Changing Pattern of Global Production Process: An Analysis of Indian Manufacturing Industries

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Abstract

Innovation in the field of 'information and communication technology' (ICT) and 'transportation' has changed the pace of 'globalization' massively over the recent years. The waning borders has made the 'production process' fragmented spanning different parts of the world. The 'production function' has assumed an international character. The indigenous 'endowment of resources' are no longer be considered as 'sole' determining factor of 'production' and 'international trade'. These issues are being increasingly dealt within the literature concerning 'global value chains' (GVCs). The major issues concerning GVC are the share and nature of participation of different entities- countries, industries and firms in global value chains that could lead to their respective growth and sustainable development. In this context, the aim of the present study is to examine the nature and share of Indian manufacturing industries in GVC. Specifically, the objectives are to examine (i) how much different Indian manufacturing industries are contributing in GVC? (ii) To compare the share of High-technology (HT) intensive industries and Low-Technology (LT) intensive industries from India in GVC and (iii) to determine the factors contributing to the global value generation emanating from Indian manufacturing industries.

Based upon the 'Trade in Value-Added' (TiVA) and 'World Input-Output Data' (WIOD) data-base, along with the other secondary data-bases for Indian manufacturing industries, the descriptive analysis show that (i) the contribution of Indian manufacturing industries to GVC has increased over the years, although the rate of increase is somewhat lower than other developing countries (ii) the share of Indian High technology (HT) industries were relatively more than that of the Low-Technology (LT) intensive industries.

Next, System GMM method was used to examine the factors determining the participation of Indian manufacturing industry to GVC. It was found that for all the industries, the impact of 'medium-skilled' labour and 'forward linkage' were dominant factors determining their

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participation in GVC. For HT industries, the ‘high-skilled’ labour rather than ‘investment in R&D’ and ‘royalty’ payments played an important part in determining the extent of ‘domestic value-added in exports’ emanating from Indian manufacturing industries. But for LT industries, factors like ‘medium-skilled’ labour along with ‘forward’ and ‘backward’ linkages were the dominant factor.

Thus, the paper concludes that in order to increase the share of Indian manufacturing industries in GVC, emphasis should be made to (i) increase the share of medium and high skilled labour force in place of low-skilled labour force trough ‘targeted’ policy perspective for enhancing skills; (ii) more emphasis should be directed to enhance the participation in both forward and backward linkages that could lead to an increase in value-generation in the process.

Keywords: Global Value Chains, Indian Manufacturing Industries, Forward and Backward Linkages, R&D, System Generalized Method of Moment (GMM).

I. Introduction

‘Integration’ for the mutual benefit of all nation states is an argument hard pressed since the Classical era of Adam Smith. The advancement in transport and communication technology (ICT) has mitigated the virtual boundaries massively during the past few decades. The contrary discourse regarding ‘integrated economies’ has a deep divide with limited over-lapping ideologies. However, ‘integration’ of economies also reflects many meanings and scholars have great apprehension for its various characteristics. From the broad concept of ‘globalization’ on the one hand to the ‘integration at a piecemeal basis’ on the other, entails an array of combinational features depicted different meanings and connotations. ‘Globalization’ is utopian that entails features in which ‘markets for goods, services, and factors of production are perfectly integrated’ (Rodrik, 2000). But the ‘increasing’ ‘integration’ over the years has transformed various things including the pattern and structure of production of goods and services. Presently, ‘production function’ is segregated across nations with fragmented chains that entails the change in the structure of ‘trade’, ‘technology’, ‘knowledge flows’ and ‘capital – both human and non-human’ etc. These changes in the pattern of ‘production’ along with ‘international trade’ has attracted the attention of scholars, that lead to the emergence of a new set of literature under the aegis of ‘Global Value Chains’ (GVC). Initially termed as ‘Global

Commodity Chains' (GCC), the scope was broadened from the concern for 'commodity' to a large concern for 'value addition' in 'Global Value Chains' (Gereffi et al, 2005).

Thus, the entities from micro level (firm) to macro levels (industry, country) of different developed and developing countries are increasingly concerned about entering the 'Global Value Networks'. The pattern however, depends largely upon the bargaining strength of 'lead firms', the quantum and magnitude of 'technology accumulation', the cost of production, availability and quality of human and non-human resources (Gereffi et.al, 2005; Sturgeon, 2001). Subsequently, during the last decade, literature started emerging that shows the changing structure of 'value' generation across countries. It was found that the share of 'value added' from developing countries started swelling, reflected the concerns for developed countries. It has been argued that the cheap labor from the developing countries of the South is taking up the jobs from developed countries[2]. On the other hand, the developing South are concerned about the transfer of 'redundant unskilled jobs', environment issues and excessive use of resources.

But amidst all the alternative concerns, the idea of the present paper is to examine the Indian manufacturing industries from the perspective of GVC. The basic objective of the paper is to examine the structure of 'value- generation' in Indian manufacturing industries. Specifically, the paper aim to examine that (i) In which industries do Indian manufacturing is contributing more 'value'? (ii) To examine the factors those are leading Indian firms to generate more 'value' for the Global Value Chains.

The structure of the paper is as follows. In section II, the various aspects related to GVC as discussed in the literature is presented. Section III, present the rationale of database used. Section III, present the broad pattern of value-added generated from different Indian manufacturing industries. Section IV present the analysis and discussion related to the determinants of value added using the firm-level data. Section V concludes the paper along with presenting some policy recommendations.

II. Review of Literature

Origin and Structure:

[2] The emergence of 'Nationalist' ideology in USA, UK and many other European countries are manifested due to the concern of the massive 'job-losses' to the developing countries.

International production and trade has transformed the structure of 'globalization', more so during the 1960s when the trend of slicing of production process in search for cost-effective and capable suppliers started emerging (Gereffi, 2014; Pietrobelli and Rabellotti, 2011). Since then, a huge literature emerged that examined the various facets of GVC and its impact on the industries of different nations.

Morrison et al. (2008) considered "*Global Value Chains as a new form of firm organization*" which is fast engulfing many developing countries. The study analyzed the potential implication for firms from developing countries and highlighted that innovation entails a risky and expensive process of learning and technology accumulation. Using OECD-WTO data Banga (2014) tried to measure the alternative ways of participation of a country in GVC. It was found that around 67 percentage of the value is generated by OECD countries and BRICS contributed around 25 percentage of the total global value added. Timmer et al. (2014) describes the fragmented production process very lucidly while taking numerous examples from across the world. Gereffi (2014) found that the world is increasingly dominated with the trade of intermediate goods rather than the trade of final goods. Further, Gereffi found that emerging economies have improved their position in the GVCs over the years. Interestingly, the paper also highlighted that emerging countries also made significant gains in high- and – medium-technology industries. Azmeh and Nadvi (2015) highlighted the role of Asian suppliers in the international garment industry. Lema *et al.* (2015) studied the global shift in innovation power towards developing countries, especially Brazil and India. Using the case of auto industry from Brazil and software industry from India, the paper found that the inter-relationship of the firms from these developing countries to the firms of developed countries lead to this transformation. Banyuls and Haipeter (2010) found that countries, regions, along with labour standards and industrial structures determine the process of global reorganisation of value-generations.

The existing literature shows that that the trade of intermediate goods has increased over the years and the share of emerging economies towards contribution to global value chains are fast increasing.

Global Value Chains: Globalization of Technology and Employment:

The 'changing structure of global production' leads Istanbul's Ministerial Declaration to invite OECD to work for understanding the role of GVCs. So OECD came up with a study in

2008 where the various opportunities and challenges before SMEs, especially from developing countries were discussed. Banyuls and Haipeter (2010) tried to find the structure and impact of participation in GVCs using the case of motor industries and found that industrialisation affected ‘labour standard’ and ‘collective bargaining’. Sturgeon and Kawakami (2010) examined the evolution of GVC in electronics industry and found that industry is spatially dispersed and tightly integrated and over time the electric industry saw an increasing dominance of developing countries. Montalbano et al. (2014) found the presence of ‘positive causal relationship between participation in international activities and firms performance’. Alfado et al (2015) presented the firm choice in production process using the property rights model and found that the integration of the firms in the market depends upon the elasticity of demand of the final product. Azhmeh and Nadvi (2015) elaborated that the firms in the process of global production try to restructure the global production function geographically and organizationally that lead to shifting of human and non-human resources across borders. Banga (2015) tried to links the employment issue with the participation in GVC and found that both higher backward and forward linkages were not able to boost employment leading to negative impact of participation in GVC on employment generation in India.

Another important aspect that concerned the scholars working in the area of ‘global value chains’ is to examine the ‘impact’ of participation in GVCs and the factors determining this participation. However, as discussed various factors including ‘skills of labour’, ‘forward and backward linkage’, ‘elasticity of demand’ etc are the determining factors. But the issue taken up in the present paper is to examine the probable factors for Indian manufacturing industries, the examination of which is lacking in the existing literature, to the best of knowledge.

Governance of Global Value Chains:

An important aspect that is taken up by the scholars working in the field of GVCs is the ‘governance issues’. The issue assumed importance as the production process crosses boundaries and it become a policy concern to manage the fragmented production process. The pioneers in the field of GVC, Gereffi, Humphery and Sturgeon (2005) linked the unequal growth in the economic growth of the nations with the GVCs. They emphasized that the countries that failed to advance, should work to enhance their position in GVCs. The paper argued that there are five governance types including, Market, Modular, Relational, Captive and Hierarchy, which were discussed using the various case studies. Manova and Yu (2012) studies the factors that lead the firm to make a choice between processing and ordinary trade, that reflect the implicitly the choice of production and position in GVCs. Using the balance sheet of Chinese firms, the study found that credit crunch restricts the firms to lower value-added stages. Azhmeh and Nadvi (2015) explored the changing power relation in the GVC. They found that in the cotemporary structure of value chains, the issue of embeddedness is driven by complex factors including "*sourcing polices, relations with the buyers, trade policies and the organisational structure and strategy of these Asian firms*" (ibid :716). Eckhardt and Poletti (2015) presented the transforming nature of political economy under the aegis of GVCs. It was found by the authors that EU is aiming to have more bilateral trade relation with countries like S. Korea, ASEAN countries along with India to get a share from production-sharing network due to scale economies. This trend has gained momentum since the last decade due to the emergence of more import-dependent firms in EU, thus pressing for more trade liberalisation strategies. In a paper published in 2014, Gereffi found that during 1970s and 1980s, the commodity chains were driven by 'producer' and 'buyers'. However, it was also highlighted in the paper that in the post-Washington era, new and complex types of typologies emerged in the global value chains. In this context, Gereffi emphasised that the need is to understand the nature of 'governance' for different typologies line, bottom-up or top-down approach, that would help in examining the distribution of profits and risks amongst different stake-holders in the GVC.

Thus, from the brief review of literature presented, it emerges that the literature on GVC is in the process of evolution. Although, the literature drew the attention towards understanding the complex relationship between 'production process' and 'international trade' under the realm of fast changing technologies and ever forward moving production frontiers. It was, however, found that over the years the share of developing countries in Global Value Chains is increasing. Various empirical studies and case-studies have tried to examine the phenomenon of participation of different entities in GVCs, with greater attention being diverted to examine the 'benefits' to accrue with the participation in GVCs. In this context, the issues of concerns concentrated around the 'nature' and 'governance' of GVCs.

It was, however found that the major gap that remained in the existing literature, to the best of knowledge is to examine the 'nature' and 'share' of different manufacturing industries, especially from developing countries in GVCs; and to find the determinants of their participation in GVCs. Thus, the present study is aimed to fulfil this gap in the literature by taking the case of Indian manufacturing industries.

III. Database

With increasing fragmentation of production, gross trade data could lead to misleading results. To understand the gains from trade, the need is to capture the data representing the values emanating from different entities across globe. But chasing the GVC is a very tedious and time consuming task, as it involves a multiple arrays of input-output arrays spanning all the geographical boundaries. Thus, numerous studies emerged (Banyuls, and Haipeter, 2010; Eckhardt and Poletti, 2015; Morrison, et al, 2008; Sturgeon and Kawakami, 2010) over the years that used the case-study approach for understanding the complex process of globalized production. An important study in this context is by Dedrick et.al (2010) that had tried to capture the value contributed by different countries in the production of Apple iPod. It was found that of the total factory gate price; only 10 percent is contributed by Chinese value-addition, with a bulk was imported from Japan and rest coming to China from USA and Korea.

But during the last decade, a number of international agencies also got involved in collecting and maintaining data on GVCs. In this context, former WTO Director General Pascal Lamy (2011) opined that measuring trade in value-added helps to provides a more meaningful relationship between trade and economic growth. But availability of the consistent international Input-Output tables for such an analysis is a great constraint. However, there are some international organizations that are trying to collect data sets while compiling input-output tables and international trade data for different countries. An earlier attempt in this regard is in a form of a project implemented by Institute of Development Economics, affiliated with Japanese External Trade Organization (IDE-JETRO) that collected data for Asian countries and the US.

Another important initiative to measure trade in value-added is undertaken by the consortium of 11 institutions funded by European Union, World Input-Output Database (WIOD). WIOD provides data for the 47 countries for the period 2000-2014 on a wide range of variables for 56 sectors as classified according to the International Standard Industrial Classification revision 4. Another joint OECD-WTO Trade in Value-Added (TiVA) initiative provides indicators for 63 economies covering OECD, and most Asian and East Asian economies. This dataset is compiled for 16 manufacturing and 14 service sectors for the period 1995 to 2011. But the limitation of the data is that it contains discrete series leading to small sample estimation. Second, TiVA database provides data at 2-digit level of industries only. Despite these limitations, the analysis fills an important void concerning data limitations for GVCs. Thus, based upon the secondary data-sources (Appendix I, Table A1), the aim of the present study is to examine the 'structure' of 'value-added' contributed by different Indian manufacturing industries in GVCs. This exercise is aimed with the perspective of providing some 'policy suggestions' so that the share of Indian manufacturing industries could be increase at a 'sustainable' rate in global value chains.

i) Variable: Choice and Construction

To examine the status of Indian Manufacturing industries in Global Value Chains, we have chosen the following two dependent variables and Eleven Independent Variables. The summarized rationale of the chosen variables with the expected signs of the coefficients is presented in Table A1, Appendix I:

Dependent Variable:

a) *Domestic Value Added share of Gross Exports (DVA)*: The variable is extracted from TiVA database and is available continuously for the years 1995, 2000, 2005 and 2008 to 2011. To make the consistent database for continuous years, we have interpolated the data for the years 2006 and 2007 and thus making the time-series available for six years from 2005 to 2011. DVA is defined as domestic value added in gross exports by industry 'i' divided by total gross exports of industry, in US dollars millions. It is a reflection of 'DVA intensity measure' as it shows the extent of value-added generated by an industry per unit of its gross exports.

b) *Value Added (VA)*: Value Added shows the value of total output minus the value of total inputs. This variable is extracted from WIOD database as it provides the consistent database for the years from 2005 to 2011.

Independent Variables

a) *Capital (cap)*: Capital compensation in millions of national currency is taken as one of the independent variable. The variable is extracted from WIOD database. WIOD provides the time-series data for the years 1995 to 2009. But to make a consistent dataset for the econometric exercise, we have extrapolated the data for two years- 2010 and 2011. Thus, for the exercise, (cap) is taken for the years 2005 to 2011. Capital is recognized as one of the important ingredient of generating growth and value in growth theories. Therefore, it is assumed that this variable would be having a positive impact on both of dependent variables. Further, for the study, an attempt is made to examine the determinant of value added (DVA and VA) for both high-technology industries (HT) and low-technology industries (LT) (Appendix I, Table A2). In both of these, it is expected that capital (cap) would be playing dominant positive role, although the magnitude would be different.

b) *Labour (lab)*: Recognized since the work of Classical economists, the labour is considered as an important ingredient of growth and value-generation in both theoretical and empirical literature. WIOD provides the time-series data for 'labour compensation' in millions of national currency for the years 1995 to 2009. Therefore, again the dataset is extrapolated for two years 2010 and 2011. It is assumed that labour would have a positive impact on both the chosen dependent variables. However, for the high technology intensive industry (HT) and low- technology intensive industry (LT), the impact of labour on DVA and VA depends upon the nature of demand and supply of labour force.

c) *High-Skilled Labour (htlab)*: The value-added and 'value-added in exports' depends upon the level of skills the labour force of the country concern possess. WIOD provides the percentage of High-Skilled labour compensation of the Total labour force compensation, which reflects the quantum of skilled labour in different manufacturing industries. In the globalised competitive environment, it is assumed that the level of high-skilled labour would have a positive impact on both the 'value-added' and 'value-added in exports'. Moreover, it is further hypothise that the impact of high-skilled labour would be positive for both high-technology and low-technology intensive industries. This could be due the nature of the former high-technology intensive industries. For even the low-technology intensive industries, the services of high-skilled labour can help in generating more values in production chains.

d) *Medium- Skilled Labour (mtlab)*: India is one of the lower-middle income economy with the average per-capita income of US$ 1398 for the years 2007 to 2015. With this, it is assumed that the majority of the processes is being done by medium-skilled labour. Therefore, it is assumed that the impact of medium-skilled labour would be positive for adding value to the global production chains. This data is again extracted from WIOD database that presents in percentage form the quantum of compensation paid to medium-skilled labour out of the total labour employed in different industries of India.

e) *Low-Skilled Labour (ltlab)*: India is predominantly an agriculture economy and in about 70 years of Independence, India earmarked on the way of development through structurally transforming its economy away from agriculture, towards manufacturing and more so towards service sector. The transformation could be understood as the shrinking share of agriculture, both in GDP and employment generation. With this transformation, the shift of labour force towards low-skilled employment opportunities in manufacturing industries is evident. Moreover, in the literature concerning global value chains, it is argued that the production process is bifurcated in the manner that the low-skilled working processes are being increasingly shifted to developing countries with high labour force. Thus, it is assumed that low-skilled labour would have a high impact in value-generation of low-technology intensive industries.

f) Import of Value Added (impva): Domestic final demand also embodied foreign value added that are being purchased by different entities in domestic market including households, government and other institutions. This shows that the industries abroad are connected to domestic market through the 'imports of value added' by the latter. This could help in generating more values from domestic industries either due to 'demonstration effect', 'learning by using', 'imitating' and 'emulating'. This import of value-added could have various impacts on the domestic value-generation. On the one hand, this import of value-added could substitute the value being generated in domestic market, and on the other, the import of value-added could lead to more value generating from the domestic manufacturing units due to the factors as discussed above. But the overall impact depends upon the unanimous dominant factor. Moreover, the impact would also be different for different manufacturing industries It is assumed that the impact of 'import of value-added' would be positive for value-generation in low-technology intensive industries as it is relatively possible to contribute value-addition in the Global production process as compared to high-technology industries. The data for 'import of value added' is downloaded from TiVA database and the data is made consistent for the years 2005 to 2011 while applying the method of interpolation for filing the missing values in the time series.

g) *Forward Linkage (forwardl)*: TiVA provides the database for the domestic value-added embodied in final demand of foreign countries. It captures the quantum of value-added from domestic manufacturing industries that are exported either 'directly' through exports of final goods and also 'indirectly' through the exports of intermediate goods. This variable measures how domestic industries are connected 'upstream' by exporting values to foreign markets. It reflects the 'exports of value-added'. The exports of value added in a year are expected to have a positive impact of value being generated domestically for indigenous consumption and exports in the subsequent period. Thus, it is again hypotheses that the impact of forward linkage would be positive on both 'value-added' and 'value-added in exports'. Similar results are expected for both the high-technology intensive and low-technology industries.

h) *Backward Linkage (backwardl)*: Backward linkage reflect the measurement of 'import content of exports' or 'FVA (foreign value-added) intensity'. TiVA provides the data for foreign value-added share of gross exports for the years 1995, 2000, 2005, 2008 to 2011. For the present analysis, we have constructed the time-series of the variable for the years 2005 to 2011 using the appropriate interpolation methodology. It is argued in the literature on GVCs (Milberg and Winkler, 2013) that the developing countries are more linked through 'backward linkages' with the foreign manufacturing industries. Therefore, for the present analysis regarding Indian manufacturing industry, it is assumed that the impact of 'backward linkage' is more and positive on 'value-added' and 'value added in exports'.

i) *Research and Development (R&D)*: Investment in Research and Development is largely assumed as an important ingredient of growth of not only firms and industries, but also the countries. Thus, to examine the determinants of 'value-added' and 'value-added in exports', the data on R&D spending is gathered. Both TiVA and WIOD does not provide data on R&D indicators. Therefore, for the Indian manufacturing industry, the data on R&D is available from two major sources. At the industrial level, the data is provided by Department of Science and Technology (DST). At the firm level, CMIE PROWESS provides the disaggregated data series for the variable. As the data in CMIE PROWESS online database contains data for a relatively large number of firms, indicating relatively better picture of the prevailing trend. Thus, for the present study, the data on R&D investment is extracted from CMIE PROWESS for the years 2005 to 2011. It is however, assumed that investment in R&D would have a positive impact on overall industries. It would also have a positive impact on high-technology industries due to the nature of these industries. Moreover, the impact of investment in R&D is also expected to have a positive impact on low-technology intensive industries. The importance of R&D is widely discussed in the literature and is argued to be an important ingredient for sustainable growth and competitiveness in both domestic and foreign markets. Secondly, it is also argued that investment in R&D is important to absorb the technology spillovers from other manufacturing industries, either situated domestically or in foreign lands.

j) *Royalty (royalty)*: Akin to the discussion above, regarding investment in R&D, the data on royalty is also gathered from online data source- CMIE PROWESS for Indian manufacturing firms. Royalty is paid for the import of technology from other firms situated either domestically or in foreign country. Royalty, is thus a reflection of the import of technology. Thus, it also assumes the similar argument as has been presented for investment in R&D. Thus, the hypothesis is 'royalty' would have a positive impact on both the dependent variables- 'value added' and 'value-added in exports'. This would also be assumed to be true for both high-technology and low technology intensive sub-group of industries.

i) *Value-Added (VA)*: Here, the variable is considered to be as one of the dependent variable, but to examine its impact on 'value-added in exports'. It is assumed that 'value-added' would have a positive impact on 'value-added in exports'. This argument could signify that if more value added could have an impact on exports rather than domestic consumption. To reiterate, the variable is taken from WIOD database and the series is constructed continuously for years 2005 to 2011.

ii) Econometric Model

Repeated observations (T) on the same set of cross-section units (N) form the panel dataset. The estimation on panel dataset refer to cases where both T>1 and N>1. More often, the cases includes the asymptotic theory that assumes that 'N' goes to infinity and T is fixed. For these datasets, the pooled estimator using OLS or its extensions to Fixed or Random Effects models are used.

But in the present case, the number of individuals N is large than T, although the number of cross section units are themselves smaller. These cases of 'small samples'/ 'aggregated form' is increasingly estimated by Generalized Method of Moments (GMM) (Roodman, 2009). The methods were developed by Holtz-Eakin, Newey and Rosen, that was published in

Econometrica vol.56 in 1988. Arellano and Bond (1991) and Arellano and Bover (1995) and Blundell and Bond (1998) further extended and improved upon the models to make them more popular (ibid). The difference- and system generalized method of moments, thus deals with 'relatively' small T and large N panels. The estimation technique is useful for estimation of panel dataset where the dataset possess characteristics like: "individual variables are not strictly exogenous, fixed effects, heteroscedasticity and autocorrelation within individuals" (ibid).

In order to examine the nature of contribution of Indian manufacturing in global value chains, the idea is to examine the factors that determine 'value-added' and more importantly 'value-added in exports'. Thus, for the analysis, these two were taken as the dependent variable. However, various traditional inputs (capital and labour), technology related inputs (high-skilled labour, medium skilled labour, low skilled labour, Research and development and Royalty payments) and linkages (forward linkage, backward linkage, import of value added and value added) were taken as the explanatory variable. It is further assume that there would a lag of a year for capturing the effect of all the independent variables on the dependent variables.

Thus, the models take the following form:

$DVA_{it*} = f\,(CAP_{i,\,(t-1)*},\ LAB_{i,\,(t-1)*},\ HTlab_{i,\,(t-1)*},\ MTlab_{i,\,(t-1)*},\ LTlab_{i,\,(t-1)*},\ IMPva_{i,\,(t-1)*},\ Forwardl_{i,\,(t-1)*},\ Backwardl_{i,\,(t-1)*},\ R\&D_{i,\,(t-1)*},\ Royalty_{i,\,(t-1)*},\ VA_{i,(t-1)*})$ …………(1)

and

$VA_{it*} = f\,(CAP_{i,\,(t-1)*},\ LAB_{i,\,(t-1)*},\ HTlab_{i,\,(t-1)*},\ MTlab_{i,\,(t-1)*},\ LTlab_{i,\,(t-1)*},\ IMPva_{i,\,(t-1)*},\ Forwardl_{i,\,(t-1)*},\ Backwardl_{i,\,(t-1)*},\ R\&D_{i,\,(t-1)*},\ royalty_{i,\,(t-1)*})$ ………………(2)

Where:

DVA_{it*} (dependent variable) = $\Delta DVA_i/\Delta DVA$; DVA is 'domestic value added in exports'

for industry i ,

for the change (Δ) in the value for year t*

where t* is [(t+1) – (t)], reflecting the change in 'value-added in export' for industry 'i' to the total change in value added in exports for all the industries.

Further in the similar manner,

VA_{it*} (dependent variable) = $\Delta VA_i/\Delta VA_t$; VA is 'value-added' for industry i ,for the change (Δ) in the value for year t*

where t* is [(t+1) – (t)], reflecting the change in 'value-added' for industry 'i' to the total change in value-added for all the industries.

Further for the independent variables:

$CAP_{i(t-1)*} = \Delta CAP_{i*}/\Delta CAP$; CAP is 'capital compensation in millions of national currency'

for industry i ,for the change (Δ) in the value for year (t-1)*

where (t-1)* is [(t) – (t-1)], reflecting the change in 'capital' for industry 'i' to the total change in capital for all the industries;

$LAB_{it*} = \Delta LAB_i/\Delta LAB_t$; lab is 'labour compensation in millions of national currency'

for industry i ,for the change (Δ) in the value for year (t-1)* ;

$HTlab_{it*} = \Delta HTlab_i/\Delta HTlab$; HTlab is 'labour compensation for high-skilled labour in millions of national currency'

for industry i ,for the change (Δ) in the value for year (t-1)* ;

$MTlab_{it*} = \Delta MTlab_i/\Delta MTlab$; MTlab is 'labour compensation for medium-skilled labour in millions of national currency'

for industry i ,for the change (Δ) in the value for year (t-1)* ;

$LTlab_{it*} = \Delta LTlab_i/\Delta LTlab$; LTlab is 'labour compensation for low-skilled labour in millions of national currency'

for industry i ,for the change (Δ) in the value for year (t-1)* ;

$IMPva_{it*} = \Delta IMPva_i/\Delta IMPva$; IMPva is 'import of value-added in US million dollars'

for industry i ,for the change (Δ) in the value for year (t-1)* ;

$Forward_{it*} = \Delta Forward_i/\Delta Forward$; Forward is 'forward linkage in US million dollars'

for industry i ,for the change (Δ) in the value for year (t-1)* ;

$Backward_{it*} = \Delta Backward_i/\Delta Backward$; forward is 'backward linkage in US million dollars'

for industry i ,for the change (Δ) in the value for year (t-1)* ;

$R\&D_{it*} = \Delta R\&D_i/\Delta R\&D$; R&D is 'investment in Research and Development'

for industry i ,for the change (Δ) in the value for year (t-1)* ;

$Royalty_{it*} = \Delta Royalty_i/\Delta Royalty$; Royalty is 'expenditure in paying royalty'

for industry i ,for the change (Δ) in the value for year (t-1)* ;

Thus, the above mentioned lagged model takes the following form after logarithmic transformation.

Equation (1) and (2) becomes:

$$dva_{it^*} = \alpha_0 + \beta_c\ cap_{i,(t-1)^*} + \beta_l\ lab_{i,(t-1)^*} + \beta_{ht}\ htlab_{i,(t-1)^*} + \beta_{mt}\ mtlab_{i,(t-1)^*} + \beta_{lt}\ ltlab_{i,(t-1)^*} + \beta_{imp}\ impva_{i,(t-1)^*} + \beta_f\ forwardl_{i,(t-1)^*} + \beta_b\ backwardl_{i,(t-1)^*} + \beta_{rd}\ r\&d_{i,(t-1)^*} + \beta_r\ royalty_{i,(t-1)^*} + \beta_{va}\ VA_{i,(t-1)^*} + \mu_{i\ (t-1)^*}$$

…………(3)

And

$$va_{it^*} = \gamma_0 + \delta_c\ cap_{i,(t-1)^*} + \delta_l\ lab_{i,(t-1)^*} + \delta_{ht}\ htlab_{i,(t-1)^*} + \delta_{mt}\ mtlab_{i,(t-1)^*} + \delta_{lt}\ ltlab_{i,(t-1)^*} + \delta_{imp}\ impva_{i,(t-1)^*} + \delta_f\ forwardl_{i,(t-1)^*} + \delta_b\ backwardl_{i,(t-1)^*} + \delta_{rd}\ r\&d_{i,(t-1)^*} + \delta_r\ royalty_{i,(t-1)^*} + \delta_{va}\ VA_{i,(t-1)^*} + \eta_{i\ (t-1)^*}$$

………………(4)

where the lower letters are the logarithmic transformation of the variable already discussed above. Further, α_0 and γ_0 are intercepts and β's and δ's are the coefficient and μ_i and η_i are disturbance terms. System approach to GMM is used for estimation[3]. System approach to GMM is an improvement upon the earlier versions of panel data estimation like OLS, fixed – effect, First- difference GMM and level GMM estimator as these were not able to present robust estimates with small samples. Arellano and Bover (1995) suggest using lagged differences that could produce unbiased estimates for the small samples.

IV. Changing Pattern of Global Value Chains: Indian Manufacturing Industries

In this section, the changing pattern of Gross Exports and Value Added from different part of the World is examined using the aggregated OECD-WTO's TiVA (Trade in Value Added) database.

Table 1. Pattern of Gross Exports and Gross Value Added (Total Manufacturing)

(Percentage)

	Gross Exports (*Percentage of Gross World Exports*)			Domestic Value Added Content of Gross Exports (*Percentage of Gross World Value Added Content of Gross Exports*)		
	1995	*2005*	*2011*	*1995*	*2005*	*2011*
OECD Countries	54.05	44.35	47.42	55.78	45.31	46.82

[3] In 2003, xtabond2 command was introduced in Stata software to estimate the panel regression using system GMM model.

Europe	46.58	40.70	35.50	45.88	40.12	34.13
Non-OECD	45.94	55.64	52.57	44.22	54.69	53.18
China	7.67	19.20	24.81	6.19	15.47	21.92
India	2.10	3.82	5.75	2.31	4.06	5.69
World#	**1.86**	**4.14**	**7.93**	**1.54**	**3.21**	**6.09**

Note: 1. # indicates that the values is in US$ Trillions.
2. The total Gross World Exports and Domestic Value Added Content of Gross Exports is equal to sum of OECD and Non-OECD countries.
Source: Own Calculations using TiVA database.

Table 1 shows that from 1995 to 2011, the world gross exports increased 7 times from around US $ 1.86 trillion to US $ 7.93 trillion. Of this, the share of group of 34 OECD countries was 54 percent in 1995 that fell to 47 percent in 2011. The share of gross export for European counties also fell over the years. On the other hand, the share of Non-OECD countries that are a group of 28 countries including the share of the 'Rest of the World' increase over the years. The share of gross exports emanating from Non-OECD countries was 45 percent in 1995 that increases by 7 percent points to reach at around 52 percent in the year 2011. China, that has emerged as the world's manufacturing hub has increased massively its share in world's gross exports over the years. India also witnesses a change in the share of her exports over the years. Of the total world export, only around 2 percent were contributed by India in 1995, whereas in 2011, its share increases to 5.75 percent. Although, the share of Indian exports swells over the years, but still as compared to countries like China, it is far behind.

As discussed, gross exports reflects state of economic growth in a limited manner. Therefore, the need has emerged to decipher the contribution of different countries in terms of value-added in gross exports. Table 1 also showed that of the total domestic value-added in gross exports of US $ 1.54 in 1995, around 55 percent emanates from OECD countries while Non-OECD countries contributed around 45 percent. China's share in domestic Value-added in gross exports were around 3 times more than India. Although, in 2011 the value of domestic value-added content of gross exports increased 6 times in 2011, the share of OECD countries fell to 46 percent and Non-OECD countries share increase to 46 percent. Chinese share which was around 6 percent increases massively to reach at 21 percent, while the share of Indian manufacturing remained increased very marginally from around 2 percent to 5 percent from 1995 to 2011.

This reflects that the share of world exports and value-added in gross exports started tilting towards developing countries, especially China and India. India, in 2014 launched a massive initiative of ‘Make in India’ where the emphasis is to make India a new manufacturing hub. In other words, given the structure of production process, it could be understood as making Indian manufacturing as an important contributor of gross value-added in global value chains (GVCs).

Therefore, next we have tried to examine the share of different manufacturing industries in gross exports and share of domestic value-added in gross exports from India, the results of which are presented in Table 2 and 3, respectively.

Table 2. Inter-industrial share of Gross Exports from India

(Percentage)

Industrial Code	Industries Name	1995	2000	2005	2010	2011
C15T16	Food Products, Beverages, tobacco	17.16	13.04	07.90	06.65	07.96
C17T19	Textiles, textile products, leather and footwear	31.22	31.08	18.13	10.84	10.07
C20T22	Wood, Paper, Paper product, printing and publishing	01.61	01.98	01.34	0.79	0.72
C23	Coke, Refined petroleum product and nuclear fuel	02.12	04.60	13.08	19.22	21.93
C24	Chemical and chemical product	11.35	14.21	14.44	13.51	12.92
C25	Rubber and Plastic Product	03.80	02.36	02.81	02.63	02.71
C26	Other Non-Metallic Mineral Product	01.48	01.76	01.42	01.01	0.92
C27	Basic Metals	05.43	06.28	09.74	09.83	06.71
C28	Fabricated Metal Products	02.95	03.67	03.04	02.41	02.30
C29	Machinery and Equipments	02.95	03.33	04.95	04.37	04.40
C30T33	Electrical and optical equipment	04.52	04.57	04.40	07.10	07.11
C34	Motor vehicles, Trailers and semi-trailers	02.69	02.15	05.40	05.14	04.35
C35	Other Transport Equipment	01.51	01.23	01.99	03.49	04.14
C36TC37	Manufacturing, nec recycling	11.22	09.74	11.36	12.33	13.75
C15TC37	Total Manufacturing	100	100	100	100	100
	Total Manufacturing #	**21.59**	**29.09**	**73.99**	**193.4**	**228.4**

Note: 1. The industrial codes are based on ISIC rev3.
2. # means that the data is in US$ Billions
Source: Author’s estimation.
Data Source: TiVA database.

From Table 1 above, it was seen that the share of total Indian manufacturing sector increases from around 2 percent in 1995 to around 5 percent in 2011. Although, the share doubled itself in the period of about one and half decade, but comparing with China, the increase is very moderate. However, Table 2 shows that Indian manufacturing exports was around US $ 21.59 billion in 1995 that increases to US $ 73.99 billion in 2000 and further to US $ 228.4 billion in 2011. Table 1 further show the industry-wise share of gross exports from total manufacturing exports for Indian manufacturing sector over the years from 1995 to 2011. It was found that for some industries like Food and Beverages (C15T16), Textiles (C17T19), Wood, Paper (C20T22), Rubber and Plastic (C25), the share in total exports fell substantially. It is pertinent to note that these are the industries that are termed as Low-technology industries according to OECD (2011) technology based industrial classification.

Further, the Table 2 also show that the share of Coke, Refined Petroleum product (C23) industry increases massively over the years from the small magnitude of 2 percent in total manufacturing exports to around 22 percent in 2011. Other industries whose shares in gross exports increases over the years includes Chemical (C24), Basic Metals (C27), Machinery and Equipments (C29), Electrical and Optical equipments (C30T33), Motor Vehicles (C34, C35) and other manufacturing (C36TC37).

This result is very significant to note as it reflect that Indian manufacturing has started drifting away from low-technology intensive industries towards a relatively high technology industries. But to better understand the contribution of Indian manufacturing sector in total exports, the need is to examine the share of each industry in terms of domestic value added, which is shown in Table 3.

Table 3. Domestic Value Added content of Gross Exports from Indian Manufacturing

(Percentage)

Industrial Code	Industries Name	1995	2000	2005	2010	2011
C15T16	Food Products, Beverages, tobacco	18.21	14.19	09.35	08.93	10.95
C17T19	Textiles, textile products, leather and footwear	32.22	33.15	20.60	13.29	12.64
C20T22	Wood, Paper, Paper product, printing and publishing	01.59	01.99	01.44	0.92	0.85
C23	Coke, Refined petroleum product and nuclear fuel	01.78	03.10	09.53	14.08	14.91
C24	Chemical and chemical product	11.15	14.49	15.11	14.98	14.45
C25	Rubber and Plastic Product	03.68	02.45	02.95	02.95	03.10
C26	Other Non-Metallic Mineral Product	01.43	01.61	01.47	01.20	01.09
C27	Basic Metals	05.07	05.49	08.88	08.97	06.08
C28	Fabricated Metal Products	02.82	03.36	02.90	02.44	02.35

C29	Machinery and Equipments	02.82	03.20	04.85	04.57	04.64
C30T33	Electrical and optical equipment	04.38	04.29	04.28	07.37	07.51
C34	Motor vehicles, Trailers and semi-trailers	02.68	02.08	05.60	05.40	04.60
C35	Other Transport Equipment	01.45	01.14	01.99	03.65	04.44
C36TC37	Manufacturing, nec recycling	10.74	09.45	11.05	11.25	12.40
	Total Manufacturing#	**18.87**	**24.66**	**55.37**	**128.2**	**145.9**

Note: 1. The industrial codes are based on ISIC rev3.

2. # show the total domestic value added content of gross exports in US $Billions.

Source: Author's estimation.

Data Source: TiVA database.

Table 3 presents the domestic value-added content of gross exports for different manufacturing industries of India. An important revelation that emerges by comparing Table 2 with Table 3 is that the value of the gross exports from total manufacturing is high as compared to the domestic value added content of gross exports throughout the period. Whereas the difference between the two (in nominal prices US$ billion) was US$ 2.72 billion in 1995, it increases substantially over the years to US $18.62 billion in 2005 and an exorbitant amount of US $82.5 billion in 2011. This reflects that although, the exports from Indian manufacturing industries has been rising over the years, the domestic value-added content of gross exports laggards far behind. This signifies that over the years comparatively less value is being contributed to GVCs from India.

Second, Table 3 also shows the industry-wise share of domestic value-added content of gross exports from India from 1995 to 2011. In 1995, two industries namely Food products and Beverages (C15T16) and Textiles (C17T19) contributed around 50 percent in to the domestic value added content of gross exports. However, the contribution to the total domestic value-added content of gross exports diversifies into other manufacturing industries over the years. In 2011, the share of Food products and Beverages (C15T16) and Textiles (C17T19) were only around 22 percent and the share of two other industries namely Coke and Refined Petroleum product (C23), Chemicals (C24) was around 29 percent. Other industries whose share in terms of domestic value-added content of gross exports increases includes Basic Metals (C27), Machinery and Equipments (C29), Electrical and Optical equipments (C30T33), Motor Vehicles and other Transport (C34 and C35), and other Manufacturing (C36T37).

Table.4 Global Value Chains and Indian Manufacturing Industries

(Percentage)

		Backward Linkages (FV)					Forward Linkages (DV)					Degree of Participation^	Relative Position^
Industrial Code	***Industries Name***	***1995***	***2000***	***2005***	***2010***	***2011***	***1995***	***2000***	***2005***	***2010***	***2011***	***2009~11***	***2009~11***
C15T37	Total Manufacturing	12.58	15.25	25.16	33.71	36.11	10.5	13.9	14	13.3	13.4	0.47	0.39
C15T16	Food Products, Beverages, tobacco	07.22	07.77	11.43	10.99	12.14	0.8	0.8	0.8	0.8	0.8	1.69	0.07
C17T19	Textiles, textile products, leather and footwear	09.77	09.60	14.96	18.74	19.83	2.3	2.9	1.6	1.1	1.1	1.78	0.06
C20T22	Wood, Paper, Paper product, printing and publishing	13.67	14.87	19.54	23.08	24.82	0.3	0.5	0.4	0.4	0.4	29.45	0.02
C23	Coke, Refined petroleum product and nuclear fuel	26.64	42.89	45.47	53.15	56.57	0.3	0.4	0.8	0.7	0.7	2.82	0.01
C24	Chemical and chemical product	14.14	13.53	21.70	26.49	28.56	1.1	1.6	1.7	1.8	1.9	2.17	0.07
C25	Rubber and Plastic Product	15.41	11.95	21.36	25.64	27.13	0.4	0.5	0.5	0.4	0.5	9.85	0.02
C26	Other Non-Metallic Mineral Product	15.84	22.57	22.44	21.59	24.54	0.1	0.1	0.1	0.1	0.1	22.35	0.00
C27	Basic Metals	18.50	25.91	31.76	39.45	42.11	0.7	1.0	1.1	1.1	1.1	5.11	0.03
C28	Fabricated Metal Products	16.34	22.56	28.65	32.69	34.72	0.3	0.4	0.5	0.5	0.4	14.19	0.01
C29	Machinery and Equipments	16.31	18.58	26.76	30.56	32.64	0.7	0.8	1.0	1.1	1.1	7.12	0.03
C30T33	Electrical and optical equipment	15.30	20.43	27.15	31.18	32.47	1.7	2.8	3.0	2.8	2.8	4.55	0.09
C34	Motor vehicles, Trailers and semi-trailers	12.80	17.95	22.35	30.34	32.48	0.9	1.1	1.3	1.1	1.2	6.83	0.04
C35	Other Transport Equipment	16.07	21.36	25.23	30.66	31.49	0.3	0.4	0.4	0.6	0.6	8.54	0.02
C36TC37	Manufacturing, nec recycling	16.33	17.71	27.23	39.51	42.37	0.6	0.6	0.6	0.6	0.6	2.98	0.02

Note: 1. Backward Linkages (FV) is defined as foreign value added in gross exports divided by total gross exports, in %.
2. Forward Linkage (DV) is defined as domestic VA embodied in foreign exports as a share of gross exports, in %.
3. Degree of Participation is (FV+DV)/Gross Exports
4. Relative Position is DV/FV
5. ^ indicates that the value is an average of three years i.e 2009 to 2011.

Data Source: TiVA database

Source: Author's calculation

Table 4 presents a comparison of *forward* and *backward linkages* across manufacturing industries of India. *Backward linkages* is referred to as 'import content of exports' and is defined as the foreign value added in gross exports as a percentage of gross exports. Higher value of *backward linkages* reflects that high value-added from trade partners is embodied in countries exports (Lossifov, 2014). *Forward Linkage* is defined as the 'ratio of domestic value added content of gross exports of foreign countries to gross exports by domestic industry'. High value of *forward linkage* reflects that a high value-added from domestic industry is embodied in the exports of trade partners.

For the Indian manufacturing industry, Table 4 shows that *backward linkages* is high as compare to *forward linkages* throughout the period from 1995 to 2011. It was also observed that the magnitude (in percentage) of *backward linkage*, for aggregated manufacturing (C15T37) increases three times, whereas for *forward linkages* it increases very marginally from 10 percent in 1995 to 13 percent in 2011. This reflects that Indian manufacturing industry has increasingly exporting more value-added generated in partner countries as compared to domestic value-added. For the two- digit level of disaggregation, industries namely Coke and refined petroleum (C23), Motor Vehicles (C34, C35) and other Manufacturing (C36TC37) have shown an increasing rate of *backward linkages* over the years. On the other hand, nearly all the manufacturing industries showed an increase in *forward linkages* from the period 1995 to 2011, but the magnitude of the increase is very marginal.

Further, combining both *forward* and *backward linkages* also reflects upon the 'degree of participation' in global value chains (GVC) in percentage of countries of gross exports. The sums of forward and backward linkages as a percentage of gross export lead to the estimation of 'degree of participation' in GVC. In India's case, the high magnitude of backward linkage also reflects upon a relatively high 'degree of participation' in GVC for some industries namely Wood and Paper (C20TC22), other Non-Metallic minerals (C26), Fabricated Metal Products (C28). Similar is the trend, however at a lower magnitude, for the other manufacturing industries too.

The last column of Table 4 shows 'relative position' of manufacturing industries in GVC. High value signifies a high magnitude of *forward linkage* as compare to *backward linkage*. However, in case of Indian manufacturing industry (C15TC37) the relative position is 0.39 reflecting a dominance of *backward linkage* as compare to *forward linkage*.

The next two Tables 5and 6 present the pattern of Value-added and Exports of Value-added from Indian manufacturing industries, respectively. The reflection upon the trend is important to understand the changing nature of global value chains and the role of Indian manufacturing sector.

Table 5 Changing Pattern of Value Added

Industrial Code	Industries Name	1995	2000	2005	2010	2011
C15T37	Total Manufacturing	100	100	100	100	100
C15T16	Food Products, Beverages, tobacco	09.20	12.07	08.72	07.37	07.09
C17T19	Textiles, textile products, leather and footwear	10.54	11.72	08.11	07.23	06.96
C20T22	Wood, Paper, Paper product, printing and publishing	04.11	04.36	03.20	02.33	02.34
C23	Coke, Refined petroleum product and nuclear fuel	05.98	06.45	14.45	11.60	11.80
C24	Chemical and chemical product	19.04	20.88	16.29	14.68	14.41
C25	Rubber and Plastic Product	02.77	03.29	02.61	03.91	03.94
C26	Other Non-Metallic Mineral Product	04.60	05.17	04.13	06.69	06.60
C27	Basic Metals	12.36	10.78	13.95	15.13	15.48
C28	Fabricated Metal Products	02.83	02.78	03.02	03.93	03.93
C29	Machinery and Equipments	08.20	06.33	05.78	07.12	07.14
C30T33	Electrical and optical equipment	08.53	07.50	07.44	08.37	08.46
C34	Motor vehicles, Trailers and semi-trailers	07.22	05.04	07.77	06.96	07.06
C35	Other Transport Equipment	03.68	02.35	03.06	02.81	02.79
C36TC37	Manufacturing, nec recycling	00.94	01.29	01.48	01.87	01.97

Note: 1.The industrial codes are based on ISIC rev3.
Source: Author's estimation.
Data Source: WIOD database.

Table 5 presents the changing share of different manufacturing industries in terms of value-added for the years 1995 to 2011. The idea is to examine the industries whose share in total value-added from Indian manufacturing industries has changed over the years. It was found that over the years barring only few, like coke, refined petroleum product and nuclear fuel (C23), other non-metallic minerals (C26), basic metals (C27) and manufacturing, nec recycling (C36TC37) have all witnessed a fall in their share. This reflects that over time, the share emanating from different manufacturing industries gets distributed among industries.

Table 6 Export of Value Added

Industrial Code	Industries Name	1995	2000	2005	2010	2011
C15T37	Total Manufacturing	100	100	100	100	100
C15T16	Food Products, Beverages, tobacco	06.65	06.05	04.13	03.69	04.29
C17T19	Textiles, textile products, leather and footwear	19.74	21.17	12.09	08.13	07.81
C20T22	Wood, Paper, Paper product, printing and publishing	04.18	04.50	03.15	01.74	01.74
C23	Coke, Refined petroleum product and nuclear fuel	04.69	05.54	14.38	14.31	15.85
C24	Chemical and chemical product	22.50	23.50	21.30	20.78	20.54
C25	Rubber and Plastic Product	03.48	03.45	03.26	03.86	04.00
C26	Other Non-Metallic Mineral Product	02.08	02.44	02.05	02.19	02.02
C27	Basic Metals	11.19	10.81	13.06	13.92	11.50
C28	Fabricated Metal Products	03.44	03.69	03.34	03.66	03.50
C29	Machinery and Equipments	04.25	04.03	05.13	06.32	06.31
C30T33	Electrical and optical equipment	05.91	06.07	05.52	08.92	09.11
C34	Motor vehicles, Trailers and semi-trailers	03.50	02.19	06.05	05.00	04.53
C35	Other Transport Equipment	02.04	01.39	02.12	03.60	04.22
C36TC37	Manufacturing, nec recycling	06.35	05.17	04.42	03.88	04.57

Note: 1.The industrial codes are based on ISIC rev3.
Source: Author's estimation.
Data Source: TiVA database.

'Exports of value-added' is an important indicator for reflecting upon the contribution in global value chains. TiVA database provides the data on 'Domestic value added embodied in foreign final demand' capturing the value added exported 'directly' through the exports of final goods and services and also through the export of intermediates in an 'indirect' manner reflecting how domestic industries are being able to meet the demand of foreign nationals.

Table 6 shows that in the year 1995, there were few industries that dominated the share of 'exports of value-added' of the total value-added exported from Indian manufacturing industries. These industries were Textiles (C17TC19), chemicals (C24) and Basic Metals (C27), with joint share of about 53 percent. But in 2011, the shares of many other industries like Coke and Refined Petroleum product and Nuclear Fuels (C23) Electrical and Optical equipment (C30TC33), also grew along with the other dominant industries like chemicals (C24) and Basic Metals (C27). The joint share of these four industries was around 57 percent.

This again reflects that Indian manufacturing is also entering the global value chains in relatively high technology intensive industries.

The major points that came of the above analysis in the present section is as follows: (i) the share of Indian exports to the total World's export increases from about 2 percent in 1995 to 5 percent in 2011; (ii) Similarly, the domestic value-added content of gross exports also increase to around 5 percent in 2011; (iii) In terms of 'domestic value-added content in gross exports', the relative share of high-technology industries like Chemicals, Machinery and Equipment, Electrical and Optimal equipment, Motor vehicles etc increases over the years; (iv) On a comparative basis, although, both 'gross exports' and 'domestic value-added content of gross exports' both increases over the years, but the rate of increase of the former is much higher as compared to latter, signifying that over the years relatively less value is being contributed to GVCs from Indian manufacturing industries; (v) Over the period from 1995 to 2011, the magnitude of 'backward linkage' increases three times, whereas 'forward linkage' saw a very marginal increase from 10 percent in 1995 to 13 percent in 2011.

V. India and Global Value Chains: Econometric Analysis

In this section, an attempt is made to examine the factors that determine the participation of Indian manufacturing industries in global value chains (GVC). For the purpose, two variables (i) value-added in exports and (ii) value-added are chosen. Different variable (Section III) were chosen as an explanatory variables. As the data taken (Appendix I, Table A1) was at aggregated level, the panel dataset, thus formed have 12 major industries (C15TC37) (Appendix I, Table A2) for the 7 years. Lagged model was used for the estimation. As the number of observations was less due to aggregated data, the estimation is done using System GMM approach. The results of which are discussed as follows.

Table 7 Econometric Result using System GMM

Dependent =>	Domestic VA in Gross Exports					
Independent	(1)	(2)	(3)	(4)	(5)	(6)
Cap	0.039 (0.51)	0.17** (1.88)		0.26** (2.23)	0.17** (1.81)	
Lab				-0.04 (-0.24)		
Htlab	-0.35 (-1.46)	0.08 (0.30)	-0.10 (-0.37)		0.13 (0.45)	
mtlab	1.08** (2.38)	0.67 (1.18)	0.81** (1.41)		0.66 (1.15)	
ltlab	-0.60** (-2.40)	-0.63** (-1.87)	-0.48 (-1.32)		-0.64** (-1.84)	
importva	-0.09 (-1.22)					-0.31 (-1.23)
forwardl	0.54*** (2.72)		0.49* (1.81)			0.52** (2.36)
backwardl	-0.32 (-0.27)		-0.01 (-0.08)			0.11 (1.09)
R&D	0.04 (0.60)	0.02 (0.39)				0.09* (1.78)
Royalty	-0.08 (-0.83)	0.03 (0.39)				-0.04 (-0.57)
VA	0.49*** (3.89)					
Constant	0.15 (0.24)	-1.59*** (-2.52)	-0.67 (-0.72)	-1.86*** (-3.59)	-1.67*** (-3.16)	-0.86 (-1.54)
Wald chi2	475.09*** [9]	33.73*** [5]	11.77* [4]	6.00* [1]	9.80 [3]	10.74 [4]
Arellano-Bond Test AR(1)	(-2.58)	(-2.18)	(-2.54)	(-1.96)	(-1.80)	(-2.57)
Sargen-Hansen	Robust	Robust	Robust	Robust	Robust	Robust

Note: 1. Values in parentheses are z-values.

2. Values in square brackets are 'degree of freedom' corresponding Wald chi2.

3. *,**,*** signifies that the coefficients are significant at 10, 5 percent and 1 percent, respectively.

Table 7 shows the results of analysis with ‘Domestic Value-Added in Gross Exports’ (DVA) as the dependent variable. System GMM approach was used for the estimation. The analysis was based on all the Indian manufacturing industries. Model 1 (Table 7) shows that the impact of ‘medium-skilled labour’ (mtlab) is positive (1.08) and significant at 5 percent level, implying that the medium-skilled labour plays an important role in determining ‘domestic value-added in gross exports’ from Indian manufacturing industries. On the other hand, the impact of ‘low-skilled labour’ (ltlab) is negative although at a low level of magnitude (-0.60). This shows that in Indian manufacturing sector, medium-skilled labour plays a dominant role in generating value-added in gross exports. The other important variable that have a positive impact on ‘DVA is ‘forward linkage’ implying that the export of domestic value-added either directly through export of final goods and services and indirectly through export of intermediate goods and services, would have a positive and significant (0.54), impact (with a lag) on DVA. Another important variable that have an impact on DVA is value-added (VA) of domestic manufacturing industries. This implies that two important variables that have a positive impact on DVA is ‘medium-skilled labour’ and ‘forward linkages’. Thus, emphasis should be made in the direction to strengthen both of these factors.

In Model (2) Table 7, after controlling for external linkages variables, it was found that capital (0.17) is an important factor determining DVA. This model is again significant as shown by the statistics of Wald chi2. Model (3), Table 7 shows the estimates of System GMM results after controlling for variables like capital, import of value-added, technology related variables (R&D and Royalty), and value-added. It was found that the impact of medium-skilled labour (mtlab) (0.81) and forward linkage (forwardl) (0.49) is positive and significant. This model is also robust and highly significant. Model 4, Table 7 considers only the two important factors of production- capital and labour while controlling for all the other chosen variables. It was found that in this case, the impact of capital (cap) is positive (0.26) and significant. Model 5, Table 7, after controlling for other variable than capital and labour, it was found that capital (cap) is positive (0.17) and significant. Again, for Model 6, Table 7, it was found that the forward linkage (forwardl) and R&D is dominant and positive (0.52) and (0.09), respectively in determining the DVA. It is pertinent to mention that in Table 7, all those models were shown that are significant and robust in the estimation. Moreover, System GMM model also test the null hypothesis of ‘no auto-correlation’ using Arellano- Bond Test for first-difference AR(1), which is rejected for all the models. Further, the Sargen-Hansen Test the null: ‘the instruments as a group are exogenous'. For all the models, the value of p is high, thus making the model robust with endogenous variables.

Thus, the analysis shows that irrespective of different controls, few variables like capital, medium-skilled labour, forward linkage and investment in Research and Development (R&D) are important factors determining the 'domestic value-added in gross exports' from Indian manufacturing industries.

Table 8. Determinant of DVA: High Tech and Low Tech Industries

Domestic VA in Gross Export					
	HT		LT		
Independent Variables	(1)	(2)	(3)	(4)	(5)
cap	-0.12 (-0.36)	0.06 (0.27)	0.22*** (2.90)	0.34** (2.39)	
lab		-0.25 (-1.20)		0.02 (0.11)	
htlab	0.55** (1.84)		-0.51** (-1.97)		
mtlab	-0.13 (-0.39)		1.39*** (2.78)		
ltlab	-0.33* (-1.72)		-0.49 (-1.64)		
importva	0.07 (0.21)		-0.12 (-0.80)		
forwardl	-0.19 (-0.95)		0.78*** (3.86)		0.76*** (3.51)
backwardl	-0.56 (-0.14)		-0.005 (-0.05)		0.10 (0.87)
R&D	-0.16** (-2.28)	-0.03 (-0.70)	0.63 (1.64)	0.14* (1.86)	0.12 (1.56)
Royalty	-0.25*** (-3.12)	-0.12*** (-3.29)	-0.007 (-0.10)	0.14*** (5.07)	0.001 (0.002)
VA	0.25 (0.32)		0.23 (1.50)		
Constant	-3.23** (-1.84)	-3.06*** (-12.98)	1.39** (1.94)	-0.93 (-1.41)	0.25 (0.61)
Wald chi2	10.66** [9]	10728*** [3]	180.4*** [9]	83.05*** [3]	76.71*** [3]
Arellano-Bond Test AR(1)	-1.46	-1.73	-2.04	-2.33	-2.07
Sargen-Hansen	Robust	Robust	Robust	Robust	Robust

Note: 1. As Table 7.

In Table 8, the classification of manufacturing industries was done according to OECD technology-based industrial classification. The idea is to compare the factors determining the 'domestic value-added in gross exports'. OECD (2011) classifies the industries into four sub-groups – High Technology, Medium- High Technology, Medium-Low Technology and Low Technology industrial sub-group. For the present analysis, instead of these four classifications, two sub-groups were made- High Technology (HT) intensive industries comprises of High Technology and Medium-High Technology industries; and Low Technology (LT) intensive industries comprises of Medium- Low Technology and Low Technology intensive industries. Thus, five industries were classified as High Technology (HT) industries and Seven as Low-technology (LT) industries (Appendix I, Table 2).

For HT industrial sub-group, Model 1 (Table 8), the impact of high-skilled labour (htlab) is positive and significant (0.55). But in these industries, it is interesting to find that the impact of investment in R&D (-0.16) and royalty (-0.25) is negative and significant. These results are somewhat contrary to the literature of 'endogenous growth theories' that emphasised the importance of technology accumulation, assimilation and diffusion through investment in R&D.

After controlling for other external factors, Model (2), Table 8 shows that the impact of capital is positive (0.06) although not-significant.

The next set of Models (3,4 and 5), shows the results for Low Technology (LT) intensive industries. It was found that (Model 3, Table 8) the impact of capital (0.22), medium-skilled labour (mtlab) (1.39) and forward linkage (forwardl) (0.78) are positive and significant for determining the DVA. In another model (Model 5, Table 8), after controlling for some variables, it was found that the impact of capital (cap)(0.34) and R&D (0.14) are both positive and significant. Moreover, for examining the impact of technology related variables, after controlling some variables (Model, 6, Table 8) shows that the impact of forward linkage (forwardl)(0.76) is positive and significant.

Thus, the analysis shows that while for HT industries, only high-skilled labour played an important role in generating 'domestic value- added in gross exports'; the case of LT industries were different. In LT industrial sub-group, the dominant factors determining DVA includes capital, medium-skilled labour, forward linkage and R&D.

Table 9. Value Added in Indian Manufacturing Industries: Determinants

Value-Added (VA)							
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ALL			**HT**		**LT**	
cap	0.20* (1.85)	0.19* (1.68)		-0.04 (-0.41)	-0.002 (-0.00)	0.14 (1.00)	
htlab	0.35** (2.09)	0.27 (1.42)		0.77*** (6.69)	0.53*** (2.76)	0.21 (0.55)	
mtlab	-0.55 (-1.27)	-0.44 (-1.05)		-0.59*** (-4.13)	-0.23 (-0.86)	-0.80 (-1.27)	
ltlab	0.23 (0.65)	0.18 (0.60)		0.07 (0.43)	-0.86 (-0.28)	0.67** (2.44)	
importva	-0.17* (-1.70)		-0.10 (-1.62)	0.23** (2.29)		-0.13 (-1.15)	-0.07 (-1.26)
forwardl	-0.06 (-0.51)		0.04 (0.43)	-0.22** (-2.00)		0.25* (2.77)	0.15 (1.20)
backwardl	0.20* (1.85)		0.21* (1.92)	-0.54** (-2.47)		0.51*** (5.82)	0.32*** (3.82)
R&D	0.07 (1.37)	0.05 (1.08)		-0.04 (-0.71)	0.04 (0.52)	0.07 (1.21)	
Royalty	0.09 (1.19)	0.12 (1.51)		-0.12** (-2.17)	-0.08 (-0.77)	-0.03 (-0.18)	
Constant	-1.66** (-1.99)	-1.73*** (-3.46)	-2.23*** (-3.82)	-3.96*** (-7.99)	-2.40*** (-10.05)	-0.02 (-0.04)	-1.47*** (-3.14)
Wald chi2	43.20*** [8]	15.37*** [5]	8.99** [2]	167.8*** [8]	227.4*** [0.00]	168.3*** [8]	20.7*** [2]
Arellano-Bond Test AR(1)	-2.51**	-2.49**	-2.02**	-2.13**	-1.60	-1.93*	-1.75*
Sargen-Hansen	Robust	Robust	Robust	Robust	Robust	Robust	Robust

Note: 1. As Table 7

Estimation of factors determining Value-added is an issue that has grasps the attention of the scholars since ages. Various estimation processes[4] of ‘Production Function’ with various assumptions were used for determining the factors that lead to value-generation. But in the present paper, the issue is not only to estimate the impact of various indigenous variables like capital, labour, energy, material etc; but to examine the impact of various traditional factors (labour, capital), but also to include some technology intensive factors (R&D and Royalty) along with the international linkage factors (forward linkage, backward linkage, import of value-added) etc. As the aim is to examine the relationship of Indian manufacturing industries with the global value-chains (GVC), the analysis was based on econometric regression

[4] Estimation techniques includes Cobb- Douglas Production Function, Divisia Index, Translog Function etc.

analysis with various probable chosen variables that could have an impact on domestic value-addition.

The results of System GMM model shows that for all manufacturing industries (Model 1, Table 9) that the impact of capital (cap), high-skilled labour (htlab) and backward linkage (backwardl) are positive to the tune of 0.20, 0.35 and 0.20, respectively. The second model (Model 2, Table 9) shows that the impact of capital (cap) is positive (0.19) and significant determinant of domestic value-added in Indian manufacturing industry. Model 3 (Table 9) further shows that the impact of backward linkage (backwardl) is positive (0.21) and significant determinant of value-addition, although with some control variables.

Again, the understand the determinants of value-added from both High Technology (HT) and Low Technology (LT) industries, an attempt is made to examine the impact of various chosen variables on the value-added of these two different industrial sub-groups. For HT industries, it was found that (Model 5, Table 9) the impact of high-skilled labour (htlab) is positive (0.77) and significant, implies that the nature of high-technology is such that it requires high-skilled labour to generate more value. Further, it was also found that the impact of imports of value-added (importva) is also positive (0.23) and significant, although the impact of both forward (-0.22) and backward linkage (-0.54) was negative and significant. This signifies that the value-addition in relatively HT industries depends more upon high-skilled labour and import of value-added, rather than forward and backward linkages. Again, after controlling for some variables, Model 6 (Table 9) shows that the impact of high-skilled labour plays a dominant role in value-addition.

For Low Technology (LT) industry, Model 7 (Table 9) shows the impact of low-skilled labour (ltlab), forward linkage (forwardl) and backward linkage (backwardl) are positive (0.67), (0.25) and (0.51), respectively, implying that the LT manufacturing industries are more dependent upon relatively low-skilled labour and international linkages.

VI. Conclusion and Policy Recommendation

Massive improvements in Information and communication technology' (ICT) and transportation has changed the nature of 'globalization' over the recent years. The 'integration' amongst nations leads to fragmented 'production process' spanning across different nations. This phenomenon lead to the emergence of relatively new 'patterns' of 'production' and 'international trade', that are increasingly studied under the aegis of GVCs. In this context, it is learned from the literature the share of developing countries in GVCs is fast increasing over the years. In 1995, whereas Indian contribution to 'domestic value added in gross exports' was very meager, it increased to about 5 percent in 2011. In this context, it becomes very important and interesting to examine the structure of 'value- generation' from Indian manufacturing industries to GVCs, which is the main aim of the present study. Specifically, the aim of the present paper is to: (i) identify and examine the industries that are contributing more 'value' to GVCs and (ii) to examine the determining factors leading to the respective contribution of various industries to GVCs.

To address these issues, secondary data-sources like WIOD and TiVA databases were used along with other variables of use. From the descriptive analysis, many points emerge concerning the contribution of Indian manufacturing industries in Global Value Chains.

It was found the from 1995 to 2011, the share of Indian exports to the total World's export and domestic value-added content of gross exports, both increased over time. In the study, a comparison between the High-Tech and Low-Tech industries in terms of their respective 'domestic value-added content in gross exports' was done. The analysis showed that the share of High-technology industries increased as compared to Low- technology industries. The industries whose share in 'domestic value-added content in gross exports' increases includes Chemicals, Machinery and Equipment, Electrical and Optimal equipment, Motor vehicles etc.

Further, on comparing the growth of both 'gross exports' and 'domestic value-added content of gross exports', it was found that over the years both of them increases, but the rate of increase of the former is much higher as compared to latter. This signified that relatively less value is being contributed to GVCs from Indian manufacturing industries over the years.

Next, an analysis of comparing the role of 'backward' and 'forward' linkage was done and it was found that over the period from 1995 to 2011, the magnitude of 'backward linkage' increases massively as compared to 'forward linkage'. This shows that Indian manufacturing industries are integrated with other industries for different countries more through ‘backward linkages’ as compared to ‘forward linkages’.

Secondly, an attempt was made to examine the factors that determining the ‘participation’ of Indian manufacturing industries in global value chains (GVC). Using System GMM methodology, it was found that that variables like capital, medium-skilled labour, forward linkage and investment in Research and Development (R&D) are important factors determining the ‘domestic value-added in gross exports’ from Indian manufacturing industries over the years.

Further, to examine the factors that could helps in determining the ‘domestic value-added content in gross exports’ from both developed and developing countries, the econometric results showed that while for HT industries, only high-skilled labour played an important role, the factors were different for LT industries as the dominant factors determining DVA includes capital, medium-skilled labour, forward linkage and R&D.

Similarly, the econometric exercise was also done to determine the factors leading to ‘value-added’ from different manufacturing industries. It was found that various factors like capital, high-skilled labour and backward linkage played a dominant role.

Thus, it could be concluded that although the share of Indian manufacturing industries has increased over the years in GVC, but a lot needs to be done to enhance the capability and capacity so as to further increase their share and participation in GVCs. This is important as the contribution in GVC is increasingly understood as factors leading to more economic and employment growth.

Thus, the paper concludes that in order to increase the share of Indian manufacturing industries in GVC, emphasis should be made to increase the share of medium and high skilled labour force in place of low-skilled labour force trough ‘targeted’ policies at different levels for enhancing skills; and more emphasis should be directed to enhance the participation in both forward and backward linkages.

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Appendix I

Table A1: Choice of the Variables

Variables Name	Short form	Data Source	Expected Signs		
			All	HT	LT
Dependent Variable					
Domestic Value Added in Exports	DVA	TiVA			
Value Added	VA	WIOD			
Independent Variables					
Capital	cap	WIOD	+	+	+
Labour	lab	WIOD	+	+	+
High-Skilled Labour	htlab	WIOD	+	+	+

Medium-skilled labour	mtlab	WIOD	+	+	+
Low Skilled labour	ltlab	WIOD	+/-	-	+
Import of Value Added	Impva	TiVA	+/-	+/-	+/-
Forward Linkage	forwardl	TiVA	+	+	+
Backward Linkage	backwardl	TiVA	+	+	+
Research and Development	R&D	CMIE	+	+	+
Royalty	royalty	CMIE	+	+	+
Value added	VA	WIOD	+	+	+

Table A2. OECD classification of Manufacturing Industries

High Technology		**Low Technology**	
Industry Code	***Industry Name***	***Industry Code***	***Industry Name***
C24	Chemical and Chemical Product	C15TC16	Food Products, Beverages and Tobacco
C29	Machinery and Equipments	C17TC19	Textiles, Textile Products, Leather and Footwear
C30TC33	Electrical and Optical Equipment	C20TC22	Wood, Paper, paper product, printing and publishing
C34TC35	Motor Vehicles and other Transport Equipment	C23	Coke, Refined petroleum product and Nuclear Fuel
C36TC37	Manufacturing, nec recycling	C25	Rubber and Plastic Product
		C26	Other Non-Metallic Mineral Product
		C27TC28	Basic Metals and Fabricated Metal Products

Note: 1.The classification is based on OECD, 2011.
2. High Technology industry includes High-Technology (HT) and Medium-High Technology (MHT) industries.
3. Low Technology industry includes Medium-Low (MLT) and Low Technology (LT) industries.

Appendix II

Table B1. Descriptive Analysis

Variable	**Mean**	**Standard Deviation**	**Variance**	**Skewness**	**Kurtosis**
cap	-2.22	1.30	1.69	0.13	2.74
lab	-2.56	1.02	1.06	0.20	4.30
htlab	-2.77	1.07	1.15	0.42	4.15
mtlab	-2.60	1.09	1.19	0.27	3.48
ltlab	-2.80	1.50	2.26	-2.30	2.54
importva	-2.58	1.46	2.14	-0.14	2.70
forwardl	-2.56	1.39	1.93	-0.12	3.21
backwardl	-2.97	1.57	2.47	-0.42	3.25
R&D	-2.24	2.35	5.52	-0.53	2.15
Royalty	-2.54	2.13	4.53	-0.37	2.27

VA	-2.72	1.08	1.17	-1.53	8.71

Note: 1. The values are in logarithm.
2. Refer Appendix I, Table A1 for the variable name.

Table B2. Correlation Matrix

	cap	*htlab*	*mtlab*	*ltlab*	*importva*	*forwardl*	*backwardl*	*R&D*	*Royalty*	*VA*
cap	1.00									
htlab	0.30	1.00								
mtlab	0.18	0.71	1.00							
ltlab	0.07	0.48	0.86	1.00						
importva	0.25	0.18	-0.03	-0.2	1.00					
forwardl	0.17	0.14	-0.21	-0.3	0.23	1.00				
backwardl	0.16	0.03	-0.12	-0.4	0.58	0.16	1.00			
R&D	0.17	0.40	0.14	0.01	0.20	0.08	0.03	1.00		
Royalty	0.03	0.06	-0.05	-0.1	0.07	0.20	0.24	0.09	1.00	
VA	0.03	0.21	0.01	-0.02	0.07	0.08	0.24	0.23	0.23	1.00

Note: As Table B1.