INDIAN INSTITUTE OF FOREIGN TRADE

WPS No. EC-21-54

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Printed and published by

Indian Institute of Foreign Trade

Delhi Centre | IIFT Bhawan, B-21, Qutab Institutional Area, New Delhi 110016
Kolkata Centre | 1583 Madurdaha, Chowbagha Road, Borough XII, Kolkata 700107

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Which Factors influence Vertical Intra-Industry Trade in India? Empirical Results from Panel Data Analysis

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Abstract

Over the last two decades, India has witnessed a rise in its both-way trade flows, reflected in the rising Intra-Industry Trade (IIT) indices both at aggregate and sectoral levels. A major branch of the associated literature focuses on decomposition of the IIT in Vertical IIT (VIIT) and Horizontal IIT (HIIT) categories, defined in terms of quality of the products being exported and imported simultaneously. Through a data analysis of select manufacturing sectors, the current paper concludes that India's IIT is predominantly vertical in nature, displaying an increasing trend over 2001-19. A panel data analysis on the determinants of India's VIIT during 2001-15 indicate that increase in capital-intensity, higher skill-intensity of workforce, higher research and development orientation and decline in industrial concentration facilitates the same. In addition, the interaction terms reveal that rising sophistication in product quality also positively influence VIIT. The paper concludes that there is a need for the country to identify and promote key technology-intensive sectors to realize the 'Make-in-India' and 'Atmanirbhar Bharat Abhiyan' objectives in long run.

JEL Classification: F12, F13, F14

Keywords: India's Trade policy, Manufacturing sector, Vertical Intra-industry Trade, Foreign Direct Investment, Panel data analysis, Atmanirbhar Bharat Abhiyan

Which Factors influence Vertical Intra-Industry Trade in India? Empirical Results from Panel Data Analysis

1. Introduction

The phenomenon of growing two-way trade in manufacturing sector since sixties has been classified in the empirical literature as Intra-Industry Trade (IIT). The IIT pattern has been explained in the theoretical and empirical literature with several underlying factors, e.g.: 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 and distance (Hümmels and Levinsohn, 1995; Stone and Lee, 1995; Holmes and Stevens, 2014) and so on. The literature in the subsequent period focused on decomposition of the computed IIT indices in two components, namely: Horizontal IIT (HIIT) and Vertical IIT (VIIT). While HIIT is inversely proportional to differences in factor endowments between countries (Helpman and Krugman, 1985), VIIT emerges owing to differences in technology (*i.e.*, capital intensity and labour productivity), growing income dissimilarity and so on (Falvey, 1981; Shaked and Sutton, 1984; Flam and Helpman, 1987; Greenaway *et al.*, 1995; Fontagné *et al.*, 2006; Kim and Niem, 2011; Jambor, 2014; Răzvan and Camelia, 2015).

It is observed from the existing empirical literature that the IIT indices for India has increased over the period (Pant and Barua, 1986; Veeramani, 1999, 2001, 2002; Chakraborty, 2002; Chakraborty and Chakraborty, 2005; Kelkar and Burange, 2016; Aggarwal and Chakraborty, 2017). IIT in India is found to be predominantly vertical in nature (Veeramani, 2002; Srivastava and Medury, 2011; Aggarwal and Chakraborty, 2017, 2020; Bagchi and Bhattacharyya, 2019, 2021; Aggarwal and Chakraborty, 2019). It is expected that the industrial consolidation process, aided by the recent initiatives, namely: 'Make-in-India' (2014) and 'Atmanirbhar Bharat Abhiyan' (2020) would facilitate the two-way trade further. The current analysis intends to identify the key underlying factors behind India's VIIT with rest of the world (ROW) for select manufacturing sectors over 2001-15. The analysis is arranged along the following lines. First, a brief review of HIIT-VIIT literature is presented, followed by discussion on data, methodology and the empirical model. Finally, based on the obtained results, certain policy conclusions are drawn.

2. Review of Literature[1]

The distinction between VIIT and HIIT is integral part of the existing literature (Blanes and Martín, 2000). As HIIT concerns products of similar quality, rise in this type of trade might be associated with certain labour market adjustment costs in the comparable product groups (Brülhart 1999, 2000). On the other hand, 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. Let us consider India simultaneously

[1] The literature survey draws from the analysis of Aggarwal and Chakraborty (2020).

exporting and importing a product, namely: Articles of leather or composition leather (HS 420500). Now, if the products being exported and imported belong to the same quality plane, their prices will be within comparable ranges. Thus, if the export and import price ratio is in close vicinity of unity and falls within the range defined in the following manner, trade is considered to be HIIT-type.

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

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 percent or 25 percent). So, if the value of the index is within the defined range, i.e., between 0.85 (or, 0.75) to 1.15 (or, 1.25), the trade is HIIT-type; and VIIT-type otherwise. 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, signifying that the exporting country is placed in higher-quality plane.

The rich literature on segregating IIT into HIIT and VIIT can be placed under three branches, based on income groups. The first branch of studies has examined the levels of HIIT-VIIT in developed countries (Greenaway *et al.*, 1994, 1995; Sharma, 2006; Fertő, 2007; Chang, 2009; Gabrisch, 2009; Ito and Okubo, 2012; Thorpe and Leitão, 2013; Jambor, 2014; Jambor *et al*., 2016). A major section of this literature studied the European economies and noted the presence of different underlying determinants. It has been noted that VIIT is a reflection of endowment or technology-based factors on one hand, while HIIT is influenced by factors such as imperfect competition and demand for varieties on the other (Greenaway *et al.*, 1994, 1995; Aturupane *et al*., 1999; Blanes and Martín, 2000; Greenaway and Torstensson, 2000; Crespo and Fontoura, 2004; Ferto and Hubbard, 2002; Ando, 2006; Leitão and Faustino, 2006, 2008; Fertő, 2007; Mezo, 2007; Cernosa, 2009; Gabrisch, 2009; Jambor, 2014; Bojnec and Fertő, 2016). The IIT involving EU economies is found to be generally vertical in nature (Greenaway *et al.*, 1994, 1995; Fontagné and Freudenberg, 1997; Gabrisch and Segnana, 2002; Janda and Munich, 2004; Fertő, 2007; Zhang and Clark, 2009; Thorpe and Leitão, 2013). Another group of studies focused on the determinants of VIIT-HIIT in the high-income economies of East Asia (e.g., China, Japan and South Korea) and observed that VIIT in the region has grown rapidly in relation to overall intra-regional trade (Fukao *et al*., 2003; Bhattacharyya, 2005; Zhang *et al.*, 2005; Wakasugi, 2007; Yoshida, 2013; Chin *et al.*, 2015). The dominance of VIIT in the two-way trade of North America Free Trade Agreement (NAFTA) countries has been explained by the growing vertical differentiation (Clark, 2006; Ekayanake *et al*., 2009). Growing participation in international production networks (IPNs) explain the growing VIIT-type trade involving Turkey (Kılavuz *et al*., 2013). The broad conclusion that emerges is that skill and technology endowments play a key role in augmenting product quality in developed countries, which in turn further influences the VIIT.

A second branch of literature has investigated HIIT and VIIT patterns involving the developing countries (Hu and Ma, 1999; Bhattacharya, 2002; Veeramani, 2002; Zhang *et al*., 2005; Azhar *et al*., 2008; Devadson, 2012; Akram and Mahmood, 2012; Yoshida, 2013; Chin *et al.*, 2015, Chin *et al.*, 2016). This literature observed that emergence of complex value chains (e.g., border crossing on more than one occasions) in vertically fragmented production process, in addition to two-way trade in quality-differentiated commodities has caused a sharp increase in VIIT (Aditya and Gupta, 2019). Conversely, HIIT is more prevalent among economies characterised by similar development profile and capital-labour ratios (Bergstrand, 1990; Frahan and Tharakan, 1998; Hu and Ma, 1999; Chang, 2009; Varma, 2015).

Finally, few studies have analysed the features and determinants of the horizontal and vertical IIT between developed and developing countries. Andresen (2003) and Wakasugi (2007) noted the contribution of international fragmentation of production process and heterogeneity in factor endowment in raising the share of VIIT between the economies. Chang (2009) examined the pattern of HIIT and VIIT in the Information Technology industry among Asia, the EU and the US markets and stressed the relevance of RTAs in enhancing vertical specialization between the regions, an observation which also confirmed the findings by Wakasugi (2007).

The rich literature on determinants of VIIT-HIIT patterns noted the influence of various country-industry-specific factors, especially among the advanced and developing countries (Fontagné and Freudenberg, 1997; Clark and Stanley, 1999; Greenaway *et al.*, 1999; Clark, 2006; Ekanayake *et al.*, 2009). It is observed from the literature that technology difference, market structure, research and development expenditure (R&D), FDI, skill intensity, education expenditure are among the key explanatory variables used for identifying their influence on VIIT and HIIT (Greenaway *et al*., 1994; Aturupane *et al*., 1999; Veeramani, 2002; Andresen, 2003; Zhang *et al*., 2005; Wakasugi, 2007; Chang, 2009; Yoshida, 2013; Jambor, 2014). In particular, the VIIT-intensity is positively correlated with increased R&D expenses in sophisticated machinery goods, which provides the firms a crucial comparative advantage (Hu and Ma, 1999; Blanes and Martín, 2000; Sharma, 2004; Chang, 2009; Doruk, 2015). Also, the VIIT is negatively correlated with tariffs, as imposition of trade barriers create frictions and reduces the chance for deepening IIT (Bhattacharyya, 2005; Zhang *et al*., 2005; Srivastava and Medury, 2011). The other industry-level drivers of VIIT, with potential repercussions on 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. A few major empirical papers on determinants of HIIT and VIIT are summarized in Annexure 1.

There exists a rich literature on VIIT-HIIT computation with Indian data in the post-1991 period. The early analyses observed presence of rising VIIT in the post-reform period (Veeramani, 2002; Srivastava and Medury, 2011). While the proportion of LQVIIT in India's trade is gradually declining, with a simultaneous rise in HIIT (Kelkar and Burange, 2016); the two-way trade composition depends on the partner's development profile as well. For instance, while India's trade with Pakistan and China is of HQVIIT and LQVIIT nature respectively (Devadason, 2012; Akram and Mahmood, 2012), the presence of both LQVIIT and HQVIIT within India-Turkey bilateral trade flows underline the existing trade complementarities (Kilavuz *et al.*, 2013).

Several studies have also focussed on VIIT-HIIT determinant analysis in the Indian context. Srivastava and Medury (2011) observed the predominance of VIIT in India's IIT and the positive role of tariff reforms on both VIIT and HIIT. Varma (2015) identified similarities in capital formation and GDP as common determinants of both VIIT and HIIT and concluded that bigger economic sizes and free trade agreements (FTA) are particularly important in facilitating VIIT. Bagchi and Bhattacharyya (2019) observed that India's IIT decomposition has a development dimension, as HIIT and VIIT-type trade occur more with developing and developed countries, respectively. 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. The present analysis explores the determinants of India's VIIT with ROW for seven selected key manufacturing product groups over 2001-15.

3. Methodology and Data

Given the relatively higher occurrence of IIT in certain key manufacturing sectors, namely: chemicals, leather and footwear; textiles and garments; iron and steel, base metals, electrical machinery and equipment and vehicles and auto-components (Pathikonda and Farole, 2016), they are selected for the current analysis. For computing IIT and further decomposing the same in VIIT-HIIT, the export and import data for the analysis, both at HS 4-digit and 6-digit levels, have been drawn from Trade Map database (ITC, undated). Among the explanatory variables, FDI data is taken from SIA Statistics (DIPP, undated). Trade-weighted average MFN tariff data is obtained from WITS (World Bank, undated). Prowess and Annual Survey of Industries (ASI) are the sources for collecting industry-specific data, e.g., sales, total expenses, R&D expenditure, skill-intensity etc. (CMIE, undated; GoI, undated). As the industry data over the period under consideration are obtained under multiple classifications, Aggarwal and Chakraborty (2020) developed a concordance between the trade codes (in HS) and industry codes (in NIC), which is reported in Annexure 2. For creating a balanced panel, the data on all the variables are collected for the period 2001-15.

To correct sectoral trade imbalance effect, the present analysis computes sectoral IITs following the method proposed by Aquino (1978, 1997), instead of the Grubel and Lloyd (1975) index. As per the Aquino method, when X_{ij} and M_{ij} represent export and import of country *j* for industry *i* at HS 4-digit level, the estimated values of export (X^e_{ij}) and import (M^e_{ij}) are first calculated as:

$$X^e_{ij} = X_{ij} * \frac{\sum_i (X_{ij} + M_{ij})}{2\sum_i X_{ij}} \; ; \quad M^e_{ij} = M_{ij} * \frac{\sum_i (X_{ij} + M_{ij})}{2\sum_i M_{ij}}$$

Then, 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:

$$A_{ij} = \frac{\sum_i (X^e_{ij} + M^e_{ij}) - \sum_i |X^e_{ij} - M^e_{ij}|}{\sum_i (X^e_{ij} + M^e_{ij})} \times 100$$

……. (2)

The sectoral IIT index thus computed is distributed between the VIIT and HIIT index values following the Rahman (1991) method, based on the unit price ratios for each HS 6-digit products calculated from equation (1). The extent of overlapping trade, i.e., simultaneous export and import for the tariff lines is noted, considering 15 percent as the threshold for determining HIIT and VIIT. The computed IIT index values are then proportionately distributed in VIIT and HIIT, which are reported in Table 2.

Several explanatory variables are included in the analysis, based on existing theoretical and empirical literature. The underlying reason behind their inclusion in the model is noted in the following. India's sectoral VIITs with ROW, calculated following Aquino (1978, 1997) and

Rahman (1991) method are the dependent variables. The independent variables include several sector-specific determinants and interaction terms. First, capital Stock per worker (K/L) may have a positive relation with VIIT, in line with Heckscher-Ohlin theorem (Greenaway and Torstensson, 2000; Jambor, 2014). Second, rise in skill-intensity may consequently increase the supply of vertically differentiated goods, and in turn, VIIT (Feenstra and Hanson, 1997). Third, VIIT is likely to be negatively correlated with sectoral tariffs, given the resulting rising frictions (Zhang *et al*., 2005). Fourth, four-firm sales concentration ratio (*CONC*) as a proxy for market structure is included, which may have a negative coefficient (Aturupane *et al.*, 1999; Menon *et al*., 1999; Sharma, 2004). Fifth, as IIT in general and VIIT in particular may get positively influenced by product sophistication and product differentiation, R&D expenses have been included in the model (Hu and Ma, 1999; Blanes and Martín, 2000; Sharma, 2004; Sawyer *et al*., 2010; Doruk, 2015). Finally, the relationship between IIT and sectoral FDI inflows may however be ambiguous (Gray, 1988). If the FDI inflows involve technology transfer and exports, VIIT might be positively related to foreign investment (Greenaway *et al*., 1994, 1995; Hu and Ma, 1999; Zhang *et al*., 2005), but market-seeking investment by foreign firms may lead to a negative relationship between the two (Ratnayake and Athukorala, 1992; Aturupane *et al*., 1999; Sharma, 2000).

The present analysis proposes five 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 (|Δ(K/L)|) may behave in association with other key industry-specific variables, namely: FDI, R&D and skill-intensity. The last two terms, i.e., (|Δ(K/L)|*R&D) and (|Δ(K/L)|*(S/U)) are expected to be positively related with VIIT owing to the improved productive capacity. On the other hand, the sign of (|Δ(K/L)|*$LFDI$) and (LFDI*(S/U) may however be ambiguous, depending on the objective influencing the incoming foreign investment (e.g., export-driven or domestic market capturing) and the corresponding trade pattern. Finally, an interaction between change in tariff and skill-intensity ($|\Delta WTARIFF| * (\frac{S}{U})$) might be positively related with VIIT, given the lower trade resistance, accompanied by rising supply of vertically differentiated goods.

A couple of important diagnostic tests are conducted first. The Harris-Tzavalis Test results, used to check stationarity of the variables included in the model are reported in Table 1.[2] Barring the exception of weighted tariff, four-firm concentration ratio and capital-labour ratio, the variables used in the regression analysis are stationary. Hence, first differences of these three variables have been included in the regression model, which becomes stationary after the transformation. Moreover, standardized FDI variable (logarithmic transformation) has been considered in the regression analysis.

Table 1: Harris-Tzavalis Panel Unit Root Test

Variables	Rho	Z
$LVIIT_{it}$	0.6056	-2.8436***
$\Delta(\frac{K}{L})$	0.0280	-10.7817***

[2] Apart from Harris-Tzavalis Panel Unit Root Test, Levin-Lin-Chu (2002) and Fisher Panel Unit Root Tests (Choi, 2001), has been performed and the results are largely similar. Hence, only the Harris-Tzavalis Test results has been reported.

(S/U)	0.2632	-7.5490***
ΔWTARIFF	-0.1806	-13.6479***
ΔCONC	-0.0090	-11.2895***
R&D	0.4258	-5.3151***
LFDI	0.5178	-4.0507***
$(\Delta(\frac{K}{L}) * LFDI)$	0.1358	-9.2999***
$(\Delta(\frac{K}{L}) * R\&D)$	0.3013	-7.0250***
$(\Delta(\frac{K}{L}) * (\frac{S}{U}))$	0.0381	-10.6430**
$(LFDI * (\frac{S}{U}))$	0.5140	-4.1026***
$(\lvert\Delta WTARIFF\rvert * (\frac{S}{U}))$	0.3387	-6.5118***

Source: Own estimation using Stata: Release 14
Notes: *** denotes the statistical significance at 1 percent.

Through a two-stage least squares (2SLS) model, the endogeneity test for the explanatory variables has been conducted. The Wald chi-square test statistic of 61.26 (Prob: 0.00) is statistically significant. The Durbin score of 0.103 (Prob 0.748) and Wu-Hausman statistic of 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, i.e., LFDI, R&D expenditure, absolute change in four-firm concentration ratio, ratio of skilled to unskilled workers are not endogenous. Finally, to test whether unobserved components that create interdependencies across cross sections are correlated with included regressors, Pesaran (2004) CD test has been performed in R software. The null hypothesis of the CD test states that the residuals are cross-sectionally uncorrelated. Correspondingly, the alternative hypothesis presumes that spatial dependence is present. Observed F-statistic of 1.44 (Prob: 0.1968) indicates that null hypothesis of spatial independence at 5 percent level of significance is not rejected.

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

$$LVIIT_{it} = \alpha_0 + \beta_1 \lvert\Delta(\frac{K}{L})\rvert_{it} + \beta_2 (\frac{S}{U})_{it} + \beta_3\lvert\Delta WTARIFF\rvert_{it} + \beta_4\lvert\Delta CONC\rvert_{it}$$
$$+ \beta_5 R\&D_{it} + \beta_6 LFDI_{it} + \beta_7 (\lvert\Delta(\frac{K}{L})\rvert * LFDI)_{it} + \beta_8 (\lvert\Delta(\frac{K}{L})\rvert * R\&D)_{it}$$
$$+ \beta_9 (\lvert\Delta(\frac{K}{L})\rvert * (\frac{S}{U}))_{it} + \beta_{10} (LFDI * (\frac{S}{U}))_{it}$$
$$+ \beta_{11} (\lvert\Delta WTARIFF\rvert * (\frac{S}{U}))_{it} + YearD_t + SectorD_i + \varepsilon_{it}$$

……. (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*
$\Delta WTARIFF_{it}$	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*
$((\Delta \frac{K}{L}) * LFDI)_{it}$	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*
$((\Delta \frac{K}{L}) * (\frac{S}{U}))_{it}$	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*
$(LFDI * (\frac{S}{U}))_{it}$	represents an interaction term of the incremental foreign direct investment and ratio of skilled workers to unskilled workers for sector *i* in year *t*
$(\lvert \Delta WTARIFF \rvert * (\frac{S}{U}))_{\boldsymbol{t}}$	represents an interaction term of the change in weighted MFN tariff and ratio of skilled workers to unskilled workers for sector *i* in year *t*
$YearD_t$	represents year dummies
$SectorD_i$	represents sector dummies
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 3.[3]

[3] 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.

4. Decomposition of India's Sectoral IIT in HIIT and VIIT

India's IIT indices in the selected sectors are reported in Table 2. For observing the evolution in India's average IIT over time, the computed values are compared over four periods, 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 2016-19 (joining negotiation in mega-regional trade agreements, e.g., RCEP). A general rise in India's sectoral IITs is noted, barring the exception of machinery equipment and vehicles and auto-components. 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. The IIT dynamics has varied across sectors, possibly given the contrasting influence of sector-specific factors (e.g., Multi-Fibre Arrangement phase out for textile and garments; adoption of UNECE 1998 membership by India for automobile products, lowering of duty for IT products under the guidance of WTO Information Technology Agreement).

The computed sectoral IIT index values as well as corresponding VIIT and HIIT results over 2001-19 are summarized in Table 2. It is observed that baring the exception of base-metals and iron-steel sectors, India's VIITs have generally shown an increasing trend over the study period at ±15 percent unit value criterion. The result can be attributed to India's rising HIIT with countries characterized by similar factor endowments (e.g., 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 at ±15 percent unit value criterion, perhaps owing to the country's growing trade with several dissimilar economies in these categories (Srivastava and Medury, 2011). In all, for all the selected sectors, VIIT is found to be higher than the corresponding HIIT values. Therefore, a determinant analysis of India's sectoral VIIT is likely to yield interesting results.

Table 2: Break up of India's Intra-Industry Trade into Vertical and Horizontal Components (HS 6-digit)

Sectors	**HS Codes**	**IIT Index (Aquino)**				**Decomposition of IIT (based on 15 percent threshold)**							
		2001-05	**2001-05**	**2011-15**	**2016-19**	**2001-05**		**2001-05**		**2011-15**		**2016-19**	
						VIIT	**HIIT**	**VIIT**	**HIIT**	**VIIT**	**HIIT**	**VIIT**	**HIIT**
Chemicals	28, 29	52.25	55.24	61.05	64.48	44.13	8.12	44.36	10.88	49.95	11.10	52.48	11.72
Leather and Footwear	41, 42, 64	34.06	39.83	49.58	53.09	26.97	7.09	34.59	5.24	39.60	9.97	43.87	10.12
Textile and Garments	50-63	23.32	32.05	38.37	37.91	15.53	7.79	23.19	8.86	27.08	11.29	28.76	8.54
Iron and Steel	72, 73	52.27	49.21	51.44	55.02	44.00	8.26	38.04	11.17	39.25	12.19	40.74	14.26
Base Metals	74-83	38.18	40.00	41.77	39.70	32.53	5.64	32.04	7.96	30.79	10.98	26.19	13.50
Machinery Equipment	84, 85	61.27	64.08	65.37	55.91	37.98	23.29	42.92	21.16	44.41	20.96	44.76	8.92
Vehicles and Auto-components	87	53.02	48.79	45.27	40.57	29.63	23.39	31.47	17.32	28.14	17.13	32.49	7.96
Average IIT for Select Sectors		**44.91**	**47.03**	**50.41**	**49.53**								
India's Aggregate Average IIT (All Sectors)	1-99	**31.95**	**30.93**	**30.19**	**33.64**								

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

5. Empirical Results

The summary statistics for the Panel data analysis is provided in Table 3. 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: 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
|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
(|Δ(K/L)|*(S/U))	105	0.439	0.681	0.000	4.684
(LFDI*(S/U))	105	9.223	1.572	0.411	11.033
(|ΔWTARIFF|*(S/U))	105	0.754	1.110	0.000	5.515

Source: Author's estimation

The estimation results are summarized in Table 4 and the following conclusions can be drawn. First, given the rising production sophistication in India, the positive and significant coefficient of (|Δ(K/L)|) imply that growing capital-intensity has facilitated VIIT. Second, positive and significant coefficient of (S/U) signal that growing presence of skilled workers *vis-à-vis* unskilled ones is associated with rise in sectoral VIIT trade. Third, as India has lowered the tariff barriers significantly over the period, the positive and significant coefficient of (|ΔWTARIFF) indicate that deeper cuts in tariffs facilitated VIIT-type trade. Fourth, the positive, significant and greater than unity coefficient value of the R&D variable 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. Fifth, change in firm concentration (|ΔCONC|), which is declining in the Indian context, is positively related to VIIT. The result signifies that homogeneity in firm structure facilitate the VIIT trade, presumably owing to the small and medium players (SMEs) also joining in the production networks. Finally, the negative and significant coefficient of (LFDI) denote that the incremental foreign investment inflows are primarily targeting the local market of the country, and thereby not contributing much to enhancing VIIT.

It is further observed that all the five interaction terms, namely: (|Δ(K/L)|*LFDI), (|Δ(K/L)|*R&D), (|Δ(K/L)|*(S/U)), L(FDI*(S/U)) and (|ΔWTARIFF|*(S/U)) are found to be positive and significant. It is known that while both capital-intensity and skill-intensity have increased in Indian manufacturing sectors, the tariff barriers have come down. The implications of these results in the Indian context are the following. First, sectors characterized by rising capital-intensity and incremental FDI inflows result in greater VIIT. Second, rising capital-intensity associated with higher R&D expenditure may lead to improvement of product quality, in turn resulting in vertical differentiation. Third, rising capital-intensity supplemented by higher skill-intensity facilitated deeper trade across quality segments. Fourth, higher skill-intensity with incremental FDI inflows resulted in higher VIIT trade. The results collectively indicate that FDI in sunrise sectors (i.e., sectors characterized by growing capital-intensity and higher skill-intensity) enable them to reach a technologically more sophisticated plane, and the resulting specialization in higher quality products lead to VIIT. Finally, decline in tariff barriers characterized by higher skill-intensity facilitated VIIT trade in the Indian context.

6. Conclusion

The recent reforms and policies undertaken to consolidate the Indian manufacturing segment, e.g., improvements in ease of doing business parameters, FDI reforms, tariff reforms, strategic participation in Asian FTAs, 'Make-in-India' initiative, 'Atmanirbhar Bharat Abhiyan' are all geared to make India a global manufacturing hub. While these interventions have led to rising both-way trade flows, it is imperative that the firms gradually embrace growing capital-intensity and skill-intensity, enabling them to specialise in exporting relatively higher quality varieties. The empirical results of the current analysis need to be viewed in this wider context. 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. The key observations are as follows. First, the prevailing VIIT in India can be linked to qualitative improvement in production structure (e.g., growing capital-intensity, skill-intensity of workforce) in general and innovation (R&D orientation) in particular. This calls for interventions to ensure access to capital for necessary upgradation of the machineries and production lines. Second, tariff reforms facilitated VIIT trade, logically by allowing imports of raw materials and intermediate products at a lower duty. It may be noted that industrial tariffs have increased in India to certain extent over the last decade (Nag et al, 2021). The need for tariff reforms, particularly in the intermediate product segments, needs to be considered by the policymakers. Third, the FDI reform-related interventions have not facilitated VIIT, underlining possible impediments in technology transfer process even in the aftermath of Make-in-India initiative, which deserve requisite attention. Fourth, positive relation between VIIT with decline in industrial concentration imply a general rise in participation of firms across size distribution in the internationalization wave, which is encouraging. Given the rising trend in R&D expenses in Indian manufacturing sector and the country's potential to move up the product quality plane, it would be crucial to identify and promote 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. The requisite interventions in these segments would enable India to effectively realize the 'Make-in-India' and 'Atmanirbhar Bharat Abhiyan' objectives of making the country a global manufacturing production hub in the long run.

Table 4: Regression Results on Determinants of VIIT in India

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
Constant	1.322***	1.222***	1.153***	1.400***	1.354***	1.291***	1.334***	1.341***	1.220***
	(0.027)	(0.034)	(0.066)	(0.072)	(0.070)	(0.036)	(0.082)	(0.083)	(0.035)
|Δ(K/L)|		0.146***	0.013***	0.016***			0.017***		
		(0.005)	(0.005)	(0.006)			(0.006)		
(S/U)	0.747***	0.869***	0.876***		0.762***	0.745***			0.885***
	(0.085)	(0.092)	(0.092)		(0.121)	(0.123)			(0.095)
|ΔWTARIFF|		0.005***	0.007**					0.006**	0.006**
		(0.003)	(0.004)					(0.005)	(0.004)
|ΔCONC|				0.634*	1.014**	1.029**	0.386*	0.460*	0.037*
				(0.619)	(0.482)	(0.487)	(0.419)	(0.420)	(0.335)
R&D				2.970**				2.342***	
				(1.392)				(1.380)	
LFDI			0.006		0.006		0.013	0.013	
			(0.006)		(0.006)		(0.008)	(0.008)	
(|Δ(K/L)|*LFDI)									0.001*
									(0.001)
(|Δ(K/L)|*R&D)					0.302*	0.258*			
					(0.586)	(0.580)			
(|Δ(K/L)|*(S/U))								0.057***	
								(0.018)	
(LFDI*(S/U))				0.008*					
				(0.008)					
(|ΔWTARIFF|*(S/U))							0.034***		
							(0.014)		
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	105	105	105	105	105	105	105	105	105
F-Statistics	82.74	76.34	72.89	80.15	82.96	84.11	68.63	57.24	64.83

Notes: Figure in the parenthesis shows the standard errors of the estimated coefficient. Source: Author’s estimation

∗∗∗, ∗∗, and ∗ implies estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

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Annexure 1: Select Literature on determinant analysis of Horizontal and Vertical Intra-Industry Trade

Year	Author	Objective	Dataset	Dependent Variable	Explanatory Variable	Estimation Technique
1994	D. Greenaway, R. Hine and C. Milner	Identify country-specific factors in explaining the relative importance of vertical and horizontal IIT in the UK's trade	5 - digit SITC level for the year 1988	IIT, HIIT, VIIT	Market Size, Difference in factor endowments, Integration dummy	Tobit, OLS
1995	D. Greenaway, R. Hine and C. Milner	Identify vertical and horizontal IIT in UK's trade	Dataset: 1965-1976	IIT	Product differentiation, concentration ratio, Scale Economies, Market structure competitiveness, Importance of multinational enterprises	WLS regression
1999	C. Aturupane, S. Djankov and B. Hoekman	Analyze the determinants of vertical and horizontal IIT between the EU and eight Central and Eastern European transition economies.	Dataset: 1990-1995	IIT, HIIT, VIIT	Product differentiation, FDI, Minimum efficient scale, Four-firm concentration ratio, Share of energy in total costs	OLS
1999	X. Hu and Y. Ma	Identify various country-specific and industry-specific determinants of vertical and horizontal IIT in China	Dataset: 1995	IIT, HIIT, VIIT	R&D, Minimum efficient scale, Concentration ratio	Tobit
2000	J.V. Blanes and C. Martín	Disentangle IIT into VIIT and HIIT and thereby analyzing their determinants in Spain	Dataset: 1988-1995	IIT, HIIT, VIIT	R&D, Scale economies, Differences in relative endowments of human capital, Dissimilarity in per capita income, Difference in market size, Distance, Horizontal product differentiation, Difference in human capital endowments	Non-linear least squares, Logit
2000	D. Greenaway and J. Torstensson	Disentangle IIT into VIIT and HIIT in OECD countries	Dataset: 1969-1994	IIT, HIIT, VIIT	Human capital endowment, physical capital endowment, market size,	Pooled regression, Fixed-effects, Random-effects
2001	N. Crespo and M.P. Fontoura	Determinants of VIIT and HIIT in Portugal	Dataset: 1991-1997	VIIT, HIIT	Difference in per capita income, Average GNP, Difference in GINI index, Difference in per capita expenditure on education	OLS, Probit regression
2002	C. Veeramani	Determinants of VIIT and HIIT in India	Dataset: 1988, 1995 and 2000	Multilateral IIT across sections	Per capita income difference, Differences in the pattern of income distribution, Market size, Distance	Probit and Tobit Regression
2002	I. Ferto and L.J. Hubbard	Compute measures of IIT in horizontally and vertically differentiated agri-food products	Dataset: 1992-1998	IIT	Difference in per capita GDP, Difference in GDP, Average GDP, Distance	OLS, Logit, Tobit

2002	R. Bhattacharyya	Disentangle IIT into VIIT and HIIT for a comprehensive analysis on less developed countries	Dataset: 1990-1992	VIIT	GNP, Industry dummy	Logit
2003	K. Fukao, H. Ishido and K. Ito	Examine VIIT patterns in the East Asian region	Dataset: 1996-2000	VIIT, HIIT	Difference in per capita GDP, Market size, Distance, FDI	OLS
2003	M.A. Andresen	Disentangle IIT into VIIT and HIIT for both developed and developing countries	Dataset: 1970-1981	IIT	Country GDP, GDP difference, GDP per capita difference, Inequality index, Relative country size, Average capital labour endowment, Distance, Inequality per capital index, Border dummy, Integration dummy, Tariff level, Trade Orientation	Fixed Effects, Random Effects, OLS
2004	K. Sharma	Disentangle Trans-Tasman IIT into HIIT and VIIT and uses country-specific features to investigate their determinants in an econometric framework.	Dataset: 1998/99	IIT, HIIT, VIIT	Market structure, Product differentiation, Economies of scale, R&D, Foreign Investment, Close economic relation, Industry protection	OLS, Tobit
2005	R. Bhattacharyya	Investigate the features and determinants of the horizontal and vertical IIT in Korea	Dataset: 1963-1995	IIT, HIIT, VIIT	GDP, Manufacturing as a proportion of GDP, Capital-output ratio, Final consumption expenditure of households, Total trade volume, Foreign investment, Custom's duty as a proportion of import value	Test for co-integration, Granger causality
2005	J. Zhang, A. Van Witteloostuijn and C. Zhou	Disentangle IIT into VIIT and HIIT and examines the features of Chinese intra-industry trade	Dataset: 1992-2001	IIT, HIIT, VIIT	GDP, Population, FDI, Tariff, Distance, Share of manufactured products in total export, Border dummy	Factor Analysis, GLS
2006	N.C. Leitão and H.C. Faustino	Country specific determinants of HIIT and VIIT in Portugal	Dataset: 1995-2003	IIT (stands for Total, Horizontal or Vertical)	Difference in per capita income, Difference in electric power consumption, Difference in school enrolment rate in secondary education, Average GDP, FDI	GMM
2007	I. Fertő	Disentangle IIT into VIIT and HIIT in agri-food products between Hungary and the EU	Dataset: 1992- 1998	IIT, HIIT, VIIT	Difference in factor endowments, Income distribution, Average economic size, Distance	GLS, Fixed-effects, Random-effects
2007	R. Wakasugi	Determine factors that explains the recent expansion of trade in East Asia	Dataset: 1996–2004	VIIT	Market size, GDP, Per capita GDP	OLS

2008	N.C. Leitão and H.C. Faustino	Identify various country-specific and industry-specific determinants of vertical and horizontal IIT in Portugal	Dataset: 1996-2003	IIT, HIIT, VIIT	Physical endowments, Difference in energy consumption, GDP, Distance, Horizontal product differentiation, Minimum efficient scale, Industrial concentration, FDI, Trade imbalance	Pooled OLS, Fixed-effects, Random-effects
2008	A.K.M. Azhar, R.J.R. Elliott and L.I.U. Junting	Disentangle IIT into VIIT and HIIT and analyse the nature of trade flows between China and its East Asian neighbours	Dataset: 2002	Product quality value	UV of exports, UV of imports	UV ratio of GHM and FF approach
2009	S. Cernosa	Industry specific determinants of VIIT in Slovenia	Dataset: 1998 - 2003	HIIT, VIIT	Product differentiation, Economies of scale, Market structure, Multinational enterprises	GLS, Random-effects
2009	S.C. Chang	Investigate the features and determinants of the horizontal and vertical IIT	Dataset: 1996 - 2005	HIIT, VIIT	Per capita GDP, FDI, R&D, Government expenditure on education, RCA, RTAs dummy, Trade barrier dummy	FGLS, Random-effects
2009	E. M. Ekayanake, B. Veeramacheneni and C. Moslares	Identify the industry-specific determinants of vertical and horizontal IIT	Dataset: 1990 – 2007	Share of VIIT	Product differentiation, Vertical product differentiation, Industry concentration, Industry size, Product quality differences	Logit
2009	H. Gabrisch	Analyze VIIT in Central-East European countries	Dataset: 1993 - 2004	VIIT	Difference in the endowment and technology, Difference in income distribution, Size difference in GDP, Distance	Pooled regression, Fixed-effects, Random-effects
2011	A. Srivastava and Y. Medury	Analyze the pattern of India's IIT at 6-digit level and disentangle IIT into HIIT and VIIT	Dataset: 2000-2008	HIIT, VIIT	Import weighted tariff rate	Correlation Coefficient, UV ratio
2012	E.S. Devadason	Analyse the extent of VIIT and HIIT in India's trade with China	Dataset: 1992-2005	IIT HIIT VIIT	Exports and Imports	Product quality value Index
2012	A. Akram and Z. Mahmood	Analyse the country specific and industry specific determinates of HIIT and VIIT between Pakistan and SAARC countries	Dataset: 1990-91, 1995-96 and 2000-01	HIIT VIIT	Distance, Average GDP, Difference in GDP per capita, Difference in human capital endowment, Product differentiation, Difference of value added, Average number of establishments	Fixed-effects, Random-effects, Unit price ratio
2013	Y. Yoshida	International fragmentation and Vertical Specialization in Asia	Dataset: 1988-2006	IIT	GDP, prefecture GDP, difference in GDP per capita, prefecture intensive margin, prefecture extensive margin	Fixed-effects, Random-effects

2013	E. Kılavuz, H. Erkekoğlu and B.A. Topcu	Analysis of HIIT-VIIT of Turkey with its trade partners	Dataset: 1985-2009	HIIT, VIIT	Exports and Imports	Unit price ratio
2014	A. Jambor	Determinants of horizontal and vertical IIT in agri-food trade	Dataset 2005-2010	IIT	Difference in GDP per capita, Average GDP, FDI, Distance	OLS
2015	Ö.T. Doruk	Analyse the effect of R&D expenditure on VIIT	Dataset: 1990 - 2010	IIT, VIIT	R&D	GMM
2016	S. Bojnec and I. Fertő	Agri-Food IIT in EU Countries	Panel Dataset: 2000-2011	HIIT, VIIT	Gini Index, GDP, GDP per capita, Country dummy	GHM, Random-effects panel model,
2019	A. Aditya and I. Gupta	Decomposition of IIT into horizontal and vertical trade is analysed using support vector machines	Dataset: 1978-2013	HIIT, VIIT	Exports, Imports	GHM, FF, Support vector machines

Source: Compilation by Authors

Annexure 2: Product Concordance between Industry and Trade Codes

Year 1998		
Sector	**NIC 4-digit code**	**HS 4-digit code**
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		
Sector	**NIC 4-digit code**	**HS 4-digit code**
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
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		
Sector	**NIC 4-digit code**	**HS 4-digit code**

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 3: Source of Data used in the Empirical Model

Sl. No.	Variable	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	$\lvert\Delta(\frac{K}{L})\rvert$	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	$\lvert\Delta \mathrm{WTARIFF}\rvert$	Weighted average MFN tariff data for each sector. Data taken from WITS, World Bank (undated).	Compiled by author
5	$\lvert\Delta \mathrm{CONC}\rvert$	Computed by calculating *Four-Firm Concentration Ratio (FFCR)*, by adding up the percentage 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	$\lvert\Delta(\frac{K}{L})\rvert * \mathrm{LFDI}$	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
9	$\lvert\Delta(\frac{K}{L})\rvert * R\&D$	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
10	$\lvert\Delta(\frac{K}{L})\rvert * (\frac{S}{U})$	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
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	$\lvert\Delta WTARIFF\rvert * (\frac{S}{U})$	Multiplication of change in weighted average MFN tariff data for each sector and skilled to unskilled worker ratio. Data taken from WITS, World Bank (undated) and ASI, GoI (undated).	Computed by author

Source: Author's construction

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.