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Productivity Growth and Levels - A comparison of Formal and Informal Manufacturing in India*

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Abstract: In this paper, a comparative analysis of growth in total factor productivity (TFP) in the formal and informal segments of Indian manufacturing industries is undertaken, along with an analysis of differences in the level of TFP between these two segments of Indian manufacturing. The period covered for the analysis of TFP growth is 1980-81 to 2011-12, which is broken into three-sub-periods, 1980-81 to 1993-94, 1994-95 to 2002-03 and 2003-04 to 2011-12, and the period covered for the analysis of TFP level differences is 2003-04 to 2011-12. The analysis of TFP growth reveals that the average growth rate in TFP in informal manufacturing during 1980-2011was significantly lower than that in formal manufacturing (0.4 percent per annum as against 4.2 percent per annum). Both formal and informal manufacturing experienced a fall in the rate of TFP growth during 1994-2002 as compared to 1980-1993, and then achieved a marked acceleration in TFP growth during 2003-11. The acceleration in TFP growth in aggregate formal manufacturing in India in the period since 2003 is contributed mainly by improved TFP growth performance of Petroleum refining industry (about 4 percentage points) with some additional contribution made by Chemicals and chemical products industry (about one percentage point). In the case of informal manufacturing, the acceleration in TFP growth after 2003 is mainly traceable to the improved TFP growth performance of Textiles and Leather Products, Wood and wood products, and Chemicals and chemical products. Comparison of the level of TFP between the formal and informal segments of Indian manufacturing brings out that it is substantially lower in informal manufacturing than formal manufacturing. Comparing TFP growth of the formal segment of Indian manufacturing during 2003-2011with that of Korean manufacturing in the same period, it is found that the performance of Indian manufacturing was significantly better. Also, an analysis of sources of output growth for this period reveals that in a majority of industries, growth of intermediate inputs was a more important source of output growth in Korean manufacturing than Indian manufacturing.

1. Introduction

Over the last three decades, 1980s, 1990s and 2000s, the share of manufacturing in GDP (at current prices) in India has stagnated at around 15 to 16 percent, whereas the share of services (construction excluded) has increased by more than 15 percentage points, from about 40 percent in 1980-81 to about 56 percent in 2011-12.[1] Similarly, in this period, the share of manufacturing in aggregate employment has stagnated at around 11 percent, whereas the share of services in aggregate employment has increased from about 17 percent in 1980-81 to about 29 percent in 2011-12.[2]

[1] Measured at 2004-05 prices, the share of manufacturing in aggregate GDP was in the range of 14 to 16 percent during 1980-81 to 2011-12, while the share of services in GDP increased from 38 percent in 1980-81 to 57 percent in 2011-12.

[2] The shares of manufacturing and services in GDP and employment reported here are based on India-KLEMS database.

The relatively mediocre growth performance of the manufacturing sector as compared to the services sector in India has emerged as a matter of concern. There has been growing recognition in the policy making circles and academia that India needs an accelerated growth in manufacturing in the next few decades, so that India's economic growth is led by manufacturing rather than services. It is believed that India's demographic dividend is likely to give a boost to the pace of economic growth in India, and it is accepted at the same time that for taking full advantage of the demographic dividend, an accelerated growth of the manufacturing sector is essential (Goldar, 2015b).

The National Manufacturing Policy, which was formulated in 2011, has set a goal of raising the share of manufacturing in GDP from 15-16 percent in 2011 to about 25 percent by 2022, reflecting the aforementioned view of policy makers on the urgency of attaining an accelerated manufacturing sector growth. It is needless to say that for fulfilling the goal of the National Manufacturing policy, a major hike is required in the growth rate of manufacturing output, and this is arguably hard to achieve without a sharp increase in the growth rate in total factor productivity (TFP) in manufacturing (Goldar, 2015b).

The informal sector of Indian manufacturing which accounts for about 80 percent of manufacturing employment in India may prove to be a major drag in India's efforts to accelerate the growth of manufacturing output and productivity. Available literature on productivity comparison between formal and informal manufacturing in India indicates that the level of total factor productivity of informal manufacturing is substantially lower than that of formal manufacturing (discussed further later in the literature review section of the paper). Also, while India's formal manufacturing sector has made some improvements in its level of TFP over the last three decades, there are indications that there has probably been very little improvement in TFP in informal manufacturing in India. Rather, some studies have reported a significant negative growth rate in total factor productivity in informal manufacturing during the period 1978-79 to 2005-06.[3]

The above context, this paper makes an attempt to analyze differences in the level and growth rate of TFP between formal and informal manufacturing sectors in India. The analysis is undertaken at the level of 13 major industries or industry groups which together constitute manufacturing (for the list, see Table 1 in Section 3). The period of the analysis is 1980-81 (fiscal year, from April 1980 to March 1981) to 2011-12. First, a comparison of rates of TFP growth in the formal and informal segments of each industry during the period 1980-81 to 2011-12, and three selected sub-period (1980-81 to 1993-94, 1994-95 to 2002-03 and 2003-04 to 2011-12) within this period is undertaken. Then, the difference in the level of productivity

[3] Unni et al. (2001) report that the growth rate of TFP in India's unorganized manufacturing was -2.7 percent per annum during 1978-79 to 1989-90 and -3.1 percent per annum during 1989-90 to 1994-95. The estimates of Kathuria et al. (2010) indicate that during 1994-95 to 2005-06, TFP growth rate in India's unorganized manufacturing was on average about -10 percent per annum. See Goldar (2014) for a review of studies on TFP growth in India's unorganized manufacturing.

between the formal and informal segments of each industry in the period 2003-04 to 2011-12 is analyzed. This is followed up by a more detailed analysis of productivity level difference between formal and informal manufacturing, which is undertaken for 25 industries for the year 2010-11 (list provided later in Section 5.2). Finally, to set the productivity analysis for Indian manufacturing in an international perspective, a comparison is made with South Korea.

The rest of the paper is organized as follows. The next section, i.e. Section 2, reviews briefly the literature on the informal sector of Indian economy with a particular focus on the role of informal manufacturing in India and on productivity of informal manufacturing enterprises. Section 3 briefly describes the data sources, construction of variables and methodology adopted for this study. Section 4 is devoted to an analysis of TFP growth rate in the formal and informal segments of the 13 major manufacturing industries which together constitute India's manufacturing sector. The growth rates in TFP achieved by the formal segment of the manufacturing industries are compared with the growth rate in TFP achieved by the informal segment of the manufacturing industries. In addition, TFP growth estimates have been made for formal manufacturing at the aggregate level and similarly for informal manufacturing at the aggregate level. Trends in TFP growth in aggregate formal manufacturing sector and aggregate informal manufacturing sector are analyzed and contrasted. Section 5 is developed to an analysis of productivity level differentials between formal and informal segments of manufacturing industries. This is divided into two sub-sections. Section 5.1 presents an analysis of formal-informal enterprises productivity level differential for 13 manufacturing industries for the period 2003-04 to 2011-12. Section 5.2 presents such an analysis for the year 2010-11 for a larger number of industries (25 industries) with the informal segment of various manufacturing industries being further split into own account enterprises (relatively small within the informal sector, these are household enterprise with no hired workers) and establishments (being an enterprise not registered as factory and having at least one hired worker). In Section 6, TFP growth rate attained by Indian manufacturing industries during 1980-2011 is compared with similar estimates available for South Korea. The aim is to do some benchmarking. A question that is particularly of interest is whether formal manufacturing in India has been able to match the rate of TFP growth attained by Korean manufacturing. Accordingly, a more detailed comparative analysis of sources of growth in India's formal manufacturing and South Korean manufacturing has been undertaken for the period 2003 to 2011, followed by an analysis of differences in the levels of labour productivity. Finally, the main findings of the study are summarized and some concluding remarks are made in Section 7.

2. Formal-Informal Divide in Indian Manufacturing: A Review

In the context of development and growth story of any developing country, including India, the informal sector plays a very significant role. This section provides a comprehensive overview of the formal and informal segments in India and discusses its role in the manufacturing sector. We

begin by providing a detailed analysis of the formal-informal divide in the Indian context. This is followed up by an overview of this divide in the manufacturing sector in India. We discuss some of the important issues that pertain to the informal segment of the manufacturing sector and conclude by indicating the brief results pertaining to the efficiency of the two segments in question.

The informal sector has been a major contributor to employment and income to the Indian Economy for a sustained period of time. This, corroborated with the large size of the sector, has made the formal-informal divide a subject to a large body of literature (*Schneider, 2002*). Given the prominence of the discourse in the academic discourse, it may be expected that there would be a consistent definition pertaining to the informal sector. However, this has not been true – there have been wide variations in its definition both over time and across countries. One of the first definitions for the informal sector of the economy was proposed in Hart (1973). The basis for the difference between the sectors at this initial stage depended on whether the activity entailed wage or self-employment. Although the International Labour Organisation (ILO) later on did develop a conceptual framework to define the term 'informal' sector, there has been no such uniform definition in the Indian context (Naik, 2009; Bairagya, 2010). One of the latest in the series of definitions for the informal sector proposed by the National Commission for Enterprises in the Unorganised Sector (NCEUS henceforth) goes as follows,

> *"The informal sector consists of all incorporated private enterprises owned by individuals or households engaged in the sale and production of goods and services operated on a proprietary or partnership basis and with less than ten total workers."*

The term "enterprises" in the above definition includes all workers in the agricultural sector except those in plantations. This is because workers in the plantation sectors are protected under the Plantations Labour Act, 1951 (Naik, 2009). As is evident from the definition, the informal sector basically comprises of the plethora of small enterprises that is a common feature of Indian markets. They generally do not fall under the purview of most legislation that governs the formal sector (for example, legislations pertaining to the registration of the enterprises, and labour protection laws). The cornerstone of these legislations (e.g. the labour laws) has been the historical concept of "employment relationship" (ILO, 2003; Chen *et al,* 2004). The conundrum with the informal sector lies in the fact that this "employment relationship" is often not defined for this sector. As an example, the employment relationship may be disguised to avoid falling under the purview of laws. For instance, *bidi* traders in Ahmedabad claim that they sell tobacco and other related materials to *bidi* producers. They then buy the *bidis* from them, thereby avoiding any legal requirements to pay retirement benefits to the *bidi* producers (Chen, 2006). The definition and basic features of informal sector as it exists in India naturally raises questions regarding the linkages it has with the formal sectors of the economy. The possible sources and sorts of linkages are varied in the existing literature. Ranis and Stewart (1999), for instance, show that informal sector produces consumer goods aimed mainly at lower end customers. These

goods often compete with goods of the formal sector. Another school of thought contends that the informal sector is integrated with the rest of the economy through complementary linkages (ILO, 1991). For instance, legalists advocate that high regulations that restricts the formal sector also raises inefficiency perpetuation of the informal sector. Crowell (2003) shows that small salt producers face high transport costs and thus remain less competitive than large firms. These small firms aren't allowed to transport their salt using rail transport due to a long-standing government law that prevented any firm with less than 90 acre landholding to book a wagon. On the other end of the spectrum, there is some consensus that a *lack* of legislation that often characterizes major parts of the informal sector is also playing an important role in its perpetuation. The lack of legislation governing street vendors in different Indian cities has often resulted in widespread eviction and bribery (Bhowmik, 2004; Mitullah, 2004). With this basic structure of the informal sector in mind, it is natural to study how the informal and formal sectors in India have shaped the major macroeconomic variables. A general picture that arises in literature is that the informal sector of India has exhibited the phenomenon of "jobless growth" (Bairagya, 2010; Naik, 2009; Narayana, 2006). Informal employment had a higher share than formal employment for the period 1980-2005. Moreover the increase in formal employment has mainly come through the increase in employment from the informal elements of the formal sector. This general trend is true for broad sectors economy as well. On the other hand, the share of the informal sector in India's NDP has been declining (although the share is still around 60%) (Bairagya, 2010). The picture of jobless growth is also evident from the fact that the share of labour income in the informal sector has remained at 70 percent while that of the formal sector has decreased to 55 percent. This is possibly due to the labour intensive technology used in the informal sector and this high labour intensity is the reason for the large employment generation in this sector. Keeping in mind the growing importance of the formal-informal divide and its related problems, an appropriate policy response would require a detailed analysis of the cost-benefits and efficiency of each segment.

The large heterogeneity that encompasses the broad definitions of the formal and informal sectors may often make it difficult to make a cost-benefit analysis and efficiency comparison. However in India, and indeed many developing countries, the formal-informal divide is most prominent in the manufacturing sector (WTO, 2009). As a result there have been quite a few studies that focus on studying the characteristics of the formal and informal segments of India's manufacturing sector. The manufacturing sector in India has undergone significant transformation over the course of the country's post-independence history. Under the first three Five Year plans (1951-65), the manufacturing sector grew rapidly (at around 8% p.a.) and got more diversified due to the well-known import-substitution regime. After a period of stagnation in industrial growth till 1980, India initiated a series of economic reforms (including the reforms following the crisis of 1990). One of the primary objectives of the liberalisation of economic policies was to promote the competitiveness and efficiency of the Indian manufacturing sector, thereby enabling it to attain a higher growth path. However, the effectiveness of such policies would depend on the structure of the manufacturing sector, in particular the formal-informal

divide in the sector. As has been mentioned above, the manufacturing sector typically comprises of a large informal sector. Traditionally it has been recognized that the firms in the informal segment are less productive than the firms in the formal segment of the manufacturing sector (Dabla-N*orris et al,* 2005).[4] This is due to the general properties of the informal sector that have been extensively discussed earlier – lack of legislation, small size of the firms, lower access to credit etc (World Bank, 2005). This general perception of the poorer performance of the informal manufacturing sector is also reflected in the growth rate of value added in each of the segments. The growth rate of total manufacturing has been increasing in each decade for the period 1980-2011, with the formal segment growing faster than the informal segment (Goldar *et al,* 2013). However, this growth did not precipitate into lower productivity growth across major industries when we compare them with the informal sector. In terms of employment, the trend has been opposite – while the growth rate of employment in total manufacturing grew at around two percent per annum, it has been the unorganised segment that has grown more than the formal segment of manufacturing (Goldar, 2000). This employment generation capability of the informal sector is also reflected in the share of labour income. For the entire period 1980-2011, the labour income share in the informal manufacturing segment remained at a high of around 70 percent while in the formal segment the share declined to around 55 percent in 2005 (Goldar, 2013; Nagaraj, 2000). The use of labour intensive technology is probably the main contributor to the large employment generation and by consequence the large income share. Thus we see that the informal segment does indeed play a very significant role even within the manufacturing sector and it makes sense to dwell a bit further into the linkages between the segments.

Having provided some insights regarding the significance and the permanence of the informal segment in general and the manufacturing sector in particular, we proceed to discuss in more depths some of the issues faced by this particular segment. One primary issue of interest, as has been discussed above, is the linkages between the formal and informal sector. One essential way in which the formal manufacturing sector interacts with the informal manufacturing sector is by means of sub-contracting. Many economic relations of production fall somewhere between the two extremes of pure formal segments and pure informal segments. In the manufacturing sector, workers are known to move between points in this spectrum with varying ease and speed (*Chen, 2004*). For instance, a big garment producing firm may try to reduce its cost of stitching by sub-contracting this work to small tailors working in the informal sector. Likewise, there are many informal enterprises that provide cheap raw materials and labour to the formal segment, thereby making their livelihood contingent on the demand from the formal segment. This is especially true in the case of Indian manufacturing – increasing competition due to openness induces high pressure to reduce costs. This, along with strict labour regulations, provides an ideal scenario for extensive sub-contracting (Mazumdar and Sarkar, 2008; Ramasawamy, 1999). Now there are

[4] In the Indian context, comparison of productivity between large scale manufacturing units and small scale manufacturing units can be traced to the study undertaken by Dhar and Lydall (1961). This pioneering study found that small scale units are relatively inefficient as compared to large scale units. Similar conclusions were reached in the study undertaken by Goldar (1988).

two contending views about the nature of sub-contracting from the formal to the informal segments. In the stagnation view, formal enterprises subcontract with the most labour intensive units to the informal enterprises to minimize labour costs (Portes, 2004; Tokman, 1978). This results in a vicious cycle of worsening labour conditions and downward pressure on wages. On the contrary, the modernisation view sees sub-contracting a vehicle for the modernisation of the informal sector. The formal enterprises establish the sub-contracts with the informal enterprises with the capability of using modern technology to ensure certain minimum standards in quality (see e.g. Ranis and Stewart, 1999; Marjit, 2003). Moreno-Monroy *et al,* (2012) adheres to the latter view by showing a significant positive relation between formal sector subcontracting and total employment in the relatively modern segments of the informal sector. However, they also find evidence of a rapid growth of the relatively traditional segments of the informal sector as well. One possible reason for this is the take-over of the more labour intensive industries by these traditional segments. Other possible reasons include strict labour laws governing the formal sector (Besley and Burgess, 2004) and structural production links between the formal and informal segments (Aghion et al, 2008). The other major issue that concerns the informal segment of the manufacturing sector is the issue of legality. It is a widespread notion that most of the enterprises in the informal sector exist there to avoid registration and taxation. Although such arrangements are indeed illegal, it must be kept in mind that this is distinct from illegal goods and services. Most of the outputs produced in this segment are indeed legal (Thomas, *1992*). For example, a street-side bicycle repairing shop may not be paying his taxes, but his output is certainly not illegal. Moreover since the enterprises in the informal manufacturing segments are generally small, their output may not be falling within the taxable bracket or the cost of registration may be too high. This cost disadvantage is evident in a study by Chen *et al.* (2004) where they show that street vendors would welcome the security that can be provided to them upon paying the legal fees. This is in general true for almost all informal workers – there are substantial disadvantages to being not under the purview of legal sanctions. Almost all of these workers are deprived from the worker's benefits and social security that the workers in the formal sector generally enjoy. Hence it seems rational to believe that the informal workers are stuck in their working environment not by choice, but by their inability to be absorbed into the formal manufacturing segment.

It has been argued extensively in the preceding paragraphs that the informal sector by definition comprises of small enterprises, and hence tends to be less efficient than its formal sector counterparts. However, there has been little systematic analysis of the difference in efficiency levels between informal and formal manufacturing firms. A primary reason for this is the lack of credible data that can allow such comparisons. Data on output and capital stock are difficult to obtain from the small enterprises in the informal sector, especially because they are not registered with the government (Kathuria *et al.* 2013). Other concerns relate to the self-selection bias that often characterizes the enterprises in the informal manufacturing sector (Straub, 2005; Dessy and Pallage, 2003). In terms of data availability in the Indian context, there is a further concern regarding the inconsistency of definitions of the informal sector. For example the

enterprises covered in the informal sector by the Economic Census and National Sample Survey Office (NSSO) data are often incomparable (Guha-Khasnobis et al, 2006). As a result each database has to be analyzed by keeping in mind its own benefits and limitations. Nonetheless, there have been a few studies that do try to compare the efficiency levels of the firms in the formal and informal manufacturing sectors. For instance Goldar and Mitra (2013) find that the firms in the formal manufacturing sector outperform the informal counterparts in terms of technical efficiency. The latter are not affected by the increase in the availability of infrastructure, and neither have they benefited from the growth process. However, the growth rate of labour productivity and total factor productivity (TFP) in the informal manufacturing sector accelerated in the 1990s and the 2000s relative to the 1980s (Goldar and Sengupta, 2013). This may be due to the economic reforms that were undertaken in India during this particular period, leading to a more competitive manufacturing sector. The general tendency of the superior efficiency of formal segment firms is also reflected in Kathuria et al. (2013). They find that firms in the formal manufacturing sector in India are technically more efficient – both in the relative and absolute sense, than the firms in the informal manufacturing sector. The authors also find significant self-selection of firms into the informal segment for most of the industries in the manufacturing sector.[5] Nevertheless, this strand of literature is still nascent and would improve with the availability of better and more consistent datasets.

To summarize, the informal sector in India comprises of small enterprises that do not fall under the purview of government legislations. It is a major contributor to India's Net Domestic Product but its share has been declining. However, it still remains a large source of employment in India, indicating that the sector has exhibited jobless growth. This general trend is also true in the manufacturing sector in India, where the size of the informal segment is quite extensive. One of the main issues that pertain to the relation between the formal and informal segments of the manufacturing sector includes extensive sub-contracting of labour intensive work to the informal sector and the legality. This raises questions on the efficiency comparisons between the formal and informal manufacturing sectors. Due to lack of comparable databases, literature on this front is still few but in general it is found that the formal firms are generally more technically efficient. This lack of literature and consistent dataset provides the main motivation of the paper – we use the extensively developed India KLEMS dataset to compare the TFP growth rates of the informal and formal manufacturing sectors in India.

[5] Taynaz (2009) explain productivity gap between formal informal enterprises in terms of self selection of entrepreneurs and managers with technical skill shift to the formal sector (in a study of Turkey). The educated workers are there in the formal sector. Heish and Klenow (2014) argue that formal sector enterprise invest in intangible capital while informal sector enterprises do not make such investment leading to differences in productivity (in a study of US, India and China).

3. Methodology, Data Sources and Measurement of Output, Inputs and Factor Incomes

3.1 Methodology

3.1.1 Measurement of Total Factor Productivity Growth

As mentioned earlier, TFP growth rate estimates for formal and informal segments have been made for 13 major manufacturing industries (see List in Table 1). These computations have been made using the framework of a gross output function. The production function at the industry level being taken as a gross output (Y) function, industry output growth can be decomposed into contributions from capital (K), labor (L) and intermediate input (X) as:

$$\Delta \ln Y_i = \bar{s}_{K,i} \Delta \ln K_i + \bar{s}_{L,i} \Delta \ln L_i + \bar{s}_{X,i} \Delta \ln X_i + \Delta \ln A_i \qquad \ldots(1)$$

where s_K, s_L, and s_X are respectively the share of capital, labor and intermediate input in total nominal output in industry i. In the growth accounting analysis presented here, X is further subdivided into three inputs: energy (E), materials (M) and services (S). Thus, the equation above may be re-written as:

$$\Delta \ln Y_i = \bar{s}_{K,i} \Delta \ln K_i + \bar{s}_{L,i} \Delta \ln L_i + \bar{s}_{E,i} \Delta \ln E_i + \bar{s}_{M,i} \Delta \ln M_i + \bar{s}_{S,i} \Delta \ln S_i + \Delta \ln A_i \qquad \ldots(2)$$

where s_E, s_M and s_S are the income shares of energy, materials and services in gross output.

Having obtained industry level TFP growth rates with help of equation (2) above, aggregate level estimates of TFP growth rate have been made for formal manufacturing, informal manufacturing and total manufacturing (formal plus informal segments combined). This has been done by applying the Domar aggregation procedure (Domar, 1961; Jorgenson et al, 2005).

3.1.2 Measurement of Difference in TFP Level between Formal and Informal Manufacturing

A simple methodology has been applied to measure TFP difference between formal and informal segments of different manufacturing industries. This analysis is based on the value added function: gross value added is taken as the measure of output, number of persons employed is taken as the measure of labour input and gross fixed capital stock is taken as the measure of capital input.

Let V^j_N, K^j_N and L^j_N denote gross value added, capital input and labour input per enterprise among the informal enterprises in industry j. Similarly, let V^j_F, K^j_F and L^j_F denote gross value added, capital input and labour input per enterprise among the formal enterprises in industry j. Define relative capital productivity (RKP) and relative labour productivity (RLP) between informal and formal segment of industry j as:

$RKP_j = [V^j_N / K^j_N] / [V^j_F / K^j_F]$ … (3),

$RLP_j=[V^j_N /L^j_N] / [V^j_F/L^j_F]$ … (4).

Then, relative total factor productivity, RTFP, or relative efficiency may be obtained as:[6]

$$\ln RTFP_j = \bar{s}_{K,j} \ln RKP_j + \bar{s}_{L,j} \ln RLP_j \quad \ldots(5)$$

In the above equation, s_K and s_L denote capital and labour shares in value added, and the bar denotes that the average between formal and informal segments are to be taken. Note that the above equation may be written as:

$$\ln RTFP_j = \ln\left(\frac{V^j_N}{V^j_F}\right) - \left[\bar{s}_{K,i} \ln\left(\frac{K^j_N}{K^j_F}\right) + \bar{s}_{L,i} \ln\left(\frac{L^j_N}{L^j_F}\right)\right] \quad \ldots(6)$$

3.1.3 Periodization

As mentioned earlier, the period considered for the analysis is 1980-81 to 2001-12. This is period for which output and input series have been constructed under the India KLEMS database. To analyze trends in TFP growth, three sub-periods are considered. These are 1980-81 to 1993-94, 1994-95 to 2002-03 and 2003-04 to 2011-12. In addition, estimates of average annual TFP growth for the entire period 1980-81 to 2001-12 are presented. This periodization has been followed also in the analysis of TFP level difference between formal and informal segments of manufacturing undertaken with the help of time series for the period 1980-81 to 2011-12.

The division of the time period, 1980-80 to 2011-12 into three sub-periods mentioned above for the purpose of the present analysis of trends in manufacturing productivity follows the periodization adopted by Panagariya et al. (2014, Chapter 2) as reflecting three distinct periods of growth of the Indian Economy. The first sub-period (1980-1993) is one in which India's per capita GDP grew at an average annual rate of 2.9 percent. The second sub-period consists of years 1993-2002, during which India's per capita GDP grew at an average annual rate of 3.9 percent. The final sub-period is from 2003 to 2011 when the per capita GDP grew at the rate of 6.9 percent per year.

[6] The method of computation of relative efficiency has been used in Goldar (1988).

Table 1: Industry shares in aggregate nominal value added, 1980-2011

	1980	1990	2000	2011
Agriculture and allied	**36.0**	**29.4**	**23.0**	**17.9**
Manufacturing	**16.4**	**16.2**	**15.3**	**14.7**
Food Products, Beverages & Tobacco products	1.7	1.8	1.7	1.6
Textiles, Leather & Footwear	4.0	3.1	2.8	1.7
Wood & Products of Wood	1.6	0.7	0.8	0.3
Pulp, Paper, Printing & Publishing	0.5	0.6	0.5	0.4
Coke, Refined Petroleum & Nuclear Fuel	0.3	0.7	0.7	0.7
Chemicals & Chemical Products	1.1	1.3	1.8	2.0
Rubber & Plastic Products	0.3	0.5	0.6	0.5
Other Non-Metallic Mineral Products	0.7	1.0	1.0	0.9
Basic Metals & Metal Products	2.2	2.5	2.1	2.9
Machinery, n.e.c.	0.9	1.1	0.8	0.9
Electrical & Optical Equipment	0.7	1.0	0.8	0.8
Transport Equipment	1.0	1.1	1.0	1.2
Mfg., n.e.c. & recycling	1.3	0.8	0.8	0.8
Non Manufacturing Industries	**8.0**	**10.3**	**10.7**	**12.5**
Mining & Quarrying	1.7	2.6	2.3	2.7
Electricity, Gas & Water Supply	1.6	2.1	2.4	1.6
Construction	4.7	5.5	6.0	8.2
Services	**39.5**	**44.1**	**51.0**	**54.9**

Source: India KLEMS Database, 2015; Authors' computations

3.2 Data Sources

The analysis presented in the paper is essentially based on the India KLEMS database. The main source of data used for the preparation of the India KLEMS database is the *National Accounts Statistics* (NAS), published annually by the Central Statistical Office (CSO). The 2004-05 national accounts series and the corresponding back series have been used. These data are supplemented by Input-Output tables (published by CSO) and *Annual Survey of Industries* (ASI) brought out by the CSO and various rounds of NSSO (National Sample Survey Office) surveys on employment & unemployment and unorganized manufacturing.

3.3 Measurement of Output, Inputs and Factor Income shares

As noted above, the analysis presented in the paper primarily relies on the India-KLEMS database. The details of the procedures that have been adopted to construct time series on gross output, gross value added, capital stock and services, labour input (number of persons employed and labour composition index reflecting changes in labour quality), energy input, materials inputs, and services input, and factor income shares for the various industries (27 industries) for India KLEMS database is provided elsewhere.[7] Therefore, only a brief discussion of the procedures adopted for constructing such series for manufacturing industries is done here.

Gross Value added*:* NAS provides estimates of Gross Domestic Product (GDP) or gross value added by industries at both current and constant prices since 1950. Time series on gross value added for the 13 industries (see list of industries and their share in aggregate GDP in Table 1) for the period 1980-81 to 2011-12 have been taken from the National Accounts series which provides data at current and 2004-05 prices. GDP estimates are adjusted for Financial Intermediation Services Indirectly Measured (FISIM). The value of such services forms a part of the income originating in the banking and insurance sector and, as such, is deducted from the GVA.

NAS provided data on gross value added separately for registered and un-registered sectors. These are also referred to as organized and unorganized manufacturing sectors. In this paper, organized sector is being called the formal sector of manufacturing, and unorganized sector as the informal sector of manufacturing.

One difficulty faced in drawing data from NAS for constructing the gross value added series for the 13 industries is that the classification chosen for India KLEMS database does not match that used in the NAS. For those industries within the manufacturing sector, where detailed data are not available from NAS, estimates have been made making use of data drawn from the Annual Survey of Industries (ASI) for registered (organized) and NSSO surveys for un-registered (unorganized) manufacturing industries. While the former source is used to split aggregate value

[7] See, for instance, Estimates of Productivity Growth for the Indian Economy, Report, Reserve Bank of India, available at https://rbi.org.in/Scripts/PublicationReportDetails.aspx?ID=785.

added data from NAS into sub-sectors in the organized sector, the latter is used for the unorganized sector.

It may be mentioned here that ASI data for 2011-12 has been corrected recently in January 2016. In the NAS 2004-05 series, the corresponding correction has not been made since the CSO has meanwhile shifted to a new NAS series with base 2011-12. In preparing the data series for this study, this correction in ASI data has been incorporated. The correction affects the estimates of gross output, value added and intermediate input for two industries: chemicals and basic metals.

Gross output: Gross Output series for different manufacturing industries are mostly derived from the NAS. As in the case of value added, NAS provides gross output series at current and 2004-05 prices for organized (or registered) and unorganized (or unregistered) segments. At certain places, it had been necessary to split the series given in NAS into parts using ASI or NSSO surveys for unorganized manufacturing. For unorganized manufacturing industries, NAS provides gross output data only for more recent period. Thus, for earlier years, the ratio of GO to GVA computed from NSSO surveys have been applied to compute gross output.

Intermediate inputs: Nominal values of intermediate inputs are basically the difference between nominal value added and nominal output. The various intermediate inputs going into the production process of output industries are aggregated into energy, material and service inputs. The segregation of intermediate inputs in energy, materials and services inputs has been done with the help of input-output tables. The input-output transaction (IOTT) tables for 1978-79, 1983-84, 1989-90, 1993-94, 1998-99, 2003-04, and 2007-08 have been used for this purpose. These are the benchmark years for the computation of intermediate inputs. In this way, for each benchmark year, estimates are obtained for material, energy and service inputs used to produce output in the different industries. The time series of input proportions for industries are compiled for the benchmark years and then linear interpolation is done to obtain the series for 1980 to 2011 at current prices.

To generate a price deflator for intermediate inputs, the wholesale price indices published by the Office of the Economic Advisor, Ministry of Commerce and Industry are used along with implicit deflators for services sectors derived from the NAS. For each industry, separate deflators have been constructed for materials, energy and service inputs, and for this purpose weights for different items of inputs have been derived from input-output tables, considering the relevant columns of IOTT for each of the industries.

Employment: Employment data is basically obtained from the quinquennial rounds of Employment and Unemployment Surveys (EUS) published by National Sample Survey Office (NSSO). Using the EUS, the total workforce has been estimated by industry groups, as per the National Industrial Classification (NIC). The work participation estimates obtained from EUS are adjusted for population, using various population censuses. In the EUS, the persons employed are classified on the basis of their activity status into usual principal status (UPS),

usual principal and subsidiary status (UPSS), current weekly *status* (CWS) and current daily status (CDS). UPSS is the most liberal and widely used of these concepts. Despite that the UPSS has some limitations,[8] this seems to be the best measure to use given the data and hence estimation of the number of employed persons has been done by using the UPSS definition.

While the India KLEMS data base contains time series on labour composition index and labour input is formed by taking into account both number of persons employed and the composition index, in this study the labour input has been measured by the number of persons employed. This has been done because the composition index is not separately available for formal and informal segments of different industries.

Factor income shares: Income shares of energy, materials and services inputs in gross output have been computed for each industry for different years by taking the nominal values of these inputs by the nominal value of gross output. Income share of labour in gross output is formed by taking first the ratio of labour income to value added and multiplying that by the share of value added in gross output at current prices. Income share of labour in value added has been computed for organized sector manufacturing industries for different years during 1980-81 to 2011-12 using ASI data. For unorganized manufacturing, the income share of labour in value added has been computed by considering data for establishments because for own account enterprises which do not use any hired labour, there is no wage payment. The ratio in question, i.e wage share in value added, has been computed by dividing wage per hired worker in establishments by gross value added per worker employed (hired or non-hired) in establishments. A weighted average of labour income shares in value added computed for organized and unorganized manufacturing industries have been taken to form the relevant ratio at the industry level (organized and unorganized segments combined). Having obtained the income shares of labour, energy, materials and services, the income share of capital input is obtained as a residual.

Capital services*:* Capital services for individual industries in India KLEMS are arrived at using the following equation:

$$\Delta \ln K = \sum_k \bar{v}_k \Delta \ln K_k \quad ,,,(7)$$

where K_k denotes the kth type of capital assets used in an industry, and v_k denotes the share of that type of capital assets in total income accruing to capital input. In order to implement the method indicated in equation (7), it was essential to obtain investment data by asset type. Sectoral investment in three different asset types – construction, transport equipment, and

[8] Problems in using UPSS includes: 1) the UPSS seeks to place as many persons as possible under the category of employed by assigning priority to work; 2) no single long-term activity status for many as they move between statuses over a long period of one year; and 3) usual status requires a recall over a whole year of what the person did, which is not easy for those who take whatever work opportunities they can find over the year or have prolonged spells out of the labor force.

machinery[9] are gathered from NAS for broad sectors of the economy, the Annual Survey of Industries (ASI) covering the formal manufacturing sector, and the National Sample Survey Organizations (NSSO) rounds for unorganized manufacturing. These sectoral data are used to construct capital stock using perpetual inventory method, i.e.

$$K_{K,t} = K_{K,t-1}(1 - \delta_K) + I_{K,t-1} \ldots (8)$$

where K_K is the capital stock in asset K, δ_K and I_K is the real investment in asset K, and the subscript t stands for year t. The assumed depreciation rates are 8 percent for machinery, 2.5 percent for construction and 10 percent for transport equipment. The rental price of capital $P_{K,k}$in (6) is measured assuming an external rate of return *(r)*, as

$$P_{K,k,t} = P_{I,k,t-1}\, r + P_{I,k,t}\, \delta_K \quad \ldots(9)$$

where the external rate of return, r, is represented by a long-run average of real bond rate and market interest rate, obtained from Reserve Bank of India.

Getting separate data for formal and informal segments: For certain variables, the formal and informal segments are estimated first and then these two are added to compute the value of the variable for the industry, the two segments, formal and informal, combined. This is the method used for gross value added, gross output and capital stock (capital service). The same applies to total value of intermediate inputs at current prices and income share labour in gross value added. In these cases, the time series for the relevant variables could readily be obtained for the formal and informal segments of each industry.

The distribution of intermediate input into energy, material and services is based on the input-output tables. Since the IOTT tables do not show input requirements separately for formal and informal segments, the same input structure has been assumed for the two segments, and therefore, the estimated materials, energy and services input for each industry each year was distributed proportionately between formal and informal segments depending on the value of intermediate inputs at current prices. This is a limitation of the estimates of intermediate inputs of formal and informal segments of different manufacturing industries.

As regards the number of persons employed, the employment in the formal segments of various industries has been obtained from ASI data for various years. Employment in the informal segments has been derived as a residual. Given the total employment in an industry given by NSSO survey on employment and the estimated employment in the formal segment given by ASI, the employment in the informal segment has been computed as the difference between the two. This procedure, though simple and appealing, faced a problem for certain industries for some of the years in the period under study, since it led to very low or even negative estimates of

[9] Land and livestock have also been included in investment data for agricultural sector as separate assets.

employment in the informal segment. To address this problem, the share of the informal sector of the industry in total estimated employment of the industry was computed for each year during 1980-81 to 2011-12 for each of the 13 manufacturing industries. The trends in this ratio were studied for each industry. Wherever this ratio was found to decline to a level much below the trend, a floor level was applied to the ratio, considering the value of the ratio in question in the benchmark years (i.e. the years for which the quinquennial rounds of Employment and Unemployment Surveys (EUS) the NSSO survey are available). With the application of the floor level ratio, the initial estimates of employment in the informal segment of some of the industries for some of the years were revised upward. Accordingly, the estimates of total employment in the industry (formal plus informal segments of the industry) were adjusted upward.

It should mentioned in passing that in the official data sources used for this study, the terms "formal" and "informal" are not used. Instead, a distinction is made between organized and unorganized sectors of Indian manufacturing which are alternatively termed as "registered" and "unregistered" segments of Indian manufacturing in *National Accounts Statistics*. "Organized" or "Registered" segment of India manufacturing in the official data sources refer to those manufacturing establishments which are registered as "Factories" under the Indian Factories Act, 1948 (which applies to factories employing 10 or more workers with the use of power or 20 or more workers without the use of power) or establishments registered as such under the *Bidi* and Cigar workers (conditions of employment) Act, 1966 with similar requirement on employment size. For the present analysis, this segment is being treated as formal manufacturing, and the rest as informal manufacturing. It should be pointed out that while the dominant portion of informal sector establishments have very low employment (median level of employment is probably about two workers), some relatively much bigger establishments with employment much higher than 10 do get included in the unorganized or informal sector because these are not registered under the Factories Act, 1948 (or *Bidi* and Cigar workers (conditions of employment) Act, 1966).

4. TFP Growth: A Comparison between formal and informal segments of manufacturing industries

The average growth rates in TFP in formal and informal segments of manufacturing industries in the period 1980-81 to 2011-12 and in the three sub-periods (1980-81 to 1993-94, 1994-95 to 2002-03, and 2003-04 to 2011-12) are shown in Table 2. It is evident from the table that in most industries there was a fall in the rate of TFP growth in the second sub-period, 1994-2002, as compared to the first sub-period, 1980-93. By contrast, there was an improvement in the growth rate of TFP in most industries in the third sub-period, 2003-2011, in comparison with the second sub-period, 1994-2002. This pattern is seen for both the formal segment and informal segment of manufacturing industries. One exception is basic metals. In this case, there was an increase in the rate of TFP growth in the sub-period 1994-2002 and a fall in the latter sub-period, 2003-2011. This pattern is observed for both the formal and informal segments of this industry.

Table 2: TFP Growth Rates, manufacturing industries, formal and informal segments and combined (percent per annum)

KLEMS Industry Description	Formal Segment of manufacturing industry				Informal Segment of manufacturing industry				Total, formal + informal segments of manufacturing industries			
	1980-93	1994-2002	2003-11	1980-2011	1980-93	1994-2002	2003-11	1980-2011	1980-93	1994-2002	2003-11	1980-2011
Food Products, Beverages and Tobacco products	1.73	-0.33	0.63	0.81	0.29	0.32	0.49	0.35	1.05	-0.13	0.65	0.59
Textiles, Textile Products, Leather and Footwear	0.81	0.45	1.84	1.00	0.68	-0.18	1.94	0.80	0.73	0.24	2.01	0.96
Wood and Products of wood	-1.07	-1.26	-0.61	-0.99	-3.15	-5.43	0.75	-2.68	-3.03	-4.63	0.57	-2.45
Pulp, Paper, Paper products, Printing and Publishing	0.95	-1.40	1.73	0.50	0.87	0.45	1.88	1.04	0.76	-0.83	1.91	0.63
Coke, Refined Petroleum Products and Nuclear fuel	0.77	-2.42	3.14	0.53	-4.39	-0.04	-1.34	-2.24	0.66	-2.41	3.17	0.50
Chemicals and Chemical Products	1.80	-0.74	1.05	0.84	0.17	-1.40	1.87	0.21	1.63	-0.79	1.24	0.81
Rubber and Plastic Products	0.91	-0.41	2.09	0.87	-0.03	1.33	2.44	1.08	0.72	-0.08	2.25	0.93
Other Non-Metallic Mineral Products	0.48	0.82	0.02	0.44	-1.35	-1.64	1.02	-0.75	0.17	0.70	0.39	0.39
Basic Metals and Fabricated Metal Products	0.51	1.36	-2.84	-0.22	-1.75	1.05	-0.63	-0.61	0.19	1.15	-2.24	-0.24
Machinery, n.e.c.	0.55	0.78	2.46	1.17	0.21	0.16	0.90	0.40	0.23	0.63	2.31	0.95
Electrical and Optical Equipment	2.35	1.19	2.81	2.15	-0.13	-0.89	2.72	0.48	2.06	0.81	2.90	1.94
Transport Equipment	0.87	0.49	1.73	1.01	-1.93	-2.23	1.87	-0.91	0.82	0.28	1.85	0.96
Manufacturing, n.e.c.; recycling	6.61	-1.28	-0.90	2.14	3.41	0.58	-0.54	1.44	4.37	0.29	-0.59	1.75

Source: India KLEMS Database, 2015; Authors' computations

Taking the entire period, 1980-2011, the growth rate in TFP is found to be relatively higher for the formal segment than the informal segment of manufacturing industries. Exceptions are (i) Paper, paper products and printing industry and (ii) Rubber and plastic products industry in which the informal segment has attained a faster growth rate in TFP than the formal segment. In the former case, the informal segment has a better performance in all three sub-periods, but in the latter case, the informal segment has a better performance in the second and third sub-periods, not in the first sub-period.

For the formal segment of manufacturing, relatively high average rates of TFP growth during the period 1980-2011 has been achieved by Electrical and optical equipment, Transport equipment, Other machinery, Textiles and leather products and the miscellaneous manufacturing products group. In the relatively more recent time period, 2003-2011, the industries that have achieved a relatively higher growth rate in TFP include Electrical and optical equipment, Transport equipment, Other machinery, Textiles and leather products, Paper, paper products and printing, Rubber and plastic products and Petroleum refining. The petroleum products industry experienced a marked fall in TFP in the second sub-period 1993-2002 which was offset by the marked increase in TFP it attained in the third sub-period, 2003-2011.

For the informal segment of manufacturing, the average growth rate in TFP during the entire period 1980-2011 is found to be relatively high for Rubber and plastic products, Paper, paper products and printing, Textiles and leather products and the miscellaneous manufacturing products group. For wood and wood products industry which has a large presence in the informal segment of manufacturing, the average growth rate in TFP is found to be significantly negative. Interestingly, this industry experienced marked fall in TFP in the first two sub-periods, 1980-1993 and 1994-2002, but had a modest increase in TFP in the more recent sub-period 2003-2011. A somewhat similar pattern of TFP growth is found for the formal segment of wood and wood products industry.

Taking the formal and informal segments of different manufacturing industries together, the average growth rate in TFP during the entire period 1980-2011 is found to be relatively high for Electrical and optical equipment, Transport equipment, Other machinery, Textiles and leather products, Rubber and plastic products the miscellaneous manufacturing products group. The average TFP growth rate is found to be negative for basic metals industry and Wood and wood products. These are the worst performers. Confining attention to the more recent sub-period, 2003-2011, it is found that the average rate of TFP growth is relatively high for Electrical and optical equipment, Transport equipment, Other machinery, Textiles and leather products, Rubber and plastic products and Petroleum refining. Basic metals industry experienced a marked decline in TFP. The growth rate in TFP was negative also for the miscellaneous manufacturing products group.

Table 3 shows TFP growth rates at aggregate level. Aggregation has been done by the Domar aggregation procedure applied to industry level TFP growth rates based on gross output function framework presented in Table 2 above. Growth rates in TFP are shown for aggregate of formal segment of India manufacturing and aggregate of informal segment of Indian manufacturing, along with TFP growth rates of total Indian manufacturing, combining the formal and inform segments. The average growth rates in TFP are shown for the entire period 1980-81 to 2011-12, and for the three sub-periods, 1980-81 to 1993-94, 1994-95 to 2002-03 and 2003-04 to 2011-12. The year-wise growth rates in TFP are depicted in Figure 1 after applying smoothening.

Table 3: TFP Growth Rate in Manufacturing, Aggregate Level Estimates Based on Domar Aggregation of Industry Level Estimates (percent per annum)

Industry Segment	1980-81 to 1993-94	1994-95 to 2002-03	2003-04 to 2011-12	1980-81 to 2011-12
Formal segment of the manufacturing sector	6.13	0.00	5.29	4.24
Informal segment of the manufacturing sector	-0.11	-1.62	3.00	0.40
Total manufacturing sector	3.31	-0.43	5.01	2.88

Source: India KLEMS Database, 2015; Authors' computations

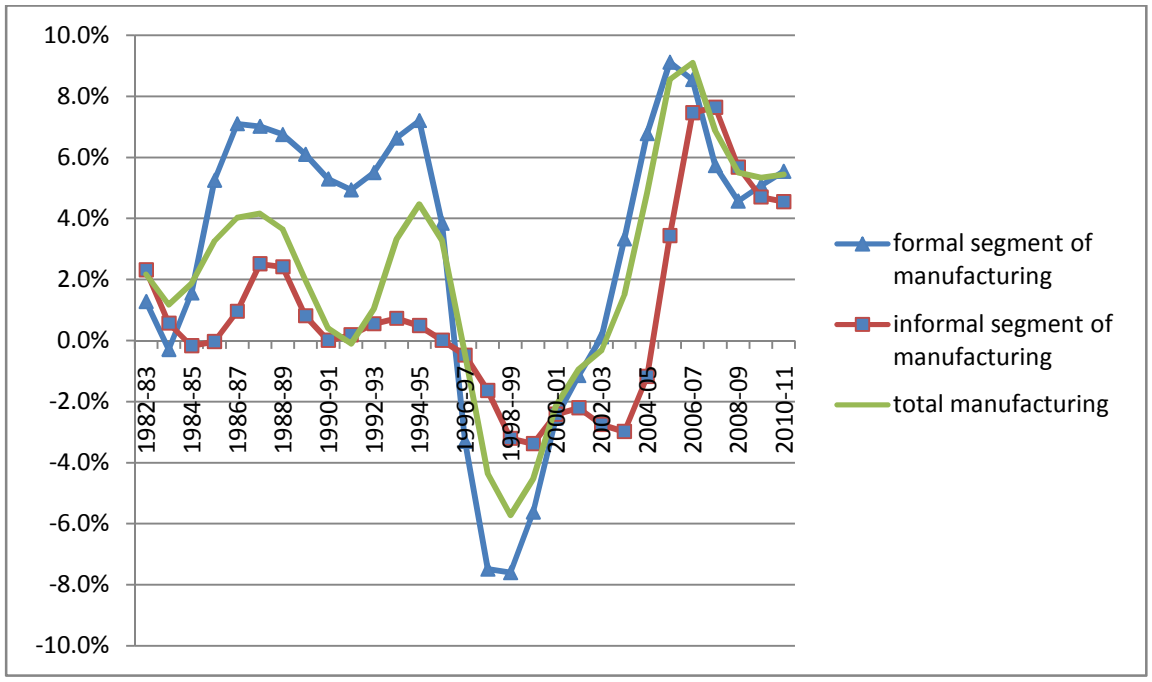


Figure 1: TFP Growth Rates in Different Years, Smoothened Time Series, Domar Aggregation, Formal Segment, Informal Segment and Total Manufacturing

Source: India KLEMS Database, 2015; Authors' computations

For the total manufacturing sector, the average growth rate in TFP is found to be 3.3 percent per annum for the sub-period 1980-1993, -0.4 percent per annum for the sub-period 1994-2002 and 5.0 percent per annum for the period 2003-2011. Growth rate in real gross value added in manufacturing (double deflated, computed by applying the Tornqvist index) is found to be 9.1 percent per annum during 1980-93, 5.7 percent per annum during 1994-2002 and 11.8 percent per annum during 2003-2011. Thus, TFP growth accounted for a substantial part of real value added growth in both the first and the third sub-periods. During the recent sub-period 2003-2011, TFP growth accounted for about one half of the real value added growth in Indian manufacturing. For the entire period, the average growth rate in TFP is found to 2.88 percent per annum while the average growth rate in real value added in the manufacturing sector was about 8.9 percent per year. Thus, TFP growth accounted for about one-third of real value added growth.

Turning to the formal and informal segments of manufacturing, it is seen from Table 3 that there was a dip in the rate of TFP growth in the second sub-period and a recovery in the third sub-period. The difference between the growth rates in the third sub-period and second sub-period is 4.6 and 5.3 percent per annum for informal and formal manufacturing respectively. The finding of a marked increase in TFP in formal manufacturing at the average rate of about 5.3 percent per annum is broadly consistent with the estimate presented in Goldar (2015a). The finding of a negative growth rate in TFP in informal manufacturing during the first two sub-periods, 1980-93 and 1993-2002 is in agreement with the findings of Unni et al. (2001) and Kathuria et al. (2010) in terms of the direction of change in TFP. However, the rate of fall in TFP in India's informal manufacturing in the period 1980 to 2002 indicated by the estimates obtained in this study are much lower than those of Unni et al. (2001) and Kathuria et al. (2010). It seems that the estimates presented in this study are more reliable.

The year-wise growth rates in TFP shown in Figure 1 indicate that negative growth rate in TFP in total Indian manufacturing in the second sub-period observed in Table 3 can be traced to a sharp decline in TFP in both formal and informal manufacturing during the late 1990s and early 2000s (traceable mostly to Petroleum refining and Food products, beverages and tobacco products in the case of formal manufacturing and Wood and wood products in the case of informal manufacturing). There has been a smart recovery after 2003 which continued till about 2006/2007 and there has been a deceleration in TFP growth thereafter.

The Domar aggregation procedure makes it possible to compute contribution of different industries to aggregate level TFP growth. Such an analysis for total manufacturing sector for the period 1980-81 to 2011-12 is presented in Figure 2. The top contributors to TFP growth in the manufacturing sector are the following industries: Textiles and Leather Products, Electrical and Optical Equipment, Chemical and chemical products, Food products, beverages and tobacco products, Transport equipment and the Miscellaneous manufacturing industries group.

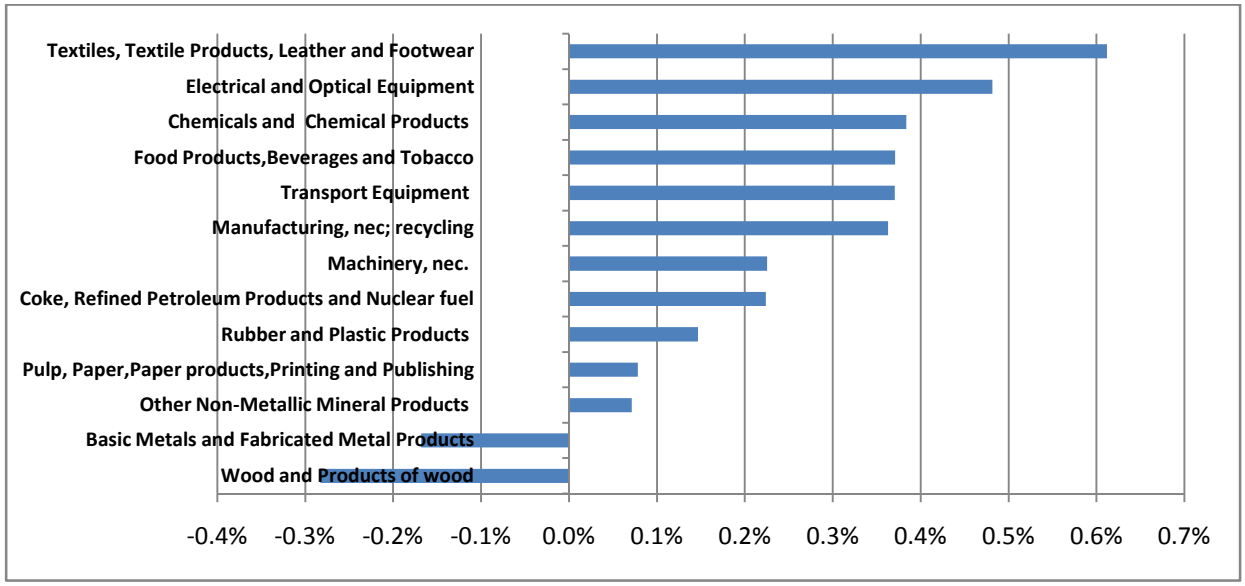


Figure 2: Industry Contributions to TFP Growth in Aggregate Manufacturing, 1980-81 to 2011-12, percent per annum

Source: India KLEMS Database, 2015; Authors' computations

Similar analysis done for formal and informal segments of the manufacturing industries separately (see Table 4) reveals that the major contributors to TFP growth of formal manufacturing sector during 1980-2011 are Electrical and Optical Equipment, Textiles and Leather Products, Transport equipment, Chemical and chemical products, and Food products, beverages and tobacco products (in that order), while the major contributors to TFP in informal manufacturing are Textiles and Leather Products, and the Miscellaneous manufacturing industries group.

An analysis of the changes in the contributions of different industries towards manufacturing TFP growth and how this explains the fall in the rate of TFP growth in Indian manufacturing between the first and second sub-period (i.e. between 1980-93 and 1994-2002) and the increase in the rate of TFP growth between the second and third sub-period (i.e. between 1994-2002 and 2003-2011) is graphically presented in Figures 3 and 4. Figure 3 deals with the fall in TFP growth between the first and second sub-periods, while Figure 4 deals with the increase in the rate of TFP growth between the second and third sub-periods.

From the analysis, it appears that the dip in the rate of TFP growth in Indian manufacturing in the second sub-period as compared to the first sub-period is mostly attributable to the changes that took place in the contributions of Food products, beverages and tobacco products, Petroleum refining, Chemicals and chemical products and the Miscellaneous manufacturing industries group in the case of formal manufacturing, and to the changes that took place in the contributions of Textiles and Leather Products, Wood and wood products, and the Miscellaneous

manufacturing industries group in the case of informal manufacturing. On the other hand, the acceleration in TFP growth in Indian manufacturing in the period since 2003 seems mostly attributable to the enhanced contributions of Petroleum refining and Chemical and chemical products in the case of formal manufacturing, and mainly to the enhanced contributions made by Textiles and Leather Products, Wood and wood products, and Chemicals and chemical products in the case of informal manufacturing.

Table 4: Industry Contributions to TFP Growth in Formal and Informal Manufacturing, 1980-81 to 2011-12, percent per annum

Formal manufacturing		Informal manufacturing	
Industry description	contribution	Industry description	contribution
Electrical and Optical Equipment	0.74	Textiles, Textile Products, Leather and Footwear	0.51
Textiles, Textile Products, Leather and Footwear	0.63	Manufacturing, nec; recycling	0.47
Transport Equipment	0.59	Food Products, Beverages and Tobacco Products	0.19
Chemicals and Chemical Products	0.57	Pulp, Paper, Paper products, Printing and Publishing	0.09
Food Products, Beverages and Tobacco Products	0.56	Rubber and Plastic Products	0.08
Machinery, nec.	0.37	Electrical and Optical Equipment	0.05
Coke, Refined Petroleum Products and Nuclear fuel	0.36	Machinery, nec.	0.04
Manufacturing, nec; recycling	0.30	Chemicals and Chemical Products	0.03
Rubber and Plastic Products	0.19	Coke, Refined Petroleum Products and Nuclear fuel	-0.02
Other Non-Metallic Mineral Products	0.09	Transport Equipment	-0.08
Pulp, Paper, Paper products, Printing and Publishing	0.07	Other Non-Metallic Mineral Products	-0.11
Wood and Products of wood	-0.03	Basic Metals and Fabricated Metal Products	-0.20
Basic Metals and Fabricated Metal Products	-0.21	Wood and Products of wood	-0.66
Aggregate	4.24	**Aggregate**	0.40

Source: India KLEMS Database, 2015; Authors' computations

It is interesting to observe that despite the marked fall in the contribution of basic metals industry, the formal manufacturing sector could achieve an increase in the growth rate of TFP by over five percentage points because of enhanced contributions of Petroleum refining and Chemical and chemical products industries along with increases in the contributions of several other industries such as Electrical and optical equipment, Transport equipment, food products beverages and tobacco products, and textiles and leather products industries.

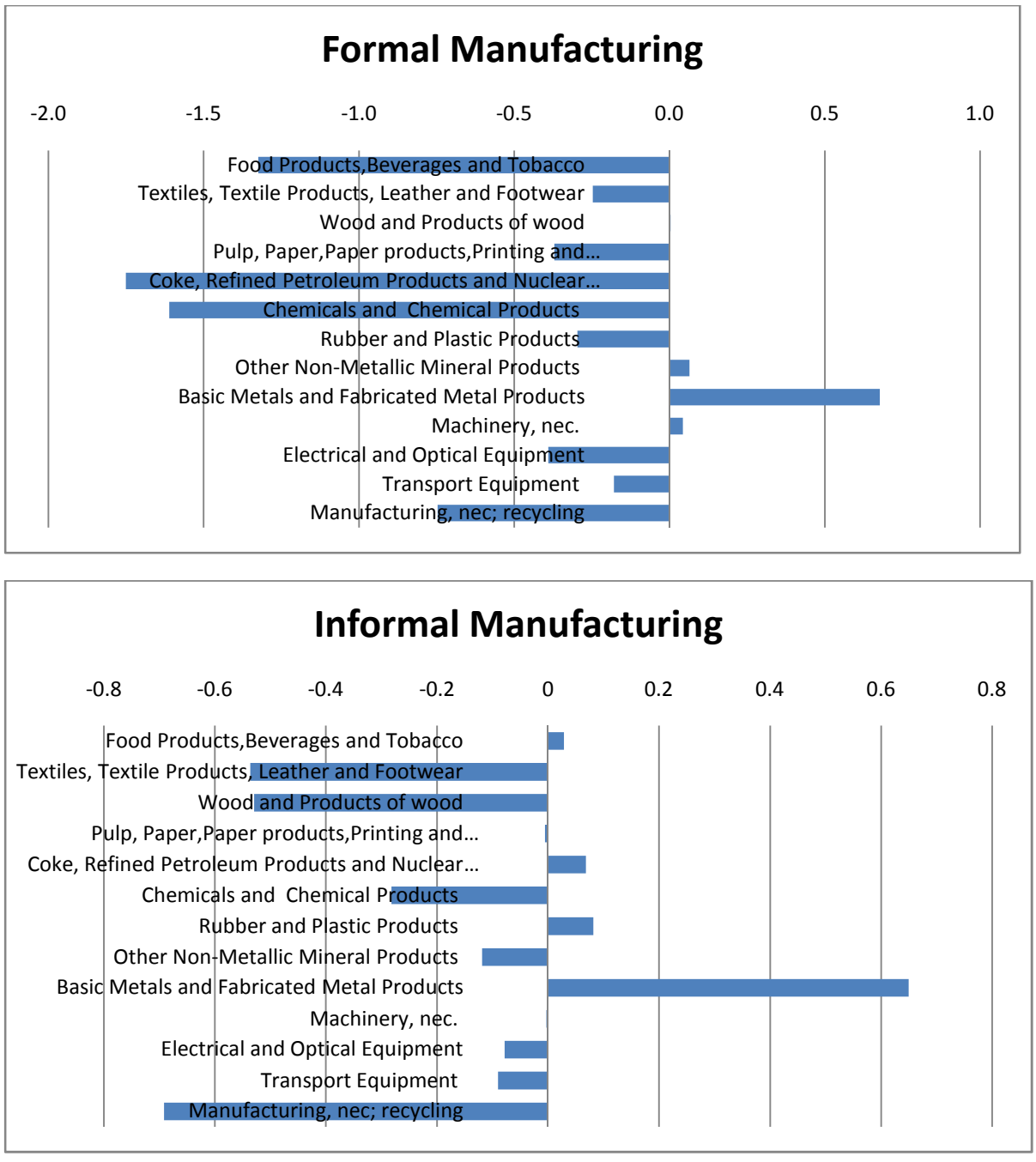
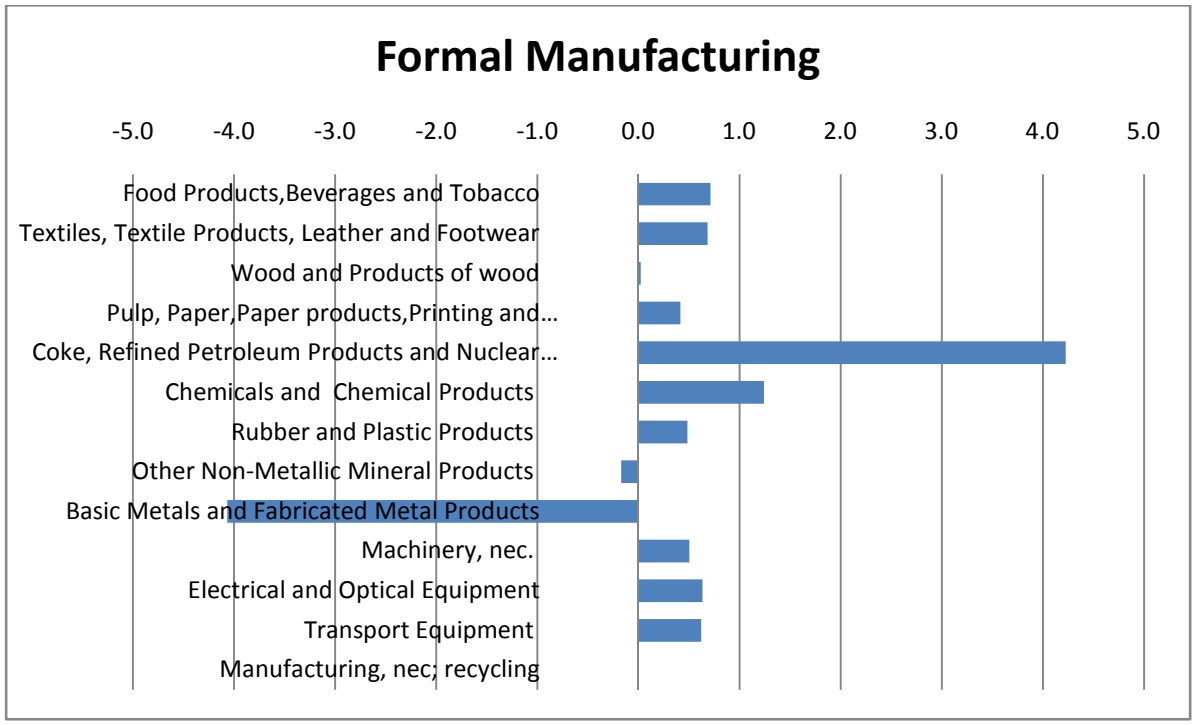


Figure 3: Change in Industry Contribution to TFP Growth in Manufacturing, 1994-2002 less 1980-1993, percent per annum

Source: India KLEMS Database, 2015; Authors' computations



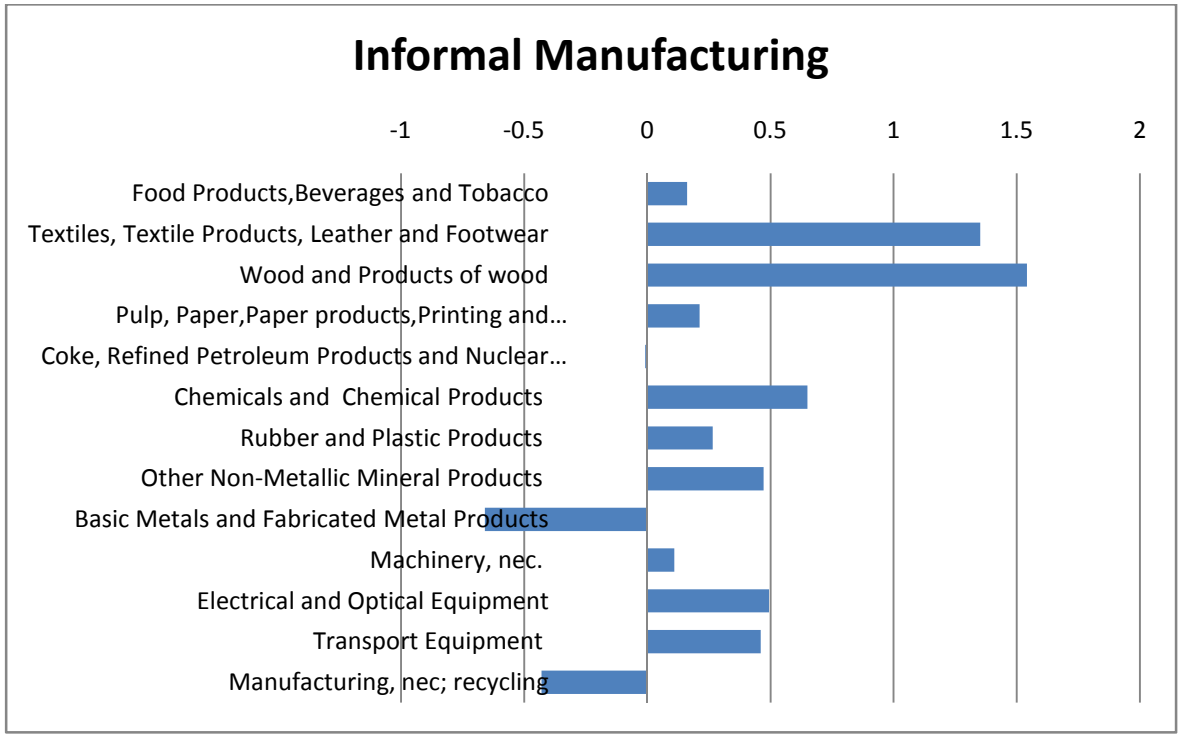


Figure 4: Change in Industry Contribution to TFP Growth in Manufacturing, 2003-2011 less 1994-2002, percent per annum

Source: India KLEMS Database, 2015; Authors' computations

5. Productivity differential between formal and informal segments of manufacturing industries

As stated earlier, this section is devoted to an analysis of productivity differential between formal and informal segments of manufacturing industries. It is divided into two sub-sections. In Section 5.1, productivity differentials between formal and informal manufacturing are analyzed in respect of the 13 manufacturing industries considered for the analysis presented in Section 4 above. This makes use of the India KLEMS database, and the analysis is done for the years 2003-04 to 2011-12. In Section 5.2, a similar analysis is presented for a larger number of industries. This makes use of ASI and NSSO survey of unorganized manufacturing enterprises; the year of comparison is 2010-11.

5.1 Analysis for KLEMS Industries

An analysis of formal-informal enterprises productivity differential for 13 manufacturing industries for the years, 2003-04 to 2011-12 is presented in this sub-section. The estimates are shown in Table 5. The period under study is divided into two sub-periods: 2003-04 to 2007-08 and 2008-09 to 2011-12. While the first period is prior to 2008 global financial crises, the second one is of post crises. The relative TFP level indicates that if the TFP of organized industry is taken as one, then how much is the TFP of unorganized industry. The simple average of relative TFP level over industry is shown in last row and of over the period 2003 to 2011 for each industry is presented in last column. Thus the last row shows the average relative TFP from 2003 to 2011(average across industry) and the last column shows the average relative TFP of each industry over the period.

It is evident that not only we have large variation over industries but also over time. It is observed that the average relative TFP for unorganized industry has been lower than the organized industry. However, it has slightly increased over the subsequent period implying that the relative efficiency of unorganized industry over organized industry has been stable over the two periods. Thus, over the years not only the relative TFP of unorganized industries has remained stable and they have 29% less TFP in second period as compared to 33% less relative TFP in the first period. So there has been no substantial impact of 2008 financial crises on the average efficiency of unorganized enterprises. Some of the industries, e.g. Textile and leather products, Wood and products of wood; Chemicals and chemical products; Rubber and plastic products; and Transport equipment have high (but less than one) relative TFP indicating that in these industries TFP of unorganized is not very low as compared to organized industry. In other cases, the relative TFP indicates that it is low in unorganized as compared to organized sector.

Table 5: Relative TFP of Informal Manufacturing vis-à-vis Formal Manufacturing, By industry, 2003-04 to 2011-12 (Formal Segment = 1)

Period\Industry	2003-04 to 2007-08	2008-09 to 2011-12	2003-04 to 2011-12
Food Products, Beverages and Tobacco	0.53	0.45	0.50
Textiles, Textile Products, Leather and Footwear	1.00	0.92	0.96
Wood and Products of wood	0.70	1.04	0.85
Pulp, Paper, Paper products, Printing and Publishing	0.37	0.40	0.38
Coke, Refined Petroleum Products and Nuclear fuel	0.33	0.22	0.28
Chemicals and Chemical Products	1.35	1.37	1.36
Rubber and Plastic Products	0.84	0.73	0.79
Other Non-Metallic Mineral Products	0.62	0.64	0.62
Basic Metals and Fabricated Metal Products	0.78	1.16	0.95
Machinery, nec.	0.37	0.24	0.31
Electrical and Optical Equipment	0.57	0.57	0.57
Transport Equipment	1.03	1.19	1.10
Manufacturing, nec; recycling	0.26	0.30	0.28
Simple Average	0.67	0.71	0.69

Source: Authors' calculations, based in India KLEMS database, 2015.

The inter-industry trend shows that the relative TFP over the entire period ranges from 1.36 in Chemical industry to 0.28 in Coke, refined petroleum and nuclear fuel and miscellaneous manufacturing. It has happened mainly because while the Chemical industry is still (2011-12) dominated by organized sector in terms of value added (91%), the unorganized sector in it has been experiencing higher TFP because of high relative labour and capital productivity. The reverse has been the case with the miscellaneous manufacturing group where the share of organized sector is only 31% in value added. The informal sector is almost missing in Coke, refined petroleum and nuclear fuel with just a 0.3% share in Value added. It indicates that industries where share of unorganized sector is relatively high may have low relative TFP and vice versa.

5.2 Analysis at the Level of Two-Digit Industries

The section presents an analysis of relative TFP for the year 2010-11(based on data from ASI for 2010-11and NSSO unorganized enterprises survey for 2010-11) for a larger number of industries (mostly two-digit level industries, according to NIC-2008) with the informal segment of various

manufacturing industries being further split into own account manufacturing enterprises (OAME) (relatively small within the informal sector, these are household enterprise with no hired workers) and establishments (being an enterprise not registered as factory and having at least one hired worker). It has been done to examine the differences in relative TFP based on the size of the enterprises.[10] The results are presented in Table 6.

It is generally expected that enterprises with small size of employment would have lower relative TFP both within unorganized sector as well as compared to organized sector. The results as presented in Table 6 confirms this, where we find that relative TFP for all the OAME (0.232) is less than that of Establishments (0.355). The same trend is observed for most of the 25 industries. However, there are four industries, viz. manufacture of beverages (industry number 3); manufacture of chemicals (industry number 12); manufacture of basic metal (industry number 16); and manufacture of furniture (industry number 23) in which we find that relative TFP in Establishments is lower than OAME. These are among the industries where we find very high - more than double the average relative TFP in OAME of these industries. Within establishments the relative TFP is only 0.121 in manufacture of coke and refined petroleum, a highly organized industry, thus indicating that in this industry the TFP of large size unorganized sector is almost 90% lower than the organized sector. The other extreme is of manufacture of basic metals with relative TFP of 0.986, implying that the relative TFP in establishment part of unorganized sector and organized sector of the industry have similar level of TFP. Between the two extremes there are quite a few industries where relative TFP in the establishment segment of the unorganized sector is less than 40 to 70% of the organized sector. There is thus a lot of variation even in the relative TFP of the relatively large unorganized (establishment) industries. So it cannot be definitely concluded that small size firms always have low TFP as compared to large size firms. There may be some industries where small size may not necessarily be an obstacle and the TFP may depend upon nature of product and the technology available and used.

Within the relatively small size enterprises of the unorganized sector (OAME) also we find very large variations in the relative TFP with organized sector. While manufacture of Coke and refined petroleum has almost zero presence of OAME, so the relative TFP is also very small - just 0.058. But on the other extreme is the manufacture of basic metals in which the relative TFP in OAME is not only higher than establishments but also higher than the organized sector of the industry- the value being greater than one. But ignoring the extremes we find that majority of the industries have relative TFP between 0.2 to 0.4, pointing out that the TFP in OAME segment of unorganized industries has been lower by 80 to 60% as compared to the organized segment of the industries.

[10] It should be pointed out that while ASI reports net book value of fixed assets, NSSO survey report on unorganized enterprises reports market value of own and rented fixed assets. The ASI data on fixed capital for the years 1990 onwards have been used to make an estimate of replacement value of capital stock in various two-digit industries for 2010-11, using the perpetual inventory method.

Table 6: Relative TFP of informal to formal segments of manufacturing industries in 2010-11

Sr. No	Industry description (NIC-2008)	Relative TFP(OAME+ Establishment)	Relative TFP(OAME)	Relative TFP (Establishment)
1	Cotton ginning, cleaning and bailing	0.165	0.091	0.220
2	Manufacture of food products	0.231	0.200	0.274
3	Manufacture of beverages	0.400	0.492	0.418
4	Manufacture of tobacco products	0.198	0.192	0.288
5	Manufacture of textiles	0.636	0.481	0.802
6	Manufacture of wearing apparel	0.351	0.312	0.416
7	Manufacture of leather and related products	0.410	0.343	0.463
8	Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials-	0.462	0.433	0.635
9	Manufacture of paper and paper products	0.361	0.161	0.446
10	Printing and reproduction of recorded media	0.356	0.234	0.385
11	Manufacture of coke and refined petroleum products	0.115	0.058	0.121
12	Manufacture of chemicals and chemical products	0.777	0.912	0.778
13	Manufacture of pharmaceuticals, medicinal chemical and botanical products	0.414	0.337	0.418
14	Manufacture of rubber and plastics products	0.344	0.200	0.407
15	Manufacture of other non-metallic mineral products	0.792	0.709	0.826
16	Manufacture of basic metals	0.979	1.085	0.986
17	Manufacture of fabricated metal products, except machinery and equipment	0.428	0.349	0.450
18	Manufacture of computer, electronic and optical products	0.438	0.321	0.450
19	Manufacture of electrical equipment	0.307	0.281	0.312
20	Manufacture of machinery and equipment n.e.c	0.297	0.209	0.306
21	Manufacture of motor vehicles, trailers and semi-trailers	0.436	0.393	0.438
22	Manufacture of other transport equipment	0.344	0.209	0.363
23	Manufacture of furniture	0.430	0.483	0.413
24	Other manufacturing	0.261	0.199	0.327
25	Repair and installation of machinery and equipment	0.208	0.164	0.248
	Total Manufacturing activities	0.290	0.232	0.355

Source: Authors' calculations, based on data drawn from ASI for organized (formal) manufacturing and NSSO survey of unorganized enterprise (67th Round) for unorganized (informal) manufacturing enterprises.

The combined picture of OAME and establishments together is not much different. The relative TFP of the total unorganized (OAME + Establishment) segment of the industries in 2011 is 0.29 as compared to organized manufacturing. Most of the 25 industries show relative TFP of less than 0.5 for unorganized segment relative to the organized one. It seems only a few (e.g. textile, chemicals, other non-metallic and basic metal industries) have a somewhat comparable TFP of unorganized and organized segments within the industry.

While the time series analysis of 13 manufacturing industries over the period 2003-04 to 2011-12 indicate that relative TFP of unorganized/informal segment in an industry as compared to organized sector has not only be lower but declining over the period, the results of relative TFP for 25 ASI industries for the period 2011-12 supports the hypothesis that enterprises with small size of employment (OAME) tend to have lower TFP as compared to large firms (Establishments). All the results thus indicate the scope to improve TFP of the unorganized sector of the Indian manufacturing industries.

6. Manufacturing Productivity: Comparing India with South Korea

This section is devoted to comparison of TFP growth of India manufacturing with that of Korean manufacturing. A comparison of the level of labour productivity is also made. The data for Korean manufacturing industries have been taken from the Asia KLEMS website. Since the Koreas data use the same industrial classification as that used for India KLEMS, inter-country comparison is facilitated. For the purpose of comparison, the estimates of TFP growth for Korean manufacturing industries based on the gross output function framework have been taken. These have been aggregated by applying the Domar aggregation procedure with the help of data on gross output and value added taken from the Asia KLEMS website.

Table 7 shows the average annual growth rates in TFP in Indian manufacturing industries for the period 1980-2011 which are compared with the TFP growth rates for Korean manufacturing. For Korea, separate estimates for formal and informal segments are not available. Hence, TFP growth rates for the formal segment and informal segment of each industry have been compared with TFP growth rate in Korean manufacturing industries. The growth rates of Indian manufacturing industries, obtained after combining the formal and informal segments have also been included in the comparison.

Table 7 brings out that in about half of the manufacturing industries, the growth rate in TFP in India exceeds that in Korea, and in the other half, Korean industries have an advantage. This is true for both formal segments and informal segments of Indian manufacturing. The industries in which India has a clear advantage include Food products, beverages and tobacco products, Textile and leather products, Rubber and plastic products, and the miscellaneous manufacturing products group. On the other hand, India has a disadvantage in Wood and wood products industry and Basic metals industry.

Table 7: TFP Growth rates, 1980-2011, Manufacturing Industries, India-Korea Comparison

KLEMS Industry, description	India	India	India	Korea
	Formal	Informal	Formal+ informal	Formal+ informal
Food Products, Beverages and Tobacco Products	0.81	0.35	0.59	-0.06
Textiles, Textile Products, Leather and Footwear	1.00	0.80	0.96	0.13
Wood and Products of wood	-0.99	-2.68	-2.45	0.18
Pulp, Paper, Paper products, Printing and Publishing	0.50	1.04	0.63	0.27
Coke, Refined Petroleum Products and Nuclear fuel	0.53	-2.24	0.50	0.61
Chemicals and Chemical Products	0.84	0.21	0.81	0.65
Rubber and Plastic Products	0.87	1.08	0.93	0.49
Other Non-Metallic Mineral Products	0.44	-0.75	0.39	0.52
Basic Metals and Fabricated Metal Products	-0.22	-0.61	-0.24	0.35
Machinery, nec.	1.17	0.40	0.95	1.62
Electrical and Optical Equipment	2.15	0.48	1.94	2.12
Transport Equipment	1.01	-0.91	0.96	1.09
Manufacturing, nec; recycling	2.14	1.44	1.75	0.48

Source: Authors' Calculations based on India KLEMS database, 2015, and such data for Korea taken from Asia KLEMS Website.

The analysis presented in Table 7 is followed up by a more detailed analysis in Table 8. The analysis now focuses on the formal segment of Indian manufacturing, since for making comparison with Korea, it is more meaningful to consider the formal segment of Indian manufacturing rather than informal segment of Indian manufacturing. Table 8 presents a comparison of average TFP growth rates by sub-periods, 1980-1993, 1994-2002 and 2003-2011 along with the comparison for the entire period 1980-2011.

It is interesting to observe that in the period 1994-2002, TFP growth in Korean manufacturing exceeded that in Indian manufacturing in 12 industries out of 13, and in the remaining case, the figures for the two countries were equal. In the next sub-period, 2003-2011, by contrast, TFP growth in Indian manufacturing exceeded that in Korean manufacturing in 9 industries out of 13. Evidently, Indian manufacturing have performed quite well in terms of TFP growth achieved in the more recent period.

Table 8: TFP Growth Rates, Formal Segment of Indian Manufacturing Compared with Korean Manufacturing, 1980-2011 and sub-periods (percent per annum)

Industry	1980-1993		1994-2002		2003-2011		1980-2011	
	India	Korea	India	Korea	India	Korea	India	Korea
Food Products, Beverages and Tobacco Products	1.73	-0.15	-0.33	0.12	0.63	-0.10	0.81	-0.06
Textiles, Textile Products, Leather and Footwear	0.81	-0.26	0.45	0.50	1.84	0.30	1.00	0.13
Wood and Products of wood	-1.07	0.62	-1.26	0.82	-0.61	-1.10	-0.99	0.18
Pulp, Paper, Paper products, Printing and Publishing	0.95	0.43	-1.40	0.03	1.73	0.28	0.50	0.27
Coke, Refined Petroleum Products and Nuclear fuel	0.77	-0.95	-2.42	3.37	3.14	0.10	0.53	0.61
Chemicals and Chemical Products	1.80	0.55	-0.74	0.86	1.05	0.58	0.84	0.65
Rubber and Plastic Products	0.91	0.77	-0.41	0.74	2.09	-0.18	0.87	0.49
Other Non-Metallic Mineral Products	0.48	0.18	0.82	0.82	0.02	0.71	0.44	0.52
Basic Metals and Fabricated Metal Products	0.51	0.66	1.36	0.42	-2.84	-0.17	-0.22	0.35
Machinery, nec.	0.55	1.10	0.78	1.62	2.46	2.38	1.17	1.62
Electrical and Optical Equipment	2.35	2.20	1.19	3.05	2.81	1.07	2.15	2.12
Transport Equipment	0.87	1.42	0.49	1.06	1.73	0.66	1.01	1.09
Manufacturing, nec; recycling	6.61	0.60	-1.28	0.20	-0.90	0.58	2.14	0.48

Source: Authors' Calculations based on India KLEMS database, 2015, and such data for Korea taken from Asia KLEMS Website.

Figure 5 presents a comparison of year-wise TFP growth rates at the aggregate level. The estimates of TFP growth rate in the formal segment of Indian manufacturing has been plotted along with such estimates for Korean manufacturing (Domar aggregation applied in both cases). It is evident that TFP growth rate in the case of Indian manufacturing shows much wider fluctuation than that for Korean manufacturing. The rate of TFP growth in formal manufacturing in India was significantly negative in the late 1990s and early 2000s, which was not experienced by the Koran Manufacturing. In the period since 2003, the rate of TFP growth achieved by formal manufacturing in India was much higher than that of Korean manufacturing (as evident also from Table 8).

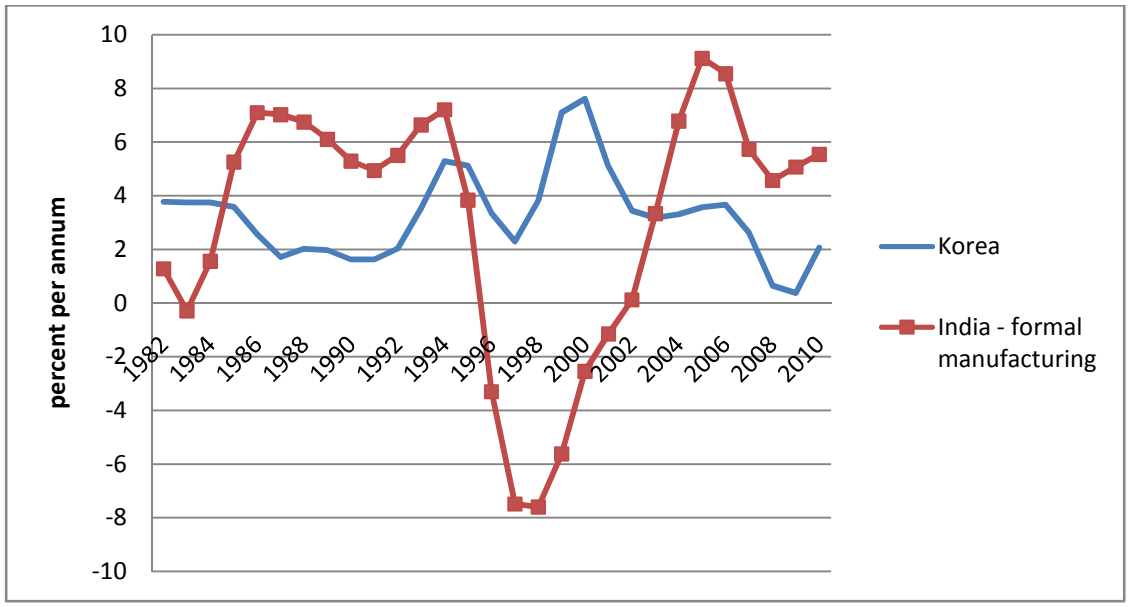


Figure 5: Year-wise TFP Growth Rate (Smoothened Time Series), Korean Manufacturing and Formal Segment of Indian Manufacturing, Percent per annum

Source: Authors' Calculations based on India KLEMS database, 2015, and such data for Korea taken from Asia KLEMS Website. Note: TFP growth rates of the formal segment of Indian manufacturing have been computed by applying Domar aggregation to industry level estimates. For Korea, similarly, the estimates of TFP growth for the manufacturing industries have been aggregated using the Domar aggregation procedure.

In Table 9, a comparison of sources of output growth has been made between Korean manufacturing industries and the formal segment of Indian manufacturing industries. The analysis is done for the period 2003-2011. It is seen from the Table that in several industries the relative contribution of TFP growth to output growth is higher for India than Korea. It may be noted particularly that in Electrical machinery and electronics, and Transport equipment, the contribution to TFP growth to output growth in higher for India than Korea. The same holds for Petroleum refining and Rubber and plastic products.

Another interesting point that emerges from the comparison shown in Table 9 is that in a majority of industries the contribution of growth in intermediate inputs to output growth is lower for India than for Korea. This is particularly noted for Paper, paper products and printing, Petroleum refining, Rubber and plastic products, Non-metallic mineral products, Electrical and optical equipment and Transport equipment. In several industries, the contribution of growth in primary inputs (capital and labour inputs) to output growth is found to be higher for India than Korea. This is observed for Petroleum refining, Chemicals and chemical products, Non-metallic mineral products, Basic metals and fabricated metal products, and Non-electrical machinery.

Table 9: Sources of Output Growth, 2003-2011, Formal Segment of Indian Manufacturing Compared with Korean Manufacturing

Industry	Country	Contributions of growth in (percent):					Rate of output growth (% p.a.)
		Interme-diate inputs	Capital input	Man-hours	Labour composition index	TFP	
Food Products, Beverages and Tobacco	Korea	92.0	34.1	-21.8	8.4	-12.8	0.8
	India	84.5	8.9	0.6	--	5.9	10.7
Textiles, Textile Products, Leather and Footwear	Korea	NC	NC	NC	NC	NC	-2.2
	India	71.0	8.1	3.1	--	17.8	10.3
Wood and Products of wood	Korea	118.6	27.6	44.6	10.8	-101.7	1.1
	India	91.6	12.3	3.2	--	-7.1	8.6
Pulp, Paper, Paper products, Printing and Publishing	Korea	88.5	33.5	-214.7	64.9	127.7	0.2
	India	72.9	9.4	2.7	--	14.9	11.6
Coke, Refined Petroleum Products and Nuclear fuel	Korea	99.6	-2.2	-0.5	0.5	2.5	3.5
	India	53.2	10.6	0.3	--	35.8	8.8
Chemicals and Chemical Products	Korea	79.2	3.1	1.1	1.4	15.3	3.8
	India	76.1	11.3	2.2	--	10.4	10.2
Rubber and Plastic Products	Korea	87.6	18.7	-3.0	2.1	-5.4	4.0
	India	70.1	10.1	2.9	--	16.9	12.4
Other Non-Metallic Mineral Products	Korea	84.2	2.4	-3.8	1.5	15.8	4.4
	India	71.4	26.4	2.1	--	0.2	9.7
Basic Metals and Fabricated Metal Products	Korea	86.9	13.2	3.3	0.7	-4.1	4.5
	India	106.9	20.2	3.0	--	-30.1	9.4
Machinery, nec.	Korea	74.6	4.5	-0.6	1.7	19.8	11.7
	India	65.8	13.0	3.3	--	17.9	13.7
Electrical and Optical Equipment	Korea	78.2	11.6	1.0	1.1	8.1	13.1
	India	69.5	8.2	2.4	--	19.8	14.2
Transport Equipment	Korea	74.9	5.0	10.6	0.6	8.9	7.1
	India	65.3	14.9	3.9	--	15.9	10.8
Manufacturing, nec; recycling	Korea	80.6	6.7	-0.6	1.4	12.0	4.4
	India	97.3	6.5	2.9	--	-6.6	13.6

Source: Authors' Calculations based on India KLEMS database, 2015, and such data for Korea taken from Asia KLEMS Website.

Notes: (1) The contribution of changes in labour composition index to output growth has not been computed for Indian manufacturing industries, as the required data are not available. (2) NC= not computed, as the growth rate in output is negative.

Besides comparing the growth rate in productivity between manufacturing industries of India and Korea, it would be useful to compare the level of productivity. A comparison of the level of labour productivity is presented in Table 10 for the years 2003 to 2011. The relative labour productivity of India to Korea has been calculated as a simple ratio of their respective labour productivity. However, to compare the level of labour productivity of the two countries, it is essential that output be expressed in the same currency and be calculated at the same level of prices. For this, we have used the PPP exchange rate for 2011 (US $ to local currency, i.e. Rupee for India and Won for Korea).[11] First the GVA each of the KLEMS industries for the year 2011 has been first converted into PPP US $ in 2011. Then using the growth rates of real GVA of each industry, we computed the GVA at PPP US$ at 2011 prices of all the previous years from 2003 to 2010. This is divided by the number of persons employed to compute labour productivity.

In most industries, labour productivity is found to be lower in India than Korea. However, in two industries, the level of labour productivity in Indian manufacturing (formal segment) is more than that in Korea. These industries are Petroleum refining and the miscellaneous manufactured products group.

In several industries, six out of 13, there is a downward trend in relative labour productivity indicating that the gap between Indian and Koran manufacturing industry has widened over time (or the labour productivity advantage of Indian industry over Korean industry in the early 2000s has withering away over time). On the other hand, in four industries (Food products, Beverages and Tobacco products, Wood and products of wood, Paper, paper products and printing, and Chemical and chemical products), there has been an upward trend in relative labour productivity, indicating that Indian manufacturing has reduced the labour productivity gap vis-à-vis Korean manufacturing. Taking an average across industries, a downward trend is observed in the relative labour productivity of Indian manufacturing vis-à-vis Korean manufacturing.

[11] The source of these data is International Comparison Program, 2011, World Bank. Industry-wise PPP exchange rates are not available. Therefore, the overall PPP exchange rate for GDP has been applied. In three cases, a deviation has been made. For Textiles and footwear, PPP exchange rate is available. This has been applied for Textiles and leather products industry. Similarly, PPP exchange rate for machinery and equipment has been applied to Machinery nec industry group. To get an appropriate PPP exchange rate for Petroleum refining, prices of petroleum products in India, Korea and the US have been compared. The prices in Korea are found to be higher. Accordingly, the PPP exchange rate has been derived. In the case of India, the price on one product is found to be higher than that in the US. But, for another product, the price in India is found to be relatively lower. Hence, the market exchange rate has been applied.

Table 10: Relative labour productivity of Indian and Korean Manufacturing industry, 2003-2011

Industry	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
Food Products, Beverages and Tobacco products	0.230	0.233	0.260	0.265	0.268	0.293	0.322	0.366	0.365	0.289
Textiles, Textile Products, Leather and Footwear	0.883	0.855	0.887	0.704	0.769	0.715	0.990	1.069	0.860	0.859
Wood and Products of wood	0.275	0.240	0.316	0.353	0.340	0.236	0.308	0.354	0.683	0.345
Pulp, Paper, Paper products, Printing and Publishing	0.527	0.582	0.644	0.623	0.642	0.528	0.508	0.672	0.594	0.591
Coke, Refined Petroleum Products and Nuclear fuel	1.347	1.244	1.342	1.407	1.289	1.182	1.081	1.365	0.986	1.249
Chemicals and Chemical Products	0.325	0.329	0.321	0.306	0.306	0.362	0.372	0.369	0.406	0.344
Rubber and Plastic Products	0.526	0.579	0.467	0.456	0.595	0.679	0.817	0.830	0.518	0.608
Other Non-Metallic Mineral Products	0.525	0.471	0.407	0.395	0.445	0.522	0.518	0.397	0.517	0.466
Basic Metals and Fabricated Metal Products	0.668	0.590	0.489	0.525	0.537	0.518	0.680	0.575	0.422	0.556
Machinery, nec.	0.635	0.561	0.563	0.537	0.494	0.384	0.632	0.463	0.407	0.520
Electrical and Optical Equipment	0.739	0.728	0.808	0.749	0.616	0.734	0.533	0.578	0.501	0.665
Transport Equipment	0.851	0.705	0.763	0.684	0.657	0.397	0.545	0.513	0.661	0.642
Manufacturing, nec; recycling	1.360	1.262	1.217	1.327	0.961	1.080	1.173	0.991	1.165	1.171
AVERAGE	0.684	0.645	0.653	0.641	0.609	0.587	0.652	0.657	0.622	0.639

Source: Author's Calculations based on India KLEMS database, 2015, and such data for Korea taken from Asia KLEMS Website. For India, only the formal manufacturing has been considered.

Note: RELATIVE LP = (INDIA LP/ KOREA LP). LP is measured as gross value added per employee. To facilitate comparison gross value added has been converted from local currency to PPP US$ using purchasing power parity exchange rate.

7. Conclusion

Productivity trends in Indian manufacturing have been analyzed above with a particular focus on the differences between the formal and informal segments of Indian manufacturing. A comparative analysis of growth in total factor productivity (TFP) in the formal and informal segments of Indian manufacturing industries has been undertaken, along with an analysis of differences in the level of TFP between these two segments of Indian manufacturing. The analysis of TFP growth revealed that the average growth rate in TFP in informal manufacturing during 1980-2011was significantly lower than that in formal manufacturing (0.4 percent per annum as against 4.2 percent per annum). Both formal and informal manufacturing experienced a fall in the rate of TFP growth during 1994-2002 as compared to 1980-1993, and then achieved a marked acceleration in TFP growth during 2003-11. The growth rate in TFP in formal segment of Indian manufacturing was about 6 percent per annum during 2003-2011 and that in the informal segment of Indian manufacturing was about 3 percent per annum in this period. Between the second and third sub-periods, there was an increase by about 4.3 percentage points per annum in the case of informal manufacturing and about 5.3 percent per annum in the case of formal manufacturing. TFP growth made a substantial contribution to output growth in Indian manufacturing in the third sub-period – about a half of the output growth at the aggregate manufacturing level was contributed by TFP growth.

The acceleration in TFP growth in aggregate formal manufacturing in the period since 2003 is contributed mainly by improved TFP growth performance of Petroleum refining industry (about 4 percentage points) with some additional contribution made by Chemicals and chemical products industry (about one percentage point). A number of other industries contributed to aggregate level TFP growth, and therefore aggregate formal manufacturing could achieve over 5 percentage points increase in TFP growth even though the drastic fall in TFP in basic metals and fabricated metal products industry tended to bring down the aggregate level TFP growth by about 4 percentage points per annum. In the case of informal manufacturing, the acceleration in TFP growth after 2002 is mainly traceable to the improved TFP growth performance of Textiles and Leather Products, Wood and wood products, and Chemicals and chemical products.

Comparison of level of TFP between formal and informal segments of Indian manufacturing revealed that the informal manufacturing enterprises are relatively less efficient. This is consistent with the findings of several earlier studies including Goldar (1988) and Goldar and Mitra (2013). While the time series analysis of 13 manufacturing industries over the period 2003-04 to 2011-12 indicated that relative TFP of unorganized/informal segment in an industry as compared to organized sector has not only be lower but declining over the period, the results of relative TFP for 25 ASI industries for the period 2011-12 support the hypothesis that enterprises with small size of employment (OAME) tend to have lower TFP as compared to large firms (Establishments). All the results thus indicate the scope to improve TFP of the unorganized sector of the Indian manufacturing industries. Based on the findings of this analysis, it may be concluded that a restructuring in Indian manufacturing with increased investment, employment

and output share of the formal sector will push up the rate of TFP growth. Similarly, it appears that a restructuring within the informal sector from own account enterprises to establishments will be TFP enhancing.

A particular focus of the paper was on productivity comparison between manufacturing sectors of India and Korea. The analysis revealed that in the recent period 2003-2011 the rate of TFP growth achieved by the formal segment of Indian manufacturing was higher than that of Korean manufacturing. A better performance of Indian manufacturing in terms of the rate of TFP growth is observed for a majority of industries. Also, it is observed that in a majority of industries growth of intermediate inputs was a more important source of output growth in Korean manufacturing than Indian manufacturing,

A comparison of the level of labour productivity (taking into account purchasing power parity exchange rate) showed that labour productivity in Indian industrial enterprises is lower than that in Korean manufacturing enterprises in most industries. Also, in six out of 13 KLEMS industries, a downward trend during 2003-11 was observed in relative labour productivity, i.e. labour productivity in Indian manufacturing divided by that in Korean manufacturing. The fact that India has achieved a relatively faster growth rate in TFP but has experienced a downward trend in relative labour productivity in several industries seems to be a puzzle. This matter needs further investigation.

References:

Aghion, P., R. Burgess, S. Redding, and F. Zilibotti (2008), "The Unequal Effects of Liberalization: Evidence from Dismantling the License Raj in India", *American Economic Review, 98*(4): 1397-1412.

Bairagya, Indrajit. "Liberalization, informal sector and formal-informal sectors' relationship: a study of India.", *Institute for Social and Economic Change*(2010).

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

Bhowmik, S. (2004). "Survey of Research on Street Vendors in Asia". *Unpublished manuscript*. Cambridge, MA: WIEGO.

Chen, M. A., J. Vanek, and M. Carr (2004). "Mainstreaming Informal Employment and Gender in Poverty Reduction: A Handbook for Policy-Makers and Other Stakeholders", *London: Commonwealth Secretariat*.

Chen, M. A. (2006). "Self-Employed Women: The Membership of SEWA," SEWA (Self-Employed Women's Association) Academy, Ahmedabad, India.

Crowell, D. W. (2003). "The SEWA Movement and Rural Development: The Banaskantha and Kutch Experience". *New Delhi: Sage Publications*.

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

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

Dhar, P.N. and H.F. Lydall (1961), The Role of Small Enterprises in Indian Economic Development, Asia Publishing House, New York.

Domar, E D (1961), "On the Measurement of Technological Change", *Economic Journal*, 71

Goldar, Bishwanath (1988), "Relative Efficiency of Small Scale Industries in India" in K. B. Suri (ed.) Small Scale Enterprises in Industrial Development: The Indian Experience (New Delhi : Sage Publications, 1988).

Goldar, Bishwanath (2000), "Employment Growth in Organised Manufacturing in India," *Economic and Political Weekly*, 35(14): 1191-95.

Goldar, Bishwanath (2013). "Wages and Wage Share in India During the Post Reform Period.", *Indian Journal of Labour Economics* 56(1): 75-94.

Goldar, Bishwanath (2014), "Productivity in Indian Manufacturing in the Post-Reform Period: A Review of Studies," in V. Kathuria, S. N. Rajesh Raj and K. Sen (ed.), *Productivity in Indian Manufacturing* (New Delhi: Routledge), pp. 75-105.

Goldar, Bishwanath (2015a), "Productivity in Indian Manufacturing (1999-2011): Accounting for Imported Materials Input," *Economic and Political Weekly,* August 29, 50(35).

Goldar, Bishwanath (2015b), "Sustaining a High Rate of Growth in India in the Next 10 Years," in Pradeep Agrawal edited '*Reviving Growth in India*', Delhi: Cambridge University Press.

Goldar, Bishwanath, and Arup Mitra (2013), "Small versus large manufacturing units: how efficient are they?", *Journal of the Asia Pacific Economy* 18, no. 4 (2013): 634-653.

Goldar, B. And Sengupta, S. (2013) "Post reform trends in growth and productivity in Indian Manufacturing", Presented at the *Conference on "Trade and Industry: Patterns, Trends and Policies*" being held at IGIDR, Mumbai on 22-24 October 2013.

Guha-Khasnobis, B., R Kanbur and E Ostrom (2006) (Ed.). "Linking the Formal and Informal Economy", *Oxford University Press, New York*.

Hart, K. (1973). "Informal Income Opportunities and Urban Employment in Ghana", *Journal of Modern African Studies*, 11(1): 61–89.

Hsieh, Chang-Tai and Peter J. Klenow (2014),"The Lifecycle of Plants in India and Mexico," Quarterly Journal of Economics, 129(3):1035-84.

International Labour Office (2003). "Scope of the Employment Relationship: Report IV", *International Labour Conference, 91st Session*. Geneva: International Labour Office.

Jorgenson, D., M.S. Ho, and K.J. Stiroh, (2005), *Information Technology and the American Growth Resurgence,* Cambridge , The MIT Press.

Kathuria, V., S. N. Rajesh Raj and K. Sen. (2010). "Organized versus Unorganized Manufacturing Performance in the Post-Reform Period," *Economic and Political Weekly,* 45(24):55-64.

Kathuria, V., S. N. Rajesh Raj and K. Sen. (2013a). "The Effects of Economic Reforms on Manufacturing Dualism: Evidence from India", *Journal of Comparative Economics*, 41(4): 1240–62.

Kathuria, Vinish, SN Rajesh Raj, and Kunal Sen (2013b). "Efficiency Comparison between Formal and Informal Firms—Evidence from Indian Manufacturing", *The Journal of Industrial Statistics* (2013).

Marjit, S. (2003), "Economic reform and informal wage – a general equilibrium analysis", *Journal of Development Economics, 72:* 371-378

Mazumdar, D. and S. Sarkar (2008), "Globalization, Labour Markets and Inequality in India". *New York: Routeledge.*

Mitullah, W. (2004). "A Review of Street Trade in Africa". *Unpublished manuscript*. Cambridge, MA: WIEGO.

Moreno-Monroy, A. I., J. Pieters, and A. A. Erumban. (2012). "Subcontracting and the size and composition of the informal sector: Evidence from Indian manufacturing", *IZA Discussion Paper*, Bonn: Institute for the Study of Labor.

Nagaraj, R. (2000), "Organised Manufacturing Employment." *Economic and Political Weekly*, 35(38): 3445-48.

Naik, Ajaya Kumar (2009). "Informal sector and informal workers in India." In *seminar Measuring the Informal Economy in Developing Countries, Kathmandu, Nepal*. 2009.

Narayana, M. R. (2006). "Formal and Informal Enterprises: Concept, Definition, and Measurement Issues in India"; In: *Guha-Khasnobis, Basudeb. Ravi Kanbur and Elinor Ostrom (Ed.), "Linking the Formal and Informal Economy*", Oxford University Press, New York, 92-118.

NCEUS. (2009). "The Challenge of Employment in India: An Informal Economy Perspective", *Report, New Delhi: Government of India.*

Panagariya, Arvind, Pinaki Chakraborty and M. Govinda Rao (2014), State level Reforms, Growth and Development in Indian States, Oxford University Press.

Portes, A. (1994), "When more labor can be less: labor standards, development and the informal economy". In: *Rakowski C. (ed). Contrapunto. The informal sector debate in Latin America.* Albany: State University of New York Press.

Raj, Rajesh, and Malathy Duraisamy (2007). "Economic Reforms and Total Factor Productivity Growth in the Indian Unorganized Manufacturing Sector: Spatial and Temporal Analysis,"*Available at SSRN 1026542* (2007).

Ramaswamy, K. V. (1999), "The Search for Flexibility in Indian Manufacturing, New Evidence on Subcontracting Activities", *Economic and Political Weekly, 34*(6): 363-368

Ranis, S., F. Stewart (1999). "V-Goods and the Role of Urban Informal Sector in Development*", Economic Development and Cultural Change*, 47(2), 259-288.

Schneider, F. (2002). "Size and Measurement of the Informal Economy in 110 Countries around the World", *Canberra: Australian National University, Australian National Tax Centre*.

Straub, S. (2005), "Informal sector: the credit channel", *Journal of Development Economics,* 78: 299-321.
World Bank (2005), "World Development Report 2005: A Better Investment Climate For Everyone", *Washington D C: The World Bank*.

Taymaz, Erol (2009), "Informality and Productivity: Productivity Differentials between Formal and Informal Firms in Turkey," Country Economic Memorandum (CEM) – Informality: Causes, Consequences, Policies.

Thomas, J. J. (1992). "Informal Economic Activity", London: Harvester Wheatsheaf.

Tokman, V. (1978). "An Exploration into the Nature of the Informal-Formal Sector Relationship". *World Development,* 6(9/10): 1065–75.

Unni, Jeemol, N. Lalitha, and Uma Rani (2001), "Economic Reforms and Productivity Trends in Indian Manufacturing, "*Economic and Political Weekly, 36*(41): 3914-22

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