	-3.7	-3.4	-6.2	-3.0	1.9	-5.8
Dec'07	5.7	1.8	7.9	5.5	7.5	5.0	1.5	4.5	24.5	4.8
Jan'08	0.9	-0.1	-0.9	-0.3	-0.7	0.4	5.6	-0.9	2.0	0.8
Feb'08	-3.1	0.4	-2.3	-4.2	-0.7	-1.1	1.0	-0.8	-2.6	-1.1
Mar'08	8.5	1.5	25.2	9.7	4.7	3.0	2.1	-2.4	3.6	5.1
Apr'08	-9.5	-2.9	-25.5	-5.3	-7.9	-4.6	-2.9	-0.3	-14.5	-4.9
May'08	2.6	1.4	5.0	0.8	4.2	2.1	9.5	9.9	-1.8	6.6
Jun'08	-5.6	-2.9	31.2	27.3	0.8	1.5	-2.7	1.8	-3.2	-7.2
Jul'08	3.1	3.4	-17.9	-15.7	1.8	1.9	-4.5	-5.7	-2.5	0.9
Aug'08	0.4	0.8	0.5	-1.0	-5.4	-5.1	2.8	3.4	-8.1	-4.8
Sep'08	0.2	1.6	21.0	16.4	0.2	-0.4	5.8	5.2	4.0	4.9

Contd.

Month	Basic Goods		Capital Goods		Intermediate		Consumer Durable		Consumer Non-Durable	
	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed
Oct'08	2.0	-1.8	-9.9	-4.7	-1.3	-0.5	0.5	0.2	-3.3	-2.7
Nov'08	-3.6	-2.8	-11.7	-6.2	-1.2	-0.8	-18.3	-16.3	9.3	1.4
Dec'08	5.0	1.0	6.5	-12.3	0.9	-1.5	-6.8	-4.0	20.3	2.1
Jan'09	1.0	0.2	-12.0	-3.9	-2.1	-1.3	-2.3	-7.3	-3.4	-2.0
Feb'09	-3.0	0.8	-17.7	-19.1	0.3	0.2	18.6	15.7	-11.2	-7.1
Mar'09	10.9	3.4	27.8	6.5	10.5	7.9	19.6	14.3	-4.4	-3.1
Apr'09	-10.1	-3.2	-20.5	6.4	-8.4	-4.8	-6.8	-4.8	0.0	6.6
May'09	3.1	1.5	10.3	7.0	3.4	1.6	1.1	2.4	1.3	-0.6
Jun'09	-0.4	2.3	11.8	9.2	1.8	1.9	-2.5	2.6	-1.0	0.8
Jul'09	-0.5	0.0	-9.5	-7.7	3.1	3.4	6.4	6.3	4.9	1.2
Aug'09	1.5	2.0	17.5	12.8	1.0	1.0	0.1	1.3	-5.7	4.5
Sep'09	-2.3	-0.8	19.0	17.0	-0.5	-0.1	1.7	0.9	-5.0	-6.4
Oct'09	3.0	-1.1	-11.5	-6.7	-1.8	-1.2	2.1	1.6	-1.1	2.9
Nov'09	-0.7	0.2	-15.2	-16.9	0.6	0.6	-0.6	0.8	11.1	3.9
Dec'09	4.7	0.9	21.5	16.5	5.0	3.1	4.6	7.4	18.2	0.4
Jan'10	3.8	3.0	-4.0	-3.0	-0.6	0.4	5.0	-0.3	-3.6	-0.7
Feb'10	-5.8	-2.2	0.4	1.3	-3.1	-3.4	-2.9	-6.6	-3.5	-1.9
Mar'10	12.7	5.2	36.3	9.0	11.1	8.6	4.8	0.5	-1.2	-1.0
Apr'10	-10.7	-4.2	-27.5	-2.1	-7.6	-4.7	1.7	2.6	-5.0	3.5
May'10	2.6	1.3	-5.7	-7.3	3.2	1.8	-6.0	-2.7	-3.3	-1.9
June'10	-2.6	-0.2	0.1	-3.6	-1.1	-0.4	3.1	9.4	4.5	0.8
July'10	0.2	0.4	22.8	23.6	3.1	2.8	0.7	0.8	-3.3	-1.9
Aug'10	0.9	1.5	-12.6	-12.2	-1.5	-1.4	-5.7	-4.6	-3.1	4.7
Sep'10	-2.6	-0.8	21.9	14.9	-1.7	-1.4	7.4	5.9	-1.2	0.3
Oct'10	9.2	4.9	-0.1	8.0	3.0	3.6	2.2	2.5	-1.9	-0.6
Nov'10	-4.5	-3.7	-12.0	-14.6	-4.4	-5.0	-6.7	-5.8	1.1	-5.2
Dec'10	6.8	3.2	16.2	12.2	8.9	7.5	5.1	6.9	24.4	4.5
Jan'11	3.6	2.9	-15.9	-14.7	-1.2	0.0	9.6	3.7	0.6	3.4
Feb'11	-7.7	-4.3	-10.2	-10.4	-4.1	-4.2	2.1	-2.7	0.8	0.1
Mar'11	13.7	6.0	65.5	30.2	7.7	5.0	1.9	-3.1	0.8	1.8
Apr'11	-10.1	-3.7	-32.5	-7.7	-6.9	-3.0	-10.1	-7.0	-11.2	-0.3
May'11	2.9	1.8	-6.1	-7.1	-0.5	-2.3	-2.7	2.0	0.8	5.0
Jun'11	-2.3	0.1	30.8	25.0	0.3	1.3	-0.3	4.1	0.0	4.0
Jul'11	2.2	2.2	-23.6	-21.4	1.5	1.3	8.1	7.2	-3.5	-1.2
Aug'11	-3.0	-3.3	5.3	4.1	-2.5	0.4	-8.7	-6.7	-7.6	-6.8
Sep'11	-3.1	-1.3	9.6	4.0	-2.0	-1.7	10.9	8.9	2.2	-3.3
Oct'11	5.1	0.9	-21.4	-14.5	-4.2	-3.6	-6.6	-6.8	-4.0	0.3
Nov'11	0.5	1.4	14.2	10.6	5.7	5.2	3.4	4.9	15.6	6.7
Dec'11	5.6	2.2	2.0	-2.8	5.4	4.1	-0.1	1.7	23.4	3.6
Jan'12	0.3	-0.6	-1.2	-8.3	-2.0	-1.5	-3.0	-7.9	-2.0	-2.2

Annexure – IV

Month	Manufacturing		Mining		Electricity		General IIP	
	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted
May'05	4.2	1.8	2.4	-0.3	5.0	0.6	4.0	1.4
Jun'05	2.6	3.5	-5.0	0.1	-3.8	1.4	0.9	2.8
Jul'05	-1.1	0.2	-2.7	-0.1	-2.3	-3.5	-1.5	-0.3
Aug'05	2.2	3.7	-4.3	-1.6	4.7	4.4	1.6	3.0
Sep'05	0.9	0.2	2.5	2.4	-6.6	-3.2	0.3	0.1
Oct'05	1.5	4.1	7.1	-1.5	7.2	1.7	2.8	3.1
Nov'05	-2.7	-5.7	0.8	-0.8	-5.4	0.8	-2.5	-4.4
Dec'05	13.2	6.5	7.4	0.5	5.8	1.2	11.6	5.2
Jan'06	1.1	0.4	2.0	0.2	2.9	1.1	1.4	0.4
Feb'06	-4.8	-3.9	-5.9	-0.3	-6.6	0.4	-5.1	-3.0
Mar'06	13.0	8.6	14.0	-1.4	8.9	-0.1	12.7	6.4
Apr'06	-15.6	-7.0	-13.3	5.2	-2.4	1.1	-14.1	-4.8
May'06	6.0	4.6	3.4	0.6	4.2	0.0	5.5	3.6
Jun'06	0.4	1.6	-3.6	1.4	-3.9	1.1	-0.5	1.5
Jul'06	4.0	4.7	-2.3	0.4	1.4	0.2	3.0	3.7
Aug'06	-2.4	-0.5	-8.3	-5.7	0.1	-0.2	-2.8	-1.2
Sep'06	3.5	2.3	6.1	5.8	-0.2	3.2	3.4	2.8
Oct'06	-2.6	-1.2	8.9	0.2	5.7	0.5	-0.4	-0.9
Nov'06	9.2	6.5	1.8	0.3	-6.1	-0.1	6.7	5.1
Dec'06	5.6	-0.7	6.7	0.2	6.1	1.7	5.8	-0.4
Jan'07	1.3	0.6	3.0	1.5	2.1	0.3	1.6	0.7
Feb'07	-4.4	-4.0	-6.1	-0.9	-10.8	-4.1	-5.2	-3.6
Mar'07	13.2	8.6	14.2	-0.2	13.8	3.8	13.3	7.1
Apr'07	-11.7	-3.3	-16.7	-0.1	-1.8	1.9	-11.5	-2.4
May'07	7.5	10.1	3.2	0.6	4.8	0.9	6.8	8.1
Jun'07	1.4	1.9	-5.2	-0.7	-6.1	-1.5	-0.1	1.3
Jul'07	-0.2	-2.0	-0.7	2.1	2.1	0.8	-0.1	-1.3
Aug'07	-2.0	0.9	-0.3	1.3	1.7	1.4	-1.5	1.0
Sep'07	0.1	-1.2	-1.3	-0.2	-4.4	-1.4	-0.5	-1.1
Oct'07	4.4	4.8	9.2	0.3	5.4	0.6	5.0	3.9
Nov'07	-2.4	-4.1	2.9	1.4	-4.8	1.5	-2.0	-3.0
Dec'07	10.4	4.7	5.5	-0.8	4.2	0.1	9.3	3.7
Jan'08	1.0	-0.1	1.8	0.5	1.9	0.1	1.2	0.0
Feb'08	-1.8	-1.7	-2.0	3.4	-5.6	1.3	-2.1	-0.9
Mar'08	8.0	4.4	11.7	-1.8	7.5	-2.7	8.4	3.1

Contd.

Month	Manufacturing		Mining		Electricity		General IIP	
	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted
Apr'08	-12.3	-4.4	-16.4	-0.4	-3.9	-0.1	-12.1	-3.6
May'08	2.9	4.0	2.9	0.6	5.5	2.0	3.1	3.5
Jun'08	3.5	2.9	-10.4	-6.1	-5.6	-1.0	1.1	1.6
Jul'08	-4.0	-3.0	1.8	4.5	4.0	2.6	-2.7	-1.7
Aug'08	-1.9	-1.2	0.0	1.1	-1.9	-2.2	-1.7	-1.0
Sep'08	5.7	5.1	1.9	3.5	-1.0	1.9	4.7	4.6
Oct'08	-3.4	-2.4	6.8	-1.9	5.4	1.0	-1.6	-2.0
Nov'08	-5.0	-5.0	1.0	-0.8	-6.4	-0.4	-4.5	-4.1
Dec'08	6.4	-2.4	7.3	0.9	3.1	-0.5	6.2	-1.8
Jan'09	-3.5	-2.2	0.0	-1.3	2.2	0.4	-2.6	-1.9
Feb'09	-3.9	-2.9	-2.9	2.7	-6.7	-0.2	-4.1	-2.0
Mar'09	10.3	5.8	12.5	-1.5	13.5	1.9	10.9	4.5
Apr'09	-8.9	-1.5	-14.7	1.9	-3.2	1.0	-9.1	-0.8
May'09	3.6	2.5	3.0	0.8	1.7	-1.4	3.4	1.9
Jun'09	1.7	2.9	-1.8	2.2	-1.4	3.5	1.0	2.9
Jul'09	1.2	0.8	-3.2	-0.6	0.5	-1.1	0.7	0.5
Aug'09	1.7	3.8	1.3	2.0	4.1	3.9	1.8	3.6
Sep'09	2.0	1.2	-1.8	0.7	-3.8	-0.9	1.1	1.0
Oct'09	-2.5	-1.0	8.9	-0.3	2.0	-2.2	-0.9	-1.0
Nov'09	-0.3	-1.7	1.7	-0.3	-8.3	-2.4	-0.8	-1.6
Dec'09	10.0	4.6	6.9	0.9	6.7	3.2	9.3	4.0
Jan'10	0.2	0.3	3.8	3.1	2.3	0.4	0.8	0.6
Feb'10	-3.3	-3.2	-5.9	-0.8	-5.1	1.4	-3.7	-2.5
Mar'10	11.3	5.0	15.5	2.4	14.5	1.9	12.0	4.4
Apr'10	-10.3	-1.9	-16.1	-1.5	-4.8	-0.2	-10.6	-1.7
May'10	-1.4	-1.2	1.7	-0.1	1.3	-1.5	-0.8	-1.1
June'10	0.8	0.8	-2.6	1.2	-3.8	0.9	0.0	0.8
July'10	4.0	4.4	-1.6	0.6	0.6	-0.9	3.0	3.5
Aug'10	-4.0	-1.9	-1.2	-0.6	1.4	1.2	-3.2	-1.5
Sep'10	4.2	3.2	-3.3	-0.3	-3.1	0.1	2.7	2.5
Oct'10	2.5	4.2	10.7	1.4	9.0	4.6	3.9	3.9
Nov'10	-5.4	-7.1	2.5	0.1	-11.9	-6.1	-5.2	-6.2
Dec'10	12.3	6.9	6.0	0.3	8.1	4.6	11.1	5.9
Jan'11	-0.4	-0.5	-0.4	-1.1	6.6	4.8	0.2	-0.1
Feb'11	-3.8	-4.7	-6.4	-1.0	-8.3	-2.2	-4.5	-4.1

Contd.

Month	Manufacturing		Mining		Electricity		General IIP	
	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted
Mar'11	14.9	8.1	14.6	1.2	15.0	1.8	14.9	6.8
Apr'11	-14.6	-5.0	-15.1	-0.2	-5.4	-0.6	-13.9	-4.1
May'11	-0.9	0.3	1.9	0.2	5.0	2.2	0.0	0.5
Jun'11	5.4	6.7	-5.6	-2.0	-5.9	-1.3	3.1	5.0
Jul'11	-3.6	-2.9	0.5	2.4	5.4	4.0	-2.5	-1.7
Aug'11	-3.2	-2.7	-7.3	-6.2	-1.8	-2.1	-3.5	-3.0
Sep'11	3.3	0.9	-5.4	-1.7	-3.5	-0.2	1.8	0.5
Oct'11	-6.5	-4.4	12.7	2.1	5.6	1.1	-3.6	-3.3
Nov'11	7.2	5.2	5.1	2.2	-4.3	2.1	5.8	4.6
Dec'11	8.1	2.4	6.1	0.2	2.9	-0.5	7.6	1.9
Jan'12	-1.6	-3.8	0.7	0.3	0.9	-0.9	-1.5	-3.1

Annexure – V

Month	NIC-15		NIC-18		NIC-24		NIC-26		NIC-34	
	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed
May'05	-1.0	-0.6	-10.5	-8.7	2.8	0.1	3.5	3.3	16.1	5.7
Jun'05	-0.2	2.6	26.1	21.5	4.1	3.2	-6.3	-4.4	-7.4	3.8
Jul'05	-6.3	6.6	-16.1	-16.8	-2.0	-1.8	-1.8	0.4	10.0	-1.0
Aug'05	-4.9	7.7	-3.2	8.8	4.2	4.4	0.5	2.9	-2.0	-0.9
Sep'05	-1.3	2.3	2.5	-2.0	-2.3	-2.3	-2.1	-1.4	5.4	5.9
Oct'05	16.8	29.6	-15.4	-4.0	2.0	1.8	8.7	4.1	5.4	9.3
Nov'05	26.3	-14.8	-14.9	-13.2	-3.2	-2.6	-3.6	-0.6	-5.4	-10.5
Dec'05	46.3	4.8	43.3	7.8	7.6	7.3	11.3	5.8	-14.9	-0.1
Jan'06	1.6	2.2	-6.5	-7.6	-0.4	0.6	1.9	-0.1	34.0	5.2
Feb'06	-10.1	-8.1	8.1	13.1	-8.8	-7.1	-5.9	-3.0	-3.5	-3.1
Mar'06	-9.5	-3.7	28.4	16.4	7.5	5.5	14.5	5.8	17.8	4.4
Apr'06	-31.2	-13.8	-22.1	-8.9	-10.8	-8.2	-7.4	-1.7	-19.1	5.1
May'06	5.2	14.9	7.8	10.8	10.7	7.2	-0.7	-0.7	13.5	6.5
Jun'06	-1.3	4.2	1.9	-1.6	3.9	2.9	-0.3	1.7	-5.2	3.3
Jul'06	2.2	8.2	2.2	2.0	1.4	1.6	-1.1	0.9	11.1	2.0
Aug'06	-9.7	5.5	-5.5	8.5	-2.9	-2.8	-6.5	-4.2	-3.6	-2.7
Sep'06	2.9	1.2	6.2	-0.2	8.4	8.6	6.4	7.5	1.7	2.1
Oct'06	-1.8	-1.2	-15.9	-5.8	-2.7	-2.9	2.9	-1.7	-5.3	-2.0
Nov'06	45.0	4.5	13.5	13.1	5.1	5.9	1.2	4.4	14.3	8.6
Dec'06	39.7	-3.7	18.1	-10.9	-0.3	-0.8	7.9	2.6	-12.0	-0.4
Jan'07	0.5	1.5	7.9	7.0	-0.2	0.7	0.7	-1.3	25.7	4.8
Feb'07	-3.8	-0.2	-2.0	0.5	-5.2	-3.5	-6.7	-3.9	-6.5	-7.0
Mar'07	4.8	10.1	10.7	-0.7	9.1	7.5	15.9	7.5	10.7	-0.5
Apr'07	-13.0	5.8	-20.4	-3.4	-7.9	-5.8	-8.1	-2.8	-17.1	2.7
May'07	-19.1	15.1	7.7	11.8	3.3	0.5	3.2	3.3	2.4	-1.0
Jun'07	-9.7	-6.1	1.7	-0.0	7.0	6.1	-3.0	-1.0	-11.8	-4.2
Jul'07	-5.9	-22.6	3.1	1.7	6.4	6.5	-0.9	0.9	10.7	0.7
Aug'07	-11.7	15.9	-14.4	-3.7	-5.8	-5.8	-0.9	1.6	6.9	8.3
Sep'07	-4.1	-6.9	-1.1	-4.9	-0.5	-0.2	-1.9	-0.9	-0.6	-0.2
Oct'07	9.5	-0.6	-1.5	9.0	-1.4	-1.7	6.8	2.0	7.7	11.2
Nov'07	16.6	-9.8	-8.1	-9.7	-3.1	-2.6	-5.2	-2.2	-3.9	-8.2
Dec'07	60.0	13.2	27.1	-4.1	-0.3	-0.7	6.6	1.4	-5.1	6.1
Jan'08	3.1	-0.4	12.5	13.1	-1.8	-0.8	1.1	-1.2	12.9	-4.2
Feb'08	-2.9	0.4	0.9	2.4	-4.0	-2.5	-2.0	1.0	5.1	4.1
Mar'08	0.7	8.5	1.1	-7.4	7.3	6.2	11.8	3.5	7.7	-2.7
Apr'08	-19.5	-1.8	-26.2	-11.0	-4.5	-3.5	-11.0	-5.7	-19.8	-3.4
May'08	-16.4	5.8	-4.9	-1.6	6.9	4.9	3.1	3.5	4.4	4.3
Jun'08	-6.8	-13.7	-1.7	-4.0	0.3	-0.7	-2.6	-0.6	-6.8	-0.1
Jul'08	-9.2	0.7	12.5	10.1	0.7	0.8	2.4	4.1	10.0	0.4
Aug'08	-11.1	-4.9	-20.4	-11.0	-3.9	-3.8	-5.3	-2.7	-1.7	-0.3
Sep'08	0.8	4.0	17.2	16.3	-1.3	-0.9	1.8	2.9	-5.2	-4.9

Contd.

Month	NIC-15		NIC-18		NIC-24		NIC-26		NIC-34	
	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed
Oct'08	3.7	-0.4	-9.6	*-1.6*	-1.0	-1.3	3.5	-1.3	-1.5	2.8
Nov'08	27.1	-0.5	10.4	*8.0*	-2.3	-2.0	-5.1	-1.7	-21.1	-25.7
Dec'08	40.1	1.5	39.4	*3.7*	1.5	1.0	8.0	2.1	-35.7	-20.9
Jan'09	-5.4	-4.2	-6.9	*-4.1*	-1.3	-0.1	-1.0	-3.4	44.2	9.0
Feb'09	-16.6	-7.7	-10.5	*-9.5*	-5.6	-3.8	0.4	3.7	29.5	27.7
Mar'09	-12.9	-7.1	-11.3	*-16.3*	8.5	6.7	13.2	4.6	20.4	7.6
Apr'09	-17.7	-5.3	18.6	*37.2*	4.0	6.1	-6.9	-1.1	-17.4	1.7
May'09	11.1	4.7	-19.8	*-15.7*	2.6	0.1	-1.7	-1.3	5.5	9.1
Jun'09	-2.0	6.1	6.8	*6.0*	0.9	-0.1	-0.6	1.5	0.2	6.4
Jul'09	4.1	-5.9	6.1	*2.6*	2.1	2.2	2.2	3.9	13.8	2.7
Aug'09	-14.7	13.6	-13.7	*-2.8*	5.4	5.6	-5.0	-1.9	2.2	4.3
Sep'09	-5.2	-9.5	-1.8	*-2.4*	-6.3	-5.9	-3.3	-2.4	6.2	6.0
Oct'09	7.2	13.6	-12.1	*-4.6*	-5.4	-5.7	4.7	-0.4	-1.6	2.7
Nov'09	33.5	7.2	11.9	*8.9*	-1.4	-1.2	0.6	4.1	4.9	-1.3
Dec'09	32.8	-3.8	41.7	*2.7*	3.5	2.9	10.4	4.4	0.5	9.8
Jan'10	-3.0	2.2	-12.2	*-8.0*	-1.7	-0.5	1.1	-1.3	9.2	-3.5
Feb'10	-4.1	0.0	6.7	*6.4*	-6.9	-5.1	-4.2	-1.1	6.2	3.7
Mar'10	-7.8	-4.9	-2.5	*-7.9*	7.2	5.5	12.1	3.6	11.6	2.6
Apr'10	-13.6	3.5	-6.2	*8.9*	-3.2	-2.3	-6.8	-1.2	-12.5	0.7
May'10	-10.6	-6.9	-0.3	*6.5*	5.7	3.3	-1.0	-0.5	-7.3	-2.8
June'10	9.9	0.8	1.4	*1.5*	3.3	2.3	-4.9	-2.8	3.5	7.6
July'10	-14.1	-10.2	-0.6	*-3.5*	2.4	2.6	-1.8	-0.6	13.1	4.3
Aug'10	-9.1	12.4	-3.9	*6.5*	-2.5	-2.6	-1.3	2.1	-1.6	0.3
Sep'10	-1.9	3.2	-11.9	*-11.6*	0.4	1.3	0.3	1.2	5.5	4.9
Oct'10	-2.6	-3.0	-0.1	*7.7*	-2.6	-3.1	8.4	3.4	-5.4	-1.4
Nov'10	22.8	-1.6	-5.8	*-8.5*	-0.3	-0.3	-11.8	-8.8	-2.5	-8.1
Dec'10	50.9	7.1	44.6	*2.3*	2.9	2.2	13.2	7.2	12.2	20.1
Jan'11	2.7	6.7	-12.2	*-4.6*	0.8	1.8	1.8	-0.7	2.5	-6.9
Feb'11	2.4	1.2	7.0	*5.2*	-4.1	-1.3	-1.9	1.0	4.6	2.5
Mar'11	0.5	6.4	7.9	*2.6*	4.7	3.3	12.9	4.4	11.9	4.3
Apr'11	-21.5	0.3	-14.3	*-2.4*	-2.2	-0.7	-11.7	-6.2	-12.2	-1.5
May'11	-2.1	8.7	-0.8	*6.7*	2.0	-0.2	-0.4	0.3	-7.2	-2.4
Jun'11	4.4	15.9	-14.0	*-13.8*	-2.5	-3.5	-3.7	-1.7	-3.7	-0.4
Jul'11	-11.1	-4.9	2.0	*-0.7*	-1.0	-0.8	7.6	8.7	8.9	1.1
Aug'11	-18.8	-15.4	-8.2	*-0.0*	0.7	0.6	-4.2	-0.8	-3.5	-1.2
Sep'11	-3.6	-16.7	9.5	*12.1*	2.2	2.9	-4.7	-3.8	3.0	2.0
Oct'11	5.9	13.4	-10.8	*-5.7*	-5.7	-5.8	10.4	5.1	-16.8	-12.5
Nov'11	39.3	9.6	3.8	*2.0*	0.3	0.1	-2.4	1.0	31.8	22.8
Dec'11	37.4	-1.6	48.8	*6.1*	9.1	8.9	7.3	1.3	-5.7	0.3
Jan'12	0.5	-1.7	-6.9	*0.9*	-8.0	-7.3	1.6	-2.3	13.2	3.7

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Industrial Heterogeneity and Trade Flows of India: A Fixed Effect Vector Decomposition Approach

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Abstract

In the present study, an attempt has been made to estimate the effect of industrial heterogeneity on trade flows of India. It is based on the Chaney model of firm heterogeneity on gravity structure. It says that firm heterogeneity when interacts with trade barriers, contorts the gravity structure. The study also explains the effect of bilateral income growth, income similarity and remoteness along with other trade barriers. The data set is across the countries and over the industries for the year 2009. Fixed effect vector decomposition method is used to know the effect of industry variant and industry invariant variables. The study confirms the effect of firm heterogeneity on gravity structure.

1. Introduction

1.1 Traditionally, theories on international trade focused on the causes and consequences of international trade assuming that firms are homogeneous in nature. But modern trade theories have made a significant departure from the traditional theories by considering that firms are heterogeneous and their heterogeneity distorts the basic results of gravity model of international trade. Chaney (2008) extended the Krugman model by considering firm heterogeneity, an idea proposed by Melitz, and found that when the trade costs go down, the existing producers face lower costs so they sell at lower price and get the larger market share by increasing their exports of existing varieties (Intensive margin). At the same time, it is profitable to go for exports by the firms which were not able to export earlier and produce same varieties at same cost. These firms strictly export positive quantities of different varieties and contribute to increase the aggregate volume of exports (Extensive margin). Thus, as per his analysis, industrial heterogeneity distorts the basic results of gravity equation and in the presence of it, trade barriers increase the trade flows in between the trading countries through intensive and extensive margins of trade. The present study is an attempt to examine Chaney's hypotheses on the Indian trade flows by considering industrial heterogeneity. Before making this assessment, the next sub section presents some of the relevant trends of India's firm level trade.

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1.2 India's Firm Level Trade

1.2.1 Understanding of the export behavior of Indian firms becomes important since it is the microeconomic basis of the observed trade flows among countries. Figure 1 explores the export intensity of Indian firms by the type of firm according to its ownership structure. It is clear from Figure 1 that increment in exports has been higher among Indian private sector firms and Indian business groups. Further, figure 2 shows the percentage of firms exporting from the year 1991 to 2010.

1.2.2 Figure 2 reveals that the percentage of exporting firms rose sharply after the liberalization phase. The rise has been slow but still growing. It has declined marginally in 2009 may be because of global slowdown.

1.2.3 The analysis concludes that India's major exports do not come from big business houses but from small firms which supports our research objective of estimating the impact of industrial heterogeneity on India's trade flows. To pursue this objective, the whole study has been divided into the six sections including the present introductory one. Section 2 presents the literature review explaining the Krugman and Melitz ideas in detail. In section 3, Chaney's model has been presented and discussed to support the empirical hypotheses theoretically. Section 4 gives the detailed report on the variables used and their construction for the empirical analysis. The appropriate methodology for the analysis purpose also explained in the same section. Further, empirical results have been presented in the Section 5 and Section 6 concludes the whole study and provides noteworthy policy implications.

2. Review of Literature

2.1 Most of the New and New-New trade theories use monopolistic competition model which is characterized by a large number of firms, each producing a unique variety of differentiated products, with free entry and exit. The model was provided by Chamberlin (1936) which gave the graphical presentation of the market equilibrium. Using the model, Dixit and Stiglitz (1977) proposed utility function in which representative consumers demand number of varieties of the differentiated goods. On the basis of this, a number of new trade economists provided their New and New-New trade theories. As per these theories, each country will export a differentiated variety of goods to another country and it becomes profitable to produce different varieties under trade but under autarky firms can produce the same varieties. Increasing competition into the international market has led to some pressure among firms as they have to be more and more productive to face the pressure.

2.2 Melitz (2003) proposed a model by assuming heterogeneous firms and shows how reduction in barriers to trade induces firms to become more productive, simultaneously forcing the least productive firms to exit the market. His model introduced the fixed cost of entering into domestic and export market. These costs are the sunk costs and cannot be recovered later. Melitz explained that trade opening will increase aggregate productivity in all trading economies. Whenever the threshold level of productivity goes up, the least productive firms disappear. At the same time, the most productive firms among the survivors

(those with productivity above the threshold productivity level) takes part in the export market with the top in their domestic market and therefore, these firms employ disproportionately more labor than the less productive firms. Hence, the aggregate productivity in the economy is the average productivity of a better pool, with a larger weight on the most productive firms. This unambiguously leads to an increase in the aggregate productivity of the economy.

2.3 The reason for this increase in aggregate productivity is provided by two forces. Firstly, domestic firms now have to face the additional competition from the best foreign firms in the export market. This reduces the market share left for domestic firms, and drives down the profits of all firms due to the constant elasticity assumption and forces the least productive firms out of the market. Secondly, when the possibility of trade (at some cost) is opened up, there are additional profits to be expected by the most productive firms, those firms that are productive enough to enter the foreign market. Here, the existing high productivity firms want to expand their scale of production in order to serve the foreign markets and therefore they want to hire more workers. New firms are also attracted by the prospect of these higher profits and they also hire workers. Real wages go up and force the least productive firms to shut down.

2.4 Instead of considering the monopolistic competition, Bernard, Eaton, Jensen and Kortum (2003) considered the assumption of perfect competition but retained the CES preference assumption. Perfect competition actually gives results which are similar to monopolistic competition with the only difference that instead of charging the price exactly equal to marginal cost, they charge a constant mark-up over their marginal cost. Actually they considered Bertrand competition.

2.5 Later, Melitz and Ottaviano (2005) proposed a model which predicts the impact of productivity, size, and the mark up price on world trading scenario. Working on similar lines, Helpman, Melitz and Rubinstein (2007) proposed a simple model that is capable of explaining the zero trade flows, larger number of exporters to larger destination markets etc. The model yields the generalized gravity equation that accounts for the self-selection of firms into export market and their impact on trade volumes. They developed a two stage estimation procedure that uses a selection equation into trading partners in the first stage and a trade flow equation into the second. The method provides estimate of extensive and intensive margins of trade flows.

2.6 Chaney (2008) extended the idea of Melitz and answered the question of how firm heterogeneity and market structure can distort gravity in international market. The main idea of the Melitz model is that if firms are heterogeneous in terms of their productivity and there exist fixed costs associated with exports then there will be endogenous selection of firms into the export market. Thus, in the presence of trade barriers (fixed costs, variable costs etc.), the set of firms that can cover all these cost is going to change. So changes in trade barriers, i.e. trade liberalization will not only change how much each firm export (through intensive margin) but also the set of firms in the market (through extensive margin). The main contribution of this study is to introduce the extensive margin of trade. Therefore, there is an extensive and intensive margin of adjustment of trade flows to trade barriers. He found that elasticity of substitution has opposite effect on each margin: higher elasticity

of substitution makes the intensive margin more sensitive to changes in trade barriers, whereas extensive margin becomes less sensitive.

3. The Chaney's Model

3.1 Thomas Chaney (2008) on the basis of Krugman and Melitz model proposed his model which explains how the heterogeneous nature of firms distorts gravity. Beginning with Krugman model:

$$X_{ij} = \lambda \times L_i \times L_j \times \left(\frac{\tau_{ij}}{P^*}\right)^{1-\sigma} \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

where, X_{ij} is the exports to the i^{th} country from country j; L_i and L_j are the market sizes of country i and country j respectively; τ_{ij} represents variable trade costs and shows that there is positive relation between elasticity of substitution (σ) and variable trade costs; P^* is the world prices and λ is the constant. In this model, there is no fixed cost associated with trade.

$$\frac{\partial \ln X_{ij}}{\partial \ln \tau_{ij}} = \sigma - 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(2)$$

3.2 Melitz (2003) contributed to the literature by introducing fixed cost of entering into domestic and export markets. He explained that if a firm wants to enter into domestic and export market, it will have to pay a fixed cost of entry in both the markets and these are the types of sunk costs. Thus, the most productive firms which have the lowest marginal costs serve the export market while the firms which are less productive and cannot bear the fixed cost of entering into export market serve the domestic market. Finally, the firms which are least productive and which cannot even bear the fixed cost of entering into domestic market go out of the market. Therefore, due to heterogeneous nature of firms only most productive firms enter into international market.

3.3 Thomas Chaney (2008) contributed to the theoretical literature by utilizing the idea of Krugman model and Melitz model. Melitz proposed that there are fixed cost of entering into domestic market as well as into export market. Chaney utilized this idea of fixed cost and gave extensive margin. The following equation shows the Chaney's model:

$$X_{ij} = \lambda \times \frac{L_i L_j}{L} \times \left(\frac{\tau_{ij}}{\theta_{ij}}\right)^{-\gamma} \times f_{ij}^{-\left(\frac{\gamma}{\sigma-1}-1\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

where θ_{ij} is the remoteness index of country i from countries other than j; f_{ij} is the fixed cost; τ_{ij} is the variable trade cost; γ is the firm heterogeneity. Now differentiating equation (3) with respect to variable trade cost and fixed trade cost gives,

$$\varsigma \equiv \frac{\partial \ln X_{ij}}{\partial \ln \tau_{ij}} = \gamma \text{ .....(4)}$$

$$\xi \equiv \frac{\partial \ln X_{ij}}{\partial \ln f_{ij}} = \frac{\gamma}{\sigma - 1} - 1 \text{ .....(5)}$$

Therefore, equations (4) and (5) have following implications:

First is that Chaney predicted that there is inverse relationship between elasticity of substitution and fixed trade costs and positive relation between firm heterogeneity and variable trade costs.

Second is that the elasticity of exports with respect to variable cost is larger in the presence of firm heterogeneity than in the absence. An increase in variable trade cost reduces export as well as some firms go out of the export market. The extensive margin then magnifies the impact of variable trade costs.

Finally third is that elasticity of exports with respect to variable trade cost does not depend upon elasticity of substitution.

3.4 In this way, he introduced two margins of trade i.e. extensive and intensive margins of trade. Krugman model only took intensive margin (scale effect) into account but Chaney introduced extensive margin (selection effect) also. Chaney added firm's heterogeneity in productivity as well as the fixed cost of exporting to the equation. When transportation costs vary, not only does each exporter changes the size of its exports (the intensive margin) but also the set of exporters varies (the extensive margin).

3.5 Intensive and Extensive Margin

3.5.1 The selection of firms into export market according to their productivity level is known as extensive margin. Earlier it has been seen that in Chaney model the elasticity of substitution (ó) has no effect on elasticity of trade flows with respect to variable trade costs (æ), and a negative effect on the elasticity of trade flows with respect to fixed costs (î). Then intensive and extensive margin can be found out as:

$$\frac{d\varsigma}{d\sigma} = 0 \textbf{ .....(6)}$$

And

$$\frac{d\xi}{d\sigma} < 0 \text{ .....(7)}$$

$$\varsigma = -\frac{d \ln X_{ij}}{d \ln \tau_{ij}} = (\sigma - 1) + (\gamma - (\sigma - 1)) = \gamma \text{ .....(8)}$$

where the expression $(\sigma - 1)$ shows intensive margin and the expression $(\gamma-(\sigma-1))$ shows the extensive margin. Since elasticity of intensive margin with respect to sigma is zero, the expression becomes applicable to extensive margin only. When variable costs moves, ((ó-1) increases with ó), and thus ó magnifies the intensive margin, whereas it dampens the extensive margin i.e.(-(ó -1) decreases with ó). Therefore, elasticity of trade with respect to fixed trade costs becomes,

$$\xi = \frac{d \ln X_{ij}}{d \ln f_{ij}} = 0 + \frac{\gamma}{\sigma - 1} - 1 \quad \text{.....(9)}$$

The main finding of his study is that the elasticity of substitution has opposite effects on each margin. A higher elasticity makes the intensive margin more sensitive to changes in trade barriers, whereas it makes the extensive margin less sensitive. The present research contributes towards the effect of firm heterogeneity on India's trade with its trading partners. For this purpose, three models have been estimated such as model with basic Chaney's structure with two more extended models including host of other augmented gravity equation variable.

4. Database and Methodology

4.1 Sources of Data and Construction of Variables

4.1.1 For the present study, data on different variables (see Table 1 for detail) over the various Indian industries have been culled out for the year 2009 for different country pairs (India with its trading partners). The main sources of secondary data used for the analysis are, the World Integrated Trade Solutions (WITS), World Development Indicators (WDI) provided by World Bank, CEPII database for readymade gravity equation variables and the Prowess database provided by Centre for Monitoring Indian Economy (CMIE), Government of India. Table 1 present the detailed list of variables used in the study with their description.

4.1.2 From the literature there are two possible ways to work out firm heterogeneity. First is to either measure the dispersion of productivity or of size (measured as sales), not a mixture of both and the second way is to measure the dispersion of a variable X_i across all the firms (may be either productivity or size), ordering them in decreasing order. After restricting to the 50% or 30% largest firms and then running the OLS regression on the following equation:

$$\ln(Rank_i) = \alpha + \beta \ln X_i + \mu_i$$

Where β is the coefficient of interest, and μ_i is a normally distributed error term.
Since, due to the lot of missing figures in the data we have taken the dispersion of sales into account to measure the industrial heterogeneity. Lower is the dispersion of sales among the firms low will be the industrial heterogeneity, as productivity is concentrated

among few firms only. As per the Chaney's model, we further divide the value of industrial heterogeneity with $(\sigma-1)$ and use this measure to account industrial heterogeneity.

4.1.3 For elasticity of substitution data, we have used estimates provided by Broda and Weinstein (2006) for each variety. They have used 6 digit HS import data (1992 classification system) from the COMTRADE database from 1994-2003 to estimate these elasticities. It gives the estimate of demand elasticity of substitution between any two varieties in any given sector. It is not the demand elasticity that whole sector faces when it exports. Here we have done our analysis on data of year 2009 while Broda and Weinstein estimated demand elasticities between two varieties taking the data from 1994 to 2003. These authors compared the demand elasticities between the two time periods and found that median elasticity fell marginally (from 2:5 to 2:2 at the 3-digit level). Thus, we assume that there would not be much difference for the period 2009.

Further, s_i has been calculated by using the following formula:

$$s_i = \frac{Y_i}{Y_i + Y_j}$$

Where $Y_i + Y_j$ is the sum of the real GDPs of two country and its impact on growth of trade is expected to be positive, $s_i s_j$ is the product of shares of two countries which is equivalent to

4.1.4 Helpman's size dispersion index and its expected sign is positive. In other words, it captures the effect of income convergence, which is assumed to augment trade flow growth.

Finally, to calculate the remoteness index, the following formula developed by Wei (1996) and Helliwell (1997) has been used.

$$REM_i = \sum_{m \neq j} \left(\frac{d_{im}}{Y_m} \right)$$

Where Rem_i is the remoteness index for country i used to represent the average distance (d_{im}) from all trading partners other than j weighted by their GDP's (Y). More is the remoteness of a country i from its trading partners other than j more will be the trade between i and j.

As our dataset have two dimensions (country pairs over different industries) as like panel data (country pairs over different time periods) so we have assumed it as panel like dataset and preceded with the panel data analyses.

4.2. Methodology Applied

As per the two dimensional feature of our dataset, the present study has utilized the Fixed Vector Variance decomposition (FEVD) technique, a panel data analysis to account for the loss in information in estimating fixed effects regression.

4.2.1 Fixed Effect Variance Decomposition (FEVD)

4.2.1.1 The utility of using FEVD approach for the present analysis is its advantage over the Fixed Effect (FE) panel data regression to include effects of those variables which are industry invariant (in other words, for panel data with different time periods, it gives us the effects of time invariant variables). The FEVD is an estimation strategy proposed by Plumper and Troeger (2007) which attempts to overcome the loss of information that occurs using the FE model. In the present case, there are many variables which are invariant for different industries such as distance in between country pairs, common border dummy, common language dummy, India's remoteness, sum of the country's GDP and their shares.

4.2.1.2 It is a three steps procedure known as augmented fixed effect regression to estimate the effects of independent variables on dependent variable. The three steps of FEVD estimation for our study are:

1. Estimate the following fixed effects regression with industry variant independent variables and obtain the fixed effect error component (FEEC):

$$\ln Exports_{ijk} = \alpha_{ij} + a_1 \ln tariff_{ijk} + a_2 \ln remoteness_i + a_3 \ln dist_{ij} * IndHetro_i + a_4 \ln tariff_{ijk} * IndHetro_i + a_5 border_{ij} * IndHetro_i + a_6 \ln comlang_{ij} * IndHetro_i + u_{ijk}$$

where subscripts *i, j and k* represent the exporter *i* and importer *j* over the products of *k industries.*

2. Regress the fixed effect error component vector (obtained from step 1), on industry invariant variables by applying OLS and obtain the residual series (e_{ij}).

$$FEEC_{ij} = \beta + b_1 \ln(Y_i + Y_j) + b_2 \ln(s_i s_j) + b_3 \ln dist_{ij} + b_4 border_{ij} + b_5 comlang_{ij} + b_6 \ln remoteness_i + e_{ij}$$

3. In the last step, regress dependent variable on all independent variables (industry variant as well as invariant) including the residual obtained from step 2 by using pooled OLS. In our study, estimate the following final regression equation with the help of pooled OLS.

$$\ln Exports_{ijk} = \lambda + c_1 \ln(Y_i + Y_j) + c_2 \ln(s_i s_j) + c_3 \ln dist_{ij} + c_4 \ln tariff_{ijk} + c_5 border_{ij} + c_6 comlang_{ij} + c_7 \ln remoteness_i + c_8 \ln dist_{ij} * IndHetro + c_9 \ln tariff_{ijk} * IndHetro + c_{10} border_{ij} * IndHetro + c_{11} \ln comlang_{ij} * IndHetro + c_{12} \hat{e}_{ij} + w_{ijk}$$

The results obtained are useful to explain the hypothesis set on the basis of the theories behind the fitted model. Further, the effect of residual (e_{ij}), obtained in step two, accounts for the unobserved unit fixed effects and captures the potential of omitted variable bias. The same procedure has been repeated for measuring the impact of elasticity of substitution on India's trade flows by replacing the industrial heterogeneity variable with the elasticity of substitution variable.

4.2.1.3 As per the Plumper and Troeger (2004)[2], the utility of using the method of FEVD for the panel data is that "*it does not require prior knowledge of correlation between the explanatory variables and the unit specific effects; The estimator relies on the robustness of the within-transformation and does not need to meet the orthogonality assumptions of random effects; and It maintains the consistency and efficiency of OLS*" pp. 10.

4.2.1.4 The present study has estimated all the six models (see Table 2 for details) in which first three models estimate the impact of industrial heterogeneity and the next three models estimate the impact of elasticity of substitution on India's trade flows.

5. Empirical Results:

5.1 Industrial Heterogeneity and Trade Flows

5.1.1 Table 3 presents the results of three estimated model as proposed in the study. In model – 1, distance has negative effect on India's exports but when distance interacts with firm heterogeneity it is positively affecting Indian exports. More heterogeneity means productivity is dispersed among firms and is not centered among few firms. Therefore, new firms can easily enter into export market and make the profit and more distance would not matter much in this case. This shows that extensive margin dominates in Indian case. Further, border and border *firm heterogeneity, common language and common language * firm heterogeneity are found to be insignificant and ambiguous results are found.

5.1.2 In model-2 bilateral income growth and income similarity index are found to be positive and significant. Further, distance has significant and negative impact on trade flows while when it interacts with firm heterogeneity; it has positive effect on trade flows. Therefore, new firms will quickly enter into export market and will make profit even if there is longer distance. Same is the case with tariff. Results of other variables are not significant.

[2] Plumper, T. And Troeger, V.E. (2004), "The Estimation of Time Invariant Variables in Panel Analyses with Unit Fixed Effects", SSRN Working Paper. Available at SSRN: http://ssrn.com/abstract=565904

5.1.3 Model-3 considers remoteness as another variable along with the rest of the variables but is found to be insignificant. The rest of the variables show the same results except tariff *heterogeneity which has become positive but insignificant.

5.2 Elasticity of Substitution and Trade Flows:

5.2.1 Table – 4 shows the effect of elasticity of substitution and trade costs on India's trade flows. In model – 1, distance is the only variable which is significant and rest of the basic gravity variables as well as the interaction term of gravity variables with sigma is also insignificant. Further, in model -2 when we have included the bilateral income growth, income similarity index and tariff also. Here bilateral income growth, income similarity index, tariff and distance are the significant variables. Here again the interaction terms are insignificant. In model – 3, the results are same along with one more significant variable i.e. common language at 10% level. Here it is important to note that the coefficient value of interaction terms in all the three models is very low. This shows that elasticity of substitution has very less contribution in Indian case. The basic reason behind this could be that the Indian trade mainly focuses on basic traditional goods which do not have many substitutes available in the market and even if it has some substitutes available, the demand is not too high.

6. Conclusion

6.1 Paper attempts to analyze the effect of firm heterogeneity and elasticity of substitution on Indian trade flows with respect to trade barriers. The empirical testing is done in context of Chaney model of firm heterogeneity. The results show that firm heterogeneity magnifies the effect of trade barriers on trade flows while elasticity of substitution has very meager impact. Finally, study confirms the effect of firm heterogeneity on gravity structure.

References:

Bernard, A.B, J. Eaton, J.B. Jensen and S. Kortum (2003), "Plants and Productivity in International Trade." *American Economic Review,* 93: 1268-1290.

Chaney, T. (2008), "Distorted Gravity: The Intensive and Extensive Margins of International Trade." *American Economic Review,* 98(4): 1707-1721.

Daniel, T. (1993), "International Factor Price Differences: Leontief Was Right." *Journal of Political Economy,* 101: 961 – 987.

Eaton, J. and S. Kortum (2002), "Technology, Geography and Trade." *Econometrica,* 44: 1741-1779.

Feenstra, R. C. (2003), "Advanced International Trade: Theory and Evidence." Princeton, NJ: Princeton University Press.

Helpman, E., M. Melitz and S. Yeaple (2004), "Export versus FDI with Heterogeneous Firms." *American Economic Review,* 94(1): 300-316.

Helpman, E., M. Melitz and Y. Rubinstein (2007), "Estimating Trade Flows: Trading Partners and Trading Volumes." NBER Working Paper 12927.

Krishna, K. L. "Quantitative Methods and Their Application in International Economics." Chapter 5.

Krugman, P. "Increasing Returns, Monopolistic Competition, and International Trade." *Journal of International Economics,* 9: 469–479.

Krugman, P. (1980), "Scale Economies, Product Differentiation, and the Pattern of Trade." *American Economic Review* 70: 950–959.

Kumar, N. and N.S. Siddharthan (1994), "Technology, Firm, Size and Export Behaviour in Developing Countries: The Case of Indian Enterprise." *Journal of Development Studies,* 31(2): 289-309.

Maddala. (1992), "Introduction To Econometrics". New York: Maxwell Macmillan Publishing Company. .

Melitz, M. J. and G. I. P. Ottaviano (2005), "Market Size, Trade and Productivity". NBER Working Paper No. 11393.

Plumper, T. and Troeger, V.E. (2004), "The Estimation of Time Invariant Variables in Panel Analyses with Unit Fixed Effects", SSRN Working Paper. Available at SSRN: http://ssrn.com/abstract=565904.

Poddar, T. (2004), "Domestic Competition Spurs Exports: The Indian Example." IMF Working Paper WP/04/173.

Figure 1: Export Intensity of the Firms as per their Ownership Structure

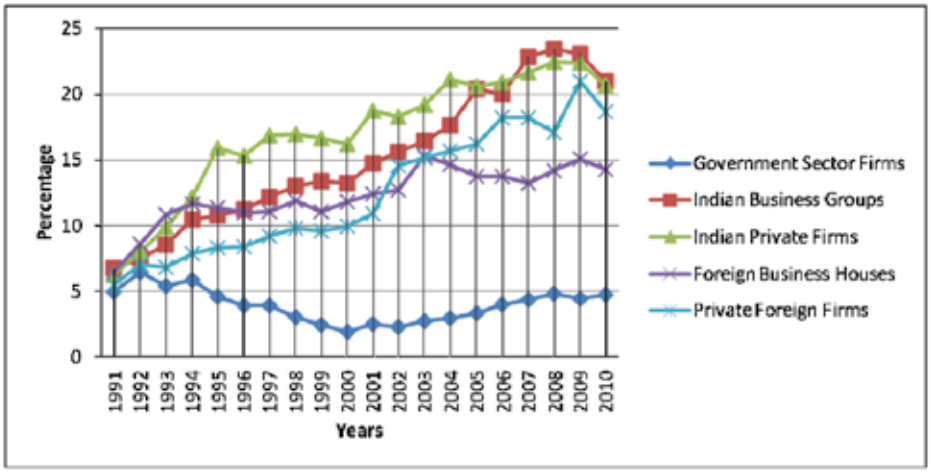

Figure 2: Percentage of Exporting Firms

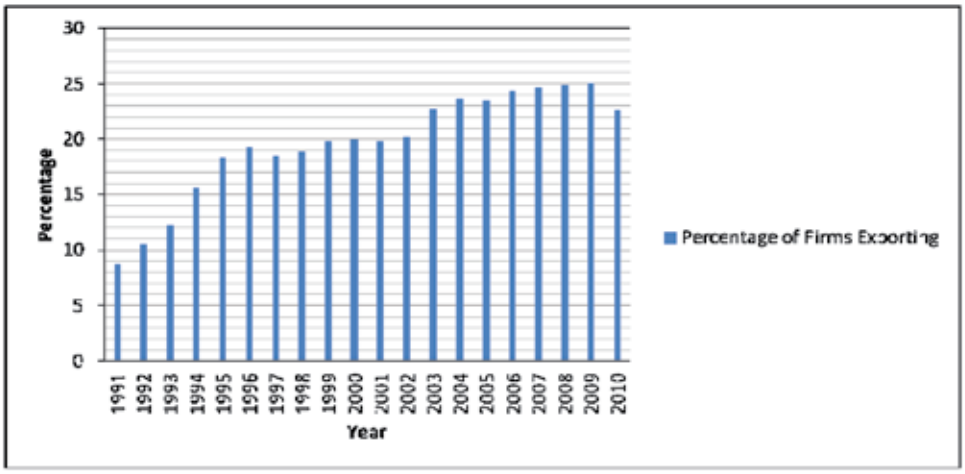

Table 1: Description of Variables and with Sources

Variable	Description	Source
Exports	India's Exports with its Trading Partners	WITS
Sum of GDP's ($Y_i + Y_j$)	National Income of both the Country Pairs	WDI
Distance (dist)	Distance in between Trading Partner	CEPII
Tariff	Tariff faced by Indian Exports	WITS
Common Language and Common Border	Dummy Variable	CEPII
Size Dispersion Index	Derived from GDP's of both the countries	Own Calculations
IndHetro	Industrial Heterogeneity	Own Calculations
Elasticity of Substitution	For Constructing Industrial Heterogeneity	Broda and Weinstein(2006) Estimates
Remoteness	India's Remoteness defined by Wei (1996) and Helliwell (1997)	Own Calculations
Source: Authors' Elaboration.		

Table 2: Description of Variables Included in the Estimated Models

Dependent variable: Exports of India (LnX_{ijk}) to Partner countries for the year 2009.			
Independent Variables	**Model 1 (Chaney's Model)**	**Model 2 (Extended Model)**	**Model 3 (Extended Model)**
Lnremoteness	×	×	√
$Ln(Y^i + Y^j)$	×	√	√
$Ln(s^i s^j)$	×	√	√
Lntariff	×	√	√
Lntariff*IndHetro	×	√	√
Lndistance	√	√	√
Border	√	√	√
Comlang	√	√	√
Lndist*IndHetro	√	√	√
Border*IndHetro	√	√	√
Comlang*IndHetro	√	√	√
Note: i) √ represent the Variable included in the estimated model; ii) In the next three models, the variable IndHetro has been replaced with elasticity of substitution.			
Source: Authors' Elaboration.			

Table 3: Results of Three Estimated Models with Industrial Heterogeneity

Dependent Variable: Exports of India (Lnexports) to Partner countries for the year 2009.			
Independent Variables	**Model 1 (Chaney's Model)**	**Model 2 (Extended Model)**	**Model 3 (Extended Model)**
Lnremoteness	—	—	5.52 (0.36)
$Ln(Y_i + Y_j)$	—	1.46 (0.00)	1.49 (0.00)
$Ln(s_i s_j)$	—	0.76 (0.00)	0.71 (0.00)
Lntariff	—	-0.50 (0.00)	-0.50 (0.00)
Lntariff * $\frac{\lambda_h}{\sigma - 1}$		0.13 (0.17)	0.13 (0.17)
Lndistance	-0.81 (0.00)	-0.67 (0.00)	-0.64 (0.00)
Border	1.47 (0.11)	-0.35 (0.71)	-0.32 (0.74)
Comlang	0.28 (0.42)	0.42 (0.23)	0.45 (0.19)
Lndist* $\frac{\lambda_h}{\sigma - 1}$	0.13 (0.00)	0.10 (0.00)	0.10 (0.00)
Border* $\frac{\lambda_h}{\sigma - 1}$	-0.25 (0.73)	-0.24 (0.74)	-0.24 (0.74)
Comlang* $\frac{\lambda_h}{\sigma - 1}$	0.06 (0.84)	0.11 (0.68)	0.11 (0.68)
Constant	14.29 (0.00)	-24.74 (0.00)	24.69 (0.65)
FEVD Residual	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
No. of Observations	**1206**	**1206**	**1206**
R^2	**0.26**	**0.27**	**0.27**
Notes: Figures in parenthesis of type ( ) are the p-values of the respective coefficients;			
Source: Authors' Calculations.			

Table 4: Results of Three Estimated Models with Elasticity of Substitution

Dependent Variable: Exports of India (Lnexports) to Partner countries for the year 2009.			
Independent Variables	**Model 1 (Chaney's Model)**	**Model 2 (Extended Model)**	**Model 3 (Extended Model)**
Lnremoteness	—	—	5.25 (0.40)
Ln($Y_i + Y_j$)	—	1.36 (0.00)	1.38 (0.00)
Ln($s_i s_j$)	—	0.74 (0.00)	0.70 (0.00)
Lntariff	—	-0.55 (0.00)	-0.55 (0.00)
Lntariff*σ_h	—	-0.00 (0.93)	-0.00 (.93)
Lndistance	-0.67 (0.00)	-0.53 (0.01)	-0.51 (0.02)
Border	1.19 (0.16)	-0.32 (0.72)	-0.28 (0.74)
Comlang	0.34 (0.27)	0.49 (0.11)	0.52 (.09)
Lndist*σ_h	0.00 (0.98)	0.00 (0.79)	0.00 (0.79)
Border*σ_h	0.00 (0.74)	0.00 (0.91)	0.00 (0.91)
Comlang*σ_h	-0.00 (0.80)	-0.00 (0.85)	-.00 (.85)
Constant	14.01 (0.00)	-22.19 (0.02)	24.83 (0.66)
FEVD Residual	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
No. of Observations	**1206**	**1206**	**1206**
R^2	**0.21**	**0.24**	**0.23**
Notes: Figures in parenthesis of type ( ) are the p-values of the respective coefficients;			
Source: Authors' Calculations.			

A Study of Cross-validation of Growth Rates of Industrial Production Based on IIP and ASI for Some Important Item-groups

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Abstract

There have been growing concerns about the volatility in the growth rates of industrial production reflected through the monthly indices. Growth rates for the capital goods sector have been criticized the most. This paper cross-validates the latest annual growth rate of production of some important items emerging from the Index of Industrial Production (IIP) with those based on the Annual Survey of Industries. A way forward is suggested for the reflection of more realistic growth rates through IIP.

1. Introduction

1.1 The All-India Index of Industrial Production (IIP) released by the Central Statistics Office is an important short-time indicator for assessing the growth of industrial sector of the economy on a monthly basis. The present IIP has 2004-05 as the base year. On every month, apart from releasing the absolute values of the indices for three sectors of the economy viz. mining, manufacturing and electricity, the indices by 'use-based classification' as well as by 2-digit of National Industrial Classification (NIC) and also the corresponding monthly and cumulative growth rates of production as compared to the corresponding periods of the previous year are released.

1.2 Of late, there have been growing concerns on the volatility in the growth rates of IIP – more so for the capital goods sector. Variations in the magnitude of the indices and growth rates as per IIP vis-à-vis National Accounts Statistics (NAS) and Annual Survey of Industries (ASI) for the period 1993-94 till 2007-08 have been discussed at length by Singhi in the Working Paper titled "Index of Industrial Production & Annual survey of industries". In his analysis, Singhi studied the variations by sector (i.e. Mining, Manufacturing & Electricity) and by broad groups / activities of industry. Two important conclusions were as follows: one, growth rate as per IIP is normally lower; and two, variation in annual growth rates for the initial three or four years after the base year is less but there are huge variations in the subsequent years.

1.3 Keeping in view the fact that the IIP is derived as an weighted average of the production relatives of various item-groups (products) in the IIP basket, in this paper, we have analyzed the behavior of the annual growth rates of production during 2009-10 over 2008-09 for some important item-groups as emerging from the IIP and compared those

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with the corresponding growth rates as revealed by the ASI based on estimated production of respective item-groups.

2. Selection of Item-groups

2.1 Unfortunately there is no common code of any given product/item-group to match the production figures as per the two sources. Thus we were left with no other option but to match the two alternative production figures by looking at the descriptions of the products manually, which was rather a cumbersome and time-consuming exercise. To optimize on the labour involved, we initially concentrated to limit our study to those item-groups (after arranging them in the descending order of their weights in IIP) having a share of 75% weight in the overall weight (roughly 76%) for the manufacturing sector.

2.2 The above criterion led us to the selection of 107 item-groups (having a total weight of 57.1%) out of a total number of 399 item-groups in the IIP basket. But unfortunately only 56 of these item-groups with a total weight of 24.4% could be identified by exact name in the ASI database. In the remaining cases, either the descriptions in the ASI database did not exactly match with those in the IIP database or the said item-groups/products were missing in the ASI database (due to zero production or some other reasons).

2.3 To achieve a higher overall weight, we expanded the coverage of the study by considering the remaining item-groups with a minimum weight of '0.75' (out of 1,000) in the weighting diagram of IIP. This resulted in netting another 100 item-groups of which only 49 item-groups could be identified by exact description in the ASI database. Thus, ultimately 105 item-groups with a total weight of about 30.5% (as against 76% weight of the manufacturing sector) were selected study. Details are given in Tables 1 and 2.

3. Ultimate Domain of Study

3.1 Of the 105 item-groups so selected, 5 item-groups show abnormally high growth rates of production based on ASI. These item-groups with corresponding growth rates in production during 2009-10 over 2008-09 are: BOPP film (16306.3%), Polyester chips (39202.4%), Railway sleeper (1672.5%), Cashew kernels (1928.8%), and Maida (2289.5%). Because of this abnormal situation, we have dropped these item-groups from our analysis ultimately leading us to 100 item-groups which comprised our domain of study.

4. Details of Study and Findings

4.1 While calculating the annual growth rate (GR) of production, for the item-groups for which IIP database is in value (monetary) terms, first we have deflated ASI 2009-10 production figures for both IIP and ASI by the corresponding WPI deflators so that they are at constant (2008-09) price. For the item-groups for which WPI deflator specific to the item-group is not available, we have used the deflator for all commodities combined. Item-group wise production figures as per IIP and ASI for the years 2008-09 and 2009-10 along with respective weights and units of different item-groups are presented in Statement A-1 and the item-group wise alternative GRs are indicated in Statement A-2. Disturbingly

enough, for majority of the item-groups two alternative GRs differ widely and in many cases two alternative GRs even show different signs. The findings seem to indicate poor quality of data of GR at the item-group level, even with regard to ASI which is based on a large sample size.

4.2 Major findings by use-based classification are summarized in Tables 3 and 4. For all item-groups taken together, annual GR as per ASI (Table 3) is much higher (17.0%) than that based on IIP (4.7%). This finding is consistent with that of Singhi. However, for item-groups pertaining to basic goods and consumer durables, GR as per ASI is found to be lower.

4.3 It is quite disturbing to note that for about a half of the item-groups studied (51 out 100), two alternative GRs show different signs altogether (Table 4). Correlation coefficient of two alternative GRs is also very small (0.01). This is true for all use-based categories. Absolute difference of two alternative GRs at the item-group level varies between 0.2% to as high as 343.5%. Variation in GRs at the item-group level is much higher in case of ASI (-100% to 331%) than that of IIP (-67% to 65%). As an illustration alternative GRs (expressed in percentages) for the item-groups studied with regard to the capital goods sector are presented in Charts 1A and 1B. It is rather difficult to comment as to which source may be reflecting the better GR. Both sources have certain advantages and disadvantages. The positive side of IIP is that it is based on panel data and for quite a few item-groups the total value of production of the reporting units is substantially high. But the IIP based GR for a number of item-groups seem to be suffering from its inadequacy in terms of number of reporting units. As regards the ASI, although sample size is quite large, it does not seem to be equipped to give robust estimates of production for many item-groups as per the existing methodology. Given the extent of divergence in the alternative GRs, it is high time to address the methodological issues of deriving the estimates based on both the sources. This includes review of sample design adopted in ASI.

4.4 For 8 out of 100 item-groups, quantity of reporting of data is different in the two sources. Interestingly, a study of the production behavior of the remaining 92 item-groups (see Table 5) reveals that for as many as 39 item-groups total reported production of sample units for the year 2009-10 as per IIP is higher than that of estimated total production of the item-group based on ASI. This can probably only happen due to two reasons: one, owing to incompleteness of the ASI frame and two, due to the limitation of the sample design adopted in ASI. Respective production behavior as per two alternative sources for a sample of 6 out of the above stated 39 item-groups (Table 6) is supportive of the same. Out of these 6 item-groups, IIP data for 4 item-groups flow from DIPP. An investigation into the unit-level database as per Department of Industrial Policy and Promotion (DIPP) confirms the incompleteness of the ASI frame (Table 7) and also supports the need for further refining the sampling methodology of ASI.

5. Concluding Observations

5.1 We observe huge divergence in the alternative growth rates of production emerging from the two sources namely IIP and ASI. Given the importance of the IIP and ASI database for policy formulations, there is an urgent need to address the methodological issues leading

to such wide divergence. We suggest a few remedial measures. While undertaking the upcoming base revision exercise of IIP, having seen the volatility in the annual production figures at the item level based on ASI, it would be desirable that the item basket is finalized not by considering only the base year production data (as is the practice) but by taking into account the average production based on three years including the previous year and the subsequent year to the base year. This is likely to eliminate the extent of volatility to a large extent. The use of three-year data would also be useful for finalization of the weighting diagram. Further, due care needs to be taken while selecting factories so that for any given item-group the factories having major productions are included in the list of selected units. Given the limitation of the ASI frame, this would involve inclusion of the units based on sources other than ASI like DIPP, Ministry of Corporate Affairs (MCA) and Economic Census. Also for each item-group, a minimum threshold in terms of both number of units/factories and percentage share in the total production must be fixed to ensure representativeness of the selected units in reflecting realistic growth rate of production. It is also important that the item descriptions in the IIP basket exactly match with those as per the ASI database so that studies of similar nature can be undertaken easily. Finally, given the divergence in the magnitude of growth rates of production as per the two alternative sources, we strongly feel the need for exploring alternative methodology of compilation of IIP where we may directly select major units based on ASI frame to be supplemented with the list of units based on other sources mentioned already. For each industry 2-digit code, it may be worth considering top units in terms of number of employees so that selected units take care of at least 80% of the total output at the 2-digit level of industry. As per ASI 2009-10, there are 44,793 units at the all-India level contributing to about 86% of the total output. From the selected units, we may collect information on total value of output rather than quantity every month through web-portal and derive the alternative IIP after deflating output values by appropriate price index, preferably the Producer Price Index (PPI), failing which by the Wholesale Price Index (WPI).

5.2 As regards the ASI, steps should be taken to improve upon its frame by tapping database as per other sources like DIPP, MCA and Economic Census. It is also high time to reconsider whether we continue with units having 100+ workers as forming the 'census sector' or expand its domain by considering units with 50+ workers. In case this is difficult to implement due to the limitation of sample size, efforts be made at least to form separate strata of units with 50 to 100 workers at district x 4-digit level of National Industrial Classification within the 'sample sector' and select a sample of them from each stratum. This is likely to improve the precision of the estimates. Lastly, given the extent of variations in annual growth rates of production at the item-group level in ASI, it is worth exploring the introduction of panel/rotational panel survey in the sample sector to improve the estimates of change parameters.

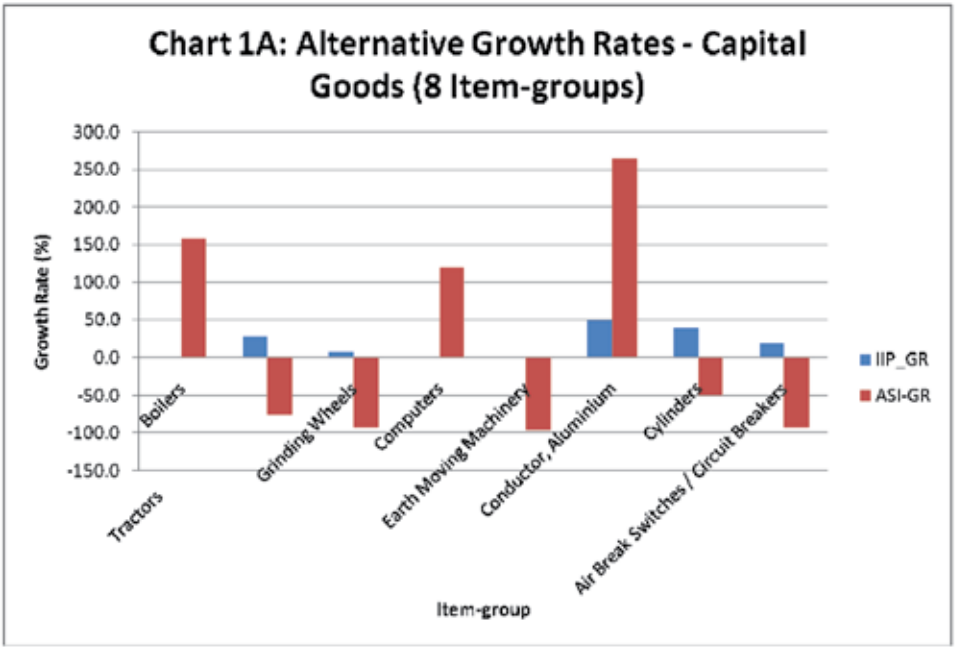
Chart 1A: Alternative Growth Rates - Capital Goods (8 Item-groups)
Growth Rate (%)
300.0
250.0
200.0
150.0
100.0
50.0
0.0
-50.0
-100.0
-150.0
Boilers
Tractors
Grinding Wheels
Computers
Earth Moving Machinery
Conductor, Aluminium
Cylinders
Air Break Switches / Circuit Breakers
Item-group
IIP_GR
ASI-GR

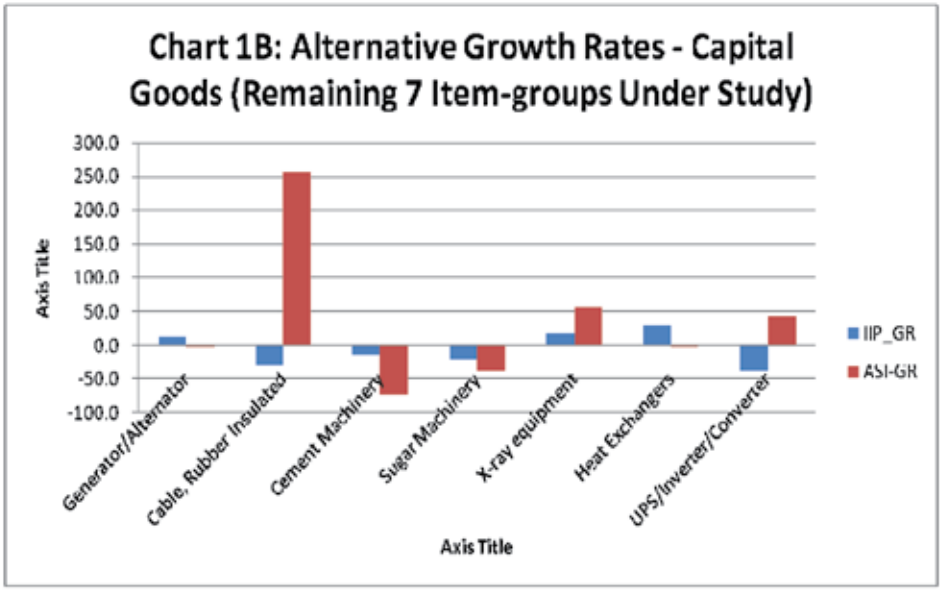
Chart 1B: Alternative Growth Rates - Capital Goods (Remaining 7 Item-groups Under Study)
Axis Title
300.0
250.0
200.0
150.0
100.0
50.0
0.0
-50.0
-100.0
Generator/Alternator
Cable, Rubber Insulated
Cement Machinery
Sugar Machinery
X-ray equipment
Heat Exchangers
UPS/Inverter/Converter
Axis Title
IIP_GR
ASI-GR

Table 1: Initial Target Population

Use-based category	No. of item-groups	Total weight (out of 1000)	75% of the weight	Target population / No. of top item-groups in terms of weight contributing to 75% of the weight
(1)	(2)	(3)	(4)	(5)
1. Basic goods	88	456.8 (212.1)	159.1	20
2. Capital goods	73	88.3	66.2	23
3. Intermediate goods	106	156.9	117.7	33
4. Consumer durables	43	84.6	63.5	9
5. Consumer non-durables	89	213.5	160.1	22
All	**399**	**1000.0 (755.3)**	**568.6**	**107 [571.3]**

( ) indicates weight excluding the weights for mining & electricity sectors not considered for the study

[ ] Total weight of the targeted item-groups

Table 2: Ultimate Domain of Study

Use-based category	No. of item-groups achieved* in the first target	Second target**				Ultimate domain of study	
		No. of item-gr. identified	Total weight (out of 1000)	No. achieved*	Weight	No. of item-groups	Weight
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Basic goods	11	27	42.3	14	20.8	25	83.5
Capital goods	12	12	11.2	3	3.0	15	27.9
Intermediate goods	18	21	21.7	10	9.0	28	73.6
Consumer durables	5	9	14.7	6	9.4	11	31.7
Consumer non-dur.	10	31	39.1	16	18.1	26	87.9
All	**56 (244.4)**	**100**	**129.0**	**49**	**60.3**	**105#**	**304.7**

* Achieved means those for which item/product description could be located in the ASI database

** Remaining item-groups of IIP basket with value of the weight being at least 0.75 out of 1,000

( ) Total weight of the achieved item-groups as per initial target # Of the 105 item-groups identified, 5 item-groups ignored for further study due to the observed abnormal growth rates in production during 2009-10 over 2008-09 based on the ASI.

Statement A-1: Production Figures as per IIP and ASI after Adjusting by WPI Deflators in Case of Value

Item group	Weight	Unit	IIP_ 08-09	IIP_Adj_ 09-10	ASI_ 08-09	ASI_Adj_ 09-10
sponge iron	9.9512	Th.tonnes	21091	20738	12050	14527
Bars & Rods	9.7746	Th.tonnes	22224	23863	11226	14407
Carbon steel	7.8075	Th. tonnes	21367	22657	1699	179
Urea	6.4322	Th. MT	19922	21112	19193	19882
Ferro manganese	6.3869	Th. tonnes	529	513	247	240
Kerosene	4.4625	TMT	8223	8547	134629391	178338984
Propylene	4.0923	MT	1887457	1858755	644518	291520
Ethylene	4.0019	MT	2638784	2515488	3794005	0
Ferro chrome	3.4280	Th. tonnes	958	922	1869	417
Ferro silicon	3.1885	Th. tonnes	76	81	78	191
Di Ammonium Phosphate(DAP)	3.1858	Th. MT	2993	4247	1856	2086
Fuel, Aviation Turbine	2.7097	TMT	7631	8074	8366	5722
Aluminium	2.5860	Tonnes	934521	1045149	3564973	1574622
Caustic soda	2.2336	MT	2050030	2102539	1286016	1828525
Steel Castings	2.1462	Tonnes	191494	186059	3454243	7178999
coal, washed	1.7045	Th.tonnes	7307	6904	8619	9249
Soda ash	1.4539	MT	1989045	2050912	2591432	1994778
Granites	1.1197	Sq. feet	19539157	19195284	7351215	5736715
coke, hard	1.0961	Th.tonnes	10577	10443	3209	2350
Aluminium Foils	1.0858	Tonnes	47405	49158	53840	57504
Molasses	1.0831	Tonnes	2690152	2164280	8673099	18197674
Other Ferro alloys	1.0212	Th. tonnes	525	550	361	322
Butadiene	0.8738	MT	213721	205427	163514	186821
Benzene	0.8732	MT	879669	822723	221112	807891
pig iron	0.7650	Th. tonnes	6206	5796	7229	6247
Boilers	4.0111	Rs.Crore	14894	15189	11309	29073
Tractors (complete)	3.7665	Numbers	293606	373700	18950025	4593516
Grinding Wheels	2.9205	Th. No.	17694	19109	12832	1017
Computers	2.3317	Rs.Crore	2993	3027	2796	6156
Earth Moving Machinery	2.2868	Numbers	9075	9314	1446239	68432
Conductor, Aluminium	2.0043	Tonnes	75582	112572	3053762	11083839
Cylinders	1.3742	Numbers	3637774	5062678	25270309	12879828
Air Break Switches / Circuit Breakers	1.3579	Th. No.	55357	65628	47275	3868
Generator/Alternator	1.3179	Rs.Crore	2787	3152	3406	3356
Cable, Rubber Insulated	1.2276	Kilo metres	41550	29351	3886906	13840632
Cement Machinery	1.2150	Rs.Crore	1000	854	664	178

Statement A-1: Production Figures as per IIP and ASI after Adjusting by WPI Deflators in Case of Value (Contd.)

Item group	Weight	Unit	IIP_ 08-09	IIP_Adj_ 09-10	ASI_ 08-09	ASI_Adj_ 09-10
Sugar Machinery	1.1399	Rs.Crore	420	334	1340	837
X-ray equipment	1.0298	Numbers	1193	1401	410829	639983
Heat Exchangers	1.0215	Rs.Crore	1221	1581	1799	1753
UPS/Inverter/ Converter	0.9285	Numbers	1900377	1186420	2616384	3753189
Gas, Liquidified Petroleum	11.1964	TMT	9158	8661	3697	10513
Fasteners (Excl. Zip-Fastener)	5.6948	Tonnes	75669	77712	1573691	1607817
Petrol (Motor Spirit)	5.6067	TMT	16020	15970	250771548	604078289
Steel Structures	5.4773	Tonnes	542799	612544	15170223	1666893
Naphtha	5.4323	TMT	14827	14811	19300	13451
Purified terephthalic acid	4.2279	MT	2154021	2985327	522308	433810
Furnace Oil	3.8649	TMT	14749	15038	116304	192903
Bearings (Ball/Roller)	3.3536	Th. No.	496355	613830	3151247	251480
Glass Bottles	2.5584	Tonnes	1094526	1120538	10841012	8217237
Plywood	2.3251	Th. Sq. Mt.	44546	47809	158722	220379
Plastic Film Excl. Bopp Film	1.9795	Tonnes	274375	298581	64491	87540
Craft Paper(Kraft Paper)	1.8564	Tonnes	1059509	1183669	4780412	2466661
Linear alkyl benzene	1.7213	MT	434348	463846	230176	214811
Printed Circuit Board/Plate	1.7157	Rs.Crore	367	352	703	1861
Colour TV Picture Tubes	1.6102	Th. No.	7018	9206	7807	13532
twine, jute (sutli)	1.4791	Th. tonnes	54	26	91	56
Adhesives	1.2891	Tonnes	46227	51022	349252	222935
Synthetic Resins	0.9583	Tonnes	122545	139027	1033808	435488
Shoe Uppers(Leather)	0.9282	Th.Pairs	19113	16696	22574	14067
Straw And Paper Boards of All Kinds	0.8398	Tonnes	1715167	1717590	4941706	1568277
Caprolactum	0.8176	MT	84461	123157	53501	377
Printing Ink	0.8070	Tonnes	155253	182129	147948	130529
Bitumen	0.7920	TMT	4713	4889	3237	3804
Hose Pipe	0.7801	Rs.Crore	357	398	705	1491
Wood Veneer	0.7533	Th. Sq. Mt.	165726	154422	314861	141642
Motor Cycles	9.5225	Numbers	6801964	8444852	59453800	7982381
Colour TV Sets	3.8056	Numbers	9330640	10015431	9967937	8778313
Glazed Tiles / Ceramic Tiles	3.5800	Tonnes	1356565	1419445	93455937	114532874

Statement A-1: Production Figures as per IIP and ASI after Adjusting by WPI Deflators in Case of Value (Contd.)

Item group	Weight	Unit	IIP_ 08-09	IIP_Adj_ 09-10	ASI_ 08-09	ASI_Adj_ 09-10
Air Conditioner (Room)	2.8741	Numbers	886417	1457770	258074461	324565887
Woollen Carpets	2.5812	Sq. metre	95608	79815	7445504	15363690
Scooter and Mopeds	2.1398	Numbers	1559447	2065479	1105825	1293882
Pressure Cooker	2.1342	Numbers	5249860	6951678	7164936	9165419
Tyre, Car/Cab	2.0075	Th.No.	13996	15864	11367	8017
Mono ethylene glycol	1.1662	MT	783203	738292	247981	55603
Refrigerators	0.9705	Th. No.	6715	8002	6598	7328
Bicycles	0.9603	Th. No.	11607	13251	10786	15030
sugar(including sugar cubes)	15.2456	Lakh tonnes	184	173	204	271
Newspapers	10.0865	Lakh Copies	56533	52936	3328596	8642839
grey cloth (bleached / unbleached)	9.0908	Mn.sq.mtr	54966	59573	523141787	473728682
Cigarettes	8.6849	Lakh No.	932061	917261	1279129	891826
Leather Garments	7.5051	Rs.Crore	409	382	1817	1131
Pens of All Kind	5.9101	Th. No.	1038284	911221	3199184	4134865
Biri	5.0706	Lakh No.	298101	295299	2925344	2390397
Vitamins	3.0131	Rs.Crore	43	56	4571	14595
Terry Towel	2.3763	Tonnes	63191	76334	65119	58064
Biscuits	2.3732	Tonnes	611426	674829	27117704	84322323
Coir Mats & Mattings	2.3521	Sq. metres	848499	952733	16925961	24117419
Milk Powder all kind	1.1491	Tonnes	168735	148046	1817654	7838390
Soyabean oil	1.0839	MT	1064201	683259	39500738	1794901
Beer	0.9935	K.Litre.	954887	1017201	7884701	967823
Tooth Brush	0.9900	Th. No.	194751	209569	65824062	4657961
Atta	0.9392	Tonnes	473665	511353	10440907	7929725
Fluorescent Tubes	0.9012	Th. No.	159103	194988	199636	92513
Groundnut Oil	0.8830	MT	45360	15013	10223439	497553
Ghee	0.8461	Tonnes	77105	74654	179458	189461
Rice bran Oil	0.8370	MT	751799	643112	11660727	1614893
Zarda/ Chewing Tobacco	0.8362	Kg.	1424890	959263	66158948	60089165
Dry Cells	0.8030	Th. No.	1863461	1985848	1079444	742646
Safety Matches	0.7892	Th. boxes	8801360	7756452	201531	256401
Mustard/ Rapeseed Oil	0.7779	MT	85442	74167	112200505	762239

Statement A-2: Alternative Annual Growth Rates of Production: 2009-10 Over 2008-09

Item-group	Growth Rate (%)		Item-group	Growth Rate (%)		Item-group	Growth Rate (%)	
	IIP	ASI		IIP	ASI		IIP	ASI
Basic Goods			**Intermediate Goods**			**Consumer Non-durables**		
Sponge iron	-1.7	20.6	Gas,Liqidified Petroleum	-5.4	184.4	Sugar(incl. its cubes)	6.0	32.8
Bars & Rods	7.4	28.3	Fasteners (excl. Zip-Fastnr)	2.7	2.2	Newspapers	-6.4	159.7
Carbon steel	6.0	-89.5	Petrol (Motor Spirit)	-0.3	140.9	Grey cloth (bleached / unbleached)	8.4	-9.4
Urea	6.0	3.6	Steel Structures	12.8	-89.0	Cigarettes	-1.6	-30.3
Ferro manganese	-3.0	-2.8	Naphtha	-0.1	-30.3	Leather Garments	-6.6	-37.8
Kerosene	3.9	32.5	Purified tereph thalic acid	38.6	-16.9	Pens of All Kind	-12.2	29.2
Propylene	-1.5	-54.8	Furnace Oil	2.0	65.9	Biri	-0.9	-18.3
Ethylene	-4.7	-100.0	Bearings (Ball/Roller)	23.7	-92.0	Vitamins	31.3	219.3
Ferro chrome	-3.8	-77.7	Glass Bottles	2.4	-24.2	Terry Towel	20.8	-10.8
Ferro silicon	6.6	144.9	Plywood	7.3	38.8	Biscuits	10.4	210.9
Di Ammonium Phosphate (DAP)	41.9	12.4	Plastic Film Excl. Bopp Film	8.8	35.7	Coir Mats & Mattings	12.3	42.5
Fuel, Aviation Turbine	5.8	-31.6	Craft Paper	11.7	-48.4	Milk Powder all kind	-12.3	331.2
Aluminium	11.8	-55.8	Linear alkyl benzene	6.8	-6.7	Soyabean oil	-35.8	-95.5
Caustic soda	2.6	42.2	Printed Circuit Board/Plate	-4.0	164.8	Beer	6.5	-87.7
Steel Castings	-2.8	107.8	Colour TV Picture Tubes	31.2	73.3	Tooth Brush	7.6	-92.9
Coal, washed	-5.5	7.3	twine, jute (sutli)	-52.4	-38.5	Atta	8.0	-24.1
Soda ash	3.1	-23.0	Adhesives	10.4	-36.2	Fluorescent Tubes	22.6	-53.7
Granites	-1.8	-22.0	Synthetic Resins	13.4	-57.9	Groundnut Oil	-66.9	-95.1
Coke, hard	-1.3	-26.8	Shoe Uppers (Leather)	-12.6	-37.7	Ghee	-3.2	5.6
Aluminium Foils	3.7	6.8	Straw And Paper Boards of All Kinds	0.1	-68.3	Rice bran Oil	-14.5	-86.2
Molasses	-19.5	109.8	Caprolactum	45.8	-99.3	Zarda/Chewing Tobacco	-32.7	-9.2

Statement A-2: Alternative Annual Growth Rates of Production: 2009-10 Over 2008-09 (Contd.)

Item-group	Growth Rate (%)		Item-group	Growth Rate (%)		Item-group	Growth Rate (%)	
	IIP	ASI		IIP	ASI		IIP	ASI
Basic Goods			**Intermediate Goods**			**Consumer Non-durables**		
Other Ferro alloys	4.8	-10.8	Printing Ink	17.3	-11.8	Dry Cells	6.6	-31.2
Butadiene	-3.9	14.3	Bitumen	3.7	17.5	Safety Matches	-11.9	27.2
Benzene	-6.5	265.4	Hose Pipe	11.4	111.5	Mustard/ Rapeseed Oil	-13.2	-99.3
Pig iron	-6.6	-13.6	Wood Veneer	-6.8	-55.0			
Capital Goods			**Consumer Durables**					
Boilers	2.0	157.1	Motor Cycles	24.2	-86.6			
Tractors	27.3	-75.8	Colour TV Sets	7.3	-11.9			
Grinding Wheels	8.0	-92.1	Glazed Tiles / Ceramic Tiles	4.6	22.6			
Computers	1.1	120.2	Air Conditioner (Room)	64.5	25.8			
Earth Moving Machinery	2.6	-95.3	Woollen Carpets	-16.5	106.3			
Conductor, Aluminium	48.9	263.0	Scooter and Mopeds	32.4	17.0			
Cylinders	39.2	-49.0	Pressure Cooker	32.4	27.9			
Air Break Switches / Circuit Breakers	18.6	-91.8	Tyre, Car/Cab	13.3	-29.5			
Generator/ Alternator	13.1	-1.5	Mono ethylene glycol	-5.7	-77.6			
Cable, Rubber Insulated	-29.4	256.1	Refrigerators	19.2	11.1			
Cement Machinery	-14.6	-73.2	Bicycles	14.2	39.3			
Sugar Machinery	-20.5	-37.5						
X-ray equipment	17.4	55.8						
Heat Exchangers	29.4	-2.6						
UPS/Inv/ Converter	-37.6	43.4						

Table 3: Alternative Growth Rates as per IIP and ASI

Use-based category	Domain of study/ No. of item-groups	Weight	Annual growth rate (GR) of production during 2009-10 over 2008-09			
			Simple Average		Weighted Average	
			IIP	ASI	IIP	ASI
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Basic goods (1)	25	83.5	1.6	11.5	3.2	-1.0
Capital goods (2)	15	27.9	7.0	25.1	9.8	26.8
Intermediate goods (3)	25	68.1	6.7	4.9	5.7	32.4
Consumer durables (4)	11	31.7	17.3	4.0	19.2	-14.0
Consumer Non-durables (5)	24	83.5	-3.7	11.5	-1.8	30.9
All	**100**	**294.7**	**4.2**	**11.1**	**4.7**	**17.0**

Table 4: Relationship of Two Alternative Growth Rates

Use-based category	Target population/ No. of item-groups of the study	No. of item-groups with two alternative GRs showing different signs	Correlation Coefficient of two alternative GRs	Growth rate as per IIP at the item-group level		Growth rate as per ASI at the item-group level		Absolute difference of two alternative GRs		
				Minimum value	Maximum value	Minimum value	Maximum value	Min.	Max.	Av.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	25	11	-0.17	-19.5	41.9	-100	265.4	0.2	271.8	53.8
2	15	9	-0.06	-37.6	48.9	-95.3	263.0	14.6	285.4	101.1
3	25	14	-0.17	-52.4	45.8	-99.3	184.4	0.5	189.8	65.2
4	11	4	-0.06	-16.5	64.5	-86.6	106.3	4.5	122.9	43.4
5	24	13	0.27	-66.9	31.3	-99.3	331.2	8.8	343.5	74.7
All	**100**	**51**	**0.01**	**-66.9**	**64.5**	**-100**	**331.2**	**0.2**	**343.5**	**67.6**

Table 5: Frequency Distribution of Total Number of Item-groups by Value of Output Ratio of IIP and ASI for the Year 2009-10

Output Ratio (R)	No. of item-groups	Output Ratio (R)	No. of item-groups
< 0.01	7	0.5 – 1.0	12
0.01 – 0.05	8	1.0 – 2.0	22
0.05 – 0.1	4	2.0 – 5.0	10
0.1 – 0.2	4	5.0 & above	7
0.2 – 0.5	18	**All**	**92**

R = (Total value of output of reporting units as per IIP item basket) / (Total estimated output as per ASI)

Table 6: Value of Output as per Two Alternative Sources for Selected Item-groups

Item-group	Weight	Unit	Value of R	Value of output		
				IIP:2009-10	ASI:2009-10	ASI:2008-09
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Color TV Sets	3.8056	No.	1.14	10015431	8778313	9967937
Bars and rods	9.7746	Th. Ton	1.66	23863	14407	11226
Fluorescent tubes	0.9012	Th. No.	2.11	194988	92513	199636
Cement machinery	1.2150	Rs. Cr.	4.79	887	185	664
Mono ethylene glycol	1.1662	MT	13.3	738292	55603	247981
Grinding wheels	2.9205	Th. No.	18.8	19109	1017	12832

Table 7: Results of Further Investigation Based on Unit Level Data of DIPP

Item-group	Total no. of units as per unit level data	No. of units not having PSL number	No. of top units meeting ASI: 2009-10 production	Remarks
(1)	(2)	(3)	(4)	(5)
Color TV Sets	16	3	7	All the units mentioned in col.4 have permanent serial (PSL) no. in DIPP database. Thus the sampling issue in ASI is responsible for underestimation of ASI production.
Fluorescent tubes	12	1	3	
Cement machinery	7	1	1	
Grinding wheels	6	5	1	

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Use of Financial Ratios in Cluster Analysis of Indian Manufacturing Industries

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Abstract

This paper aims to measure performance of Indian manufacturing industries in terms of certain financial ratios. We derive these ratios from the ASI data and utilise them in our empirical analyses to have a proper judgment about profitability, liquidity, leverage, debt-servicing capacity and working capital management efficiency of major industries in India. Finally we group them into four homogeneous groups on the basis of similar characteristics.

1. Introduction

1.1 The widely used measure of efficiency of industrial units is productivity, which is measured in terms of capital, labour or, what goes in the name of total factor productivity**.** It is true that productivity is a basic measure. A unit that performs well in terms of productivity growth should maintain a good financial health. There are, however, certain finer issues concerning inner strength of an unit's financial health. These are mainly leverage, debt and interest servicing capacity, return on investment, working capital management efficiency and liquidity of an industrial unit. These issues are rarely addressed in an economic analysis. Accounting ratios used by financial analysts to assess financial health of a company may help develop a finer understanding about financial performance of an industry group. Financial analysts derive these ratios from balance sheet and profit and loss account of an individual company. Prowess Data base complied by The Centre for Monitoring Indian Economy (CMIE) provides data for deriving these financial ratios for individual companies at micro level. These ratios can, however, not be derived from ASI data base which provides industry level data at macro level. This is because the way ASI present the data does not strictly follow the language of a financial analyst. In this paper, we develop these financial ratios at macro level, seeking a correspondence between the accounting numbers and basic industry attributes. We keep in mind the definition given by financial analyst for the financial ratios and choose the synonymous data from the Annual Survey of Industries (ASI) in such a manner that would take care of the mismatch between these two sets of data and maintain definitional parity as well. In the context of Indian manufacturing industries, there are several studies on the performance of productivity growth (Ahluwalia 1985, 1991; Golder 1986; Siddharthan and Lal 2003; Balakrishnan 2003). Gupta and Huefner (1972) using a form of cluster analysis grouped 20 industries

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according to their characteristics as reflected in four select financial ratios. Falk and Heintz (1975) used certain financial ratios to develop a ranking of industry according to degree of risk based on particular industry characteristics. No empirical study appears to have been made to assess performance of Indian manufacturing industries in terms of financial ratios and develop groupings based on a simultaneous comparison of the ratios and thus, the industry characteristics as a whole. The modest goal of this paper is to take up such an exercise with respect to the Indian manufacturing sector. We develop our exercise based on the ASI data (2-digit level NIC-87 classifications) on the factory sector. The paper is planned as follows. In Section-1, we briefly explain why the reference period is kept from 1980-81 to 1997-98. In Section-2, we describe the financial ratios considered for assessing the performance of an industry group. How the accounting items can be discerned from the ASI data and compatibility of these accounting items with what is available in ASI data are discussed in Section-3. In this section, methodology for selecting 15 major industry groups amongst 27 categories of industries appearing in the ASI during our reference period is also described. Performance of the major industry groups on the basis of selected financial ratios are documented and analysed in Section-4. In this section, we show that these ratios can capture the heterogeneity or homogeneity in performance of the manufacturing industry groups and broadly classify them in four groups. Implications and conclusion of the study and directions for future research are presented in Section-5.

2. Reference Period

2.1 We have considered reference period from 1980-81 to 1997-98 (18 years). One may say that this study should have been made based on more recent data. We submit that this would have been possible but for the frequent changes in National Industrial Classification (NIC) of the ASI data. NIC-1970 classification was followed from 1980-81 to 1986-87. During the next ten years (1987-88 to 1997-98) NIC-1987 was followed. In NIC-87, industry codes 30 and 31 interchanged their position and industry codes 35 and 36 were clubbed together as code 35-36. In NIC-98, various changes were made. For example, beverages which was under industry code 22 (NIC-87) were separated from tobacco products and grouped as 'food products' under industry code 15. Paper, paper products and printing, publishing and allied activities (Code 28 under NIC 1987) was put under two industry codes, namely, code 21 (Paper and paper products) and code 22 (Publishing, printing and reproduction of recorded media) under NIC-1998. Besides, some new industry code such as 30 (Office accounting and computing machinery), 37 (Recycling of metal and non-metal wastes and scrap), 39 (Other manufacturing industries), 43 (Non-conventional energy) were introduced under NIC-1998. In NIC-04, a new industry code 34 (Motor vehicles, trailers and semi-trailers) was introduced. In NIC-08, many changes were made. For example, beverages industries were again separated from food products (code 15 under NIC-04) and included under separate code 11; publishing was separated from publishing, printing and reproduction of recorded media (code 22 of NIC-04) and put under industry code 58 (Information and communication). With such changes, concordance between various NIC classifications would have needed a few approximations which we decided to avoid in order to have continuity in the time series data. This paper seeks to explore the usefulness of ratios in measuring the inner strength of financial health of industries. Empirical results on the basis of 18 years time series data from 1981 to 1998 would be adequate to meet our objectives.

3. The Financial Indicators

3.1 The financial ratios are selected with a view to having a proper judgment about profitability, liquidity, leverage, debt-servicing capacity and working capital management efficiency of an industrial sector. We choose seven ratios, namely, Return on Invested Capital (ROIC), Operating Cash Flow to Invested Capital (OCF/IC), Interest Coverage Ratio (ICR), Debt Service Coverage Ratio (DSCR), Leverage Ratio (LR), Working Capital Management Efficiency Ratio (WCMER) and the Composite Ratio (CR). CR is the average of first six ratios. These ratios are normally used by financial analysts to assess financial performance of a company. ROIC is conceptualised as the return on invested capital, return being measured in terms of profit after tax and bank interest paid by an industrial unit added back. OCF / IC is conceptualised as the ratio of whatever operating cash is generated by the unit with invested capital – a concept that is hardly taken care of in an economic analysis. The ratio is constructed with profit, interest and depreciation in the numerator. ICR determines interest servicing capacity of an unit and is visualized as interest as a proportion to the total return, namely, the sum total of interest and profit. Debt servicing capacity of an unit is assessed by DSCR. It is conceptualised as operating cash flow expressed as a percentage of interest paid and 20% of outstanding loan. Desirable payback period being five years, a fifth of the loan is considered. ROIC gives an overall indication of the profitability of a company. OCF/IC indicates whether cash generated from operations is adequate to meet various obligations of an unit. DSCR and ICR are vital for examining debt servicing and interest servicing capacity of a company. WCMER indicates the level of efficiency in working capital management as it measures liquid assets in relation to the firm's size. This is derived from dividing working capital by invested capital; a higher ratio would indicate a better condition prevailing in a unit, a low ratio might lead to the problem of availability of working capital at the adequate level, even when the firm is better placed with respect to availability of fixed assets. The concept of LR is that a favourable LR would indicate less dependence on outside loans compared to its shareholders fund. It is basically equity-debt ratio. While it is true that productivity would serve as a good measure in examining the overall situation, a deeper analysis of the scenario would need some additional instruments that would help a researcher develop a finer understanding about financial health of an industry group. These ratios are proposed with this end in view.

4. Deriving the Ratios from ASI Data

4.1 In order to maintain conformity and parity, we utilise ASI data for deriving these seven ratios on the basis of ASI-given items, namely, profit, fixed capital, invested capital, physical working capital, working capital, outstanding loan, interest, employees cost, etc. In order to do so, we have kept in mind the definition given by financial analysts for these ratios and chosen synonymous data from ASI in such a manner that would maintain definitional parity in analyzing economic behaviour of an entity. For example, there is no term as 'invested capital' in the company level balance sheet. Synonymous term in the balance sheet of a company is 'total assets'. We thus conceptualise 'Return on Invested Capital' (ROIC) as 'Return on Investment' (ROI) as defined in the language of financial analysts and define ROIC as (profit + interest)/invested capital in order to keep parity with the definition of ROI as (net profit + interest)/total assets as given by financial analysts.

Similarly, OCF/IC has been taken as same as 'Operating Cash Flow to Total Assets' and same has been derived as (profit + interest + depreciation)/invested capital. We derive DSCR from ASI data as (profit + interest + depreciation)/(interest paid + 20% of outstanding loan). ICR is derived from ASI data as (profit + interest)/interest. LR is defined by financial analysts as a ratio between net worth and outstanding loan of a company. While net worth is defined in the Companies Act[2], it does neither feature in ASI nor is it used by an economist as a tool for measuring performance of an industry sector at the macro level. In order to maintain conceptual parity, we consider 'net worth' as almost equivalent to (fixed capital + working capital – outstanding loan) in respect of industry level data[3]. We thus conceptualise the LR as (fixed capital + working capital – outstanding loan)/outstanding loan. It is basically the equity-debt ratio[4]. 'Working capital' as defined in the ASI is almost equivalent to 'net working capital' or 'net current assets' (current assets – current liabilities) of a company. In the language of financial analysts, WCMER indicates efficiency of a firm in regard to management of assets and liabilities. For macro level analyses, we thus derive WCMER as a ratio between working capital and invested capital. In this way, we make an attempt to remove definitional mismatch to the extent it is required for the purpose of our empirical study. All the variables taken from ASI data are deflated by WPI with 1982 as the base year and used CPI only to deflate employees cost. There are, however, certain limitations while directly using WPI as deflator. While ASI classifications is based on activities, WPI is based on nature of commodities. We submit that identifying the nature of commodity grouped under the ASI activity based classification is difficult, if not impossible. At best, one can approximate commodities based on the nature of economic activities which prompt us to use WPI only (except for employees' compensation).

5. Major Industries

5.1 We select major industry groups for our empirical analysis with respect to three parameters, namely, value of output, number of workers and invested capital of respective industry groups. After initial screening, we find that out of 27 industry groups, there are

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[2] In terms of Section 2(29A) of the Companies Act, 'net worth' means the sum total of the paid-up capital and free reserves after deducting the provisions or expenses as may be prescribed.
Explanation:- For the purposes of the clause, 'free reserves' means all reserves created out of the profits and share premium account but does not include reserves created out of revaluation of assets, write back of depreciation provisions and amalgamation.

[3] In the language of a financial analyst, total assets of a company comprise of net block (gross fixed assets minus accumulated depreciation), investments and current assets. Liabilities of a company comprise of net worth or share holders fund, term loan and current liabilities. Again, according to the accounting equation, assets are equal to liabilities. Thus, net worth of a company is equal to total assets minus total of term loan and current liabilities. Keeping this interpretation of the financial analysts and definition given in the ASI for various items, we find that the sum total of fixed capital and working capital of an industry sector is equivalent to total assets minus current liabilities. If we deduct outstanding loan from this figure, what we get is essentially net worth of an industry sector or an individual industry.

[4] Shareholders' Fund = Fixed Capital + Working Capital – Outstanding Loan;
Equity = Shareholders' Fund;
So, (Equity / Debt) = (Fixed Capital + Working Capital – Outstanding Loan) / Outstanding Loan
i.e. Equity / Debt = (Fixed Capital + Working Capital)/ Outstanding Loan – 1
i.e. Equity / Debt is < 0 , if, Outstanding Loan > (Fixed Capital + Working Capital)

15 industry groups that account for 92.27%of value of output, 90.28% of number of workers and 91.91% of invested capital. Thus, exclusion of balance 12 industry groups which account for only 7.73% of value of total output, 9.72% of number of workers and 8.09% of invested capital, would not affect the result of our analyses on the performance of Indian industries. We thus finally select 15 such major industry groups for performing our analyses[5].

6. Industry Level Performance in Terms of Financial Ratios

6.1 Given the values of the seven ratios for each of the 15 major industry groups, we plan to check in this section whether the select ratios would help identify groups of industries having similar values of a particular ratio. Idea is to obtain an independent grouping of the industries according to the select ratios. From the results, we would be able to assess whether these ratios can capture the heterogeneity or homogeneity in performance of industry groups and identify the industries which are performing well and which are not performing well. But then, there is a problem. This is related to non-availability of a composite concept called 'industry characteristics'. However, some of the characteristics could be developed on the basis of best available quantifiable firm level standard. For example, return on investment of a company should be more than weighted average cost of borrowings; annual cash generation from the business should be at least one third of outstanding loan making DSCR of minimum 1.33; total outstanding loan should not be more than two times of shareholders fund making LR of 2:1; profit should be at least 33% of interest obligation making ICR of 1.33; net working capital should be at least 25% of total assets making WCMER of 0.25 etc. These firm level standards are accepted by financial analysts for assessing financial health of a company at micro level. As a number of firms constitute an industry group, one can compare the results with these firm level standards and have an idea about overall characteristics of the major industry groups. With this objective, we first calculate mean value and CV of seven ratios derived in respect of major industry groups over the 18 years period (Table 1). For each of the seven ratios, quartiles[6] are found out. These are given in Table 2. For each of the ratios, the industries having value of ratios below Q_1 (lower quartile) are the 'below average' performer. The industries with value of ratios lying between Q_1 and Q_2 (Median[7]) are 'average performer. The industries with value of ratios lying between Q_2 and the upper quartile (Q_3) are 'good'

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[5] Selected 15 major industry groups are: IC 20-21(Manufacture of food products), IC 22(Manufacture of beverages, tobacco and related products), IC 23(Manufacture of cotton textiles), IC 24(Manufacture of wool, silk and man-made fibre textiles), IC 25(Manufacture of jute and other vegetable fibre textiles (except cotton), IC 26(Manufacture of textile products (including wearing apparel), IC 28(Manufacture of paper and paper products and printing, publishing and allied industries), IC 30(Manufacture of basic chemicals and chemical products (except products of petroleum and coal), IC 31(Manufacture of rubber, plastic, petroleum and coal products; processing of nuclear fuels), IC 32(Manufacture of non-metallic mineral products), IC 33(Basic metal and alloys industries), IC 34(Manufacture of metal products and parts, except machinery and equipment), IC 35-36(Manufacture of machinery and equipment other than transport equipment), IC 37(Manufacture of transport equipment and parts) and IC 40(Electricity).

[6] Quartiles are such values which divide the total number of observations into four equal parts. Three quartiles - first quartile (Lower quartile), second quartile (Middle quartile) and third quartile (Uppar quartile) divided the observations into four groups arranging the series in ascending order.

[7] Since the series is arranged in order of magnitude Q_2 corresponds to the median value of the series.

performer and the industries with value of ratios above Q_3 are 'excellent' performer with respect to a particular ratio. Table 3 presents the groupings of 15 major industries according to their seven financial parameters. In order to identify firm groupings of industries having similar values of a particular ratio, we perform cluster analysis. Clusters analysis classifies items into groups (clusters), such that the items within a group are sufficiently homogeneous and items in different groups are less homogeneous. There exists a variety of computation methods and homogeneity criteria (Jensen, 1971 and Johnson, 1967). In our analysis, we employ one of the non-hierarchical clustering techniques, namely, K-Means Method[8] using SPSS package. Results of cluster analysis (Table 4) show the four clusters[9] thus developed.

7. Consistency in Performance

7.1 With a view to assess the consistency in performance, we construct a scatter diagram with respect to the 15 major industries with average rank score with respect to a chosen ratio into on the horizontal axis and rank in items of the measure of volatility (i.e., CV) on the vertical axis. The idea is to analyse performance of any industry group simultaneously in terms of a score on individual value of a ratio and associated dispersion of the concerned ratio. The findings of this exercise is placed in Table 5.

8. Discussion of Results

8.1 The groupings of industries obtained from cluster analysis are almost similar to the groupings based on value of quartiles. Select financial ratios have thus displayed their representative power in segregating Indian manufacturing industries into three/four groups. We also gather a general idea about characteristics of each group of industries with respect to its profitability, operating management efficiency, liquidity, debt and interest servicing capacity, capital structure and working capital management efficiency. Table 6 gives a summary of characteristics of each group.

9. Implications and Conclusion

9.1 Results of empirical analyses demonstrate that financial ratios can depict underlying industry characteristics on the basis of which major Indian industries can be grouped in an

[8] MacQueen (1967) suggests the term K
– means for describing his algorithm that assigns each item to the cluster having the nearest centroid (mean). In its simplest version, the process is composed of three steps as follows:

a. Partition the items into K initial clusters.
b. Proceed through the list of items, assigning an item to the cluster whose centroid (mean) is nearest (distance is usually computed using Euclidean distance with either standardised or unstandardised observations). Recalculate the centroid for the cluster receiving the new item and for the cluster losing the item.
c. Repeat Step 2 until no more reassignments take place.

[9] Three clusters would have been adequate. However, we wanted to get four clusters to compare with the groupings based on value of Quartiles (Table 3). Besides, value of each of the ratios of IC 25 is so low that would have affected centroid of other clusters.

ordinal manner. The industry groupings match satisfactorily with classifications with qualitatively expressed economic characteristics of the industries, namely, profit earned by these industries over the reference period. For example, IC 25 earned profit only once in 1981 during the 18 years period. On the other hand, IC 22, IC 26 and IC 30 earned profit in all the years. Classifications of industries emanated from our results would help the entrepreneurs decide the type of industries in which they can invest. Financial ratios corresponding to a set of industry characteristics may serve as a bench mark for these sets of characteristics at the firm level. In this context, the results could find wide application in several aspects of planning at the firm, industry, or total economy level. Group averages might not only serve as the firm's target but also enable the management of a firm to evaluate its operating efficiency against several industries having similar characteristics. At macro level, group ratios might be used with reasonable confidence in their correspondence to economic factors. For example, our results indicate that industries that are performing well represent 73.07% of value of output, 57.42% of invested capital and 62.26% of number of workers. The industries that are not performing well represent 19.20% of value of output, 34.49% of invested capital and 28.02% of number of workers. The policy maker may thus get an idea about the group of industries that harbor more bad performing industrial units and decide on capital or any other type of subsidy support needed by an industry group. In recent time, there has been growing use of statistical grouping as a methodology in accounting research. In this context, our paper would find an indirect use as well. We have made an initial effort to examine the reasonableness of certain industry-wide accounting data in finding out industry characteristics. Using such groupings and corresponding accounting ratios, empirical models may be developed to predict future status of financial health of a firm at micro level.

References

Ahluwalia, Isher Judge (1985), "Industrial Growth in India: Stagnation since the Mid-Sixties", Oxford University Press, Oxford.

- (1991), "Productivity and Growth in Indian Manufacturing", Oxford University Press, New Delhi.

Balakrishnan, Pulapre and M. Suresh Babu (2003), "Growth and Distribution in Indian Industry in the Nineties", *Economic and Political Weekly*, 38(38), September 20.

Falk, H and Heintz, J. A (1975), "Assessing Industry Risk by Ratio Analysis", *The Accounting Review (October)*, : 758-779.

Golder, B N (1986): "Productivity Growth in Indian Industry", Allied Publishers, Delhi.

Gupta, M. C and Huefner, R. J (1972), "A Cluster Analysis Study of Financial Ratios and Industry Characteristics", *Journal of Accounting Research (Spring)*: 77-95.

Jensen, Robert E. (1971), "A Cluster Analysis Study of Financial Performance of Selected Business Firms", *The Accounting Review*, XLVI, January, : 36-56.

Johnson, Stephen C. (1967), "Hierarchical Clustering Schemes", *Psychometrika*, 32, September, : 241-54.

Mac Queen, J. B (1967),"Some Methods for Classification and Analysis of Multivariate Observations, Proceedings of 5th Berkeley Symposium on Mathematical Statistics and Probability", 1, Berkeley, Calif.: University of California Press.

Marks, S. Aldenderfer and Roger K. Blashfield (1984), "Cluster Analysis", Beverly Hills.

Siddharthan, N. S. and K. Lal (2003),"Liberalisation and Growth of Firms in India", *Economic and Political Weekly*, 38 (20).

Table 1: Mean and CVs of Selected Financial Ratios of Representative Industries and All Industries in India

Industry Group	Composite Ratio		ROIC		OCF/IC		ICR		LR		DSCR		WCMER	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
IC 20-21	0.72	30.78	0.17	31.76	0.22	25.97	2.01	35.65	0.48	99.90	1.18	30.05	0.30	28.31
IC 22	1.71	27.38	0.37	26.53	0.42	24.00	5.06	28.08	1.22	50.42	2.80	36.48	0.40	28.08
IC 23	0.27	51.36	0.08	63.04	0.15	33.45	0.72	63.85	-0.03	-649.83	0.57	36.47	0.15	65.60
IC 24	0.37	119.57	0.02	727.69	0.09	142.85	0.2	669.30	1.07	188.74	0.40	151.11	0.44	168.83
IC 25	-0.17	-201.36	-0.04	-190.48	0.004	2066.36	-0.40	-293.73	-0.46	-103.32	0.09	480.77	-0.19	-105.55
IC 26	1.36	51.03	0.36	39.15	0.41	34.89	3.77	49.76	0.98	108.30	2.15	54.74	0.47	22.34
IC 28	0.70	32.74	0.13	37.00	0.21	25.20	1.74	38.69	0.79	56.16	1.09	31.72	0.23	16.62
IC 30	1.48	31.60	0.24	41.71	0.30	36.60	4.17	40.27	1.63	56.49	2.08	38.47	0.49	51.14
IC 31	0.84	21.04	0.18	24.41	0.25	15.92	2.20	27.12	0.78	32.92	1.28	19.86	0.32	26.18
IC 32	0.79	21.87	0.16	32.06	0.14	24.19	2.07	32.27	0.81	18.93	1.25	22.18	0.21	13.63
IC 33	0.73	28.63	0.09	47.40	0.24	24.19	1.64	42.35	1.28	46.88	1.00	33.44	0.20	23.07
IC 34	0.67	16.77	0.30	29.59	0.35	25.00	1.52	23.85	0.44	84.82	1.06	17.70	0.35	18.61
IC 35-36	0.94	19.47	0.23	20.32	0.28	18.08	2.49	17.05	1.79	108.57	1.48	22.35	0.40	9.93
IC 37	0.88	27.53	0.15	42.73	0.21	31.33	2.28	36.25	0.98	35.85	1.35	29.96	0.32	27.70
IC 40	0.39	30.36	0.08	32.91	0.11	33.32	1.17	33.84	0.36	55.38	0.50	38.60	0.12	32.31
All	0.68	21.48	0.14	23.06	0.19	18.14	1.86	19.62	0.64	40.12	0.99	23.23	0.25	14.14

Source : Annual Survey of Industries - Various Years

Table 2: Quartiles and Medians in Respect of Seven Ratios

	ROIC	OCF/IC	ICR	DSCR	LR	WCMER	CR
Q_3	0.24	0.3	2.49	1.48	1.22	0.4	0.94
Q_2 = Median	0.16	0.22	2.01	1.18	0.81	0.32	0.73
Q_1	0.08	0.14	1.17	0.57	0.44	0.2	0.39

Table 3: Groupings of 15 Major Industries Based on Value of Quartiles

	ROIC	OCF/IC	ICR	LR	DSCR	WCMER	CR
Group-1 (Excellent performer)	IC 30, IC 34, IC 26, IC 22	IC 30, IC 34, IC 26, IC 22	IC 35-36, IC 26, IC 30, IC 22	IC 22, IC 33, IC 30, IC 35-36	IC 35-36, IC 30, IC 26, IC 22	IC 35-36, IC 24, IC 26, IC 30	IC 35-36, IC 26, IC 30, IC 22
Group-2 (Good performer)	IC 32, IC 20-21, IC 31, IC 35-36	IC 20-21, IC 33, IC 31, IC 35-36	IC 20-21, IC 32, IC 31, IC 37	IC 32, IC 26, IC 37, IC 24	IC 20-21, IC 32, IC 31, IC 37	IC 31, IC 37, IC 34, IC 22	IC 33, IC 32, IC 31, IC 37
Group-3 (Average performer)	IC 40, IC 33, IC 28, IC 37	IC 32, IC 23, IC 28, IC 37	IC 40, IC 34, IC 33, IC 28	IC 34, IC 20-21, IC 31, IC 28	IC 23, IC 33, IC 34, IC 28	IC 33, IC 32, IC 28, IC 20-21	IC 40, IC 34, IC 28, IC 20-21
Group-4 (Below average performer)	IC 25, IC 24, IC 23	IC 25, IC 24, IC 40	IC 25, IC 24, IC 23	IC 25, IC 23, IC 40	IC 25, IC 24, IC 40	IC 25, IC 40, IC 23	IC 25, IC 23, IC 24

Table 4: Clusters of Homogeneous Industries

Clusters	Industry Groups ROIC	Mean of	Mean of OCF/IC	Mean of ICR	Mean of LR	Mean of DSCR	Mean of WCMER
Cluster 1 (Excellent performer)	IC 22, IC 26, IC 30	0.32	0.38	4.33	1.28	2.34	0.45
Cluster 2 (Good performer)	IC 20-21, IC 28, IC 31, IC 32, IC 33, IC 34, IC 35-36, IC 37	0.18	0.24	1.99	0.92	2.21	0.29
Cluster 3 (Average performer)	IC 23, IC 24, IC 40	0.06	0.12	0.70	0.47	0.49	0.24
Cluster 4 (Below average performer)	IC 25	-0.04	-0.004	-0.04	-0.46	0.09	-0.19

Table 5: Findings from the Analysis of Scatter Diagram

Chosen ratios	Consistently good performer (high value of mean with low value of CV)	Inconsistently good performer (high value of mean with high value of CV)	Consistently bad performer (low value of mean and low value of CV)	Worst performer (low value of mean with high value of CV)
ROIC	IC 20-21, IC 22, IC 31, IC 32, IC 34, IC 35-36	IC 26, IC 30	IC 40	IC 23, IC 24, IC 25, IC 28, IC 33, IC 37
OCF/IC	IC 22, IC 31, IC 32, IC 34, IC 35-36	IC 20-21, IC 26, IC 30	IC 28, IC 33	IC 23, IC 24, IC 25, IC 37, IC 40
ICR	IC 20-21, IC 22, IC 31, IC 32, IC 35-36	IC 26, IC 30, IC 37	IC 34, IC 40	IC 23, IC 24, IC 25, IC 28, IC 33
DSCR	IC 20-21, IC 31, IC 32, IC 35-36, IC 37	IC 22, IC 26, IC 30	IC 28, IC 33, IC 34	IC 23, IC 24, IC 25, IC 40
LR	IC 22, IC 32, IC 33, IC 37	IC 24, IC 26, IC 30	IC 28, IC 31, IC 40	IC 20-21, IC 23, IC 25, IC 34, IC 35-36
WCMER	IC 26, IC 34, IC 35-36	IC 22, IC 24, IC 30, IC 37	IC 28, IC 31, IC 32, IC 33	IC 20-21, IC 23, IC 25, IC 40
CR	IC 22, IC 31, IC 35-36, IC 37	IC 26, IC 30	IC 32, IC 33, IC 34	IC 20-21, IC 23, IC 24, IC 25, IC 28, IC 40

Table 6: Characteristics of Industry Groups

Group	Industry	Characteristics
1 (Excellent performer)	IC 22 - Manufacture of beverages, tobacco and related products. IC 26 - Manufacture of textile products (including wearing apparel) IC 30 - Manufacture of basic chemicals and chemical products (except products of petroleum and coal)	• Efficient operating management, better liquidity position, higher capacity utilisation and assets turnover giving rise to satisfactory level of profit margin. • Cash generated from operation can meet the entire interest obligation and two times loan installment obligation. • Share holder's fund can cover more than 50% of total liabilities. • Net working capital can fund about 45% of total liabilities. • Performance is consistently good.

Table 6: Characteristics of Industry Groups (Contd.)

Group	Industry	Characteristics
2 (Good performer)	IC 20-21 - Manufacture of food products IC 28 - Manufacture of paper and paper products and printing, publishing and allied industries IC 31 - Manufacture of rubber, plastic, petroleum and coal products; processing of nuclear fuels IC 32 - Manufacture of non-metallic mineral products IC 33 - Basic metal and alloys industries IC 34 - Manufacture of metal products and parts, except machinery and equipment IC 35-36 - Manufacture of machinery and equipment other than transport equipment IC 37 - Manufacture of transport equipment and parts	• Satisfactory level of operating management, liquidity position, capacity utilisation and assets turnover giving rise to accepted level of profit margin. • Cash generated from operation can meet entire interest obligation and almost two times loan installment obligation indicating satisfactory level of interest and debt servicing capacity. • Share holder's fund can cover almost about 50% of total liabilities. • Net working capital can fund about 30% of total liabilities. • Performance is good but not consistent.
3 (Average performer)	IC 23 - Manufacture of cotton textiles IC 24 - Manufacture of wool, silk and man-made fibre textiles IC 40 - Electricity	• Inefficient operating management, sub-optimum level of capacity utilisation and assets turnover giving rise to moderate level of liquidity and profit margin. • Cash generated from operation is not adequate to meet interest and loan installment obligation indicating poor debt and interest servicing capacity. • Share holder's fund can hardly cover one third of total liabilities. • Net working capital can fund not more than one fourth of total liabilities. • Performance is consistently bad.
4 (Worst performer)	IC 25 - Manufacture of jute and other vegetable fibre textiles (except cotton)	• Worst operating management, capacity utilisation and assets turnover giving rise to incurring such a level of loss that causes liquidity crisis, non payment of interest and debt obligation. • Accumulated losses exceeds net worth. • Current liabilities are much less than current assets.

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Gender Bias in Indian Industry

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Abstract

In this paper an attempt has been made to look into the gender issues in terms of female workforce participation and wage differentials in the organized manufacturing sector in India. The major data sources for this paper are from the Annual Survey of Industries (ASI). Only female workers directly employed by the industry and engaged directly in the production process are considered for the study. From the analysis, it is found that around twenty percent of female workers are directly contributing to the production process during the year 2000-01 to 2009-10. However, there is a significant variation observed with respect to female work participation across different industry divisions. Similarly, it is observed that female participation rates have no uniformity within the States. It is also observed that significant wage differentials exist with respect to industry divisions and States.

1. Introduction

1.1 Gender discrimination in economic activities is a matter of concern for any welfare, democratic and developing State. Equal opportunity and compensation to female workforce are required to be in built in the governmental policies of such States. For this reason, there are campaigns across the globe focusing on the empowerment and rights of women in all aspects including education, employment and economic participation with a view to reducing gender inequality. Keeping development as a broader goal in the mind and focusing women participation in all economic activities, many international movements have been taking place to establish the gender equality and women empowerment.

1.2 The Millennium Development Goals (MDGs) emphasize on increasing gender equality in education as well as in the labour market. To monitor the growth in the female participation in the non-agricultural sector, an indicator is defined as the share of female workers in the non-agricultural sector expressed as a percentage of total employment in the sector. This measures the degree to which labour markets are open to women in industry and service sectors. Such indicators direct the policy makers not only towards the equal employment opportunity for women but also towards the economic efficiency through flexibility of the labour market. It also focuses on raising the status of women and for ensuring their full participation and integration in the development at all levels and draws attention on the problems specific to women such as steadily declining trend of their participation in the workforce.

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1.3 There are many studies across the globe on female workforce participation to find out the trend and pattern of female workforce participation with respect to different socio-economic background and characteristics (Ghosh, 2004; Karan and Selvaraj, 2008; Khanna, 2012). Some study concludes that in India, female workforce participation is the lowest among urban females. However, in rural India, the poverty considerations lead to greater labour force participation among females.

1.4 There are studies focused on the effect of economic development on the women participation in economic activity. They have concluded that female participation rate falls with the economic development (Reilly and Dutta, 2005). Another study examined the effect of certain development variables like marital status, income, literacy on female participation rates and concludes that socio-cultural factors have a significant bearing on the levels of female participation rate (Ghosh, 2004).

1.5 However, none of these studies did find out the exact determinants of female workforce participation. The female workforce participation varies across socio-economic, demographic and cultural backgrounds with respect to geographical region. It has been observed that in spite of higher level of literacy and educational level, the share of women in the labour force is poor. Indian society is believed to be male dominated. Lower value for women in the society or family may be a cause for their invisibility in economic activities of the country.

1.6 There are studies which focused on female participation as a whole with reference to their socio economic background (Ghosh, 2004; Karan and Selvaraj, 2008; Khanna, 2012). However, studies on female participation in several sectors in the economy are very few. Though in the economy as a whole the female participation is in upward trend, the female participation in manufacturing sector has not yet been examined properly. What is the level of female participation in manufacturing sector? Are there any differentials in female participation with respect to different industry division in manufacturing sector? Is there any variation in female participation in manufacturing sector with respect to different States in India? What is the wages pattern of the female workers vis-à-vis male workers in the manufacturing sector? This paper tries to answer some of these questions.

2. Need for the Study

2.1 There is no elaborate data-based study so far on gender bias in the Indian manufacturing sector. It is a fact that the manufacturing sector is dominated by the male workers. An attempt is being made to look into the female workforce participation and wage differentials in manufacturing sector in India. It will be interesting to find out the proportions of female workers in the manufacturing sector as a whole. Not only the overall female workforce participation in manufacturing sector but also it will be useful to examine the industry where female workforce participation is high in comparison to other industry and what are the industries where significant proportions of female workers are contributing in the manufacturing sector? Not only female workforce participation but also an attempt has been made to look into the wage differentials in manufacturing sector with respect to industry division and States in India.

2.2 The gender bias in Indian industry can be studied on the basis of female workforce participation and wage differentials in manufacturing sector. Keeping this in mind the paper focused on the following objectives as follows:

3. Objectives of the Study

(i) To examine the female workforce participation rate in organised manufacturing sector in India.
(ii) To study the female workforce participation with respect to major industry divisions.
(iii) To look into inter-State differentials in female workforce participation in organised manufacturing sector in India.
(iv) To look into the gender bias in wage structure in the organized manufacturing sector in India.

4. Data Sources and Methodology

4.1 The major data source for this paper is the Annual Survey of Industries (ASI) of different years. ASI is the principal source of industrial statistics in India. It collects information on organized manufacturing sector only those industries are registered under Section 2m(i) and 2m(ii) of the Factories Act, 1948 i.e. those factories employing 10 or more workers using power and those employing 20 or more workers without using power. ASI collects various information related to fixed capital, working capital, employment and labour cost, other expenses or receipts, various input items consumed, products and by-products manufactured by the unit etc. In this paper, the major focus is to study the female workforce participation in manufacturing sectors, so the Block E: Employment and labour cost (ASI Schedule) is used. In this block, information related to male workers employed directly, female workers employed directly, man days worked (manufacturing and non-manufacturing), average number of persons worked, no of mandays paid for and wages/salaries are available for analysis. Information related to female workers employed directly is used for analysis. It will be very much useful to analyse the proportions of female workers directly employed with respect to the total workers employed directly in the industry, as gender wise data are not available for the workers employed through contractor.

4.2 Before proceeding to analysis, it is important to know the definition of worker in manufacturing sector. Here workers are defined to include all persons employed directly or through any agency whether for wages or not and engaged in any manufacturing process or in cleaning any part of the machinery or premises used for manufacturing process or in any other kind of work incidental to or connected with the manufacturing process or the subject of the manufacturing process. Labour engaged in the repair & maintenance, or production of fixed assets for own use of the factory, or employed for generating electricity, or producing coal, gas etc. are included. In other words, the persons, directly involved in the production process, are considered as workers. Whereas, the persons, not directly engaged in the production process, are not included in the workers. Any persons though engaged in manufacturing and its ancillary activities but not receiving any payment or salaries like working proprietors (working member in case of a cooperative factory) or unpaid family members, etc., are not to be included as workers even if they may be termed

as workers under the Factories Act, 1948. It also excludes all persons holding positions of supervision or management or employed in confidential position even if classified as workers under the Factories Act, 1948.

4.3 In this paper, the female workforce participation is defined as the proportions of female workers directly employed in the total workers and contributing in the manufacturing process in the industry.

4.4 Therefore, the female workforce participation rate = (Total female workers directly employed / Total workers directly employed) × 100

5. All India Average

5.1 For the development of any society, female participation in manufacturing sector is one of the indicators of measurement. Table-1 presents the female participation rate in organized manufacturing sector in India during the year 2000-01 to 2009-10. From the table, it is observed that on an average 20 percent of females are participating in the organized manufacturing sector during the year 2000-01 to 2009-10. The remaining 80 percent are male workers. From this analysis, it is clearly understood that the organized manufacturing sector in India is dominated by male workers. Even if there are lots of changes taking place with respect to female literacy, female empowerment, female employment etc. but during this ten years there is no significant change in the proportions of female participation in the organized manufacturing sector.

5.2 During this period, the female participation rate is almost constant at around 20 percent. Despite many welfare policies for the protection and safety of female workers for improving the female labour force participation in the manufacturing sector, female participation in organized manufacturing sector has not grown up.

6. Industry-wise Variation in Female work Force Participation

6.1 Though overall average is not varying, there are indications of inter-industry variation in female workers. For this reason, an attempt has been made to look into the female work force participation with respect to industry division. Table -2 presents the percentage distribution of female workers in Indian industries during the year 2008-09 and 2009-10. The data reveal that more than 50 percent of workers in the industry of tobacco products (58.78 percent) and wearing apparel (50.36 percent) are female. Similarly, in the leather product related industry (31.58 percent) and food products industry (31.35 percent), significant proportions of workers are female. Again,industry like post harvest crop & seed processing activities (28.06 percent), computer, electronic & optical products (23.26 percent), chemical & chemical products (22.92 percent), textiles (19.28 percent), significant proportions of workers are female.

6.2 Industry dealing with transport equipment, publishing activities, basic metals, machinery & equipment, waste collection, treatment & disposal activities, fabricated metal products, manufacture of furniture, repair & installation of machinery & equipment, coke & refined petroleum products, motor vehicles, trailers and semi-trailers etc., the female

workforce participation is very minimal. From the data, it may be said that industries related to tobacco products, wearing apparel, leather & related products, food products, post harvest crop & seed processing activities, where the female workforce participation is significantly high in comparison to other industry, provide a conducive nature of work for the female. Tables 3 to 6 present the industry wise analysis of female workers in manufacturing sector in India.

7. Industry on Tobacco Product: Under this division, industries like manufacturing of bidi, cigars & cheroots, stemming & re-drying of tobacco, snuff, zarda, pan masala & related products etc. are included. From the Table-3, it is evident that higher proportions (68.73 percent) of female workers are working in the manufacture of bidi industry followed by manufacture of cigars & cheroots, manufacture of other tobacco products including chewing tobacco and stemming & re-drying of tobacco industry.

8. Industry on Wearing and Apparel: Under this division, the major industries namely manufacturing of rain coats of waterproof textile fabrics or plastic sheet, manufacturing of hats, caps and other clothing accessories such as gloves, belts, ties, cravats etc., manufacturing of all types of textiles garments & clothing accessories, manufacturing of wearing apparel made of leather & substitutes of leather etc. are important. From Table 4, it is evident that higher number of female workers are working in manufacturing of all types of textile garments & clothing accessories (54.78 percent) followed by manufacturing of knitted or crocheted wearing apparel (38. 77 %) and manufacturing of hats, caps & other clothing accessories industries such as gloves, belts, ties etc. (72.54 percent).

9. Leather and Related Product: All kinds of products made of leather are included in this division. From Table 5, it is evident that a higher number of female workers is working in the industry related to leather footwear such as shoes, sandals, chappals, leather-cum-rubber/plastic cloth sandals and chappals (41.20 percent) followed by manufacturing of purses, ladies handbags, artistic leather gift articles and novelties (29.12 percent).

10. Food Processing: Under this division, all kinds of food processing industry such as processing of edible nuts, grain milling other than wheat, rice & dal, manufacture of pickles, chutney etc. and other similar industries are included. From Table 6, it is evident that a very high proportion (94.53 percent) of female workers is working in the processing of edible nuts industry. Similarly, in grain milling, manufacturing of pickles, chutney etc. processing & preserving of fish etc., significantly higher proportions of female workers are contributing to the production process.

11. Interstate Variation in Female Work Participation

11.1 Female workforce participation in manufacturing sector not only varies across industry divisions but also across different States in India. Research studies (Fajimi and Omonona, 2010) found that higher proportions of females are participating in the workforce because of poverty. There may be a possibility to interpret that higher rates of female workforce participation in a State implies higher proportions poor people in that State.

11.2 The Graph-1 presents the inter-State differentials in female participation in manufacturing sector in India during the year 2009-10. From the graph, it is evident that there are variations in female workforce participation in manufacturing sector over different States. The top seven States with relatively higher proportions of females workers in the manufacturing sector are Kerala (65 percent) , Manipur (43 percent), Karnataka, (41 percent), Tamil Nadu (41 percent), Sikkim (31 percent), Andhra Pradesh (23 percent) and Puducherry (20 percent). However, in States such as West Bengal, Chattisgarh, Uttar Pradesh, Punjab, Rajasthan, Haryana, Bihar, Chandigarh etc. female workforce participation is less than 5 percent. It is observed that the States with higher female literacy rate are showing a trend of higher female participation in the manufacturing sector. The perception that female labour force comes from the poorer sections of the population may not be true in case of organized manufacturing sector. From our study, it is revealed that the poorer States like Odisha, Bihar, Uttar Pradesh, Madhya Pradesh and Rajasthan, the female participation in organized manufacturing sector is minimal at around 5 percent. It might be possible that the relationship between poverty and female workforce participation may not hold good for the organized manufacturing sector at the macro level.

12. Wage Differentials

12.1 Apart from studying the gender differentials in work participation in manufacturing sector, an attempt has been made to look into the wage differentials also. Studies from across the globe found that irrespective of sectors or geographic regions, the female workers are getting lesser wages than their male counterparts (Perinelli and Beken, 2011). A study by Karan and Selvaraj (2008) found that irrespective of different sectors such as agriculture, manufacturing and services in India, female workers are getting lower wages than their male counterparts. There are studies revealing wage differentials and the reasons thereof in India (Khanna, 2012; Reilly and Dutta, 2005). In the following section an attempt has been made to look into the wage differential in the registered manufacturing sector in India.

12.2 We define Wage Differential Ratio = Average female workers wage/ Average male workers wage. The average wage has been calculated on the basis of total annual wages to total man-days worked. So, the average female workers wage has been calculated on the basis of total female annual wage to total man-days worked for female workers. Similarly, the average male worker wage has been calculated on the basis of total annual wage to total man-days worked for male workers.

13. Wage Differentials Industry-wise

13.1 An attempt has been made to look into the wage differentials in different industry divisions in manufacturing sector. Table-7 presents the wage differentials with respect to NIC divisions based on ASI 2009-10 all India data. From the analysis, it is observed that irrespective of industry divisions female workers are getting lower wages than that of male workers. At an aggregate level, the female workers are getting on an average 48 percent lesser wage than that of male. The wage differentials also vary across industry divisions. There are industries such as chemicals and chemical products, tobacco products, waste collection, food products, non metallic minerals products, paper and paper products,

the male-female wage differentials are very high. In the chemical and chemical products industries, the female workers are getting only 24 percent of the average male workers wage. Similarly, in tobacco products industries where significantly large number of female workers (58.79%) are in the production process, wage differential ratio is also as high as 0.39. Again in food products industry, the participation of female workers is moderately high (31.35 %) but the female workers are getting lesser wage. The wage differential ratio is as high as 0.50. In the industries dealing with pharmaceuticals products, wearing apparel, post-harvest crop activities, seed processing for propagation and publishing activities, the wage differentials are comparatively better for female than other industries. In these industries, average female workers wage is around 75 percent of the male workers wage.

13.2 Now the question arises whether there is any relation with the female work participation and wage differentials with respect to industry divisions or not? It is already observed that the industries related to tobacco products, wearing apparel, leather related products and food products with high proportions of female workers show higher wage differentials. In tobacco products industries, average male workers are getting Rs. 214 per-day whereas average female workers in the same industry are getting Rs. 84 per-day. Similarly, in food products industries average male workers are getting Rs. 221 per-day, whereas average female workers are getting only Rs. 110 per-day. From this analysis, it may be concluded that those industries where female participation is high, the wage differential is also comparatively high. Those industries such as transport equipment, publishing activities, basic metals, machinery & equipment, fabricated metal products, manufacture of furniture, repair & installation of machinery & equipment, coke & refined petroleum products, motor vehicles, trailers and semi-trailers etc. where the female workforce participation is low, the wage differential is also comparatively low. This may indicate that in female worker dominated industry, the wage profile of female workers is bad.

14. Wage Differentials State-wise

14.1 It is already observed that there is a significant difference in female workforce participation across different States in India. Table-8 showing the state wise wage differentials based on ASI 2009-10 reveals that in the States namely Kerala, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu, the wage differentials are very high. In Kerala, the average male workers are getting Rs. 375 per-day whereas the average female workers are getting Rs. 113 per-day. Similarly, in Maharashtra, the average male workers are getting Rs. 426 per-day whereas the average female workers are getting Rs. 174 per-day. Similar pattern is also observed in other States namely, Andhra Pradesh, Karnataka and Tamil Nadu. The States namely, Himachal Pradesh, Chandigarh, Delhi, Manipur, Punjab, Haryana, Bihar, Jammu & Kashmir and West Bengal, the wage differentials are comparatively low. In these States, the wage difference between male workers and female workers is much lower than that of other States. In Himachal Pradesh, the average male workers are getting Rs. 223 per-day whereas the average female workers are getting Rs. 207 per-day. In Chandigarh, the average male workers are getting Rs. 326 per-day whereas the average female workers are getting Rs. 297 per-day. From the above data, it is observed that those States where female work participation is higher, the wage differentials are also comparatively higher.

14.2 Apart of inter industry and inter state wage differentials, an attempt has also been made to look into the wage differentials within a State with respect to industry divisions. For this analysis, selected States namely Kerala and West Bengal are considered on the basis of female work participation rate. From the Table-9, it is observed that the same all India picture exists in the State of Kerala also. The industries related to food products, pharmaceuticals, textiles, paper & paper products with higher female workforce participation also exhibit higher wage differentials. In food products industries, around 90 percent of female workers are engaged in Kerala but getting 55 percent less wages than the male workers in the same industry. In food processing industries, a male worker is getting Rs. 231 per-day whereas a female worker is getting Rs. 104 per-day in Kerala. Similarly, in wearing apparel, pharmaceutical products and textiles industries, where the female workforce participation is comparatively higher, the female workers are getting lower wages than their male counterpart. In wearing apparel industry, around 76 percent of workers are female but getting only 54 percent of wages of their male counterpart. In wearing apparel industry a male workers is getting Rs. 282 per-day whereas a female worker in the same industry is getting Rs. 151 per-day. Similarly in pharmaceuticals, medicinal, chemical and botanical products where 43 percent of the female workers are engaged, female workers are getting 60 percent lower wages in comparison to the male workers in the same industry. In this industry when a male worker is getting Rs. 364 per-day whereas a female worker is getting Rs. 160 per-day.

14.3 Table-10 presents the NIC wise wage differentials in the state of West Bengal based on ASI 2009-10. From the table, the same picture is revealed. The reasons for taking these two States are based on the common perception that women are comparatively better in terms of female literacy and societal attitude towards women. However, the results do not reverse the gender bias already present in the manufacturing sector.

15. Conclusion

15.1 From the above discussion, it is found that around 20 percent of female are participating in organized manufacturing sector as worker. However, there are significant variations observed in female work participation with respect to industry divisions. It is found that the industry related to tobacco products, wearing apparel, leather and related products, food products, post-harvest crop activities and seed processing, there are significant proportions of female workers. Again, there are some other industries related to coke & refined petroleum products, repair & installation of machinery & equipment, manufacture of furniture, fabricated metal products, waste collection, machinery & equipment, basic metals, publishing activities, female participation is low.

15.2 It is observed that the female participations have variation within the States in India. There are States namely Kerala, Manipur, Karnataka, Tamil Nadu, Sikkim, Andhra Pradesh, Puducherry where significant proportions of females workers are found as against the States namely West Bengal, Chhattisgarh, Uttar Pradesh, Punjab, Rajasthan, Haryana, Bihar, Chandigarh.

15.3 Not only female work participation in manufacturing sector is low but also wage differentials with respect to industry divisions and States are also alarming. From the

analysis, it is found that industries with a comparatively higher proportion of female workers are paying them lower than the average male-wages. Thus, wage differentials may be one of the major reasons for less participation of female workers in manufacturing sector. Exploitation or gender bias is well exhibited in the factory sector revealed through ASI.

15.4 In the development of the economy, the informal sectors are growing fast. There is a possibility of engagement of female workforce in the informal sector. Women are also traditionally associated with the service sector jobs. Formal sector service employment of women remains quite limited. Even in the emerging service sectors such as IT, the share of women is quite low. In the software industry, for example, the share of women workers is estimated to be around 27 percent. On the whole, in the emerging sectors, women's work tends to be concentrated in a low end- low skilled job (Ghosh, 2004). Agriculture continues to register highest share of female employment (Khanna,2012).

15.5 The variation in female participation within the State may be due to the following reasons:

(i) The position of industrialization in the State.
(ii) Possibilities of alternative employment like in primary and services sector.
(iii) Social restrictions.
(iv) Degree of hardship and labour involved.
(v) Wage differentials
(vi) Higher engagement in the informal sectors.

15.6 Government of India has implemented many laws and policies for safety and protection of the female work force in manufacturing sector, in terms of policies such as The Factories Act, 1948, The Maternity Benefit Act, 1961, The Equal Remuneration Act, 1976, The Mines Act, 1952 etc. for the safety in the work place with special reference to female workers. However, the gender bias as revealed in the study requires to be removed through proper policy planning and serious institutional corrections. The absence collective bargaining power of female workers is revealed in female worker dominated industries where the wage differentials are found to be very high against women. This directs towards weakness in women empowerment in the society.

16. Limitations of the Study

This study has not taken the input from the informal/unorganized sector due to data limitation.

References:

Census of India (2001), "Primary Census Abstract". Office of the Registrar General and Census Commissioner, India, New Delhi.

Fajimi, F. O. and Omonona, B. T., (2010), "Women Participation in Agro-allied Small and Medium Scale Enterprise and its Impact on Poverty Alleviation in Oyo State Nigeria", *Journal of American Science*, 6(12) : 771-780.

Ghosh, J. (2004), "Informalisation and Womens Workforce Participation: A Consideration of Recent Trends in Asia" available at: http://www.networkideas.org/featart/apr2004/Women_informal_work.pdf.

Government of India, (2011), "Millennium Development Goals India Country Report-2011". Central Statistics Office, Ministry of Statistics and Programme Implementation.

Karan, Anup K. and Selvaraj, Sakthivel (2008), "Trends in wages and earnings in India: Increasing wage differentials in a segmented labour market". ILO Asia-Pacific Working Paper Series.

Khanna, Shantanu (2012), "Gender Wage Discrimination in India: Glass Ceiling or Sticky Floor?" Working Paper no. 214, Centre for Development Economics, Delhi School of Economics, University of Delhi.

Perinelli, Bruno and Beken Victor A. (2011), "The Gender Gap: A Comparative Analysis of Wages in Times of Recession". Wage Indicator Foundation.

Reilly, Barry and Dutta, Puja Vasudeva (2005), "The Gender Pay Gap and Trade Liberalisation: Evidence for India". PRUS working Paper no. 32.

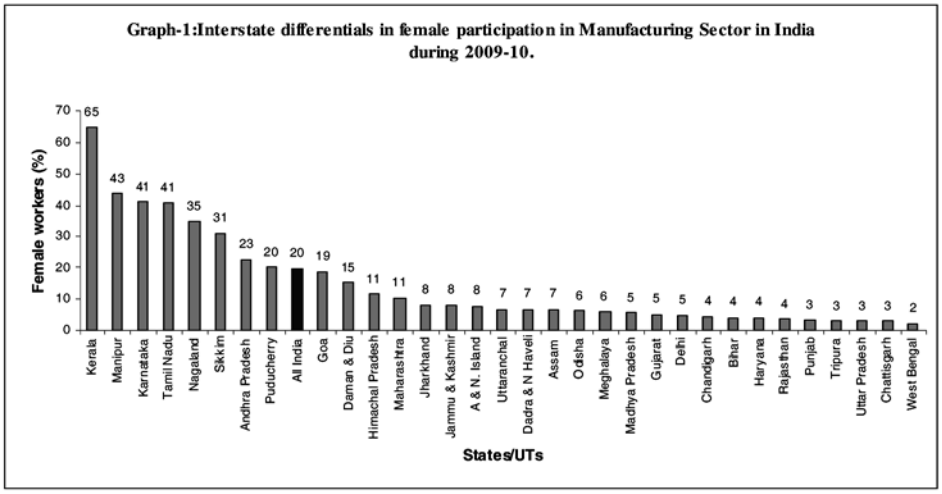

Table-1: Percentage of Female Participation in Manufacturing Sector in India during 2000-01 to 2009-10.

Year	Female Participation (%)
2000-01	18.05
2001-02	19.08
2002-03	19.62
2003-04	19.49
2004-05	20.36
2005-06	19.81
2006-07	20.66
2007-08	19.78
2008-09	20.05
2009-10	19.81

Table – 2: Percentage distribution of Female workers in Indian Industries (NIC-2008) during 2008-09 and 2009-10.

NIC-08 (2-digit)	Description	Female worker (%)	
		2008-09	2009-10
12	Tobacco products	50.70	58.79
14	Wearing apparel	52.56	50.36
15	Leather and related products	33.08	31.58
10	Food products	32.57	31.35
01	Post harvest crop and seed processing activities	34.19	28.06
26	Computer, electronic and optical products	23.17	23.26
20	Chemicals and chemical products	23.69	22.92
32	Other manufacturing	20.31	21.43
13	Textiles	19.54	19.28
21	Pharmaceuticals, medicinal chemical and botanical products	13.96	15.27
16	Wood and products of wood and cork, except furniture	10.36	11.67
11	Beverages	12.09	11.22
18	Printing and reproduction of recorded media	8.72	10.80
17	Paper and paper products	10.95	10.54
23	Other non-metallic mineral products	8.94	9.90
22	Rubber and plastics products	9.21	9.86
08	Other mining and quarrying	2.83	9.32
27	Electrical equipment	10.42	8.47
29	Motor vehicles, trailers and semi-trailers	5.30	7.12
19	Coke and refined petroleum products	4.37	6.01
33	Repair and installation of machinery and equipment	2.60	5.79
31	Manufacture of furniture	3.68	4.81
25	Fabricated metal products, except machinery and equipment	3.14	3.32
38	Waste collection, treatment & disposal activities; materials recovery	12.13	3.21
28	Machinery and equipment n.e.c.	2.21	2.21
24	Basic metals	1.92	1.67
58	Publishing activities	1.31	1.38
30	Other transport equipment	1.58	1.09
Other	Other industries	1.31	2.62

Table-3: NIC-2008 wise percentage of female workers in Tobacco Industries during 2009-10.

NIC-2008	Description	Male Workers (no.)	Female Workers (no.)	Total Workers (no.)	Female Workers (%)
12002	Manufacture of bidi	30670	67402	98072	68.73
12004	Manufacture of cigars and cheroots	46	92	138	66.67
12009	Manufacture of other tobacco products including chewing tobacco n.e.c.	2363	2754	5117	53.82
12001	Stemming and redrying of tobacco	4742	4295	9037	47.53
12005	Manufacture of snuff	475	217	692	31.36
12006	Manufacture of zarda	2478	305	2783	10.96
12008	Manufacture of pan masala and related products.	4585	307	4892	6.28
12007	Manufacture of catechu(katha) and chewing lime	1765	51	1816	2.81
12003	Manufacture of cigarettes, cigarette tobacco	5774	26	5800	0.45
Total		**52898**	**75449**	**128347**	**58.79**

Table-4: NIC-2008 wise percentage of female workers in Wearing Apparel Industries during 2009-10.

NIC-2008	Description	Male Workers (no.)	Female Workers (no.)	Total Workers (no.)	Female Workers (%)
14102	Manufacture of rain coats of waterproof textile fabrics or plastic sheetings	42	118	160	73.75
14103	Manufacture of hats, caps and other clothing accessories such as gloves, belts, ties, cravats, hairnets etc.	2981	7874	10855	72.54
14101	Manufacture of all types of textile garments and clothing accessories	193644	234540	428184	54.78
14104	Manufacture of wearing apparel made of leather and substitutes of leather	3618	4304	7922	54.33
14201	Manufacture of wearing apparel and clothing accessories made of fur	104	123	227	54.19
14309	Manufacture of other knitted and crocheted apparel including hosiery	13981	9383	23364	40.16
14301	Manufacture of knitted or crocheted wearing apparel and other made-up articles directly into shape (pullovers, cardigans, jerseys, waistcoats and similar articles)	93079	58930	152009	38.77
14109	Manufacture of wearing apparel n.e.c.	6057	3401	9458	35.96
14105	Custom tailoring	562	167	729	22.91
14202	Manufacture of fur and skin rugs and other similar articles	177	3	180	1.67
Total		**314245**	**318843**	**633088**	**50.36**

Table-5: NIC-2008 wise percentage of female workers in Leather and Related Product Industries during 2009-10.

NIC-2008	Description	Male Workers (no.)	Female Workers (no.)	Total Workers (no.)	Female Workers (%)
15121	Manufacture of travel goods like suitcase, bags, hold alls etc.	1092	1075	2167	49.61
15201	Manufacture of leather footwear such as shoes, sandals, chappals, leather-cum-rubber/plastic cloth sandles and chappals	60380	42306	102686	41.20
15129	Manufacture of other consumer goods of leather and substitutes of leather n.e.c.	2143	1124	3267	34.40
15116	Embroidering and embossing of leather articles	164	83	247	33.60
15122	Manufacture of purse, ladies' handbags, artistic leather presented articles and novelties	13660	5612	19272	29.12
15209	Manufacture of other footwear n.e.c.	8936	2279	11215	20.32
15112	Tanning and finishing of sole leather	1948	405	2353	17.21
15115	Finishing of upper leather, lining leather and garment leather etc.	12789	2246	15035	14.94
15114	Scraping, currying, tanning, bleaching, shearing and plucking and dyeing of fur skins and hides with the hair on	161	27	188	14.36
15123	Manufacture of saddlery and harness	1411	125	1536	8.14
15119	Other tanning, curing, finishing, embossing etc. of leather	2105	157	2262	6.94
15202	Manufacture of footwear made primarily of vulcanized or moulded rubber and plastic.	11485	722	12207	5.91
15111	Flaying and curing of raw hides and skins	933	46	979	4.70
15113	Tanning and finishing of industrial leather	5046	223	5269	4.23
Total		**122253**	**56430**	**178683**	**31.58**

Table-6: NIC-2008 wise percentage of female workers in Food Processing Industries during 2009-10.

NIC-2008	Description	Male Workers (no.)	Female Workers (no.)	Total Workers (no.)	Female Workers (%)
10793	Processing of edible nuts	10484	181062	191546	94.53
10736	Preserving in sugar of fruit, nuts, fruit peels and other parts of plants	305	862	1167	73.86
10614	Grain milling other than wheat, rice and dal	3627	5561	9188	60.52
10306	Manufacture of pickles, chutney etc.	1906	2798	4704	59.48
10204	Processing and preserving of fish crustacean and similar foods	2251	2727	4978	54.78
10205	Processing and canning of fish	3227	3878	7105	54.58
10796	Manufacture of papads, appalam and similar food products	1274	1204	2478	48.59
10799	Other semi-processed, processed or instant foods n.e.c. except farinaceous products and malted foods and manufactu-ing activities like manufacture of egg powder, sambar powder etc. (this excludes the activities covered under 10619)	8576	7964	16540	48.15
10615	Vegetable milling (production of flour or meal of dried leguminous vegetables (except dal), of roots or tubers, or of edible nuts)	364	282	646	43.65
10622	Manufacture of sago and sago products	2314	1768	4082	43.31
10203	Radiation preservation of fish and similar food	135	101	236	42.80
10798	Processing of salt into food-grade salt, e.g. iodized salt	3175	2033	5208	39.04
10407	Manufacture of non-defatted flour or meals of oilseeds, oilnuts or kernels	22	13	35	37.14
10797	Manufacture of vitaminised high protein flour, frying of dal and other cereals	1783	1049	2832	37.04
10795	Grinding and processing of spices	5160	2998	8158	36.75
10623	Manufacture of glucose, glucose syrup, maltose etc.	172	95	267	35.58
10307	Canning of fruits and vegetables	2935	1597	4532	35.24
10750	Manufacture of prepared meals and dishes	7740	3790	11530	32.87
10304	Manufacture of fruit or vegetable juices & their concentrates, squashes and powder	2003	934	2937	31.80
10739	Manufacture of other cocoa, chocolate, sugar confectionery products n.e.c.	1738	762	2500	30.48
10792	Coffee curing, roasting, grinding blending etc. and manufacturing of coffee products	2709	1070	3779	28.31

Table-6: NIC-2008 wise percentage of female workers in Food Processing Industries during 2009-10 (contd.)

NIC-2008	Description	Male Workers (no.)	Female Workers (no.)	Total Workers (no.)	Female Workers (%)
10309	Preservation of fruit and vegetables n.e.c.	2218	749	2967	25.24
10619	Other grain milling and processing n.e.c.	8574	2816	11390	24.72
10505	Manufacture of ice-cream, kulfi etc.	1466	445	1911	23.29
10740	Manufacture of macaroni, noodles, couscous and similar farinaceous products	1418	405	1823	22.22
10209	Production, processing and preservation of other fish products n.e.c	775	221	996	22.19
10616	Manufacture of cereal breakfast foods obtained by roasting or swelling cereal grains	1751	498	2249	22.14
10104	Poultry and other slaughtering, preparation	467	129	596	21.64
10305	Manufacture of sauces, jams, jellies and marmalades	1972	543	2515	21.59
10727	Manufacture of 'boora' and candy from other than sugarcane	27	6	33	18.18
10719	Manufacture of other bakery products n.e.c.	2989	627	3616	17.34
10308	Manufacture of potato flour & meals and prepared meals of vegetables	442	78	520	15.00
10732	Manufacture of chocolate and chocolate confectionery	1576	276	1852	14.90
10612	Rice milling	84763	14476	99239	14.59
10613	Dal (pulses) milling	7605	1292	8897	14.52
10109	Production, processing and preserving of other meat and meat products n.e.c.	683	91	774	11.76
10406	Manufacture of oil cakes & meals incl. residual products, e.g. Oleostearin, Palmstearin	2119	278	2397	11.60
10105	Preservation, Processing and canning of meat	2706	333	3039	10.96
10803	Manufacture of prepared feeds for pets, including dogs, cats, birds, fish etc.	1562	186	1748	10.64
10733	Manufacture of sugar confectionery (except sweetmeats)	3568	420	3988	10.53
Total		**578357**	**264068**	**842425**	**31.35**

Table-7: NIC-2008 wise Wage differentials based on ASI 2009-10 (All India).

NIC -08	Description	Female Participation (%)	Average Male Workers Wages (Rs.) per day	Average Female Workers Wages (Rs.) per day	Wage Differential ratio (F/M)
All		19.81	303	147	0.48
20	Chemicals and chemical products	22.92	412	101	0.24
12	Tobacco products	58.79	214	84	0.39
38	Waste collection, treatment & disposal activities; materials recovery	3.21	232	98	0.42
10	Food products	31.35	221	110	0.50
17	Paper and paper products	10.54	276	138	0.50
23	Other non-metallic mineral products	9.90	254	130	0.51
31	Manufacture of furniture	4.81	320	165	0.52
22	Rubber and plastics products	9.86	299	155	0.52
18	Printing & reproduction of recorded media	10.80	285	153	0.54
19	Coke and refined petroleum products	6.01	961	540	0.56
11	Beverages	11.22	299	176	0.59
32	Other manufacturing	21.43	294	173	0.59
16	Wood and products of wood and cork, except furniture	11.67	168	100	0.60
29	Motor vehicles, trailers and semi-trailers	7.12	447	271	0.61
27	Electrical equipment	8.47	379	232	0.61
13	Textiles	19.28	203	128	0.63
26	Computer, electronic and optical products	23.26	407	270	0.66
15	Leather and related products	31.58	205	142	0.69
30	Other transport equipment	1.09	424	301	0.71
28	Machinery and equipment n.e.c.	2.21	417	309	0.74
01	Post harvest crop and seed processing activities	28.06	168	125	0.74
33	Repair and installation of machinery and equipment	5.79	549	411	0.75
08	Other mining and quarrying	9.32	150	113	0.75
14	Wearing apparel	50.36	204	158	0.77
21	Pharmaceuticals, medicinal chemical and botanical products	15.27	347	269	0.78
58	Publishing activities	1.38	374	300	0.80
25	Fabricated metal products, except machinery and equipment	3.32	298	240	0.80
24	Basic metals	1.67	394	488	1.24
Other	Other industries	2.62	267	255	0.96

Table-8: Selected State-wise Wage differentials based on ASI 2009-10 (All India).

State Name	Female Participation (%)	Average Male Workers Wages (Rs.) per day	Average Female Workers Wages (Rs.) per day	Wage Differential ratio (F/M)
All India	19.81	303	147	0.48
Kerala	64.77	375	113	0.30
Maharashtra	10.61	426	174	0.41
Andhra Pradesh	22.66	309	136	0.44
Karnataka	40.93	354	166	0.47
Tamil Nadu	40.72	276	133	0.48
Rajasthan	3.70	239	128	0.53
Madhya Pradesh	5.44	307	177	0.58
Goa	18.54	480	278	0.58
Uttarakhand	6.66	359	208	0.58
Daman & Diu	15.40	202	120	0.59
Odisha	6.18	385	236	0.61
Gujarat	5.04	276	176	0.64
Assam	6.57	191	126	0.66
Dadra & N Haveli	6.61	216	142	0.66
Puducherry	20.23	287	197	0.69
Chattisgarh	2.83	308	215	0.70
Jammu & Kashmir	8.12	209	151	0.72
West Bengal	2.25	261	198	0.76
Sikkim	30.76	264	204	0.77
Uttar Pradesh	2.88	270	209	0.77
Punjab	3.48	222	174	0.78
Haryana	4.11	302	239	0.79
Manipur	43.44	126	105	0.83
A & N. Island	7.67	210	180	0.85
Delhi	4.83	233	208	0.89
Chandigarh	4.37	326	297	0.91
Jharkhand	8.36	481	446	0.93
Himachal Pradesh	11.44	223	207	0.93
Bihar	4.12	274	276	1.01
Meghalaya	6.07	250	284	1.14

Table-9: NIC-2008 wise Wage differentials based on ASI 2009-10 (Kerala).

NIC-08	Description	Female Participation (%)	Average Male Workers Wages (Rs.) per day	Average Female Workers Wages (Rs.) per day	Wage Differential ratio (F/M)
All		64.77	375	113	0.30
19	Coke and refined petroleum products	1.06	1262	158	0.13
20	Chemicals and chemical products	8.29	707	218	0.31
29	Motor vehicles, trailers and semi-trailers	13.64	335	114	0.34
28	Machinery and equipment n.e.c.	6.90	590	206	0.35
24	Basic metals	1.81	436	163	0.37
21	Pharmaceuticals, medicinal chemical and botanical products	43.17	364	159	0.44
30	Other transport equipment	2.39	1043	469	0.45
10	Food products	88.99	231	104	0.45
17	Paper and paper products	21.72	523	238	0.46
23	Other non-metallic mineral products	29.19	321	150	0.47
13	Textiles	37.21	230	108	0.47
27	Electrical equipment	26.72	492	254	0.52
14	Wearing apparel	76.33	282	151	0.54
22	Rubber and plastics products	15.53	406	222	0.55
26	Computer, electronic and optical products	36.75	781	454	0.58
33	Repair and installation of machinery and equipment	25.51	344	214	0.62
31	Manufacture of furniture	4.15	254	167	0.66
32	Other manufacturing	57.96	299	208	0.69
11	Beverages	26.46	668	470	0.70
16	Wood and products of wood and cork, except furniture	38.62	152	107	0.71
18	Printing and reproduction of recorded media	10.02	454	322	0.71
15	Leather and related products	26.17	200	149	0.75
58	Publishing activities	3.97	513	400	0.78
12	Tobacco products	83.94	80	65	0.81
38	Waste collection, treatment & disposal activities; materials recovery	41.03	142	118	0.84
25	Fabricated metal products, except machinery and equipment	6.28	291	255	0.88
Other	Other industries	4.71	244	169	0.69

Table-10: NIC-2008 wise Wage differentials based on ASI 2009-10 (West Bengal)

NIC-08	Description	Female Participation (%)	Average Male Workers Wages (Rs.) per day	Average Female Workers Wages (Rs.) per day	Wage Differential ratio (F/M)
All		2.25	261	198	0.76
27	Electrical equipment	0.61	450	120	0.27
12	Tobacco products	6.18	129	45	0.35
11	Beverages	0.77	469	203	0.43
20	Chemicals and chemical products	3.17	482	230	0.48
32	Other manufacturing	8.91	216	108	0.50
15	Leather and related products	5.66	244	136	0.56
21	Pharmaceuticals, medicinal chemical and botanical products	7.83	343	206	0.60
17	Paper and paper products	1.06	245	148	0.60
14	Wearing apparel	8.41	207	139	0.67
23	Other non-metallic mineral products	1.83	233	160	0.69
13	Textiles	1.93	231	162	0.70
16	Wood and products of wood and cork, except furniture	1.33	134	102	0.76
19	Coke and refined petroleum products	5.68	970	747	0.77
28	Machinery and equipment n.e.c.	1.62	328	288	0.88
10	Food products	3.24	110	107	0.97
22	Rubber and plastics products	1.54	167	165	0.99
26	Computer, electronic and optical products	6.85	473	495	1.05

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Employment and Productivity Trends in the Organised Manufacturing Sector of Tamil Nadu - 1983-2006

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Abstract

Examining the hypothesis of jobless growth in the organised manufacturing sector (OMS) in the State of Tamil Nadu (T.N.), the paper finds that there is some evidence of jobless growth in the post-reform years (1994-2006). However, in both the pre-reform period (1983-93) and the combined period of 1983-2006 there is growth with employment generation. The results of the test for structural change reveal that there is evidence of structural stability in respect of employment generation in the state. This means that the net effect of employment generation over a longer time frame has not been adverse for the state.

1. Introduction

1.1 The performance of organised manufacturing sector in India, for close to three decades now, is widely reported to be marked for its jobless growth status, meaning that growth in output was at the expense of job creation (i.e. negative employment growth). In the backdrop of such a growth process considered undesirable for a labour surplus economy like India, it is important to study the feature of jobless growth with a focus on individual states. This is because a certain trend prevailing at the 'all India' level may not necessarily prevail at the sub-national level as it bears a relationship with the effectiveness of state focused industrial and employment policies pursued. Against this background, the present paper analyses the employment and productivity trends in the fourteen 2-digit level industries of organised manufacturing sector (OMS) in Tamil Nadu during the period 1983-2006. The focus on only the OMS is guided by the two considerations of: (i) time series data availability for the OMS on the one hand and (ii) the need to focus on its (i.e. OMS's) own growth/performance in the light of current employment challenges in India on the other.[1] However, a study focused on limited data available on the larger unorganised manufacturing sector (UMS) in the state has supported the hypothesis of employment based industrial growth in the state.[2]

1.2 With this background in view, the present paper analyses the employment and productivity trends in T. N.'s organised manufacturing. In this, as many of the economic variables would generally be moving in the same direction over time, and therefore the growth profiles of these individual variables would by themselves not reveal the true

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performance of industries, the paper relies on the indicator of total factor productivity growth (TFPG).[3] Further, since the broader aim is to test for the hypothesis of jobless growth, the results of a test for structural stability, construed in terms of an empirical framework with employment as the focus is also presented in the paper.

2. Literature Review

2.1 The term productivity has many dimensions. In its two partial factor dimensions, it refers to the two concepts of labour and capital productivities. Defined as the ratio of output (or value added) to labour and capital inputs respectively, an improvement in either one of these two partial factor productivities would theoretically result in an increase in output. However, as there are a host of other factors also contributing to output (e.g. managerial relations, industrial climate, ease of conducting business, training of workers, etc.) consideration of these two partial factor productivities is often looked at as limited in their scope. In view of this, the concept of total factor productivity, which is defined as the residual growth of output after accounting for the weighted contributions to growth by labour and capital, has become a commonly employed yardstick. However, the TFP method too has its limitations. For instance, an increase in TFP does not mean increase in both labour productivity as well as capital productivity. Further, a rising TFP may mean rising capital productivity and declining labour productivity. Or, it may have differential rates of growth i.e. the growth in labour/capital productivities could both have a different direction (i.e. sign) as compared to the TFP growth. In view of these limitations, even the use of TFP growth has not been unambiguous in conveying the trends of industrial growth and performance. However, there appears to be a general consensus that labour productivity and 'technology' are too important factors to be focused upon. The latter i.e. technological progress is taken to be indicated by the TFP growth.

2.2 Neoclassical economists believe that an increase in productivity would prove beneficial for the employment market in the long run. However, in the short and medium run, an increase in labour productivity especially originating from a higher capital labour ratio decreases the demand for labour (Miron Wolnicki, et al 2006). The neoclassical economists dealing with growth theories hypothesized that the rate of per capita production is inversely proportional to per capita income (Solow, 1956). According to Harrod's growth model, in the long-run the employment rate is determined by the difference between the guaranteed rate of growth and productivity growth. Therefore, when gains in labour productivity are sufficiently high, economic growth is possible when there is no/zero growth in employment, and even when there is a negative employment growth. In other words, a rise in joblessness is entirely possible when labour productivity grows at a rate faster than by a 'stable' wage growth. According to Romer (2000), technology reduces the absorption of new labour. Therefore, if economic growth occurs as a result of productivity gains (as a result of technological progress), the resulting growth does not have to create demand for new workers as the individual productivity gains would be sufficient to reach higher output growth.

2.3 There is a large body of literature on productivity growth, its components and determinants in the manufacturing sector in India. Recently, attention has shifted to examining the relationship between economic reforms and productivity in the

manufacturing sector. Krishna and Mitra (1998), Pattnayak and Thangavelu (2005), Unel (2003) among others find an acceleration in total factor productivity growth (TFPG) in the reform period. However, studies by Trivedi et al (2000), Srivastava (2000), and Balakrishnan et al (2000) find a deceleration in TFPG in the 1990s. A few studies (Unni et al 2001; Prakash 2006) have also analysed the productivity performance of the unorganised manufacturing sector (UMS), especially after the introduction of reforms. Using the data from the ASI and national accounts statistics (NAS), Prakash (2006) estimates the TFP growth in OMS, UMS and TMS at 1.8 per cent, 2.8 per cent and 2.5 per cent, respectively during 1985-95. For 1995-2001, there is negative TFP growth for all three sectors although the TMS has registered an employment growth of 1.7 per cent during 1995-01.

2.4 There is also a debate on whether value added or gross value of output should be considered for calculating the TFP growth. The use of value added for measuring TFP means the contribution of intermediate inputs is implicitly taken. As a result, the TFP growth based on the value added understates the TFP growth. Rao (1996) asserts that ss long as material inputs are separable from the other factors it does not matter as to which of the two measures of production (i.e. gross output or value added) is used for the measurement of productivity. However, if material inputs are not separable, gross output should be preferred to real value added. Pradhan and Barik (1998), however, suggest that the production functions for the aggregate manufacturing in India cannot be assumed to be separable in material and non-material inputs on the basis of statistical tests. Their results imply that till this issue is settled we must work with gross output rather than value added as the measure of output.

2.5 Kathuria et al (2010) analysed the productivity performance of both the organised and unorganised segments using unit level data for selected Indian states for the period 1994-95 to 2005-06. They employed a method developed by Levinsohn and Petrin (2003) to correct the endogeneity bias associated with the production function estimation. Their production function analysis shows that capital rather than labour played a significant role in the production process in both sectors. More surprisingly, 'labour' played lesser role in the production process of even in the unorganised sector. This is a cause for concern as this segment is a significantly larger employment provider particularly to the 'relatively low skilled'. TFP grew steadily in the organised manufacturing sector while there was a decline in the unorganised manufacturing sector. They, however, attribute the growth in GVA to be mostly productivity driven in both the sectors.

2.6 The literature is abundant with work related to the issue of structural change. Most of it is specifically designed for the case of single change. There are two approaches to examine a structural break. While one is based on an a-priori assumption, the other looks for evidence for a structural break by a sequential testing procedure. The first approach adopts the standard Chow's test (1960) which splits the sample into two sub periods, estimates the parameters for each sub-period, and then tests the equality of the two sets of parameters using the classical F statistic. The important limitation of the Chow test is that the break date must be known a priori (Hansen, 2001). There are, therefore, two choices: to pick up a break date based on a major policy change (e.g. introduction of reform measures in 1991) or to pick a break date based on observed feature in the data. In the first case, the

Chow test may be uninformative as the true break date can be missed. In the second case, the Chow test can be misleading as the observed break date is endogenous — i.e. correlated with the data — with the test likely to indicate a break falsely when none in fact may exist.

3. Database and Methodology

3.1 Data from annual survey of industries (ASI) for the period 1981-82 to 2005-06 (1982-2006) have been used in the study. Value based variables [viz. fixed capital (FC) and GVA] are suitably deflated[4] to make them temporally comparable. The series of net capital stock is generated by the perpetual inventory method (PIM)[5]. The database on the three key variables viz. employment (E_t), gross value added (GVA_t) and net capital stock (K_t) in year 't' (in addition to a fourth variable TFP_t discussed below) is first tested for 'stationarity'[6]. The dataset on the four variables, taken in their logarithmic form, are considered in their first difference in order to obtain a final database that is stationary.[7] With this, the original database stands transformed to the period 1983-2006. In order to facilitate the comparison of industrial performance between a moderately liberalised regime with that of a more liberalised policy regime, the period of 1983-2006 is divided into two sub-periods: 1983-1993 (first period or the pre-reform years) and 1994-2006 (second period or the post-reform years). Estimation of growth rates and TFPG for the combined period is made by the 'trend based' method[8] and for the two sub-periods by the Kinked exponential model.[9] The test for structural change is focused on examining whether the two exogenous variables viz. changing levels of output (GVA_t) on the one hand, and all other factors taken together represented by TFP_t[10] on the other, have impacted the process of employment generation significantly or not. This part of analysis is based on the results of the Chow test[11].

4. Growth Profile in GVA and Employment

4.1 Employment in the combined period of 1983-2006 has grown by a marginal 0.1 percent (Table 1). Over the two sub-periods, there is a decline from 0.2 percent growth in the pre-reform period to -0.1 percent in the post-reform years. The corresponding trends in GVA is the opposite i.e. marginal negative growth of -0.1 percent during the combined period and an improvement in the growth profile during the two sub-periods from -0.4 percent to 0.1 percent. Although these percentages are not high, they yet provide an initial indicator for the inference of jobless growth. This inference is, however, valid only from a comparative profile of the two sub-periods as for the total period of study such a conclusion is not plausible. From a perspective of individual industries (i.e. in terms of the trend in employment growth and the number of industries registering such a trend), four industries have registered a turn around from negative growth rate to positive growth rate. However, there are also five industries which have suffered a reversal from positive growth rate to negative growth rate over the two periods of comparison. Three industries have retained their position in the positive growth segment (with a decline in their employment growth registered) with two others having remained in the negative growth slot during both the periods of comparison. On average, therefore, it is a mixed situation to be expected from the individual industry growth profiles. Since employment growth and variation therein depends very much on the role of capital[12] we now take a look at the trends in total factor productivity growth.

5. Total Factor Productivity Growth (TFPG)

5.1 The TFPG profiles (Table 2) for 'all Industries' suggest stability over the period of the study with the TFPG registered at a modest 0.2 percent per annum over all three periods of focus in the study. Three industries (viz. wood, paper and basic metals) have registered a turn around from the negative TFPG in the first period to positive TFPG in the second period. Three others (viz. tobacco, machineries and other manufacturing) have retained their position in the positive growth slot over both the periods. The remaining seven industry groups (viz. chemicals, metal products, transport, textiles, leather, rubber and non-metallic) have evidenced a relative position of distress having either remained in the negative segment during both the sub-periods of comparison or for having shifted from a positive segment to a negative one. The net effect on 'all Industries' is, however, one of overall relative stability. The TFPG trends are, however, suggestive of a stable overall efficiency in the performance of industries in which employment is a part. Since our focus is more on assessing the process of employment generation, we now turn towards a more decisive confirmation of this observed situation of stability by a specific test on an employment model considered for the purpose.

6. Structural Stability/Change

6.1 Comparison of the R-square values in the two regression models, one without including TFP_t and the other by including TFP_t, shows consistent improvement both for 'all Industries' as also for the thirteen individual industry groups[13]. This speaks for the significance of including TFP_t as an explanatory variable in the model. The results of the test for structural stability (i.e. the null hypothesis of 'no structural change') is accepted at the 'all Industries' level ($F = 2.3$; the critical value being 3.2) [Table 3]. By sub-industry groups, there is indication of 'structural change' for six industries viz. paper, chemicals, rubber, non-metallic, metal products and other manufacturing. The conclusion of structural stability for majority of industry groups (8 out of 14), with the cumulative impact at the 'all Industries' level also being one of structural stability, therefore, vindicates the earlier inference drawn on the basis of TFPG trends on the general performance of stability by the OMS industries in the State.

7. Policy Implications

7.1 Productivity, one of the major determinants of employment growth has not increased to any significant extent in the post-liberalisation period in T.N. The process of industrial growth during the post-reform period, manufacturing sector of the state has not attained any significant industrial efficiency and the growth was primarily due to growth in demand. It is imperative for the policy makers at the state level to look at an appropriate "competitiveness enhancement strategy" for the sustenance of long term growth of manufacturing industry in the state.

Notes

1. There is an argument on the current employment challenge in the country that in the dichotomised structure of the economy comprising of a small organised and a large unorganised sector presence, the latter with huge divergent income and efficiency characteristics, the employment challenge should focus on: (i) promoting the organised sector to grow with employment creation and (ii) policies to promote the unorganised sector to acquire at least some of the characteristics of the organised counterpart must be pursued (Ghose, 2010).

2. In other words, the growth of the UMS in the state was not jobless (Prakash and Balu, 2010).

3. Refers to the residual growth in output after discounting for the combined weighted contribution of labour and capital.

4. The deflation is effected by applying the wholesale price index for GVA and the index of material and machinery for fixed capital (FC).

5. Following the outline presented in Veermani and Goldar (2004), and using the same factor of 2.57 as used by them for arriving at the bench mark year estimate, the series of net capital stock (NCS) is constructed by following the five steps outlined below:

   Step 1: Book value of fixed capital/assets and the depreciation in year't' (i.e. B_t and D_t respectively) are both drawn from the ASI reports.

   Step 2: Gross investment for year 't' (GI_t) at constant prices is computed as:

   $GI_t = [(B_t - B_{t-1}) + D_t] \div P_t$ where P_t is the price index in year 't' for capital goods used as the deflator to convert the book values to a constant base.

   Step 3: Capital Stock in bench mark year (1981-82) is obtained as: $K_0 = 2.57 * B_0$ where B_0 is the book value of FC in 1981-82;

   Step 4: Real investment (I_t) is obtained as $I_t = GI_t - \delta K_{(t-1)}$ where δ is the rate of depreciation taken as 5 percent.

   Step 5: The Net Capital Stock (NCS) series for subsequent years is obtained as

   $K_t = K_0 + \Sigma I_t$; t = 1, 2,…,23.

6. This is done by applying the unit root test i.e. by comparing the ADF statistic with the Mackinnon Asymptotic critical values.

7. The variables taken in natural log and in first difference are thus: $dLnGVA_t$, $KLnE_t$ and $dLnK_t$. For TFP_t it is simply $dTFP_t$. The results of a MWD test for assessing the appropriateness of the form of model are supportive of the form of the model considered with the sign of individual co-efficients and other summary statistics being of the expected sign/magnitude.

8. The growth rate of variable 'Y_t' for the combined period is obtained by fitting the equation $Ln\ Y_t = A + b\ T$. Likewise, the TFPG for the combined period is obtained by fitting the equation: $Ln\ GVA_t = b_0 + b_1\ Ln\ E_t + b_2\ Ln\ K_t + b_3 T$; the coefficient b_3 taken as the TFPG for the combined period.

9. The sub-period growth rates are obtained by fitting the equation:
   $Ln\ Y_t = \beta_0 + \beta_1 (D_1 t + D_2 k) + \beta_2 (D_2 t - D_2 k)$ where for the sub-period 1983-93, $D_1 = 1$ and $D_2 = 0$ and for the sub-period 1994-2006, $D_1 = 0$ and $D_2 = 1$. β_1 and β_2 are the growth rates for the first and the second sub-periods respectively.

Likewise, the TFPG for the two sub-periods are obtained by fitting the equation: $\text{Ln } GVA_t = b_0 + b_1 \text{ Ln } E_t + b_2 \text{ Ln } K_t + (D_1t + D_2k)\, T_1 + (D_2t - D_2k)\, T_2$; the coefficients of T_1 and T_2 are respectively taken as the TFPG for the first and the second sub-periods. The advantage of using this method for the two sub-periods is that the assumption of continuity in time series (i.e. there is no structural break in the time series used) is methodologically relaxed. The layout of values for the time variable 't', the two dummies, the constant 'k' and other terms used in these equations are as shown in the Table below.

Year	t	D_1	D_2	D_1t	D_2t	$K = 23 \div 2$	D_2k	D_1t+D_2k	D_2t-D_2k
1982-83	1	1	0	1	0	11.5	0	1	0
1983-84	2	1	0	2	0	11.5	0	2	0
1984-85	3	1	0	3	0	11.5	0	3	0
1985-86	4	1	0	4	0	11.5	0	4	0
1986-87	5	1	0	5	0	11.5	0	5	0
1987-88	6	1	0	6	0	11.5	0	6	0
1988-89	7	1	0	7	0	11.5	0	7	0
1989-90	8	1	0	8	0	11.5	0	8	0
1990-91	9	1	0	9	0	11.5	0	9	0
1991-92	10	1	0	10	0	11.5	0	10	0
1992-93	11	1	0	11	0	11.5	0	11	0
1993-94	12	0	1	0	12	11.5	11.5	11.5	0.5
1994-95	13	0	1	0	13	11.5	11.5	11.5	1.5
1995-96	14	0	1	0	14	11.5	11.5	11.5	2.5
1996-97	15	0	1	0	15	11.5	11.5	11.5	3.5
1997-98	16	0	1	0	16	11.5	11.5	11.5	4.5\
1998-99	17	0	1	0	17	11.5	11.5	11.5	5.5
1999-00	18	0	1	0	18	11.5	11.5	11.5	6.5
2000-01	19	0	1	0	19	11.5	11.5	11.5	7.5
2001-02	20	0	1	0	20	11.5	11.5	11.5	8.5
2002-03	21	0	1	0	21	11.5	11.5	11.5	9.5
2003-04	22	0	1	0	22	11.5	11.5	11.5	10.5
2004-05	23	0	1	0	23	11.5	11.5	11.5	11.5
2005-06	24	0	1	0	24	11.5	11.5	11.5	12.5

10. The TFP_t values are obtained by first fitting the equation $\text{Log } GVA_t = b_0 + b_1 \text{ Log } E_t + b_2 \text{ Log } K_t$. In the second step, using the estimated values of the regression co-efficients, the expected values of GVA is obtained. The difference between the observed and expected values of GVA [i.e. the unexplained residual of output net of input] is taken as TFP_t.

11. The Chow test uses the residuals of the three regressions viz. the residual of the combined period (R-1), of the pre-reform period (R-2) and of the post-reform period (R-3). We obtain R-4 as [(R-2) + (R-3)] and R-5 as [(R-1) – (R-4)]. The null hypothesis of structural stability (i.e. there is no structural change in the employment model considered) is rejected if the statistic $F = [(R\text{-}5) \div k]/[(R\text{-}4) \div (n_1 + n_2 - 2k)]$ is greater than the critical value of F-distribution with 'k' and '$n_1 + n_2 - 2k$' d.f.

12. The series of NCS has registered consistent negative growth rate (GR) for all three periods both at the 'all Industries' level as also at the individual industry level except for some positive turn around for wood, non-metallic, metal products and transport sectors from the pre-reform

years to the post-reform years. We have, therefore, not discussed the trends of GR in the NCS series but discussed the TFPG trends as it takes into account the net contribution of both the factor inputs viz. labour and capital to output i.e. GVA.

13. In particular, the values of R-square for 'all Industries' has increased from 16 percent to 66 percent between the two situations of 'without TFP_t' and 'with TFP_t'. The one exception to this trend is 'food products'.

References

Balakrishnan, P, K Pushpangadan and M Suresh Babu (2000), "Trade Liberalisation and Productivity Growth in Manufacturing: Evidence from Firm-level Panael Data", *Economic and Political Weekly*, 35 (41): 3679-82.

Chow, G.C. (1960), "Tests of equality between sets of coefficients in two regressions", *Econometrica* 28:591–603.

Ghose, A. (2010), "India's Employment Challenge", *The Indian Journal of Labour Economics*, 53(4): 583-85.

Hansen, B. (2001), "The new econometrics of structural change: dating breaks in US productivity", *The Journal of Economic Perspectives*, 15:117–128.

Kathuria, V, R. S N Raj and Sen. K. (2010), "Organised versus Unorganised Manufacturing Performance in the Post-Reform Period", *Economic and Political Weekly*, June 12, 24:55-64.

Krishna, P and Mitra. D. (1998), "Trade Liberalisation, Market Discipline and Productivity Growth: New Evidence from India", *Journal of Development Economics*, 56 (2): 447-62.

Levinsohn, J and A Petrin (2003), "Estimating Production Functions Using Inputs to Control for Unobservables", *Review of Economic Studies*, 70 (2): 317-42.

Miron Wolnicki, Eugeniusz Kwiatkowski and Ryszard Piasecki (2006), "Jobless growth: a new challenge for the transition economy of Poland", *International Journal of Social Economics*, 33(3):192-206.

Pattnayak S.S and Thangavelu S.M. (2005), "Economic Reform and Productivity Growth in Indian Manufacturing Industries: an interaction of Technical Change and Scale Economies", *Economic Modeling*, 22:601-615.

Pradhan, G and Barik, K. (1998), "Fluctuating Total Factor Productivity in India: Evidence from Selected Polluting Industries", *Economic and Political Weekly*, February 28:M25-M30.

Prakash, B. S. (2006), "Productivity Trends in Manufacturing: Implications for Employment Planning", *The Indian Economic Journal*, October- December, :25-50.

Prakash, B. S. and Balu, A. (2011), "Growth of Unorganised Sector in Tamil Nadu: 2001-06", *Man and Development*, September-2011, XXXIII(3):127-134.

Rao, J M. (1996), "Manufacturing Productivity Growth: Method and Measurement", *Economic and Political Weekly,* November 2:2927-2936.

Romer, D. (2000), "Makroekonomia dla Zaawansowanych (Macroeconomics for the Advanced)", Wydawnictwo Naukowe PWN (Science Publishing PWN), Warsaw.

Solow, R.M. (1956), "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, February, :65-94.

Srivastava, V. (2000), "The Impact of India's Economic Reforms on Industrial Productivity, Efficiency and Competitiveness", Report of a Project sponsored by the Industrial Development Bank of India, National Council of Applied Economic Research (NCAER), New Delhi.

Trivedi, P., Prakash, A. and D. Sinate (2000), "Productivity in Major Manufacturing Industries in India: 1973-74 to 1997-98", Development Research Group Study no.20, Department of Economic Analysis and Policy, Reserve Bank of India, Mumbai.

Unel, Bulent (2003), "Productivity trends in India's Manufacturing Sectors in the Last Two Decades", IMF Working Paper No. WP/03/22.

Unni, J. N., Lalitha and U Rani (2001), "Economic Reforms and Productivity Trends in Indian Manufacturing", *Economic and Political Weekly*, 36 (41): 3915-22.

Veermani, C. and Goldar, B. (2004), "Investment Climate and TFP in Manufacturing: Analysis of Indian States", Working Paper No. 127, ICRIER, New Delhi.

Table 1: Growth Rates (%) in Employment and GVA: 1983-2006

Industry	GVA			Employment		
	1983-93	1994-06	1983-06	1983-93	1994-06	1983-06
Food	-1.1	0.3	-0.4	0.8	-0.4	0.1
Tobacco	-1.3	0.3	-0.4	0.2	-0.4	-0.2
Textiles	-0.02	-0.1	-0.1	0.5	-0.1	0.2
Wood	-2.3	4.7	1.6	-0.6	1.4	0.5
Paper	-0.02	0.2	0.1	0.1	0.0	0.03
Leather	-0.8	-0.8	-0.8	-0.4	-0.3	-0.4
Chemicals	3.3	-0.6	-0.4	-0.1	-0.5	-0.3
Rubber	-0.8	-0.8	-0.8	0.1	-0.1	0.01
Non-metallic	-0.3	-0.4	-0.3	-0.2	0.3	0.1
Basic metals	0.5	0.6	0.5	1.3	0.1	0.7
Metal prods.	1.4	-0.4	0.4	0.8	0.2	0.5
Machineries	-0.9	1.0	0.2	-0.5	0.1	-0.2
Transport	0.8	0.8	0.8	-0.7	0.8	0.1
Other manfg.	0.5	-1.4	-0.6	1.7	-1.2	0.1
All Industries	***-0.4***	***0.1***	***-0.1***	***0.2***	***-0.1***	***0.1***

Table 2: TFPG by Industries

Sl. No.	Industry	TFPG (%)		
		1983-93	1994-06	1983-06
1	Food	-2.1	-0.3	-1.0
2	Tobacco	0.1	1.0	0.7
3	Textiles	-0.6	-0.1	-0.2
4	Wood	-2.1	2.9	0.9
5	Paper	-0.1	0.2	0.1
6	Leather	-0.1	-0.7	-0.7
7	Chemicals	2.7	-0.3	0.7
8	Rubber	-0.1	-0.7	-0.5
9	Non-metallic	-0.04	-0.5	-0.3
10	Basic metals	-0.4	0.5	0.1
11	Metal prods.	3.8	-0.9	0.4
12	Machineries	1.3	0.9	1.0
13	Transport	4.4	-0.8	1.1
14	Other manufacturing	0.4	0.3	0.3
15	***All Industries***	***0.2***	***0.2***	***0.2***

Table 3: Results of Test for Structural Stability 1983-2006

Industry	1	2	3	4	5	6	7	8	9	10	11	12	13	14	**15**
F-value	0.3	2.6	3.0	0.5	4.0	2.3	3.7	4.9	4.5	0.3	4.1	2.8	1.7	4.7	**2.3**

Note: The industries indicated chronologically carry the same description as in Table 2.

Corrigendum

In The Journal of Industrial Statistics, Vol. 1, No. 2, September, 2012, page no. 278, Table-2, Sl. No. 35 (West Bengal), the sixth column (4th Census) figures may be read as 362227 instead of 3622274.

SECTION II

- Selected Economic Indicators of manufacturing Sector of India: Table 1
- All India ASI Data Based on 100 and more Workers: Table 2
- Fixed Assets by Industry Division in Manufacturing Sector: Table 3
- Employment by Industry Division in Manufacturing Sector: Table 4
- Employment by Industry Group in Manufacturing Sector: Table 5
- 2-digit NIC Division and Description
- Selected Characteristics of Branches, Selected Years and Countries: Table 7

Table 1: Selected Economic Indicators by 2-digit Industry Div. based on ASI 2009-10 and 2010-11

All India

NIC-2008	Description	Labour Productivity (Rs. Lakh)		Capital Productivity	
		2009-10	2010-11(p)*	2009-10	2010-11(p)*
01	Crop and animal production, hunting and related service activities	3.75	4.05	1.09	0.94
08	Other mining and quarrying	2.27	1.04	0.21	0.39
10	Manufacture of food products	3.15	3.95	0.44	0.47
11	Manufacture of beverages	6.97	7.78	0.47	0.40
12	Manufacture of tobacco products	1.79	2.28	2.23	3.42
13	Manufacture of textiles	2.23	3.05	0.27	0.35
14	Manufacture of wearing apparel	1.61	1.85	0.80	0.80
15	Manufacture of leather and related products	2.11	1.83	0.71	0.73
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2.21	1.83	0.43	0.25
17	Manufacture of paper and paper products	2.99	4.43	0.17	0.24
18	Printing and reproduction of recorded media	5.64	7.42	0.54	0.57
19	Manufacture of coke and refined petroleum products	65.08	91.47	0.43	0.50
20	Manufacture of chemicals and chemical products	12.30	13.23	0.46	0.50
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	13.36	14.79	0.67	0.76
22	Manufacture of rubber and plastics products	5.65	8.08	0.52	0.69
23	Manufacture of other non-metallic mineral products	6.12	4.64	0.47	0.31
24	Manufacture of basic metals	10.90	10.86	0.27	0.24
25	Manufacture of fabricated metal products, except machinery and equipment	5.26	6.13	0.79	0.71
26	Manufacture of computer, electronic and optical products	9.03	11.88	0.71	0.83
27	Manufacture of electrical equipment	8.60	8.90	0.90	0.83
28	Manufacture of machinery and equipment n.e.c.	10.43	9.86	1.03	0.88
29	Manufacture of motor vehicles, trailers and semi-trailers	7.09	6.82	0.42	0.39
30	Manufacture of other transport equipment	9.81	10.62	0.87	0.93
31	Manufacture of furniture	4.17	5.36	0.81	0.90
32	Other manufacturing	4.63	4.67	1.18	1.04
33	Repair and installation of machinery and equipment	6.34	8.04	0.72	1.08
38	Waste collection, treatment and disposal activities; materials recovery	1.40	4.20	0.23	0.63
58	Publishing activities	9.41	19.46	0.37	0.65
Others	Other Industries	13.13	15.78	0.20	0.20
Total		6.47	7.18	0.44	0.44

*2010-11(p) is Provisional

Labour Productivity: Net Value Added / No. of Workers

Capital Productivity: Net Value Added / Fixed Capital

Table 1 (cntd.): Selected Economic Indicators by 2-digit Industry Div. based on ASI 2009-10 and 2010-11

All India

NIC-2008 Div.	Description	Ratio of Total Output to Total Inputs		Output per Worker (Rs. Lakh)	
		2009-10	2010-11(p)*	2009-10	2010-11(p)*
01	Crop and animal production, hunting and related service activities	1.12	1.08	37.91	61.34
08	Other mining and quarrying	1.43	2.23	10.90	2.43
10	Manufacture of food products	1.12	1.11	35.50	45.32
11	Manufacture of beverages	1.35	1.32	32.41	38.73
12	Manufacture of tobacco products	1.51	1.54	5.56	6.75
13	Manufacture of textiles	1.22	1.21	16.77	21.88
14	Manufacture of wearing apparel	1.27	1.25	8.58	10.28
15	Manufacture of leather and related products	1.21	1.20	13.99	12.44
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	1.17	1.11	18.50	25.61
17	Manufacture of paper and paper products	1.21	1.23	24.51	30.37
18	Printing and reproduction of recorded media	1.40	1.44	23.39	29.08
19	Manufacture of coke and refined petroleum products	1.15	1.15	566.75	799.72
20	Manufacture of chemicals and chemical products	1.30	1.26	64.35	75.83
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	1.52	1.51	43.62	48.39
22	Manufacture of rubber and plastics products	1.25	1.30	33.53	39.40
23	Manufacture of other non-metallic mineral products	1.57	1.41	19.69	19.78
24	Manufacture of basic metals	1.22	1.18	72.89	84.23
25	Manufacture of fabricated metal products, except machinery and equipment	1.31	1.30	25.02	29.61
26	Manufacture of computer, electronic and optical products	1.27	1.26	50.22	67.18
27	Manufacture of electrical equipment	1.26	1.23	46.03	52.74
28	Manufacture of machinery and equipment n.e.c.	1.35	1.29	44.08	48.05
29	Manufacture of motor vehicles, trailers and semi-trailers	1.22	1.19	49.03	53.64
30	Manufacture of other transport equipment	1.31	1.28	45.51	52.13
31	Manufacture of furniture	1.24	1.28	24.17	26.88
32	Other manufacturing	1.05	1.11	101.62	51.13
33	Repair and installation of machinery and equipment	1.25	1.40	35.69	30.55
38	Waste collection, treatment and disposal activities; materials recovery	1.06	1.09	34.34	64.25
58	Publishing activities	1.47	1.87	35.33	46.74
Others	Other Industries	1.32	1.27	75.58	95.26
Total		1.23	1.22	40.76	47.26

*2010-11(p) is Provisional

Ratio of Total Output to Total Inputs: Gross Value of Output / Total Inputs

Output per Worker: Gross Value of Output / No. of Workers

Table 1 (cntd.): Selected Economic Indicators by 2-digit Industry Div. based on ASI 2009-10 and 2010-11

All India

NIC-2008 Div.	Description	Wage Rate (Rs.)	
		2009-10	2010-11(p)*
01	Crop and animal production, hunting and related service activities	29883	35523
08	Other mining and quarrying	36820	42282
10	Manufacture of food products	51634	62203
11	Manufacture of beverages	74048	83478
12	Manufacture of tobacco products	25415	32437
13	Manufacture of textiles	60220	71323
14	Manufacture of wearing apparel	54547	65039
15	Manufacture of leather and related products	57921	61854
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	47793	58338
17	Manufacture of paper and paper products	75637	86944
18	Printing and reproduction of recorded media	80659	91755
19	Manufacture of coke and refined petroleum products	186635	269413
20	Manufacture of chemicals and chemical products	92048	106619
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	88657	103261
22	Manufacture of rubber and plastics products	79438	80042
23	Manufacture of other non-metallic mineral products	54162	62053
24	Manufacture of basic metals	103892	124706
25	Manufacture of fabricated metal products, except machinery and equipment	78378	95408
26	Manufacture of computer, electronic and optical products	121886	112544
27	Manufacture of electrical equipment	97670	104621
28	Manufacture of machinery and equipment n.e.c.	117771	113091
29	Manufacture of motor vehicles, trailers and semi-trailers	109575	123283
30	Manufacture of other transport equipment	108999	115216
31	Manufacture of furniture	84712	92833
32	Other manufacturing	78956	93450
33	Repair and installation of machinery and equipment	127185	146581
38	Waste collection, treatment and disposal activities; materials recovery	61018	62007
58	Publishing activities	113571	169913
Others	Other Industries	77384	85814
Total		75281	86389

*2010-11(p) is Provisional

Wage Rate: Wages to Workers / No. of Workers

Table 2: Selected Characteristics of Factory Sector (100 and more workers) by 2-digit Industry Div.(NIC-2008) for all-India during 2010-11

(Value in Rs. Lakh unless otherwise mentioned)

Characteristics		2-Digit Industry Div: NIC-2008 (Provisional)								
		All	01	08	10	11	12	13	14	15
1	Number of Factories (no.)	27526	204	10	3769	326	514	2947	2308	836
2	Fixed Capital	136420549	160526	12930	7799922	1547396	219113	9123620	1407964	459372
3	Physical Working Capital	62182080	284298	2939	9135321	438223	373536	4719221	1203052	529604
4	Working Capital	47016463	198710	1903	3719424	454052	269520	3621816	1028778	210824
5	Invested Capital	198602637	444824	15869	16935243	1985619	592649	13842841	2611015	988976
6	Gross Value of Addition to Fixed Capital	31629450	27777	421	1773671	358177	69389	1905333	262627	112885
7	Rent Paid for Fixed Assets	1020176	1681	66	80239	10215	5368	28565	67687	15242
8	Outstanding Loan	66356262	143396	2623	5450763	649076	81271	6679005	992538	203747
9	Interest Paid	6753100	24272	322	800196	65047	15191	640065	139666	46971
10	Rent Received for Fixed Assets	159310	97	0	16979	3836	1223	6840	8003	2150
11	Interest Received	1047631	6821	87	64926	5031	4345	43116	12019	4064
12	Gross Value of Plant & Machinery	131887590	98130	14995	7172451	1340973	316614	10391120	905693	326776
13	Value of Product and By-Product	329589829	990557	9430	31406398	2794631	1851397	18519124	4982790	2051372
14	Total Output	367448624	1460881	9859	35249317	3075915	1944376	21132290	5867888	2316204
15	Fuels Consumed	15432112	9558	1463	914850	139147	20015	1586197	129224	50444
16	Materials Consumed	239668324	819350	1894	26036039	1835770	926062	13326430	3017375	1493564
17	Total Inputs	297663090	1333260	4647	31091540	2368677	1213027	17197593	4586221	1901070
18	Gross Value Added	69785533	127620	5212	4157777	707238	731349	3934698	1281667	415134
19	Depreciation	9921297	11021	1407	577121	117839	26083	828255	134481	46867
20	Net Value Added	59864234	116599	3805	3580656	589399	705265	3106443	1147186	368267
21	Net Fixed Capital Formation	13859723	16151	-991	881101	174346	14751	767847	91939	42674
22	Gross Fixed Capital Formation	23781022	27172	416	1458222	292185	40835	1596101	226420	89541
23	Addition in Stock of	12880385	106178	-398	1687627	49045	73328	1602048	190787	101082
	(a) Materials, Fuels etc.	5990661	60818	8	592285	33115	48810	891128	91739	50795
	(b) Semi Finished Goods	2404614	-2030	261	83862	3350	3462	177682	67728	30211
	(c) Finished Goods	4485113	47389	-667	1011481	12580	21055	533238	31320	20076
24	Gross Capital Formation	36661407	133350	18	3145850	341231	114162	3198150	417207	190623
25	Income	52090964	90646	3418	2700222	514137	684706	2437813	939833	306054
26	Profit	34760419	60050	1251	1470204	350644	515068	1111251	171418	76754

Table 2 (cntd.): Selected Characteristics of Factory Sector (100 and more workers) by 2-digit Industry Div.(NIC-2008) for all-India during 2010-11

(Value in Rs. Lakh unless otherwise mentioned)

Characteristics		2-Digit Industry Div: NIC-2008 (Provisional)								
		16	17	18	19	20	21	22	23	24
1	Number of Factories (no.)	141	475	441	174	1436	1145	1077	1883	1705
2	Fixed Capital	240478	2694192	864500	14956042	10521840	4635300	3402233	9902434	31742728
3	Physical Working Capital	165205	681540	224518	7487763	3892504	2473736	1369113	2054639	10085938
4	Working Capital	91551	682328	189161	3784598	3672228	3450298	942235	2256297	11012626
5	Invested Capital	405684	3375732	1089019	22443805	14414344	7109037	4771346	11957073	41828666
6	Gross Value of Addition to Fixed Capital	49926	602567	141161	2247430	1856854	1103271	924662	2164951	9213600
7	Rent Paid for Fixed Assets	2140	27376	19788	34336	66925	28509	21981	81474	96310
8	Outstanding Loan	185828	1430643	362036	2794343	4222216	2241916	1539897	4069784	17593580
9	Interest Paid	19874	124814	48315	346499	582153	204399	187259	381846	1358727
10	Rent Received for Fixed Assets	121	2279	7716	3972	9298	25407	7227	10320	8214
11	Interest Received	1548	8204	9062	43474	72341	47505	16599	34222	287804
12	Gross Value of Plant & Machinery	177757	3141059	838309	16911123	15916107	3839498	3717685	10151303	26876941
13	Value of Product and By-Product	542702	3714435	959985	65348230	26510431	10248457	9655333	10619409	46595831
14	Total Output	632170	3886226	1773823	65909883	28618985	11553172	10186255	11257280	50751244
15	Fuels Consumed	24264	471313	37136	649671	1861152	381271	422340	2381313	4263365
16	Materials Consumed	414209	2289178	835123	55222572	17749205	5235617	6192178	4212768	32167776
17	Total Inputs	548542	3049089	1217738	57080498	22556481	7336103	7296774	7718576	41920744
18	Gross Value Added	83628	837137	556085	8829385	6062504	4217069	2889480	3538704	8830500
19	Depreciation	20170	189087	91073	977699	1048769	365491	297840	709112	1522370
20	Net Value Added	63458	648050	465012	7851687	5013735	3851577	2591640	2829591	7308129
21	Net Fixed Capital Formation	26057	123512	27632	376063	132811	513407	520377	768601	6086213
22	Gross Fixed Capital Formation	46227	312599	118705	1353762	1181579	878898	818217	1477713	7608583
23	Addition in Stock of	29985	88930	38160	1471790	132564	498994	218573	345618	2546173
	(a) Materials, Fuels etc.	17709	66101	27899	623140	-320513	255173	-21229	153431	1238464
	(b) Semi Finished Goods	659	15207	5036	541349	148354	147808	90450	98590	374440
	(c) Finished Goods	11618	7622	5226	307301	304723	96013	149352	93597	933270
24	Gross Capital Formation	76212	401529	156865	2825552	1314143	1377892	1036790	1823331	10154756
25	Income	41445	495860	396910	7470851	4364657	3618669	2382401	2366271	5853092
26	Profit	4378	216554	190358	6880409	3115812	2623982	1891068	1609890	3696659

Table 2 (cntd.): Selected Characteristics of Factory Sector (100 and more workers) by 2-digit Industry Div.(NIC-2008) for all-India during 2010-11

(Value in Rs. Lakh unless otherwise mentioned)

	Characteristics	2-Digit Industry Div: NIC-2008 (Provisional)								
		25	26	27	28	29	30	31	32	33
1	Number of Factories (no.)	1343	573	1137	1432	1452	466	131	628	117
2	Fixed Capital	2464135	1963064	3323421	4124020	9146239	2214724	159680	571754	227173
3	Physical Working Capital	2040613	1405003	2862942	3471203	3164381	1696884	137427	1251332	96306
4	Working Capital	1155066	1529709	3347501	3448463	-1238967	1057758	47428	1454628	197301
5	Invested Capital	4504748	3368068	6186362	7595223	12310620	3911608	297107	1823087	323479
6	Gross Value of Addition to Fixed Capital	471245	412370	877371	1357600	2050085	597616	59657	151078	71348
7	Rent Paid for Fixed Assets	45714	54824	64798	65213	59947	19228	5690	12816	5775
8	Outstanding Loan	1121049	1405738	2407454	2524259	3344301	1166632	83735	637041	36648
9	Interest Paid	183777	154778	304962	268528	314171	125338	13198	84836	11301
10	Rent Received for Fixed Assets	5230	8096	2204	6946	10567	1684	2781	1036	2532
11	Interest Received	41216	27677	37806	65736	78585	24450	661	71473	6092
12	Gross Value of Plant & Machinery	2040975	2361723	3094929	3491001	10152046	1534761	121391	456951	141408
13	Value of Product and By-Product	7979645	7773355	14347442	14465601	26395970	9340803	605252	6406162	234552
14	Total Output	9592110	10001322	15750096	17794970	28217685	9997736	751702	7347497	859451
15	Fuels Consumed	276110	127971	248995	231835	564541	148587	18367	41263	11795
16	Materials Consumed	5572294	5635855	10577738	10573295	20197303	6605318	366741	5556451	173740
17	Total Inputs	7236562	7998082	12704685	13764888	23720616	7727460	566930	6673671	586228
18	Gross Value Added	2355548	2003240	3045412	4030083	4497069	2270276	184772	673826	273223
19	Depreciation	225211	245455	283887	347487	963083	180753	13415	59450	19706
20	Net Value Added	2130336	1757785	2761525	3682595	3533986	2089523	171357	614376	253517
21	Net Fixed Capital Formation	-32883	107225	417017	777573	616836	7169	31602	69400	33283
22	Gross Fixed Capital Formation	192329	352680	700904	1125060	1579918	187923	45017	128851	52989
23	Addition in Stock of	371290	221466	660014	794979	866009	234404	21584	249756	4591
	(a) Materials, Fuels etc.	153392	142027	276425	621240	527768	102029	16212	99641	5633
	(b) Semi Finished Goods	153331	19507	162392	26829	96223	99789	8031	51355	-258
	(c) Finished Goods	64568	59932	221198	146910	242017	32586	-2659	98760	-784
24	Gross Capital Formation	563619	574146	1360918	1920039	2445928	422327	66601	378607	57580
25	Income	1900845	1548183	2391766	3348855	3159869	1944957	152469	516724	236441
26	Profit	1117088	959529	1447088	1915065	1543504	1451692	77042	232293	134659

Table 2 (cntd.): Selected Characteristics of Factory Sector (100 and more workers) by 2-digit Industry Div.(NIC-2008) for all-India during 2010-11

(Value in Rs. Lakh unless otherwise mentioned)

(Provisional)

	Characteristics	2-Digit Industry Div: NIC-2008		
		38	58	Others
1	Number of Factories (no.)	10	53	793
2	Fixed Capital	14054	189595	12332100
3	Physical Working Capital	15247	37450	882142
4	Working Capital	21379	98677	311171
5	Invested Capital	29302	227046	13214245
6	Gross Value of Addition to Fixed Capital	2826	29301	2734251
7	Rent Paid for Fixed Assets	288	2930	95051
8	Outstanding Loan	13941	43021	4929781
9	Interest Paid	1706	7335	297554
10	Rent Received for Fixed Assets	1	112	4439
11	Interest Received	819	2106	29842
12	Gross Value of Plant & Machinery	13706	150655	6191510
13	Value of Product and By-Product	25782	88611	5126142
14	Total Output	45004	318465	11146818
15	Fuels Consumed	1693	7144	411088
16	Materials Consumed	25996	103392	2505091
17	Total Inputs	31135	160626	8071627
18	Gross Value Added	13869	157838	3075190
19	Depreciation	3707	16020	598438
20	Net Value Added	10163	141818	2476754
21	Net Fixed Capital Formation	-1151	9886	1261275
22	Gross Fixed Capital Formation	2556	25907	1859713
23	Addition in Stock of	-1110	11163	265755
	(a) Materials, Fuels etc.	-1130	11944	226607
	(b) Semi Finished Goods	0	185	811
	(c) Finished Goods	19	-965	38337
24	Gross Capital Formation	1445	37070	2125466
25	Income	8169	131554	2084147
26	Profit	5309	75252	1816148

Table-3: Estimated and Proportions of Fixed Assets by 2-digit Industry Div.(NIC-2008),during 2009-10 (All India).

NIC-2008	Plant & Machinery (Rs. Lakh)	Transport Equipment (Rs. Lakh)	Computer Equipment (Rs. Lakh)	Pollution Control Equipment (Rs. Lakh)	Total Fixed Assets (Rs. Lakh)	Plant & Machinery (%)	Transport Equipment (%)	Computer Equipment (%)	Pollution Control Equipment (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
01	127999	8445	578	1	250094	51.18	3.38	0.23	0.00
08	37670	4291	27	0	64809	58.12	6.62	0.04	0.00
10	4901112	191705	28729	23975	8409923	58.28	2.28	0.34	0.29
11	812377	28687	3611	23396	1538118	52.82	1.87	0.23	1.52
12	177593	11801	1504	596	319465	55.59	3.69	0.47	0.19
13	6375643	132530	27749	30297	9730281	65.52	1.36	0.29	0.31
14	708880	68672	15782	4057	1497707	47.33	4.59	1.05	0.27
15	265293	27301	6013	737	645131	41.12	4.23	0.93	0.11
16	145312	18211	1516	138	294238	49.39	6.19	0.52	0.05
17	2167441	38046	7962	15152	3274402	66.19	1.16	0.24	0.46
18	587467	21882	20985	1609	959840	61.20	2.28	2.19	0.17
19	10678629	26373	41894	237389	14488682	73.70	0.18	0.29	1.64
20	8134499	117474	38299	105793	11526236	70.57	1.02	0.33	0.92
21	2781560	58505	38346	33969	5089493	54.65	1.15	0.75	0.67
22	2565516	83301	32934	10926	4073771	62.98	2.04	0.81	0.27
23	5273790	181437	46675	85793	8505737	62.00	2.13	0.55	1.01
24	14025944	217272	60426	118515	28172580	49.79	0.77	0.21	0.42

Table-3: (Contd.) Estimated and Proportions of Fixed Assets by 2-digit Industry Div.(NIC-2008),during 2009-10 (All India).

NIC-2008	Plant & Machinery (Rs. Lakh)	Transport Equipment (Rs. Lakh)	Computer Equipment (Rs. Lakh)	Pollution Control Equipment (Rs. Lakh)	Total Fixed Assets (Rs. Lakh)	Plant & Machinery (%)	Transport Equipment (%)	Computer Equipment (%)	Pollution Control Equipment (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
25	1538407	95148	30821	1793	2895543	53.13	3.29	1.06	0.06
26	1365088	30279	44047	3503	2542697	53.69	1.19	1.73	0.14
27	1719636	56245	35678	22307	3172264	54.21	1.77	1.12	0.70
28	1806904	145172	72274	4131	3893227	46.41	3.73	1.86	0.11
29	4879382	110928	83496	4057	8075474	60.42	1.37	1.03	0.05
30	785643	27619	14690	3014	2010100	39.08	1.37	0.73	0.15
31	74763	8898	1863	38	197648	37.83	4.50	0.94	0.02
32	274342	19493	9516	1238	636509	43.10	3.06	1.50	0.19
33	75465	64085	1851	14	221796	34.02	28.89	0.83	0.01
38	13945	3899	166	5	45399	30.72	8.59	0.37	0.01
58	157237	7410	6172	1	297832	52.79	2.49	2.07	0.00
Others	5334878	70827	24503	7582	12326748	43.28	0.57	0.20	0.06
Total	**77792415**	**1875936**	**698107**	**740026**	**135155744**	**57.56**	**1.39**	**0.52**	**0.55**

Table 4: Estimated and Proportions of Employment with respect to 2-digit Industry Div. (NIC-2008) during 2010-11 (All India).

(Provisional)

NIC 2008	Total Persons Engaged (no.)	Total Workers (no.)	Directly Emp. Workers (no.)	Contract Workers (no.)	Total workers (%)	Direct Emp. Workers (%)	Contract Workers (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
01	119734	96961	48740	48221	81	50	50
08	5931	5208	2057	3150	88	39	60
10	1548187	1199885	852747	347137	78	71	29
11	127828	99700	49441	50258	78	50	50
12	412470	392960	127375	265585	95	32	68
13	1456600	1242727	1057933	184794	85	85	15
14	873685	745082	637403	107679	85	86	14
15	292657	251424	211179	40245	86	84	16
16	80889	62193	45725	16468	77	74	26
17	249043	196273	140158	56115	79	71	29
18	158996	103024	83217	19807	65	81	19
19	114052	85008	42497	42511	75	50	50
20	629904	466915	298495	168420	74	64	36
21	467638	286957	167041	119917	61	58	42
22	512083	400780	278039	122740	78	69	31
23	925022	739397	325218	414179	80	44	56
24	1007845	764861	446853	318008	76	58	42
25	669768	523687	279994	243693	78	53	47
26	229511	161881	107151	54730	71	66	34
27	506644	376159	240662	135497	74	64	36
28	678666	462458	306256	156202	68	66	34
29	717074	560334	326981	233353	78	58	42
30	260325	209849	114925	94924	81	55	45
31	57704	44129	30831	13297	76	70	30
32	226172	177821	140561	37261	79	79	21
33	47563	35147	20616	14531	74	59	41
38	8118	6521	5163	1359	80	79	21
58	16715	8025	6712	1313	48	84	16
Others	313601	199791	149716	50075	64	75	25
Total	**12714425**	**9905157**	**6543686**	**3361469**	**78**	**66**	**34**

Table 5: Estimated and Proportions of type of Employment by 3-digit Industry Group (NIC-2008), during 2010-11(All India).

(Provisional)

NIC 2008	Total Persons Engaged (no.)	Total Workers (no.)	Directly Emp. Workers (no.)	Contract Workers (no.)	Total workers (%)	Direct Emp. Workers (%)	Contract Workers (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
016	119734	96961	48740	48221	81	50	50
089	5931	5208	2057	3150	88	39	60
101	17497	14187	6841	7346	81	48	52
102	32935	27296	14659	12637	83	54	46
103	57628	46321	24012	22309	80	52	48
104	116798	89809	54289	35520	77	60	40
105	112408	78953	47574	31378	70	60	40
106	364738	277847	157628	120219	76	57	43
107	809238	639341	532661	106680	79	83	17
108	36945	26131	15083	11048	71	58	42
110	127828	99700	49441	50258	78	50	50
120	412470	392960	127375	265585	95	32	68
131	1204505	1033157	889620	143538	86	86	14
139	252095	209570	168314	41256	83	80	20
141	639195	545792	466004	79788	85	85	15
142	515	422	286	136	82	68	32
143	233975	198867	171113	27754	85	86	14
151	90587	74766	56174	18592	83	75	25
152	202070	176658	155005	21653	87	88	12
161	10013	7413	6511	902	74	88	12
162	70876	54780	39214	15566	77	72	28
170	249043	196273	140158	56115	79	71	29
181	158259	102851	83044	19807	65	81	19
182	737	173	173	0	23	100	0
191	33151	27024	17492	9532	82	65	35
192	80901	57984	25004	32979	72	43	57
201	259292	180249	102390	77859	70	57	43
202	346691	267959	181176	86782	77	68	32
203	23920	18708	14929	3779	78	80	20
210	467638	286957	167041	119917	61	58	42

Table 5: (Contd.) Estimated and Proportions of type of Employment by 3-digit Industry Group (NIC-2008), during 2010-11(All India).

(Provisional)

NIC 2008	Total Persons Engaged (no.)	Total Workers (no.)	Directly Emp. Workers (no.)	Contract Workers (no.)	Total workers (%)	Direct Emp. Workers (%)	Contract Workers (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
221	173526	140171	96775	43396	81	69	31
222	338556	260609	181265	79344	77	70	30
231	70509	56849	30272	26576	81	53	47
239	854514	682548	294946	387602	80	43	57
241	683537	517305	307615	209691	76	59	41
239	854514	682548	294946	387602	80	43	57
241	683537	517305	307615	209691	76	59	41
242	116187	85873	43113	42760	74	50	50
243	208121	161683	96126	65558	78	59	41
251	296555	238246	96494	141751	80	41	59
252	3064	2458	1287	1171	80	52	48
259	370149	282983	182212	100771	76	64	36
261	93456	67538	48009	19528	72	71	29
262	19400	14903	8125	6777	77	55	45
263	32163	23243	11433	11810	72	49	51
264	32065	22584	13135	9449	70	58	42
265	37561	22719	18332	4386	60	81	19
266	10141	7481	5475	2006	74	73	27
267	4561	3322	2579	743	73	78	22
268	165	92	62	30	56	67	33
271	227408	161529	103357	58172	71	64	36
272	41667	31049	20921	10127	75	67	33
273	85388	66745	42025	24720	78	63	37
274	49356	40670	23592	17078	82	58	42
275	49916	38621	24804	13817	77	64	36
279	52909	37544	25962	11582	71	69	31
281	368736	250521	166273	84249	68	66	34
282	309930	211937	139983	71954	68	66	34
291	128152	91470	68210	23261	71	75	25
292	47391	38169	18691	19478	81	49	51

Table 5: (Contd.) Estimated and Proportions of type of Employment by 3-digit Industry Group (NIC-2008), during 2010-11(All India).

(Provisional)

NIC 2008	Total Persons Engaged (no.)	Total Workers (no.)	Directly Emp. Workers (no.)	Contract Workers (no.)	Total workers (%)	Direct Emp. Workers (%)	Contract Workers (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
293	541531	430695	240081	190615	80	56	44
301	33214	27532	9432	18100	83	34	66
302	38187	30269	19130	11139	79	63	37
303	4588	3218	2185	1033	70	68	32
304	632	417	397	20	66	95	5
309	183704	148412	83781	64632	81	56	44
310	57704	44129	30831	13297	76	70	30
321	132571	105215	84662	20553	79	80	20
322	1214	767	727	40	63	95	5
323	10221	8428	8001	427	82	95	5
324	3078	2495	2400	95	81	96	4
325	28596	20344	16975	3369	71	83	17
329	50493	40572	27796	12777	80	69	31
331	36829	28279	15990	12289	77	57	43
332	10733	6869	4627	2242	64	67	33
381	510	430	130	300	84	30	70
382	1945	1422	718	704	73	50	50
383	5663	4669	4314	355	82	92	8
581	16715	8025	6712	1313	48	84	16
Others	313600	199792	149716	50075	64	75	25
Total	**12714424**	**9905158**	**6543686**	**3361468**	**78**	**66**	**34**

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

2-digit NIC Division and Description (cntd.)

NIC-2008	DESCRIPTION
38	WASTE COLLECTION, TREATMENT AND DISPOSAL ACTIVITIES; MATERIALS RECOVERY
39	REMEDIATION ACTIVITIES AND OTHER WASTE MANAGEMENT SERVICES
41	CONSTRUCTION OF BUILDINGS
42	CIVIL ENGINEERING
43	SPECIALIZED CONSTRUCTION ACTIVITIES
45	WHOLESALE AND RETAIL TRADE AND REPAIR OF MOTOR VEHICLES AND MOTORCYCLES
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

2-digit NIC Division and Description (cntd.)

NIC-2008	DESCRIPTION
79	TRAVEL AGENCY, TOUR 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

2-digit NIC (India) Division and Description (cntd.)

NIC-2004	DESCRIPTION
01	AGRICULTURE, HUNTING AND RELATED SERVICE ACTIVITIES
02	FORESTRY, LOGGING AND RELATED SERVICE ACTIVITIES
05	FISHING, AQUACULTURE AND SERVICE ACTIVITIES INCIDENTAL TO FISHING
10	MINING OF COAL AND LIGNITE; EXTRACTION OF PEAT
11	EXTRACTION OF CRUDE PETROLEUM AND NATURAL GAS; SERVICE ACTIVITIES INCIDENTAL TO OIL AND GAS EXTRACTION, EXCLUDING SURVEYING
12	MINING OF URANIUM AND THORIUM ORES
13	MINING OF METAL ORES
14	OTHER MINING AND QUARRYING
15	MANUFACTURE OF FOOD PRODUCTS AND BEVERAGES
16	MANUFACTURE OF TOBACCO PRODUCTS
17	MANUFACTURE OF TEXTILES
18	MANUFACTURE OF WEARING APPAREL; DRESSING AND DYEING OF FUR
19	TANNING AND DRESSING OF LEATHER; MANUFACTURE OF LUGGAGE, HANDBAGS, SADDLERY, HARNESS AND FOOTWEAR
20	MANUFACTURE OF WOOD AND OF PRODUCTS OF WOOD AND CORK, EXCEPT FURNITURE; MANUFACTURE OF ARTICLES OF STRAW AND PLAITING MATERIALS
21	MANUFACTURE OF PAPER AND PAPER PRODUCTS
22	PUBLISHING, PRINTING AND REPRODUCTION OF RECORDED MEDIA
23	MANUFACTURE OF COKE, REFINED PETROLEUM PRODUCTS AND NUCLEAR FUEL
24	MANUFACTURE OF CHEMICALS AND CHEMICAL PRODUCTS
25	MANUFACTURE OF RUBBER AND PLASTICS PRODUCTS
26	MANUFACTURE OF OTHER NON-METALLIC MINERAL PRODUCTS
27	MANUFACTURE OF BASIC METALS
28	MANUFACTURE OF FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT
29	MANUFACTURE OF MACHINERY AND EQUIPMENT N.E.C.
30	MANUFACTURE OF OFFICE, ACCOUNTING AND COMPUTING MACHINERY
31	MANUFACTURE OF ELECTRICAL MACHINERY AND APPARATUS N.E.C.
32	MANUFACTURE OF RADIO, TELEVISION AND COMMUNICATION EQUIPMENT AND APPARATUS
33	MANUFACTURE OF MEDICAL, PRECISION AND OPTICAL INSTRUMENTS, WATCHES AND CLOCKS
34	MANUFACTURE OF MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS
35	MANUFACTURE OF OTHER TRANSPORT EQUIPMENT
36	MANUFACTURE OF FURNITURE; MANUFACTURING N.E.C.
37	RECYCLING

2-digit NIC (India) Division and Description (cntd.)

NIC-2004	DESCRIPTION
40	ELECTRICITY, GAS, STEAM AND HOT WATER SUPPLY
41	COLLECTION, PURIFICATION AND DISTRIBUTION OF WATER
45	CONSTRUCTION
50	SALE, MAINTENANCE AND REPAIR OF MOTOR VEHICLES AND MOTORCYCLES; RETAIL SALE OF AUTOMOTIVE FUEL
51	WHOLESALE TRADE AND COMMISSION TRADE, EXCEPT OF MOTOR VEHICLES AND MOTORCYCLES
52	RETAIL TRADE, EXCEPT OF MOTOR VEHICLES AND MOTORCYCLES; REPAIR OF PERSONAL AND HOUSEHOLD GOODS
55	HOTELS AND RESTAURANTS
60	LAND TRANSPORT; TRANSPORT VIA PIPELINES
61	WATER TRANSPORT
62	AIR TRANSPORT
63	SUPPORTING AND AUXILIARY TRANSPORT ACTIVITIES; ACTIVITIES OF TRAVEL AGENCIES
64	POST AND TELECOMMUNICATIONS
65	FINANCIAL INTERMEDIATION, EXCEPT INSURANCE AND PENSION FUNDING
66	INSURANCE AND PENSION FUNDING, EXCEPT COMPULSORY SOCIAL SECURITY
67	ACTIVITIES AUXILIARY TO FINANCIAL INTERMEDIATION
70	REAL ESTATE ACTIVITIES
71	RENTING OF MACHINERY AND EQUIPMENT WITHOUT OPERATOR AND OF PERSONAL AND HOUSEHOLD GOODS
72	COMPUTER AND RELATED ACTIVITIES DIVISION
73	RESEARCH AND DEVELOPMENT DIVISION
74	OTHER BUSINESS ACTIVITIES
75	PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY
80	EDUCATION
85	HEALTH AND SOCIAL WORK
90	SEWAGE AND REFUSE DISPOSAL, SANITATION AND SIMILAR ACTIVITIES
91	ACTIVITIES OF MEMBERSHIP ORGANIZATIONS N.E.C.
92	RECREATIONAL, CULTURAL AND SPORTING ACTIVITIES
93	OTHER SERVICE ACTIVITIES
95	ACTIVITIES OF PRIVATE HO USEHOLDS AS EMPLOYERS OF DOMESTIC STAFF
96	UNDIFFERENTIATED GOODS-PRODUCING ACTIVITIES OF PRIVATE HOUSEHOLDS FOR OWN USE
97	UNDIFFERENTIATED SERVICE-PRODUCING ACTIVITIES OF PRIVATE HOUSEHOLDS FOR OWN USE
99	EXTRATERRITORIAL ORGANIZATIONS AND BODIES

Table 7: Selected Characteristics of Branches, Selected Years and Countries

General purpose machinery (ISIC 291)														
Country or area	Latest year (LY)	Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	23.5	40.0	7.8	12.4	50.8	58.8	58.5	16.4	13.1	12.9	32.8	28.1	28.6
Chile	2008	17.7	32.0	8.1	15.5	47.9	58.1	56.5	23.9	20.5	21.1	28.2	21.5	22.5
China	2007	...	17.6	...	3.1	...	72.7	73.0	...	4.6	4.8	...	22.7	22.2
Ecuador	2008	5.7	11.6	0.9	4.2	69.2	68.0	72.3	5.0	10.3	10.0	25.8	21.8	17.7
Egypt	2006	...	7.3	...	2.4	...	30.6	65.5	...	5.5	11.5	...	63.9	23.0
Eritrea	2008	...	1.5	...	0.8	...	55.0	36.5	...	4.6	35.9	...	40.4	27.6
Ethiopia	2008	1.2	3.8	0.3	0.9	53.0	70.3	63.4	13.5	7.6	8.6	33.4	22.1	28.0
India	2008	6.0	13.6	2.2	3.3	73.8	78.5	70.7	9.5	5.7	7.0	16.7	15.8	22.3
Indonesia	2009	5.3	15.3	1.4	3.0	57.3	67.9	49.7	11.2	4.1	9.8	31.5	28.0	40.5
Iran (Islamic republic of)	2008	28.6	22.1	9.9	7.4	59.6	64.1	65.9	14.0	13.7	11.4	26.3	22.2	22.6
Jordan	2009	8.7	23.1	3.8	5.9	68.3	67.7	57.3	13.7	10.0	11.0	18.0	22.3	31.7
Kuwait	2009	...	18.8	...	9.0	...	59.7	78.5	...	22.6	10.2	...	17.7	11.2
Malaysia	2008	21.7	22.4	5.5	8.0	69.2	79.4	78.3	7.8	8.5	7.7	23.0	12.2	14.0
Morocco	2009	8.4	12.9	5.4	8.1	63.3	65.2	66.0	23.6	19.9	21.4	13.1	14.9	12.6
Oman	2007	21.0	76.5	7.1	7.7	59.8	54.7	51.9	13.5	7.3	4.9	26.7	38.1	43.3
The f. Yugosl. Rep of Macedonia	2009	...	12.8	...	7.0	...	63.9	62.0	...	31.4	20.9	...	4.7	17.1
Turkey	2008	22.7	24.5	8.1	11.3	51.0	75.0	74.5	17.5	11.1	11.8	31.5	14.0	13.8
Uruguay	2007	13.3	17.0	13.1	10.2	58.7	50.1	47.7	40.9	29.8	31.5	0.5	20.1	20.8

a/At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Special purpose machinery (ISIC 292)														
Country or area	Latest year (LY)	Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	20.4	36.0	7.1	11.1	53.2	56.8	55.5	16.3	13.9	13.7	30.5	29.3	30.8
Chile	2008	23.5	34.2	11.1	21.9	45.3	56.1	61.3	25.8	17.8	24.8	28.9	26.1	13.9
China	2007	...	16.2	...	3.1	...	72.1	71.1	...	5.9	5.5	...	22.1	23.4
Ecuador	2008	...	56.6	1.2	5.2	...	21.3	46.9	8.3	2.5	4.9	...	76.1	48.3
Egypt	2006	...	3.9	...	2.5	...	66.3	60.0	...	15.5	25.7	...	18.2	14.3
India	2008	5.4	13.6	1.9	4.2	75.1	78.9	80.1	8.6	6.2	6.2	16.3	14.9	13.8
Indonesia	2009	6.2	24.7	1.2	2.6	60.2	41.0	30.1	7.7	13.8	7.4	32.1	45.1	62.5
Iran(Islamic republic of)	2008	24.1	21.3	11.1	7.1	55.3	59.6	59.8	20.5	13.4	13.3	24.1	27.0	26.8
Jordan	2009	5.7	21.0	2.4	3.9	65.9	63.7	63.3	14.4	7.5	6.7	19.7	28.8	29.9
Kuwait	2009	...	9.2	...	7.3	...	39.7	28.9	...	57.0	56.8	...	3.4	14.3
Madagascar	2006	...	1.0	...	0.2	...	12.6	7.2	...	15.5	16.3	...	71.9	76.4
Malaysia	2008	14.0	20.1	5.3	8.5	62.2	72.4	72.3	14.4	13.5	11.7	23.4	14.1	16.1
Morocco	2009	7.1	20.1	3.5	8.5	62.0	52.9	56.5	18.8	28.7	18.4	19.2	18.5	25.1
Oman	2007	37.9	67.9	9.1	12.4	27.1	27.0	18.4	17.5	22.3	14.9	55.4	50.7	66.7
Senegal	2009	12.2	...	4.4	...	63.5	88.0	85.3	13.2	...	...	23.3	...	...
The f.Yugosl. Rep of Macedonia	2009	...	8.5	...	5.3	...	63.3	58.0	...	23.3	26.3	...	13.4	15.7
Turkey	2008	22.0	21.3	9.0	9.4	56.5	79.4	77.7	17.8	9.7	9.8	25.8	10.9	12.4
Uruguay	2007	51.3	15.3	19.7	7.8	76.2	60.8	60.9	9.1	11.3	20.0	14.7	27.9	19.1

a/At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Domestic appliances n.e.c. (ISIC 2930)														
Country or area	Latest year (LY)	Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	28.1	44.3	7.6	11.9	57.9	64.4	62.0	11.4	9.5	10.2	30.7	26.0	27.8
Chile	2008	31.8	40.4	7.5	12.1	62.4	64.2	62.1	8.9	10.3	11.4	28.7	25.5	26.5
China	2007	....	15.7	...	3.0	...	76.7	76.5	...	4.3	4.6	...	19.1	18.9
Ecuador	2008	4.7	13.4	1.4	4.6	80.4	69.2	75.2	6.0	9.1	8.5	13.6	21.6	16.2
Egypt	2006	...	7.7	...	2.1	...	83.4	78.9	...	6.4	5.9	...	10.2	15.3
India	2008	6.3	15.5	1.6	2.7	76.8	84.1	77.4	6.0	4.5	3.9	17.2	11.4	18.8
Indonesia	2009	7.0	24.3	1.0	1.7	67.8	45.3	62.5	4.8	11.7	2.6	27.5	43.1	34.9
Iran (Islamic republic Of)	2008	39.1	18.3	10.2	6.5	60.5	68.1	67.3	10.3	12.0	11.6	29.2	19.8	21.1
Jordan	2009	10.6	24.9	3.6	8.1	64.8	64.1	69.3	12.0	9.7	10.0	23.2	26.1	20.7
Kuwait	2009	...	14.8	...	7.6	...	58.6	66.1	...	17.2	17.3	...	24.1	16.6
Malaysia	2008	15.7	22.70	6.2	8.3	77.2	84.8	80.8	8.9	4.8	7.0	13.9	10.3	12.2
Morocco	2009	10.4	25.10	4.8	9.5	77.1	73.8	62.2	10.6	12.6	14.3	12.3	13.6	23.5
Oman	2007	18.7	32.20	6.7	9.4	49.4	56.7	58.5	18.1	12.3	12.1	32.5	31.0	29.4
Qatar	2006	9.4	39.10	9.4	11.4	68.4	...	5.6	31.5	...	27.5	0.1	...	66.9
The f.Yugosl.Rep of Macedonia	2009	...	11.30	...	5.5	...	64.7	74.3	...	12.8	12.4	...	22.5	13.2
Trinidad and Tobago	2006	...	...	7.6	...	...	67.8	58.3	11.7	21.9	30.9	...	10.3	10.9
Turkey	2008	42.8	26.80	8.8	12.0	54.7	75.6	80.2	9.3	7.5	8.8	36.0	16.8	10.9
United Republic of Tanzania	2007	...	24.90	...	3.9	...	23.2	36.4	...	9.6	10.0	...	67.2	53.6
Uruguay	2007	21.4	36.00	12.2	9.0	59.7	50.8	49.8	23.1	17.0	12.5	17.2	32.2	37.7

a/ At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Office, accounting and computing machinery (ISIC 3000)														
Country or area	Latest year (LY)	Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	74.6	43.8	13.6	12.3	64.5	69.1	71.5	6.4	8.1	8.0	29.0	22.8	20.5
China	2007	...	20.4	...	4.1	...	83.0	85.0	...	2.2	3.0	...	14.8	11.9
Egypt	2006	...	7.7	...	2.3	...	52.6	74.0	...	21.2	7.7	...	26.2	18.3
India	2008	10.8	22.4	2.5	4.3	80.2	67.6	82.9	4.6	3.7	3.3	15.2	28.6	13.8
Iran(Islamic republic of)	2008	47.7	20.3	8.7	6.9	54.8	48.9	55.5	8.3	15.6	15.1	37.0	35.6	29.4
Malaysia	2008	20.6	33.0	4.8	8.1	85.8	86.7	85.8	3.3	3.4	3.5	10.9	9.8	10.7
Mongolia	2008	...	117.4	...	17.0	...	71.1	88.0	...	...	1.7	...	...	10.2
Morocco	2009	12.4	36.6	7.5	16.2	53.9	83.0	58.8	27.8	12.4	18.2	18.2	4.6	23.0
The f.Yugosl.Rep of Macedonia	2009	...	14.5	...	5.8	...	67.2	62.7	...	16.2	14.9	...	16.6	22.4
Turkey	2008	53.1	63.8	7.3	15.8	76.1	92.7	90.9	3.3	1.4	2.2	20.6	6.0	6.8
Uruguay	2007	13.7	17.9	3.8	10.4	81.7	82.6	54.0	5.0	12.3	26.8	13.3	5.0	19.2

a/ At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Electric motors, generators and transformers (ISIC 3110)														
Country or area	Latest year (LY)	Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	22.0	34.6	7.8	11.8	53.8	57.8	58.8	16.3	13.6	14.1	29.9	28.7	27.1
Chile	2008	25.1	61.7	11.6	18.3	62.5	53.2	63.4	17.3	14.2	10.9	20.3	32.6	25.7
China	2007	...	15.5	...	3.1	...	73.2	73.2	...	5.4	5.4	...	21.4	21.4
Ecuador	2008	8.0	29.2	1.3	6.0	71.4	75.9	72.5	4.7	7.6	5.7	23.8	16.5	21.8
Egypt	2006	...	5.3	...	3.2	...	44.4	75.7	...	15.5	14.6	...	40.1	9.7
India	2008	5.6	19.0	3.1	4.2	75.6	79.3	79.1	13.3	4.1	4.6	11.1	16.6	16.3
Indonesia	2009	12.8	21.9	1.0	4.1	31.3	61.3	33.5	5.5	5.7	12.4	63.2	33.0	54.0
Iran(Islamic republic Of)	2008	33.1	28.1	12.1	7.6	66.5	59.8	66.9	12.2	9.8	9.0	21.3	30.5	24.1
Jordan	2009	22.3	21.8	5.1	3.8	78.1	78.5	85.2	5.0	5.9	2.5	16.9	15.6	12.2
Malaysia	2008	8.6	8.8	3.2	4.9	73.3	81.4	81.2	10.0	11.5	10.4	16.7	7.0	8.4
Morocco	2009	9.8	12.2	5.9	6.0	58.2	70.3	71.0	25.0	24.4	14.3	16.8	5.3	14.7
The f.Yugosl. Rep of Macedonia	2009	...	10.2	...	5.5	...	61.7	58.2	...	26.9	22.7	...	11.4	19.0
Turkey	2008	28.8	64.9	11.1	19.2	59.6	77.5	70.8	15.6	10.0	8.7	24.7	12.5	20.5
United Republic of Tanzania	2007	...	2.5	...	1.5	...	80.6	83.9	...	9.0	9.3	...	10.4	6.8

a/ At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Country or area	Latest year (LY)	Dairy products (ISIC 1520)												
		Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Albania	2009	8.1	6.3	0.9	2.8	65.3	61.7	85.7	4.1	2.9	6.3	30.6	35.4	8.0
Brazil	2007	29.5	42.3	5.3	8.3	63.2	70.0	66.4	6.6	5.5	6.6	30.2	24.5	27.0
Chile	2008	49.4	54.6	8.9	12.1	60.0	65.4	71.5	7.2	6.6	6.3	32.8	28.0	22.2
China	2007	…	23.1	…	2.8	…	70.1	70.8	…	3.8	3.6	…	26.1	25.7
Ecuador	2008	14.7	29.1	2.6	7.0	74.3	79.7	76.8	4.5	4.6	5.6	21.2	15.7	17.6
Egypt	2006	…	14.3	…	2.0	…	80.2	78.2		5.0	3.0		14.7	18.8
Eritrea	2009	1.3	2.1	0.8	1.1	68.9	92.2	82.4	17.8	4.8	8.7	13.3	3.0	8.9
Ethiopia	2009	3.2	7.8	0.4	1.3	53.1	64.7	66.7	6.4	6.3	5.6	40.6	28.9	27.7
India	2008	6.6	9.3	1.8	3.0	87.1	87.8	90.3	3.6	3.4	3.1	9.3	8.8	6.6
Indonesia	2009	…	23.4	…	3.0	…	72.8	88.0	…	2.9	1.5	…	24.3	10.5
Iran(Islamic Republic of)	2008	37.7	20.0	10.8	6.3	81.6	74.1	81.1	5.3	5.2	5.9	13.2	20.7	13
Jordan	2009	8.1	16.0	3.0	4.2	75.5	78.6	68.5	9.0	8.0	8.3	15.6	13.4	23.9
Kuwait	2009	…	31.9	…	15.6	…	68.6	69.4	…	12.1	15.0	…	19.2	15.6
Madagascar	2006	…	0.3	…	0.1	…	72.3	73.5	…	4.3	4.6	…	23.4	22
Malaysia	2008	33.4	31.2	7.5	13.0	73.2	80.8	80.7	6.1	7.3	8.0	20.8	11.9	11.3
Mongolia	2008	…	3.0	0.4	0.9	…	68.9	82.3	13.1	10.3	5.5	…	20.8	12.2
Morocco	2009	17.3	36.6	6.6	14.1	75.6	77.0	73.5	9.3	9.3	10.3	15.0	13.6	16.3
Oman	2007	27.9	50.2	6.4	5.2	71.4	76.1	76.9	6.6	3.2	2.4	22.0	20.7	20.7
Qatar	2006	21.2	16.3	4.8	4.7	47.4	56.2	56.2	11.9	12.6	12.6	40.7	31.2	31.2
Trinidad and Tobago	2006	30.4	…	14.1	…	58.9	57.0	58.9	19.1	17.7	17.7	22.0	25.3	23.4
Turkey	2008	48.4	29.8	7.4	8.5	60.5	74.6	78.4	6.1	6.4	6.2	33.5	19.0	15.5
United Republic of Tanzania	2007	…	8.7	….	0.9	…	59.5	58.8	…	4.3	4.3	…	36.1	36.9
Uruguay	2007	26.4	24.9	16.7	11.1	74.7	81.4	80.3	16.1	8.9	8.7	9.3	9.7	10.9

a/ At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Basic Iron and steel (ISIC 2710)														
Country or area	Latest year (LY)	Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	61.6	137.0	10.7	17.9	55.1	56.5	58.8	7,8	5.1	5.4	37.1	38.4	35.8
Chile	2008	55.0	74.8	16.8	19.4	59.2	62.5	75.4	12.5	9.3	6.4	28.3	28.2	18.2
China	2007	…	38.9	…	4.0	…	73.1	73.3	…	3.0	2.7	…	23.9	24.0
Ecuador	2008	17.6	137.0	1.8	6.8	83.9	81.2	63.9	1.6	3.7	1.8	14.5	15.0	34.3
Ethiopia	2009	8.3	20.7	1.2	1.3	66.1	66.7	65.3	5.0	2.6	2.1	28.9	30.7	32.6
India	200.8	7.9	24.00	2.5	4.3	80.7	79.6	82.7	6.2	3.1	3.1	13.2	17.3	14.2
Indonesia	2009	16.7	40.4	2.5	8.5	77.0	87.6	77.5	3.4	2.4	4.7	19.6	9.9	17.8
Iran(Islamic Republic of)	2008	94.7	113.0	17.9	12.6	58.4	53.1	64.2	7.9	4.9	4.0	33.8	42.0	31.8
Jordan	2009	35.4	86.8	4.2	9.2	60.7	66.8	59.9	4.7	3.2	4.3	34.7	30.0	35.8
Malaysia	2008	14.7	34.8	5.5	9.6	86.3	89.4	88.2	5.1	3.8	3.3	8.6	6.8	8.6
Morocco	2009	25.7	46.1	5.8	11.7	77.8	80.7	86.1	5.0	3.5	3.5	17.1	15.8	10.3
Oman	2007	14.1	80.1	3.5	16.1	88.2	90.4	79.4	2.9	1.9	4.1	8.8	7.6	16.5
Qatar	2006	167.0	409.6	20.1	28.9	36.1	32.4	33.4	7.7	4.6	4.7	56.2	63.1	61.9
The f.Yugosl. Rep of Macedonia	2009	…	20.5	..	7.3	…	76.5	75.1	…	6.6	8.8	…	16.9	16.1
Trinidad and Tobago	2006	18.2	…	12.5	…	91.0	82.0	76.7	6.2	4.9	4.5	2.8	13.1	18.7
Tunisia	2006	…	…	…	…	…	72.4	72.3	…	0.7	0.6	…	26.9	27.1
Turkey	2008	39.3	133.2	14.3	23.1	73.5	86.6	82.9	9.7	5.3	3.0	16.8	8.2	14.1
United Republic of Tanzania	2007	…	3.8	…	1.4	…	87.1	89.3	…	3.7	3.8	…	9.3	6.9

a/ At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Country or area	Latest year (LY)	Basic precious and non-ferrous metals (ISIC 2720)												
		Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	61.4	109.0	9.3	16.4	55.3	63.1	65.3	6.8	6.0	5.2	37.9	30.9	29.5
China	2007	…	38.3	…	3.5	…	75.7	75.2	…	2.8	2.2	…	21.5	22.6
Ecuador	2008	…	43.1	…	7.7	…	76.6	84.5	…	3.2	2.8	…	20.3	12.7
India	2008	11.9	39.0	2.0	5.4	76.8	80.2	80.0	3.9	2.5	2.8	19.2	17.3	17.3
Indonesia	2009	18.8	45.8	1.8	5.3	63.9	68.2	67.4	3.4	3.6	3.8	32.7	28.2	28.8
Iran(Islamic Republic of)	2008	106.9	56.9	19.6	10.3	54.0	65.0	69.8	8.4	7.0	5.5	37.5	28.1	24.7
Jordan	2009	16.0	26.5	3.7	5.0	64.8	56.1	63.4	8.0	5.1	6.9	27.1	38.8	29.7
Kuwait	2009	…	22.4	…	6.8	…	74.7	75.2	…	10.6	7.5	…	14.7	17.3
Madagascar	2006	…	0.3	…	0.1	…	84.9	83.8	…	6.4	6.8	…	8.7	9.4
Malaysia	2008	27.4	27.0	5.8	8.6	77.0	88.7	88.6	4.8	4.4	3.6	18.1	7.0	7.7
Morocco	2009	13.6	43.6	4.1	10.5	81.1	61.6	61.9	5.7	8.0	9.2	13.2	30.4	29.0
Oman	2007	38.6	92.0	11.4	21.1	50.3	61.4	51.4	14.6	11.5	11.2	35.0	27.2	37.5
The f.Yugosl. Rep of Macedonia	2009	…	49.9	…	10.0	…	76.9	75.8	…	8.6	4.8	…	14.5	19.4
Turkey	2008	29.8	68.8	10.5	17.0	76.1	87.6	82.5	8.4	4.9	4.3	15.5	7.4	13.2
United Republic of Tanzania	2007	…	2.0	…	1.9	…	86.5	88.8	…	10.3	10.6	…	3.2	0.5

a/ At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Casting of metals (ISIC 273)														
Country or area	Latest year (LY)	Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	9.3	25.7	4.2	8.7	52.3	58.1	52.4	21.3	15.1	16.1	26.4	26.7	31.5
China	2007	…	15.5	…	2.5	…	73.3	72.6	…	4.8	4.5	…	21.8	22.9
Ecuador	2008	3.4	13.6	0.6	4.2	41.1	47.5	63.1	10.2	10.6	11.5	48.7	41.9	25.4
Egypt	2006	…	4.3	…	2.8	…	65.6	84.9	…	9.6	10.1	…	24.8	5.0
India	2008	2.5	8.5	1.2	2.4	81.2	83.9	85.1	9.3	5.2	4.2	9.6	10.9	10.8
Indonesia	2009	12.5	52.8	1.3	3.3	71.2	49.3	50.3	3.0	2.6	3.1	25.8	48.0	46.6
Iran (Islamic Republic of)	2008	21.8	18.7	10.4	7.3	55.4	58.2	60.2	21.2	17.4	15.6	23.4	24.4	24.2
Jordan	2009	3.3	20.8	3.1	2.6	73.5	57.7	45.2	25.6	22.1	6.8	0.9	20.2	48.0
Kuwait	2009	…	24.3	…	14.5	…	25	41.7	…	46.9	34.7	…	28.1	23.6
Malaysia	2008	15.3	17.7	4.9	7.2	74.4	83.1	78.4	8.2	8.2	8.8	17.4	8.7	12.8
Mongolia	2008	1.4	1.3	1.0	0.9	77.2	…	95.4	15.6	…	3.2	7.2	…	1.4
Morocco	2009	5.4	14.5	4.1	8.4	31.2	66.7	66.7	52.5	20.7	19.3	16.3	12.6	14.0
Oman	2007	…	15.1	…	7.2	…	50.5	64.4	…	20.7	17.0	…	28.9	18.6
Qatar	2006	23.8	18.8	9.6	6.0	29.9	72.6	73.8	28.3	8.2	8.4	41.8	19.2	17.9
The f.Yugosl. Rep of Macedonia	2009	…	17.3	…	7.7	…	76.3	75.0	…	12.0	11.2	…	11.7	13.8
Turkey	2008	22.0	47.3	9.0	15.5	53.4	79.9	81.1	19.0	7.1	6.2	27.5	13.0	12.7
United Republic of Tanzania	2007	…	9.8	…	3.0	…	83.9	86.7	…	4.0	4.1	…	12.1	9.2

a/ At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Struct. metal products: tanks, steam generators (ISIC 281)														
Country or area	Latest year (LY)	Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	10.6	21.6	4.2	7.7	53.8	55.0	53.8	18.4	15.0	16.5	227.8	30.0	29.6
Chile	2008	…	28.6	…	11.0	…	61.2	58.5	…	17.9	16.0	…	20.9	25.5
China	2007	…	18.4	…	3.0	…	73.5	72.9	...	4.4	4.4	…	22.1	22.7
Ecuador	2008	7.2	35.0	1.1	5.8	64.8	70.7	61.6	5.5	9.1	6.3	29.7	20.2	32.1
Egypt	2006	...	7.0	...	3.4	...	69.7	70.2	...	15.2	14.5	…	15.2	15.2
Eritrea	2009	5.7	6.1	1.0	1.6	52.2	60.5	47.6	8.8	9.2	13.8	39.0	30.4	38.6
Ethiopia	2009	1.9	7.9	0.5	0.1	58.0	72.6	63.9	11.4	6.5	0.6	30.6	20.9	35.5
India	2008	3.3	11.5	1.8	3.4	79.0	78.8	79.9	11.8	5.2	5.9	9.3	16.0	14.3
Indonesia	2009	15.2	26.9	1.6	3.3	60.1	48	63.9	4.1	6.4	4.4	35.9	45.6	31.7
Iran (Islamic Republioc of)	2008	33.2	18.9	14.2	6.8	52.9	63.3	64.5	20.2	13.0	12.8	26.9	23.7	22.7
Jordan	2009	6.4	10.0	2.3	3.6	59.9	65.9	64.0	14.7	9.6	12.8	25.4	24.5	23.2
Kuwait	2009	…	16.6	…	9.1	…	66.9	69.7	…	16.6	16.7	…	16.4	13.6
Malawi	2009	1.1	8.9	0.6	3.7	69.4	81.6	82.4	16.0	11.1	7.2	14.6	7.3	10.4
Malaysia	2008	11.0	15.0	4.4	6.6	68.7	73.9	76.8	12.4	13.9	10.2	18.8	12.2	13.0
Mongolia	2008	1.4	6.6	0.6	4.2	70.7	56.6	86.5	12.2	9.1	8.5	17.1	25.3	5.0
Morocco	2009	7.2	18.3	4.2	12.0	56.5	75.3	65.3	25.5	14.6	22.7	18.0	10.1	12.0
Oman	2007	9.3	18.8	6.0	6.8	51.1	65.1	52.0	31.4	17.7	17.4	17.2	17.2	30.6
The f. Yugosl. Rep of Macedonia	2009	…	9.0	…	6.1	…	78.9	68.0	…	18.8	21.7	…	2.3	10.3
Trinidad	2006	17.2	…	14.2	…	64.8	72.6	75.3	28.9	18.3	13.3	6.3	9.1	11.3
Turkey	2008	27.9	17.0	6.5	7.1	55.5	79.2	80.2	10.3	8.2	8.3	34.1	12.6	11.5
United Republic of Tanzania	2007	…	0.3	…	0.1	…	61.2	67.8	…	7.2	7.6	…	31.7	24.6
Uruguay	2007	16.0	18.4	10.7	7.7	59.7	68.5	77.4	26.9	11.9	9.4	13.4	19.6	13.2

a/ At current prices

Sources: UNIDO, 2012

Table 7 (contd): Selected Characteristics of Branches, Selected Years and Countries

Other metal products, metal Working Services (ISIC 289)														
Country or area	Latest year (LY)	Value added per employee (current 1000 dollars		Wages and salaries per employee (current 1000 dollars		Percentage in output [a/]								
						Costs of input materials and utilities			Costs of labour			Operating surplus		
		2000	LY	2000	LY	2000	2005	LY	2000	2005	LY	2000	2005	LY
Developing Countries														
Brazil	2007	16.2	27.7	5.3	8.3	54.2	54.7	56.3	14.9	12.4	13.1	30.9	33.0	30.6
Chile	2008	25.3	43.5	9.1	14.1	55.4	67.4	67.8	16.0	13.0	10.4	28.6	19.6	21.7
China	2007	…	13.9	…	2.7	…	74.2	73.1	…	5.4	5.2	…	20.4	21.7
Ecuador	2008	24.3	37.1	2.6	6.8	59.6	71.3	71.2	4.4	9.1	5.3	36.0	19.7	23.6
Egypt	2006	…	6.4	…	2.3	…	69.6	78.8	…	10.5	7.6	…	19.9	13.7
Eritrea	2009	1.6	3.0	0.7	0.9	53.9	69.4	46.8	21.0	19.6	16.9	25.0	11.0	36.3
Ethiopia	2009	2.8	8.2	0.8	0.8	53.7	64.7	69.2	13.0	7.6	2.8	33.3	27.7	28.0
India	2008	3.8	8.0	1.1	2.3	77.8	81.1	79.4	6.6	5.9	6.0	15.6	13.0	14.6
Indonesia	2009	6.0	17.7	1	2.4	62.2	68.3	54.2	6.4	6.7	6.2	31.3	25.1	39.6
Iran(Islamic Republic of)	2008	27.0	19.1	8.9	6.5	57.1	64.9	67.0	14.2	11.0	11.3	28.7	24.1	21.8
Jordan	2009	10.0	17.9	3	4.4	66.9	60.1	62.0	10.0	6.6	9.4	23.1	33.3	28.6
Kuwait	2009	…	26.2	…	12.0	…	63.1	77.6	…	22.0	10.2	…	14.8	12.1
Madagascar	2006	…	0.3	…	0.1	…	48.1	49.1	…	10.8	11.9	…	41.0	39.1
Malawi	2007	5.0	1.7	2.2	0.8	79.4	84.8	84.2	9.3	12.6	7.2	11.3	2.6	8.6
Malaysia	2008	14.6	17.3	4.5	6.5	72.2	79.3	77.0	8.7	9.1	8.7	19.1	11.6	14.4
Mongolia	2008	0.5	4.3	0.2	2.8	82.3	81.3	80.2	7.9	7.7	13.0	9.7	10.9	6.8
Morocco	2009	9.1	15.2	4.9	8.6	65.9	73.6	77.7	18.5	11.9	12.6	15.7	14.5	9.7
Oman	2007	14.5	20.7	4.7	7.4	48.9	61.2	55.1	16.4	15.1	16.0	34.7	23.7	28.9
The f. Yugosl. Rap of Macedonia	2009	…	7.8	…	4.9	…	67.4	66.5	…	20.9	21.3	…	11.7	12.2
Trinidad and Tobago	2006	6.8	…	4.9	…	61.1	69.5	64.7	28.0	15.6	19.0	10.9	14.8	16.3
Turkey	2008	21.9	22.5	6.4	9.5	54.8	79.1	78.7	13.2	9.1	9.0	32.0	11.8	12.3
United Republic of Tanzania	2007	…	4.4	…	2.6	…	83.1	86.0	…	7.8	8.1	…	9.1	5.9
Uruguay	2007	19.3	19.3	12.2	8.2	70.0	60.8	67.3	19.0	12.7	14.0	10.9	26.4	18.7

a/ At current prices

Sources: UNIDO, 2012

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