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Identifying Employment Creating Sectors in India:

An Analysis of Input-Output Linkages

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Inhalt

Abstract

For a labour surplus economy like India employment generation remains a perennial concern. While growth of GDP is supposed to address this problem, not all sectors of the economy are equally employment intensive. This paper attempts to identify the relatively more employment generating sectors within the major sectors of the economy by considering both forward and backward linkages of the sectors. A linkage based analysis is considered useful as it shows the creation of employment within the sector concerned as well as in the related sectors through its direct and indirect linkages. Thus this paper is an attempt to identify the employment generating sectors in terms of their employment linkages under the Input-Output framework for the time periods 2003–04 and 2007–08 (the most recent period). The analysis utilizes the data provided by the Central Statistical Organisation (CSO) on input-output matrix and appends this matrix by incorporating employment data from the national sample survey organization (NSSO) in India. By considering the broad sectors of the economy the exercise shows that while the share of in-house employment from agriculture is declining, its employment generation capability through linkages with other sectors of the economy is increasing. The next attempt is to go to a more disaggregated analysis of the sectors. The exercise is expected to provide important policy inputs for the state that is trying to achieve inclusive growth.

Keywords: Input-Output Analysis, Employment linkages, Output linkages, Forward and backward linkages

1 Introduction

Generation of employment remains an important issue in a labour surplus economy like India with a growing working age population. It is well-known that the official statistics on unemployment in India do not take into account disguised unemployment and thus provides an underestimate of the unemployment rate. Nonetheless to quote certain officials figures: according to the Labour Bureau, Government of India (2010), the unemployment rate was at 9.4 percent in 2009–10, an increase of 1.1 percent over the previous survey in 2004–05. The growth of labour, on the other hand, stood still at around 2 percent for the decade between 1994 and 2005, which has added to growing unemployment in the nation[1]. Secondly, 93 percent of the population working in the informal sector also shows the concerns India has on the employment front.

Historically, since the mid 1970s employment generation has been considered as an inevitable development policy in India, and several programs for the creation of employment were subsequently taken up. Later, India adopted a series of reform measures during the 1990s, but what the period witnessed was a phase of jobless growth. One of the reasons for low employment growth coupled with high output growth may be because the high output achieved was through the growth of certain sectors which were not particularly employment intensive. Subsequently, though programs like National Rural Employment Guarantee Act (NREGA) were adopted by the government for the generation of employment, these programs were not adequately linked with the production process. Therefore, if our collective concern is about inclusive growth, it is essential to identify the sectors that are not only growth oriented but also employment generating.

In the existing literature, a number of studies have focused on the issue of employment by studying its trend, patterns, share across sectors and other such indicators. However, while examining the employment creation potentials of different sectors within the economy, the authors have mostly concentrated on the employment generated only within a sector. However, it is also important to capture how employment generation in one sector in turn helps to create employment opportunities in other sectors through linkage effects. More precisely, if output of sector X rises, by implication employment in the sector also increases through direct effect. In addition, employment of the sectors which supply input to X would also rise due to higher input demands; and the same process

1 Labour Bureau, Ministry of Labour and Employment, Government of India (2010), "Report on Employment and Unemployment Survey 2009–10", downloaded from http://labourbureau.nic.in/Final_Report_Emp_Unemp_2009_10.pdf, accessed on 03.07.2014.

of employment generation in turn goes on for the sectors that supply inputs to these first sets of input supplying sectors and so on. Similar effects can be seen for the sectors that demand output of sector X as their input, and therefore the final picture needs to be evaluated considering all the linkage effects. This is an area where not many authors have worked in India and the current study attempts to fill this gap by examining employment generation potentials of major sectors of the Indian economy using both direct and indirect linkage effects of the sectors.

Thus, this paper essentially incorporates the employment aspect within an Input-Output framework in order to understand employment linkages of individual economic sectors by estimating employment multipliers for the time periods 2003–04 and 2007–08. To achieve this, the analysis uses National Sample Survey Organization (NSSO) data on employment and appends this in the standard input-output table provided by the Central Statistical Organisation. This exercise we believe is of considerable importance. This helps in the **identification** of sectors which have the potential to create employment through direct and indirect employment linkage effects. Further, an analysis is presented to show whether a highly linked sector in terms of output (calculated by measuring the standard backward and forward linkage effects) is also employment generating or not, and this exercise is expected to provide policy inputs for fostering **inclusive growth**. Often a sector with high backward linkage is found to be dependent on capital intensive intermediate products. Thus, if policy thrust is given to such sectors, the employment generation objective may not be accomplished. In this context, inclusion of the employment generation aspect within an Input-Output framework serves a useful purpose in the process of determining key sectors.

Against this backdrop the paper is organized as follows. Section 2 reviews the literature on employment aspects within an Input-Output framework. Methodological details regarding estimation of employment multipliers and data sources are discussed in Section 3. In the penultimate section, the employment linkage of each sector is presented using the Input-Output tables for 2003–04 and 2007–08 both at the aggregate and disaggregates levels. Interpretations of these results as well as the comparison between output and employment linkages are also discussed in this section. A concluding section follows at the end.

2 Review of Literature

As mentioned above, employment creation has been an issue of intense debate in academia. One set of literature in this context has focused on the role of employment in affecting economic growth, while the other strand of literature has incorporated the employment aspect within the Input-Output framework.

By analyzing the employment trends of the Indian economy, *Mehrotra et al. (2012)* suggested that employment should be created in the non-agricultural sector, especially in the organized manufacturing and services sector, with appropriate policies. Thus, informal employment in the unorganized sector must be transformed to formal employment in non-agricultural organized sectors, which will in turn help to ensure faster growth of the economy. Concentrating on the problem of jobless growth, *Mehrotra et al. (2013)* calculate employment intensity of output in the Indian context. In addition, Papola and *Sahu (2012)* have examined growth and structural changes in employment in the long and short term, emphasizing the post-reform period of the Indian economy. They argue that good quality productive employment should be created to ensure inclusive growth.

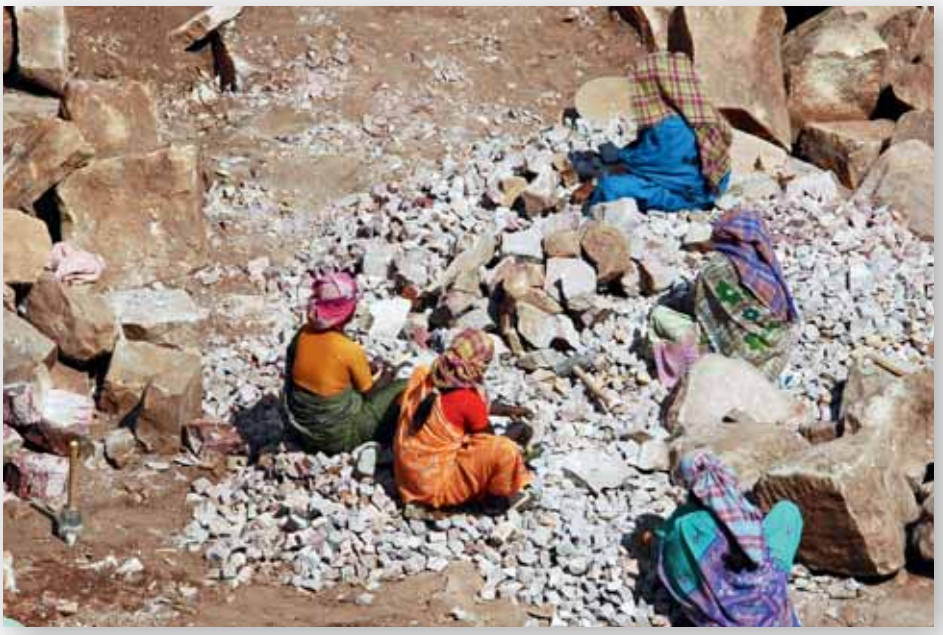
Another set of literature has incorporated the employment aspect within an Input-Output (I-O) framework in order to relate the employment conditions with that of the change in final demands of several sectors. On the one hand, *Gorg and Ruane (2000)* have incorporated employment within the I-O framework for the Irish economy considering average employment as a proxy for firm size. They expected this variable to have a negative relation with the firm's linkage. The reason for this negative relation may be that large firms have lower linkages than small firms because of their vertical integration for attaining self-sufficiency, and to reap the benefits of economies of scale. Even the trend of globalization and out-sourcing of activities also will support the fact that the small firms have higher linkages within the domestic economy because they are more comfortable in local markets. On the other hand, *Bin (2010)* calculated employment elasticity and included it in the partial non-linear I-O framework in order to measure the employment effect of changes in final demand using the 2007 I-O table for China along with China's employment data for the years 2002–09. Using a non-linear output-employment relationship, he has found that employment loss in China due to the US sub-prime crisis will affect the output as well as export of China adversely, which will in turn reduce the growth of China's economy. Thus, he concludes that this non-linear formulation and employment elasticity estimated thereby will reflect the economic situation in a better way, and highlight the need for appropriate policies for sustaining the growth of Chinese

economy. Using 1996–97 I-O tables, *Valadkhani (2003)* had identified the high employment generating industries for the Australian economy. Measuring sectoral employment elasticity, he showed that the sectors like retail trade, construction, health & community services, and education will be the most employment generating industries in future.

In the Indian context, *Sarma & Ram (1989)* evaluated the employment, income and output linkages for India's manufacturing industries using 1979–80 I-O tables. Measuring forward and backward linkage in output and employment generation as well as grouping the manufacturing sectors into four broad categories (agro-based industries, non-agro based final goods industries, non-agro based intermediate goods industries and capital goods industries), their study identified the sectors that have relatively higher income, output and employment potentials. Their results showed that agro-based industries had potential to generate relatively more income and employment than the others.

The above review clearly reveals that the existing studies have either seen the employment trends through measuring employment elasticity or have incorporated employment within the I-O framework in order to identify certain other firm related features, while identification of employment generating industries through direct and indirect linkage effects have received less attention. Needless to say, it would be insightful for policy makers to relate output growth and employment growth through identification of key sectors in terms of their output linkage along with employment linkage. This is especially valid for a labour surplus economy like India. However, the literature review presented reveals that only limited Indian studies have included employment generation capacity for identification of key sectors. In addition, there is no recent study on the topic in the Indian context even though the economy has witnessed significant change in the post-reform era. In this context, the current research makes an attempt to examine whether the highly linked sectors are also able to create employment or not and thus seeks to fill the gap in the existing literature by providing a new direction for determination of key sectors.

3 Methodology and Data Sources



Input-Output Framework

A broad Input-Output model has been used for addressing the aforementioned objectives. In the famous *Leontief Input-Output model (1936)*, **i, jth** element of the Leontief inverse **$(I - A)^{-1}$)** can be interpreted as the total effect (both direct and indirect) on the gross output of the **ith** sector when the **jth** sector final demand changes by one unit. Now with each output change, there will be an associated change in employment. Also following the dual-sector Lewis model, we have assumed that a change in output is linked to a fixed proportional change in employment, that is, the proportion of labour consumed per unit of output remains the same irrespective of the scale of production *(Pradhan, Saluja & Singh, 2006)*. This constant return to scale assumption is considered standard in respect of an Input-Output framework. Though this assumption appears somewhat restrictive, it is to be noted that the entire literature on input-output analysis is developed and based on this assumption. Following this assumption, we get the fixed employment coefficients for each sector, noted as follows:

$E_i = L_i / X_i$ --------- (1), (i = 1, 2, …, n), where Li is the employment in sector **'i'**, **X_i** is the gross output and **E_i** is the fixed employment coefficient. In other words, **E_i** is the labour requirement per unit of gross output, **X_i**. We can, therefore, write:

$L_i = \hat{E}_i * X_i$ --------- (2), where **$\hat{E}_i$** is a diagonalised matrix formed from the vector **'E'**, whose elements are defined by equation (1). The diagonalised matrix of **$\hat{E}_i$** clearly shows the labour requirement for each sector with respect to per unit of gross output.

Now, from our conventional I-O model, we have, **$X = (I - A)^{-1} F$ --------- (3)**

Substituting the relation of **X** from (3) in (2), we have got the following labour equation:

$L = \hat{E} (I - A)^{-1} F = KF$ --------- (4), where **$\hat{E}$** is the diagonalised matrix formed with elements of **E_i**, **$(I - A)^{-1}$** is the Leontief Inverse matrix, **'F'** is the vector comprising final demand, **'L'** is the employment requirement, **$K = [k_{ij}]$**, the **i, j^{th}** element of **K**, which measures employment created directly and indirectly in the **i^{th}** sector when the **j^{th}** final demand changes by one unit. Again, **$\sum_i k_{ij}$** gives the employment multiplier, thus measuring the total direct and indirect employment created throughout the economy, when the **j^{th}** sector final demand increases by one unit *(Pradhan, Saluja & Singh, 2006; Bulmer-Thomas, 1982)*.

A mere consideration of employment multiplier (**$\sum_i k_{ij}$**) does not provide adequate information as far as selecting a key employment generating sector is concerned. Thus, it would be more appropriate if one could calculate appropriate indices to capture employment forward and backward linkages, which, in turn, helps to identify a key employment generating sector. These indices as we consider are as follows:

Employment Backward Linkage (Y_j') = $[(1/n) k_j] / [(1/n^2)\sum_j k_j]$, (j = 1, 2, …, n),

Employment Forward Linkage (Z_i') = $[(1/n) k_i] / [(1/n^2)\sum_i k_i]$, (i = 1, 2, …, n).

Based on these measures, we can identify key employment generating sectors of an economy *(Bulmer-Thomas, 1982)*.

Data Sources

For examining the above mentioned objectives, we have used Input-Output tables for the years 2003–04 and 2007–08, as given by the Central Statistical Organization (CSO), India. Since the I-O table does not provide information on the absolute employment numbers of respective sectors, we have used a large sample unit level data of the 61st National Sample Survey (NSSO) round on the employment-unemployment situation for 2004–05 and the 64th National Sample Survey (NSSO) round on employment-unemployment and migration particulars for 2007–08. From the unit level data, we have used the usual principal as well as the subsidiary status (UPSS) of the sample observations as their employment status. From the very definition, the usual activity status relates to the activity status of a person during the reference period of 365 days preceding the date of the survey. The activity status on which a person spent relatively longer time (i.e. major time criterion) during the 365 days preceding the date of the survey is considered as the usual principal activity status of the person. In addition, a person whose usual principal status was determined on the basis of the major time criterion could have pursued some economic activity for a shorter time throughout the reference year of 365 days preceding the date of the survey or for a minor period, which is not less than 30 days, during the reference year. The status in which such economic activity was pursued was the usual subsidiary economic activity status of that person *(NSSO, 2007–08)*. NSSO's major focus is to estimate the number of persons gaining employment in different sectors in order to arrive at an employment or unemployment rate. Thus, as per NSSO, if a person belongs to both the categories principal and subsidiary, he/she is counted only once (according to their principal status) in order to avoid the double counting problem. On the other hand, in the present exercise we are not bothered with the double counting issue since our objective is to measure total employment generation capabilities (both through principal and subsidiary status) of the major sectors. Subsequently, by incorporating this information in an I-O table, we can identify the key employment generating sectors for the Indian economy by measuring their linkage effects.

Measuring Employment Linkage using I-O Tables

In this section, we will present the employment linkages (both forward and backward) of each sector using the I-O tables for the years 2003–04 and 2007–08 at aggregate as well as disaggregate levels. Further we show a comparison of the output linkage vs. employment linkage to examine whether the highly linked sectors (based on output linkage) are also highly employment generating or not.

Measurement of Employment Linkages at the aggregate level

Three broad sectors of the Indian economy (primary, secondary and tertiary) have been considered at the aggregate level analysis. Further, the secondary sector is sub-divided into manufacturing and non-manufacturing sectors. It is to be noted that the non-manufacturing sector considers three sectors, 'mining & quarrying', 'electricity & water supply' and 'construction', while the manufacturing sector includes other industries from 'food, beverages & tobacco' to 'other miscellaneous manufacturing'. With this specification, the employment forward and backward linkages have been computed at the aggregate level for the years 2003–04 and 2007–08. Further, in order to compare the employment linkages across different time periods, we have deflated I-O tables with respect to a base year, i.e, 2004–05. In addition, for measuring the employment linkage, we have taken the employment figures from the 61st and 64th NSSO survey on employment-unemployment particulars, which requires a match between the sectors in the I-O table and that presented in the NSSO employment-unemployment survey. Table A in the appendix shows such concordance between the I-O table and the NSSO survey as per NIC (National Industrial Classification)-04 codes. Finally, following the aforementioned methodology, we have calculated employment forward and backward linkages for broad sectors (as aggregated from 130 sectors in the I-O table) through measuring the employment multiplier. Table 1 depicts the employment linkages of the broad sectors.

Table 1: Employment Forward & Backward Linkage Coefficient for the years 2003–04 & 2007–08 (for broad sectors)

SC	Sectors in the I-O Table	2003–04			2007–08		
		ES	EB	EF	ES	EB	EF
1	Agriculture	63.14	2.37	2.98	60.71	2.44	3.12
2	Manufacturing	10.50	0.68	0.26	10.44	0.64	0.21
3	Non-manufacturing	6.43	0.53	0.39	7.81	0.54	0.36
4	Services	19.92	0.42	0.36	21.04	0.38	0.31

SC = Sector Code
ES = Employment share
EB = Employment Backward Linkage Co-efficient
EF = Employment Forward Linkage Co-efficient

Source: Author's estimation by using I-O table for 2003–04 (CSO, 2008) & 2007–08 (CSO, 2012).

Table 1 depicts the employment share along with employment forward and backward linkages for four broad sectors of the Indian economy for the years 2003–04 and 2007–08. The employment share shows how much in-house employment is generated by the sectors out of the total employment in the economy, while employment backward and forward linkage coefficients represent the amount of employment generated by the sector both within itself as well as in other sectors through their linkage effect.

Thus, **Table 1** shows that the employment share of the agriculture sector is decreasing over time, but it is evident that there is an increase in employment linkages. This implies that although its potentiality to generate in-house employment is decreasing, its contribution to generating employment outside the sectors through a linkage effect is increasing. Keeping in mind the existing argument of jobless growth *(Mehrotra et al., 2012, 2013)*, this study also reveals that for the manufacturing sector, the share of generating in-house employment as well as its contribution to generating employment outside the sectors decreased between 2003–04 and 2007–08. In sharp contrast, the non-manufacturing and service sector showed an increasing trend in the share of employment, however, it also shows a decreasing trend in linkage effect. The non-manufacturing sector's increase in in-house employment share may be due to the booming investment in the construction sector in recent years *(Mehrotra et al., 2012, 2013)*. This is a generalized picture of employment for the broad sectors of the Indian economy. However, heterogeneity may exist in terms of linkage effects across different industry groups within manufacturing, non-manufacturing and services.

After having presented the employment linkages for the aggregate sectors, we move on to compute the employment linkages of the sectors at the disaggregate level. Using I-O tables, we have combined similar sectors from 130 sectors before arriving at 21 sectors in order to identify the key employment generating sectors in a somewhat aggregate manner. It is to be noted here that we present the employment forward and backward linkages for 21 sectors, and then carry out a comparison between output linkage and employment linkage with a view to examining whether the highly linked sectors (based on output linkage) possess the potential to generate employment or not.

Table B in the appendix shows the sectors merged together to present a consolidated picture. **Table 2** presents the forward as well as backward linkages for employment with respect to 21 sectors for the years 2003–04 and 2007–08.

Measurement of Employment Linkages at the disaggregate level

Table 2: Employment Forward & Backward Linkage Coefficients for the years 2003–04 & 2007–08 (for 21 major sectors)

		2003–04			2007–08		
SC	**Sectors in the I-O Table**	**ES**	**EB**	**EF**	**ES**	**EB**	**EF**
1	Agriculture	63.14	3.78	4.95	60.71	4.22	7.53
2	Mining and quarrying	0.54	0.30	1.33	0.49	0.35	2.02
3	Food, beverages & tobacco	2.07	2.11	0.36	1.83	2.46	0.58
4	Textiles	3.18	1.49	0.83	3.23	1.58	1.10
5	Wood & wood products	1.08	3.20	6.05	0.77	1.90	1.52
6	Paper, paper products	0.11	0.97	0.50	0.10	1.11	0.48
7	Printing & publishing	0.17	0.81	0.57	0.15	0.93	0.64
8	Leather & plastic products	0.37	0.86	0.37	0.38	0.95	0.37
9	Petroleum products	0.02	0.27	0.01	0.03	0.28	0.01
10	Chemicals	0.38	0.57	0.15	0.39	0.62	0.26
11	Non-metallic mineral products	0.98	0.97	1.33	1.02	0.85	1.24
12	Metals	0.67	0.45	0.30	0.82	0.47	0.33
13	Machinery	0.39	0.43	0.10	0.45	0.45	0.17
14	Transport equipment & parts	0.19	0.41	0.11	0.28	0.50	0.18
15	Other miscellaneous manufacturing.	0.89	0.89	1.05	1.00	0.78	0.68
16	Construction	5.67	0.81	0.52	7.10	0.96	0.69
17	Electricity & water supply	0.23	0.46	0.19	0.22	0.31	0.24
18	Transport, storage & communication	3.42	0.58	0.53	3.82	0.55	0.62
19	Trade, hotels & restaurant	9.27	0.91	1.06	9.32	0.95	1.34
20	Financing, insurance, real estate & business services	1.10	0.21	0.21	1.35	0.21	0.29
21	Other comm., social & personal services	6.14	0.53	0.50	6.55	0.58	0.71

SC = Sector Code
ES = Employment share
EB = Employment Backward Linkage Co-efficient
EF = Employment Forward Linkage Co-efficient

Source: Authors' estimation by using I-O tables for 2003–04 (CSO, 2008) & 2007–08 (CSO, 2012).

Table 2 clearly shows the employment share along with employment forward and backward linkages across 21 sectors for the time periods 2003–04 and 2007–08. It is to be noted that the sectors having more than unitary employment backward linkage are capable of creating above average (more than one unit) employment in other sectors, when final demand increases by unity. In contrast, the sectors having more than unitary employment forward linkage are capable of creating above average employment within that sector, when final demand for all the sectors increases by unity. Thus, an employment linkage analysis captures additional employment generation capabilities not captured through mere employment share, since employment share represents the creation of only direct employment within the sectors, while a linkage analysis covers the creation of employment not only within the sectors, but also in other sectors.

Focusing on **Table 2**, as expected we have found that the 'agriculture' sector has the highest employment forward and backward linkages; thus it has the highest employment generation capacity in respect to both within the sector as well as outside the sector with a change in the final demand. With respect to an in-house employment share of the agriculture sector, we have found the employment share of agriculture decreased in 2007–08 as compared to 2003–04 **although its employment linkage has increased over time**, which again illustrates that considering only the employment share does not reflect the actual potential of a sector in terms of generating employment. Within the manufacturing sectors, 'textiles', 'wood & wood products' also possess high employment forward as well as backward linkages. Looking at the employment share of those sectors, it has been found that 'wood & wood products' generates a lesser amount of in-house employment (in terms of absolute employment share), while it has the capacity to affect other sectors by way of creating employment through its high employment linkage. Even the 'paper, paper products' sector creates a lesser amount of employment within it, while it has moderate employment linkage with others. 'Mining & quarrying' holds the second position in terms of employment forward linkage, thus creating more employment within itself in order to serve the demand from other sectors. In contrast, the agro based industry 'food, beverages & tobacco' occupies the second place with its employment backward linkage, thus creating proportionately more employment in other sectors through creating more demand. Thus, employment linkage provides more insight into the sectors' employment generation rather than their employment share.

Now, in order to identify the **key** employment generating sectors, it is useful to rank them in terms of their high employment forward as well as backward linkage coefficients. According to *Diamond (1975)*, a key employment sector is the one which has high employment forward as well as backward linkage; more precisely, which has both employment forward as well as backward linkage coefficients greater than unity. Based on this criterion, we identify the key employment generating sectors for 2003–04 and 2007–08 (see **Table 3**).

Table 3: Key Employment Generating Sectors
for the years 2003–04 & 2007–08 (for 21 major sectors)

	2003–04		2007–08	
Sectors in the I-O Table	**EB**	**EF**	**EB**	**EF**
Agriculture	3.78	4.95	4.22	7.53
Wood & wood products	3.20	6.05	1.90	1.52
Textiles	–	–	1.58	1.10

EB = Employment Backward Linkage Co-efficient
EF = Employment Forward Linkage Co-efficient

Source: Author's estimation by using I-O tables for 2003–04 (CSO, 2008) & 2007–08 (CSO, 2012).

From **Table 3**, we can clearly identify the key employment generating sectors with both forward and backward linkages greater than unity.

However, Diamond's specification imposes a strict restriction of both forward and backward linkages in that they have to be greater than unity. If we marginally relax this strict assumption to consider the sectors which have at least one of the linkage coefficients (either employment forward or backward) greater than unity, we can arrive at a number of sectors with moderately high linkage effects. Table 4 lists those sectors.

Table 4: Key Employment Generating Sectors with relaxed norms* for 2003–04 & 2007–08 (for 21 major sectors)

	2003–04		2007–08	
Sectors in the I-O Table	**EB**	**EF**	**EB**	**EF**
Mining and quarrying	0.30	1.33	0.35	2.02
Food, beverages & tobacco	2.11	0.36	2.46	0.58
Textiles	1.49	0.83	–	–
Paper, paper products	–	–	1.11	0.48
Non-metallic mineral products	0.97	1.33	0.85	1.24
Other miscellaneous manufacturing	0.89	1.05	-	-
Trade, hotels & restaurants	0.91	1.06	0.95	1.34

EB = Employment Backward Linkage Co-efficient
EF = Employment Forward Linkage Co-efficient
*Either forward or backward linkage coefficients are greater than unity.

Source: Author's estimation by using I-O tables for 2003–04 (CSO, 2008) & 2007–08 (CSO, 2012).

Finally, we attempt to examine whether the sectors that have been identified in terms of their high output linkage also display a similar performance in terms of generating employment or not. This necessitates calculation of output forward and backward linkages of the sectors as well. This was done using the standard I-O technique[2]. In **Table 5** we present both output and employment linkage coefficients which aid in presenting a comparative picture.

2 Here, we have used the demand driven standard Leontief model for measuring the backward linkage coefficients, while the supply driven *Ghosh model (1958)* is used for measuring the forward linkage coefficients. For both these models, we have broadly used the *Chenery-Watanabe method (1958)* and the *Rasmussen method (1956)* in order to find the direct as well as indirect forward and backward linkage coefficients using the technical coefficient matrix (A), allocation coefficient matrix (B) and Leontief inverse matrix $(I-A)^{-1}$, $(I-B)^{-1}$.

Table 5: Comparison between Employment & Output Linkage coefficients for 2003–04 & 2007–08 (for 21 major sectors)

	Employment Linkage for 2003–04		Output Linkage for 2003–04		Employment Linkage for 2007–08		Output Linkage for 2007–08	
Sectors	**EB**	**EF**	**EB**	**EF**	**EB**	**EF**	**EB**	**EF**
1. Agriculture	**3.78**	**4.95**	0.76	0.70	**4.22**	**7.53**	0.74	0.77
2. Mining & quarrying	0.30	1.33	0.66	3.03	0.35	2.02	0.69	3.31
3. Food, beverages & tobacco	2.11	0.36	1.13	0.55	2.46	0.58	1.11	0.64
4.Textiles	1.49	0.83	1.14	0.58	**1.58**	**1.10**	1.15	0.66
5.Wood & wood products, furniture & fixtures	**3.20**	**6.05**	0.91	1.12	**1.90**	**1.52**	0.94	0.77
6. Paper, paper products	0.97	0.50	**1.16**	**1.35**	1.11	0.48	**1.15**	**1.26**
7. Printing & publishing	0.81	0.57	1.09	0.83	0.93	0.64	1.18	0.82
8. Leather & plastic products	0.86	0.37	1.16	0.93	0.95	0.37	1.19	0.91
9. Petroleum products	0.27	0.01	**1.04**	**1.23**	0.28	0.01	0.99	1.00
10. Chemicals	0.57	0.15	**1.13**	**1.20**	0.62	0.26	**1.20**	**1.37**
11. Non-metallic mineral products	0.97	1.33	1.05	0.97	0.85	1.14	1.04	0.95
12. Metals	0.45	0.30	**1.13**	**1.23**	0.47	0.33	**1.14**	**1.27**
13. Machinery	0.43	0.10	1.23	0.82	0.45	0.17	1.26	0.95
14. Transport equipment & parts	0.41	0.11	1.16	0.70	0.50	0.18	1.33	0.75
15. Other miscellaneous manufacturing.	0.89	1.05	**1.12**	**1.01**	0.78	0.68	1.19	0.76
16. Construction	0.81	0.52	0.97	0.53	0.96	0.69	1.07	0.56
17. Electricity & water supply	0.46	0.19	**1.28**	**1.30**	0.31	0.24	0.91	1.22
18. Transport, storage & communication	0.58	0.53	1.00	0.83	0.55	0.62	0.86	0.85
19. Trade, hotels & restaurant	0.91	1.06	0.68	0.78	0.95	1.34	0.70	0.86
20. Financing, insurance, real estate & business services	0.21	0.21	0.62	0.82	0.21	0.29	0.57	0.81
21. Other comm., social & personal services	0.53	0.50	0.59	0.48	0.58	0.71	0.59	0.51

EB = Employment Backward Linkage Co-efficient
EF = Employment Forward Linkage Co-efficient

Source: Author's estimation by using I-O tables for 2003–04 (CSO, 2008) & 2007–08 (CSO, 2012).

Table 5 shows that divergence exists among the sectors in terms of their employment and output generating capabilities. More precisely, it has been found that the sectors like 'agriculture', 'textiles', and 'wood & wood products' are key employment generating sectors for both years, while 'paper & paper products', 'petroleum products', 'chemicals', and 'metals', are the sectors with a potential to influence others in terms of their high output linkage.

In order to get a clearer picture, we present the sectors classified in terms of output as well as employment linkage coefficients for the years 2003–04 and 2007–08 in a 2*2 format in **Tables 6** and **7**, respectively. Here we have incorporated those sectors in the 'high' category which have both forward and backward linkages greater than unity. The rests are presented in the low category.

Table 6: Sectors classified using Output & Employment Linkage Coefficients for 2003–04 (following the strict assumption for high linkage)

OUTPUT LINKAGE ↓	EMPLOYMENT LINKAGE →	
	HIGH	**LOW**
HIGH	Nil	Paper & paper products, petroleum products, chemicals, metals, other miscellaneous manufacturing, electricity & water supply
LOW	Agriculture, wood & wood products	Mining & quarrying, food, beverages & tobacco, textiles, printing & publishing, leather & plastic products, non-metallic mineral products, machinery, transport equipment & parts, construction, transport, storage & communication, trade, hotels & restaurants, financing, insurance, real estate & business, other community, social & personal services

Source: Author's estimation by using I-O table for 2003–04 (CSO, 2008).

Table 7: Sectors classified using Output & Employment Linkage Coefficients for 2007–08 (following the strict assumption for high linkage)

OUTPUT LINKAGE ↓	EMPLOYMENT LINKAGE →	
	HIGH	**LOW**
HIGH	Nil	Paper & paper products, chemicals, metals
LOW	Agriculture, wood & wood products	Mining & quarrying, food, beverages & tobacco, printing & publishing, leather & plastic products, petroleum products, non-metallic mineral products, machinery, transport equipment & parts, other miscellaneous manufacturing, construction, electricity & water supply, transport, storage & communication, trade, hotels & restaurants, financing, insurance, real estate & business, other community, social & personal services

Source: Author's estimation by using I-O table for 2007–08 (CSO, 2012).

Supporting the results from **Table 5**, **Tables 6** and **7** also show that there is no sector that possesses both high employment as well as output linkage, although sectors like 'chemicals' and 'metals' exhibit a high output linkage with low employment linkage for both years. In addition, 'agriculture', 'textiles', and 'wood & wood products' show a high employment linkage with low output linkage. Thus, focusing only on the output oriented highly linked sectors may not fulfill certain important goals of the economy such as employment generation.

As mentioned, the above classification is based on a strict assumption that both forward and backward output and employment linkage coefficients need to be greater than unity for a sector to be considered as highly linked output and employment generating. This results in no matches. As a second step it is useful to relax this strict assumption in the manner described above and examine whether one can identify certain sectors which are important from the point of view of generating both output and employment through direct plus linkage effects. This exercise is presented in **Tables 8** and **9** for 2003–04 and 2007–08, respectively.

Table 8: Classification of Sectors based on Output & Employment Linkage Coefficients for 2003–04 (Relaxing the strict assumption)

			EMPLOYMENT LINKAGE COEFFICIENTS →			
			Both greater than unity	One greater than unity (either forward or backward)	Both greater than 0.5 but less than one	Either one or both less than 0.5
			1	2	3	4
OUTPUT LINKAGE COEFFICIENTS ↓	Both greater than unity	1		Other miscellaneous manufacturing	Paper & paper products	Petroleum products, chemicals, metals, electricity & water supply
	One greater than unity (either forward or backward)	2	Wood & wood products	Mining & quarrying, food, beverages & tobacco, textiles, non-metallic mineral products	Printing & publishing, transport, storage & communication	Leather & plastic products, machinery, transport equipment & parts
	Both greater than 0.5 but less than one	3	Agriculture	Trade, hotels & restaurants	Construction	Financing, insurance, real estate & business
	Either one or both less than 0.5	4			Other community, social & personal services	

Source: Author's estimation by using I-O table for 2003–04 (CSO, 2008).

Table 9: Classification of Sectors based on Output & Employment Linkage Coefficients for 2007–08 (Relaxing the strict assumption)

			EMPLOYMENT LINKAGE COEFFICIENTS →			
			Both greater than unity	One greater than unity (either forward or backward)	Both greater than 0.5 but less than one	Either one or both less than 0.5
			1	2	3	4
OUTPUT LINKAGE COEFFI-CIENTS ↓	Both greater than unity	1		Paper & paper products		chemicals, metals
	One greater than unity (either forward or backward)	2	textiles	Mining & quarrying, food, beverages & tobacco, non-metallic mineral products	Printing & publishing, Other miscella-neous manu_ facturing, construction	Petroleum products, Leather & plastic products, machinery, transport equipment & parts, electricity & water supply
	Both greater than 0.5 but less than one	3	Agriculture, wood & wood products	Trade, hotels & restaurants	Transport, storage & communication, other community, social & perso-nal services	Financing, insurance, real estate & business
	Either one or both less than 0.5	4				

Source: Author's estimation by using I-O table for 2007–08 in CSO (2012).

Tables 8 and **9** depict four sets of sectors from the point of view of output and employment generation capabilities. For both the time periods, the sectors located at cell (1,2) (i.e., 1st row, 2nd column), cell (2,1) (i.e., 2nd row, 1st column) and cell (2,2) (i.e., 2nd row, 2nd column) are having reasonably good employment as well as output linkage. Following this, for both time periods, the sectors like 'mining & quarrying', 'food, beverages & tobacco', 'textiles', and 'non-metallic mineral products' can be identified as the sectors capable of generating output growth and sufficient employment opportunities. On the other hand, the second set of sectors like 'printing & publishing', 'construction', 'trade, hotels & restaurant', and 'transport, storage & communication' (located at the cells 2,3; 3,2; 3,3) have moderate output and employment linkage for both years, implying less importance as compared to the first set of sectors. Further, some sectors like 'chemicals', 'metals', 'petroleum products', and 'leather & plastic products' (located at the cells 1,4 and 2,4) are not so important in terms of employment generation, although they have high output linkage. Finally, the fourth set of sectors like 'financing, insurance, real estate & business services', and 'other community, social & personal services' (located at the cells 3,4 and 4,3) have low output as well as employment linkages.

4 Conclusion

In this paper an attempt has been made to identify certain key sectors in terms of their employment generating capabilities. While highlighting such sectors, linkage effects are also taken into consideration. It has been found that sectors like 'agriculture', 'textiles', and 'wood & wood products' are key employment generating sectors possessing high employment forward as well as backward linkages for both the time periods under consideration, 2003–04 and 2007–08, although they have a low output linkage. In contrast, 'petroleum products', 'chemicals', and 'metals', are the sectors that affect others in terms of their output linkage for both time periods, although they have a low employment linkage. In addition, discrepancies also exist between the direct employment share and employment linkage of the sectors. For example, the employment share of the sectors like 'agriculture', 'wood & wood products', and 'paper & paper products' has decreased from 2003–04 to 2007–08, even though their employment linkage has increased over time. Thus computation of employment linkage provides additional insightful information regarding the employment creation capabilities of a sector which only the share of employment is unable to fully capture.

Policy makers, therefore, should focus on those sectors that are highly linked to others in terms of their output linkage along with their capacity to generate direct and indirect employment. Marginally relaxing the strict assumption of high linkage, our results have identified certain sectors like 'mining & quarrying', 'food, beverages & tobacco', 'textiles', and 'non-metallic mineral products' which have a reasonably good output as well as employment linkage for both the time periods. Thus, policy measures for boosting growth in some of these sectors can go a long way toward fostering inclusive growth in the economy.

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6 Appendices

Table A: Concordance between I-O & NIC-2004

Sector Code	21 Sectors in the Consolidated I–O Table	I–O Code of Sectors to Merge	NIC–04 Code
1	Agriculture	1–26	01+02+05
2	Mining and quarrying	27–37	10+11+12+13+14
3	Food, beverages & tobacco	38–45	15+16
4	Textiles	46–54	17+18
5	Wood & wood products	55–56	20
6	Paper, paper products	57	21
7	Printing & publishing	58	22
8	Leather & plastic products	59–62	19+25
9	Petroleum products	63	23
10	Chemicals	64–73	24
11	Non–metallic mineral products	74–76	26
12	Metals	77–82	27+28+37
13	Machinery	83–94	29+30+31
14	Transport equipment & parts	95–100	34+35
15	Other miscellaneous manu.	101–105	32+33+36
16	Construction	106	45
17	Electricity & water supply	107–108	40+41
18	Transport, storage & communication	109–115	60+61+62+63+64
19	Trade, hotels & restaurant	116–117	50+51+52+55
20	Financing, insurance, real estate & business services	118–120, 123, 126	65+66+67+70+74
21	Other comm., social & personal services	121–122, 124–125, 127–130	71+72+73+75+80+85+90+91+92+93

Source: Author's estimation by using the I-O table for 2007–08 in CSO (2012) & 64th round of NSSO employment-unemployment survey (2007–08).

Table B: Merging Sectors

Sector Code	21 Sectors in the Consolidated I–O Table	I–O Code of Sectors to Merge
1	Agriculture	1–26
2	Mining and quarrying	27–37
3	Food, beverages & tobacco	38–45
4	Textiles	46–54
5	Wood & wood products	55–56
6	Paper, paper products	57
7	Printing & publishing	58
8	Leather & plastic products	59–62
9	Petroleum products	63
10	Chemicals	64–73
11	Non–metallic mineral products	74–76
12	Metals	77–82
13	Machinery	83–94
14	Transport equipment & parts	95–100
15	Other miscellaneous manufacturing	101–105
16	Construction	106
17	Electricity & water supply	107–108
18	Transport, storage & communication	109–115
19	Trade, hotels & restaurant	116–117
20	Financing, insurance, real estate & business services	118–120, 123, 126
21	Other comm., social & personal services	121–122, 124–125, 127–130

Source: Author's estimation by using the I-O tables for 2003–04 (CSO, 2008) & 2007–08 (CSO, 2012).

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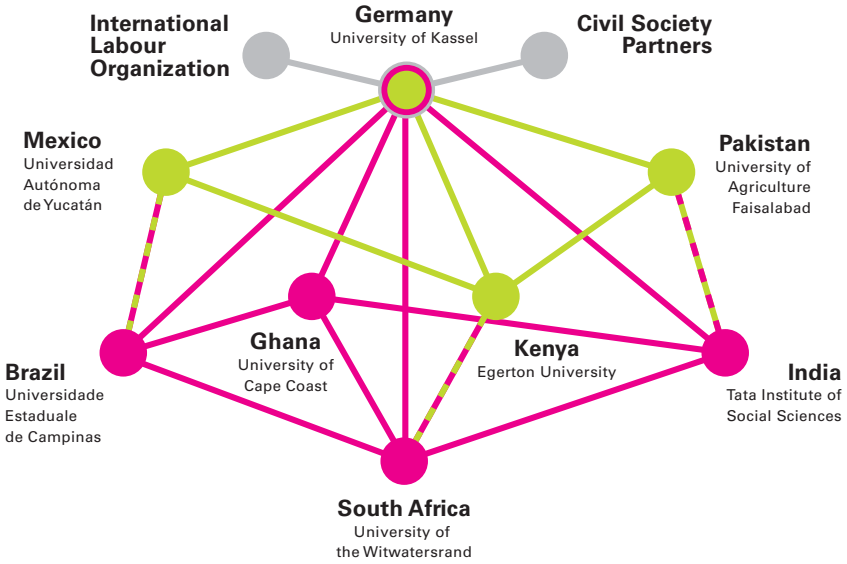

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