‘Tilting Towards South’: Pattern and Determinants of Global Value Chains

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Geographical fragmentation of production process reoriented the attention of scholars towards the issues concerning international trade. From *trade in goods* the world is increasingly experiencing *trade in tasks*. The concerns of the countries are largely shifting towards increasing their share in global value-chains (GVC) for enhancing growth and employment opportunities. Therefore, it becomes important to examine the changing pattern of world production process. For the same, manufacturing sector of various developed and emerging economies is examined. It was found that the share from emerging countries in terms of “value-added” and “domestic value-added content in gross exports” has increased over the years as compared to G7 and other European Union (EU) countries. The paper also tried to econometrically examine the determinants of such change. It was also found that developed countries benefitted relatively more because of openness as compared to the manufactures belonging to emerging economies. The paper also discusses policy implications based upon systems of innovation approach.

Keywords: Global Value Chains (GVC), G7 countries, Innovation
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I. Introduction

Modern manufacturing process (Alfaro *et al.* 2015) and pattern of trade (Manova and Yu 2012) become increasingly fragmented across geographies paving the way for the new paradigm of theoretical literature contained in the notion of global value chains (GVC) (Gereffi *et al.* 2005). Initially termed as global commodity chain (GCC),[1] Gereffi in a series of research work during mid 1990s formulated and popularized the literature that was later termed as GVC[2] (Neilson and Pritchard 2009) that involved a group of inter-disciplinary scholars (Kawakami 2011). GVC can be described as sequential of value-adding activities from inception of the product or services to end use including after-sale services and recycling spanning across countries (Sturgeon 2001; Kawakami 2011). Gereffi (2004) has distinguished the value chains as either "buyer driven" or "producer-driven." The process in the former is driven by large retailers who themselves focus on design and marketing. They subcontract the production of the products to some other firms. In the producer-driven process, research and development (R&D) and final production is done indigenously while subcontracting some parts of the production (Milberg and Winkler 2013).[3] In the nutshell, the products in the GVC took specific forms with segmentations based upon the level of technological proximity of different firms belonging to distinguished geographies (Baldwin and Venables 2013).

It was found that the scope of GVC literature remained concentrated largely upon productive side of goods and services (Kawakami 2011). The firms within the value-added chains are also found to be largely concerned about issues like earmarking the activities to keep in-house

[1] In a paper published in 1994, Gereffi presented the GCC perspective wherein the discussion was focused on inter-organizational networks that cluster around one commodity. This literature was criticized of being static in nature (Kawakami 2011).

[2] In the meanwhile, alternate terminology to the concept was also developed. Stabell and Fjelstad (1998) termed these complex production processes as "value workshop" and "value network" describing "problem solving activities" (OECD 2008) and "confiscation of network to generate value", respectively.

[3] Milberg and Winkler (2013) further found that the buyer-driven GVC are mostly of low-technology industries like textiles, footwear etc while producer-driven GVC are of medium- to high technology industries like automobiles, aircrafts, spacecrafts *etc.*

and what and where to outsource (Gereffi *et al.* 2005). These issues has broadened the realm of traditional trade theories massively as the contemporary trade pattern are based upon the "power relations between producers, between management and labour within firms, and among governments, firms and households" (Milberg and Winkler 2013). The related GVC literature (Kawakami 2011; Milberg and Winkler 2013) however found that the lead firms[4] tend to locate suppliers for cost cutting. This process of disintegrated production process and integration through information technology (ICT) and transportation has created the complex web of interdependent but segregated value added chains. These distinct processes are characterised by proximate skill and technology that combine and contribute in GVC. In other words, the present production processes took trans-national form with contribution from different parts of the world. However, capturing the complex structure empirically is the biggest challenge in GVC. Therefore, most of the work on GVC took case studies as the unit of analysis to capture the underlying complexity of segregated production process (Johnson 2014; Lee *et al.* 2017).

Given the complexities, it is increasingly become important to understand the nature and structure of GVC. It was found that massive growth in international trade[5] is because of the fragmented production process with the emerging trend of international outsourcing (Daudin *et. al.* 2011). The literature also tried to build the relationship between GVC, growth and employment. There are few studies (Conelly 2012; Anderson and Gascon 2007; Friedman 2005; Dobbs 2004) that argued that the segmented production structure took away jobs from developed countries. There are also some (Scheve and Slaughter 2004; Levy 2005) that found that high-skilled jobs remained concentrated in developed countries while cheap, monotonous and less-skilled jobs got transferred. But at the same time, literature also captured the evidence of transference of high-skilled work out of developed countries in recent years (Milberg and Winkler 2013). Further, it was also found that the literature on GVC largely tried to capture the case of developed

[4] The lead firm is the firm that controls the GVC and more likely is responsible for the final sale of the product (Milberg and Winkler 2013).

[5] The merchandise trade as a percentage of world GDP has increased massively from 20 percent in 1970 to 34 percent in 1980 reaching to 48 percent in 2015 (World Development Indicators, available online).

countries (Antras and Chor 2013) and successful firms (Lee 2017). Therefore, it is equally important to understand the participation of emerging countries in GVC.

Therefore, the aim of the present paper is to present a holistic picture of participation of various developed and emerging countries in GVC. Specifically, the objective of the paper is to examine the pattern, structure and determinants of variables reflecting the participation of different manufacturing industries in GVC.

Thus, the aim of the paper is to examine (i) which countries/ countries groupings contribute more value from their respective manufacturing industries in GVC? (ii) What are the factors that determine the variable(s) reflecting participation of respective manufacturing industries from developed and emerging countries in GVC? The choice of the variable and data related issues are discussed in section III following the section II on review of theoretical and empirical literature. Section IV examines the pattern and structure of manufacturing industries in GVC. The regression analysis for determining the factors reflecting participation of manufacturing industries in GVC is presented and discussed in section V. In section VI role of public policy for growth and development with special emphasis on GVC is discussed. Section VII concludes the paper by presenting the summary of the paper and policy implications.

II. Review of Theoretical and Empirical Literature

A. International Trade, Technology and Production Process: Theoretical Perspective

Trade theories witnessed a paradigm shift from the exchange of complete goods leading the contemporary trade theorists G. Grossman and Rossi-Hansberg (2006) to acclaim in the opening statement of their paper that the "*nature of international trade has changed*" from trade in goods to trade in tasks which was largely due to the advancement in transportation and communication technology. However, the argument of "trade in tasks" is not new for economic jargon. It could be derived from Adam Smith's work on specialisation through division of labour, which remained agglomerated in a geographical location due to high cost of movement of goods and exchange of knowledge. The present globalised world could be understood as a manifestation of Adam

Smith's notion of dexterity through division of labour, which is rather international in character. The production process has become very flexible by combining vast array of suppliers within the production chains so as to combine the benefits of high average productivity, decrease average cost of production and introduction of technological superior products. This phenomenon has also broadened the Ricardian comparative advantage argument from "endowment in resources" to "endowments in tasks/processes" that leads to complex web of inter and intra- industrial along with inter and intra regional trade. The true picture of globalisation could be manifested in the manner in which the production process is carried out with the inter-play of numerous suppliers closely inter-linking in a competitive environment wherein technology and skills are dominant sources of growth and determinants of trade. This has been argued in the theoretical framework of Grossman (1992) wherein trade is determined by the endowment of technological capabilities.

Thus, the long enduring debate concerning the relationship between free trade and economic growth[6] get subsumed in the recent wave of globalisation that re-asserted the need to examine determinants and pattern of international trade. 'Where' and 'how much' to enter the GVC determine the pattern of production and international trade that subsequently transform into the ways and means to increase the content of value-addition to the GVC (Gereffi 2005). This could be seen as an extension of early 1980s models of trade theories (Helpman and Krugman 1995) that tried to discuss the relationship between trade and industrial organisation. These models examined the pattern of international trade in innovative world under the assumptions of imperfect competition and increasing returns.

In a paper published in 2010, Sen argued that the focus of trade theories transformed from 'location-specific' to 'product-specific' and 'organisation- specific' aspects. It was further asserted that the contemporary pattern of trade also took the form as that of product life-cycle (PLC) theories of Posner (1961) and Vernoon (1970). These theories considered three stages in the life of a product - new, maturing and standardized. PLC theories argued that the stage of product determines the pattern of trade. Initially the new product is exported from most

[6] This literature is discussed by Nayyar (2008).

advanced countries to the other advanced countries. In the second stage, technology gets transferred to other advanced countries mainly through trade that lead them to produce and export the products. By the time, the product become standardize, the production of that product get shifted to less advanced countries, which in turn exports the products to the advanced countries. But the present pattern under GVC can be understood with respect to "processes" and thus PLC can assume a broadened scope. Further, flying-geese paradigm (Ozawa 2009; Sen 2010) discussed the phenomenon underlying transfer of the production process from developed countries to developing countries that determines and reflects the shifting of competitiveness from one country to another (Akyuz 2009).

Another strand of literature reflected in the work of Grossman and Hansberg (2006) conceptualized the production function in terms of tasks describing international division of labour to propose a new paradigm to capture the contemporary pattern of production process in which each country contribute value in the global value chains. Simultaneously, the concerns of the theoretical literature also started shifting towards governance of the value-chains that spread to different geographical regions. Gereffi *et al.* (2005) build the theoretical framework for global value chain literature by drawing on three literatures including transaction cost economics, production networks, and technological capability and firm learning to build the framework for the governance of global value chains. It was further argued that governance could take different forms like hierarchy, captive, relational, modular and market, both in isolation and also with different degrees of overlapping.

Thus, the above selective review shows that the theoretical literature on GVC has expanded its horizons to various dimensions to explore its structure, pattern, determinants and governance issues over the years. These strands of literature reflect the changing structure of production process. Subsequently, review of some of empirical literature is presented in the following sub-section.

B. Review of Empirical Literature Related to GVC

During 1970s and 1980s, globalisation took the form of segregated production with a surge in international trade that lead to the intellectual origin of GVC literature. Initially, researchers (Gereffi and

Korzeniewicz 1994) termed it as *global commodity chains* which was later made more inclusive as *global value chains* after the work of researchers from Institute for Development Studies (IDS) at University of Sussex (Neilson and Pritchard 2009).[7] The GVC approach aimed to "understand the business strategies adopted in capitalist process for the operation of industry in different geographies creating opportunities and constraints for different people and places" (ibid).

In the field of GVC research, the contribution of Gereffi and colleagues is very significant. In an edited book published in 1994, Gereffi found that the value chains have three analytical dimensions: input-output structure, territoriality and governance structure. Later in 1995, Gereffi also added the fourth dimension of *institutions* in which the industrial value-chain is embedded. Further, Gereffi (1999) and Humphrey and Schimdt (2002) added another dimension for the element of analysis referred to as *upgrading* depicting dynamic movement within the value-chains. These dimensions became the main point of analysis in subsequent GVC literature.

Data related issues and method of analysis are the biggest challenges for the researchers working in the area of GVC (Kaplinsky and Morris 2001; Neilson *et al.* 2009). Researchers have used different secondary (Banga 2014) and primary (Neilson *et al.* 2009) data sources. But Sturgeon (2001) argued that multi-national and multi-research collaborations would do a much needed task in GVC framework with focus on quantitative and qualitative research. However, researchers have resorted to case studies including some lead firms or suppliers from certain industries and countries to reflect upon the GVC framework. In a very comprehensive paper, Gereffi and Fernandez-Stark (2011) presented all the dimensions of GVC literature. The paper also discusses the complex structure of social and economic upgrading and workforce development under GVC.

In an interesting paper, Kaplinsky (2000) talked about the impact of increasing globalisation on inequality within and between countries and further raise an important issue "*that how to participate in global production process so as to provide sustainable income growth for poor people and poor nations?*" Taken the case of four value chains of fresh

[7] Nielson *et al.* (2009) highlighted that the GVC approach borrowed the influential terminology attached to the work of Michael Porter (1990) that studied the comparative advantage.

fruits and vegetables, canned deciduous fruit, footwear and automobile components, the author discussed the ways and policies for reaping benefits from participation in global value-chains. While taking the case of automobile industry, Humphrey and Salerno (2000) examined the impact of globalisation on the structure of supply chain network in Brazil and India. It was found that the assemblers created new linkages in emerging markets that lead to transformation of auto- component industry in both the countries. In a similar framework, Appelbaum (2009) found that the production function has become more complex and integrated between production and distribution. He further found that the production function has largely become more buyer-driven with the emergence of giant retailers and giant transnational contractors.

Banyuls and Haipeter (2010) examined the issues of labour in context of global value chains. They discussed the case of motor industry in four countries namely Germany, Italy, Spain and Hungary and found that the impact of GVC on employment is different in these countries. These differences could have been resulted due to varied policy regimes and labour standard in these countries. Azmeh and Nadvi (2014) discussed the role of Asian firms in restructuring the global value chains. Using the case studies of some of the largest production firms like Nien Hsing (Taiwanese) and Crystal group (Hong Kong), the authors examined the process of expansion and entry in the global value chains. Further, the authors also examined how these firms managed complex international production linkages to ensure the incorporation of Jordan into the global garment industry.

Los *et al.* (2015) raised the issue of whether the fragmentation of production takes places within a region or is it spreads to the whole world? Based upon the new input-output model of the world economy covering 40 countries and 14 manufacturing product groups, the study found that in almost all products, more value is added outside the country-of-completion, specifically after 1995. Further, the study also found that the evidence of transition from regional production system to global production system. However, Koopman *et al.* (2012) proposes a framework for gross exports accounting that breaks it up into various value-added components by source. Further, based on a value-added pattern of trade, the authors also computed revealed comparative advantages. Choi (2013) measured the trade in value-added using data from World Input-Output tables for 40 countries for 35 industries from 1996 to 2009. The paper also examined the determents of value-added

and found that factor endowments and technological differences are the dominant factors of changing pattern of trade over the years. In a paper published in 2014, Timmer et al found that the relatively unskilled-labour intensive production processes are getting relocated to lower-wage countries, while the strategic high valued added functions are concentrated in relatively matured economies. The study also found a worldwide fall in the demand of unskilled workers.

Alfaro *et al.* (2015) presented a theoretical model along with empirical evidence describing a property right model in which firm's boundaries were shaped by characteristic of production function and the position of firm in global value chains. Examining the present trend of trade negotiations, Eckhardt and Poletti (2015) found that the contemporary pattern of production lead EU to have trade negotiations with the Asian countries.

Research concerning global value chains is still evolving and is engulfed with complexities and dynamism with various actors spreading across geographies. In a very important study prepared for IDRC, Kaplinsky and Morris (2001) penned a handbook dealing with all the relevant terminological, methodological and analytical aspect concerning global value-chains literature.

The review of the above literature show that the interest of development and trade theorists started diverting to the issues concerning GVC. An interesting literature started pouring in during the past few years on GVC. But discussions on some important issues needs more research within the field. Some of these issues include: which countries are contributing more values in GVC? Are the factors determining the participation in GVC from developed and emerging economies are same? Since, the consistent analysis at the level of manufacturing industries is lacking in the literature on the issues raised above, the present study tries to fill the gap in existing literature.

III. Database and Methodology

To reiterate, the issues related to data, choice of appropriate variables and unit of analysis are the challenges for the researchers working on the area of GVC. It is a complex exercise consisting of an array of input-output relationship of different firms of numerous industries spanning different countries. In the past, researchers generated the requisite databases by compiling data for value-addition using various data-

sources including trade statistics and input-output tables. However, an initiative in the form of World Input-Output database (WIOD) was undertaken by European Commission that provides the time-series database from 1995 to 2009. Timmer *et al.* (2015) described that the WIOD database was constructed by merging three datasets viz. Input-output tables, national accounts data and international databases for different countries. The WIOD database was first released in 2012 in Brussels. Apart from providing the value-added data, WIOD also provides comparable data on various indicators like wages and workers according to their skills.[8]

In 2013, OECD-WTO jointly released a dataset for inter-country input-output system (ICIO) to calculate 'Trade in Value-Added' (TiVA). It provides data for 63 countries and their aggregates for agriculture, manufacturing and service. Till early 2016, the data for years 1995, 2000, 2005 and 2008- 2011 was available. The dataset is unique as it provides a consistent dataset to examine the structure of value-added emanating from different industries for different countries. This database could be considered as a part of 'Made in World' initiative.[9]

TiVA provides data for a range of variables reflecting the participation of different industrial sectors from different countries in GVC. For the present analysis, manufacturing industries were chosen as the unit of analysis for various developed and emerging economies. Data for some chosen variables like gross exports, domestic value-added content in gross exports, total production, value-added were extracted. These variables reflect the participation of manufacturing industries in GVC. In all, data for 61 individual countries along with 'rest of the world' was extracted. These countries were classified as G7 countries, EU countries[10] and emerging countries, apart from 'rest of the world' countries.

[8] The basis of classification of labour into high-skill, medium-skill, and low-skill is International Standard Classification of Education (ISCED).

[9] Timmer *et al.* 2015 discuss the issues related to alternative GVC datasets.

[10] G7 countries are largely the part of European Union (EU) countries. The classification of these sub-groups is done to distinguish the most developed countries (G7) countries from the rest of the developed countries. According to IMF, G7 countries are group of seven most industrialized countries that are holding annual economic summits since 1975. EU is a politico-economic union of 28 European countries (as on 2013) that started in 1951.

For the second part of the paper, wherein the objective is to find out the factors that determine the participation of manufacturing industries from developed and emerging economies in GVC, the first task was to choose the variables that best reflect the participation of manufacturing industries in GVC. Thus, two variables namely "value-added" and "domestic value-added content of gross exports" were chosen that indicates the participation of manufacturing industries from different countries in global production network.

TiVA defines Value-added as "*the value that is added by industry i in country c when producing goods and services. It is equivalent to the difference between the industry's production and the sum of its intermediate inputs of goods and services*."

Domestic value-added content in gross exports is defined in TiVA as "*the domestic value added embodied in exports by industry i in country c covering value added generated anywhere in the domestic economy*."

It needs to be highlighted that however, both WIOD and OECD-WTO's TiVA database provides data on *value-added*. The data on *domestic value-added content in gross exports* is available in TiVA database only. To maintain consistency in the dataset used, data for both *value-added* and *domestic value-added content in gross exports* were taken from TiVA database. But TiVA provides data for the years 1995, 2000, 2005 and 2008 to 2011.[11] Therefore, for the regression analysis we have extracted the data for continuously from 2008 to 2011. Thus the non-availability of long-term data is the major constraint of the present analysis. Further, of the 61 countries, the dataset for regression analysis was extracted for only 27 countries as data for all the chosen variables were not available for all the countries. Further, countries were classified into three major groupings- G7 is the group of seven most advanced countries, EU are the countries of European Union after excluding G7 countries. This classification helps in comparing the most developed countries (G7) with other developed countries (EU). The third group of countries termed as *emerging countries* include the countries from South-East Asia and some other emerging countries for which the requisite data was available at consistent basis (Appendix Table 1).

The other major data-sources used in the present paper are WIOD database, UNESCO's UIS database, World Development Indicators,

[11] As available in Jan' 2016, when the data for the present work was extracted.

etc. The details of the databases and variables taken from them are presented in Appendix Table 2. Thus, the following variables were chosen for the regression analysis, the result of which is presented in section V.

Regression Analysis: Dependent and Independent Variables

Dependent variable

To reiterate, the aim of the paper is to examine the factors that determine the participation of manufacturing industries from different countries in GVC. As discussed above, "value-added" and "domestic value-added content of gross exports" were chosen as variables that reflects the participation of manufacturing industries in GVC. Thus, for the regression analysis, the following two variables were chosen as dependent variables.

Value added: This data-series was taken from OECD-WTO's TiVA database for the year 2008 to 2011 for regression analysis. The data was, however available at current USD prices that was made constant using the 'Price Levels of Gross Value added' (1995=100) i.e. value added deflators extracted from WIOD Socio Economic Accounts, Basic Data on output and employment, July 2014 release. The dataset was constructed for the manufacturing industries for the selected developed and emerging economies (Appendix Table 1).

Domestic Value-added content of gross exports: This is another important variable that depicts the participation of domestic manufacturing industries in GVC. The data series were extracted from Trade in Value-added (TiVA) dataset for different selected countries (Appendix Table 1). TiVA provides the dataset in a comprehensive manner for comparable data series for different countries. This data was extracted from 2008 to 2011 and was made constant using the value-added deflators from WIOD database at 1995 price levels.

Independent Variables

Price Level: "Price level gross output" taken from WIOD database with 1995 as base was taken as a measurement for the price level. It was assumed that there would be negative relationship of price with the level of value-added and domestic value-added content in gross exports due to price competition in the international market. Thus, it

is expected that lower the price level, higher would be the content of value-added and domestic value-added content in gross exports.

Skill Intensity of the Total Persons Engaged: The debate concerning the impact of globalisation on employment has been into the centre-stage since decades (Nayyar 2008). It was argued that the cheap low-skilled manpower from developing world is taking up the jobs from developed countries (Scheve and Slaughter 2004; Levy 2005). But, there are some studies (Milberg and Winkler 2013) that found increasingly transfer of high-skilled jobs to low-wage countries. So the issue remained largely inconclusive. Thus, the present study tried to examine the impact of high skilled (HS), medium skilled (MS) and low skilled (LS) workers from different developed and emerging economies on the extent of participation of their respective manufacturing industries in GVC. WIOD database was used to construct the data series for high-skilled (HS), medium-skilled (MS) and low-skilled (LS) employees for chosen countries. First, the data on "total hours worked by employees" was extracted. Then the proportion of high skilled (HS), medium skilled (MS) and low skilled (LS) employees were calculated based on the proportion of HS, MS and LS employees from WIOD database.

Given the nature of skill endowment in different countries, it is assumed that for developed countries, relatively high-skilled (HS) employees have a positive impact on both the chosen dependent variable(s). Similarly, for emerging countries, it is assumed that relatively low- skilled (LS) employees have a positive impact on dependent variable(s).

Capital: Capital is largely regarded as an important ingredient of growth. From its explicit importance in neo-classical theories, capital is also regarded as a means to transfer embodied technology in endogenous growth theories of late twentieth century. For the present analysis, it is assumed that capital stock would have a positive impact on both value-added and domestic value-added content in gross exports from the manufacturing industries of both developed and emerging economies. The "real fixed capital stock" at 1995 prices was taken from WIOD database.

Digital Base: The technological advancements in information and communication technology led to the emergence of digital world, which is more sophistically integrated. The digital era has mitigated the virtual boundaries massively over the years. The countries are trying to capture the benefits of technological development in the field of digitalization.

ICT and other forms of digitalization has changed the pattern and pace of growth altogether over the years. For the present analysis, it is hypothesis that digital base have a positive impact on both value-added and domestic value-added content of gross exports for both developed and emerging economies. For the same, data for two variables, ICT density and Telephone density, both per 100 people were extracted from World Bank Indicators, an online data source. Then, an average of both the variables was done and was included as independent variable in the regression analysis.

Innovation: Innovation is largely acclaimed to be important for growth, development, competitiveness (Lall 2001) and catching-up (Lee 2015). But the process of its generation and dissemination are expensive, strategic and tedious task involving various actors. Subsequently, it is equally complex to generate/find indicators that depict innovation. For the analysis, we consider two types of innovation- product innovation and process innovation. Product innovation could be understood as an introduction of a new product. Process innovation connotes an introduction of a new method of producing an old product. Both are inter-related but literature on innovation found that both of these innovations results due to different types and magnitudes of efforts. But it is also pertinent to note that the effort, resources and complexity is relatively more involved in introducing product innovation as compared to process innovation. Therefore, it is expected that product innovation would have a positive impact on value-added and domestic value-added content in gross exports emanating from manufacturing sector of developed countries. Further, it was also hypothesis that process innovation would have a positive impact on the respective dependent variables for manufacturing sector of emerging countries. Data on both product and process innovation was taken from UNESCO's UIS.stat database to find their impact on both the dependent variables.

Openness: Openness is a relative term. It is an indicator that tries to capture the extent of integration through international trade amongst nations. It can be used as a proxy of size in the realm of international integration. Openness indicator was derived by adding the values of total exports and total imports of goods and services (both at constant prices) divided by GDP at constant prices. It is assumed that openness would have a positive impact on the chosen dependent variable(s).

Methodology: Descriptive Analysis and Panel Regression Estimation

For the results presented in section IV, simple descriptive techniques like estimation of shares were done. However, for the results presented in section V, the following panel regression model was estimated. The basic model takes the following form:

Model 1:

Value added = *f* (price, human capital, innovation, digital base, openness)

Model 2:

Domestic value-added content in gross exports = *f* (price, human capital, innovation, digital base, openness)

Specifically, the models takes the general form as:

For Model 1:

$$\ln VA_{it} = \alpha_{o\,it} + \beta_o P_{it} + \beta_1 HS_{it} + \beta_2 MS_{it} + \beta_3 LS_{it} + \beta_4 K_{it} + \beta_5 PR_{it} + \beta_6 PS_{it} + \beta_7 D_{it} + \beta_8 O_{it} + u_{it} \quad (1)$$

For Model 2:

$$\ln VAE = \alpha_{o\,it} + \beta_o P_{it} + \beta_1 HS_{it} + \beta_2 MS_{it} + \beta_3 LS_{it} + \beta_4 K_{it} + \beta_5 PR_{it} + \beta_6 PS_{it} + \beta_7 D_{it} + \beta_8 O_{it} + u_{it} \quad (2)$$

where:

α_o is constant, β_i's are the regression coefficients for the following chosen independent variables that are transformed by taking logarithms.

VA is value-added in manufacturing industries,

VAE is domestic value-added content in gross exports from manufacturing industry,

P indicates general price level,

HS is the proportion of total hour worked by high-skilled labour in respective manufacturing industries in respective chosen countries,

MS is the proportion of total hours worked by medium-skilled labour in respective manufacturing industry in respective chosen countries,

LS is the proportion of total hours worked by low-skilled labour in respective manufacturing industries in respective chosen countries,

K indicates the stock of real fixed capital in respective manufacturing industries in respective chosen countries,

PR is the variable for product innovation in respective manufacturing industries in respective chosen countries,

PS is the variable for process innovation in respective manufacturing industries in respective chosen countries,
D is the variable for digital base in the economy. It is an average of the level of telephone and ICT density per 100 persons,
O indicates the openness index which is calculated as (Exports+ Imports)/ GDP
μ is the error term

For the models 1 and 2, data for seven G7 countries, eleven EU countries and nine emerging countries for the years 2008 to 2011 was collected (Appendix Table 1). All data-series were made constant at 1995 prices.

For the estimation, the panel dataset was constructed for three different countries grouping for four years. The model (Johnston and DiNardo 1997) consists of the explanatory variables and disturbance term. The generalization approach in the form of generalized linear regression model is a relatively better methodological estimation technique to analyze data observed across countries for number of time periods. But these estimation techniques depend upon the structure of covariance across the groups (Greene 2007).

However, feasible general least regression (FGLS) model uses the sample of data to estimate the variance-covariance disturbances, thus providing the efficient estimates of the parameters. Thus, in the present paper, FGLS estimation technique was used that presents the coefficients after controlling for autocorrelation and heteroscedasticity. STATA software was used to estimate the feasible generalized linear regression model.

IV. Value-Added in Production and Exports

As the aim of the present section is to present the structure of participation of manufacturing industries in GVC, various variables like gross exports, domestic value-added content in gross exports, total production, value-added etc was chosen for the analysis. The data is extracted for various developed and emerging countries. The developed countries are classified as G7 and EU countries which are compared with the chosen emerging countries. The results for the respective variables for the years 1995, 2000, 2005 and 2011 are presented in Table 1 and 2. The data for G7 countries, EU countries (excluding the

TABLE 1
GROSS EXPORTS AND DOMESTIC VALUE-ADDED CONTENT IN GROSS EXPORTS

	1995		2000		2005		2011	
	EX	*VAE*	*EX*	*VAE*	*EX*	*VAE*	*EX*	*VAE*
G7	***54.38***	***58.38***	***51.22***	***56.32***	***44.93***	***49.73***	***38.61***	***42.08***
of which:								
Canada	3.93	3.53	4.73	4.28	3.65	3.51	2.53	2.48
France	6.08	6.15	5.42	5.35	5.15	5.17	4.02	4.02
Germany	11.51	12.41	9.45	10.10	10.78	11.66	9.32	9.76
Italy	5.35	5.52	4.45	4.71	4.54	4.79	4.05	4.14
Japan	9.31	11.32	8.33	10.61	6.79	8.48	5.78	7.12
United Kingdom	5.21	5.15	4.52	4.71	3.68	3.93	3.12	3.01
United States	12.99	14.26	14.32	16.56	10.34	12.19	9.79	11.55
EU	***16.16***	***20.12***	***13.94***	***18.43***	***13.53***	***18.92***	***11.26***	***17.59***
South-East Asia#	***12.58***	***9.99***	***14.82***	***11.73***	***19.56***	***15.93***	***26.84***	***23.55***
Some of which are								
China	2.69	1.83	4.43	3.07	9.01	6.79	13.91	12.52
India	0.62	0.71	0.68	0.81	1.13	1.23	2.12	2.04
Indonesia	0.81	0.85	0.83	0.88	0.80	0.90	0.92	1.23
S. Korea	3.07	2.92	3.51	3.19	3.89	3.49	4.61	3.67
Other Emerging Countries	***5.23***	***5.29***	***6.42***	***6.05***	***7.56***	***7.66***	***8.32***	***8.69***
including								
Mexico	1.67	1.34	3.01	2.28	2.41	1.89	2.23	1.89
Poland	0.56	0.59	0.62	0.60	1.08	1.02	1.33	1.19
Turkey	0.52	0.59	0.52	0.58	0.92	0.94	1.02	0.99
Brazil	0.96	1.12	0.94	1.13	1.30	1.61	1.30	1.67
Russia	1.52	1.64	1.33	1.44	1.85	2.19	2.44	2.92
Other Countries*	***11.65***	***4.01***	***13.6***	***4.98***	***14.42***	***5.66***	***14.97***	***6.43***
World	***100***	***100***	***100***	***100***	***100***	***100***	***100***	***100***

Note: 1. EX and VAE means Gross Exports and Domestic Value-added content in Gross Exports, respectively.
2. The total of different countries may not be equal to Worlds due to rounding-off errors.
3. # means the group of 'South East Asia' also includes countries Hong Kong, Malaysia, Philippines, Singapore, Thailand, and Vietnam.
4. * means the group of 'Other Countries' includes countries that are not included in the other sub-groups like G7, EU, South Asian countries and other Emerging countries. This is included to present the shares of different countries groupings in a more profound manner.

Data Source: TiVA
Source: Author's Calculation.

G7 countries) and 10 South East Asian countries including countries like *China*, Hong Kong, *India, Indonesia, South Korea*, Malaysia, Philippines, Singapore, Thailand and Vietnam, some other emerging countries like *Mexico, Poland, Turkey, Brazil* and *Russia* (Shares of the countries in Italics are specifically shown in Tables 1 and 2) are presented. The present section also shows the results of the '*other countries*' with shares of all the countries that are not included in the above mentioned sub-groups.

In the first part of the section, the structure of "gross export" and "domestic value-added content in gross exports" from the total manufacturing industries are presented for different developed and emerging countries. As already discussed, the countries are sub-grouped into four categories to have the comparative analysis of the broad pattern of growth in gross exports and domestic value-added content in gross exports to examine the changing structure of GVC. Thus, the exercise in the present section is very holistic in nature as it tries to present the shares of almost all the major developed and emerging countries over the years in terms of gross exports and domestic value-added in content in gross exports.

Table 1 shows the share of gross exports from developed countries, G7 and European Union countries fell steadily from around 70 percent of the world's export in 1995 to around 50 percent in 2011. The share was subsequently swell up for South Asian countries. It was observed that from 1995 to 2011, share of Germany, Japan, France, United Kingdom and United States fell and that of China, South Korea and India increased over the same period.

Similarly, domestic value-added content in gross exports also fell for developed countries. Its share for both G7 and EU countries was around 78 percent in 1995 that fell to around 60 percent over the period of around one and half decades. On the other hand, the share of China in terms of domestic value-added content in gross exports increased massively over the years from a meagre 1.83 percent in 1995 to massive 12.5 percent in 2011. Apart from China, other countries whose share in domestic value-added content in gross exports has increased over the years are South Korea and India.

Further, the share of different developed and emerging countries in terms of "total production" is presented in Table 2. It was found that in 1995, G7 countries were manufacturing around 60 percent of the worlds' total production that fell massively and reached to around 35

TABLE 2
TOTAL PRODUCTION AND VALUE-ADDED INTENSITY IN DIFFERENT COUNTRIES

	1995		2000		2005		2011	
	P	VAP	P	VAP	P	VAP	P	VAP
G7	***61.77***	***34.38***	***59.27***	***33.05***	***49.86***	***31.71***	***35.51***	***29.69***
Of which								
Canada	1.78	33.52	2.31	32.2	2.14	30.41	1.50	29.78
France	4.58	31.44	3.89	28.69	3.88	26.85	2.75	23.68
Germany	8.27	36.89	6.48	33.87	6.91	32.92	5.65	31.34
Italy	4.42	30.86	4.08	29.05	4.33	27.78	2.96	26.65
Japan	19.34	36.59	15.7	36.28	11.0	33.26	8.35	30.77
United Kingdom	3.6	36.72	3.5	36.76	3.06	35.99	1.78	32.86
United States	19.78	34.63	23.31	34.51	18.54	34.73	12.52	32.74
EU Countries	8.07	31.57	7.33	30.87	8.07	29.92	5.99	27.71
South-East Asia[#]	***13.6***	***28.18***	***16.71***	***26.91***	***22.6***	***24.87***	***38.21***	***23.13***
Some of which are								
China	5.53	26.58	8.42	25.49	12.80	22.57	27.15	19.68
India	1.58	26.34	1.74	25.82	2.28	25.14	2.95	23.34
Indonesia	1.03	34.61	0.73	34.92	0.79	39.06	1.22	38.91
S. Korea	2.96	26.63	3.08	25.46	3.63	23.63	3.68	20.31
Other Emerging Countries	***5.86***	***34.97***	***6.17***	***33.65***	***7.95***	***27.34***	***8.58***	***26.12***
including								
Mexico	1.17	34.04	2.22	33.83	1.88	32.97	1.46	32.31
Poland	0.49	31.43	0.56	29.13	0.76	26.17	0.81	23.96
Turkey	0.83	42.93	0.72	41.79	1.70	20.31	1.47	20.63
Brazil	2.40	30.34	1.95	27.49	2.12	25.35	2.81	24.97
Russia	0.95	35.2	0.73	36.05	1.47	31.93	2.01	28.75
Other Countries[*]	***9.11***	***32.65***	***8.78***	***31.14***	***9.92***	***30.33***	***10.36***	***29.39***
World	***100***	-	***100***	-	***100***	-	***100***	-

Note: 1. 'P' indicates total production.
2. VAP means value-added as a percentage of production.
3. Same as Table 1, Notes 2, 3, and 4.
Data Source: TiVA
Source: Author's Calculation.

percent in 2011. The share of Japanese manufacturing production, of the total world production fell from 19 percent in 1995 to around 8 percent in 2011. Similarly, the shares of France, Germany, Italy and United Kingdom fell to half of their respective shares in total world production in 2011 as compared to 1995. Further, the share of the

remaining EU countries was around 8 percent in 1995 that fell further to 6 percent in 2011. On the other hand, the share of South-East Asian countries in terms of total manufacturing production increased from 13.6 percent in 1995, to 22.6 percent in 2005 to subsequently reaching at 38 percent of world's production in 2011. Table 2 shows a massive increase in the share of Chinese manufacturers that lead to an increase in the share of South-Asian countries as compared to G7 and EU. The share of China in global manufacturing production was 5 percent in 1995 that jumped to more than 12 percent in 2005 and further to 27 percent in 2011.

Further, we have also extracted the data for the variable "value-added as a percentage of production" for different developed and emerging countries from TiVA database. The variable can be termed as 'value-added intensity' indicating the share of value-added of industry i from country c in its gross output. It was found that (Table 2) value-added intensity for the manufacturing industry of few countries namely China, Indonesia and Philippines has increased in 2011 as compared to 1995.

V. Determinants of Participation in GVC: Regression Analysis

This section discuss the results of the Models 1 and 2 presented in section III. The descriptive analysis of the dataset used is presented in Appendix Table 3 and 4. Appendix Table 3 shows the mean, standard deviation along with the minimum and maximum values of different variables used in the estimation process while Appendix Table 4 shows the correlation matrix. It was found that for G7 countries the variability is high for ln domestic value-added content in gross exports, ln capital, ln product innovation and ln openness. Amongst EU countries, variability is high in ln low skilled labour, ln capital, ln product innovation and ln process innovation. From the emerging countries subgroup, the variability is highest for the indicator of digital base along with other variables except product and process innovation. However, Appendix Table 4 shows that the correlation between product and process innovation is high for all different groups of countries. The correlation between value-added and domestic value-added content in gross exports is high in EU and emerging countries and not for G7 countries signifying that for G7 countries the high contribution to value-added is not leading to higher exports of value-added from these

TABLE 3
VALUE-ADDED IN MANUFACTURING INDUSTRIES IN DEVELOPED AND EMERGING COUNTRIES: RESULTS OF REGRESSION ANALYSIS

Dependent Variable: ln value-added			
	G7	Developed (EU)	Emerging
	Coeff (z values)	Coeff (z values)	Coeff (z values)
ln price (ln P)	0.31	-0.79	-0.69***
	(0.52)	(0.94)	(-9.49)
ln high skill labour (ln HS)	-0.44	0.72***	0.08
	(-1.00)	(5.55)	(0.17)
ln medium skill (ln MS)	0.95**	0.72***	0.05
	(2.04)	(4.24)	(0.13)
ln low skill (ln LS)	0.28*	-0.27**	0.07
	(2.35)	(-2.68)	(1.45)
ln capital (ln K)	0.35**	0.01	0.07
	(4.34)	(0.11)	(1.61)
ln digital base (ln D)	-0.41	-1.14*	0.03*
	(-0.66)	(-1.74)	(1.84)
ln product innovation (ln PR)	2.25***	-0.01	-3.23***
	(3.12)	(-0.02)	(-7.47)
ln process innovation (ln PS)	-1.00	0.28	2.15***
	(-1.47)	(0.56)	(5.44)
ln openness (ln O)	0.02**	1.66**	-0.12
	(6.33)	(2.48)	(-0.38)
Constant	-5.33	7.32*	14.27***
	(-1.12)	(1.69)	(9.07)
Number of observations	28	44	36
Wald Chi2 (9)	1003.58***	841.29***	1701.09***

Note: 1. ***, **, * means that the coefficients are significant at 1 percent, 5 percent and 10 percent level, respectively.
2. Refer Appendix I, Table 1 for the List of Countries chosen for the analysis.
Source: Author's Estimation.

countries. Further, the correlation between price level and value-added is negative for emerging countries as compared to other groupings. The result of the regression analysis for determining the factors for value-added and domestic value-added content in gross exports is presented in the following Table 3 and 4, respectively.

Table 3 presents the results of the regression analysis with log of value-added as the dependent variable for different developed (G7 and EU countries) and emerging countries.

The impact of various chosen variables on 'value-added' from manufacturing sector of chosen emerging economies was examined. It was found that the coefficients for price and product innovation were highly significant although negative in magnitude. The negative coefficient for price signifies that lower prices had a positive impact on value-added from the manufacturing industry of emerging economies. This could be understood in terms of the lower costs of production that could have been reflected in lower prices. It was also found that for manufacturing industries from emerging economies, the coefficient for product innovation was significant, but its magnitude was negative. On the other hand, the coefficient for process innovation was significant and positive. This implies that process innovation had a positive and significant impact on value-added of manufacturing industries from emerging economies.

Further, Table 3 also tried to capture the determinants of value-added from manufacturing industries of developed countries. As already discussed, developed countries were classified into two subgroups-G7 and European Union (EU) for the analysis. It was found that the determinants of value-added in these two sub-groups of developed countries were very different. For the group of G7 countries, the impact of medium-skilled labour, capital and product innovation were found to be positive and highly significant. Amongst these, the magnitude of product innovation was the highest signifying the importance of product innovation in generating value in manufacturing industries of these countries. For EU countries, however, it was found that the impact of high and medium skilled labour played a dominant part in determining value-added from the respective manufacturing industries. It was also found that the impact of openness was also positive and highly significant implying that the opening of the economies had a positive impact on the manufacturing of the developed economies.

In the nutshell, the result of the regression analysis (Table 3) signifies that there were different factors that determined the value-added from manufacturing industries of different countries' sub-groupings. For highly developed G7 countries, the impact of variables likes openness, capital stock, product innovation, and medium-skilled labour played a dominant role. For EU counties (group of developed

TABLE 4
DETERMINANTS OF 'DOMESTIC VALUE-ADDED CONTENT IN GROSS EXPORTS': RESULTS

Dependent Variable: ln domestic value-added content in gross exports			
	G7	Developed (EU)	Emerging
	Coeff (z values)	Coeff (z values)	Coeff (z values)
ln price (ln P)	1.67***	-0.14	-0.88***
	(2.78)	(-1.27)	(-16.17)
ln high skill labour (ln HS)	-0.13	0.08***	-0.47
	(-0.28)	(4.99)	(-1.22)
ln medium skill (ln MS)	-3.30***	0.07***	0.63**
	(-6.93)	(3.37)	(2.12)
ln low skill (ln LS)	2.52***	-0.02**	-0.04
	(20.66)	(-2.09)	(-0.97)
ln capital (ln K)	1.39***	0.003	-0.02
	(17.03)	(0.43)	(-0.57)
ln digital base (ln D)	-0.79	-0.15*	0.03***
	(-1.26)	(-1.94)	(2.81)
ln product innovation (ln PR)	5.31***	-0.002	-0.99***
	(7.23)	(-0.03)	(-3.99)
ln process innovation (ln PS)	-5.22***	0.02	0.65**
	(-7.53)	(0.46)	(2.19)
ln openness (ln O)	0.03***	0.19**	0.41
	(7.61)	(2.39)	(1.63)
Constant	-5.75	2.41***	14.09***
	(-1.18)	(4.76)	(11.93)
Number of observations	28	44	36
Wald Chi2 (9)	18061.03***	674.64***	3369.94***

Note: 1. ***, **, * means that the coefficients are significant at 1 percent, 5 percent and 10 percent level, respectively.
2. Refer Appendix I, Table 1 for List of Countries chosen in the analysis.
Source: Author's Estimation.

countries after excluding the countries already included in G7), value-added in manufacturing sector were largely influenced by factors like high-skilled labour, medium-skilled labour and openness of economy. Further, the value-added in manufacturing sector in emerging counties was influenced mainly by variables like low price level and process innovation.

Table 4 presents the regression results with log of domestic value-added content in gross exports as the dependent variable. For emerging economies, it was found that with one unit decrease in price, the domestic value-added content in gross exports increases by 0.88 units. The impact of price in G7 countries was however, positive and significant. This implies that even the price increase lead to more value-added from the manufacturing industries, probably due to quality products.

An attempt was also made to examine the impact of different levels of skills possessed by labour on domestic value-added content in gross exports from manufacturing industries from G7, European Union countries and emerging countries. It was found that for G7 countries, impact of medium-skilled labour was negative and that of the low-skilled labour was positive and both of them were significant. This is somewhat contrary to general perception of high-skilled labour dominated production and export processes in these countries. There could be various arguments for these results. It could be due to the advent of industrial automation in these countries wherein relatively less skilled workers were adding value in manufacturing industries. On the other hand, for EU countries, it was found that the impact of high-skilled and medium-skilled labour is positive and significant. But for emerging countries, it was found that the impact of medium-skilled labour was positive on domestic value-added content of gross exports from the chosen countries.

Further, the result of regression models also show that the impact of capital stock was positive and highly significant in determining the domestic value-added content in gross exports for G7 countries. Moreover, the impact of digital base was also found to be positive and significant for value-added in exports from emerging countries, but its impact on developed (G7 and EU) countries remain ambiguous.

Further, the impact of product and process innovation on domestic value-added content in gross exports for the manufacturing industries of three different groups of countries was also done. The results show that the impact of product innovation was positive and highly significant for G7 countries. However, the impact of product innovation was negative for emerging counties. Rather, the impact of process innovation was significant but negative for G7 counties and positive for emerging countries. This result signifies that the domestic value-added content in gross exports for G7 counties were determined by product

innovation rather than process innovation, whereas the latter was a determining factor for emerging countries.

It was again found that developed countries were benefited from opening their economies as compared to emerging countries. This became evident as the regression results show that the opening of the economy has a positive (0.03) and significant impact on domestic value-added content of gross exports for G7 countries whereas for emerging counties the coefficient is not-significant.

VI. Discussion and Policy Implications

Global value chains transformed the manner in which the global production process and international trade pattern were studied earlier. Globalization of production with numerous nods of value-addition units are integrated through trade that engulfed the whole world in the present era. The world had virtually become the manufacturing unit. In this context, it has become even more challenging to formulate requisite policies both at the aggregated level (country/ industry) and at the micro level (firms) for (i) entering the GVC (ii) maintain the position in GVC (iii) climb up the ladder within the GVC.

Public policy at the level of a country is a combination of policies including trade policies, science and technology policies, foreign direct investment policies, intellectual property rights (Cimoli *et al.* 2009), employment policies, policies related with international relations, advancement in transportation and information technology, education and skill development policies, etc. It is although well evident in the literature that public policies had played a very dominant role in the developmental process of now developed countries (Maio 2009; Singh and Bangoo 2014). The infamous debate of protectionism and free trade basically revolves around the alternative policy paradigms for growth and structural transformation within different countries. Amsden (2001) found that targeted intervention through various public policies has been a common norm during the developmental phase of many developed and developing countries. Maio (2009) observed that targeted criterion varied across countries depending upon the potential capacity and capability of various entities in these countries.

During the mid 1980s, a new paradigm emerged within the realm of economic growth models. To look into the black box, associated public policies for growth and sustainability witnessed a sea change towards

strategies to accumulate technology. Further, evolutionary theories and innovation system approach (Edquist 1997), gave a new dimension to process of technology accumulation along with the discourses of public policies. However, literature on GVC looks into the governance issues as policy parameters. Gereffi *et al.* (2005) provided the detailed analysis concerning the governance patterns within global value chains. They developed theoretical framework of five types of governance mechanisms for global value chains which could be due to difference in explicit coordination and power asymmetry. These two different arguments are varied in nature. The former is concerned about the strategic role that 'public policy' can take to increase share of value-added in world's production, the latter is more about the 'power struggle' amongst various suppliers in production chains. Specifically, institutional framework of public policy acts for the latter to work effectively.

It can be thus argued that to increase the share in world's total production and world's trade, strategic policies should be framed and implemented. The idea could be to find the areas to work upon and then through targeted approach using the mix of policies for science and technology, human capital, trade, finance, market, marketing, transport, communication technology, etc should be framed to meet the challenges of entering global value chains.

Consequently, if the result of the descriptive and empirical is considered, we found that the share of value-added in GVC from the emerging countries has increased as compared to the already developed countries over the years. Further, the regression analysis signified that certain factors like price advantage, low-skilled labour and process innovation played a dominant part in increasing the share of value-added from manufacturing industries of emerging countries over the years. For developed countries, however factors like skilled labour, product innovation, capital stock and openness played a dominant role.

Further, the issue of concern for these different developed and emerging countries includes: what path the public policy should take to increase and sustain the domestic value-added content from the respective manufacturing industries in GVC? The issue is very important and can determine the future path for different manufacturing industries in different countries. However,it is beyond the scope of the present paper to draw varied consistent policy implications for the same. These issues are thus, left for future research and thoughts.

VII. Summary

Global value chains literature has gained a centre-stage recently when the production process becomes increasingly fragmented and spread amongst different countries. The advancements in communications and transport systems have resulted in movements of commodities and processes more easily and frequently. This phenomenon leads to a massive surge in the world trade. Consequently, the share of value-added in GVC determines the level of growth and employment generation capability of a nation. In this context, the aim of the paper was to compare the share and examine the trend of value-added from manufacturing industries by different developed and emerging countries into GVC. It was found that the trend has started shifting towards emerging counties, especially South-East Asian countries.

The paper also tried to examine the factors that lead to the shift in the structure of value-added into GVC from manufacturing industries of different developed and emerging economies. It was found that emerging countries are gaining in terms of price effectiveness combined with the increasing proximity in process innovation. It signifies that relatively standardized products and innovation gets transferred to emerging countries initially through trade and then they probably increase the efficiency in the production with price controls. On the other hand, for developed countries, it was largely found that innovation and high-skilled labour were the ingredients that lead to value-added in GVC by these countries. An interesting finding from the analysis was that the impact of openness was highly significant for the value-added production and exports of developed countries as compared to emerging countries. This implies that it was developed countries that benefitted more as compared to emerging economies from opening the economies unlike acclaimed by the Washington Consensus hypothesis.

To conclude, the path of development in the contemporary era largely lies in the quantum of value-added in GVC by respective countries. Thus, for growth and sustainability the need is to formulate targeted strategic policy frameworks for the same.

Appendix

Appendix Table 1
List of the Countries Chosen

Countries Groupings/ Aggregates		Countries
G7	Group of Seven	Canada, France, Germany, Italy, Japan, United Kingdom, United States
EU	European Union Countries	Austria, Belgium, Denmark, Finland, Greece, Ireland, Luxemburg, Netherlands, Portugal, Spain, Sweden
Emerging Countries	South East Asia	China, India, Indonesia, South Korea,
	Other emerging Countries	Mexico, Poland, Turkey, Brazil, Russia

Appendix Table 2
List of the Variables and Their Datasources

Database	Variables Taken
OECD-WTO 'Trade in Value Added' (TiVA)	Value-Added, Domestic Value-added content in Gross Exports
World Input- Output Database (WIOD) www.wiod.org	Price level of Gross value-added (1995=100), Price level Gross Output (1995=100), Total hours worked by Employees (millions), Hours worked by high-skilled persons engaged (share in total hours), Hours worked by medium-skilled persons engaged (shares in total hours), Hours worked by low-skilled persons engaged (share in total hours), Real Fixed Capital Stock (1995=100)
World Development Indicators	Telephone density per 100 people ICT density per 100 people GDP at market prices (constant 2005 $US) Imports of goods and services (constant 2005 $US) Exports of goods and services (constant 2005 $US)
UNESCO UIS.Stat http://data.uis.unesco.org/	Percentage of process innovators in manufacturing Percentage of Product innovators in manufacturing

APPENDIX TABLE 3
DESCRIPTIVE ANALYSIS OF CHOSEN VARIABLES

Variable	Obs	Mean	Std. Dev	Min	Max
			G7		
ln VA	28	12.82	0.85	11.75	14.11
ln VAE	28	11.15	3.64	2.46	13.34
ln P	28	4.82	0.15	4.45	4.96
ln HS	28	9.61	0.85	8.37	11.37
ln MS	28	10.23	0.78	9.52	11.88
ln LS	28	8.78	0.99	6.51	10.04
ln K	28	16.52	2.15	14.82	21.41
ln PR	28	3.03	1.29	0	3.90
ln PS	28	2.86	1.22	0	3.87
ln D	28	4.13	0.62	3.70	4.28
ln O	28	28.37	68.22	0.76	208.27
			EU		
ln VA	44	10.36	1.01	7.48	11.79
ln VAE	44	2.33	0.10	2.01	2.46
ln P	44	4.92	0.10	4.75	5.01
ln HS	44	7.25	0.88	5.01	9.13
ln MS	44	7.61	0.87	5.38	8.83
ln LS	44	7.12	1.20	4.01	9.42
ln K	44	13.86	1.30	11.30	15.70
ln PR	44	3.19	1.04	0	3.72
ln PS	44	3.21	1.03	0	3.72
ln D	44	4.07	0.15	3.73	4.30
ln O	44	1.09	0.06	0.94	1.26
Emerging Countries					
ln VA	36	10.50	1.26	7.66	12.38
ln VAE	36	10.09	1.33	7.17	12.16
ln P	36	6.05	1.08	4.88	8.39
ln HS	36	9.50	1.07	8.14	11.59
ln MS	36	10.55	1.36	8.57	13.16
ln LS	36	10.24	1.97	7.19	13.78
ln K	36	16.67	3.29	10.58	21.68
ln PR	36	2.72	0.41	2.07	3.26
ln PS	36	2.64	0.61	1.77	3.46
ln D	36	11.90	20.87	2.98	72.11
ln O	36	1.26	0.21	0.70	1.56

Note: The names of the variables are presented in Section II.
Data Source: Appendix Table 2

Appendix Table 4
Correlation Matrix

	G7										
	ln VA	ln VAE	ln P	ln HS	ln MS	ln LS	ln K	ln PR	ln PS	ln D	ln O
ln VA	1.00										
ln VAE	0.57	1.00									
ln P	-0.37	0.18	1.00								
ln HS	0.78	0.43	-0.12	1.00							
ln MS	0.83	0.23	-0.36	0.89	1.00						
ln LS	0.52	0.93	0.36	0.47	0.30	1.00					
ln K	0.79	0.35	-0.78	0.46	0.62	0.17	1.00				
ln PR	-0.69	-0.32	-0.01	-0.85	-0.89	-0.51	-0.31	1.00			
ln PS	-0.66	-0.40	-0.11	-0.89	-0.85	-0.57	-0.24	0.98	1.00		
ln D	-0.32	-0.16	-0.16	0.29	0.04	-0.31	0.01	0.14	0.05	1.00	
ln O	0.60	0.23	0.13	0.82	0.83	0.44	0.14	-0.97	-0.96	-0.09	1.00
	EU										
	ln VA	ln VAE	ln P	ln HS	ln MS	ln LS	ln K	ln PR	ln PS	ln D	ln O
ln VA	1.00										
ln VAE	0.99	1.00									
ln P	-0.19	-0.20	1.00								
ln HS	0.87	0.86	0.19	1.00							
ln MS	0.90	0.90	-0.76	0.86	1.00						
ln LS	0.65	0.65	0.40	0.83	0.77	1.00					
ln K	0.74	0.73	-0.32	0.66	0.75	0.46	1.00				
ln PR	0.10	0.07	-0.59	-0.15	-0.14	-0.30	0.13	1.00			
ln PS	0.14	0.12	-0.51	-0.08	-0.11	-0.19	0.13	0.98	1.00		
ln D	-0.11	-0.14	-0.40	-0.20	-0.21	-0.51	0.26	0.51	0.41	1.00	
ln O	-0.34	-0.33	0.51	-0.31	-0.39	-0.34	-0.21	-0.35	-0.38	0.05	1.00
	Emerging Countries										
	ln VA	ln VAE	ln P	ln HS	ln MS	ln LS	ln K	ln PR	ln PS	ln D	ln O
ln VA	1.00										
ln VAE	0.95	1.00									
ln P	-0.92	-0.95	1.00								
ln HS	0.64	0.65	-0.58	1.00							
ln MS	0.47	0.49	-0.45	0.92	1.00						
ln LS	0.24	0.16	-0.24	0.66	0.72	1.00					
ln K	0.790	0.63	-0.60	0.26	0.16	0.15	1.00				
ln PR	-0.13	-0.23	0.10	0.08	-0.05	0.41	-0.13	1.00			
ln PS	-0.15	-0.28	0.13	0.11	0.03	0.44	-0.29	0.93	1.00		
ln D	0.48	0.49	-0.36	0.04	-0.27	-0.36	0.61	-0.86	-0.31	1.00	
ln O	0.41	0.57	-0.51	0.51	0.39	0.14	-0.07	-0.20	-0.21	0.16	1.00

Note: Refer Section II for the nomenclature of various variables used.
Data Source: Refer Appendix Table 2.

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