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Foreign Direct Investment and Intra-Industry Trade in India's Manufacturing Sector: A Causal Relationship

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Abstract

The post-liberalisation era has witnessed a significant increase in foreign direct investment (FDI) inflows and intra-industry trade (IIT) of India. Considering this fact, the paper attempts to investigate a causal relationship between FDI and IIT in the manufacturing sector of India for the period 1992 to 2013. Causality across various industries of the manufacturing sector has also been analysed. For the manufacturing sector, causality tests depict uni-directional causality from IIT to FDI. The results at industry-level reveal uni-directional causality from FDI to IIT for industries like manufacture of food products and beverages (15), tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19), manufacture of fabricated metal products, except machinery and equipment (28) and manufacture of motor vehicles, trailers and semi-trailers (34). In addition, industries such as manufacture of chemical and chemical products (24) and manufacture of electrical machinery and apparatus n.e.c. (31) exhibit uni-directional causality from IIT to FDI. The results, therefore, assert that FDI inflows have aided to increase IIT in the manufacturing sector of India.

Key words: FDI, IIT, granger causality, manufacturing

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1. INTRODUCTION:

India stepped into the era of liberalisation with the enactment of New Economic Policy (NEP) of 1991. Amongst the various policy measures initiated under the NEP, significant importance was laid on liberalisation of foreign trade and foreign investment. With respect to trade, several measures relating to reduction in trade barriers were adopted to promote free trade. The traditional import-substitution policy was replaced by an export-promoting policy. The reform process was upheld from time to time. This led to an increase in simultaneous exchange of goods and services between industries (inter-industry trade) and within industries (intra-industry trade (IIT)).As a result, India has emerged as a major contributor in world trade in the recent years. The share of India's foreign trade in its GDP was 14.73percent in the year 1992which rose to41.52 percent in the year 2013 (World Bank, 2013).In a similar manner, the reform process encouraged foreign investment, especially foreign direct investment (FDI), in various industries of the India. Due to concentrated efforts of the government, FDI inflows in India have increased considerably. India attracts highest amounts of FDI inflows in the South Asian region and is the second most preferred destination for FDI (UNCTAD, 2013).

The vast literature on the subject explains the possible links between FDI and trade. The traditional theories based on Heckscher-Ohlin theorem view FDI as a substitute to foreign trade (Mundell, 1957). The recent literature, however, emphasizes that FDI complements foreign trade, particularly IIT (Helpman, 1984; Markusen 1997).Taking this into consideration, the paper attempts to establish a causal relationship between FDI and IIT in the manufacturing sector of India for thepost-liberalisation period. The objective of the study is to find out whether an increase in FDI leads to an increase in IIT. It is also intended to investigate if a causal relationship exists from IIT to FDI. The estimation of a bi-directional causality between FDI and IIT is the focus of the study. In addition to it, an examination of bi-directional causality at an industry-level is also carried out. This study will help to isolate the industries in which FDI and IIT are assisting each other in their growth process.

The paper is organised as follows: *Section* Two reviews the literature related to FDI and IIT. The data sources and methodology applied for the purpose of estimation are explained in *Section* Three. The Fourth *Section* covers the trends in FDI and IIT in the Indian manufacturing sector. The empirical results are discussed in *Section* Five while the last *Section* concludes the paper.

2. REVIEW OF LITERATURE:

The literature on FDI and trade is exhaustive. The earliest studies trying to establish a link between FDI and trade considered foreign investments as a substitute to trade. They relied on the foundations of Heckscher-Ohlin theorem which stated that differences in factor endowments formed the basis of trade. In such type of a model, factor mobility was restricted. Mundell (1957) stated that once mobility of the factors of production was taken into account, factor price differentials between the countries would be eliminated. If production functions across the trading countries were identical, foreign investment would substitute foreign trade. This approach was challenged by studies comprising of Agmon (1979), Helpman (1984), Markusen, et al. (1996), Markusen (1997) and Markusen and Maskus (1999). According to them, FDI would replace trade under the conditions of perfect competition. However, in the case of imperfectly competitive markets with economies of scale, technological changes and product differentiation, FDI and trade would complement each other. Thus, FDI would lead to an increase in foreign trade, especially IIT. Agmon (1979) stated that FDI would boost IIT as the factors determining FDI inflows and IIT were similar. Helpman (1984) propounded the 'factor proportions approach' which stated that within FDI, it was vertical FDI (production process of multinational enterprises fragmented in different locations) that gave an impetus to IIT. Markusen, et al. (1996), further, presented the knowledge-capital model in which vertical FDI and IIT took place under the regimes of free trade and investment liberalisation. Despite this, empirical literature dealing specifically on FDI and IIT is meagre. Most of the empirical studies have analysed the relationship between FDI and trade. Therefore, the studies reviewed in this section deal with analysis of FDI and trade for India as well as for other economies.

Hsiao and Hsiao (2006) studied the causal relationship between FDI, exports and economic growth for East-Asian countries during the period from 1986 to 2004. To analyse causality among these three variables for each country, the study made use of granger causality tests. Using a vector auto regressive (VAR) model, the study showed bi-directional causality between GDP and FDI and uni-directional causality from exports to GDP for China. Therefore, their findings supported exports-led growth for China. In the case of Taiwan, an increase in FDI inflows was found to granger cause exports and GDP. However, no causal relationship was observed between GDP, FDI and exports for Korea, Malaysia and Philippines. Furthermore, using vector error correction mechanism (VECM) for Singapore and Thailand, Hsiao and Hsiao found uni-directional causality from GDP to FDI. Bi-directional causality was found between exports and FDI in the case of Singapore and between GDP and exports for Thailand. The results from granger causality analysis, thus, varied across countries.

Goldar and Banga (2007) analysed whether IIT led to an increase FDI inflows in India for the period 1991-92 to 1997-98. By using panel data techniques for 78 industries belonging to the manufacturing sector at three-digit level, the impact of IIT on FDI was evaluated at industry-level and state-level. The results at industry-level revealed that trade liberalisation, reduction in tariffs and policy aimed towards export promotion had a positive impact on the growth of IIT. It was found that India's IIT was primarily horizontal in nature than vertical IIT. Goldar and Banga stated that vertical IIT had a favourable impact on FDI than the horizontal one. However, since India's IIT was encountered to be primarily horizontal, favourable impact on FDI was not detected. Furthermore, the state-level analysis of FDI and IIT inflows exhibited that states with higher amounts of international trade attracted more FDI inflows during the studied period.

The relationship between FDI inflows, trade and economic growth was studied by Dash (2007) in the Indian context. He applied Granger non-causality tests by using Toda and Yamamoto procedure for the period 1991Q3 to 2005Q4. The results showed uni-directional causality from exports to FDI. Moreover, bi-directional causality was found to prevail between economic growth and FDI inflows.

Jayachandran and Seilan (2010) examined the relationship between trade, FDI and economic growth in India for the period 1970 to 2007. For the purpose of analysis, the study relied on granger causality tests. The results depicted a causal relationship from exports to economic growth and from FDI to economic growth. However, economic growth did not influence the export performance and FDI inflows in the economy.

Cho (2013) assessed the causality between foreign trade and FDI for India and four East Asian economies (Korea, Japan, Singapore and China). In addition, countries like U.S., U.K., Germany and Netherlands were also included in the study. Using quarterly data for the period 2004Q3 to 2012Q4, the analysis employed appropriate causality tests. The results portrayed a bi-directional causality between trade and FDI in the case of trade between India and U.K. Moreover, uni-directional causality was witnessed from FDI to trade for U.S. and India and from trade to FDI for Germany and India. The analysis revealed that though trade and FDI inflows from Korea, Japan and Singapore increased significantly during the period of study, the results failed to establish a causal relationship for these countries. The study, further, asserted that causality between the countries was due to existence of long-term economic relationship between trade and FDI.

Sultan (2013) analysed the causal relationship between India's export and FDI for the period 1980 to 2010. Using VECM, the study found that there was causality from exports to FDI. However, no causality was observed from FDI to exports. The study, thus, concluded that FDI inflows in India were market seeking.

It can be, therefore, inferred that empirical studies relating to FDI and IIT are meagre. In the context of India, except for Goldar and Banga (2007), none of the studies tried to find out the impact of FDI on IIT and vice-versa. In addition, it can be noticed that most of the studies examined causality between FDI and trade at an aggregate level rather than industry-level or sectoral-level. Taking this into consideration, the present study intends to test causality between FDI and IIT for the manufacturing sector of India. Moreover, a scrutiny of causality across various industries of the manufacturing sector will also be undertaken. Such type of an investigation will help to identify the industries where FDI and IIT influence each other and aid in their growth process. The study will help to fill the existing gap in the literature.

3. DATA SOURCES AND METHODOLOGY:

This section discusses the data sources and methodology adopted for estimating bi-directional granger causality between FDI and IIT. Sub-section 3.1 deals with various data sources used for the purpose of analysis. The adjustments made to the original data are also discussed in this part. Sub-section 3.2 gives a detailed account of the methodology applied to establish a causal relationship between FDI and IIT.

3.1 Data Sources, Coverage and Adjustments:

In order to analyse causality between FDI and IIT, the study relies on secondary data sources. The time period chosen for the analysis is from 1992 to 2013. The data on FDI inflows in India have been taken from 'Factsheets on FDI in India' compiled by the Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce and Industry (GOI, 2014). Since the original data is at current prices, indices of real effective exchange rates have been used to convert it into constant prices with 2004-05 as the base year (RBI, 2014). The DIPP data on FDI inflows is organised according to National Industrial Classification (NIC) of 2008 using the concordance provided by National Council of Applied Economic Research (NCAER) (NCAER, 2009). Furthermore, this data has been re-organised at two digit level of industrial classification as per NIC-2004.

To determine the level of IIT in the Indian economy, an index of IIT has been constructed. To calculate the index, data on exports and import of India to world is obtained from World Integrated Trade Solutions (WITS) (WITS, 2014). The data reported by WITS is compiled by United Nations Statistics Division Commodity Trade (UN Comtrade). The data on underlying variables have been extracted at 6-digit level of Harmonised Classification System (HS) (1988).Since the study aims to examine causal relationship at an industry-level, it is necessary to achieve a concordance between trade and industry classifications. The concordance between trade data (exports and imports) and industry is given by WITS. Using this, the trade data (HS-1988) have been arranged as per International Standard Industrial Classification (ISIC) (Revision 3). In the context of India, ISIC-Revision 3 corresponds to NIC of 1998. The data as per NIC-1998 has been, further, classified according to NIC-2004at two digit level. IIT index is then constructed by applying methodology explained in sub-section 3.2.1.

Before conducting granger causality tests both the variables (FDI and IIT) have been expressed into natural logarithmic form. Some industries such as manufacture of tobacco products (16),manufacture of wearing apparel; dressing and dyeing of fur (18), manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20), publishing, printing and reproduction of recorded media (22), manufacture of office, accounting and computing machinery (30), manufacture of radio, television and communication equipment and apparatus(32), manufacture of medical, precision and optical instruments, watches and clocks (33) and manufacture of other transport equipment (35) have not been included in the analysis due to unavailability of data on FDI inflows. The analysis of granger causality between FDI and IIT has been, therefore, conducted on rest of the industries belonging to manufacturing sector (NIC-2004).

3.2 Methodology:

The methodology applied for examining causality between FDI and IIT is explained in this section. The methodology of the paper can be classified into two steps: The first part is the construction of IIT index for measuring IIT of India at industry level and second part explains the steps involved in estimation of granger causality.

3.2.1 Construction of IIT Index:

In order to measure IIT of India at industry-level, an IIT index formulated by Grubel and Lloyd (GL) (1975) has been employed. The GL index indicates the degree of IIT in a particular industry. The index lies between 0 and 100. If exports of an industry exactly match its imports, GL index takes the maximum value of 100 and zero otherwise.

$$GL_i = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \times 100 \qquad \text{.................... (1)}$$

Where,

GL_i= IIT of the i^{th} industry

X_i= Exports of thei^{th} industry

M_i= Imports of thei^{th} industry

To evaluate IIT at industry-level, weights have been assigned for each industry. The share of a particular industry in total trade has been used as weight of that industry in the manufacturing sector.

3.2.2 Estimation of Granger Causality:

The main objective of the study is to determine a causal relationship between FDI and IIT. It is intended to examine a bi-directional causality between the two. The basic relationship between FDI and IIT can be stated as follows:

$$\ln IIT = f(\ln FDI) \qquad \text{.................... (1)}$$

$$\ln FDI = f(\ln IIT) \qquad \text{.................... (2)}$$

For the purpose of analysis, granger causality approach propounded by Granger (1969) is applied. This approach investigates if a time series is useful in forecasting another time series. Granger (1969) argues that if a time series has an ability to predict future values of another time series by utilising its own past values, causality is said to exist between the two. Consider a bi-variate model comprising of two time series 'X_t' and 'Y_t'. If lagged values of X_t are found to provide statistically significant information about the future values of Y_t, it can be asserted that X_t granger causes Y_t. Causality in this case is described to be uni-directional. On the other hand, if lagged values of Y_t are also encountered to be determining the future values of X_t, a bi-directional causality is said to exist between the two. In order to test granger causality, VAR model with appropriate lags is formulated and the null hypothesis of non-granger causality is tested with the help of standard F-test. In the context of present study, the equations for analysing bi-directional granger causality between FDI and IIT can be stated as follows:

$$\Delta \ln IIT_t = \alpha_0 + \sum_{j=1}^{p} \delta \, \Delta \ln IIT_{t-i} + \sum_{i=1}^{p} \beta \, \Delta \ln FDI_{t-i} + \varepsilon_{1t} \quad \text{………… (3)}$$

$$\Delta \ln FDI_t = \alpha_1 + \sum_{i=1}^{p} \beta \, \Delta \ln FDI_{t-i} + \sum_{j=1}^{p} \delta \, \Delta \ln IIT_{t-i} + \varepsilon_{2t} \quad \text{………… (4)}$$

In equation 3, the joint significance of coefficients in vector β has to be tested to find out whether FDI granger causes IIT. Similarly, to investigate granger causality from IIT to FDI, the coefficients in vector δ (Equation 4) have to be examined using the F-test. The F-test for joint significance of coefficients can be given as follows:

$$F = \frac{[SSR\ (restricted) - SSR\ (unrestricted)]/r}{SSR\ (unrestricted)/n-k} \quad \text{………………….. (5)}$$

Where,

SSR = sum of the squared residuals from restricted and unrestricted models

r = number of restrictions

n =number of observations

k = number of parameters estimated in the unrestricted model

However, before carrying out granger causality tests, one of the pre-conditions is that of stationary of the underlying time series (FDI and IIT). Granger causality can be carried out only if the variables are stationary at levels (log form) or at their first difference. For this purpose, the Augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1979) has been used. Dickey and fuller developed the tests for stationary on the basis of following three equations:

$$\Delta Y_{t-1} = \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \quad \text{………. (6)}$$

$$\Delta Y_{t-1} = a_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \quad \text{………. (7)}$$

$$\Delta Y_{t-1}=a_0+\gamma y_{t-1}+a_2 t+\sum_{i=2}^{p}\beta_i \Delta y_{t-i+1}+\varepsilon_t \qquad \text{..........} (8)$$

Equation 6 represents a random walk model. Equation 7 includes drift term while equation 8 comprises of both, a drift and linear time trend. The null hypothesis is that of presence of unit root (non-stationarity) in the time series. The ADF test is conducted on the coefficient of Y_{t-1} in the above equations. The ADF test statistics gives the estimated value of γ and its associated standard error. By dividing the estimated value of γ by its standard error, the t-statistic is computed. To check the null hypothesis of non-stationarity, the t-statistic is compared with appropriate critical values (τ) designed by Dickey and Fuller. If the estimated t-statistic is found to be greater than the critical τ value, the null hypothesis is rejected (Enders, 2004). In addition to it, Dickey-Fuller also proposed ϕ statistics similar to F-statistics, in order to, test the significance of drift and trend terms. The ϕ statistic is given as follows:

$$\phi_i=\frac{[\text{SSR (restricted)-SSR (unrestricted)}]/r}{\text{SSR(unrestricted)/(T-k)}} \qquad \text{..........} (9)$$

Where,

SSR = sum of the squared residuals from restricted and unrestricted models

r = number of restrictions

n = number of usable observations

k = number of parameters estimated in the unrestricted model

The null hypothesis $\gamma=a_0=0$ is tested using the ϕ_1 statistic. The joint significance of drift and time trend is tested using ϕ_2 statistic ($a_0=\gamma=a_2=0$). Finally, the significance of trend term is tested with the help of ϕ_3 ($\gamma=a_2=0$). Comparing the calculated ϕ statistic with its appropriate critical values reported by Dickey and Fuller (1981) allows checking for the significance of drift and trend terms in the given model (Enders, 2004). If the drift and trend terms turn out to be insignificant, model represented by equation 6 is chosen for further analysis. In the present study, stationarity of concerned variables FDI and IIT has been tested using the ADF test (equations 6, 7 and 8). Similarly, on the basis of ϕ statistics it has been decided whether to include a drift, time trend or both for further investigation.

If the results of ADF tests show the variables to be stationary at levels, granger causality can be estimated using a VAR model with appropriate lags presented in equations 3 and 4. However, if the variables appear to be stationary at their first difference, granger causality tests are carried out using VECM. Before proceeding to VECM, the order of co-integration has to be tested. Co-integration involves testing for a long-run equilibrium relationship between the concerned time series (Enders, 2004). If the variables under consideration turn out to be co-integrated, causality tests can be carried out using VECM. However, if the variables are not co-integrated, granger causality is estimated using the standard VAR in its first differences (equations 3 and 4). In the present study, co-integration between FDI and IIT is analysed with the help of Johansen's methodology (Johansen, 1988).In Johansen's method, co-integration is checked using the maximum eigen value statistic or the trace statistic. The null hypothesis is that of no co-integration among the variables. The maximum eigen value statistic tests the null hypothesis of r co-integrating vectors in given a model. In the case of trace statistics, the null hypothesis is that of presence of less than or equal to r co-integrating vectors. The trace statistics is, therefore, based on testing the null hypothesis of no co-integration against a general alternative while maximum eigen value statistic comprises of testing the null hypothesis against a specific alternative (Enders, 2004).

In the analysis, trace statistics has been used to detect co-integration between FDI and IIT. Prior to that, appropriate lags on the basis of Schwartz Information Criterion (SIC) have been selected. The trace statistics can be stated as follows:

$$\lambda_{trace}(r)=\sum_{i=r+1}^{n}\ln\left(1-\widehat{\lambda}_i\right) \quad \text{.......... (10)}$$

If the calculated value of λ is found to be greater than its critical value, the null hypothesis of no co-integration is rejected. The existence of co-integration implies that there is long-run equilibrium relationship between FDI and IIT. If the variables appear to be co-integrated, granger causality is estimated within the framework of

VECM. However, if the variables are not co-integrated, causality between FDI and IIT is estimated using VAR (equation 3 and 4).

Once the variables are co-integrated of order r, granger causality is tested by employing VECM. The VECM can be stated as follows:

$$\Delta \ln IIT_t = \alpha_0 + \sum_{j=1}^{p} \delta \Delta \ln IIT_{t-i} + \sum_{i=1}^{p} \beta \Delta \ln FDI_{t-i} + \emptyset_1 ECT_{t-1} + \varepsilon_{1t} \ldots (11)$$

$$\Delta \ln FDI_t = \alpha_1 + \sum_{i=1}^{p} \beta \Delta \ln FDI_{t-i} + \sum_{j=1}^{p} \delta \Delta \ln IIT_{t-i} + \emptyset_2 ECT_{t-1} + \varepsilon_{2t} \ldots (12)$$

The VECM involves inclusion of an error-correction term (ECT) that represents the speed at which the co-integrated system responds to deviation from the equilibrium path. The VECM representation enables to draw inferences about the short-run dynamics of the given model. In the context of granger causality, VECM can be used to examine both, long-run and short-run causality between the concerned variables. ECT introduced in the VECM helps to establish a long-run causality between the underlying variables. If the ECT in equations 11 and 12 appear to be negative and statistically significant, it can be concluded that there exists a long-run causality from FDI to IIT and vice-versa. Similarly, short-run causality is determined on the basis of significance of coefficients included in vector β and vector δ. If the results from VECM depict that coefficients in β are statistically significant, it can be inferred that FDI granger-causes IIT in the short-run. In a similar manner, if coefficients in δ turn out to be statistically significant, short-run causality exists from IIT to FDI (Chakraborty and Basu, 2002; Enders, 2004, p. 334; Sultan, 2013).

4. TRENDS IN FDI AND IIT:

Before analysing granger causality, it is important to study the trends in FDI and IIT during the period of study. This will enable to highlight the industries with significant level of FDI and IIT inflows. To assess the trends in FDI and IIT, compound annual growth rates (CAGR) for both are calculated for the entire manufacturing sector as well as across its industries. A detailed account of the level of FDI and IIT inflows along with CAGR is given in Appendix-A1 and Appendix-A2. Table 1 gives the CAGR of FDI and IIT for the period 1992 to 2013. It can be seen that IIT of the manufacturing sector increased at a CAGR of 2.87 percent during the studied period. Similarly, FDI registered a CAGR of 17.19 percent.

Table 1: CAGR of FDI and IIT (1992 to 2013)

Percent

NIC Code	Industry	IIT	FDI
15	Manufacture of food products and beverages	0.21	13.86
17	Manufacture of textiles	-1.63	13.24
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	-1.42	7.38
21	Manufacture of paper and paper products	1.38	17.19
23	Manufacture of coke, refined petroleum products and nuclear fuel	3.05	14.86
24	Manufacture of chemicals and chemical products	1.52	16.92
25	Manufacture of rubber and plastics products	2.24	21.18
26	Manufacture of other non-metallic mineral products	2.08	19.76
27	Manufacture of basic metals	3.14	30.30
28	Manufacture of fabricated metal products, except machinery and equipment	3.14	11.25
29	Manufacture of machinery and equipment n.e.c.	2.95	19.70
31	Manufacture of electrical machinery and apparatus n.e.c.	3.88	7.46
34	Manufacture of motor vehicles, trailers and semi-trailers	1.32	17.32
36	Manufacture of furniture; manufacturing n.e.c.	13.24	16.28
15-36	**Manufacturing Sector**	**2.87**	**17.19**

At an industry-level it can be observed that CAGR for IIT is highest in the case of manufacture of furniture; manufacturing n.e.c. (36) followed by manufacture of electrical machinery and apparatus n.e.c. (31) and manufacture of basic metals (27). On the contrary, industries such as manufacture of textiles (17), tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19) and manufacture of food products and beverages (15). In a similar manner, CAGR of FDI inflows is highest for manufacture of basic metals (27) followed by manufacture of rubber and plastics products (25) and manufacture of other non-metallic mineral products (26). On the other hand, tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19), manufacture of electrical machinery and apparatus n.e.c. (31) and manufacture of fabricated metal products, except machinery and equipment (28) depict low CAGR.

On the basis of Table 1, it can also be deduced that industries like manufacture of basic metals (27) and manufacture of machinery and equipment n.e.c. (29) display CAGR that is higher than that of the entire manufacturing sector. Since liberalisation both these industries have witnessed considerable increase in FDI and IIT. It would be useful to know whether existence of a causal relationship between the two is the factor behind this rise. Likewise, for industries where the CAGR of IIT or FDI is found to be high, it can be investigated whether high level of IIT is leading to higher amounts of FDI and vice-versa. This can be achieved with the help of granger causality results discussed below.

5. EMPIRICAL RESULTS:

This section presents the empirical results based on methodology discussed in Section 3.2. The results are divided into two parts. The first part deals with the total manufacturing sector while the second part gives results at an industry-level. The granger causality results for the entire manufacturing sector are presented in Table 2. Since the variables are integrated of order one, Johansen's technique is applied to check for co-integration among FDI and IIT. Prior to that, lag of one period has been chosen on the basis of SIC. The Johansen's trace statistic reveals that the underlying variables are co-integrated. Thus, in order to, determine the causality between FDI and IIT, VECM technique has been employed. In the VECM estimation, ECT represents the long-run causality between the variables. It can be observed from Table 2 that ECT for IIT is negative but insignificant. This suggests that in the long-run FDI does not granger cause IIT. On the other hand, ECT for FDI is negative and significant indicating uni-directional causality from IIT to FDI. However, in the short-run the coefficient of FDI in equation related to IIT is insignificant. Similarly, the coefficient for IIT in equation pertaining to FDI is also insignificant. Thus, it can be concluded that there is no causal relationship between FDI and IIT in the short-run. Furthermore, it can be also encountered that lag values of FDI and IIT are not helpful in predicting their future values.

Table 2: Granger Causality Results for the Manufacturing Sector

ADF TEST RESULTS						
NIC Code	**Sector**	**Variables**	**Order of Integration**	**T-statistic**	**Critical value (5 percent)**	**Model Chosen**
15-36	Manufacturing Sector	IIT	I(1)	-2.0265	-1.9500	None
		FDI	I(1)	-3.0692	-1.9500	
JOHANSEN'S CO-INTERGATION RESULTS						
NIC Code	**Sector**	**Hypothesis**	**Trace statistic**	**Critical Value**	**Conclusion**	
15-36	Manufacturing Sector	r ≤ 1	4.3900	8.18	FDI and IIT are co-integrated of rank 1	
		r =0	21.6100	17.95		
LONG-RUN CAUSALITY USING VECM						
NIC Code	**Sector**	**Equation**	**ECT**	**p-value**	**Granger Causality Direction**	
15-36	Manufacturing Sector	IIT	-0.1394	0.4727	Uni-directional causality from IIT to FDI	
		FDI	-5.4416	0.0033***		
SHORT-RUN CAUSALITY USING VECM						
NIC Code	**Sector**	**Equation**	**IIT_{t-1}**	**p-value**	**FDI_{t-1}**	**p-value**
15-36	Manufacturing Sector	IIT	-0.8560	0.0012***	-0.0555	0.1418
		FDI	-2.7148	0.1438	-1.6731	0.0000***

*** Significant at 1 percent level of significance

After assessing granger causality for the manufacturing sector, a scrutiny across various industries is undertaken. Table 3 presents the results for stationarity of FDI and IIT using the ADF test at industry-level. It can be seen (Table 3) that for most of the industries the data series on FDI and IIT are stationary at their first difference. The data series for IIT is stationary at levels (I (0)) in the case of four industries, such as manufacture of food products and beverages (15), tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19), manufacture of paper and paper products (21) and manufacture of rubber and plastics products (25). On the other hand, the series on FDI is stationary at levels for manufacture of paper and paper products (21). Thus, granger causality for these industries can be estimated within a VAR framework (equations 3 and 4) by conducting F-test for joint significance of coefficients. For the rest of industries, causality can be analysed by using VECM (equations 11 and 12).

Table 3: ADF Test Results (Industry-level)

NIC Code	Industry	Variables	Order of Integration	T-statistic	Critical value (5 percent)	Model Chosen
15	Manufacture of food products and beverages	IIT	I(0)	-3.24	-3.00	Constant
		FDI	I(1)	-3.45	-3.00	
17	Manufacture of textiles	IIT	I(1)	-2.29	-1.95	None
		FDI	I(1)	-4.41	-1.95	
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	IIT	I(0)	-3.62	-3.00	Constant
		FDI	I(1)	-7.14	-3.00	
21	Manufacture of paper and paper products	IIT	I(0)	-3.85	-3.00	Constant
		FDI	I(0)	-3.24	-3.00	
23	Manufacture of coke, refined petroleum products and nuclear fuel	IIT	I(1)	-3.90	-1.95	None
		FDI	I(1)	-2.83	-1.95	
24	Manufacture of chemicals and chemical products	IIT	I(1)	-2.78	-1.95	None
		FDI	I(1)	-3.36	-1.95	
25	Manufacture of rubber and plastics products	IIT	I(0)	-5.42	-3.60	Both
		FDI	I(1)	-4.15	-3.60	
26	Manufacture of other non-metallic mineral products	IIT	I(1)	-4.40	-3.60	Both
		FDI	I(1)	-4.35	-3.60	
27	Manufacture of Basic Metals	IIT	I(1)	-3.71	-3.00	Constant
		FDI	I(1)	-4.55	-3.00	
28	Manufacture of fabricated metal products, except machinery and equipment	IIT	I(1)	-3.63	-3.00	Constant
		FDI	I(1)	-4.56	-3.00	
29	Manufacture of machinery and equipment n.e.c.	IIT	I(1)	-4.14	-3.00	Constant
		FDI	I(1)	-3.69	-3.00	
31	Manufacture of electrical machinery and apparatus n.e.c.	IIT	I(1)	-3.65	-3.00	Constant
		FDI	I(1)	-3.87	-3.00	
34	Manufacture of motor vehicles, trailers and semi-trailers	IIT	I(1)	-5.05	-1.95	None
		FDI	I(1)	-2.80	-1.95	
36	Manufacture of furniture; manufacturing n.e.c.	IIT	I(1)	-4.78	-3.00	Constant
		FDI	I(1)	-3.29	-3.00	

In addition to it, Table 3 also states the model chosen for further investigation. As pointed out earlier, the Φ statistics designed by Dickey and Fuller (1981) allows determining whether the drift and trend terms in the model play a significant role. It can be inferred from the table that for most of the industries, constant (drift) term turns out to be significant. Thus, a model including constant term has been chosen for these industries. A detailed account on Φ statistics is given in Appendix-B1.

Table 4: Johansen's Co-integration Tests Results (Industry-level)

NIC Code	Industry	Hypothesis	Trace statistic	Critical value (5 percent)
17	Manufacture of textiles	r ≤ 1	6.26	8.18
		r =0	31.24	17.95
23	Manufacture of coke, refined petroleum products and nuclear fuel	r ≤ 1	8.32	8.18
		r =0	26.2	17.95
24	Manufacture of chemicals and chemical products	r ≤ 1	6.7	8.18
		r =0	23.76	17.95
26	Manufacture of other non-metallic mineral products	r ≤ 1	14.35	12.25
		r =0	32.18	25.32
27	Manufacture of Basic Metals	r ≤ 1	18.25	9.24
		r =0	39.15	19.96
28	Manufacture of fabricated metal products, except machinery and equipment	r ≤ 1	10.29	9.24
		r =0	34.2	19.96
29	Manufacture of machinery and equipment n.e.c.	r ≤ 1	9.07	9.24
		r =0	30.76	19.96
31	Manufacture of electrical machinery and apparatus n.e.c.	r ≤ 1	13.31	9.24
		r =0	31.45	19.96
34	Manufacture of motor vehicles, trailers and semi-trailers	r ≤ 1	8.51	8.18
		r =0	28.86	17.95
36	Manufacture of furniture; manufacturing n.e.c.	r ≤ 1	14.63	9.24
		r =0	41.09	19.96

After checking for stationarity of the underlying time series, the next step is to check the co-integration among the variables found to be stationary at their first difference. However, before proceeding to co-integration appropriate lags have been chosen for the concerned industries on the basis of SIC. Table 4 gives the results for co-integration using Johansen's trace statistics. It can be depicted from Table 4 that all the industries are co-integrated of rank one. Thus, there exists a long-run equilibrium relationship between FDI and IIT for these industries. Granger causality can now be tested using VECM. Prior to testing causality with VECM, Table 5 displays results for granger causality in the case of industries falling under the framework of VAR.

Table 5 presents the granger causality results estimated in a VAR framework. From Table 3, it has been observed that out of fourteen industries, the data series for

IIT is stationary at levels for four industries (NIC-15, NIC-19, NIC-21, and NIC-25). Similarly, the series for FDI is stationary at levels for NIC-21 and stationary at first difference for the rest of three. Thus, it is appropriate to test granger causality using standard VAR represented by equations 3 and 4. Before estimating VAR results, appropriate lags for these four industries have been chosen with the help of SIC.

Table 5: Granger Causality Results using VAR (Industry-level)

Hypothesis	NIC Code	Industry	Equation	F-Statistic	P>|F|	Granger Causality Direction
FDI does not Granger cause IIT	15	Manufacture of food products and beverages	IIT	4.4581	0.0490**	FDI to IIT
IIT does not Granger cause FDI			FDI	1.9013	0.1848	
FDI does not Granger cause IIT	19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	IIT	10.3341	0.0048***	FDI to IIT
IIT does not Granger cause FDI			FDI	0.8141	0.3788	
FDI does not Granger cause IIT	21	Manufacture of paper and paper products	IIT	0.1207	0.7323	--
IIT does not Granger cause FDI			FDI	0.4538	0.5091	
FDI does not Granger cause IIT	25	Manufacture of rubber and plastics products	IIT	4.7504	0.0428**	FDI to IIT
IIT does not Granger cause FDI			FDI	0.1269	0.7258	
*** Significant at 1 percent and ** 5 percent level of significance respectively						

It can be seen from Table 5 that out of four industries, three industries portray uni-directional causality from FDI to IIT. These comprise of manufacture of food products and beverages (15), tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19) and manufacture of rubber and plastics products (25). However, there is no causality running from IIT to FDI in the case of all four industries.

After analysing granger causality in a VAR framework, the rest of the industries which are stationary at first difference and co-integrated of rank one can be studied using the VECM approach. The results obtained from VECM estimation are reported in Table 6 and Table 7. Table 6 gives the long-run granger causality test results using VECM framework. As pointed out earlier, ECT in a VECM represents the long-run causality between the underlying variables. A negative and significant ECT for IIT implies a long-run causality from FDI to IIT while a negative and significant ECT for FDI connotes long-run causality running from IIT to FDI. From the table, it can be pointed out that there exists bi-directional causality between FDI

Table 6: Long-run Granger Causality Results using VECM (Industry-level)

NIC Code	Industry	Equation	ECT	p-value
17	Manufacture of textiles	IIT	-0.2601	0.0058***
		FDI	-3.8516	0.0027***
23	Manufacture of coke, refined petroleum products and nuclear fuel	IIT	-1.4721	0.0002***
		FDI	-0.0188	0.9726
24	Manufacture of chemicals and chemical products	IIT	-0.4906	0.1363
		FDI	-8.6615	0.0047***
26	Manufacture of other non-metallic mineral products	IIT	-0.5639	0.0238***
		FDI	-9.3542	0.0031***
27	Manufacture of Basic Metals	IIT	0.6715	0.1104
		FDI	2.5219	0.0046***
28	Manufacture of fabricated metal products, except machinery and equipment	IIT	-0.1755	0.0777*
		FDI	4.8915	0.0009***
29	Manufacture of machinery and equipment n.e.c.	IIT	-0.7809	0.0170***
		FDI	-5.0259	0.0189***
31	Manufacture of electrical machinery and apparatus n.e.c.	IIT	-0.3024	0.2240
		FDI	-5.0872	0.0000***
34	Manufacture of motor vehicles, trailers and semi-trailers	IIT	-1.3916	0.0009***
		FDI	2.0626	0.0937***
36	Manufacture of furniture; manufacturing n.e.c.	IIT	-1.1864	0.0001***
		FDI	-0.3431	0.7968

*** Significant at 1 percent, ** 5 percent, * 10 percent level of significance respectively

and IIT in the long-run for three industries. These comprise of manufacture of textiles (17), manufacture of non-metallic mineral products (26) and manufacture of machinery and equipments n.e.c. (29).

It can be, further, observed that industries experiencing uni-directional causal relationship from FDI to IIT in the long-run are considerable. Industries such as manufacture of coke, refined petroleum products and nuclear fuel (23), manufacture of fabricated metal products, except machinery and equipment (28), manufacture of motor vehicles, trailers and semi-trailers (34) and manufacture of furniture; manufacturing n.e.c. (36) fall under this category. On the contrary, only two industries display causality from IIT to FDI (manufacture of chemical and chemical products

(24) and manufacture of electrical machinery and apparatus n.e.c. (31)). Therefore, it can be concluded that in the long-run granger causality from FDI to IIT is pronounced in the case of majority of industries.

Lastly, Table 7 presents short-run causality results from VECM estimation. It can be seen from the table that none of the industries witness causality from FDI to IIT and vice-versa in the short-run. In fact, for industry comprising of manufacture of non-metallic mineral products (26) past values of FDI are inferred to be adversely affecting IIT. Similarly, past values of IIT are having a negative impact on FDI inflows in manufacture of machinery and equipments n.e.c. (29). In addition, it can also be seen that past values of FDI and IIT have a negative effect on their present values. The coefficients for lagged values of IIT in equation pertaining to IIT are found to be negative and significant for majority of the industries. This holds true in the case of FDI also. Thus, it can be asserted that increase in FDI and IIT inflows is influenced by factors other than its own past values. Therefore, the VECM results do not portray a causal relationship between FDI and IIT in the short-run.

6. CONCLUSIONS:

The present study tries to establish a causal relationship between FDI and IIT in the manufacturing sector of India for the period 1992 to 2013. Using granger causality approach, the existence of bi-directional causality is tested for the manufacturing sector and across its various industries. The granger causality results for the entire manufacture sector reveals uni-directional causality from IIT to FDI.

At industry-level, granger causality is estimated with the help of standard VAR for industries where either or both of the variables (FDI and IIT) are encountered to be level stationary. In the case of industries with variables stationary at their first difference, the VECM approach has been adopted. The results at industry-level display mixed evidence. Out of four industries analysed under VAR set up, uni-directional granger causality is found to exist from FDI to IIT for three industries. These comprise of manufacture of food products and beverages (15), tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear

Table 7: Short-run Granger Causality Results using VECM

			IIT						FDI					
NIC Code	Industry	Equation	IIT_{t-1}	p-value	IIT_{t-2}	p-value	IIT_{t-3}	p-value	FDI_{t-1}	p-value	FDI_{t-2}	p-value	FDI_{t-3}	p-value
17	Manufacture of textiles	IIT	-0.5369	0.0055***					-0.0257	0.1928				
		FDI	-3.5165	0.1299					-1.2748	0.0001***				
23	Manufacture of coke, refined petroleum products and nuclear fuel	IIT	-1.1849	0.0001***					-0.2389	0.0686				
		FDI	-0.1384	0.7196					-0.7097	0.0048***				
24	Manufacture of chemicals and chemical products	IIT	-0.5691	0.0422**					-0.0406	0.2234				
		FDI	-5.9589	0.0141					-1.6210	0.0000***				
26	Manufacture of other non-metallic mineral products	IIT	-0.6905	0.0038***					-0.0451	0.0338**				
		FDI	-3.7157	0.1413					-1.2554	0.0001***				
27	Manufacture of Basic Metals	IIT	-1.3732	0.0006	-1.0785	0.0144	-0.0456	0.9115	-0.1399	0.1972	-0.2386	0.1732	-0.3369	0.1372
		FDI	-0.1812	0.7285	1.6248	0.0338**	1.0189	0.1903	-1.3195	0.0000	-1.8614	0.0001***	-4.3740	0.0014
28	Manufacture of fabricated metal products, except machinery and equipment	IIT	-0.4160	0.0606*					0.0250	0.2656				
		FDI	-1.1238	0.6777					-1.5199	0.0001***				
29	Manufacture of machinery and equipment n.e.c.	IIT	-0.3802	0.1180					-0.0502	0.2160				
		FDI	-3.2640	0.0466**					-1.2157	0.0002***				
31	Manufacture of electrical machinery and apparatus n.e.c.	IIT	-0.3621	0.1790					-0.0453	0.3560				
		FDI	-0.3045	0.7262					-1.5611	0.0000***				
34	Manufacture of motor vehicles, trailers and semi-trailers	IIT	-0.9168	0.0013***					0.0543	0.3830				
		FDI	1.2402	0.1382					-0.4471	0.0464**				
36	Manufacture of furniture; manufacturing n.e.c.	IIT	-0.3697	0.0670*					-0.0407	0.2088				
		FDI	-1.2518	0.2498					-0.6287	0.0025***				

***Significant at 1 percent level of significance, ** significant at 5 percent level of significance, * significant at 10 percent level of significance

(19) and manufacture of rubber and plastics products (25). However, the VAR results do not support for causality from IIT to FDI in any of these industries.

In the case of VECM estimation, granger causality in the long-run and short-run has been analysed separately for industries stationary at their first difference and co-integrated of rank one. It is inferred that most of the industries depict long-run causality from FDI to IIT. Out of ten industries analysed under VECM approach, three industries witness bi-directional causality between FDI and IIT in the long-run. These constitute of manufacture of textiles (17), manufacture of non-metallic mineral Products (26) and manufacture of machinery and equipments n.e.c. (29). On the contrary, only two industries, *viz*., manufacture of chemical and chemical products (24) and manufacture of electrical machinery and apparatus n.e.c. (31) experience uni-directional causality from IIT to FDI. In the short-run, however, the VECM results do not show evidence in favour of existence of causality between FDI and IIT. In fact, it is noticed that the past values of FDI and IIT are adversely affecting its present values for majority of industries.

If the granger causality results are compared with trends in FDI and IIT, it can be pointed out that for manufacture of basic metals (27) causal relationship between FDI and IIT does not exist despite high CAGR for FDI and IIT. On the other hand, industries such as manufacture of food products and beverages (15), manufacture of textiles (17) and tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19) witness causal relationship even though CAGR for FDI and IIT is low in these industries. Thus, it can be stated that high level of FDI inflows and IIT need not necessarily translate into a causal relationship between the two. Lastly, it can be concluded that the results from granger causality tests support causality from FDI to IIT rather than causality from IIT to FDI at industry-level. The results are, therefore, in concordance with the empirical view that FDI boosts IIT. Policies aiming to encourage FDI inflows in the manufacturing sector would be beneficial to increase the level of IIT in the economy.

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Appendix-A1: Level of IIT in the Manufacturing Sector of India (Industry-level) (1992 to 2013)

Industry	15	17	19	21	23	24	25	26	27	28	29	31	34	36	Total
1992	2.60	2.04	0.65	0.22	4.04	11.06	0.93	0.82	5.82	1.21	3.40	1.21	2.08	0.54	36.62
1993	2.08	2.34	0.76	0.21	2.92	11.64	0.93	0.68	7.23	1.40	3.43	1.35	1.94	0.80	37.72
1994	6.91	2.22	0.53	0.36	2.47	12.36	1.18	0.78	5.34	1.22	2.98	1.32	2.00	0.92	40.59
1995	4.58	1.96	0.50	0.47	2.04	11.25	1.56	0.73	5.29	1.27	2.66	1.24	2.42	0.93	36.90
1996	4.80	1.90	0.42	0.40	2.10	12.57	0.92	0.64	5.63	1.37	3.09	1.57	2.95	0.99	39.35
1997	4.63	1.99	0.49	0.29	1.45	13.79	1.07	0.67	6.06	1.29	3.37	1.69	2.03	1.05	39.87
1998	9.75	1.99	0.50	0.29	0.42	12.68	1.18	0.77	4.01	1.58	3.41	1.62	1.62	1.52	41.33
1999	9.35	1.93	0.50	0.39	0.19	14.11	1.18	0.73	4.87	1.54	3.11	1.65	1.99	2.25	43.78
2000	6.19	2.13	0.61	0.55	5.15	16.37	1.28	0.76	6.40	1.50	3.55	2.06	1.95	2.34	50.84
2001	6.31	2.32	0.63	0.59	5.29	17.09	1.35	0.90	5.46	1.33	4.20	2.55	1.42	2.08	51.52
2002	6.37	2.75	0.56	0.70	5.97	17.90	1.39	0.84	8.00	1.45	4.35	2.41	1.65	2.14	56.49
2003	7.21	2.79	0.47	0.52	5.92	18.02	1.35	0.87	8.99	1.50	4.59	2.38	1.79	3.16	59.56
2004	5.98	2.47	0.52	0.51	8.43	16.93	1.34	0.95	10.43	1.61	4.53	1.93	1.97	4.44	62.04
2005	4.58	2.65	0.49	0.50	9.95	15.86	1.37	0.97	10.22	1.64	4.86	2.17	1.84	5.56	62.64
2006	3.27	2.20	0.51	0.45	10.28	16.26	1.45	1.00	12.37	1.67	4.91	2.81	1.87	2.99	62.04
2007	2.95	1.96	0.48	0.35	11.36	15.26	1.51	1.02	11.29	2.33	4.85	2.79	2.24	2.89	61.29
2008	2.81	1.62	0.45	0.35	11.86	14.64	1.46	1.07	10.49	2.62	5.03	3.15	2.72	4.94	63.21
2009	5.17	1.67	0.42	0.35	5.66	14.78	1.58	0.99	8.25	2.35	4.67	2.86	2.54	8.17	59.47
2010	4.95	1.55	0.44	0.40	5.75	14.01	1.58	0.96	10.93	1.91	4.12	2.49	2.78	11.61	63.48
2011	4.69	1.44	0.41	0.35	6.24	14.04	1.47	0.98	6.87	1.99	4.23	2.23	2.74	9.80	57.47
2012	5.76	1.44	0.45	0.37	6.08	15.94	1.59	1.07	6.96	2.06	4.51	2.26	2.91	5.96	57.35
2013	5.04	1.46	0.49	0.45	5.43	17.89	1.56	0.94	8.99	1.93	5.04	2.54	2.46	4.59	58.81
CAGR (%)	**0.21**	**-1.63**	**-1.42**	**1.38**	**3.05**	**1.52**	**2.24**	**2.08**	**3.14**	**3.14**	**2.95**	**3.88**	**1.32**	**13.24**	**2.87**

Appendix-A2: FDI Inflows in the Manufacturing Sector of India (Industry-level) (1992 to 2013) (Constant Prices) (Base Year=2005)

(U.S. $ in thousands)

Year	15	17	19	21	23	24	25	26	27	28	29	31	34	36	FDI
1992	34473.29	11002.44	2160.68	15.43	5740.41	59873.04	5848.42	1543.12	14690.50	77.16	37852.73	53685.13	63777.14	2546.15	295277.65
1993	46293.53	11486.44	9538.91	2119.04	17507.88	119375.51	1172.49	26699.02	4540.92	481.10	24890.60	51539.93	18789.67	18561.13	354989.17
1994	84590.86	43166.06	1645.06	4204.05	27138.73	143091.60	7397.97	21712.90	5214.18	885.06	35075.43	89468.33	40135.68	11467.34	517187.26
1995	51267.52	46285.23	2525.54	34876.07	97690.33	110396.65	1267.68	53183.79	18189.80	442.22	112519.29	158047.84	72208.88	102200.93	863096.76
1996	197758.76	46001.54	2475.89	93189.00	105672.46	271057.45	14418.39	27057.89	38594.69	790.62	58287.34	232025.85	151060.23	22917.55	1263303.65
1997	158991.87	44041.35	15345.94	40753.65	430113.39	297780.74	45014.75	34019.31	28089.52	595.96	98660.98	368630.30	419187.47	11730.46	1994952.70
1998	63002.04	13394.63	1418.26	62277.15	149883.29	340685.87	9623.12	47958.03	33481.32	1670.39	48735.45	209208.38	392804.12	15212.10	1391352.16
1999	102954.29	31102.85	41.85	12794.75	184357.33	139497.26	4425.33	46052.72	40895.06	73.23	55646.16	175266.05	281515.80	20107.52	1096729.21
2000	68039.78	1888.04	3093.17	60708.56	113041.45	175417.11	3786.13	110169.21	15275.06	871.81	38734.97	280544.85	286329.48	20778.50	1180678.11
2001	38729.15	4006.12	6916.98	10992.17	117726.74	68242.24	670.98	136711.42	27332.42	472.52	85095.58	411298.60	250777.39	46169.09	1207142.38
2002	210316.94	46189.46	70.41	11416.60	651229.13	197351.30	46541.51	68479.49	43916.20	256.34	86514.71	668660.82	445146.89	28295.07	2506386.87
2003	70429.99	18300.55	7020.90	7372.45	161982.95	145811.78	18210.15	16532.77	31759.79	40.18	60556.53	295872.26	330454.47	14363.22	1180710.99
2004	96302.43	38744.65	439.37	3814.55	155427.97	545231.12	43687.59	34740.37	186333.82	283.06	82611.99	861089.90	175049.94	8427.96	2234188.71
2005	64079.61	76936.44	944.78	26668.18	60943.32	407697.86	33291.40	447076.78	138581.04	525.96	213579.21	997037.41	212858.45	36515.34	2718740.79
2006	79015.68	118317.09	7904.59	4994.49	253551.01	629970.55	18507.81	257367.37	176770.77	3272.60	169963.76	2050883.30	405137.86	8669.87	4186332.77
2007	133377.24	93158.70	5426.90	21122.17	323318.77	553237.24	6086.68	145030.21	472261.18	957.14	313031.82	555328.08	348185.87	98501.97	3071030.97
2008	629543.45	200535.89	4611.72	223623.97	1344624.89	905754.74	78281.17	896039.66	1496850.84	521.15	371552.86	256731.96	1137835.16	210221.47	7758736.93
2009	380373.87	212046.65	4694.13	63605.46	398969.03	758710.07	36827.58	104295.03	502197.21	4224.72	505301.74	840206.56	1484315.85	274350.55	5572127.45
2010	301557.80	81511.30	1808.12	14912.15	576110.43	705780.00	16914.69	620049.74	1005762.98	612.43	797090.15	94984.73	1274210.77	129514.03	5622829.33
2011	353091.97	144617.97	14002.49	303471.49	1979711.60	9092754.37	127605.24	234692.26	1581805.82	30704.49	2046752.66	483717.17	892411.27	195656.18	17483006.00
2012	587895.35	174797.25	47454.85	102630.27	227018.53	1587841.22	580049.06	322389.15	1667613.55	21192.31	1189880.49	284865.26	1195914.48	230014.58	8221568.35
2013	4194851.67	129014.35	8966.51	27942.58	108976.08	2521578.95	395263.16	419875.60	444784.69	162.68	1122650.72	198363.64	1691435.41	240832.54	11506711.56
CAGR (%)	**13.86**	**13.24**	**7.38**	**17.19**	**14.86**	**16.92**	**21.18**	**19.76**	**30.30**	**11.25**	**19.70**	**7.46**	**17.32**	**16.28**	**17.19**

Appendix-B1: Model Selection based on Φ Statistics

NIC Code	Industry	Variables	Order of Integration	Φ Statistic	Critical value	Model Chosen
15	Manufacture of food products and beverages	IIT	I(0)	5.5407	5.18	Constant
		FDI	I (1)	6.0133	5.18	
17	Manufacture of textiles	IIT	I(1)	--	--	None
		FDI	I(1)	--	--	
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	IIT	I(0)	7.1761	5.18	Constant
		FDI	I (1)	25.5097	5.18	
21	Manufacture of paper and paper products	IIT	I(0)	7.7547	5.18	Constant
		FDI	I(0)	5.5114	5.18	
23	Manufacture of coke, refined petroleum products and nuclear fuel	IIT	I(1)	--	--	None
		FDI	I(1)	--	--	
24	Manufacture of chemicals and chemical products	IIT	I(1)	--	--	None
		FDI	I(1)	--	--	
25	Manufacture of rubber and plastics products	IIT	I(0)	11.0497	5.68	Both
		FDI	I(1)	5.7395	5.68	
26	Manufacture of other non-metallic mineral products	IIT	I(1)	6.5492	5.68	Both
		FDI	I(1)	6.4288	5.68	
27	Manufacture of Basic Metals	IIT	I(1)	6.9909	5.18	Constant
		FDI	I(1)	10.3744	5.18	
28	Manufacture of fabricated metal products, except machinery and equipment	IIT	I(1)	6.5925	5.18	Constant
		FDI	I(1)	10.745	5.18	
29	Manufacture of machinery and equipment n.e.c.	IIT	I(1)	8.857	5.18	Constant
		FDI	I(1)	6.8362	5.18	
31	Manufacture of electrical machinery and apparatus n.e.c.	IIT	I(1)	6.6664	5.18	Constant
		FDI	I(1)	7.5372	5.18	
34	Manufacture of motor vehicles, trailers and semi-trailers	IIT	I(1)	--	--	None
		FDI	I(1)	--	--	
36	Manufacture of furniture; manufacturing n.e.c.	IIT	I(1)	11.4891	5.18	Constant
		FDI	I(1)	5.4292	5.18	

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