Does economic development cause intra-industry trade? The case of India: 1971 to 2000

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Abstract

India's intra-industry trade (IIT) is evaluated and analyzed from 1971 to 2000. IIT is found to have an upward trend with a growth rate that is close to the growth rate of GNP. A host of macro economic indicators are cointegrated with IIT suggesting that there is a stable relationship between IIT and the level of economic development of India. The causation of this relationship is not however unidirectional as the existing theoretical literature on IIT suggests. There is bi-directional causality for these variables. This implies that though economic development boosts IIT, it can equally be interpreted as a proxy for economic development and a predictor of future industrial progress rather than one that strictly follows it.

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1 Introduction

It is generally believed that the level of economic development of a country is positively related to the extent of intra industry trade (IIT). However the analytical question is: does economic development cause IIT? The suggestion in the literature seems to be in the affirmative. Such an argument, for example can easily be constructed from Krugman (1981) where IIT positively depends on the extent of horizontal product differentiation and economies of scale - factors that are positively influenced by economic development. Also in many models [including the above one and, say, the vertical IIT model suggested by Shaked and Sutton (1989)] there is a positive relationship between IIT and the level of purchasing power of the consumer. At the empirical level, research work by many authors like Havrylyschyn and Civan (1983), Helpman (1987) and more recently Bhattacharyya (2002) have explicitly confirmed this relationship between IIT and economic development by using multiple regression methods on cross-country data over different periods of time. Also, it has been repeatedly shown that for roughly the same years IIT in DCs are much greater than that in LDCs [see, for example, Tharakan (1986), Havrylyschyn and Civan (1983), Globerman and Deane (1990)]. These empirical and theoretical results apparently seem to complement each other and decisively establish the relationship between economic development and IIT. In reality, however, this is not generally true. The theoretical works not only imply a positive relationship but also implicitly argue in favor of a one-way causation from economic development to IIT. The empirical results on the other hand are silent on the issue of dynamic causation. In this paper we look at the time series data of a less developed country (India) to address this issue. Since country specific studies of IIT in less developed countries (LDCs) are extremely rare[1], the paper is also expected to be informative regarding the magnitude, trend and determinants of IIT in these countries[2].

The rest of the paper is arranged as follows: in the next section we take a look at India's IIT data to study some of its broad characteristics. We also justify our choice of variables to be used in the regression analysis and report the simple correlation results with these variables. In section 3 we briefly discuss the theoretical rationale for our empirical analysis. Section 4 presents the results of the unit root, cointegration and causality analysis. Section 5 concludes the paper.

2 IIT in India

2.1 The basic data

In line with the general trend in case of less developed countries, there has been very little effort to study IIT in India. Bhattacharyya (1994) presented a time series data for India's IIT between 1971 and 1987. The paper concluded that (1) about 20 to 24 per cent of total trade in India is intra-industry in character and there is a positive time trend to the data, (2) among the different categories of industries considered, manufactured products (SITC 6) had the highest amount of IIT and (3) India's bilateral IIT appears to be higher with developed rather than with less developed trading partners. However the paper did not comment on the determinants of IIT in the context of India thus missing out crucial insights into the nature and characteristics of her IIT[3].

Table 1 and figure 1 report the value of the Grubel-Lloyd (uncorrected) index ($I_{GL(U)}$, first suggested by Grubel and Lloyd (1975)) for India between 1971 and 2000. The index is defined as follows:

[1] There has however been a lot of work on groups of less developed countries like the Transition countries (see Aturupane, Chonira, et al (1999), Kandogan (2003) and others)

[2] For more on IIT in developing countries see, for example, Clark and Stanley (1999) and Ekanayake (2001).

$$I_{GL(U)} = 1 - \frac{\sum_i |X_i - M_i|}{\sum_i (X_i + M_i)}$$

Where X_i and M_i are the export and import values of the ith industry[4]. The value of the index varies from zero (no IIT) to 1 (all trade is IIT). The time trend and the growth rate of the series can be inferred from the following equations:

$$IIT_t = 0.17 + 0.006t \qquad (1)$$

$$(11.4) \qquad (7.8) \qquad \bar{R}^2 = .67 \qquad F = 61.09$$

$$\text{Ln } IIT_t = -1.77 + 0.03t \qquad (2)$$

$$(-29.6) \qquad (7.8) \qquad \bar{R}^2 = .68 \qquad F = 62.1$$

The first equation suggests that IIT in India clearly has a positive time trend. Its growth rate over time is about 3 per cent per annum. Interestingly this growth rate is very close to the average annual growth rate of GNP over the same period (the so called 'Hindu rate of growth'). However the estimate of the slope coefficient in a regression with IIT as the dependent variable and GNP as the independent variable has fallen over the decades[5]. This is also obvious from table 2 where we regress IIT with GNP and report the actual and the predicted values of IIT when the decade of the 1980s is predicted from the nature of the

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3 Panchamukhi (1997) observes that IIT for India is higher in natural resource intensive and human capital-intensive products than in labour intensive and technology intensive products. However, for a cross section data on Indian Industries in 1990, he finds no evidence of any statistically significant relationship between economies of scale and labour intensity of products to IIT.

4 The raw data for calculating the IIT values has been taken from the various issues of the International Trade Statistics Yearbook.

5 The coefficient changes from .00019 in the 1970s to .00005 in the 1980s to .0000057 in the 1990s.

relationship from the 1970s and that for the 1990s from that of the 1980s. It can be seen that in all cases the predicted value of IIT is much higher than the actual value confirming he fall in slope.

Table 3 compares India's IIT with some other less developed countries. On an average about 27 per cent of total trade was intra-industry in character in the countries reported in the table. It should be noted that among the countries chosen India has the lowest per capita GNP but it ranks sixth as far as IIT is concerned. Thus economic development is not the only criteria determining the magnitude of IIT. Turning to the commodity composition of IIT in India we find that Manufactured goods (SITC 6) accounts for the highest amount of IIT (48.7%) followed by machinery and transport equipment (SITC 7) (27.9%) and then chemical products (SITC 5) (18.7%). The overwhelming importance of SITC 6 is also confirmed from table A.1 in the appendix where it is seen that *all* industries with high bilateral IIT with different countries are of this category. Finally turning to the direction of India's IIT it can be seen from table 4 (and table A.1 in the appendix) that India's IIT is overwhelmingly with developed rather than underdeveloped countries. USA, UK and Singapore are the three largest IIT partners of India. To the extent that these countries are also India's major trading partners, India's bilateral IIT suggests a positive relationship between IIT and the trading volume of a country.

2.2 Determinants of IIT

Some of the standard determinants of IIT in developed countries (DCs) are: (1) Variables that affect export, or the supply side variables proxying for industrial structure, notably (a) the extent of economies of scale (b) the extent of horizontal product differentiation and/or (c) the extent of vertical differentiation. (2) Variables that affect import, or the demand side variables such as average purchasing power of consumers. (3) Policy variables like tariff. It should however be noted that the variables that are usually found to be relatively important for DCs do not automatically qualify as probable candidates for a LDC.

High levels of industrial concentration, small number of varieties for a product and little or non-existent scale advantages for the average industrial firm usually characterizes the production structure in LDCs such as India (see, for example, Rodrik (1988)). Firms in India typically have a low and declining propensity to adapt to foreign technology, low level of R & D expenditure (Katrak, 1985) and as a result lower levels of competitiveness compared to foreign firms (Kathuria (1995)). Here firms are even known to have negative externality in the core sectors (Patibandala 1992). Thus, the so-called 'supply side' variables need to be modified or replaced by more general variables that are meaningful. In our context, given our broad emphasis on economic development, one such variable is the size of the manufacturing sector (MANU). We consider this as the 'supply side' variable (determining the level of production) which proxy for economic development from the supply side.

Secondly, since it has been observed that the LDCs such as India have higher IIT with DCs rather than LDCs, so not only exports in general, but also export to DCs would be of special importance. Thus, a high and rising IIT with DCs should imply that goods are more and more conforming to the market demands of these countries. Relatively more capital or technology intensive goods have a larger market in DCs. This means that the level of capital intensity of the goods should determine the pattern of production from the supply side and hence the extent of IIT in countries like India. It is also a broad indicator of economic development implying industrial sophistication. We thus choose the capital-labor ratio (denoted by KL) over economies of scale and the extent of product differentiation to define industrial structure in the regression analysis below.

From the demand side, for obvious reasons, we have retained the variable that is considered for DCs, that is Gross National Product per capita (GNP). Also as a policy variable we have retained tariffs (TARF) for this section. Unlike in the case of DCs, the variable, for a country like India, is of indeterminate sign. On the one hand tariffs by hindering trade in general also hinders IIT. On the other hand, tariffs by giving protection to domestic industries enhances it production and possibility of export, which coupled with the fact that there is usually a large demand for foreign industrial goods in LDCs like India may well lead to an increase in IIT. Finally, we have added the role of foreign direct investment (FDI) as an additional cause of IIT in LDCs such as India[6] which would typically proxy the

[6] FDI in India has been very low for the last forty years mainly because the government has actively discouraged it. In the 1980s the annual average rate of FDI inflow was only about 92 million dollars. Most of these had come through foreign capital participation in collaboration agreements.

extent of opening up of the economy. Table 5 presents the proposed causal determinants of IIT and their respective data sources.

2.3 Adjusting the data

Let us now turn to see whether we can establish any relationship between the explanatory variables and IIT[7]. For this we conduct a simple correlation analysis on IIT in India. In doing so, however, we need to keep in mind that our ultimate objective is drawing conclusions regarding causality through regression techniques. Since IIT is a positive fraction the application of OLS regressions will lead to erroneous results.

To overcome this problem Bergstrand (1983) suggests a logit transformation:

$$IIT_i = [\{\exp(x_i'\beta)\} / \{1 + \exp(x_i'\beta)\}].u_i \qquad (3)$$

where u_i's are homoscedastic disturbance terms. This implies that:

$$\ln\{IIT_i / (1 - IIT_i)\} = x_i'\beta + \ln\{u_i / (1 - u_i)\}$$

$$= x_i'\beta + \varepsilon_i \text{ (say)} \qquad (3')$$

assuming $Z_i^1 = \ln\{IIT_i/(1-IIT_i)\}$ we regress Z_i^1 on the independent variables. However, for the transformed regression the random error term $\varepsilon_i = f(u_i) \sim N(\theta, f' \delta_u^2)$. Thus, $V(\varepsilon_i) = \sigma_u^2/\{IIT_i/(1-IIT_i)\}$ and the transformed model has heteroscedastic disturbances. So, while running the regression we will have to apply $\{IIT.(1 - IIT)\}^{1/2}$ as weights[8]. So the series that we will be working with ultimately is an adjusted version of the actual series.

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[7] Note that through out this paper financial years have been made consistent with calendar years by taking, say, the 1971-72 data as the data for 1971 (in which it has nine months) and not 1972 (in which it has three months).

[8] It should be noted that adjusting the data set in the above manner has certain (restrictive) implications regarding the rate of fluctuation of the dependant variable with respect to the independent variables.

2.4 A Simple Correlation Analysis

Since adjusting a series in the above fashion distorts the series to a large extent it is useful to look at the simple correlation between the dependent and the independent variables of both the actual and the adjusted series. This would help us to determine whether the nature of the relationship between the two has been significantly affected due to the adjustment. This will also help us to get an indication about the results that we should expect from the regression analysis. Tables 6 and 7 report the simple correlation results both with and without adjustment. It can be seen from the tables that *both before and after adjustment* all the independent variables, except tariff, have a significant correlation with IIT. Thus the nature of the relationship between the dependent and the independent variables has not been affected by the adjustment of the data. The tables also suggest that there should be a strong statistical link between the extent of economic development and IIT in India, though such a link may not exist for trade policies like tariff.

3 Theoretical Rationale for the causality analysis

It has now been demonstrated that the level of economic development of India and her IIT are positively correlated. Theoretically such an argument can for example, be easily constructed from Krugman (1979,1981) where the extent of IIT positively depends on the extent of horizontal product differentiation and economies of scale - factors that are positively influenced by economic development. Also in many models (including the above one and, say the one suggested by Shaked and Sutton (1989)) there is a positive relationship between IIT and the level of purchasing power of the consumer. In addition empirical works by Harylyschyn and Civan (1983) (and also Helpman (1987) and Bhattacharyya (2002)) have explicitly confirmed this relationship between IIT and economic development by using multiple regression methods on cross-country panel data. Also, it has been noted that for roughly the same years, IIT of DCs is much greater than that of LDCs (see, for example, Tharakan (1986), Havrylyschyn and Civan (1983) Globerman and Deane (1990)).

At a first glance these empirical and theoretical results apparently seem to complement each other and to work in tandem to firmly establish the relationship. In reality however this is not generally true. The theoretical works not only imply a positive relationship but also implicitly argue in favor of a one-way causation from economic development to IIT. The empirical results on the other hand in so far as they use simple regression techniques or compare static values of IIT across developed and underdeveloped counties are silent on the issue of causation. In the rest of the paper we take another look at the Indian time series data to address this causality aspect.

4 Results for the Time Series Analysis

4.1 Unit root tests

To take a closer look at the IIT series we first determine its nature and order of stationarity. We use the usual three following equations to do this:

$$\Delta Y_t = \gamma Y_{t-1} + u_t$$

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + u_t$$

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + u$$

where Δ is the first difference operator and in all cases we test for the null hypothesis of $\gamma=0$ (presence of unit root) against the alternative of $\gamma<0$. Acceptance of H_1: $\alpha \neq 0$ implies the presence of a drift in the series and acceptance of H_1: $\beta \neq 0$ implies the presence of a trend in the series. Table 8 reports the estimates of equations (5) and (6). A one period lag had to be used to eliminate autocorrelation in the equations as is testified by the LM values in column 5 of the table. The ϕ_1, ϕ_2 and ϕ_3 values respectively test for $(\alpha,\gamma) = (0,0)$ in equation (5) and for $(\alpha,\beta,\gamma) = (0,0,0)$ and $(\alpha,\beta,\gamma) = (\alpha,0,0)$ in equation 6. Turning to ϕ_3 first, the table value for rejecting the null hypothesis is 10.61 for 25 observations and 9.31 for 50 observations (see Hamilton (1994) page 764). Since the number of observations here is 30 in our case we use the first of these table values. The test thus points out the presence of unit root in the IIT series. The conclusion is further strengthened by looking at the ϕ_1 tests whose table value for 25 observations is 7.88. The ϕ_2 test confirms the presence of a drift in the series (table value for 100 observations in 4.88, see Holden and Perman (1994), p- 100). The t-tests for H_o=0 vs H_1<0 for γ also confirm the same conclusion (see Fuller (1976) table 8.5.2). Thus we conclude that the IIT series has a unit root (see also figures 2-4).

A similar exercise with the first difference of the IIT series shows that ΔIIT (plotted in fig 2) is stationary. This test and all such tests with the independent variables are summarized in table 9. It can be noted from the table that all he variables are I(1) except TARF which is I(2).

4.2 Cointegration

Before coming to the cointegration results it should be noted that in view of the high correlation between MANU, GNP and KL (which are all I(1)) as reported in table 7 muticollinearity is a potential problem to be encountered in the cointegrating regressions. To avoid this problem we consider the variables separately in the cointegrating regressions[9]. The Johansen method of cointegration for the above variables has been used. The results are reported in table 10. It can be seen that all the independent variables except TARF conitegrate with IIT. However since MANU and GNP have more than one cointegrating vectors as opposed to a single one for KL, we can say that the relationship between IIT and KL is less "stable" (See Dickey, Jansen and Thronton (1994) p 22) than the rest of the variables. The failure of TARF was in fact imminent from tables 6 and 7 where the simple correlations with variables having high correlations with IIT were also very low. Its failure implies that trade policy has not significantly affected IIT in India and that other factors have overwhelmed it. It should be noted that the result could also be due to the fact that we have used a proxy for TARF (see table 5). However since TARF is not an indicator for economic development this does not affect our basic contention regarding the positive relationship between economic development and IIT.

4.3 Causality

[9] Correlation with ΔATARF (which is I(1)) is -.31 (GNP), -.32 (MANU) and -.34 (AKL).

We use the error correction model to test for causality (see Mehra (1994) p- 154). The steps are as follows: first estimate a set of equations similar to the second step of the Engle-Granger procedure (for this discussion we assume that x_t and y_t are both I(1)):

$$x_t = \alpha_0 + \beta_0 y_t + \nu_{1t}$$

$$y_t = \alpha_1 + \beta_1 x_t + \nu_{2t}$$

After calculating ν_{it} from the above we estimate the following error correction equations:

$$\Delta x_t = \alpha_3 + \lambda_1 v_{1\ t-1} + \sum_s \beta_{1s} \Delta x_{t-s} + \sum_s \beta_{2s} \Delta y_{t-s}$$

$$\Delta y_t = \alpha_4 + \lambda_2 v_{2\ t-1} + \sum_s \beta_{2s} \Delta x_{t-s} + \sum_s \beta_{1s} \Delta y_{t-s}$$

Where λ_1 and λ_2 are error correction coefficients. If $\lambda_1 \neq 0$ then y_t Granger causes x_t and if $\lambda_2 \neq 0$ x_t Granger causes y_t (since ν_{it-1} depends on lagged levels of the ith variable, i = 1,2) Further if $\beta_{2s} = 0$ then lagged y_t's (x_t's) do not enter the x_t (y_t) equation.

The results of this test are presented in table 11. It can be seen that generally not only is there causality from the variables to IIT but reverse causality is also clearly present from IIT to the variables. Thus IIT is indeed caused by economic development and the process of causation is a complex one, as proxies of economic development do not cause it unidiretionally. In this sense it apparently seems to behave more like a parameter that itself has a role to play in the development process of the nation. Since, as we have already pointed out, economic theory implicitly suggests a one-way causation form the different variables signifying economic development to IIT, the second implication of the result seems to be rather surprising. However, let us note that Granger causality has a thematic implication that is not always appreciated while interpreting results derived from it (see Hamilton (1994) page 11). By its very statistical nature Granger causality is a tool that comments on the extent to which a series can forecast the values of another series. This ability to forecast may well translate into causality if economic logic supports it. If economic logic dictates something which is quite contrary to what the Granger causality analysis suggests, then all we can say is that the series contains "the market's best information as to where (the explained series) might be headed" (Hamilton(1994) p 307). The reverse causation from IIT to GNP and MANU, in this interpretation is thus a reflection of the fact that it is itself an indicator of economic development and can be considered as an yardstick for it.

5 Conclusion

As an economic phenomenon IIT is a relatively recent discovery, its presence being almost unknown before the mid 1970s. Much is yet to be determined regarding the nature and causes of such trade between nations. One interesting issue that has been sparsely analysed in the literature is the nature of IIT in LDCs and its relationship with the level of economic development. In this paper we have investigated this issues with the Indian data. We have found that, in India, IIT is present, has an upward trend and has a positive relationship with economic development but the nature of the linkage is complex rather than a straightforward one. Though economic development boosts IIT, it can equally be interpreted s a proxy for economic development and a predictor of future industrial progress rather than one that strictly follows it.

Table 1: India's IIT: 1971 - 2000

YEAR	IIT	YEAR	IIT
1971	0.143	1986	0.237
1972	0.142	1987	0.285
1973	0.151	1988	0.346
1974	0.161	1989	0.355
1975	0.176	1990	0.301
1976	0.215	1991	0.311
1977	0.259	1992	0.354
1978	0.311	1993	0.351
1979	0.226	1994	0.256
1980	0.222	1995	0.270
1981	0.218	1996	0.340
1982	0.249	1997	0.302
1983	0.279	1998	0.317
1984	0.242	1999	0.365
1985	0.231	2000	0.339

Source: Calculated from the International Trade Statistics Yearbook, UN, (various issues).

Table 2: Static Forecasts of IIT Based on OLS Regression of IIT on (Intercept and) GNP

OBSERVATION	ACTUAL	PREDICTED	U^1_i	σ_u^2
Based on 1971 to 1979 data				
1980	0.222	0.267	-0.045	0.021
1981	0.218	0.310	-0.092	0.024
1982	0.249	0.314	-0.065	0.024
1983	0.279	0.377	-0.098	0.029
1984	0.242	0.402	-0.160	0.031
1985	0.231	0.431	-0.200	0.034
1986	0.237	0.456	-0.219	0.037
1987	0.285	0.475	-0.190	0.038
1988	0.346	0.580	-0.235	0.049
1989	0.355	0.647	-0.292	0.056
Based on 1971 to 1989 data				
1990	0.301	0.371	-0.070	0.040
1991	0.311	0.366	-0.055	0.040
1992	0.354	0.384	-0.030	0.041
1993	0.351	0.405	-0.054	0.043
1994	0.256	0.437	-0.181	0.046
1995	0.270	0.471	-0.201	0.049
1996	0.340	0.513	-0.173	0.054
1997	0.302	0.535	-0.233	0.056
1998	0.317	0.570	-0.253	0.060
1999	0.365	0.606	-0.241	0.065
2000	0.339	0.635	-0.296	0.068

Notes: 1. Error 2. Standard Deviation of error. Computed value of the F statistic for predictive failure test: F (10, 7) = 4.72* for IIT and 1.07 for ΔIIT (for the first regression) F(3, 17) = 3.17* for IIT and 2.67 for ΔIIT (for the second regression) where '*' implies F values are statistically significant at 5%.

Table 3: India's IIT compared to some other LDCs and NICs (1992)

COUNTRY	IIT	COUNTRY	IIT
1.PAKISTAN	0.031	10.PHILIPPINES	0.282
2.PERU	0.037	11.MEXICO	0.296
3.CHILE	0.084	12.BRAZIL	0.323
4.COLUMBIA	0.121	13.INDIA	0.354
5.SRILANKA	0.123	14.THAILAND	0.355
6.VENEZUELA	0.126	15.KOREA	0.433
7.INDONESIA	0.136	16.MALAYSIA	0.489
8.ARGENTINA	0.202	17.SINGAPORE	0.676
9.URUGUAY	0.217	18.HONG KONG	0.796

Source: Calculated from the International Trade Statistics Yearbook, UN, (various issues).

Table 4: India's Bilateral IIT with Selected Countries (1992)

COUNTRY	IIT
Developed countries	
USA	0.218
SINGAPORE	0.194
UK	0.179
ITALY	0.167
GERMANY	0.152
JAPAN	0.130
HONG KONG	0.098
SWITZERLAND	0.087
NETHERLANDS	0.084
FRANCE	NA
Underdeveloped countries and NICs	
MALAYSIA	0.094
KOREA	0.080
THAILAND	0.074
BRAZIL	0.035
CHINA	0.029
BANGLADESH	0.023
PAKISTAN	0.008
SRILANKA	0.007
ARGENTINA	0.000
PHILIPPINES	0.000

Source: Calculated from International trade statistics (Series D) (UN)

Table 5: Explanatory Variables and their Data Sources

VARIABLE	PROXY	DATA SOURCES
1. The size of the manufacturing sector	Index no. of manufacturing production in India (MANU)	Economic Survey (Govt. of India)
2. The capital intensity of industrial goods	Productive capital per worker per factory in Indian manufacturing (KL)	Calculated from the Annual Survey of industries (Govt. of India)
3. Average purchasing power	Gross national product per capita in India (GNP)	Economic Survey (Govt. of India)
4. Tariffs	Ratio of total customs duty earned by the Govt. of India to the import bill (TARF)	Calculated from the Reserve Bank of India Bulletin

Table 6: Correlation Matrix of Independent Variables at Level

Variables	IIT	MANU	GNP	TARF
MANU	.739**			
GNP	.748**	.998**		
TARF	-0.003	-0.325	-0.346	
K/L	.665**	.986**	.985**	-.435*

Notes: 1. Pearson correlation 2.** Correlation is significant at the 0.01 level (2-tailed). 2. * Correlation is significant at the 0.05 level (2-tailed). 3. No. of observations 30.

Table 7: Correlation Matrix of the adjusted series at Level

Variables	AIIT	AMANU	AGNP	ATARF
AMANU	.782**			
AGNP	.837**	.994**		
ATARF	0.26	-0.112	-0.075	
AKL	.689**	.982**	.965**	-0.258

Notes: 1. Pearson correlation 2.** Correlation is significant at the 0.01 level (2-tailed). 2. * Correlation is significant at the 0.05 level (2-tailed). 3. No. of observations 30.

Table 8: Unit Root Tests for IIT Series

α	β	γ	θ	LM_1^2	ϕ_1	ϕ_2	ϕ_3
-0.11		-0.28	0.08				
(-1.4**)		(-1.7)	(0.73)	0.07	3.7		
-0.49	0.008	-0.83	0.36	0.41		7.5**	10.0
(-3.7**)	(3.1**)	(-4.0)	(1.9**)				

Table 9: Unit Root Test for the Dependent and the Independent Variables[1]

Variable	LM[2]	Level	First diff.	Second diff.	Conclusion
IIT	.41*[4]	-2.16	-6.24	NA	I(1)[3]
GNP	2.27	.96	-4.60	NA	I(1)
MANU	.95	2.21	-2.98	NA	I(1)
KL	.35	-.75	-3.66	NA	I(1)
TARF	1.35	-1.14	-2.83	-4.81	I(2)

Notes: 1. There is trend in the data generating process for GNP and KL and no-trend in IIT, MANU and TARF (Results not reported). Accordingly appropriate Dickey Fuller statistic is reported (i.e, 'Dickey Fuller Statistic with trend' or 'Dickey Fuller statistic without trend'). Also since serial correlation is present in the basic Dickey-Fuller equation in all cases we use the Augmented version of the test in all cases. 2. LM gives the Lagrange multiplier statistic of order 1 (F version) in the following augmented Dickey Fuller equation: $\Delta y_t = \alpha + \beta_t + \gamma Y_{t-1} + \lambda \Delta Y_{t-1} + \varepsilon_t$. It can be seen from the LM values that one period lag is enough to remove serial correlation in all situations. 3. NA= Not Applicable (as the variables have become stationary at the previous level of differencing) 4. Integrated of order one. 8. Critical values for ADF tests, for our case [see Hamilton (1994)], are around –2.96 for Dickey Fuller without trend and -3.57 for Dickey Fuller with trend.

Table 10: Test for Cointegration of AIIT Series[1]

Maximum eigen value		Cointegration vector(s)			
k = 0	**k ≤ 1**	**AGNP**	**AMANU**	**ATARF**	**AKL**
17.7*[2]	6.8*	0.003[3]			
		0.0001			
19.8*	4.6*		-0.02[4]		
			0.01		
12.05	.93			None	
23.16*	.70				0.52[4]

Notes: 1. Five lagged differences used. 2. '*' implies that null hypothesis is rejected at 95% level 3. Normalized coefficients. 4. There are two cointegration vectors for MANU and GNP, one for KL and none for TARF.

Table 11: Error Correction Coefficients for Granger Causality

Variable	From y_t to x_t			From x_t to y_t		
	λ_1[1]	θ_1[2]	η_1[3]	λ_1[1]	θ_1[2]	η_1[3]
y_t = AGNP	.25	.22	.26	-.76	-.62	-.72
	(3.56*)	(2.31*)	(2.05*)	(-3.34*)	(-2.22*)	(-2.18*)
y_t = AMANU	0.10	0.08	0.09	-.66	-0.51	-.62
	(2.61*)	(1.73**)	(1.65**)	(-3.31*)	(-2.18*)	(-2.25*)
y_t = AKL	0.03	-0.03	-0.12	-0.43	-0.32	-0.27
	(.96)	(-1.13)	(-2.86*)	(-2.47*)	(-1.66**)	(-1.12)

Notes: 1. One period lag. 2. Two period lag. 3. Three period lag. See also notes at the end of table 11.

Fig1: Intra Industry Trade in India (1971 to 2000)

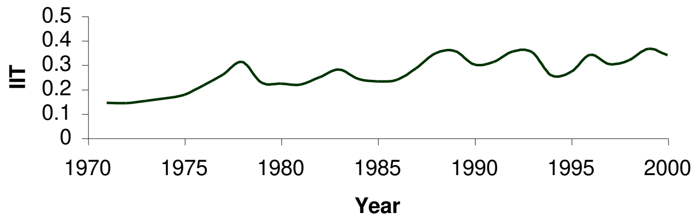


Fig 2: AIIT at First Difference

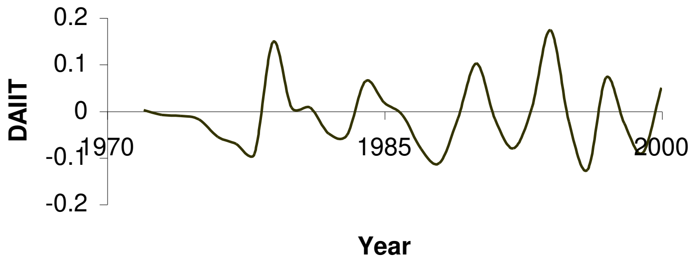


Fig 3: Autocorrelation Function of AIIT

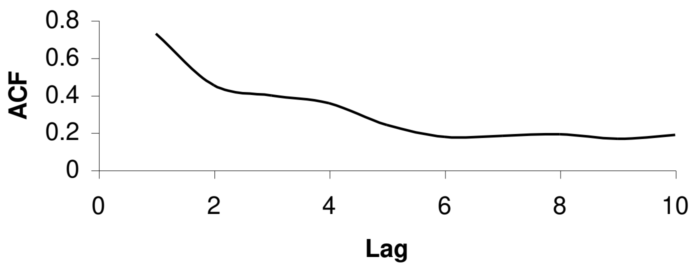
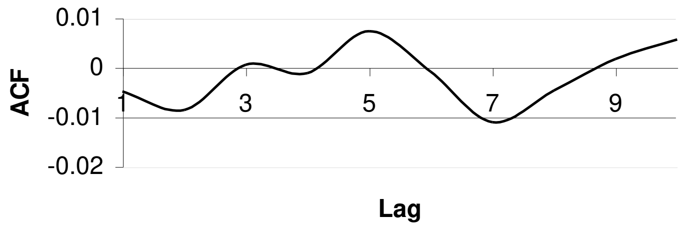


Fig 4: Autocorrelation Function of First Difference of AIIT



Appendix

Table A1: Country wise Breakup of Industries with High Bilateral IIT of India

COUNTRY	SITC	COMMODITY	GLU
USA	635	Wood manufactures, nes	0.998875
UK	665	Glassware	0.993662
THAILAND	681	Silver, platinum, etc.	0.986595
GERMANY	694	Nails, screws, nuts, etc.	0.985507
FINLAND	652	Cotton fabrics, woven	0.985281
KOREA REPUBLIC	699	Manufacts. base metal, nes	0.981935
ITALY	694	Nails, screws, nuts, etc.	0.9568
SINGAPORE	675	Flat-rolled, alloy steel	0.954635
MALAYSIA	625	Rubber tyres, tubes, etc.	0.950495
GERMANY	676	Iron, steel bar, shapes etc.	0.949971
EGYPT	659	Floor coverings, etc.	0.948863
AUSTRIA	695	Tools	0.945205
JAPAN	699	Manufacts. base metal, nes	0.943404
AUSTRALIA	665	Glassware	0.931116
HONG KONG	699	Manufacts. base metal, nes	0.923908
SINGAPORE	629	Articles of rubber, nes	0.918556
ITALY	695	Tools	0.914435
DENMARK	699	Manufacts. base metal, nes	0.906976
HUNGARY	695	Tools	0.906630
CANADA	676	Iron, steel bar, shapes etc.	0.906422
AUSTRALIA	663	Mineral manufactures, nes	0.888059
GERMANY	621	Materials of rubber	0.884233
CANADA	679	Tubes, pipes etc. iron, steel	0.878291
GERMANY	681	Silver, platinum, etc.	0.878048
AUSTRALIA	679	Tubes, pipes etc. iron, steel	0.864269
SWITZERLAND	694	Nails, screws, nuts, etc.	0.862015
UK	672	Ingots etc. iron or steel	0.861660
KOREA REPUBLIC	652	Cotton fabrics, woven	0.859787
THAILAND	652	Cotton fabrics, woven	0.858840
SAUDI ARABIA	673	Flat-rolled, iron etc.	0.854838
QATAR	684	Aluminium	0.853717
SWITZERLAND	675	Flat-rolled, alloy steel	0.851851
NETHERLANDS	694	Nails, screws, nuts, etc.	0.848484
UK	678	Wire of iron or steel	0.846590
SINGAPORE	687	Tin	0.844230
HONG KONG	641	Paper & paperboard	0.841638
ITALY	693	Wire products excl. elect.	0.833957
THAILAND	611	Leather	0.831683
USA	684	Aluminium	0.830227
UK	684	Aluminium	0.823008
GERMANY	665	Glassware	0.816034
HUNGARY	611	Leather	0.801104
USA	611	Leather	0.790994
FRA M	625	Rubber tyres, tubes, etc.	0.789743

COUNTRY	SITC	COMMODITY	GLU
KOREA REPUBLIC	695	Tools	0.787906

Table A1: Country wise Breakup of Industries with High Bilateral IIT of India

COUNTRY	SITC	COMMODITY	GLU
USA	695	Tools	0.784693
JAPAN	651	Textile yarn	0.783114
FINLAND	675	Flat-rolled, alloy steel	0.781799
KOREA REPUBLIC	651	Textile yarn	0.775761
ITALY	625	Rubber tyres, tubes, etc.	0.766423
SINGAPORE	692	Containers, storage, transp.	0.765613
ISRAEL	695	Tools	0.763948
UK	693	Wire products excl. elect.	0.761187
ITALY	699	Manufacts. base metal, nes	0.751586
CYPRUS	652	Cotton fabrics, woven	0.740331
ITALY	692	Containers, storage, transp.	0.738738
NETHERLANDS	699	Manufacts. base metal, nes	0.730098
SINGAPORE	673	Flat-rolled, iron etc.	0.726495
SPAIN	625	Rubber tyres, tubes, etc.	0.725440
AUSTRALIA	662	Clay, refect. constr. matrl.	0.720779
INDONESIA	676	Iron, steel bar, shapes etc.	0.712933
ICELAND	652	Cotton fabrics, woven	0.696542
JAPAN	676	Iron, steel bar, shapes etc.	0.691146
ITALY	675	Flat-rolled, alloy steel	0.679197
ZAMBIA	699	Manufacts. base metal, nes	0.664190
FRA M	699	Manufacts. base metal, nes	0.659016
THAILAND	658	Textile articles nes	0.657754
SWEDEN	693	Wire products excl. elect.	0.657575
USA	663	Mineral manufactures, nes	0.652889
SWITZERLAND	663	Mineral manufactures, nes	0.649563
BRAZIL	611	Leather	0.645082
UK	695	Tools	0.641984
ITALY	662	Clay, refect. constr. matrl.	0.640483
MALAYSIA	629	Articles of rubber, nes	0.638509
ITALY	665	Glassware	0.637826
HONG KONG	612	Manufact. leather etc. nes	0.618226
AUSTRIA	665	Glassware	0.611012
SINGAPORE	695	Tools	0.607632
NETHERLANDS	665	Glassware	0.604060
USA	629	Articles of rubber, nes	0.594485
INDONESIA	652	Cotton fabrics, woven	0.592592
MALAYSIA	663	Mineral manufactures, nes	0.586440
AUSTRALIA	641	Paper & paperboard	0.574394
GERMANY	693	Wire products excl. elect.	0.566113
CHINA	678	Wire of iron or steel	0.549177
SRILANKA	692	Containers, storage, transp.	0.541322
JAPAN	692	Containers, storage, transp.	0.535211
NETHERLANDS	679	Tubes, pipes, etc. iron, steel	0.531450
DENMARK	695	Tools	0.522151
MALAYSIA	681	Silver, platinum, etc.	0.513350

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