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Determinants of Vertical Intra-Industry Trade in India: Empirical Estimates on Select Manufacturing Sectors

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There exists a rich empirical literature on the presence of intra-industry trade (IIT), i.e., simultaneous exports and imports within the same product groups and its determinants, both in the context of developed and developing countries. With deepening of Global Value Chains (GVCs) and International Production Networks (IPNs) across the globe, a rise in IIT has generally been noticed and India is no exception to this trend. The current paper analyses India's IIT in select sectors and decomposes the same in Vertical IIT (VIIT) and Horizontal IIT (HIIT) categories in terms of product quality, using trade data at the HS 6-digit level. It is observed that India's IIT is predominantly vertical in nature. India's VIIT has increased significantly over 2001-18 in select sectors, barring the exception of base-metals and iron-steel segments. The analysis next focuses on the determinants of India's VIIT during 2001-15 in a panel data framework by considering both country-specific and sector-specific factors. The empirical results reveal that increase in capital-intensity, higher skill-intensity of workforce, multilateral as well as regional trade policy reforms, higher research and development orientation, trade facilitation measures and decline in industrial concentration facilitates India's cross-sector VIIT pattern. The interaction terms in the model indicates that growing sophistication in production may create greater scope for trade in vertically differentiated products. The results have interesting implications for India's recent manufacturing sector policy framework, particularly the 'Make-in-India' initiative.

Keywords: India's Trade Policy, Vertical Intra-Industry Trade, Foreign Direct Investment, Empirical Estimation, Atmanirbhar Bharat Abhiyan

JEL Classification: F12, F13, F14

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Section I
Introduction

The Classical Theories predicted that international trade would lead to specialization in products across nations, in accordance with their Absolute (Adam Smith)/Comparative Advantages (David Ricardo) or factor endowments (Heckscher-Ohlin). Since 1960s however, simultaneous export and import within the same product groups emerged as a common phenomenon, and this two-way exchange of goods necessitated deeper look into the causes and consequences of such trade flows. The resulting empirical literature, classified as Intra-Industry Trade (IIT), has enriched over the subsequent decades (Balassa, 1966; Grubel, 1967; Grubel and Lloyd, 1975). Moving beyond the debate on measurement of IIT through appropriate trade indices in the initial years (Grubel and Lloyd, 1975; Aquino, 1978, 1997), the focus of the empirical research gradually shifted towards explaining the level and occurrence of such trade. The existence of IIT has been explained in the theoretical and empirical literature with several underlying factors, namely: presence of scale economies and consumer preference for product diversity (Krugman, 1979, 1981; Zahavi and Lavie, 2013, product differentiation Falvey and Kierzkowski, 1987; Bertschek *et al,* 2015), country size, per capita income, distance and trade orientation (Hümmels and Levinsohn, 1995; Stone and Lee, 1995; Holmes and Stevens, 2014) and so on.

During eighties, with rising trend in North-North, North-South and South-South IITs, importance of the distinction between horizontal and vertical product differentiation and defining IIT in that light became apparent. Horizontal differentiation refers to products that are produced with similar factor intensity, comparable in quality but differing by characteristics relating to style and consumer preferences (Lancaster, 1980; Eaton and Kiezkowski, 1984; Helpman and Krugman, 1985). The literature postulates that the larger the difference in factor endowments between countries, the smaller would be the extent of Horizontal IIT (HIIT) in trade (Helpman and Krugman, 1985). The Vertical IIT (VIIT) in contrast is explained as both-way trade involving products that are different in quality, i.e., dissimilar by unit production costs and factor intensities (Falvey, 1981; Shaked and Sutton, 1984; Greenaway *et al,* 1994; Fontagné *et al,* 2006; Kim and Niem, 2011). The existence of VIIT between countries can be explained both through supply-side (different factor endowments) as well as demand-side (differences in per capita income) factors. On the supply side, the VIIT can be linked with differences in technology (i.e., capital intensity and labour productivity), where the country with higher productivity, characterized by higher wages and hence prices, exports the varieties with higher quality (Flam and Helpman, 1987). The results are in line with the framework developed by Stiglitz (1987). On the demand side, the VIIT can be explained through unequal incomes (Falvey and Kierzkowski, 1987). On the whole, growing income dissimilarity may increase the share of VIIT in trade, owing to

the consequent dissimilarity in demand (Wu and Lin, 2013; Jambor, 2014; Răzvan and Camelia, 2015).

The new millennium has witnessed significant deepening of Global Value Chains (GVCs) and International Production Networks (IPNs) (Baccini *et al*, 2018). Moreover, introduction of several trade facilitation measures have reduced trade costs (Fontagné *et al*, 2019), with consequent implications for IIT. India, a developing country aspiring to enhance its participation in GVCs, is no exception to this trend (Srivastava and Sen, 2015). The 'Make-in-India' initiative launched in 2014 aspires to attract foreign multinationals to relocate production base in India, which is expected to facilitate the both-way trade in parts and components as well as final products further. The announcement of the 'Atmanirbhar Bharat Abhiyan' in May 2020 is expected deepen the process further (GoI, 2020). There is a rich literature on measurement of India's aggregate IIT, which has shown a gradual rise in the index over the years (Pant and Barua, 1986; Veeramani, 1999, 2001, 2002; Chakraborty, 2002; Chakraborty and Chakraborty, 2005; Kelkar and Burange, 2016; Aggarwal and Chakraborty, 2017). Empirical findings of several analyses have indicated that IIT in India is vertical in nature (Veeramani, 2002; Srivastava and Medury, 2011; Aggarwal and Chakraborty, 2017; Bagchi and Bhattacharyya, 2019; Aggarwal and Chakraborty, 2019). The current analysis, through decomposition of India's IIT in HIIT and VIIT across select manufacturing segments, intends to analyze the key underlying factors behind India's VIIT with Rest of the World (ROW) over 2001-15. The study is arranged along the following lines. Section I is Introduction of the study. A brief review of HIIT-VIIT literature is presented, followed by discussion on the evidence in Indian context in Section II. Section III discusses the data, methodology and empirical model, followed by estimated results in Section IV. Finally, based on obtained empirical results, certain policy conclusions are drawn in Section V.

Section II
Literature Review on VIIT

The VIIT-HIIT distinction is important given their potential sectoral implications on welfare (Blanes and Martin, 2000). As HIIT concerns products of similar quality, rise in this type of trade might be associated with certain labour market adjustment costs (Brulhart 1999, 2000). Conversely, VIIT may lead to displacement of workers in the country specializing in lower quality (Shaked and Sutton, 1984; Motta, 1992), given the difference in factor content (Greenaway and Hine, 1991). Since early nineties a major branch of literature has focused on decomposing IIT into HIIT and VIIT, based on quality differences. The methodology proposed by (Rahman, 1991), which drew on the framework developed by (Stiglitz, 1987) to assume that prices represent relative qualities, even under imperfect information, is most widely acknowledged in this regard. According to this approach, quality differences are captured through differences

in unit values (UV), i.e., per unit export and import prices of the commodity group under consideration. Suppose, India is simultaneously exporting and importing a product, namely: Men's or Boys' Suits, Knitted or Crocheted (HS 610310). Now, if the export and import products belong to the same quality plane, their prices will be comparable. Thus, if the export and import price ratio is in close vicinity of unity and falls within the following range, trade is considered to be HIIT-type.

$$1 - \alpha \leq \frac{UV^X}{UV^M} \leq 1 + \alpha \quad (1)$$

where, UV^X and UV^M represent unit price of exports and imports of a product (usually classified at HS 6-digit level) respectively and α is the defined threshold for the quality range (usually, 15 per cent or 25 per cent).

The index can be explained in the following manner. If a country is simultaneously exporting and importing a product at HS 6-digit level, occurrence of two-way trade, i.e., existence of IIT, is confirmed. The underlying reason behind considering the HS 6-digit data is that at the higher levels of aggregation, more dissimilar products would be clubbed, whereby the average price ceases to truly represent the quality of the group. According to (Rahman, 1991) proposition, if the trade is HIIT-type, then the quality and price of the export and import products at the HS 6-digit level are similar and the ratio should lie within the defined range, i.e., between 0.85 (or, 0.75) to 1.15 (or, 1.25). Conversely, if the price ratio is lower than 0.85 (or, 0.75), the IIT is defined as low-quality vertical (LQVIIT) in nature, i.e., the exporting country is specializing in relatively lower-quality products. Alternatively, when the ratio lies above 1.15 (or, 1.25), the IIT is considered high-quality vertical (HQVIIT) type, with the exporting country specializing in higher-quality products.

There exists a rich literature on decomposition of IIT in HIIT-VIIT, both for developed countries (Lee, 1989; Greenaway *et al,* 1994; Greenaway *et al,* 1995; Sharma, 2006; Fertő , 2007; Chang, 2009; Gabrisch, 2009; Ito and Okubo, 2012; Thorpe and Leitão, 2013; Jambor, 2014; Jambor, 2016) and also for developing countries (Bhattacharya, 2002; Devadason, 2012; Akram and Mahmood, 2012; Yoshida, 2013; Chin *et al,* 2015, Chin *et al,* 2016). A significant segment of the literature involving both developed and developing countries have noted prominence of VIIT in bilateral trade flows. Analyzing the US and US-NAFTA IIT patterns, (Clark, 2006 and Ekanayake *et al,* 2009) noted the dominance of VIIT in trade patterns. The IIT is also found to be predominantly vertical in the EU context in general (Fontagné and Freudenberg, 1997; Gabrisch and Segnana, 2002) and at various constituent country levels in particular, e.g., for Czech Republic (Janda and Munich, 2004, Hungary Fertő , 2007 and UK Greenaway *et al,* 1994, 1995; Zhang and Clark, 2009; Thorpe

and Leitão, 2013). The IIT analysis on China (Zhang *et al,* 2005; Wu and Lin, 2013, Chin *et al,* 2015, Japan Wakasugi, 2007 and Turkey Kilavuz *et al,* 2013) also underline the predominance of VIIT in trade patterns. On the other hand, HIIT is more prevalent among economies characterised by similar development profile and capital-labor ratios (Bergstrand, 1990; Frahan and Tharakan, 1998; Hu and Ma, 1999; Chang, 2009; Varma, 2015).

A major section of the literature has attempted to analyze the IIT specialization-type with country and industry-level determinants (Fontagné and Freudenberg, 1997; Clark and Stanley, 1999; Greenaway *et al,* 1999; Clark, 2006; Ekanayake *et al,* 2009). While the determinants of VIIT and HIIT generally differ (Aturupane *et al*, 1999), some factors are found to be common for both analyses, namely: geographical distance, trading structure and economic size (Hu and Ma, 1999; Thorpe and Zhang, 2005; Zhang *et al*, 2005). The country-level drivers of VIIT, which might influence product quality, includes: skill endowments (Falvey, 1981; Shaked and Sutton, 1984; Falvey and Kierzkowski, 1987; Flam and Helpman, 1987), educational expenditure and research and development (R&D) investment (Hu and Ma, 1999), etc. The industry-level drivers of VIIT, which might influence product differentiations, includes: number of firms in an industry (Greenaway *et al,* 1994; Fontagné and Freudenberg, 1997), firm concentration (Greenaway *et al,* 1995; Greenaway and Torstensson, 2000; Cernosa, 2009; Crespo and Fontoura, 2004) and so on. On the other hand, differences in factor endowments are negatively related to HIIT (Jambor, 2014; Varma, 2015; Fertő and Jambor, 2015; Bojnec and Fertő , 2016 Bagchi and Bhattacharyya 2019) have arrived at similar set of conclusions by analysing determinants of India's VIIT and HIIT.

The VIIT-HIIT decomposition analysis in Indian context upto late nineties was relatively scarce, but in the last two decades several studies have filled the void through HS 6-digit level detailed analysis. Most of the studies observed predominance of VIIT in India's trade pattern. Veeramani (2002) explained the VIIT with the dissimilarity in income pattern with trading partners. Srivastava and Medury (2011) justified the rise in VIIT through tariff reforms. Akram and Mahmood (2012) observed that LQVIIT dominates Pakistan's VIIT with India, in comparison to other South Asian nations. Analyzing India-Turkey trade, Kilavuz *et al,* (2013) observed existence of both LQVIIT and HQVIIT in IIT, thereby underling the possible trade complementarities. The analysis of Devadason (2012) involving China-India bilateral trade observed IIT to be primarily of LQVIIT in nature. Kelkar and Burange (2016) observed that the proportion of LQVIIT in India's trade is gradually declining, while a rise in HIIT is noticed.

Recently, a number of studies have focussed on VIIT-HIIT determinant analysis in Indian context. Srivastava and Medury (2011) found that India's IIT is generally vertical in nature and tariff reforms facilitate both VIIT and HIIT. Varma (2015) noted that while similarities in capital formation and GDP

determine both VIIT and HIIT, bigger economic sizes and free trade agreements (FTA) are important in facilitating VIIT. Bagchi and Bhattacharyya, (2019) observed that India's trade is more HIIT-type with countries belonging to comparable income group, while higher values of VIIT is more common with higher income trade partners. The analysis concluded that while convergence in income level between India and the partner countries enhances both VIIT and HIIT, similarity in relative factor endowments and participation in South Asian Free Trade Area (SAFTA) promotes HIIT.

It is observed that empirical analysis on sector-level HIIT-VIIT dynamics in the Indian context is being focused only in recent period (Varma, 2015; Bagchi and Bhattacharyya, 2019). Most of the existing studies investigating the determinants of VIIT focus on country-specific factors, but evidence on the effects of various industry-specific variables are relatively scarce. To bridge this gap, the present analysis explores the determinants of India's VIIT with ROW for seven selected key manufacturing product groups over 2001-15. The contribution of the study in the literature is incorporation of several new sector-level determinants in the model, namely: skill-intensity, foreign direct investment (FDI) and several interaction terms. On country-level factors, logistics performance index (LPI) and a FTA dummy have been incorporated in the model to understand the potential impacts of trade facilitation and trade preference on VIIT.

Section III
Methodology and Data

The present analysis first identifies the major sectors in the Indian context, which experience simultaneous exports and imports. Seven major manufacturing product groups, namely: chemicals, leather and footwear; textiles and garments; iron and steel, base metals, electrical machinery and equipment and vehicles and auto-components are selected based on their share in India's exports and imports. All these sectors are part of the 'Make-in-India' initiative. The selected sectors collectively account for more than 40 per cent of India's aggregate export and import flows (Aggarwal and Chakraborty, 2017). The trade data (export and import) for the purpose of the analysis is drawn in Harmonized System (HS) classification at HS 4-digit (i.e., tariff headings) and 6-digit (i.e., tariff sub-headings) levels for the period 2001-18 from Trade Map database, maintained by International Trade Centre (ITC, undated).

The time period of the current empirical analysis is limited by data availability, as for the key industry-related independent variable that needs to be constructed (i.e., state of technology difference, proxied by capital-labour ratio), data points beyond 2015-16 are not available. FDI data is obtained from SIA Statistics, Department for Promotion of Industry and Internal Trade (DIPP, undated). Trade-weighted average MFN tariff data is sourced from WITS (World Bank,

undated). Data on sales, total expenses and R&D expenditure for each industry groups have been taken from Prowess (CMIE, undated). Data for other industry-specific explanatory variables have been obtained from Annual Survey of Industries (ASI), as released by Central Statistical Office (CSO), under Ministry of Statistics and Programme Implementation, Government of India (GoI, undated). The product groups under the 4-digit National Industrial Classification (NIC) levels are considered as industry. The industry data over the period under consideration are available in multiple classifications. First, NIC-1998 classification, based on International Standard Industrial Classification (ISIC) Rev. 3, was followed to classify ASI data over 1998-99 to 2003-04. Second, NIC-2004 format, developed on the basis of ISIC Rev. 3.1, was used for ASI data over 2004-05 to 2007-08. Finally, ASI data in NIC-2008 classification, developed on the basis of ISIC Rev. 4, is available from 2008-09 onwards. All the industry-related and employment-specific variables for the period 2000-15 are collected directly from the publications of ASI (GoI, undated) and Prowess (CMIE, undated). For the empirical analysis, a concordance between the trade codes (reported in HS) and industry codes (reported in NIC) has been developed by the authors by matching the product descriptions, which is reported in Annexure 1.

The analysis first computes sectoral IITs by considering HS 4-digit data. While Grubel and Lloyd (1975) index is appropriate for measuring aggregate IIT, in case of sectoral trade imbalance the index might be an inefficient one. To correct this, Aquino (1978; 1997) proposed an alternate measure, which has been adopted in the current context. Suppose X_{ij} and M_{ij} represent export and import of country *j* for industry *i* at HS 4-digit level of classification. Following Aquino method to correct trade imbalance, in the first step the corresponding estimated values of export (X_{ij}^{e}) and import (M_{ij}^{e}) are calculated as:

$$X_{ij}^{e} = X_{ij} * \frac{\sum_i (X_{ij} + M_{ij})}{2\sum_i X_{ij}} \quad M_{ij}^{e} = M_{ij} * \frac{\sum_i (X_{ij} + M_{ij})}{2\sum_i M_{ij}}$$

In the second step, the Aquino index for measuring the IIT of country *j* for industry *i* with a partner country (ROW in the current context) is calculated as:

$$A_{ij} = \frac{\sum_i \left(X_{ij}^{e} + M_{ij}^{e}\right) - \sum_i \left|X_{ij}^{e} - M_{ij}^{e}\right|}{\sum_i \left(X_{ij}^{e} + M_{ij}^{e}\right)} \times 100 \qquad (2)$$

Following Rahman (1991) the unit price ratios for each HS 6-digit products are earlier computed from equation (1). The current analysis considers α, the defined threshold for the quality range at both 15 and 25 per cent. Then the percentage of HS sub-headings with values falling within the 0.85-1.15 (and 0.75-1.25) range and otherwise are determined with respect to the total number of 6-digit products under the respective HS 2-digit groups. The percentized representation of the two numbers depict HIIT-type and VIIT-type trades within the industry group respectively. Finally, the sectoral IIT index value computed by equation (2) is distributed between vertical and horizontal types to obtain the VIIT and HIIT index values in the following manner. For instance, the IIT index for Iron and Steel sector, computed by equation (2), is 55.21 during the year 2016. For the sector, at quality threshold range α = 15 per cent, the proportion of horizontal and vertical trade in the corresponding year turns out to be 24 and 76 per cent respectively, as obtained through (Rahman, 1991) methodology by considering all the corresponding HS 6-digit codes. Thus during 2016, through proportional distribution, the HIIT and VIIT for India in Iron and Steel sector are computed as 13.25 and 41.96 respectively.

Given the time period (2001-2015) and various sectors, i e , having relatively large N, fixed T asymptotic, with the centered and rescaled test statistic being N(0,1), a balanced panel data model is estimated here. There is a need for controlling of non-stationarity in the series, if any, in order to avoid spurious results (Baltagi, 2005; Pesaran, 2015; Bagchi and Bhattacharyya, 2019). The stationary analysis for all the explanatory variables in the proposed model has been undertaken with the help of STATA software (Version 14). Table 1 reports the Harris-Tzavalis Test results, which has a null hypothesis of unit root versus an alternative hypothesis with a single stationary value. All the variables used in the regression analysis are found to be stationary except weighted tariff, four-firm concentration ratio and capital-labour ratio. Therefore, the regression model uses first differences of these three variables, so that the modified series becomes stationary. Also, standardized FDI variable (logarithmic transformation) has been used in the model.

Table 1
Harris-Tzavalis-Type Panel Unit Root Test

Variables	*Rho*	*Z*
$LVIIT_{it}$	0.6056	-2.8436***
$\Delta(\frac{K}{L})$	0.0280	-10.7817***
(S/U)	0.2632	-7.5490***
LPI	0.1023	-8.7342***
ΔWTARIFF	-0.1806	-13.6479***
ΔCONC	-0.0090	-11.2895***
R&D	0.4258	-5.3151***
LFDI	0.5178	-4.0507***
$\left(\Delta\left(\frac{K}{L}\right) * LFDI\right)$	0.1358	-9.2999***
$\left(\Delta\left(\frac{K}{L}\right) * R\&D\right)$	0.3013	-7.0250***
$\left(LFDI * \left(\frac{S}{U}\right)\right)$	0.5140	-4.1026***
$\left(\Delta\left(\frac{K}{L}\right) * \left(\frac{S}{U}\right)\right)$	0.0381	-10.6430***

Source: Authors estimation.

The endogeneity check for the explanatory variables is performed in the analysis using two-stage least squares (2SLS) regression. It is observed that Wald chi-square test statistic of 61.26 (Prob: 0.00) is statistically significant. The null hypothesis of the Durbin and Wu-Hausman tests is that the variables under consideration can be treated as exogenous. Durbin score of 0.103 (Prob 0.748) and Wu-Hausman statistic is 0.099 (Prob 0.753) are not significant, so null hypothesis of exogeneity is not rejected. Therefore, it is observed that explanatory variables used in the panel data analysis such as, LFDI, R&D expenditure, absolute change in four-firm concentration ratio, ratio of skilled to unskilled workers are not endogenous.

In the current context the following panel data model is estimated to identify the determinants of India's VIIT over 2001-15:

$$\begin{aligned} LVIIT_{it} = {} & \alpha_0 + \beta_1 \left|\Delta\left(\frac{K}{L}\right)\right|_{it} + \beta_2 \left(\frac{S}{U}\right)_{it} + \beta_3 LPI_t + \beta_4 |\Delta WTARIFF|_{it} + \beta_5 |\Delta CONC|_{it} \\ & + \beta_6 R\&D_{it} + \beta_7 LFDI_{it} + \beta_8 \left(\left|\Delta\left(\frac{K}{L}\right)\right| * LFDI\right)_{it} + \beta_9 \left(\left|\Delta\left(\frac{K}{L}\right)\right| * R\&D\right)_{it} \\ & + \beta_{10} \left(LFDI * \left(\frac{S}{U}\right)\right)_{it} + \beta_{11} \left(\left|\Delta\left(\frac{K}{L}\right)\right| * \left(\frac{S}{U}\right)\right)_{it} + \beta_{12} FTA \\ & + YearD_t + SectorD_i + \varepsilon_{it} \end{aligned} \quad (3)$$

where,

α	represents the constant term
βs	are coefficients
L	represents logarithmic transformation of the variables
Δ	represents absolute change of the variables
$VIIT_{it}$	represents sectoral Aquino measure of VIIT between India and ROW for sector i in year t
$\Delta(K/L)_{it}$	represents change in fixed capital to employment ratio for sector i in year t
$(S/U)_{it}$	represents ratio of skilled workers to unskilled workers for sector i in year t
LPI_t	represents the logistic performance index of India for year t
$\Delta WTARIFF_{it}$	represents change in weighted MFN tariff imposed by India on sector i in year t
$\Delta CONC_{it}$	represents change in four-firm concentration ratio for sector i in year t
$R\&D_{it}$	represents R&D expenses to total expenses ratio for sector i in year t
$LFDI_{it}$	represents foreign direct investment inflows in sector i in year t
$(\left(\Delta\frac{K}{L}\right) * LFDI)_{it}$	represents an interaction term of the change in fixed capital to employment ratio and foreign direct investment for sector i in year t
$((\Delta\frac{K}{L}) * R\&D)_{it}$	represents an interaction term of the change in fixed capital to employment ratio and R&D to total expenses ratio for sector i in year t
$(LFDI * (\frac{S}{U}))_{it}$	represents an interaction term of the incremental foreign direct investment and ratio of skilled workers to unskilled workers for sector i in year t

$((\Delta\frac{K}{L}) * (\frac{S}{U}))_{it}$ represents an interaction term of the change in fixed capital to employment ratio and ratio of skilled workers to unskilled workers for sector i in year t

FTA epresents a dummy variable which takes the value of 0 upto 2010 and 1 afterwards

ε_{it} represents the error term

The description of the independent variables used in the empirical analysis and the corresponding data sources are summarized in Annexure 2. Several variables included in the model are obtained on the basis of existing literature. The underlying reason behind their inclusion is noted in the following.

India's sectoral VIITs with ROW, calculated through Aquino (1978; 1997) and Rahman (1991) method are considered as the dependent variables. For the regression analysis, the defined threshold for the quality range is defined as 15 per cent. The independent variables are considered next. First the country-level independent variables included in the model are described. A rich empirical literature exists on the influence of trade facilitation measures on trade linkages (Djankov *et al*, 2010; Puertas, 2013). Trade facilitation has often been proxied by World Bank's Logistic Performance Index (LPI) in empirical literature (Hastiadi, 2012). In the Indian context, Aggarwal and Chakraborty (2017) observed that higher LPI between trading partners significantly augment bilateral IIT. A trade preference dummy (FTA) is included in the study which takes the value of 1 for the year 2011 onwards 0 otherwise, given India's entry into a number of FTAs from 2010-11. An RTA is expected to augment bilateral trade flows in general and intensity of IIT in particular, given the tariff and trade facilitation reforms enshrined in the preferential arrangements (Varma and Ramakrishnan, 2014; Pant and Paul, 2018).

Two more variables are incorporated in the model which are relevant for ROW trade partners, but capture sectoral dynamics. VIIT is found to be negatively correlated with sectoral tariffs, given the rise in trade barriers (Zhang *et al,* 2005; Pant and Paul, 2018). The relationship between IIT and sectoral FDI inflows is however, ambiguous (Gray, 1988). VIIT might be positively related to FDI, if foreign firms bring in technology to reap local factor endowment advantages to produce goods belonging to diverging quality spread for exports (Greenaway, 1988; Lee, 1989; Greenaway *et al*, 1994; Greenaway *et al*, 1995; Hu and Ma, 1999; Zhang *et al*, 2005). The Product Life Cycle theory of Vernon, (1966) also supports positive association between FDI and VIIT. However, if FDI inflows are primarily targeting local market or only facilitates inter-firm exchanges between the subsidiaries of the parent multinational corporation (MNC), a negative relation between FDI and VIIT is expected (Ratnayake and Jayasuriya, 1991; Ratnayake and Athukorala, 1992; Aturupane *et al,* 1999; Sharma, 2000).

The sector-specific independent variables of the model are discussed now. Capital Stock per worker (K/L), obtained from the ASI database has been considered as a key independent variable in the analysis. This is a straightforward measure of relative endowment of physical capital, and a positive coefficient for the variable is consistent with Heckscher-Ohlin theorem (Greenaway *et al*, 1994; Greenaway and Torstensson, 2000; Jambor, 2014). The current analysis also incorporated ratio of skilled to unskilled workers (S/U) in the model, as rising skill-intensity would increase the supply of vertically differentiated goods (Ethier, 1982; Feenstra and Hanson, 1997; Thorpe and Zhang, 2005). The theoretical literature on the influence of market structure on VIIT provides ambiguous evidence (Greenaway *et al*, 1995). On one hand, VIIT may result if large numbers of firms produce different varieties by qualities without enjoying economies of scale in production (Falvey, 1981) On the other hand, small numbers of firms operating in presence of scale economies can also result in VIIT (Shaked and Sutton, 1984). The present analysis includes four-firm sales concentration ratio (CONC) as a proxy for the influence of market structure on IIT. The empirical literature fails to observe any significant influence of industrial concentration on VIIT (Aturupane *et al*, 1999; Menon *et al*, 1999; Sharma, 2004). In addition, it has been argued that IIT in general and VIIT in particular tend to be higher in sophisticated manufactured goods (i.e., increased product differentiation), requiring a high level of R&D expenses (Lee, 1989; Krugman and Ostfeld, 1994; Hu and Ma, 1999; Blanes and Martin, 2000; Sharma, 2004; Sawyer *et al*, 2010; Doruk, 2015).

The present analysis proposes four important interaction terms in the regression model. For the first three terms, the idea is to note how absolute change in fixed capital to employment ratio $|\Delta(K/L)|$ may behave in association with other key industry-specific variables. First, an interaction term between $|\Delta(K/L)|$ and R&D orientation has been incorporated ($|\Delta(K/L)|$*R&D). A positive relationship for this interaction variable with VIIT is expected, i.e., a sector witnessing relatively higher absolute change in physical capital endowment and R&D orientation is more likely to generate VIIT-type trade. Second, an interaction term between $|\Delta(K/L)|$ and ratio of skilled to unskilled workers (S/U) intensity has been included, namely, ($|\Delta(K/L)|$*(S/U)). A positive coefficient for this interaction term with VIIT is expected, as a sector characterized by relatively higher absolute change in physical capital endowment associated with higher skill-intensity, would positively influence VIIT-type trade. Thirdly, an interaction term of $|\Delta(K/L)|$ and incremental FDI, namely, ($|\Delta(K/L)|$*LFDI), has been incorporated. The sign of the coefficient may however be dubious, depending on the relationship between the objective behind incremental FDI inflows (i.e., export-driven or domestic market capturing) and corresponding trade pattern. Finally, an interaction between incremental FDI and (S/U) in an industry, i.e., (LFDI*(S/U) has been incorporated in the model. The sign of the coefficient might be dubious in this case as well.

Decomposition of India's Sectoral IIT in HIIT and VIIT

India's IITs in the seven selected product categories, namely – chemicals, leather and footwear, textile and garments, iron and steel, base metals, electrical and electronics machinery and equipment and automobile products, as computed following the (Aquino, 1978; 1997) methodology, are reported in Table 2. The corresponding HS 2-digit codes under each product category are noted in the second column of the Table. For observing the temporal perspective, the average IIT levels are compared over four ranges, namely: 2001-05 (India's reliance on multilateral reforms for export growth), 2006-10 (inclination towards regional trade agreements for exports, e.g., India-Singapore trade agreement), 2011-15 (participation in preferential trade agreements with ASEAN, Japan and South Korea) and 2016-18 (joining negotiation in mega-regional trade agreements, e.g., RCEP).

It is observed from Table 2 that India's IITs in all the selected sectors have increased over the period barring the exception of machinery equipment and vehicles and auto-components. The observation indicates rise in India's IIT values after entry into trade agreements with partners from 2010-11 onwards. The extent of IIT increase across sectors has however, varied, given the initial conditions. For instance, the textile and garments sector has started from a low IIT base, because upto 2005 (i.e., till the Multi-Fibre Arrangement phase out) imports remained at a low level. In leather sector on the other hand, given the simultaneous rise in final products as well as raw hide and skin exports and imports, the IIT index has increased considerably. A similar scenario is noted for chemicals as well. On the other hand, the iron and steel sector as well as base metals has only reported a marginal increase in IIT. In these product groups, where both exports and imports have indeed increased, the specialization patterns in exports and imports across the HS 4-digit codes have been different. As a result the sectoral IIT indices, which are constructed with simultaneous exports and imports data at HS 4-digit levels, have not witnessed major movements.

The rise in IIT indices essentially underlines the values of export and import series coming closer in select sectors, i.e., a deeper 'overlapping' of intra-sectoral trade flows. It can be noted that increasing internationalization of these industrial sectors over the last two decades, coupled with growing presence of foreign players in the country, has contributed significantly to growth of simultaneous export and import within the same product categories (involving intermediates, parts and components and final products), which in turn led to rise in India's IIT index. The evolving changes enabled the firms to specialize in and consequently export narrower product lines, while importing quality inputs.

The major reason behind the fall in IIT indices for the two sectors (machinery equipment and vehicles and auto-components) is that the divergence between the exports and imports at HS 4-digit level has significantly gone up, resulting in a lower IIT at sectoral level in recent years.

Table 2
India's IIT in Selected Sectors

Sector	*HS Codes*	*Intra-Industry Trade (IIT) Index*			
		2001-05	*2006-10*	*2011-15*	*2016-18*
Chemicals	28, 29	52.25	55.24	61.05	64.99
Leather and Footwear	41, 42, 64	34.06	39.83	49.58	53.15
Textile and Garments	50-63	23.32	32.05	38.37	37.64
Iron and Steel	72, 73	52.27	49.21	51.44	56.04
Base Metals	74-83	38.18	40.00	41.77	40.03
Machinery Equipment	84, 85	61.27	64.08	65.37	54.36
Vehicles and Auto-components	87	53.02	48.79	45.27	40.00
Average IIT for Select Sectors		44.91	47.03	50.41	49.46
India's Aggregate Average IIT (All Sectors)	1-99	31.95	30.93	30.19	32.06

Source: Author's computation from ITC (undated) data.

The computed sectoral IITs for India are now segregated into vertical and horizontal components across the selected sectors. For this purpose, each of the HS 6-digit tariff lines under all the industry groups defined in Table 2 (column 2) are analysed with respect to their unit price ratios and accordingly categorized under VIIT/HIIT over 2001-18. This analysis reveals for how many tariff lines overlapping trade exists (i.e., simultaneous export and import) in these product groups and what is the relative proportion of VIIT and HIIT therein. The computed IIT index values are then proportionately distributed to arrive at the sectoral decomposition of the IIT result, which are summarized in Table 3.

It is observed from Table 3 that baring the exception of base-metals and iron-steel sectors, India's VIITs have generally shown an increasing trend over the study period both at ±15 per cent and ±25 per cent unit value criterion. The result can be attributed to India's rising HIIT with similar factor endowments countries like Indonesia and Thailand in both base-metals and iron-steel sectors. Further, it is noted that India's HIIT in the electrical machinery and vehicles-auto components has declined over the study period both at ±15 per cent and ±25 per cent unit value criterion. The result can be part explained by the fact that India enjoys VIIT-type trade in heavy machinery and components with dissimilar economies such as USA, Singapore, Japan and several EU member countries (Srivastava and Medury, 2011).

On the whole, two broad observations emerge from the analysis of India's IIT. First, all the seven sectors, which are characterized by simultaneous exports and imports, have shown different levels of changes in respective overall IIT

indices, based on sectoral trade dynamics. Second, in all of the sectors considered here, at the 15 per cent criterion, VIIT is consistently higher than the corresponding HIIT values. The subsequent empirical analysis therefore intends to determine which country-specific and sector-specific factors significantly influence India's VIIT patterns (computed at ±15 per cent unit value criterion).

Section IV
Empirical Results

The summary statistics for the variables selected for the empirical analysis is provided in Table 4. Then Panel data regression analysis has been undertaken with help of STATA Software (version 14). Hausman test is first conducted; the chi-square test statistic is 10.66 (Prob: 0.15) which indicates the presence of underlying random effect model. LM Test is then performed to detect the presence of first order autocorrelation. It is observed that chi-square test statistic of 16.90 (Prob: 0.00) is statistically significant. Breusch-Pagan/Cook-Weisberg test for heteroscedasticity has been conducted to check the existence of heteroscedasticity in the estimated model. The chi-square test statistic is 8.09 (Prob: 0.00) Estimated mean variance inflation factor (VIF) is 1.72, indicating that the values of VIF are within the tolerance limit of multicollinearity for all the variables.

Table 3

Break up of India's Intra-Industry Trade into Vertical and Horizontal Components (HS 6-digit)

Sector	*HS Codes*	*2001-05*				*2006-10*				*2011-15*				*2016-18*			
		(± 15%)		*(± 25%)*		*(± 15%)*		*(± 25%)*		*(± 15%)*		*(± 25%)*		*(± 15%)*		*(± 25%)*	
		VIIT	*HIIT*	*VIIT*	*HIIT*	*VIIT*	*HIIT*	*VIIT*	*HIIT*	*VIIT*	*HIIT*	*VIIT*	*HIIT*	*VIIT*	*HIIT*	*VIIT*	*HIIT*
Chemicals	28, 29	44.13	8.12	39.22	13.03	44.36	10.88	38.13	17.11	49.95	11.10	44.53	16.52	53.86	11.14	47.43	17.56
Leather and Footwear	41, 42, 64	26.97	7.09	22.63	11.43	34.59	5.24	31.29	8.54	39.60	9.97	33.65	15.93	43.10	10.05	32.89	20.26
Textile and Garments	50-63	15.53	7.79	12.18	11.14	23.19	8.86	19.13	12.92	27.08	11.29	21.03	17.34	28.95	8.69	24.32	13.32
Iron and Steel	72, 73	44.00	8.26	38.53	13.74	38.04	11.17	31.54	17.67	39.25	12.19	30.85	20.59	41.36	14.68	33.86	22.19
Base Metals	74-83	32.53	5.64	30.04	9.31	32.04	7.96	26.41	13.59	30.79	10.98	25.63	16.13	28.45	11.58	23.16	16.86
Machinery Equipment	84, 85	37.98	23.29	29.98	31.29	42.92	21.16	34.95	29.13	44.41	20.96	36.55	28.81	45.78	8.58	41.23	13.13
Vehicles and Auto-components	87	29.63	23.39	25.32	27.70	31.47	17.32	24.83	23.96	28.14	17.13	21.97	23.30	32.44	7.56	28.86	11.14

Source: Author's computation from ITC (undated) data.

Table 4
Summary Statistics

Variable	*Observation*	*Mean*	*Std Dev*	*Min*	*Max*
LVIIT	105	1.529	0.125	1.160	1.722
|Δ(K/L)|	105	1.337	1.910	0.000	10.709
S/U	105	0.303	0.108	0.160	0.575
LPI	105	3.079	0.165	3.070	3.120
|ΔWTARIFF|	105	2.418	3.427	0.000	18.126
|ΔCONC|	105	0.020	0.019	0.000	0.096
R&D	105	0.007	0.009	0.001	0.049
LFDI	105	9.769	1.516	0.962	11.424
(|Δ(K/L)|*LFDI)	105	13.606	20.261	0.000	114.687
(|Δ(K/L)|*R&D)	105	0.010	0.019	0.000	0.117
(LFDI*(S/U))	105	9.223	1.572	0.411	11.033
(|Δ(K/L)|*(S/U))	105	0.439	0.681	0.000	4.684
RTA	105	0.333	0.473	0	1

Source: Author's estimation.

The robust estimation results of the selected models are summarized in Table 5. Several conclusions emerge from the empirical results, which are discussed in the following. The results on country-specific and ROW-related determinants are noted first. First, the coefficient of LPI is positive and significant indicating that improvement in India's trade facilitation measures (ports infrastructure, custom clearance procedure, regulatory administration etc) facilitate more VIIT-type trade. The result can be explained by the greater possibility of having simultaneous trade in both high and low value product categories, deepening from the trade facilitation initiatives. Second, the coefficient of absolute change in weighted tariff is found to be positive and significant. A look into the raw data reveals that the actual changes in protectionist intent in all the sectors have generally been negative, signifying tariff reforms. The result therefore stresses that deeper cuts in tariffs facilitate VIIT-type trade in the Indian context. Third, the coefficient of FDI is negative and significant, indicating that incremental foreign investment inflows are generally directed towards accessing the local market. Lastly, the FTA dummy is found to be significant in all the model specification, signifying higher VIITs after entry into several preferential trade partners in East and Southeast Asia.

The sector-specific determinants are discussed next. First, the coefficient of |Δ(K/L)| is positive and significant in several model specifications, indicating that increase in absolute change in capital-intensity facilitates VIIT in India's trade pattern across the sectors. A look into the raw data reveals that the

actual changes in capital-intensity within all the sectors have been positive. In other words, the growing capital-intensity has significantly facilitated VIIT in Indian context. Second, the coefficient of (S/U) variable is positive and significant in various model specifications, i.e., a larger relative presence of skilled workers *vis-à-vis* unskilled ones is associated with rise in VIIT-type trade in the sector. This observation underlines the importance of skill-intensity in positively influencing VIIT. It may be argued that the growing skill-intensity may enable the firms to specialise in exporting relatively higher quality varieties across different categories. Third, coefficient of the proxy for market structure (|ΔCONC|), namely the absolute value of the four-firm concentration ratio, is found to be positive and significant. A look into the raw data reveals that the four-firm concentration is generally declining, signifying emergence of a more equitable market presence among firms. The positive coefficient of this variable with VIIT therefore indicates specialization across quality spectrum. Finally, the positive, significant and greater than one coefficient value of R&D implies that production of higher quality products through innovation has a more than proportionate influence on VIIT-type trade. The underlying logic is that as R&D expenses help firms within a sector to graduate to a higher quality plane, the country can accordingly advance from HIIT to VIIT.

Lastly, all the interaction terms (|Δ(K/L)|*R&D), (|Δ(K/L)|*(S/U)), (|Δ(K/L)|*LFDI) and L(FDI*(S/U)) incorporated in the model are found to be positive and significant. The implications of these results in the Indian context are the following. First, rise in capital-intensity complemented by higher R&D expenditure may create greater scope for production of vertically differentiated products and trade across sectors. Second, rise in capital-intensity complemented by higher skill-intensity might be positively associated with greater trade potential across quality segments. Third, sectors characterized by rise in capital-intensity and incremental FDI inflows lead to greater VIIT. Finally, higher skill-intensity with incremental FDI inflows results in higher VIIT-type trade. The last two results collectively indicate that FDI in sunrise sectors (growing capital-intensity and higher skill-intensity) enable them to reach a technologically more sophisticated plane, and the resulting specialization in higher quality products may lead to VIIT.

Table 5
Regression Results on Determinants of VIIT

Independent Variables	*Dependent Variable: LVIIT*									
	Baseline Regressions									
	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*	*Model 8*	*Model 9*	*Model 10*
Constant	1.322***	1.287***	0.135***	0.110*	1.400***	1.283***	1.357***	1.291***	1.379***	1.236***
	(0.027)	(0.034)	(1.867)	(1.891)	(0.072)	(0.033)	(0.070)	(0.036)	(0.067)	(0.029)
(S/U)	0.747***	0.749***	0.560***	0.793***		0.743***	0.768***	0.745***	0.842***	
	(0.085)	(0.108)	(0.179)	(0.107)		(0.106)	(0.124)	(0.123)	(0.124)	
|Δ(K/L)|		0.004*	0.008*	0.006*	0.016***					
		(0.005)	(0.005)	(0.005)	(0.006)					
FTA		0.050**		0.092***		0.054**			0.094***	0.031*
		(0.025)		(0.028)		(0.028)			(0.029)	(0.033)
LPI			0.392**	0.460**		0.408**				0.493***
			(0.604)	(0.021)		(0.012)				(0.024)
|ΔWTARIFF|			0.002*	0.010**		0.007*			0.009**	0.011**
			(0.003)	(0.004)		(0.004)			(0.004)	(0.005)
LFDI				-0.018**			-0.007		-0.016**	-0.009*
				(0.007)			(0.006)		(0.007)	(0.008)
R&D					2.970**					2.854**
					(1.392)					(1.257)
|ΔCONC|					0.634*	0.818**	1.016**	1.029**	0.606**	0.540*
					(0.619)	(0.491)	(0.485)	(0.487)	(0.479)	(0.560)
(|Δ(K/L)|*LFDI)						0.001*				
						(0.001)				
(|Δ(K/L)|*R&D)							0.305*	0.258*	0.029*	
							(0.587)	(0.580)	(0.573)	
(LFDI*(S/U))					0.008*					
					(0.008)					
|Δ(K/L)*(S/U)|										0.067***
										(0.016)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	105	105	105	105	105	105	105	105	105	105
F-Statistics	83.70	86.60	77.67	79.42	20.15	88.19	97.31	84.11	98.54	82.64

Notes: Figure in the parenthesis shows the standard errors of the estimated coefficient. ***, **, and * implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.
Source: Author's estimation.

Section V
Conclusion

Since nineties, reliance on export-led industrialization and development has deepened across developing countries like India. The various Foreign Trade Policy (FTP) statements of the country, i.e., FTP (2004-09), FTP (2009-14) and FTP (2015-20) endeavoured to enhance Indian exports through several policy initiatives. The export orientation towards specific trade partners has been further facilitated from 2010 onwards, when India joined a series of regional trade agreements, namely - ASEAN-India Free Trade Agreement (FTA) (2010), India-South Korea Comprehensive Economic Partnership Agreement (CEPA) (2010), India-Japan CEPA (2011) and Indo-Malaysia CECA (2011). All these preferential trade partners are part of the Asian GVCs and IPNs and India's manufacturing trade with them significantly increased in the post-bloc period. At the same time, the import barriers and procedures have been reformed, so as to enable Indian firms to access hi-quality raw material, parts and components and machineries. Moreover, rise in income levels have created a consumer demand for varieties across product qualities, resulting growing trade in final products. The opportunities for the foreign MNCs, interested to take the advantages of India's low labour cost and rich endowments, have also been expanded with eased entry norms and relaxation of permissible FDI upper limits. The growing orientation towards industrialization has been further promoted in the country through the 'Make-in-India' initiative launched in 2014, when several key manufacturing sectors were identified for improving production and export frameworks. All these steps are expected to deepen India's participation in Asian GVCs and IPNs across a wide array of industrial segments on one hand, which in turn would increase corresponding sectoral IIT indices on the other. The key concern is that in these rising both-way trade flows, whether India moves up the quality ladder or slides downward.

The empirical results of the current analysis need to be viewed in this wider context. With increasing internationalization of Indian industrial firms, coupled with growing presence of foreign players in the country, the IIT level across sectors has witnessed a rise. Interestingly India's sectoral IIT has been observed to be predominately vertical in nature, underlining qualitative differences to be a crucial factor in overlapping trade flows. A few observations emerge from the results. First, the prominence of VIIT across sectors can be linked with the corresponding technology-intensity (capital-intensity, skill-intensity of workforce, R&D orientation), given the positive coefficient of the base variables and their interaction terms. The magnitude of the coefficient of R&D orientation (greater than unity) particularly underlines the importance of facilitating innovation. Second, the MFN tariff policy reforms have facilitated the VIIT, by enabling imports at different stage of processing at lower duty. On the other hand the FTA dummy has also been significant, underlining the positive influence of preferential trade bloc participation on VIIT. It may hence be noted that both multilateral (MFN) as well as preferential (FTA) trade policy reforms

facilitate VIIT in the Indian context. Third, the policy of boosting foreign investment inflows has however not facilitated VIIT, perhaps owing to greater focus of the MNCs entering the country to access the domestic market instead. Fourth, positive relation between VIIT with decline in industrial concentration may indicate a general rise in participation of firms across size distribution in the internationalization wave. Fifth, through incorporation of LPI in the model it is observed that trade facilitation measures positively influence VIIT, given the easier transport and procedural opportunities. The country is already on the track on improving the ease of doing business in general and port performances in particular. In summary, the positive relationships between quality drivers (capital and skill-intensity and innovation orientation) and reform measures (multilateral and preferential tariff reforms as well as trade facilitation) with VIIT across sectors underline India's potential to move up the product quality plane.

The policy implications of the current results are the following. First, the negative relationship between FDI and VIIT underlines possible impediments in technology transfer process even in the aftermath of Make-in-India initiative. The policymakers therefore, need to re-visit the current process to facilitate technology transfer. Second, given the role of innovation is enhancing product quality and thereby export opportunities in the global market, an enabling framework needs to be devised so that the country could graduate further towards HQVIIT across industrial segments. In addition, ensuring access to capital for necessary upgradation of the machineries and production lines would be crucial. Third, given the significance of interaction terms included in the model, there is a case for identifying key technology-intensive sectors (rich in both skill and capital-intensity), which are ideal candidates for productivity growth, realization of scale economies and quality improvement. These sectors are likely to emerge as the growth drivers in long run. Finally, the positive relation between the FTA dummy and VIIT underlines a concern area as well. India joined the Regional Comprehensive Economic Partnership (RCEP) negotiations since 2013 to enter into preferential relations with 15 partner countries in the Asia-Pacific. However, it pulled out of the negotiations at the last moment in November 2019, given the balance of trade concerns (Dhar, 2019). India's IIT in several product categories have been of LQVIIT or HIIT-type (Kelkar and Burange, 2016), signifying specialization in low/mid-product category, which resulted in widening trade deficit with the 'East'. Now the 'Atmanirbhar Bharat Abhiyan' launched in May 2020 in principle envisions to lower the import-dependence of domestic industry on one hand and improve the trade deficit scenario on the other. It can further be argued that the country's long-term objective is to transform the LQVIIT-type trade to HQVIIT-type, by sliding upwards on the quality scale.

An important area of future research can be on cross-country analysis of India's HIIT and VIIT trends and determinants in leading manufacturing product groups over the period, in particular in the aftermath of launching the Make-

in-India initiative. Such an exercise would offer a deeper understanding of the nature of India's pattern of trade in general and cross-country trade overlaps within sectors in particular.

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Annexure 1
Product Concordance between Industry and Trade Codes

Sector	*NIC 4-Digit Code*	*HS 4-Digit Code*
Year 1998		
Chemical	2411, 2412	2801-2853, 2901-2942
Leather and footwear	1911, 1912, 1920	4101-4115, 4201-4206, 6401-6406
Iron and Steel	2710, 2731, 2811, 2812, 2813, 2891, 2892, 2893	7201-7229, 7301-7326
Vehicles	3410, 3420, 3430, 3591, 3592, 3599	8701-8716
Textiles and Garments	1711, 1712, 1721, 1722, 1723, 1729, 1730, 1810, 2430	5001-5007, 5101-5113, 5201-5212, 5301-5311, 5401-5408, 5501-5516, 5601-5609, 5701-5705, 5801-5811, 5901-5911, 6001-6006, 6101-6117, 6201-6217, 6301-6310
Base Metals	2720, 2732, 2899	7401-7419, 7501-7508, 7601-7616, 7801-7806, 7901-7907, 8001-8007, 8101-8113, 8201-8215, 8301-8311
Electrical Machinery and Equipment's	2911, 2912, 2913, 2914, 2915, 2919, 2921, 2922, 2923, 2924, 2925, 2926, 2927, 2929, 2930, 3000, 3110, 3120, 3130, 3140, 3150, 3190, 3210, 3220, 3230	8401-8487, 8501-8548
Year 2004		
Chemical	2411, 2412	2801-2853, 2901-2942
Leather and footwear	1911, 1912, 1920	4101-4115, 4201-4206, 6401-6406
Iron and Steel	2711, 2712, 2713, 2714, 2715, 2716, 2717, 2718, 2719, 2731, 2811, 2812, 2813, 2891, 2892, 2893	7201-7229, 7301-7326
Vehicles	3410, 3420, 3430, 3591, 3592, 3599	8701-8716
Textiles and Garments	1711, 1712, 1713, 1714, 1721, 1722, 1723, 1724, 1725, 1729, 1730, 1810, 2430	5001-5007, 5101-5113, 5201-5212, 5301-5311, 5401-5408, 5501-5516, 5601-5609, 5701-5705, 5801-5811, 5901-5911, 6001-6006, 6101-6117, 6201-6217, 6301-6310

(Contd.)

Annexure 1 (Contd.)
Product Concordance between Industry and Trade Codes

	Year 2004	
Sector	*NIC 4-Digit Code*	*HS 4-Digit Code*
Base Metals	2720, 2732, 2899	7401-7419, 7501-7508, 7601-7616, 7801-7806, 7901-7907, 8001-8007, 8101-8113, 8201-8215, 8301-8311
Electrical Machinery and Equipment's	2911, 2912, 2913, 2914, 2915, 2919, 2921, 2922, 2923, 2924, 2925, 2926, 2927, 2929, 2930, 3000, 3110, 3120, 3130, 3140, 3150, 3190, 3210, 3220, 3230	8401-8487, 8501-8548
	Year 2008	
Chemical	2011, 2012	2801-2853, 2901-2942
Leather and footwear	1511, 1512, 1520	4101-4115, 4201-4206, 6401-6406
Iron and Steel	2410, 2431, 2511, 2512, 2513, 2591, 2592, 2593, 2599	7201-7229, 7301-7326
Vehicles	2910, 2920, 2930, 3091, 3092, 3099	8701-8716
Textiles and Garments	1311, 1312, 1313, 1391, 1392, 1393, 1394, 1399, 1410, 1430, 1709, 2030	5001-5007, 5101-5113, 5201-5212, 5301-5311, 5401-5408, 5501-5516, 5601-5609, 5701-5705, 5801-5811, 5901-5911, 6001-6006, 6101-6117, 6201-6217, 6301-6310
Base Metals	2420, 2432, 2599	7401-7419, 7501-7508, 7601-7616, 7801-7806, 7901-7907, 8001-8007, 8101-8113, 8201-8215, 8301-8311
Electrical Machinery and Equipment's	2610, 2620, 2630, 2640, 2660, 2710, 2720, 2731, 2732, 2733, 2740, 2750, 2790, 2811, 2812, 2813, 2814, 2815, 2816, 2817, 2818, 2819, 2821, 2822, 2823, 2824, 2825, 2826, 2829	8401-8487, 8501-8548

Source: Author's construction, based on analysis with ASI data, NIC Classification (1998, 2004, 2008), MOSPI, CSO, GoI (undated) and Trade Map (ITC, undated) classifications.

Annexure 2
Source of Data used in the Empirical Model

Sl No	*Variable*	*Description and Data Source*	*Category*
1.	VIIT	Computed with import and export data across sectors obtained from Trade Map, ITC (undated)	Computed by author
2.	$\left\|\Delta\left(\frac{K}{L}\right)\right\|$	Computed by dividing Fixed Capital by No of Persons Employed data, obtained from Annual Survey of Industries (ASI), GoI (undated) at NIC 4-digit level	Computed by author
3.	S/U	Computed by dividing skilled to unskilled worker data taken from ASI, GoI (undated) at NIC 4-digit level	Computed by author
4.	|ΔWTARIFF|	Weighted average MFN tariff data for each sector Data taken from WITS, World Bank (undated)	Compiled by author
5.	|ΔCONC|	Computed by calculating Four-Firm Concentration Ratio (FFCR), by adding up the per centage market share of top four firms in each of the industry. To obtain market share, Sales data has been taken from Prowess database (CMIE, undated)	Computed by author
6.	R&D	Computed by dividing the research and development expenditure by total expenses in the industry Data has been obtained from Prowess database (CMIE, undated)	Computed by author
7.	LFDI	Sector-wise FDI inflows obtained from SIA Statistics, Department for Promotion of Industry and Internal Trade (DIPP, undated)	Compiled by author
8.	LPI	Obtained from the Logistics Performance Index database (World Bank, undated)	Compiled by author
9.	$\left\|\Delta\left(\frac{K}{L}\right)\right\| * LFDI$	Multiplication of absolute change in Fixed Capital to Employment Ratio and Foreign Direct Investment Inflows Data obtained from DIPP, (undated) and ASI database (GoI, undated) respectively	Computed by author
10.	$\left\|\Delta\left(\frac{K}{L}\right)\right\| * R\&D$	Multiplication of absolute change in Fixed Capital to Employment Ratio and Research & Development Expenditure to Total Expenses Ratio Data obtained from ASI, GoI (undated) and Prowess database (CMIE, undated) respectively	Computed by author
11.	LFDI*(S/U)	Multiplication of Foreign Direct Investment Inflows and skilled workers to unskilled workers ratio Data obtained from DIPP, (undated) and ASI database (GoI, undated) respectively	Computed by author
12.	$\left\|\Delta\left(\frac{K}{L}\right)\right\| * \left(\frac{S}{U}\right)$	Multiplication of absolute change in Fixed Capital to Employment Ratio and skilled workers to unskilled workers ratio Data obtained from ASI, GoI (undated)	Computed by author
13.	RTA	The dummy takes the value of 1 from the year 2011 onwards and 0 otherwise	Compiled by author

Note: First difference of the variables (K/L), WTARIFF, CONC has been incorporated in the analysis so that the modified series is stationary. Δ represents the first difference of the modified variable. Rest of the variables are stationary, and hence incorporated in the model without transformation.

Source: Author's construction.

Endnote

1. It may be noted that another version of this model had been estimated with lagged values of VIIT as an independent variable. To appropriately handle the dynamic panel data, Generalized Method of Moments (GMM) model had been estimated. However, the lagged values of VIIT are found not to be significant determinant of VIIT in the current period. So, the lagged values of VIIT have been dropped from the model.