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C. Veeramani
Indira Gandhi Institute of Development Research, India

Garima Dhir
Indira Gandhi Institute of Development Research, India

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C. Veeramani

Indira Gandhi Institute of Development Research, India

veeramani@igidr.ac.in

Garima Dhir

Indira Gandhi Institute of Development Research, India

garima@igidr.ac.in

Abstract

Using Input-Output (IO) analysis, this study provides consistent time series estimates, for 112 sectors, of domestic value added (DVA) and number of jobs supported by India's merchandise and services exports for the period 1999-2000 to 2012-13. The estimates show that the DVA content of India's exports increased from US$46 billion in 1999-00 to US$ 295 billion in 2012-13, with a growth rate of 17.7% per annum. The ratio of DVA to gross exports steadily declined from 0.86 in 1999-00 to 0.65 in 2012-13. The decline has been particularly sharp for manufacturing sectors suggesting that Indian industries have become more involved in global production sharing (GPS). We find that the total number of jobs supported by Indian exports increased from about 34 million in 1999-00 to 62.6 million in 2012-13, with a growth rate of 3.4% per annum. Throughout the period, export related jobs grew significantly faster than that of total employment. Backward linkages, particularly from manufacturing to agriculture and services, have become an important source of export related DVA and job creation. Finally, using an econometric analysis, we show that greater participation in GPS, as measured by the ratio of DVA to exports, leads to higher absolute levels of gross exports, DVA, and employment.

JEL Classification: C67, F14, F15

Keywords: Exports, Domestic Value Added, Employment, India, Global Production Sharing

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1. Introduction

By 2020, India is projected to be the youngest nation in the world with the average age of its population being 29. In an increasingly globalised landscape, this 'youth bulge' represents a major challenge for policy makers in terms of creating employments opportunities for the masses. The recently launched "Make in India" campaign aims to create 100 million additional jobs by 2022 in manufacturing sector by promoting exports and foreign investment. In this context, whether exports offer a viable path to job creation is a question with significant policy implications.

While assessing the potential contribution of exports to domestic job creation, it is important to consider the fact that production processes for most of the goods and services are increasingly fragmented across countries. Global production sharing (GPS) imply that intermediate inputs cross borders several times during the manufacturing process. However, unlike the recording of domestic transactions, trade data are usually collected and reported as gross flows at each border crossing rather than the net value added between border crossings. This leads to double (or multiple) counting, meaning that official trade data does not capture the domestic value added (DVA) content of exports. Yet, domestic value addition is what really matters for job creation within the borders of a country.

While the estimation of DVA is pertinent to assess the potential for job creation through exports, it also helps us to understand the nature and extent of a country's involvement GPS. In general, countries (and sectors) with greater participation in GPS tend to record relatively low share of DVA in gross exports and vice versa (Johnson and Noguera, 2012). The DVA share of gross exports is a measure that illustrates how much value-added is generated throughout the economy for a given unit of exports.

Using Input-Output (IO) analysis, this study provides consistent time series estimates, for 112 sectors, of DVA and number of jobs supported by India's merchandise and services exports for the period 1999-2000 to 2012-13. The major advantage of the IO framework is that, in addition to the direct effect of exports within a given sector, the DVA and employment generated in other sectors through indirect linkages, backward and forward, can be taken into consideration. The study makes use of the official I-O Tables (IOT) for the benchmark years 1998-99, 2003-04, 2007-08 as well as the recently published Supply Use Tables (SUT) for the years 2011-12 and 2012-13. The IOT and SUT, compiled by India's Central Statistical Organization (CSO), do not distinguish imported inputs from domestic inputs. We construct the 'domestic use tables' (DUT) by relying on a 'proportionality' assumption to separate domestic inputs from imported inputs. For the intervening years - the years for which IOT and SUT are unavailable - we construct the DUT by making use of detailed production and trade data from various official sources. This enables us to have year-specific DUT for the estimation.

An important question, as far as the strategies for job creation are concerned, is whether it is desirable to minimize the reliance on imports (to develop 'indigenous' industries with significant potential for local linkages) or to integrate domestic industries with global production networks wherein linkages and value added are globally dispersed. Apart from providing the estimates of export related DVA and employment, more importantly, the present paper contributes to this policy question by analyzing which of the alternative strategies may help a country to maximize DVA and employment generation.

While greater participation in GPS may imply that DVA generated from *per unit* of the good produced is usually less than when inputs are sourced locally, the *total* DVA generation (and hence job creation) from GPS participation could be considerably higher due to the scale effect of producing for the world market[1]. The implication, if this indeed is the case, is that developing countries can reap rich dividends by adopting policies aimed at strengthening their participation in GPS. We carry out a regression analysis in a simultaneous equation framework to test the hypothesis that greater participation in GPS, as measured by a declining share of DVA in gross exports, leads to higher absolute amounts of gross exports, DVA and employment. To the best of our knowledge, these relationships have not been studied before in a multiple regression framework.

Rest of the paper is organized as follows. Section 2 provides a brief review of related literature. Section 3 discusses the IO methodology used to estimate the DVA and number of jobs supported by India's exports across sectors. Section 4 presents the estimates of DVA and jobs attributable to exports at the aggregate and disaggregated levels. Section 5 carries out a regression analysis to

[1] For example, the often-cited case study by Dedrick et al (2010) shows that although the factory-gate price of an assembled iPod from a Chinese factory is \$144, only about \$4 of this constitutes of Chinese value added with much of the rest being captured by US, Japan and Korea. However, despite the low DVA per unit, the aggregate DVA in China from iPod assembly could be very high due to the scale effect. Consider the following simple back-of-the-envelope calculation. In 2008 (close to the years for which Dedrick provided the estimates) Apple sold 54.83 million units of iPods. Assuming that the whole assembly was done in China, the aggregate DVA in China from the assembly of this single product was 219 million dollars (\$4 × 54.83 million units), which accounts for 0.015% of China's gross merchandise exports and about 0.022% of aggregate export related DVA in China in 2008.

analyze whether greater participation in GPS leads to higher absolute amounts of gross exports, DVA and employment. Appendix A1 and A2 discusses the data and methodology involved in the construction of harmonized DUT.

2. A Brief Review of Related Literature

World-wide reduction in tariff barriers and technology-led decline in the costs of transportation and communication has made it possible to unbundle the production processes in several industries, with various stages occurring in different countries[2]. Firms located in labour abundant countries ("factory economies") like China tend to specialize in low skilled labour-intensive activities involved in the production of a final good while capital and skill-intensive activities are being carried out in countries where those factors are abundant ("headquarter economies").

The growth of GPS have major implications for a wide range of issues ranging from the usual practice of collecting and recording trade data, to the nature of industrial and trade policies, to the influence of global supply chains on employment, income distribution and welfare and to the ways in which trade theories are traditionally formulated.

Ideally, trade statistics should be collected and reported on value added basis rather than in gross terms. Domestic value addition is what really matters for employment and income generation within the borders of a country. Driven by the concerns on the use (and misuse) of official international trade statistics, attempts have been made by different agencies (OECD, WTO, World Bank) as well as by individual researchers to estimate value added content of exports. Estimates for India are available in World Input Output Database (WIOD), OECD-WTO TiVA data base, and in Goldar et al (2017). A limitation of WIOD and TiVA, from the perspective of our objective in this study, is that the estimates are available only at a relatively aggregate level of sectors: in order to obtain comparable estimates across countries, WIOD and TiVA make use of harmonized inter-county IOT with rather aggregate level of sector classification[3].

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[2] See for example, Feenstra (1998), Hummels et al. (2001), Johnson and Noguera (2012), Athukorala (2012), Baldwin and Lopez-Gonzalez (2013), Koopman et al. (2014), Timmer et al (2014) and Los et al. (2015).

[3] WIOD and TiVA database make use of 35×35 and 34×34 IOT, respectively. India's official IOT from CSO is more disaggregated (130 ×130 matrix for the year 2007-08). Official IOT, prepared by the statistical agencies in different countries, form the basis of the construction of the inter-country IOT by WIOD and TiVA tables: for India, the official IOT for the benchmark years 1998-99, 2003-04 and 2007-08 were used. WIOD and TiVA estimates are for each country are based on a time series of inter-country IOT. In order to construct this time series, official IOT are benchmarked on

Using the official IOT, Goldar et al (2017) provide estimates of domestic (and foreign) value added share in India's gross exports for the benchmark years 1998-99, 2003-04, and 2007-08. This study makes use of more disaggregated IOT as compared to WIOD and TiVA. However, the estimates provided by Goldar et al (2017) has certain limitations: (i) the estimates are provided only for the years for which official IOT are available, with the latest year being 2007-08; (ii) inter-temporal comparison of their estimates at the sector level is problematic, as the sector classification for the year 1998-99 is not harmonized with that for 2003-04 and 2007-08[4].

Recently, the CSO has brought out SUT for the years 2011-12 and 2012-13. These tables suggest that Indian economy had undergone significant changes since 2007-08 in terms of various structural characteristics, including inter-industry relationships. These changes are not captured in any of the available estimates, including the estimates by WIOD, TiVA and Goldar et al (2017).

The present study contributes to the literature dealing with the estimation of DVA content of India's exports in a number of ways. First, we provide consistent time series estimates for 112 sectors (covering the whole economy) of DVA content of India's exports (merchandise plus services) for the period 1999-2000 to 2012-13. Second, our estimates are based on harmonized annual time series of DUT with considerably more disaggregated sector classification than the estimates based on WIOD and TiVA. Third, the DUT have been constructed making use of information on the changing input-output relations and other structural features as reflected not only in the available official IOT since 1998-99 but also the latest SUT for the years 2011-12 and 2012-13.

Turning to the question of export supported jobs, a number of studies have provided estimates of export dependent jobs, using the IO approach, for different countries and years [see EXIM Bank (2016) for a detailed review). Based on a survey of literature, Table 1 reports the latest available estimates for different countries[5]. The US Department of Commerce has been regularly publishing reports on jobs supported by exports. The recent estimates show that the number of jobs supported

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consistent time-series from the National Accounts Statistics (NAS). The NAS data on gross output, value added, imports, exports and final use by use category are used to generate the time series of IOT using an algorithm known as RAS method (Temurshoev and Timmer, 2011).

[4] The estimates by Goldar et al (2017) cover 115 sectors for the year 1998-99 and 130 sectors for 2003-04 and 2007-08. The number of sectors is determined by sector classification in the respective IOT.

[5] We consider only those studies that have used the IO approach. We do not cover studies which analyze the effects of imports on employment and studies which have used alternative methodologies (regression analysis or accounting identity calculations) to estimate the employment effects of exports.

by US goods and services exports increased significantly from 7.4 million jobs in 1993 to 11.7 million jobs in 2011 (see Table 1). Export-supported jobs accounted for 6.9 percent of total US employment in 2008. Estimates for the EU suggest the number of jobs supported by EU's exports to the world increased from 18.6 million in 1995 to 31.2 million in 2011. For China, export related employment stood at 129 million jobs in 2007 (up from 88 million in 2002), accounting for 17% of total employment.

Turning to the studies on India, Taylor (1976) and Banerjee (1975) provided one of the earliest estimates. Taylor's estimate showed that India's manufactured exports in 1964-65 generated about 2.2 million man-years of employment, accounting for 2.7% of total employment. Banerjee (1975) showed that manufactured exports created about 2.2 million jobs in 1964 and 2.4 million jobs in 1970. Estimations by Nambiar (1979) showed that employment associated with India's goods and services exports increased from 4.9 million in 1963-64 to 5.4 million jobs in 1973-74. Jobs tied to exports accounted for roughly 2 per cent of total employment in 1973-74.

Using IOT for the year 1968-69, Chishti (1981) calculated that India's goods and services exports had supported 5.4 million person-years of employment in 1970-71 and 7.2 million person-years of employment in 1975-76. Jobs tied to exports represented 4.3 percent of total employment in 1975-76. Employment generated through backward linkages accounted for 40 percent of export related employment in 1975-76. To the best of our knowledge, IOT based estimates of export supported jobs are not available for India for the post 1980 period[6].

The literature identifies certain general trends and patterns with respect to export related jobs. First, exports are becoming increasingly important for job creation as evident from the increasing share of export related jobs in total employment in many countries. Second, estimates of the number jobs supported per million dollars of exports, show a consistent decline over the years in most of the

[6] A couple of recent studies focusing on India's manufacturing sector have used growth accounting and regression based analysis (Goldar, 2002; Sen 2008; Sankaran et al 2010; Raj and Sen, 2012; Raj and Sasidharan, 2015, Vashisht, 2016). None of these studies have estimated the actual number of jobs supported by exports using the I-O framework. Using the IOT for 2003-04, UNCTAD (2013) provides some estimates of the impact of predicted changes in exports on employment for 10 sectors and for the years 2008-09, 2009-10, and 2010. As noted by Feenstra and Hong (2007) employment predictions based on IO framework can give highly unreliable estimates as export composition, employment coefficient and technology do not remain the same. Therefore, we do not attempt any forecasting exercise in our study.

countries[7]. Yet, total number of jobs supported by exports tends to increase as the positive volume effect from export growth more than offset the negative effect from the rise in labor productivity. Third, most of the export related jobs in developing countries, especially at the early stage of export growth, went to low skilled workers. Fourth, backward linkages, particularly from manufacturing to agriculture and services, have become an important source of export related job creation in many countries.

3. Methodology and Data

Making use of the concept of backward linkages, the total DVA content of exports from '*n*' sectors can be estimated as:

$$\boldsymbol{dva_1} = \boldsymbol{v}(\boldsymbol{I} - \boldsymbol{A^d})^{-1}\widehat{\boldsymbol{X}} \qquad (1\ )$$

where $\boldsymbol{v}$ is a $1 \times n$ vector containing value added to output ratio for each sector *n*, $\widehat{\boldsymbol{X}}$ is an $n \times n$ diagonal matrix of exports from *n* sectors, $(\boldsymbol{I} - \boldsymbol{A^d})^{-1}$ is the inverse Leontief matrix that measures the total direct and indirect uses of each commodity *i* by each sector *j*[8]. $\boldsymbol{A^d}$ is domestic coefficient matrix with dimensions $n \times n$. The elements of the A^d matrix (denoted as a_{ij}) measure the amount of domestic input from sector *i* required to produce one unit of output in sector *j*. $\mathbf{I}$ is identity matrix with ones on the diagonal and zeros elsewhere. $\boldsymbol{dva_1}$ is the resulting $1 \times n$ vector of DVA content of exports. By summing the appropriate elements of this vector, we get the aggregate DVA for broad sector groups (agriculture, manufacturing and services) and for the economy as a whole. Such aggregate estimates may be denoted as $\sum dva_{i1}$ where dva_{i1} are the individual elements of the vector $\boldsymbol{dva_1}$.

Total DVA in (1) can be decomposed into direct and indirect (backward linkage) effects as shown below.

$$\boldsymbol{dva_1^d} = \boldsymbol{v}(\widehat{\boldsymbol{I} - \boldsymbol{A^d}})^{-1}\widehat{\boldsymbol{X}} \qquad (1a)$$

$$\boldsymbol{dva_1^{bw}} = \boldsymbol{dva_1} - \boldsymbol{dva_1^d} \qquad (1b)$$

[7] This result is mainly driven by: (*i*) a general shift in the composition of exports towards capital and skill-intensive products; (*ii*) growth of labor-productivity; and (*iii*) introduction of labor saving technology.

[8] Each element of Leontief inverse matrix indicates input requirement from *i*th sector if there is a unit increase of the final-use (consumption, foreign trade, or investment) of *j*th sector's output.

where $\left(\widehat{\boldsymbol{I}-\boldsymbol{A}^{\boldsymbol{d}}}\right)^{-\mathbf{1}}$ is a matrix consisting of the diagonal elements of $(I-A^d)^{-1}$ and zeros elsewhere; dva_1^d and dva_1^{bw} are respectively vectors of direct and indirect DVA content of exports from *n* sectors. Note that dva_1^{bw} in equation (1b) measures the DVA attributable to sector *i*'s backward linkages with all upstream sectors *j*. For example, gross exports of 'automobile' embodies value added generated within the automobile sector (dva_1^d) as well as in other sectors (such as 'iron and steel') which are used as inputs for producing the automobile (dva_1^{bw}).

Using a slightly different approach, we can measure the extent of DVA generated in sector *j* as a result of its forward linkages with all downstream sectors *i*. For example, DVA is generated in 'iron and steel' sector as a result of exports from all sectors (such as, automobiles, machine tools etc) where 'iron and steel' is used as an input. Thus, making use of the concept of a sector's forward linkages with other sectors, the total DVA attributed to exports in different sectors can be estimated as:

$$dva_2 = \hat{V}(I-A^d)^{-1}x \qquad (2)$$

which can be decomposed into direct and indirect (forward linkage) effects as below.

$$dva_2^d = \hat{V}\left(\widehat{I-A^d}\right)^{-1}x \qquad (2a)$$

$$\boldsymbol{dva_2^{fw} = dva_2 - dva_2^d} \qquad (2b)$$

where $\widehat{\boldsymbol{V}}$ is $n \times n$ diagonal matrix of value added to output ratios and *x* is ($n \times 1$) vector of exports from different sectors. Note that dva_1 and dva_2 give identical estimates for the economy as a whole (when aggregated for all sectors) but not for individual sectors. However, even at the sector level, the two approaches give identical estimates of direct DVA – that is, the vectors dva_1^d and dva_2^d are identical across sectors. However, dva_1^{bw} and dva_2^{fw} give different values across sectors due to the differences in the type of linkages (backward versus forward) that they capture.

Employment supported by exports can be computed, in an analogous manner, using the two different concepts of linkages. The relevant equations for estimation are:

$$\left.\begin{aligned}
&\boldsymbol{e_1} = \boldsymbol{l}\left(\boldsymbol{I} - \boldsymbol{A^d}\right)^{-1}\boldsymbol{\widehat{X}} && (3)\\
&\boldsymbol{e_1^d} = \boldsymbol{l}\left(\widehat{\boldsymbol{I} - \boldsymbol{A^d}}\right)^{-1}\boldsymbol{\widehat{X}} && (3a)\\
&\boldsymbol{e_1^{bw}} = \boldsymbol{e_1} - \boldsymbol{e_1^d} && (3b)
\end{aligned}\right\}\ \text{based on backward linkages}$$

$$\left.\begin{aligned}
&\boldsymbol{e_2} = \boldsymbol{\hat{L}}\left(\boldsymbol{I} - \boldsymbol{A^d}\right)^{-1}\boldsymbol{x} && (4)\\
&\boldsymbol{e_2^d} = \boldsymbol{\hat{L}}\left(\widehat{\boldsymbol{I} - \boldsymbol{A^d}}\right)^{-1}\boldsymbol{x} && (4a)\\
&\boldsymbol{e_2^{fw}} = \boldsymbol{e_2} - \boldsymbol{e_2^d} && (4b)
\end{aligned}\right\}\ \text{based on forward linkages}$$

Where *l* is $1 \times n$ vector containing employment coefficients (labor/output ratios) while $\boldsymbol{\hat{L}}$ is the diagonal matrix of sectoral employment coefficients. The resulting vector of employment supported by exports is given by $\boldsymbol{e_1}$ and $\boldsymbol{e_2}$ where the former measures direct employment ($\boldsymbol{e_1^d}$) plus employment attributed to backward linkages ($\boldsymbol{e_1^{bw}}$) while the latter represents direct employment ($\boldsymbol{e_2^d}$) plus employment due to forward linkages ($\boldsymbol{e_2^{fw}}$).

Following the method outlined above, we estimate DVA and employment supported by India's exports for the period 1999-2000 to 2012-13. However, official IOTs are available for only once in five years. Therefore, by making use of detailed production and trade data from various official sources, we construct annual time series of DUT. For constructing these tables, we make use of information on the changing IO relations and other structural features of the economy as reflected in available official IOT since 1998-99 and the latest SUTs for the year 2011-12 and 2012-13. The methodology and data used for the construction of DUT are discussed in detail in Appendix A1 and A2.

4. Estimates of Export Related DVA and Employment

4.1. Aggregate Level Estimates

Table 2 provides the estimates of the DVA content, in terms of billions of US dollar, of India's aggregate merchandise and services exports. These values are obtained by summing the estimates for 112 sectors for each year. Table 2 also reports a number of other indicators, which include dollar value of aggregate gross exports, ratio of total DVA to gross exports and value of gross exports required to generate $1 billion worth of DVA. The average annual growth rates pertaining to the various indicators are shown in Table 3.

In 1999-2000, India's gross exports stood at about 53.3 billion dollars, of which the contribution of DVA was 46 billion dollars, with the ratio of DVA to gross export being 0.86. In 2012-13, India's gross exports increased to 452.1 billion dollars, of which 295.4 billion dollars was the DVA content. It can be seen that the ratio of DVA to gross exports declined significantly to 0.65 in 2012-13 at the rate of 2 % per annum during the period 1999-2000 to 2012-13. In other words, the share of foreign value added increased steadily during this period. The ratio of DVA to gross exports declined slowly but consistently from 0.86 in 1999-2000 to 0.81 in 2007-08. Since 2007-08, however, DVA to export ratio declined much faster reaching 0.73 in 2010-11 and 0.65 in 2012-13. Thus, based on the trends in DVA to gross export ratio, it can be said that Indian industries have become more involved in GPS, especially since the second half of the 2000s. Consistent with these trends, the estimates shown in column 5 (Table 2) suggest that the gross exports ($ billion) required to generate $1 billion worth of DVA increased from 1.16 billion dollars in 1999-2000 to 1.53 billion dollars in 2012-13.

Table 4 shows the estimates of total number of employment (in millions) supported by India's aggregate merchandise and services exports. This table also reports the share of export supported employment in total employment and the number of jobs generated per million dollar worth of exports. It is evident that the total number of jobs supported by Indian exports increased from about 34 million in 1999-00 to 62.6 million in 2012-13, with a growth rate of 3.4% per annum. The total number of jobs tied to exports increased steadily at the rate of 7.6% per annum during the first half of the 2000s. Export-supported jobs declined briefly in 2009-10, in the aftermath of the global financial crisis. During the period 2006-07 to 2012-13, consistent with declining growth rate of export values and DVA, growth rate of employment tied to exports fell to 2.6% per annum. Nevertheless, it may be noted that export related jobs grew significantly faster than total employment throughout the period. As a result, the share of export-supported jobs in total employment in the country increased from little over 9% in 1999-2000 to 14.5% in 2012-13.

The number of export-supported jobs per million dollar worth of exports shows a steady decline over the years. One million dollar worth of exports supported 638 jobs in 1999-2000, which has declined to 138 in 2012-13. Yet, this number for India is significantly higher than those reported for other countries in earlier studies: for example, 1 million dollar worth of exports from US supported only 6.6 jobs in 2009 and 5.2 jobs in 2014. Estimates for China suggest that 1 million dollar worth of its exports supported 140 jobs in 2007 as compared to 191 jobs in India for the same year[9].

The observed decline in the number of jobs per million dollar worth of exports is consistent with the general pattern observed for other countries. This is partly driven by the improvements in labor productivity. Further, this can arise as a result of a change in the composition of gross exports in favor of more skill and capital intensive products. While the share of capital-intensive products in India's merchandise exports increased consistently from about 32% in 2000 to nearly 53% in 2015, the share of unskilled labor-intensive products declined from about 30% to 17% (EXIM Bank, 2016). A similar trend was observed in services export basket with the increasing share of skill intensive software and business services at the cost of traditional services.

Turning to the relative importance of direct and indirect effects, we find that direct employment contributed more than indirect employment during the period 1999-2000 to 2009-10. However, the share of indirect jobs increased significantly in recent years with its contribution becoming similar to that of direct jobs. The share of indirect jobs in total export-supported jobs increased from about 38% in 2007-08 to 52% in 2010-11. During 2011-12 and 2012-13, the share of indirect employment stood at about 50%[10]. During the period 1999-00 to 2005-06, direct and indirect jobs tied to exports grew at the rate of 8.4% and 6.5% per annum, respectively. However, during 2006-07 to 2012-13, while job creation through indirect linkage channels registered a growth rate of 8.4% per annum, the growth rate of direct job creation was negative (-1.9%).

4.2. Estimates for Sector Groups: Agriculture, Manufacturing and Services

In what follows in this Section, we provide a brief background on the changes in the composition of gross exports (sub-section 4.2.1) before turning to the estimates of export related DVA and employment across sector groups (sub-section 4.2.2). Based on the decomposition of total export related DVA and employment across sector groups into direct and indirect effects, sub-section 4.2.3 discuss the relative importance of the two types of linkages (backward and forward) across sector

[9] These estimates are based on the studies listed in Table 1 for the respective countries.
[10] The share of indirect DVA in total DVA was 46% in 1999-2000 which was declined to 37% in 2007-08 and then increased to 46% in 2012-13.

groups. Finally, at a more disaggregated level within each sector group, we look at the relationships among export related DVA, DVA to export ratio and export related employment in top and fast growing export sectors (sub-section 4.2.4).

4.2.1. *Composition of Gross Exports*

Using the data on gross exports from official IOT and SUT, Table 5 reports the composition of exports across three broad sector groups. The percentage shares are reported for the years 1998-99, 2003-04, 2007-08 (years for which official IOTs are available) and for 2012-13 (the latest year for which SUT is available). It is clear that the share of (i) Agriculture, mining and allied activities (henceforth agriculture) declined consistently over the years from about 11% in 1998-99 and 2003-04 to less than 4% in 2012-13. The share of manufacturing declined from 68.7% in 1998-99 to 42.7% in 2007-08 and then rebounded to 63.6% in 2012-13. The share of services exports shot up from about 20% in 1998-99 to nearly 49% in 2007-08 and then showed a decline to about 32.5% in 2012-13. Manufacturing accounted for the largest share of exports for all years, except for 2007-08 when services recorded higher share (48.7%) than manufacturing (42.7%). With this background on the changes in the sectoral composition of gross exports, we turn to the estimates of export related DVA and employment at the sector level.

4.2.2. *Total DVA and Jobs Supported by Exports across Sector Groups*

Note that the two estimates of total DVA (dva_1 and dva_2) provide identical values at the aggregate economy wide level but not at the sector level. The same holds true for the estimates of total employment (e_1 and e_2). While the two approaches give identical estimates of direct DVA and direct employment at the sector level, the estimates of indirect effects provide different values due to the differences in the type of linkages (backward versus forward) that they capture.

On the question as to which of the two measures one should look at the sector level, the answer depends on the purpose. The appropriate measures are the ones based on backward linkages (dva_1 and e_1) if the objective is to assess whether export growth from a given sector has the potential for generating significant DVA and employment in the economy through its linkages with other sectors. However, if the purpose is to understand the extent of a sector's direct and indirect dependence on exports for growth and employment generation, the appropriate measures are those based on forward linkages (dva_2 and e_2).

A. Estimates based on dva_1 and e_1

Table 6 reports the dollar values of total DVA ($\sum dva_{i1}$) and total number of employment ($\sum e_{i1}$) attributed to exports from each sector group. Total DVA content of agriculture exports increased steadily from 4.6 billion dollars in 1999-2000 to about 21 billion dollars in 2007-08 and then declined gradually to 16 billion dollars in 2012-13. While employment attributed to agriculture exports recorded some increase during the first half of the 2000s, the latter half witnessed a significant decline resulting in a negative average annual growth rate (-4.0%) for the whole period.

The value of DVA attributed to manufacturing exports increased steadily from about 24 billion dollars in 1999-2000 to 165 billion dollars in 2011-12, before declining to 154 billion dollars in the following year. Job creation tied to manufactured exports fluctuated within the range of 17.5 - 25 million jobs until 2009-10, before rising to 45 million in 2012-13.

Turning to services sector, we find consistent increase in the dollar value of DVA from 17.5 billion dollars in 1999-00 to about 116 billion dollars in 2008-09. The DVA value declined to about 99 billion dollar in 2009-10 and then gradually rebounded, crossing 125 billion dollars in 2012-13. Employment attributed to services exports increased consistently from 7.8 million in 1999-00 to 18.9 million in 2007-08 and then declined to 11.2 million in 2012-13.

The composition of total DVA and total employment attributed to exports from different sector groups are shown in Figure 1. The observed changes in the composition of DVA and employment over the years are broadly consistent with the changes in the composition of gross exports shown in Table 5[11]. The share of manufacturing, both in terms of DVA and employment, increased significantly since 2007-08 while the shares of services and agriculture declined. For the year 2012-13, employment attributed to manufacturing exports accounted for 72% of total export related employment generated in the country[12]. It can be seen that the employment shares attributed to agriculture and manufacturing exports are generally higher than the corresponding DVA shares whereas the reverse is true for services.

[11] A notable contrast, however, is that the manufacturing sector usually accounts for higher share in gross exports as compared to its share in DVA tied to exports. This mismatch is mainly driven by two sectors: 'Petroleum Products' and 'Gems & Jewelry'. While both these sectors account for a high share in gross exports, their share in DVA is relatively less owing to their high import dependence. For example, in 2012-13, these two sectors together accounted for about 24% of gross exports but only about 7% of total DVA attributed to exports.

[12] The major increase in the share of employment attributed to manufactured exports during the period 2010-11 to 2012-13 was mainly brought about by sectors such as readymade garments, miscellaneous textile products, gems and jewelry, cotton textiles and miscellaneous food products.

As discussed earlier, the extent of a sector's participation in GPS can be gauged by looking at the ratio of sector-specific DVA to gross exports. Clearly, $\boldsymbol{dva_1}$ is the appropriate measure for this purpose; a higher (lower) ratio of $\boldsymbol{dva_1}$ to gross exports implies that the given sector is mainly involved in the local (foreign) sourcing of intermediate inputs.

The ratio of $\sum dva_{i1}$ to gross exports for the three sector groups is shown in Figure 2 (panel a). Until 2007-08, the ratio of DVA to gross exports in agriculture remained very high and unchanged in the range of 0.95 – 0.96. Since then, however, this ratio recorded a small decline with the value being 0.91 in 2012-13. Turning to the services sector, we find that DVA to export ratio declined rather slowly, at the rate of -0.6 % per annum, and remain quite high at 0.86 in 2012-13, down from 0.92 in 1999-2000.

Manufacturing sector witnessed the fastest decline in DVA to export ratio: it declined from 0.81 in 1999-2000 to 0.53 in 2012-13, at the rate of -3% per annum. The ratio declined slowly during the initial years and at a much faster rate during the later years. The significant decline in this ratio reflects the fact that the global production sharing activities by Indian manufacturing industries have increased over the years. It may also be noted that the significant decline in the ratio of DVA to gross exports in the manufacturing sector since the mid-2000s coincided with a major increase in the share of manufacturing in gross exports.

In general, manufactured products are more tradable and hence more amenable to global production sharing, resulting in relatively low DVA to gross export ratios, as compared to services and agriculture. Indeed, as can be seen in Figure 2, throughout the period, $\sum dva_{i1}$ to gross export ratio remained less for manufacturing as compared to other sectors.

B. Estimates based on dva_2 and e_2

Table 7 reports the dollar values of total DVA ($\sum dva_{i2}$) and total employment ($\sum e_{i2}$) generated in different sector groups as result of the direct effect of exporting from each sector plus due to each sector's forward linkages with other exporting sectors. Comparing the values for each sector group in Table 7 with those in Table 6, it is immediately evident that the values are significantly different from each other. For agriculture and services, the estimates in Table 7 are higher than those in Table 6 for all years while the opposite is true for manufacturing. These patterns imply that forward linkages with export oriented manufacturing sectors are an important source of DVA and employment generation in agriculture and services.

The distribution of export related total DVA and total employment across sector groups is depicted in Figure 3. It is clear that services sector accounts for the largest share of total export related DVA (about 58% in 2012-13). The pattern of employment generation, however, is very different with agriculture accounting for the largest share (42.5% in 2012-13) of total employment attributed to exports followed by manufacturing (38.5%) and services (19%).

Figure 2 (panel b) shows the ratio of $\sum dva_{i2}$ to gross exports across sector groups. Throughout the period, this ratio is above 1 for agriculture and services and less than 0.5 for manufacturing. Values of these ratios reinforce the observation that exports from downstream manufacturing sectors generates significant DVA in upstream agriculture and services through linkages even though a number of upstream industries do not directly engage in export activities. The relative importance of the two types of linkages across sector groups is discussed in more detail in sub-section 4.2.4.

4.2.3. *Relative Importance of Backward and Forward Linkages across Sectors*

A. <u>Backward Linkages</u>

Table 8 shows the estimates of DVA ($\sum dva_{i1}^{bw}$) and job creation ($\sum e_{i1}^{bw}$) attributed to the backward linkages of exporting sectors. Both DVA and employment values recorded positive average annual growth rates during the period. The composition of indirect DVA and employment attributed to backward linkages is shown in Figure 4. It is evident that, throughout the period, exports from manufacturing sectors account for the bulk of DVA and employment created through backward linkages. This pattern is clearly different from that for direct DVA where services generally account for the largest values followed by manufacturing[13]. It can be seen that export related employment shares attributed to backward linkages from agriculture and manufacturing are generally higher than the corresponding DVA shares whereas the reverse is true for services.

Figure 5 depicts indirect DVA ($\sum dva_{i1}^{bw}$) and employment ($\sum e_{i1}^{bw}$) attributed to backward linkages as a share of total DVA ($\sum dva_{i1}$) and total employment ($\sum e_{i1}$) generated by exports from each sector group. These shares are significantly higher for manufacturing as compared to services and

[13] This figure is not included here but available from authors upon request.

agriculture. In general, DVA through backward linkages accounted for more than 60% of total DVA attributed to manufactured exports while this proportion is less than 30% for services. This proportion is the lowest for agriculture exports, varying in the range of 15% - 25%.

We find broadly similar pattern with respect to the importance of backward linkages for employment generation across sector groups. The estimates suggest that, of the total employment attributed to manufactured exports in 2012-13, about 55% was in the form of indirect job creation due to backward linkage effects. Though the potential for job creation by services exports through backward linkages has increased noticeably in recent years, it remains below that of manufacturing. Much of the DVA and employment attributed to agriculture and services exports are in the nature of direct DVA, with their backward linkages being relatively weak.

B: Forward Linkages

Turning to forward linkages, Table 9 reports the estimates of DVA ($\sum dva_{i2}^{fw}$) and job creation ($\sum e_{i2}^{fw}$) attributed to each sector *j*'s forward linkages with all exporting sectors *i*. The DVA generated in agriculture sector, as a result of its linkage with other exporting sectors (primarily manufacturing), increased consistently from 4.2 billion dollars in 1999-00 to 30.6 billion dollars in 2012-13 at the rate of 18.1% per annum. It increased at the same rate (18.1% per annum) for services sector, from 12.5 billion dollars in 1999-00 to 81.2 billion dollars in 2012-13. Forward linkages with exporting sectors (mostly in manufacturing) were responsible for the creation of 21.2 million jobs in agriculture and 6.1 million jobs in services in 2012-13. For manufacturing, forward linkages were responsible for the creation of only 3.7 million jobs in the same year.

Figure 6 shows the composition of DVA and employment across sector groups attributed to each sector's forward linkages with all exporting sectors. Services sector accounts for the largest share of DVA (about 60% in 2012-13) generated through forward linkages followed by agriculture (23% in 2012-13). The pattern of employment generation through such linkages, however, is very different with agriculture accounting for the largest share (68% in 2012-13) followed by services (20% in 2012-13). Manufacturing sector accounts for the lowest share in terms of both DVA and employment attributed to forward linkages.

Figure 7 shows indirect DVA ($\sum dva_{i2}^{fw}$) and employment ($\sum e_{i2}^{fw}$) attributed to forward linkages as a share of total export related DVA ($\sum dva_{i2}$) and employment ($\sum e_{i2}$) for each sector group. Clearly, forward linkages contribute a very large share of export related DVA (71% in 2012-13) and employment (80%) in agriculture. Next to agriculture is the services sector with the corresponding shares being 47% and 51% for the same year. It is evident that forward linkages are least important for the manufacturing sector. This pattern is in complete contrast with what we have noticed with respect to backward linkages, which is most important for manufacturing.

It can be seen that the importance of forward linkages increased significantly for both agriculture and services since 2007-08. This was driven by an increased share of manufactured exports in India's export basket during this period (see Table 5). Agriculture and services, through their strong forward linkages with manufacturing, have clearly benefited from the growth in manufactured exports since 2007-08.

Exports of manufactured products offer the greatest potential to generate value addition and employment directly as well as indirectly through its strong backward linkages with agriculture and services. It is clear that even domestic market oriented industries sometimes may have heavy export dependence due to their forward linkages with export-oriented industries. Thus, domestic market-oriented industries are not necessarily protected from negative external shocks.

4.2.4. *DVA and Employment in Top and Fast Growing Export Sectors*

Table 10 provides the following indicators for top exporting sectors – that is, all sectors with share in total gross exports greater than or equal to 1% in 2012-13[14]: (i) share of each sector in gross exports $\left(\frac{x_i}{\sum x_i}\right)$; (ii) share of each sector in total export related DVA $\left(\frac{dva_{i1}}{\sum dva_{i1}}\right)$; (iii) share of each sector in total export related employment $\left(\frac{e_{i1}}{\sum e_{i1}}\right)$; and (iv) DVA to gross export ratio$\left(\frac{dva_{i1}}{x_i}\right)$.

Within agriculture, there is only one sector - 'Forestry & Logging' - with share in gross exports greater than 1%. Its share in total DVA increased from just 0.2% in 2007-08 to 1.5% in 2012-13. The increase in DVA share in this sector was accompanied by a significant increase in its export related employment share while DVA to export ratio declined moderately from 0.96 in 2007-08 and to 0.92 in 2012-13.

[14] Detailed times series estimates of export supported DVA and employment for all 112 sectors are available, respectively, in Veeramani and Dhir (2017) and Exim Bank (2016).

Within manufacturing, there are 13 sectors with share in gross exports greater than or equal 1%, with each accounting for greater than or equal to 1% share in total DVA as well. These sectors together account for 38% of total export related DVA in 2012-13 while their contribution to total export related employment is much higher at 57%. Sectors such as 'Gems & Jewelry', 'Miscellaneous food products', 'Readymade garments', and 'Cotton textiles' accounts for significantly higher share in export related employment than in export related DVA. The share of DVA in gross exports has dropped significantly over the years in all manufacturing sectors with the exception of 'Miscellaneous Food Products'.

'Petroleum Products' and 'Gems & Jewelry', each with share in gross exports greater than 10%, recorded a substantial decline in DVA to export ratio, even as the absolute value of DVA increased significantly in both the sectors. The DVA value in Petroleum Products increased from 1.4 billion dollars in 2003-04 to 14.7 billion dollars in 2012-13 while DVA to export ratio declined consistently from 0.45 to 0.24. DVA to export ratio for 'Gems & Jewelry' declined drastically from nearly 0.65 in 2003-04 to around 0.14 in 2012-13. Consistent with their high import dependence, these two sectors record one of the lowest DVA to export ratios and accounts for a much smaller share in total DVA as compared to gross exports.

Within services group, 'Computer Related Services' and 'Business Services' record the largest absolute values of DVA and gross exports. Both these sectors record significantly higher DVA shares relative to employment shares. The DVA to export ratio remain relatively high for most of the services sectors, despite some decline over the years.

Table 11 shows the same set of indicators for the fast growing sectors in the export basket, identified as those whose shares in gross exports increased by at least 0.5 percentage points in 2012-13 as compared to 2003-04. It can be seen that most of these sectors have also increased their DVA shares at least by 0.5 percentage points, with the exception of 'Gems & Jewelry' and 'Chemicals'. Further, all these sectors, with the exception of 'Chemicals' experienced an increase in their employment shares.

As can be seen in Figure 8, barring few exceptions, there exist a high positive correlation between (i) percentage point change in gross export shares and DVA shares and (ii) percentage point change in DVA shares and employment shares. We also note a very high positive correlation between (i) absolute dollar values of sector level gross exports and DVA and (ii) absolute dollar values of sector level DVA and number of employment (see Figure 9). It can be seen that all fast growing sectors experienced a decline in the ratio of DVA to gross exports over the years, with the exception of 'Miscellaneous Food Products' and 'Ships and Boats'.

5. Impact of GPS Participation on Absolute Levels of Gross Exports, DVA and Employment

As seen in previous Sections, the ratio of DVA in India's gross exports has declined significantly during 1999-2000 to 2012-13. This may imply that India's participation in GPS has increased over the years. As mentioned earlier, what really matters for employment generation within a country is the absolute value of DVA rather than the DVA per unit of the good exported. In this section, we analyze whether the decline in DVA to export ratio (implying greater participation in GPS) leads to an increase in the absolute dollar values of both gross exports and DVA and hence the absolute number of jobs.

We hypothesize that the absolute dollar value of India's exports will increase with greater participation in GPS. This, in turn, will lead to an increase in the absolute dollar value of DVA, even as the ratio of DVA to exports falls. As the DVA per unit of export falls, the total DVA generated from exports would increase as a result of the scale effect of producing for the world market that participation in GPS entails. An increase in the absolute value of DVA, in turn, would lead to an increase in the absolute number of jobs linked to exports. In order to test these hypotheses, we estimate the following simultaneous equation model.

$$\boldsymbol{ln(x_{it}) = \alpha_0 + \alpha_1 ln\left(\frac{dva_{i1}}{x_i}\right)_{t-1} + \alpha_2 ln(wd_{it}) + \alpha_3 ln(y_{it}) + \alpha_4 ln(rpo_{it}) + \alpha_5 D(t) + \alpha_6 J + u1_{it}} \quad \textbf{(5)}$$

$$\boldsymbol{ln(dva_{i1t}) = \beta_0 + \beta_1 ln(x_{it}) + \beta_2 ln(wd_{it}) + \beta_3 ln(gva_{it}) + \beta_4 ln(rpv_{it}) + \beta_5 D(t) + \beta_6 J + u2_{it}} \quad \textbf{(6)}$$

$$\boldsymbol{ln(e_{i1t}) = \gamma_0 + \gamma_1 ln(dva_{i1t}) + \gamma_2 ln(rw_{it}) + \gamma_3 ln(gva_{idt}) + \gamma_4 ln(l_{it}) + \gamma_5 D(t) + \gamma_6 J + u3_{it}} \quad \textbf{(7)}$$

The notations *i, t* and *ln* in the above equations stand respectively for sector, year and natural logarithm. Variable *x* is the dollar value of India's exports to the world; dva_{i1} is the dollar value of total DVA attributed to exports from sector *i*; *wd* is world demand; *y* is value of output; *rpo* (*rpv*) is exchange rate adjusted relative prices based on sector specific output (value added) deflators; *gva* is gross value added; e_{i1} is the number of total employment attributed to exports from sector *i*; *rw* stands for real wage rate; gva_{id} is gross value added attributed to domestic (as opposed to export) sales by sector *i*; *l* stands for employment coefficients (labor to output ratio); *D*(t) is the vector of year dummies and *J* is the vector of sector dummies. The variables *x*, dva_{i1} and e_{i1} are endogenous while other variables are assumed to be exogenous to the system.

Note that we use one year lagged value of DVA to export ratio $\left(\frac{dva_{i1}}{x_i}\right)$, rather than its contemporaneous value, assuming that the effect of GPS on gross exports will be observed with one year lag[15]. Our regressions exclude the observations where the values of *x* and dva_1 are zero as in such cases the ratio between the two (zero divided by zero) is undefined[16].

The variable *wd* is measured as a weighted average of total imports (in US dollars) in a given sector by the world from all countries, except from India. The share of each partner country in India's total exports in the given sector is taken as the weight. As required data were not available for services sectors, *wd* was constructed only for merchandise sectors.

The variable *rpo* (*rpv*) is constructed by taking the ratio of output (value added) deflator for India to that of United States for each IO sector[17]. These ratios were adjusted by dollar per rupee nominal exchange rate for the given year: an increase in the ratio implies a deterioration of India's price competiveness in the given sector, and vice versa. The variable *rw* is real wage rate computed using the data on sector specific nominal wage rates and output deflators. As required data were not available for other sectors, *rw* was computed only for manufacturing sectors. The variable gva_{id} is computed by subtracting dva_{i1} from gross value added (gva_i) for each sector *i*. Further details pertaining to variable definition, variable construction, and data sources are given in Appendix Table A2.

Before proceeding to the estimation, we perform the Hausman specification test for simultaneity. Results show that simultaneity problem is indeed present in the system and hence OLS estimators will not be consistent. Therefore, we use a three-stage least squares (3SLS) econometric approach to simultaneously estimate equations (5) through (7)[18]. The regressions have been estimated for two sample groups: (i) all sectors and (ii) sub-set of sectors within manufacturing. While all explanatory

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15 Use of lagged ratio also enables us to treat this variable as exogenous.

16 For merchandise sectors, the observations with zero export values account for less than 5% of total observations.

17 Output (value added) deflator for the United States is taken as a proxy for world prices.

18 The 3SLS approach, a combination of seemingly unrelated regressions (SUR) and 2SLS, obtains instrumental variable estimates, taking into account the covariances across equation disturbances.

variables were included in the regressions for the sample of manufacturing sectors, regressions for the full sample exclude *wd* and *rw* due to non-availability of data.

Regression results for the sample of manufacturing sectors are reported in Table 12 while Table 13 shows the results for the full sample. While 3SLS is our preferred specification, the tables also report the results of fixed effect regressions for comparison. Overall, 3SLS and fixed effect regressions give similar results with respect to the sign and statistical significance of different variables.

As expected, DVA to export ratio show statistically significant negative coefficient values in all specifications of equation (5), for the full sample as well as for the sample of manufacturing. For the manufacturing group, the elasticity of gross exports with respect to $\left(\frac{dva_{i1}}{x_i}\right)$ ranges from -1.9 to -3.6 in 3 SLS specifications. This implies that a 10% decline in the ratio of DVA to exports leads to an increase in the dollar value of gross exports in the range of 19% to 36%, which is quite large. For the full sample, in Table 13, the elasticity values are even higher (-3.2 to -6.7). The marginal gain from GPS participation for services and primary sectors is higher than for manufacturing, possibly due to the fact that the current level of involvement in GPS is relatively high for manufacturing as compared to other sectors.

Thus, it can be concluded that greater participation of a sector in GPS, as captured by a decline in DVA to export ratio, causes the absolute dollar value of exports to increase. The results corresponding to equation (6) confirm that higher value of gross exports, in turn, leads to higher absolute value of DVA. For the manufacturing sample, the elasticity of DVA values with respect to gross exports ranges from 0.62 to 0.80 in 3SLS specifications, which means that a 10% increase in gross exports causes an increase in DVA in the range of 6.2% to 8.0%. The elasticity estimates are slightly higher (0.75 to 0.88) in the regressions using the full sample.

Does higher absolute dollar values of DVA, in turn, lead to higher employment creation? The results corresponding to equation (7) confirm that it does. The elasticity estimates obtained for the manufacturing sample suggest that a 10% increase in export related DVA in a sector causes employment generation in the range of 6.2% to 9.2%. The elasticity estimates for the full sample are not significantly different from those obtained for the manufacturing sample.

The variable *wd*, representing world demand conditions, generally yields statistically significant positive coefficients in equations (5) and (6), implying that Indian exports as well as DVA respond positively to increase in world demand. The point estimates suggest that a 10% increase in world demand raises India's gross exports by about 3.3% to 3.6%. Our results suggests that world demand exerts an independent positive effect on DVA, though quantitatively small, even after controlling for the effect of gross exports on the latter.

The variables *y* (gross output) and *gva* (gross value added) are included to capture the effect of domestic supply capacity on exports and DVA, respectively. It is evident that both these variables show statistically significant positive coefficients in all specifications of equations (5) and (6). The variables representing exchange rate adjusted relative prices (*rpo* and *rpv*) is expected to show a negative sign. For the full sample, these variables yield correct sign with statistical significance in 3SLS specifications with sector and year dummies (see column 3, Table 13). For the manufacturing sample, however, these variables are not statistically significant in 3SLS with sector and year dummies (column 3, Table 12) though the variable *rpo* yield the correct sign with significance in fixed effect regression (column 4, Table 12).

As expected, the variable representing real wages (*rw*) yield statistically significant negative coefficient in all specifications of the employment equation (7) in Table 12. This result implies that a fall in real wages leads to an increase in export related employment. Finally, the results confirm that higher labor to output ratio (*l*), representing higher labor-intensity, leads to an increase in export related employment.

6. Conclusions and Implications

Using Input-Output (IO) analysis, this study provides consistent time series estimates, for 112 sectors, of domestic value added (DVA) and number of jobs supported by India's merchandise and services exports for the period 1999-2000 to 2012-13. The major advantage of the IO framework is that, in addition to the direct effect of exports within a given sector, the DVA and employment generated in other sectors through indirect linkages, backward and forward, can be taken into consideration. The study makes use of the official I-O Tables (IOT) for the benchmark years 1998-99, 2003-04, 2007-08 as well as the recently published Supply Use Tables (SUT) for the years 2011-12 and 2012-13. The IOT and SUT, compiled by India's Central Statistical Organization (CSO), do not distinguish imported inputs from domestic inputs. We construct the 'domestic use tables' (DUT) by relying on a 'proportionality' assumption to separate domestic inputs from imported inputs. For the intervening years - the years for which IOT and SUT are unavailable - we construct the DUT by making use of detailed production and trade data from various official sources. This enables us to have year-specific DUT for the estimation.

The estimates show that the DVA content of India's exports increased from US $46 billion in 1999-00 to US $295 billion in 2012-13, with a growth rate of 17.7% per annum. The total number of jobs supported by aggregate Indian exports increased from about 34 million in 1999-00 to 62.6 million in 2012-13, with a growth rate of 3.4% per annum. Further, export related jobs grew significantly faster than that of country's total employment: the share of export-supported jobs in total employment in the country increased from little over 9% in 1999-00 to 14.5% in 2012- 13. At the sometime, as shown in this study, the ratio of DVA to gross exports steadily declined from 0.86 in 1999-00 to 0.65 in 2012-13.

The decline in the ratio of DVA to gross exports has been particularly sharp for manufacturing sectors, suggesting that Indian industries have become more involved in global production sharing (GPS), especially since the second half of the 2000s. Backward linkages, particularly from manufacturing to agriculture and services, have become an important source of export related DVA and job creation in the country. An implication is that the industries which are less export oriented are not necessarily protected from negative external shocks.

Using an econometric analysis, we show that greater involvement in GPS, as measured by the declining share of DVA in gross exports, leads to higher absolute levels of gross exports, DVA and employment. A pertinent question is, despite its increasing involvement in GPS, why has the manufacturing sector not yet become the engine of India's growth unlike for China and other dynamic East Asian countries. In order to provide an explanation, we need to look at the extent of decline and the level of DVA to export ratio in a proper comparative perspective. The DVA to export ratio available in TiVA database show that while India's involvement in GPS has increased over the years, the level of its integration remains significantly less than that of other countries in East Asia (Veeramani and Dhir, 2017b). For the year 2011, the DVA to export ratio for India's manufacturing sector was 0.64 as compared to 0.48 for Malaysia, 0.51 for Singapore and Vietnam, 0.52 for Thailand, 0.53 for Korea and 0.60 for China. The difference between India and other countries is starker for sectors, such as electronics and electrical machinery, where GPS is more prevalent.

It must be noted that the DVA to export ratio reported in TiVA is an overestimation for countries heavily involved in processing trade such as China and Mexico. This bias is because the calculation of DVA content of exports is based on the assumption that production techniques and input requirements are identical for exports and domestically absorbed final goods. This assumption would overstate the DVA content of exports for countries such as China and Mexico that have large export processing sectors (Koopman et al, 2010; Johnson and Noguera, 2012). For example, in China, processing exports account for about half of overall exports. Estimates for the year 2004 by Johnson and Noguera (2012) confirm that, once processing exports are separately taken into account, the aggregate DVA to export ratio fall substantially from 0.70 to 0.59 for China and from 0.67 to 0.52 for Mexico.

Our point in this paper is not to say that India has exhausted the potential gains from GPS involvement. Far from it, our argument is that the country can reap rich dividends by adopting policies aimed at strengthening its involvement in GPS. Based on imported parts and components, India has a huge potential to emerge as a major hub for final assembly in several industries, particularly in electronics and electrical machinery. Since this strategy involves processing or assembly of imported parts and components, DVA *per unit* of exported good would be less. However, since the scale of operations is usually very large, the potential for total domestic value addition and job creation is very high.

Greater involvement of domestic industries in GPS must form an essential part of the "Make in India" initiative. It is important create an ecosystem which will result in a realignment of India's specialization patterns towards labor-intensive processes and product lines. A number of studies have noted the idiosyncratic nature of India's specialization patterns in that, despite being a labor-abundant country, the fast growing exports are either capital-intensive or skill-intensive (Kochhar et al., 2006; Panagariya, 2008; Krueger, 2010, Felipe et al., 2013, Veeramani et al, 2017)[19]. Studies

[19]There are several reasons to believe that the general incentive structure is biased against labor-intensive industries in India. Many argue that India's rigid labor laws create severe exit barriers and discourage large firms from choosing labor-intensive activities and technologies (see Kochhar et al., 2006; Panagariya, 2007; Krueger, 2010). Another group of scholars, however, question this argument (see Bhattacharjea, 2006 and Nagaraj, 2011). Though there is no unanimity of opinion in this regard, a growing number of econometric studies suggest that the role of labor laws cannot be ignored (see Hasan et al., 2007 and Aghion et al., 2008). Other constraints that stand in the way of labor-intensive manufacturing include inadequate supply of physical infrastructure (especially power, road and ports) and a highly inefficient and cumbersome land acquisition procedure. Faced with power shortages, capital and skill-intensive industries, such as automobiles and pharmaceuticals, might be in a position to rely on high-cost internal sources of power. But this option

suggest that a low level of service link cost - cost related to transportation, communication, and other related tasks involved in coordinating the activity in a given country with what is done in other countries within the production network - is critical for countries to involve in GPS. Supply disruption in a given location due to shipping delays, power failure, political disturbances, labor disputes etc could disrupt the entire production chain. Clearly, the policy should focus on reducing India's high service link costs with other countries within the production network.

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is unaffordable to firms in labor-intensive segments which typically operate with relatively low margin. Similarly, cumbersome land acquisition procedures create a bias against large scale labor-intensive manufacturing.

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Tables

Table 1: Estimates of Jobs Supported by Exports, Survey of Literature

	Country	Year	Jobs Supported	
			Million	% of total emp.
Tschetter (2010)	USA	1993 2008	7.4 10.3	- 6.9
Rasmussen and Johnson (2015)	USA	2011 2014	9.7 11.7	-
Sousa et al (2012)	EU	2000 2007	22.0 25.0	
Arto et al (2015)	EU	1995 2011	18.6 31.2	-
DBERR (2007)	UK	2004	7.0	-
Kiyota (2012)	Japan	2006	6.4	9.9
Chen et al (2012)	China	2002 2007	88.0 129.0	12.0 17.0
Aswicahyono and Manning (2011)	Indonesia	2000 2005	18.0 15.8	19.0 17.0
Nambiar (1979)	India	1963/64 1973/74	4.9 5.4	- 2.0
Chishti (1981)	India	1970/71 1975/76	5.4 7.2	3.7 4.3

Source: Based on literature survey

Table 2: DVA Content of India's Merchandise plus Services Exports ($ Billion).

Year	DVA			Gross Exports	Ratio of Total DVA to Gross Exports	Share of Direct DVA in Total DVA	Gross exports ($ billion) required to generate $1 billion worth of DVA
	Total	Direct	Indirect				
	(1)			(2)	(3)	(4)	(5)
1999-00	46.0	24.6	21.3	53.3	0.86	53.5	1.16
2000-01	53.0	29.2	23.8	61.8	0.86	55.1	1.17
2001-02	53.3	29.4	23.9	61.9	0.86	55.2	1.16
2002-03	63.7	35.5	28.2	74.5	0.85	55.7	1.17
2003-04	79.0	44.9	34.1	92.9	0.85	56.8	1.18
2004-05	105.7	61.5	44.3	128.1	0.83	58.2	1.21
2005-06	132.5	79.1	53.4	162.9	0.81	59.7	1.23
2006-07	163.7	100.4	63.3	202.6	0.81	61.3	1.24
2007-08	207.2	130.0	77.3	256.1	0.81	62.7	1.24
2008-09	229.4	137.4	92.0	296.0	0.77	59.9	1.29
2009-10	213.2	120.2	93.0	278.4	0.77	56.4	1.31
2010-11	278.1	150.1	128.0	380.8	0.73	54.0	1.37
2011-12	304.2	159.6	144.6	452.0	0.67	52.5	1.49
2012-13	295.4	160.1	135.3	452.1	0.65	54.2	1.53

Note:
Total DVA $=\sum \boldsymbol{dva_{i1}}$; Direct DVA $= \sum \boldsymbol{dva^{d}_{i1}}$; Indirect DVA$=\sum \boldsymbol{dva^{bw}_{i1}}$; Gross exports $= \sum \boldsymbol{x_i}$

Estimates of DVA based on the two concepts of linkages give identical value for the whole economy.
Source: Authors' estimation

Table 3: Average Annual Growth Rates, Aggregate Values (%)

Period	DVA Supported by Exports			Employment Supported by Exports			Gross Exports ($)	DVA to Export Ratio	Total Employ ment
	Total	Direct	Indirect	Total	Direct	Indirect			
1999-2000 to 2012-13	17.7	17.7	17.7	3.4	1.6	5.8	20.1	-2.0	0.8
1999-2000 to 2005-06	19.3	21.3	16.8	7.6	8.4	6.5	20.5	-0.9	1.5
2006-07 to 2012-13	10.2	7.0	14.8	2.6	-1.9	8.4	14.5	-3.8	0.9

Note: Growth rates are calculated using semi-logarithmic regression

Source: Authors' estimation

Table 4: Employment Supported by India's Merchandise plus Services Exports

	Export Supported Employment (Millions)			Share of Employment Supported by Exports in Total Employment (%)	No of jobs per million dollar worth of exports
	Total employment	Direct employment	Indirect employment		
1999-00	34.0	19.9	14.1	9.2	638
2000-01	37.9	23.0	14.9	10.3	614
2001-02	41.2	25.7	15.4	9.9	666
2002-03	43.5	26.8	16.7	11.0	584
2003-04	43.6	27.5	16.1	11.1	468
2004-05	52.1	32.6	19.6	12.8	406
2005-06	53.5	32.6	20.8	13.3	328
2006-07	53.5	33.0	20.5	13.2	264
2007-08	49.0	30.6	18.5	12.0	191
2008-09	54.1	31.1	23.0	13.4	184
2009-10	44.5	23.2	21.3	11.1	160
2010-11	49.3	23.6	25.7	12.0	129
2011-12	58.0	29.0	28.9	13.8	128
2012-13	62.6	31.4	31.2	14.5	138

Source: Authors' estimation

Table 5: Composition of Exports across Broad Sectors

Broad Sectors	Percentage share (%)			
	1998-99	2003-04	2007-08	2012-13
Agriculture, mining & allied activities	11.1	10.9	8.6	3.8
Manufacturing	68.7	53.7	42.7	63.6
Services	20.2	35.4	48.7	32.5
Total	100	100	100	100

Source: Authors' estimation using IOT and SUT from CSO.

Table 6: Total DVA and Employment Generated by Exports from Each Sector Group

	Total DVA: $\sum dva_{i1}$ ($ Billion)			Total Employment: $\sum e_{i1}$ (Million)		
	Agriculture	Manufacturing	Services	Agriculture	Manufacturing	Services
1999-00	4.6	23.9	17.5	8.7	17.5	7.8
2000-01	5.6	27.1	20.3	9.5	19.9	8.5
2001-02	5.9	27.0	20.4	11.2	21.3	8.7
2002-03	7.5	31.7	24.5	11.4	22.5	9.6
2003-04	9.7	38.8	30.5	12.4	21.4	9.7
2004-05	12.6	48.1	45.1	14.4	24.8	12.9
2005-06	15.1	55.9	61.6	15.2	22.4	15.8
2006-07	17.6	63.8	82.3	14.4	20.9	18.2
2007-08	21.0	74.3	112.0	12.3	17.8	18.9
2008-09	20.5	93.1	115.9	12.0	24.1	18.0
2009-10	16.2	98.2	98.8	8.1	23.9	12.5
2010-11	18.1	140.4	119.7	6.7	31.5	11.0
2011-12	16.5	164.9	122.9	5.1	42.4	10.5
2012-13	16.0	153.8	125.6	6.3	45.1	11.2
r	11.3	17.3	19.4	-4.0	5.4	3.4

r stands for average annual growth rates, calculated using semi-logarithmic regression
Source: Authors' estimation

Table 7: Total Export Related DVA and Employment Generated across Sector Groups

	Total DVA: $\sum dva_{i2}$ ($ Billion)			Total Employment: $\sum e_{i2}$ (Million)		
	Agriculture	Manufacturing	Services	Agriculture	Manufacturing	Services
1999-00	8.1	13.1	24.9	16.0	8.9	9.1
2000-01	9.4	15.2	28.4	16.9	11.2	9.8
2001-02	9.6	14.7	28.9	19.0	12.1	10.0
2002-03	11.9	17.1	34.7	19.6	12.7	11.3
2003-04	14.9	21.1	42.9	19.3	13.0	11.2
2004-05	19.5	26.1	60.1	23.6	14.0	14.6
2005-06	23.2	30.2	79.2	24.5	11.0	18.0
2006-07	26.9	34.8	102.0	23.0	10.1	20.4
2007-08	32.3	40.6	134.4	19.6	8.6	20.9
2008-09	33.4	50.3	145.7	22.7	10.6	20.9
2009-10	30.0	52.7	130.5	19.1	10.3	15.1
2010-11	39.8	73.9	164.5	22.2	13.9	13.2
2011-12	42.8	86.7	174.7	24.1	22.6	11.4
2012-13	42.9	81.6	171.0	26.6	24.1	11.9
r	14.9	16.9	18.9	2.7	4.0	3.1

r stands for average annual growth rates, calculated using semi-logarithmic regression
Source: Authors' estimation

Table 8: DVA and Employment Attributed to Backward Linkages of Exporting Sectors, Estimates for Sector Groups

	Indirect DVA: $\sum dva_{i1}^{bw}$ ($ Billion)			Indirect Employment: $\sum e_{i1}^{bw}$ (Million)		
	Agriculture	Manufacturing	Services	Agriculture	Manufacturing	Services
1999-00	0.8	15.4	5.1	0.6	10.5	3.0
2000-01	1.0	17.3	5.5	0.8	10.9	3.2
2001-02	1.0	17.3	5.6	0.8	11.2	3.4
2002-03	1.2	20.3	6.7	0.9	12.1	3.8
2003-04	1.4	24.4	8.2	0.8	11.3	3.9
2004-05	1.9	30.5	11.9	1.1	13.5	5.0
2005-06	2.3	35.6	15.5	1.2	14.1	5.5
2006-07	2.6	40.9	19.7	1.2	13.6	5.8
2007-08	3.1	48.0	26.2	1.1	11.9	5.5
2008-09	3.8	59.8	28.5	1.2	16.3	5.6
2009-10	3.6	62.9	26.5	0.9	16.0	4.4
2010-11	4.1	90.3	33.6	0.9	20.3	4.5
2011-12	4.2	105.2	35.3	0.9	23.2	4.8
2012-13	3.8	95.7	35.9	0.9	24.8	5.5
r	14.8	17.2	19.3	2.1	6.4	4.0

r stands for average annual growth rates, calculated using semi-logarithmic regression
Source: Authors' estimation

Table 9: DVA and Employment Attributed to Each Sector's Forward Linkages with All Exporting Sectors, Estimates for Sector Groups

	Indirect DVA: $\sum dva_{i2}^{fw}$ ($ Billion)			Indirect Employment: $\sum e_{i2}^{fw}$ (Million)		
	Agriculture	Manufacturing	Services	Agriculture	Manufacturing	Services
1999-00	4.2	4.6	12.5	7.9	1.9	4.3
2000-01	4.7	5.4	13.7	8.1	2.2	4.6
2001-02	4.7	5.1	14.2	8.6	2	4.8
2002-03	5.6	5.6	16.9	9	2.3	5.4
2003-04	6.6	6.8	20.7	7.7	2.9	5.5
2004-05	8.8	8.6	26.9	10.2	2.7	6.7
2005-06	10.4	9.9	33.1	10.4	2.7	7.7
2006-07	11.9	11.9	39.5	9.9	2.7	8
2007-08	14.4	14.2	48.6	8.4	2.6	7.5
2008-09	16.8	17.0	58.3	11.8	2.7	8.5
2009-10	17.4	17.3	58.2	11.9	2.4	7
2010-11	25.9	23.8	78.4	16.4	2.7	6.6
2011-12	30.5	27.0	87.1	19.9	3.4	5.7
2012-13	30.6	23.5	81.2	21.2	3.9	6.1
r	18.1	15.9	18.1	7.3	3.7	3.2

r stands for average annual growth rates, calculated using semi-logarithmic regression
Source: Authors' estimation

Table 10: DVA in Top Exporting Sectors (Sectors with Share in Gross Exports ≥ 1%)

Sectors	$\left(\frac{x_i}{\sum x_i}\right)$, %	$\left(\frac{dva_{i1}}{\sum dva_{i1}}\right)$, %			$\left(\frac{dva_{i1}}{x_i}\right)$			$\left(\frac{e_{i1}}{\sum e_{i1}}\right)$, %		
		2003-04	**2007-08**	**2012-13**	**2003-04**	**2007-08**	**2012-13**	**2003-04**	**2007-08**	**2012-13**
Agriculture										
Forestry & Logging	1.00	0.30	0.20	1.50	0.99	0.96	0.92	0.15	0.04	0.53
Manufacturing										
Petroleum	13.6	1.80	3.00	5.00	0.45	0.34	0.24	0.22	0.51	1.16
Gems & Jewelry	10.2	6.50	1.70	2.10	0.65	0.73	0.14	5.17	1.67	8.28
Misc. Food Prod.	4.2	2.70	1.20	6.10	0.91	0.91	0.93	6.07	3.19	16.51
Readymade Garments	3.9	8.30	4.90	5.00	0.87	0.85	0.82	14.54	7.72	16.25
Chemicals	3.6	2.90	2.50	3.10	0.79	0.71	0.56	0.91	1.34	0.32
Iron & Steel	3.5	3.20	3.30	3.60	0.78	0.72	0.68	1.04	1.35	1.41
Non-Elect Machinery	2.4	2.30	1.60	2.30	0.79	0.68	0.63	1.07	0.80	0.93
Drugs & Medicines	2.2	1.70	1.50	2.70	0.85	0.79	0.79	0.62	1.13	1.65
Motor Vehicles	2.2	1.30	1.20	2.10	0.83	0.71	0.64	0.77	0.87	1.56
Khadi & Cotton Textiles	2.1	2.00	1.60	2.80	0.89	0.87	0.88	3.37	3.94	7.10
Misc. Manufacturing	1.3	0.60	1.10	1.20	0.78	0.78	0.60	0.62	0.85	0.76
Plastic & Synthetic Fiber	1.1	1.30	1.00	1.00	0.77	0.70	0.58	0.53	0.63	0.33
Silk & Synthetic Fiber Textile	1.0	1.00	0.60	1.00	0.80	0.75	0.65	0.71	0.48	0.39
Services										
Computer Services	14.9	16.20	19.40	20.70	0.96	0.94	0.91	3.89	5.66	6.22
Business Services	12.5	1.50	8.20	15.90	0.91	0.83	0.83	1.29	7.20	8.56
Water Transport	1.5	0.20	2.10	1.40	0.86	0.81	0.62	0.05	0.84	0.68
Banking	1.4	0.40	0.00	2.00	0.98	0.00	0.92	0.07	0.00	0.63

$\left(\frac{x_i}{\sum x_i}\right)$ = share in gross exports; $\left(\frac{dva_{i1}}{\sum dva_{i1}}\right)$ = share of each sector in total export related DVA; $\left(\frac{dva_{i1}}{x_i}\right)$ = DVA to gross export ratio; $\left(\frac{e_{i1}}{\sum e_{i1}}\right)$ = DVA to gross export ratio. These indicators are measured using export data available in official IOT/SUT rather than the estimates based on interpolated shares. For the period under consideration, 2003-04 is the earliest year for which official export data are available as per IO classification while 2012-13 is the latest year. Source: Authors' estimation

Table 11: DVA in Fast Growing Export Sectors

Sectors	$\left(\frac{x_i}{\sum x_i}\right)$, %			$\left(\frac{dva_{i1}}{\sum dva_{i1}}\right)$, %			$\left(\frac{dva_{i1}}{x_i}\right)$			$\left(\frac{e_{i1}}{\sum e_{i1}}\right)$, %		
	2003-04	**2012-13**	**Percentage Point Change**	**2003-04**	**2012-13**	**Percentage Point Change**	**2003-04**	**2012-13**	**Percentage Point Change**	**2003-04**	**2012-13**	**Percentage Point Change**
Business Services	1.4	12.5	11.1	1.5	15.9	14.4	0.91	0.83	-0.08	1.3	8.6	7.3
Petroleum	3.4	13.6	10.3	1.8	5	3.2	0.45	0.24	-0.21	0.2	1.2	0.9
Gems & Jewelry	8.5	10.2	1.7	6.5	2.1	-4.4	0.65	0.14	-0.51	5.2	8.3	3.1
Misc. Food Prod.	2.5	4.2	1.7	2.7	6.1	3.4	0.91	0.93	0.02	6.1	16.5	10.4
Water Transport	0.1	1.5	1.3	0.2	1.4	1.2	0.86	0.62	-0.24	0.1	0.7	0.6
Banking	0.3	1.4	1.1	0.4	2	1.6	0.98	0.92	-0.06	0.1	0.6	0.6
Motor Vehicles	1.3	2.2	0.8	1.3	2.1	0.8	0.83	0.64	-0.19	0.8	1.6	0.8
Forestry & Logging	0.3	1	0.8	0.3	1.5	1.2	0.99	0.92	-0.07	0.2	0.5	0.4
Ships and Boats	0.1	0.8	0.7	0.1	1.1	1	0.57	0.84	0.27	0.1	0.4	0.3
Mis. Manufacturing	0.7	1.3	0.6	0.6	1.2	0.6	0.78	0.6	-0.18	0.6	0.8	0.1
Computer Services	14.3	14.9	0.6	16.2	20.7	4.5	0.96	0.91	-0.05	3.9	6.2	2.3
Air Transport	0.3	0.8	0.6	0.2	0.9	0.7	0.8	0.7	-0.1	0.1	0.3	0.2
Drugs & Medicines	1.7	2.2	0.6	1.7	2.7	1	0.85	0.79	-0.06	0.6	1.7	1.0
Chemicals	3.1	3.6	0.5	2.9	3.1	0.2	0.79	0.56	-0.23	0.9	0.3	-0.6

$\left(\frac{x_i}{\sum x_i}\right)$ = share in gross exports; $\left(\frac{dva_{i1}}{\sum dva_{i1}}\right)$ = share of each sector in total export related DVA; $\left(\frac{dva_{i1}}{x_i}\right)$ = DVA to gross export ratio; $\left(\frac{e_{i1}}{\sum e_{i1}}\right)$ = DVA to gross export ratio.Source: Authors' estimation

Table 12: Regression Results, 3SLS and Fixed Effects, Manufacturing Sectors

	3SLS			Fixed Effects
	(1)	(2)	(3)	(4)
Equation (5) Dep. Variable: $ln(x_{it})$				
$ln\left(\frac{dva_{i1}}{x_i}\right)_{t-1}$	-3.565***	-1.994***	-1.930***	-1.121***
	(0.164)	(0.119)	(0.0911)	(0.302)
$ln(wd_{it})$	0.333***	0.356***	-0.0167	0.0964**
	(0.0276)	(0.0505)	(0.0558)	(0.0441)
$ln(y_{it})$	0.520***	0.588***	0.144***	0.196*
	(0.0373)	(0.0339)	(0.0305)	(0.102)
$ln(rpo_{it})$	6.768	34.12***	1.150	-18.64**
	(13.58)	(6.715)	(6.519)	(8.125)
Constant	0.0898	-1.361	16.13***	12.59***
	(0.812)	(1.034)	(1.312)	(2.311)
Year Dummy (*D(t)*)	No	No	Yes	Yes
Industry Dummy (*J*)	No	Yes	Yes	-
Observations	726	726	726	1,073
R^2	0.474	0.899	0.924	0.404
Equation (6) Dependent Variable: $ln(dva_{i1t})$				
$ln(x_{it})$	0.803***	0.728***	0.624***	0.983***
	(0.0109)	(0.0131)	(0.0181)	(0.00344)
$ln(wd_{it})$	0.0623***	0.0600***	-0.00622	-0.00453
	(0.00754)	(0.0165)	(0.0209)	(0.00473)
$ln(gva_{it})$	0.0995***	0.143***	0.0942***	0.0618***
	(0.00945)	(0.0133)	(0.0122)	(0.0117)
$ln(rpv_{it})$	-0.00187	3.830***	0.0910	1.708**
	(1.824)	(1.443)	(1.737)	(0.793)
Constant	0.244	1.062***	5.340***	-1.042***
	(0.163)	(0.287)	(0.581)	(0.247)
Year Dummy (*D(t)*)	No	No	Yes	Yes
Industry Dummy (*J*)	No	Yes	Yes	-
Observations	726	726	726	1,164
R^2	0.972	0.991	0.986	0.992
Equation (7) Dependent Variable: $ln(e_{i1t})$				
$ln(dva_{i1t})$	0.916***	0.621***	0.628***	1.011***
	(0.0163)	(0.0308)	(0.106)	(0.0204)
$ln(rw_{it})$	-0.356***	-0.172***	-0.264***	-0.168***
	(0.0345)	(0.0297)	(0.0608)	(0.0562)
$ln(gva_{idt})$	0.0192***	0.00288	0.00461	0.0138***

	(0.00428)	(0.00350)	(0.00516)	(0.00349)
$\boldsymbol{ln(l_{it})}$	0.418***	0.400***	0.438***	0.379***
	(0.0138)	(0.0204)	(0.0247)	(0.0222)
Constant	-7.797***	-0.721	-1.064	-9.255***
	(0.347)	(0.656)	(2.058)	(0.408)
Year Dummy (*D(t)*)	No	No	Yes	Yes
Industry Dummy (*J*)	No	Yes	Yes	-
Observations	726	726	726	781
R^2	0.903	0.963	0.964	0.829

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 13: Regression Results, 3SLS and Fixed Effects, All Sectors

	3SLS			Fixed Effects
	(1)	(2)	(3)	(4)
Equation (5) Dep. Variable: $\boldsymbol{ln(x_{it})}$				
$\boldsymbol{ln\left(\frac{dva_{i1}}{x_i}\right)_{t-1}}$	-6.722***	-3.147***	-3.228***	-1.164***
	(0.186)	(0.129)	(0.117)	(0.308)
$\boldsymbol{ln(y_{it})}$	0.585***	0.546***	0.152***	0.262***
	(0.0288)	(0.0371)	(0.0390)	(0.0988)
$\boldsymbol{ln(rpo_{it})}$	27.24***	13.38***	-9.618*	-11.36
	(9.978)	(4.682)	(5.056)	(7.160)
Constant	4.642***	6.765***	16.18***	13.11***
	(0.678)	(0.899)	(0.946)	(2.137)
Year Dummy (*D(t)*)	No	No	Yes	Yes
Industry Dummy (*J*)	No	Yes	Yes	-
Observations	1,242	1,242	1,242	1,247
R^2	0.266	0.852	0.870	0.409
Equation (6) Dependent Variable: $\boldsymbol{ln(dva_{i1t})}$				
$\boldsymbol{ln(x_{it})}$	0.884***	0.794***	0.754***	0.984***
	(0.00371)	(0.00960)	(0.0117)	(0.00288)
$\boldsymbol{ln(gva_{it})}$	0.0678***	0.0979***	0.0631***	0.0618***
	(0.00377)	(0.0106)	(0.00911)	(0.0104)
$\boldsymbol{ln(rpv_{it})}$	1.866*	1.354	-3.107***	0.888
	(1.097)	(0.962)	(1.095)	(0.650)
Constant	0.590***	1.811***	3.410***	-1.152***
	(0.0862)	(0.170)	(0.318)	(0.219)
Year Dummy (*D(t)*)	No	No	Yes	Yes
Industry Dummy (*J*)	No	Yes	Yes	-
Observations	1,242	1,242	1,242	1,355

R^2	0.988	0.993	0.991	0.994
Equation (7) Dependent Variable: : $\boldsymbol{ln(e_{i1t})}$				
$\boldsymbol{ln(dva_{i1t})}$	0.936***	0.648***	0.894***	1.027***
	(0.0114)	(0.0181)	(0.0836)	(0.00912)
$\boldsymbol{ln(gva_{idt})}$	0.00688**	0.00363	0.0102**	0.0136***
	(0.00315)	(0.00277)	(0.00516)	(0.00262)
$\boldsymbol{ln(l_{it})}$	0.530***	0.525***	0.548***	0.530***
	(0.0103)	(0.0142)	(0.0133)	(0.0144)
Constant	-8.523***	-1.988***	-7.227***	-10.20***
	(0.248)	(0.457)	(1.734)	(0.193)
Year Dummy (*D(t)*)	No	No	Yes	Yes
Industry Dummy (*J*)	No	Yes	Yes	-
Observations	1,242	1,242	1,242	1,348
R^2	0.939	0.965	0.984	0.927

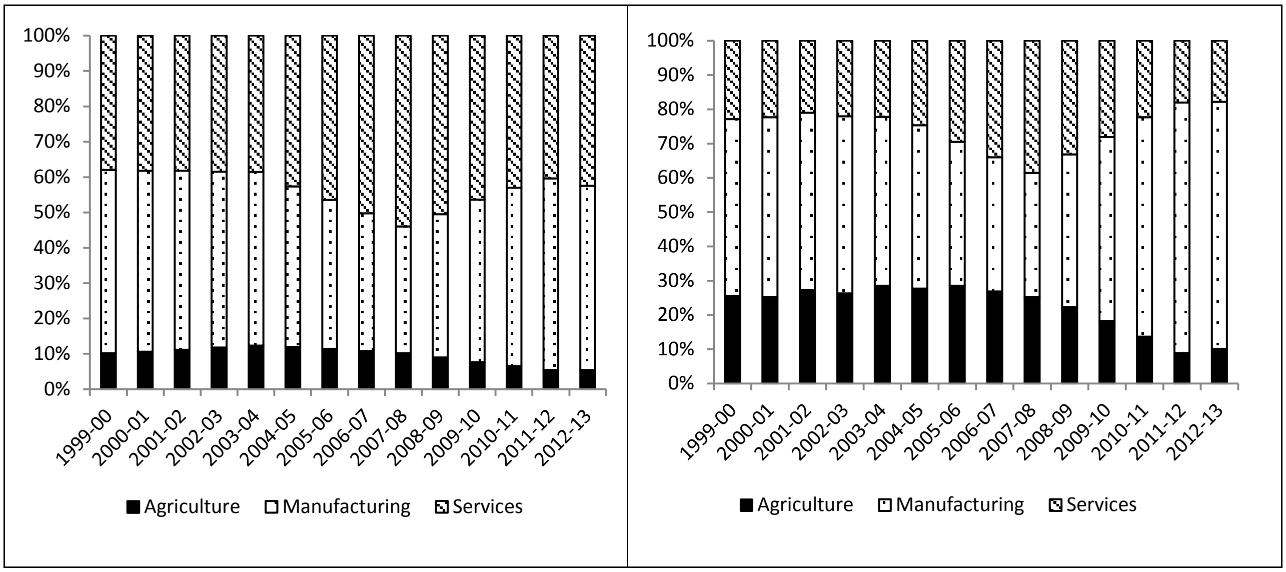
Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Figures

Figure 1: Composition of Total DVA and Employment across Sector Groups

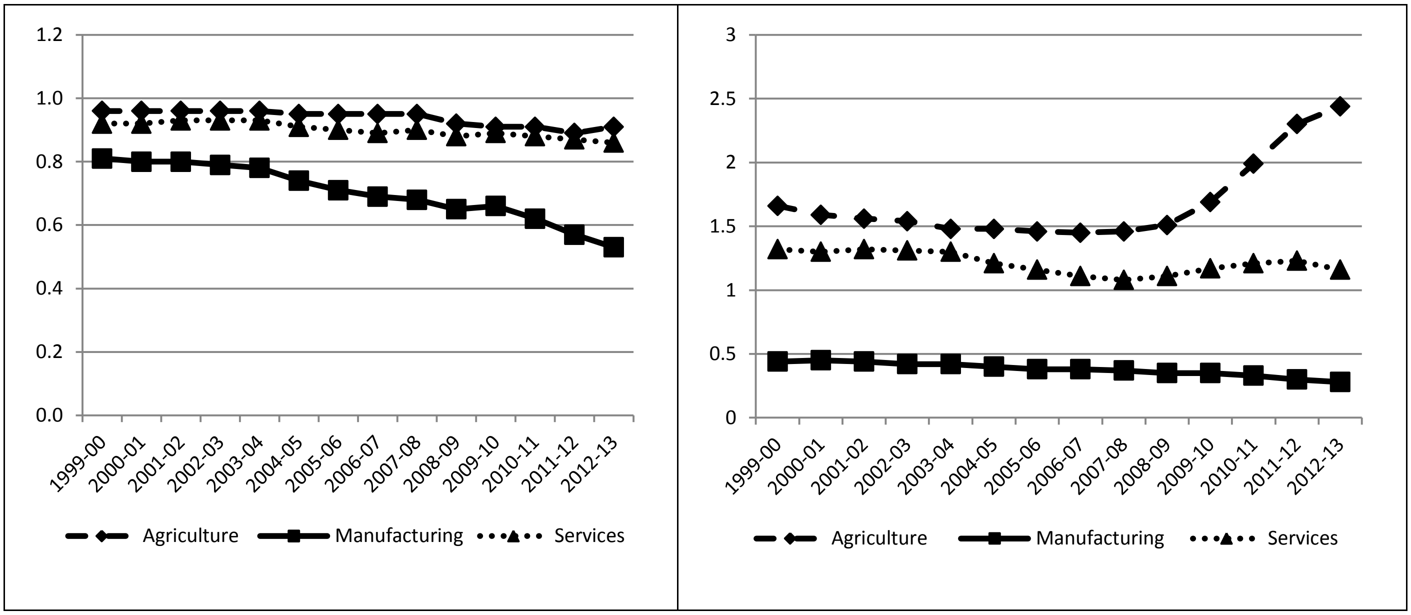
(a) Total DVA ($\sum dva_{i1}$) (b) Total Employment ($\sum e_{i1}$)



Source: Authors' estimation

Figure 2: DVA to Gross Export Ratio

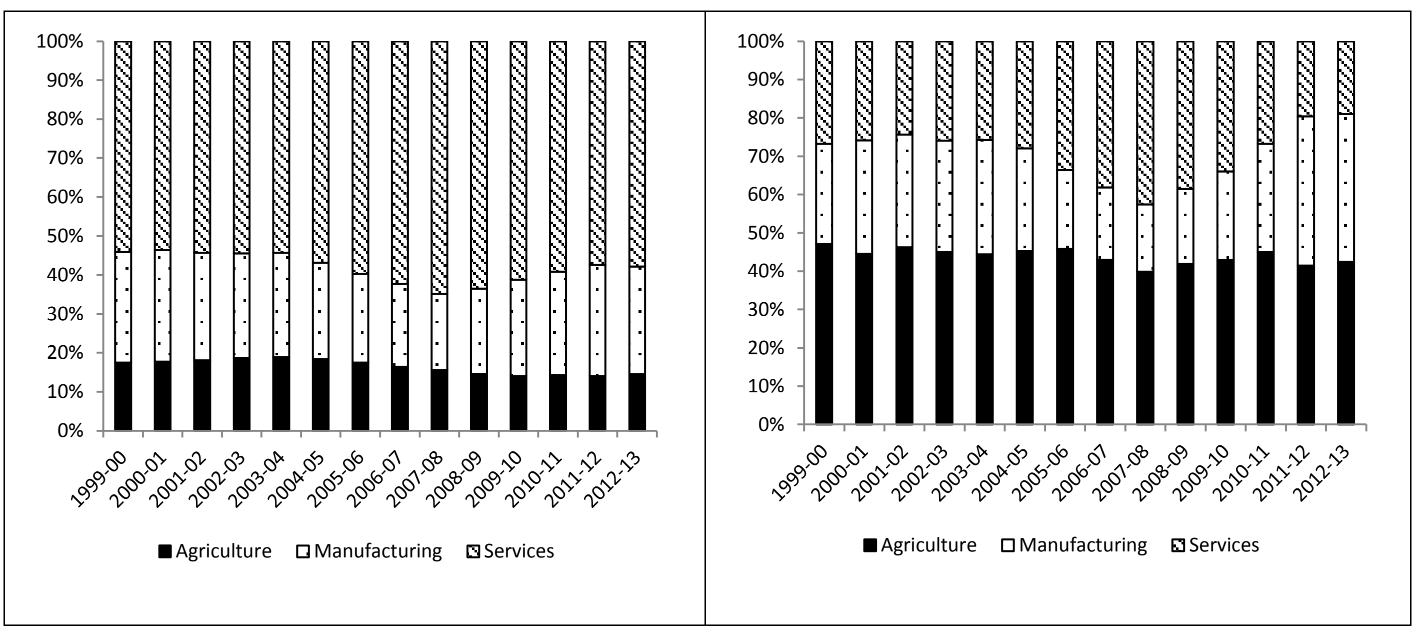
(a) Ratio of $\sum dva_{i1}$ to Gross Exports (b) Ratio of $\sum dva_{i2}$ to Gross Exports



Source: Authors' estimation

Figure 3: Distribution of Export Related Total DVA and Total Employment across Sector Groups

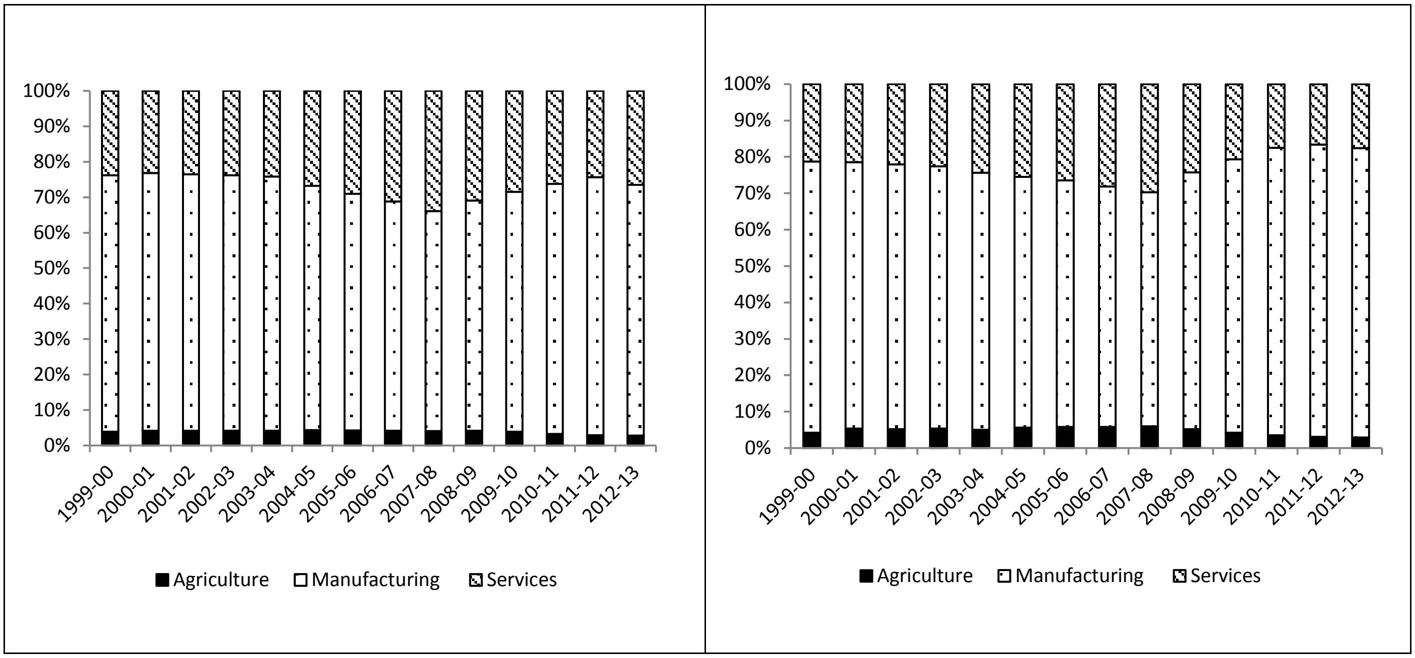
(a) Total DVA ($\sum dva_{i2}$) (b) Total Employment ($\sum e_{i2}$)



Source: Authors' estimation

Figure 4: Composition of DVA and employment attributed to backward linkages of exporting sector

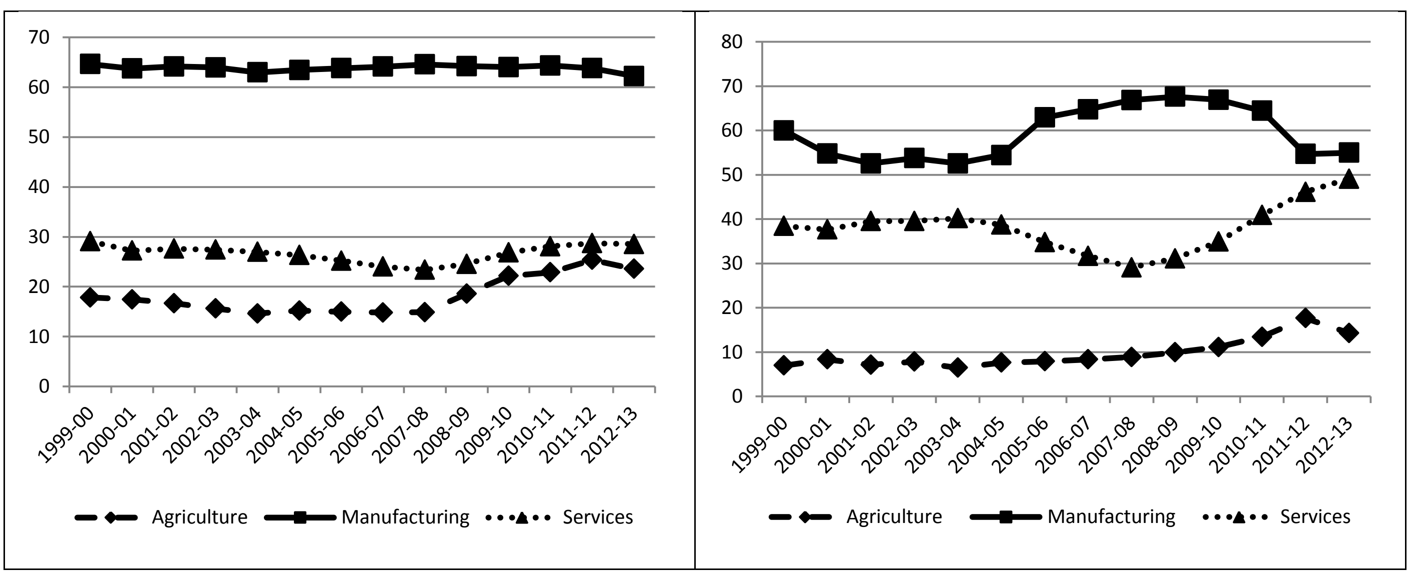
(a) Indirect DVA ($\sum dva_{i1}^{bw}$) (b) Indirect employment ($\sum e_{i1}^{bw}$)



Source: Authors' estimation

Figure 5: DVA and Employment attributed to Backward Linkages as a Share of Total DVA and Employment Generated by Exports from Each Sector Group

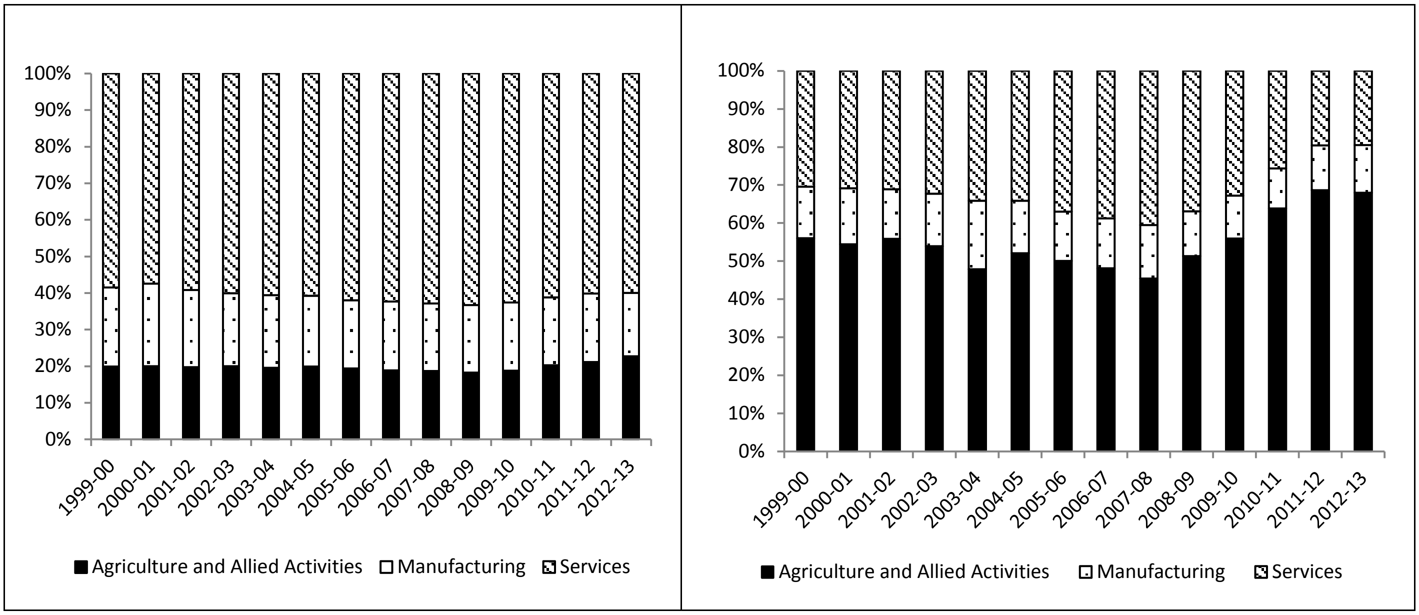
(a) Share of $\sum dva_{i1}^{bw}$ in $\sum dva_{i1}$ (%) (b) Share of $\sum e_{i1}^{bw}$ in $\sum e_{i1}$ (%)



Source: Authors' estimation

Figure 6: Composition of DVA and Employment Attributed to Each Sector's Forward Linkages with All Exporting Sectors

(a) Indirect DVA ($\sum dva_{i2}^{fw}$) (b) Indirect Employment ($\sum e_{i2}^{fw}$)



Source: Authors' estimation

Figure 7: DVA and Employment attributed to Forward Linkages as a Share of Total Export Related DVA and Employment in Each Sector Group

(a) Share of $\sum dva_{i2}^{fw}$ in $\sum dva_{i2}$ (%) (b) Share of $\sum e_{i2}^{fw}$ in $\sum e_{i2}$ (%)

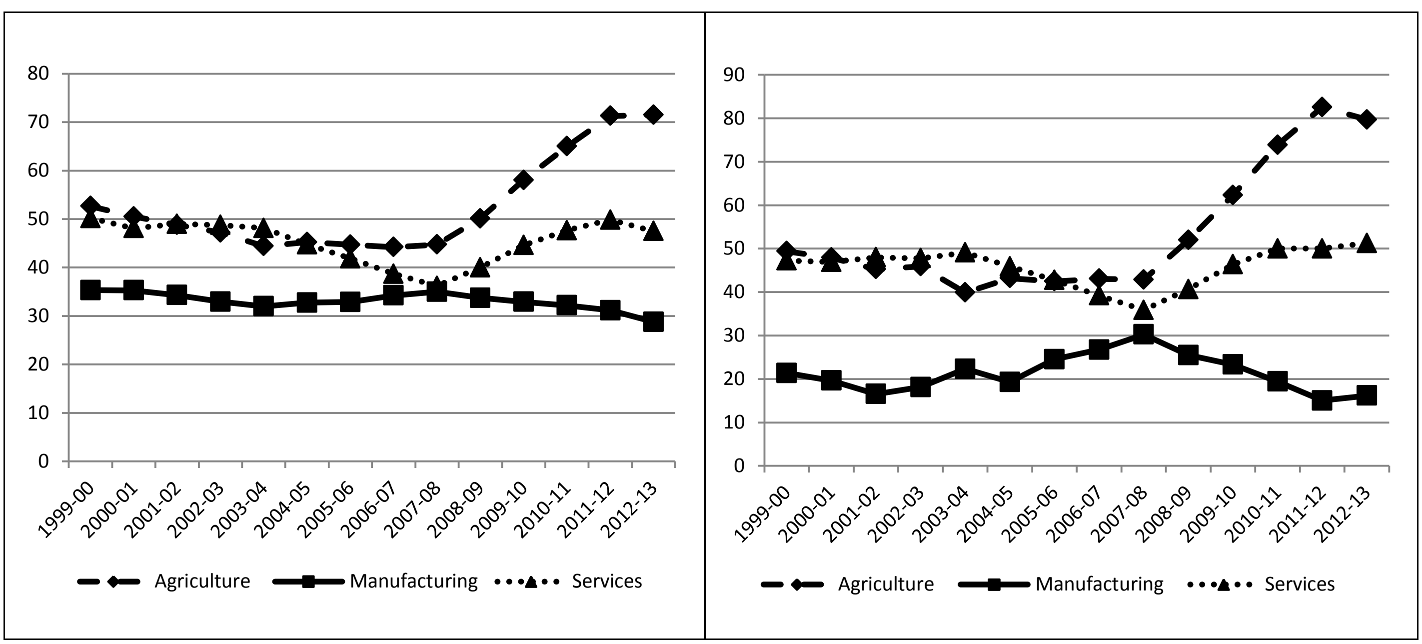


Figure 8: Correlation between percentage point change in export share, DVA share, and employment share (between 2003-04 and 2012-13)

(a) Export (x_i) share and DVA (dva_{i1}) share (b) DVA (dva_{i1}) share and employment (e_{i1}) share

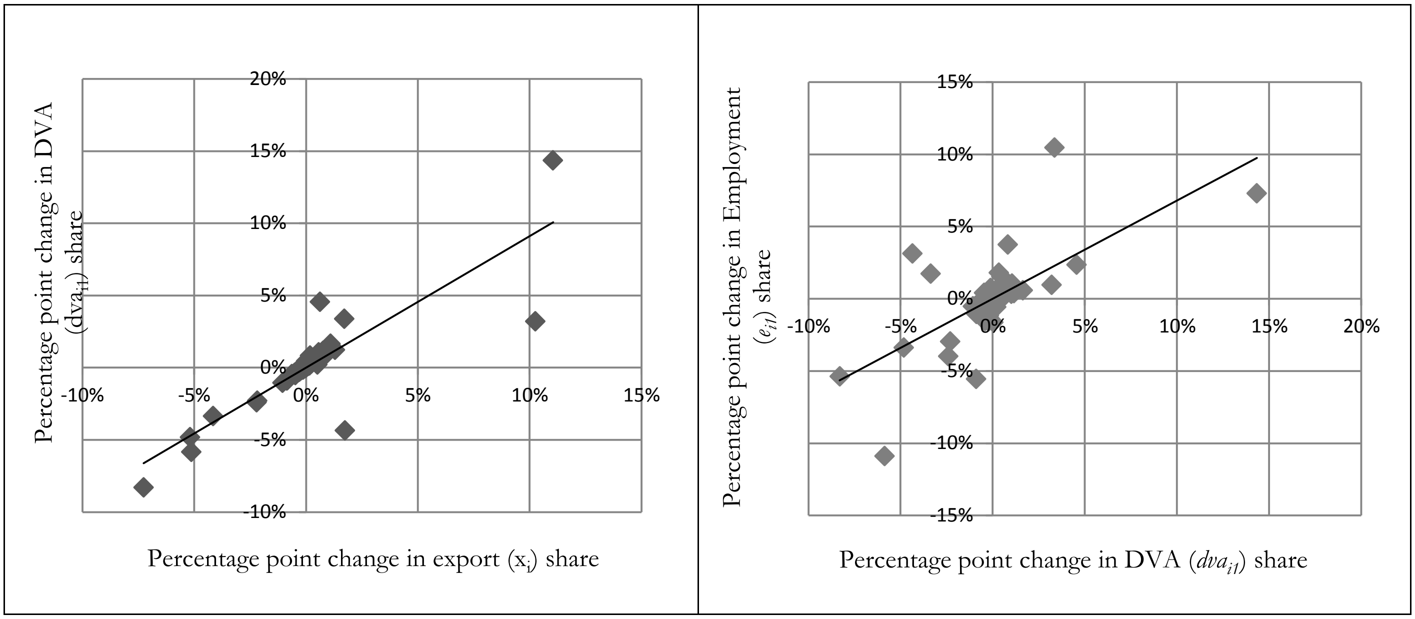
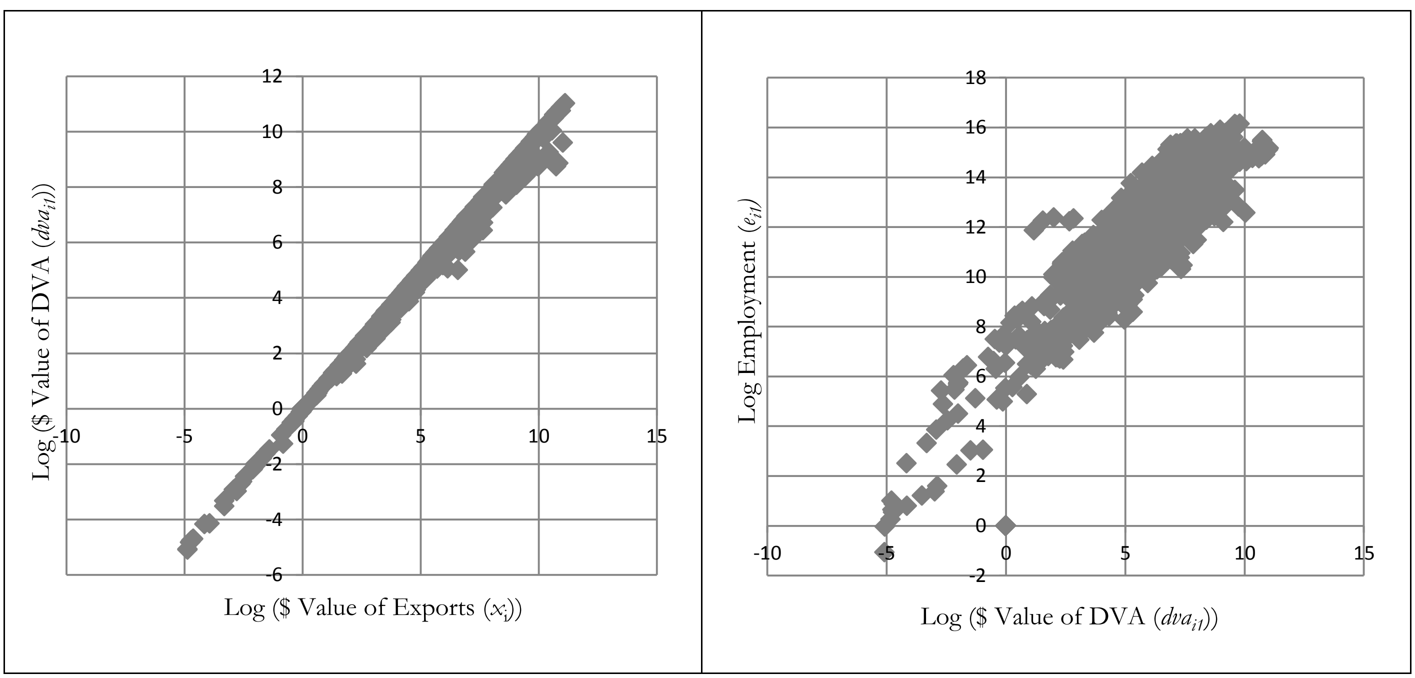


Figure 9: Correlation between the absolute values of gross export, DVA and employment, 1999-00 to 2012-13

(a) \$ Values of Export (x_i) and DVA (dva_{i1}) (b) \$ Values of DVA and No of Employment



Appendix A1: Construction of Annual DUT

In India, the Central Statistics Office (CSO), under the Ministry of Statistics and Program Implementation, has been compiling and publishing IOT. So far, IOT have been prepared for the years 1968-69, 1973-74, 1978-79, 1983-84, 1989-90, 1993-94, 1998-99, 2003-04 and 2007-08. The tables consisted of 115 sectors since 1973-74 till 1998-99. The IOTs for 2003-04 and 2007-08 contained 130 sectors. In addition to IOT, this study makes use of the recently published SUT for the years 2011-12 and 2012-13[20].

Looking across the rows in the absorption matrix of IOT, we can observe how the output of each product *i* (y_i) is used for intermediate consumption by the various industries *j* and for the final demand purposes (i.e., for private consumption, government consumption, investment and exports). Each column records a given sector *j's* purchase of inputs from each sector *i* for producing the output of sector *j* (y_j). Sector *j's* purchase of inputs represents total flows – that is, without separating domestically sourced inputs from imported inputs. Let z_{ij} denote the intermediate use of product *i* by industry *j*, F_i denote the final use of product *i* and m_i denote total import of product *i* for intermediate and final use. Note that F_i includes exports from sector *i* (x_i) along with final household consumption, government consumption and investment by firms. Assuming that there are *n* sectors in an economy, the gross value of output of each product *i* (y_{it}) can be obtained by subtracting the value of imports from the sum of all row entries (i.e., the sum of all z_{ij} and F_i in a given row). This can be expressed for year *t* as follows:

$$\boldsymbol{y_{it} = z_{i1t} + z_{i2t} + \ldots + z_{iit} + \ldots + z_{int} + F_{it} - m_{it}} \qquad \text{(A.1)}$$

Similarly, by the supply perspective, the output of each product *j* (y_{jt}) can be obtained by summing the column entries – that is, the sum of the value of all input purchases and value added in sector *j*:

$$\boldsymbol{y_{jt} = z_{1jt} + z_{2jt} + \ldots + z_{jjt} + \ldots + z_{njt} + t_{jt} + v_{jt}} \qquad \text{(A.2)}$$

Where t_{jt} stands for net indirect taxes and v_{jt} stands for value added, defined as payments made for labor and capital.

[20] The SUT are not available for previous years. A major difference between IOT and SUT is that the former contains equal number of rows and columns (square matrix) while the number of rows exceeds the number of columns in SUT. The sectors represented by SUT columns are more aggregated than the sectors represented by SUT rows.

Our major task is to construct DUT for the years for which official IOT are not available. To this end, using available official IOT, we calculate the ratio of intermediate use to total availability (imports plus industry output) for each sector *i* and year *t*. This ratio (r_{it}) is defined as:

$$\boldsymbol{r_{it} = IIUSE_{it}/(y_{it} + m_{it})} \quad \text{(A.3)}$$

where $IIUSE_{it}$ stands for total intermediate use of sector *i*'s output for year *t* (i.e., the sum of all z_{ij}'s in equation A.1 for a given sector *i* and for a given year *t*); *y* is gross value of output and *m* is imports[21]. We compute this ratio for 112 sectors and for the years for which official IOT and SUT are available (i.e., 1998-99, 2003-04 and 2007-08, 2011-12 and 2012-13). For the intervening years, we obtain the ratios by linear interpolation. Using these ratios, we obtain total domestic use ($DIIUSE_{it}$) – that is, the total amount of a given sector's gross value of output used by other sectors for year *t*.

$$\boldsymbol{DIIUSE_{it} = r_{it} \times y_{it}} \quad \text{(A.4)}$$

Next, we distribute the value of $DIIUSE_{it}$ across cells within a row on the basis of the share of each sector *j* in the total intermediate use of sector *i*'s output – that is, by using the following identities for each sector *i*[22].

$$\boldsymbol{1 = \frac{z_{i1t}}{IIUSE_{it}} + \frac{z_{i2t}}{IIUSE_{it}} + \ldots + \frac{z_{iit}}{IIUSE_{it}} + \ldots \frac{z_{int}}{IIUSE_{it}}} \quad \text{(A.5)}$$

Using 112×112 absorption matrices, we compute the ratios in (A.5) for years 1998-99, 2003-04, 2007-08, 2011-12 and 2012-13. The ratios thus obtained have been interpolated for the intervening years. Using these shares and *DIIUSEit* values, we obtain the annual time series of DUT for the period 1999-00 to 2012-13. Having obtained the DUT, we are now in a position to estimate the domestic technical coefficient matrix $(\boldsymbol{A^d})$ needed for computing the DVA and employment supported by exports. The elements of the $\boldsymbol{A^d}$ matrix (denoted as a_{ijt}) measure the amount of domestic input from sector *i* required to produce one unit of output in sector *j*.

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[21] For calculating this ratio, we have made appropriate adjustments for the Change in Stocks (CIS). Whenever CIS is negative we have proportionately subtracted CIS value from IIUSE on the basis of percentage shares of IIUSE in total (final plus intermediate) use. Note that output (y_{it}) values in IOT are already net of CIS whenever CIS is negative

[22] Note that $DIIUSE_{it}$ does not include imported intermediates. Total imported intermediate use $MIIUSE_{it}$ can be obtained in an analogous manner: $MIIUSE_{it} = r_{it} \times m_{it}$. By summing the two, we get total use: $IIUSE_{it} = DIIUSE_{it} + MIIUSE_{it}$

Appendix A2: Database

The IOT for 1998-99 contains 115 sectors while that for 2003-04 and 2007-08 include 130 sectors. We have used a concordance table prepared by the CSO (available in CSO's website) for matching the sector descriptions in 1998-99 IOT with those in 2003-04[23]. In order to obtain a consistent time series data on domestic use, it was necessary to club some of the sectors in official IOT. The final domestic use tables that we have constructed contain 112 sectors [see Veeramani and Dhir (2017a) and EXIM Bank (2016) for the list of the sectors]. As noted earlier, unlike IOTs, the SUTs are not available as square matrices: the SUTs for the years 2011-12 and 2012-13 contain 140 rows and 66 columns. We have converted them into square matrices (with 112 rows and columns) by splitting 66 SUT columns and by aggregating 140 SUT rows[24].

For constructing the domestic use tables for intervening years, we need time series data on gross value of output (y_{it}), and imports (m_{it}) for 112 sectors. Further, we need data sector wise time series on gross value added (to compute value added to output ratio, v), employment (to compute labor to output ratios, l) and exports (x).

(i) *Gross Value of Output and Gross Value Added*

The statistical sources for constructing sector wise time series data on gross value of output (y) and gross value added (GVA) at current prices are: National Accounts Statistics (NAS), Annual Survey of Industries (ASI) and NSSO unorganized sector surveys. The data used for the purpose correspond to the 2004-05 series for the whole period[25]. For manufacturing industries, time series on y and GVA is obtained by adding the values for registered and unregistered segments. We used the ASI plant level data for registered manufacturing sector and the NSSO surveys for unregistered manufacturing sector. Using these two sources, we obtain output and value added data at the 5-digit

[23] Some of the aggregate sectors in 1998-99 IOT have to be split into subcategories based on their percentage shares (as per IOT for 2003-04) within each of the aggregate sectors.

[24] Each of the 66 columns in SUT has been split into subcategories using a concordance table between our 112 sectors and 66 broad groups. The z_{ij} values at the broad group level have been split on the basis of the percentage shares (as per IOT for 2007-08) of sub categories within each broad group. Similarly, the 140 SUT rows have been aggregated and converted to 112 sector rows using a concordance table.

[25] For the period 1999-2000 to 2003-04, we used NAS back series which provide output and value added data for this period as per 2004-05 base year. Note that the output and value added values in official IOT for the year 2003-04 are as per 1999-00 base year and those in SUTs for 2011-12 and 2012-13 are according to 2011- 12 base year. We have converted the sectoral output and value added values in these tables as per the 2004-05 series by distributing aggregate output and value added values (as per 2004-05 series) using the percentage shares of IO sectors in total output and total GVA. The values in 2007-08 IOT are already as per 2004-05 series.

NIC (National Industrial Classification) level for the period 1999-2000 to 2012-13. Using concordance tables between NIC and IOT classification, data at the 5-digit level have been aggregated to obtain y and GVA for 112 sectors[26].

While the ASI plant level data is available for all years of the study period, the NSSO surveys for registered sector were available only for 1999-00 (55th round), 2000-01 (56th round), 2005-06 (62nd round) and 2010-11 (67th round). For these years, we obtain the percentage distribution of output and value added at the 5-digit NIC level. The NAS, however, provides the annual break-up of output and value added for about 21 broad industry groups, with the corresponding NIC codes, for unregistered manufacturing sector. Having identified the 5-digit NIC codes corresponding to each of the broad industry groups for which data are available in NAS, we split the NAS value of output and value added for each of the 21 industry groups based on the percentage distribution at the 5-digit level. The above procedures ensure that the aggregate value of output and GVA for the manufacturing sector in our database is identical to those reported in NAS.

The NAS disaggregated statements provide detailed product level data on gross value of output for primary sectors, construction and railways. For the rest of the sectors, however, the NAS provides only gross value added (GVA) but not value of output. In the case of these sectors, estimates of gross output were derived by applying output to value added ratios obtained from the available official IOT and SUT. The GVA to output ratios obtained for these years were then linearly interpolated for the intervening years.

We validate our estimates of gross value of output and GVA with the corresponding values available in the official IOT. At the aggregate level, our estimates match exactly with the corresponding values in IOT. However, we notice certain discrepancy for some of the individual sectors, due to the fact that the concordance tables that we have used to obtain output values at the IO sector level may not match exactly with the ones used by the CSO for preparing the IOT. As discussed in detail in Veeramani and Dhir (2017a) and EXIM Bank (2016), we adopted certain reclassification procedures which ensured that any sector level mismatches with official IOT were below 1%.

[26] The NIC, used for reporting industrial production data, had undergone two revisions during the study period: NIC 1998 was used until 2003-04, followed by NIC 2004 until 2007-08 and NIC 2008 thereafter. We have prepared concordance tables to match the 112 sectoral classifications in our domestic use tables with the 5-digit codes in each version of the NIC.

(*ii*) *Exports and Imports*

Trade data came from Directorate General of Commercial Intelligence and Statistics (DGCI&S) for merchandise and from the Reserve Bank of India (RBI) for services. Aggregating merchandise and services data from the two sources gives total export (and import) which matches exactly with the data reported in official IOTs for the benchmark years. The percentage share of each of the 112 sectors in total exports has been computed using the IOT for the benchmark years 1998-99, 2003-04, 2007-08 and SUT for 2011-12 and 2012-13. Shares for the intervening years have been obtained through linear interpolation. Using these shares, we have distributed the aggregate value of exports and imports for the 112 sectors[27].

(*iii*) *Employment*

We use unit level data from various rounds of Employment and Unemployment Surveys (EUS) by NSSO for estimating employment by sector. The study has used the unit-level data provided in the 55th (1999-2000), 60th (2003-2004), 61st (2004-05), 62nd (2005-2006), 64th (2007-2008), 66th (2009-2010) and 68th (2011-12) rounds of EUS. We use the measure based on usual principal and subsidiary status (UPSS), which is the commonly used measure for tracking employment trends.

Using the unit level data, we obtained estimates at the 5-digit level of NIC for the years mentioned above. Next, we linearly interpolated the percentage shares of employment at the 5-digit level for the intervening years. Using 56th through 59th rounds of NSSO surveys on "Household Consumption Expenditure and Employment-Unemployment Situation in India", we obtained employment data at the 2-digit NIC level for the period 2000-01 to 2003-04. We split the employment numbers for each of the 2-digit NIC industry group based on the percentage distribution at the 5-digit NIC level. For the remaining years (2006-07, 2008-09, 2010-11 and 2012-13) estimates of aggregate employment, obtained through linear interpolation and extrapolation, were split based on percentage shares at the

[27]In order to obtain the sectoral values of exports and imports, we experimented with an alternative approach using a concordance table that we have prepared between 6-digit codes of Harmonized System (HS) and our 112 I-O sector classification. Using this concordance table, we estimated sector-wise merchandise export and import data for the corresponding non-service IOT sectors. However, for the majority of the non-service sectors, we noticed that our estimates were significantly higher than the corresponding values in the IOT. Given that our aggregate data (merchandise plus services) matches exactly with IOT aggregate (merchandise plus services), the mismatch that we observe for non-service sectors may imply that some portion of merchandise trade could have been assigned to services sectors while preparing the official IOT. Due to these issues, we did not follow this approach for obtaining sectoral values of exports and imports.

5-digit NIC level. Thus, we obtain the estimates of employment at the 5-digit level for the entire period. Using a concordance table between NIC 5-digit codes and our 112 sector classification, we obtain the time series of sector-wise employment for the period 1999-2000 to 2012-13. Finally, matching employment data with output at the sector level, we obtain the time series estimate of employment coefficients for 112 sectors.

Table A2: Description of Variables

Variable Name	Variable Description	Variable Computation	Formula	Data Source	Remarks
World Demand (*wd_i*)	This variable captures the world demand for each IO product category	WD is the weighted average of total imports (in US dollars) in a given sector by rest of the world from all countries other than India. Weights used are the shares of each country j in India's total exports of given IO product category. Rest of the world includes 96 countries that have consistently reported import data for each year from 1999 to 2012	$wd_i = \sum_{r=1}^{96} w_r^i m_r^i$ where m_r^i stands for imports of sector *i* by each of the 96 countries from world (excluding India); w_r^i is the weight given as the share of *r* in India's total exports of sector *i*.	UN-COMTRADE WITS database according to 6-digit HS 1996 classification. A concordance table is used to identify the HS codes corresponding to each IO category.	This variable could not be constructed for sectors corresponding to services as trade data for services sector are not available at the required level of disaggregation.
Relative Prices rpo_i (rpv_i)	RPO (RPV) is exchange rate adjusted relative price measured using sector specific output (value added) deflators.	It is computed as the ratio of India's price deflator to the price deflator of United States for each IO category. This ratio is then adjusted by the dollar per rupee nominal exchange rate prevailing in that particular year	$rpo_i = \frac{India's\ output\ deflator_i}{US\ output\ deflator_i} \times e_{\$\ to\ Rupee}$ $e_{\$\ to\ Rupee}$ stands for nominal exchange rate between US dollar and Indian rupee in year t. *rpv* is computed in analogous manner using value added deflator.	Data for US Price Deflator is taken from U.S. Bureau of Economic Analysis, https://www.bea.gov/industry/gdpbyind_data.htm Data for India's Price deflator is collected from National Account Statistics; Data for exchange rate is taken from World Bank, World Development Indicators	
Gross Value of Output and Gross Value added y_i (gva_i)	Output and value added for each IO category in US $			National Accounts Statistics, Annual Survey of Industries and unorganized sector surveys of NSSO	Refer Appendix A2 for details

Real wage rate (rw_i)	Output deflated Wage Rate	Wage Rate is computed as the ratio of wages and mandays. The wage rate thus obtained is indexed by taking 2004 as the base year. Output deflator is then used to obtain real wage rate index	$rw_{it} = \frac{(Wage\ Rate_{it}/Wage\ Rate_{i,2004})}{Output\ deflator_{it}}$	Annual Survey of Industries (ASI) Data	Computed only for manufacturing sectors