INDIA'S INTRA-INDUSTRY TRADE UNDER ECONOMIC LIBERALIZATION: TRENDS AND COUNTRY SPECIFIC FACTORS

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ABSTRACT

This paper focuses on two aspects of India's intra-industry trade (IIT) in manufactured commodities under economic liberalization. First, it examines the changes in the intensity of multilateral IIT as between 1987-88, 1994-95 and 1998-99 to understand the impact of trade liberalisation on IIT. Second, within the theoretical framework of vertical IIT, it analyzes the influence of various country specific factors on the intensity and the probability of IIT in India's bilateral trade with her major trading partners. The findings confirmed the hypothesis that trade liberalization biases trade expansion towards IIT. In most of the industries, the increased levels of IIT are export-led, that is, caused by a faster growth of exports than of imports. The econometric exercise showed that, certain country specific factors which are found to be crucial in theory, are pertinent in determining the country pattern of India's IIT.

JEL Classification : F 14

Key Words: India, Liberalisation, Intra-industry trade, country specific factors.

I. Introduction

Economic liberalization was started in India in the early 1980s and got intensified in the early 1990s. It is held that, liberalization would lead to a restructuring in which production units respond to market signals. These changes, in turn, are expected to be manifested in the structure of India's international trade[1] . Evidence from other countries suggest that, liberalization would bias trade expansion in the direction of intra-industry trade (IIT) i.e., the simultaneous occurrence of exports and imports within the same industry[2] . The present paper focuses on two aspects of India's IIT in manufactured commodities under economic liberalization. First, it examines the changes in the intensity of multilateral IIT as between 1987-88, 1994-95 and 1998-99 (henceforth 1988, 1995 and 1999) to understand the impact of trade liberalization on IIT. Second, it analyses the influence of various country specific factors on the intensity and the probability of IIT in India's bilateral trade with her major trading partners.

Ever since the publication of Grubel and Lloyd's book in 1975, there has been a proliferation of theoretical and empirical research on IIT. There are mainly two strands of theoretical literature, one dealing

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1 It is held that, the commodity structure of international trade under the import substitution regime was shaped mainly by the nature and bias of protection policy.

2 See Balassa (1986) for evidence. Globerman and Dean (1999), however, pointed out that, one must be cautious in generalizing this result for a convincing theoretical argument linking increased IIT to trade liberalization *per se* has yet to be made.

with horizontal IIT (i.e., the exchange of commodities differentiated by attributes excluding quality) and the other dealing with vertical IIT (i.e., the exchange of commodities differentiated by quality). The models of horizontal IIT are considered to be of greater relevance to trade among the developed countries. The models of vertical IIT, on the other hand, are considered to be particularly relevant to trade among unequal partners.

Recent empirical studies, however, show that, even among the developed countries, vertical IIT are predominant as compared to horizontal IIT[3]. However, most of the econometric studies investigating the influence of country specific factors on the intensity of IIT in bilateral trade derived hypotheses from the models of horizontal IIT. As Greenaway et al (1994, p.96) rightly pointed out ".... one should be rather more cautious in interpreting these results" because the determinants of the two types of IIT are likely to differ. This difference arises because while the horizontal models are profoundly different from the basic construct of the Ricardian and Heckscher-Ohlin-Samuelson (H-O-S) models, the vertical models are not. Thus, different industry and country characteristics are deemed to be important as the determinants of IIT in the two types of models. In the present study, we concentrate on deriving and testing hypotheses from the models of vertical IIT assuming that India's bilateral IIT are vertical in nature[4]. This assumption is particularly

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3 For example, Greenaway et al (1994) found that vertical IIT are dominant in the UK's bilateral trade, accounting for almost 80 per cent or more of the total number of SITC 5-digit products with every developed country. Vertical IIT accounts for 80 to 90 percent of total IIT of European Union with the Central and East European Countries (Aturupane et al (1999). The predominance vertical IIT in China's manufacture industries and India's capital goods industries are observed respectively by Hu and Ma (1999) and Veeramani (1998).

4 Some studies attempted to disentangle (based on the unit values of exports and imports) horizontal and vertical IIT to test various hypotheses derived from the two strands of theories separately. It will be shown later that this procedure is inappropriate in the present study (see foot note 14).

justified on the ground that, the major chunks of India's total trade and IIT are with unequal trade partners, as will be seen later in the paper.

The paper is organized as follows. Section II provides a brief review of the theoretical literature dealing with vertical IIT. Section III attempts an overview of the estimates of the level of India's IIT in multilateral and bilateral trade. The rationale for the selection of the particular group of industries for the detailed analysis of IIT is provided before analyzing the levels of IIT across years, countries and sections of industries. Section IV presents the regression models formulated to explain the influences of country specific factors on the intensity and the probability of bilateral IIT. Section V concludes.

II. A Review of Theoretical Literature

It is generally held that the Ricardian and the H-O-S models can not provide a proper understanding of IIT. This called for new theoretical formulations. While the earlier attempts were aimed at explaining horizontal IIT analytical interest on vertical IIT is rather recent[5]. Horizontal IIT is explained by economies of scale in the presence of product differentiation and imperfect competition. On the other hand, the explanations for vertical IIT are being sought without recourse to economies of scale by Falvey (1981), Falvey and Kierzkowski (1987), and Falm and Helpman (1987). Nevertheless, economies of scale is a critical element of the model of vertical IIT developed by Shaked and Sutton (1984). In general, these models predict the pattern of IIT along the lines similar to the pattern of inter-industry trade predicted in the standard trade model, according the central role to factor endowment differences.

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5 See Helpman and Krugman (1985) and Greenaway and Milner (1986) for a synthesis of the literature.

Falvey (1981) adopts a partial equilibrium approach by concentrating on trade within a single industry, which is assumed to posses a stock of industry specific capital and produces a continuum of products differentiated by quality. Higher quality products are characterized by higher capital labor ratio used in their production. The comparative advantages of capital abundant countries, therefore, lie on the higher ends of the quality spectrum and that of labor abundant countries lie on the lower ends. Vertical IIT between two countries will arise given an overlap in the demand for different qualities and this possibility is enhanced the greater is the difference in factor endowments between the countries. Assuming that, the relative capital abundance is reflected in relative income per capita, the following hypothesis can be drawn from this model. The shares of IIT are positively correlated with the differences in per capita income between the trading partners. Another testable hypothesis, which the model suggests, is that the shares of IIT vary inversely with the levels of trade restriction of partner countries.

The supply side in the Falvey and Kierzkowski (1987) model is a close kin of Falvey (1981), the demand side being fully elaborated in the former. Each individual is assumed to demand only one type of differentiated product and given relative prices this preferred quality is determined uniquely by the individual's income. Since the aggregate income of a society is not equally distributed, there is, at any point in time, an aggregate demand for a variety of differentiated goods. This holds good in the 'integrated economy' (a term to represent two or more trading economies combined) as well and consequently vertical IIT will emerge, the intensity of IIT being higher the more dissimilar (in income distribution) are the trading countries. The model also suggests that the share of vertical IIT will be positively correlated with the market size of countries.

In the preceding models, capital assumes the decisive role among the factors of production in determining the product specification. Whereas, Falm and Helpman (1987) ascribe the central role to labor. Population in every country is characterized by a non-degenerate distribution of skills and differences in skills are reflected in differences in the endowment of effective labor supply. Higher quality products are characterized by relatively larger inputs of labor used in their production. The pattern of IIT reflects differences in technology and in income distribution.

A radically different mode of analysis was put forth by Shaked and Sutton (1984) focusing on the markets where R&D expenditure (which is considered to be a sunk cost) is a prerequisite to quality improvement. Given that, the average variable cost rises only slowly with quality, the number of firms in the market is bounded; by extending the distribution of income the upper bound on the number of firms increases, however. Thus, the 'integrated economy' can support a large number of firms if the two countries are more dissimilar (in income distribution). The higher income country specializes in higher quality products and the lower income country specializes in lower quality products resulting in vertical IIT.

In sum, a number of testable hypotheses relating country specific factors and IIT can be drawn from the above models. Such country specific factors include cross-country differences in per capita income, income distribution, market size, human capital endowment and technology. Hypotheses relating these factors and IIT in bilateral trade are explicitly specified in Section IV.

III. Levels of IIT: Multilateral and Bilateral

In the first subsection, the measure of IIT used in this study is discussed and the rationale for the selection of the particular group of

industries for the detailed analysis of IIT is provided. The following subsection analyzes the changes in the levels of IIT in India's multilateral trade as between 1988, 1995 and 1999. An overview of the patterns of IIT with India's major trading partners will be attempted in the final subsection.

1. Measurement of IIT and Selection of Industries

In India, the comprehensive data on foreign trade are officially collected and published by the Directorate General of Commercial Intelligence and Statistics (DGCI&S). A new commodity classification system, known as the Harmonized System has been adopted by DGCI&S from April 1987. This data from 1988 onwards is available in a computer database (India Trades) supplied by the Centre for Monitoring Indian Economy (CMIE). The present study uses this data source and the products grouped under the 4-digit level of the Indian Trade classification (ITC) are considered an industry. The intensity of IIT is measured by the well-known Grubel Lloyd index:

$$GLi = \frac{(Xi + Mi) - |Xi - Mi|}{(Xi + Mi)} \times 100$$

where GLi is the IIT index for industry i, and Xi and Mi are values of exports and imports in industry i. The value of GLi ranges from 0 to 100. If there is no IIT (i.e., one of Xi or Mi is zero) GLi takes a value of 0. If all trade is IIT (i.e., Xi = Mi), GLi takes a value of 100. Grubel and Lloyd (1975) proposed the following weighted index to arrive at an overall measure of IIT[6]:

$$GLi = \frac{\sum |\ (Xi + Mi) - |\ Xi - Mi\ |}{\sum (Xi + Mi)} \times 100$$

Table 1 is constructed with the primary objective of selecting the group of industries for the detailed analysis of IIT. The GLi index (in multilateral trade) is calculated for the year 1995 for 1221 industries and the weighted average (GL) for 19 commodity sections are shown, under two groups, in the table. In general, Group A is characterized by relatively low intensity of IIT, low growth of export and a falling share in the export basket. This group largely comprises of resource intensive and primary commodities with little scope for product differentiation. The relatively intense one way trade as opposed to two way trade in this group might well be explained by the conventional factor proportions theory and it may be convenient to call these goods as the 'H-O goods'[7].

Group B, on the other hand, is generally characterized by relatively high intensity of IIT, high growth of export and a rising share in the export basket. The high values of GL in this group support the hypothesis that, the intensity of IIT is generally high in manufactures as compared

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6 Grubel and Lloyd (1975, p.22), however, observed that GL is a biased downward measure of IIT if the country's total commodity trade is imbalanced or if the mean is an average of some subset of all industries for which exports are not equal to imports. They considered this an undesirable feature of a measure of average IIT and proposed to use an adjusted measure. The present study uses the unadjusted measure (GL), following the conclusion of Vona (1991, p.690) that "...correction for trade balance raises more empirical problems than it solves...the uncorrected GL measure is the best available one and on the whole, possesses desirable properties."

7 Yet, some sections in this group shows significant GL index. This, however, is caused by very few industries within the Sections, as evident from the high coefficient of variations. For example, while there are 75 industries under Vegetable Products (Section 2), the high value of GL in this Section is caused by just two industries (Coconuts, Brazil nuts and Cashew nuts [0801]; Other nuts [0802]). When these two industries are dropped the GL index fell from 25.02 to 8.72 per cent.

Table 1: Intensity of IIT across Sections in Multilateral Trade

Sections	GL 1995		Growth of Export (in US $ 1988-99	Share of Export in total in (%) 1988	1999
Group A					
1. Live Animals	1.12	(1.67)	12.09	5.21	4.27
2. Vegetable Products	25.02	(1.68)	7.25	16.67	9.71
3. Fats & Oils	14.69	(1.40)	29.62	0.28	0.50
4. Beverages&Tobacco	6.45	(1.42)	15.60	3.98	4.38
5. Mineral Products	13.88	(1.38)	1.40	9.13	3.44
8. Hides, Skins&Leather	10.96	(1.63)	6.73	5.18	3.38
9. Wood and Cork	9.28	(1.47)	12.60	0.16	0.01
11. Textiles	7.06	(1.38)	13.01	23.74	26.85
12. Footwear,Umbrellas	7.19	(2.02)	6.73	2.52	1.59
Group B					
6. Chemicals	27.82	(0.78)	17.87	3.95	9.44
7. Plastics & Rubber	32.45	(0.83)	25.73	0.85	2.08
10. Paper	21.68	(0.82)	20.94	0.21	0.33
13. Stone & Cement	21.48	(0.83)	27.29	0.29	0.94
14. Gems and Jewellery	47.98	(1.30)	10.08	16.78	15.31
15. Base Metals	32.69	(0.85)	22.96	1.96	6.31
16. Machinery	37.66	(0.66)	12.74	4.74	5.82
17. Transport Equipments	21.43	(1.35)	18.78	1.56	2.66
18. Instruments&Apparatus	21.23	(1.19)	6.97	0.55	0.45
20. Mis. Manufactures	32.29	(0.86)	19.12	0.31	0.49

Notes: (1) Figures in parentheses are coefficient of variations.

(2) Arms and Ammunition (19) and Works of Art (21) are not considered. They together account for only 0.2 per cent in the total exports.

Source: CMIE, *India Trades*.

to primary commodities. It is also important to note that, the coefficients of variations in this group are substantially less as compared to the former. Regarding export, the growths in most of the sections during 1988-99 are above the average (10.61). The higher growth are also reflected in the shares which have improved significantly in most of the commodity sections, the combined share having increased from 31.2 per cent to 43.8 per cent. The analysis, henceforth, is confined to the Sections under Group B (consisting of 743 industries) for these commodities correspond better with the emphasize of the underlying theoretical construct and for their growing importance in the export basket.

2. Changes in the Levels of IIT in Multilateral Trade

It is evident from Table 2 that, there is in general an upward trend in the levels of multilateral IIT during the study period. Regarding the overall level of IIT, the GL index increased by more than 11 percentage points in 1995 over 1988 and about 6.5 percentage point in 1999 over 1995. This trend is observed in most of the individual commodity sections with the notable exception of Gems and Jewellery and Instruments and Apparatus[8]. The growing empirical significance of India's IIT is further

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8 The trend in Transport Equipment is interesting in that the increase of the GL value in this section in 1999 was preceded by a significant decline in 1995 from the 1988 level. This is, in fact, driven by two specific industries in this section, i.e., 8714 (parts and accessories of light motor vehicles) and 8708 (parts and accessories of heavy motor vehicles). When 8714, which recorded a high GLi value (96 per cent) in 1988 was dropped, the aggregate GL in Transports Equipment was declined substantially (i.e., to 19 percent from the earlier level of 30 per cent). The GL index of 8714 declined sharply to 30 per cent in 1995 and further to 25 per cent in 1999. As a result, the aggregate GL index declined to 21 per cent in 1995. Whereas, the aggregate GL index actually increased to 38 percent in 1999 despite a sharp decline of the GL of 8714. This increase was caused by another industry (i.e., 8708) the GL index of this industry being increased to 84 per cent in 1999, from 69 per cent in 1995 and 50 per cent in 1988. Thus, when this industry was dropped, the aggregate GL declined substantially (i.e., to 21 percent from the earlier level of 38 per cent).

Table 2: Levels of Multilateral IIT (GL) Across Sections

Sections	1988	1995	1999
6. Chemicals	24.30	27.82	32.90
7. Plastics & Rubber	13.95	32.45	35.73
10. Paper	8.42	21.68	20.61
13. Stone & Cement	19.16	21.48	26.69
14. Gems and Jewellery	86.88	47.98	50.95
15. Base Metals	15.15	32.69	39.43
16. Machinery	28.80	37.66	41.40
17. Transport Equipments	30.22	21.43	37.99
18. Instruments&Apparatus	30.11	21.23	22.99
20. Mis. Manufactures	23.69	32.29	44.97
Total	23.61	35.02	41.53

Note: One industry (7102) is dropped from the calculation of the level of total IIT as it is found to be unduly influencing the values.

Source: Same as for Table 1.

Table 3: Distribution of GLi Indices across Industries in Multilateral Trade (in per cent)

Classes of GLi Indices	Per cents of the total no. of industries		
	1988	1995	1999
A: greater than 80% and less than 100%	10.8	12.3	13.9
B: greater than 60% and less than 80%	10.2	12.9	15.4
C: greater than 40% and less than 60%	11.2	16.0	17.4
D: greater than 20% and less than 40%	15.4	19.4	20.8
E: greater than 0% and less than 20%	39.7	32.3	27.8
F: equal to 0	12.7	7.1	4.9

Source: Same as for Table 1.

evident from Table 3 which provides the frequency distribution of the values of the GLi index. Over the period, a consistent decline of the per cent of industries in both of the two lowest classes of GLi (E and F) is accompanied by a corresponding increase in each of the 4 higher classes (A, B, C, and D). Therefore, the hypothesis that trade liberalization biases trade expansion towards IIT is confirmed in the Indian context.

Table 4: Relative Importance of Exports and Imports in Determining Changes in the Levels of IIT across Industries.

	1988	1995	1999
Industries with trade deficit (percent)	70.80	61.64	63.48
Industries with positive growth in total trade (percent)	-	95.63	97.82 (85.14)
Industries with trade deficit (in the base year) and greater growth of X than M (percent)	-	77.61	78.91 (59.52)
Rank correlation between growth of export and growth of Gli	-	0.502	0.526 (0.174)
Rank correlation between growth of import and growth of Gli	-	-0.132	-0.174 (0.005)
Industries with high export and high GLi (number)	52	53	60
Industries with high import and high GLi (number)	18	34	39

Notes: 1) Percentage growth are calculated for the respective years using the 1988 values as the base year. Figures in parentheses are the respective values obtained by calculating growth using 1995 values as the base year.

2) 100 largest export (import) industries are considered as high export (import) industries. GLi is considered to be high if its value is greater than or equal to 40.

Source: Same as for Table 1.

It is worthwhile to differentiate the relative importance of exports and imports across industries in propelling the levels of IIT upward. What will happen to the value of the GLi when industry i shows trade deficit (surplus) in the base year, but both export and import records positive growth in the current year? Under such circumstances, it can be easily seen that, a proportionately higher growth of export (import) compared to import (export) causes GLi to increase.

It is clear from Table 4 that, a substantial proportion of the total number of industries are characterized by trade deficit throughout the period and positive growth in both exports and imports (in current US $), the growth being proportionately larger in the former in majority of the cases. Thus, it follows that, in most of the industries, the increased levels of IIT are export-led (i.e., caused by a faster growth of exports than of imports). The relative importance of exports in determining the levels of IIT is further evident from the following observations. First, the rank correlation coefficients indicate a direct and relatively strong relationship between the growth of export and the growth of GLi, while an inverse and relatively weak relationship between the growth of import and GLi. Second, when exports and imports are ranked separately in terms of their values, the GLi's are generally found higher in those industries with high export than in those with high import.

3. Patterns of IIT in Bilateral Trade

Having analyzed the trends in the levels of IIT in multilateral trade, we now turn to the patterns of IIT in bilateral trade. Table 5 provides the values of GL index across sections of commodities and India's major trading partners. The countries given in the table account for about 90 per cent of the total value of India's trade. The strikingly high intensity of overall IIT with Belgium and Israel should not be emphasized for this having been caused by a single industry (Diamonds whether or not

Table 5: Intensity of IIT across Countries and Sections

Countries	6	7	10	13	14	15	16	17	18	20	Total
High Income											
USA	16	18	10	8	7	20	33	6	13	26	15
Japan	18	2	20	9	1	19	2	2	3	31	6
Germany	35	16	7	5	21	12	10	39	6	25	17
Belgium	24	10	6	4	79	5	10	5	6	18	68
Hong Kong	34	22	9	4	17	7	26	6	12	6	18
Singapore	22	18	13	7	3	20	48	27	30	6	29
Switzerland	48	12	3	35	2	7	10	6	2	30	9
France	42	15	12	8	3	9	8	3	26	8	15
Netherlands	25	10	17	3	3	11	18	2	22	57	17
Sweden	13	4	1	1	0	5	9	6	6	18	7
Denmark	26	33	14	3	0	5	9	6	6	18	7
UK	24	17	25	14	8	13	28	33	15	6	17
UAE	11	22	12	2	2	9	22	22	2	2	11
Italy	29	26	9	22	6	12	10	24	10	21	16
Australia	11	12	14	7	0	5	24	27	6	2	10
Canada	2	10	1	6	0	2	18	1	8	9	4
Spain	18	5	5	9	2	6	9	8	19	2	12
Israel	4	1	6	2	80	8	8	0	3	0	60
Low and Middle Income											
Korea	22	5	30	1	1	14	8	11	28	13	13
Russia	3	3	0	0	5	0	12	3	2	0	3
China	17	36	4	5	1	15	9	18	11	2	16
Saudi Arabia	3	4	0	1	3	1	3	5	0	0	3
Thailand	15	17	2	4	9	1	24	4	30	55	11
Malaysia	6	14	11	5	0	4	36	1	23	15	12
Bangladesh	0	0	1	0	0	0	0	0	0	0	0
Indonesia	18	38	1	0	0	2	5	4	0	3	11
Sri Lanka	2	3	3	0	1	1	3	0	1	1	1
Ukraine	0	0	0	0	0	0	23	0	0	0	1
Brazil	8	6	0	0	2	2	11	1	14	0	4
South Africa	5	3	0	5	27	2	6	2	0	0	3
Multilateral	***28***	***33***	***22***	***22***	***48***	***33***	***38***	***21***	***21***	***32***	***35***

Notes: (1) Descriptions of the Section Codes are given in Table 1.

(2) Countries are grouped on the basis of the World Bank classification.

Source: Same as for Table 1.

Worked, but not Mounted or Set [7102]) under Section 14 (Gems and Jewellery); when this industry is dropped the GL index fell to 13 and 5.5 per cents respectively. Leaving these two apart, countries at the higher end of the scale include Singapore, Hong Kong, Germany, Netherlands, USA, France, UK, and Italy (all high-income countries). China is the only country, which can be included in this group from the category of lower and middle-income countries. Countries at the lower end of the scale include Japan, Denmark, Sweden, Switzerland Canada (all High Income Countries), and most of the low and middle-income countries.

In general, it has been observed that countries at similar stage of development (proxied by per capita incomes) carry out more IIT with each other (Havrylyshyn and Civan, 1983). India, however, records relatively more IIT with high-income countries than with countries of similar levels of income. The observed pattern is, however, consistent with the prediction of vertical IIT models[9]. Another feature, which makes India's IIT distinct from that of industrial countries is that it is apparently characterized by a greater extent of complementarity. That is to say, within the same industry, there are imports from one group of countries and simultaneous export to another[10]. This inference is derived from the observation that in all bilateral cases (ignoring Belgium and Israel), the values of aggregate GL index is less than that for the multilateral case[11].

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9. It might be argued that, though, in terms of per capita income, India is at the lower end of the scale, in terms of the bulks and diversity of the industrial sector, she might well fall at the higher end of the scale.

10. Hu and Ma (1999) report a similar finding for China.

11 The proportion of total number of industries with GLi greater than 50 is as high as 32.3 per cent in the multilateral case. When all the bilateral cases are pooled together this proportion is as low as 11.1 per cent. This implies that the high proportion of industries with GLi greater than 50 per cent in the multilateral case is the result of importing from one group of countries and exporting to another. Further, while in the multilateral case, only 7.1 per cent of the total number of industries recorded zero IIT, the same figure in the bilateral cases is as high as 58.7 per cent, again indicating the greater extent of complementarity in India's IIT.

Interesting segmentations are brought to the light when the focus shifts from the aggregate to specific sections of commodities. First, in a number of cases, bilateral IIT are found to be of particular significance to specific sections of commodities. For example, USA, Singapore and Malaysia recorded high values of GL in section 16 (Machinery); Japan, Netherlands and Thailand in section 20 (Mis. Manufactures); Germany, UK and Taiwan in section 17 (Transport Equipments); Belgium and Israel in section 14 (Gems and Jewellery); Hong Kong, Switzerland and France in section 6 (Chemicals); and so on. Second, the observed relationship between income and IIT at the aggregate level is not uniformly spread across different sections. For example, in section 7 (Plastics and Rubber) some of the high GL values are seen in the group of low and middle income countries; Indonesia and China recorded the highest values of GL among all countries. Third, there are many exceptions to the observed complementarity at the aggregate level. Section 15 (Base Metals) is the only one, which is quite in accordance with the pattern at the aggregate level. That is, the observed level of multilateral IIT in Base Metals is largely the result of importing from one group of countries and exporting to another. In Section 17 (Transport Equipments), on the other hand, there are as many as 7 bilateral cases for which the values of GL are greater than that at the multilateral level. That is, a significant amount of observed IIT in Transport Equipments is the result of importing from and exporting to the same countries. A similar conclusion can be drawn in some other cases (notably Chemicals, and Gems and Jewellery). In sum, the aggregate GL index masks important heterogeneity at the levels of the sections of commodities, industries and countries.

IV. The Model

What follows is a discussion of the various hypotheses relating country specific factors and IIT in bilateral trade, the econometric method

and the results of the regression analysis. Our approach is eclectic, in the sense that, rather than testing a specific theoretical model we pick hypotheses from various models. The data sources on country specific factors are explained in the Appendix.

1. Hypotheses and Variables

(a) *Per capita Income Difference*: The intensity and the probability of IIT are positively correlated with the differences in per capita income between the trading partners (Falvey (1981), Falvey and Kierzkowski (1987)).

(b) *Technology Gap:* The intensity and the probability of IIT are positively correlated with the differences in the level of technology between the trading partners (Falm and Helpman (1987) and Shaked and Sutton (1984)[12] .

(c) *Human Capital Endowment Difference:* The intensity and the probability of IIT are positively correlated with the differences in human capital endowment between the trading partners (Falm and Helpman (1987)).

Per capita income difference is defined as the absolute difference of per capita GNP (current US dollar) between India and her trading partner (PCIDIF). Technology gap is measured by the absolute difference of total R&D expenditure as a percentage of GNP between India and her trading partner (TG). Human capital endowment difference is defined as the absolute difference in the enrolment ratio of degree students in the particular age group (HCEDIF).

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12 That technological differences among countries cause IIT was also being observed by Grubel and Lloyd (1975).

It may be noted that, the above variables reflect the typical factor endowment attributes of countries. It appears to be incorrect to expect a continuous positive relationship between the intensity of IIT and the differences across trading partners in terms of these attributes. This is because, too much differences in factor endowments between countries might lead to relatively intense inter-industry trade which in turn might suppress IIT. To detect a possible non -linearity in the relationship, quadratic terms of PCIDIF, TG, and HCEDIF will be included in the regression analysis.

(d) Income Distribution Similarity: The intensity and the probability of IIT are negatively correlated with the similarity of income distribution between the trading partners (Falvey and Kierzkowski 1987), Falm and Helpman (1987) and Shaked and Sutton (1984).

Following Tharakan and Kerstens (1995), income distribution similarity is measured by a dummy variable (IDS); the value of 1 is given to the cases where the ratio between the average Gini coefficient of a partner country and India falls into the range of 1.1 & 0.9 and the value of 0 is given to the remaining cases.

(e) *Market Size:* The intensity and the probability of IIT are positively correlated with the market size of partner countries (Falvey and Kierzkowski (1987).

(f) *Market Size Difference*: Difference in market size between two countries indicates differences in their ability to manufacture differentiated products (Dixit and Norman 1980, Helpman 1981). The potential for overlapping demand for differentiated products is enhanced, as countries become more similar in terms of their market size. Therefore, the intensity and the probability of IIT are negatively correlated with the differences in market size between the trading partners.

Market size is measured by the total GNP (current US dollar) of the trade partner (SIZE). Market size difference represents the absolute difference of total GNP between India and her trading partner (SIZEDIF).

(g) *Level of Trade Restriction*: The intensity and the probability of IIT are negatively correlated with the levels of trade restriction of partner countries (Falvey (1981).

Countries generally adopt a host of non-tariff and tariff measures to restrict trade. As comparable data on these measures are hard to come by for many countries, the level of trade restriction is proxied by the percentage of total trade in GDP (LTR).

(h) *Inward Foreign Direct Investment:* The intensity and the probability of IIT are positively correlated with the foreign direct investment to India from the partner countries, indicating the possibilities of IIT based on foreign processing and intra-firm trade (Grubel and Lloyd, (1975), Mainardi (1986), Greenaway and Milner (1986), Helpman and Krugman (1985)).

A dummy variable (FDI) is used to measure the inward foreign direct investment, which takes values 4,3,2,1, and 0 in accordance with the actual stock of foreign direct investment from different country groups to India during the period 1991-94[13].

Having discussed the specific hypotheses to be tested and definitions of the explanatory variables, we now turn to the question of

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13 Data on the inflow of foreign direct investment is not available for few countries in our sample. This is because, either the value is 0 or it is insignificant. As there is no way to differentiate between 0 and insignificant values, countries are ranked rather than using the actual FDI values. The whole countries (for which data are available) are grouped into 4 groups on the basis of percentile values and the remaining countries are taken under a single group.

the dependent variable to be used in the regression analysis. That the aggregate GL index often masks important hetrogenities at particular sections of commodities and industries is evident from the discussion in Section 2. Under such circumstances, it is inappropriate to choose the aggregate GL index as the dependent variable while trying to establish an empirical relationship between IIT and the explanatory variables emerging from theory. Instead, it is more appropriate to relate country specific factors to the GLi's in specific industries. For example, in the present case, choosing the aggregate GL index as the dependent variable amounts to accord undue weight to Belgium and Israel; this problem does not arise, if GLi's are taken as the dependent variable.

An additional difficulty in using the GL index as the dependent variable stems from the fact that, countries differ not only in the intensity of IIT in specific industries but also in the total number of industries in which IIT occur. In general, larger countries tend to do IIT in a greater number of industries while smaller countries do it in few industries. The aggregate GL index is insufficient to capture such discrepancies, and thus is inappropriate in cross-country regressions (Nilsson, 1999). By using GLi's, rather than GL, both the intensity and extend of IIT are better captured. All GLi's in bilateral trade are, thus, pooled together to test the influence of country specific factors on IIT.

2. Specification of the Model

The postulated theoretical relationships between country specific factors and the level of IIT are empirically verified in the framework of a tobit and a probit model. While the tobit model is used to analyze the influence of country specific factors on the intensity of IIT in bilateral trade, the probit model is used to analyze the influence of the same set of factors on the probability of observing IIT, if any, in bilateral trade.

The necessity of using the tobit model rather than an OLS model arises due to the limited nature of our dependent variable (GLi). In as much as 58.7 per cent of the cases the GLi index recorded 0 values[14], which leads to a non zero mean of the disturbance and to biasedness and inconsistency of the least square estimators. These estimation problems are solved by using a tobit model. The following specification is formulated to test the determinants of the intensity and the probability of occurring IIT in bilateral trade.

$$GLi = f(PCIDIF^{+}, PCIDIF^{2-}, TG^{+}, TG^{2-}, HCEDIF^{+}, HCEDIF^{2-}, ID^{-}, SIZE^{+}, SIZEDIF^{-}, LTR^{+}, FDI^{+}),$$

where GLi takes its actual value in the tobit model while it is a dichotomous variable taking values 1 or 0 in the probit model. The superscripts represent the expected signs of the coefficients.

3. Regression Results

The models as outlined above are estimated using a data set comprising of 743 industries and 28 countries for the year 1995 which produced 13561 observations[15]. The results of the tobit model explaining the intensity of IIT and the probit model explaining the probability of observing IIT are presented in Table 6 and Table 7 respectively.

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14 This means that, either exports or imports are zero in majority of the cases. Since unit values of both exports and imports are not available, these cases can not be considered when trying to differentiate vertical from horizontal IIT. Further, even in a sizeable proportion of the cases where the values of the dependent variable are above zero, unit values are not available and not easy to calculate. Dropping of these cases from the regression analysis might give rise to serious selection bias problem. Thus, the usual procedure of disentangling vertical and horizontal IIT is inappropriate in the present study.

15 All countries except UAE and Saudi Arabia listed in Table 2 are included in the regression analysis. The two countries are dropped for non-availability of data on income distribution. The resulting data set can produce 20804 (743 * 28) potential observations. The actual falls short of the potential because bilateral trades with many countries are being recorded in less than 743 industries.

Overall, the set of coefficients in both the models showed high statistical significance in terms of chi-square distribution. Individually, all the coefficients have the expected signs with statistical significance in both the models, with the exception of HCEDIF in the probit model (which has the expected sign but not statistically significant). The coefficient of the inverse Mills ratio (sigma), is highly significant, supporting our position that, dropping of those observations with zero GLi's in the regression analysis would create serious selection bias problem. The remarks in relation to specific variables may be summarized as follows.

Table 6: Tobit Regression Results for 1995

Variable	Coefficient	T-statistics	P - Value
PCIDIF	7.95e-06	2.986	0.003
$PCIDIF^2$	-2.41e-10	-4.149	0.000
TG	0.193914	6.340	0.000
TG^2	0.072839	-6.233	0.000
HCEDIF	0.002271	2.138	0.033
$HCEDIF^2$	-0.000037	-3.917	0.000
ID	-0.022587	-1.956	0.050
SIZE	5.71e-13	13.648	0.000
SIZEDIF	-5.28e-13	-12.871	0.000
LTR	0.001375	12.070	0.000
FDI	0.024356	2.799	0.005
Sigma	0.453995	96.177	0.000
Constant	-0.556206	-24.765	0.000
Log Likelihood	-7821.00		
Chi-Square	1247.90		
No.of Observations	13561.00		

Table 7: Probit Regression Results for 1995

Variable	Coefficient	Z-Statistics	P - Value
PCIDIF	0.000027	4.241	0.000
$PCIDIF^2$	-7.60e-10	-5.414	0.000
TG	0.527740	7.142	0.000
TG^2	-0.1972x27	-7.064	0.000
HCEDIF	0.002335	0.920	0.358
$HCEDIF^2$	-0.000071	-3.181	0.001
ID	-0.059167	-1.944	0.052
SIZE	1.42e-12	14.439	0.000
SIZEDIF	-1.28e-12	-13.252	0.000
LTR	0.003326	11.997	0.000
FDI	0.065783	3.121	0.002
Constant	-1.337157	-26.017	0.000
Log Likelihood	-8334.36		
Chi-Square	1770.69		
No.of Observations	13561.00		

The positive sign of the coefficient of PCIDIF indicates that the intensity and the probability of IIT increase when countries are more dissimilar in income. This is in contrast with the findings of other studies undertaken in the context of trade among developed countries as well as between developed and developing countries[16] . Nevertheless, the present finding is consistent with the prediction of vertical IIT models. Further, in agreement with our conjuncture, the relationship is non-linear in that the positive relationship holds good only up to a threshold level.

16 For example, Loertscher and Wolter, (1980); Balassa and Bauwens (1987); Nilsson (1999)

Differences in the level of technology across countries cause the intensity and the probability of IIT to increase, as evident from the positive sign of the coefficient of TG in both the models. While the coefficient of HCEDIF is positive in both the models, its statistical significance is established only in the tobit model. Thus, differences in the human capital endowment is important in determining the intensity of IIT while it does not appear to be so in determining the probability of IIT. As in the case of PCIDIF, the quadratic terms of TG and HCEDIF also appear to be negatively significant. This finding confirms our supposition that too much difference between countries in endowment attributes might lead to relatively more inter industry trade, which in turn suppress IIT.

The intensity and the probability of IIT appears to be more when countries become similar in market size, while it is found to be less when they become similar in terms of income distribution. This is evident from the negative signs of the coefficients of SIZEDIF and ID. Larger market size and fewer trade restrictions of the partner countries are found to be conducive for enhancing the intensity and probability of occurring IIT. This is evident from the positive signs of the coefficients of SIZE and LTR. As expected, foreign direct investments to India from the partner countries prompt IIT. Thus, probably the observed increase of India's IIT is due in part to the intra-firm trade between the multinational parents located in developed nations and their subsidiaries operating in India.

V. Conclusion

The IIT, a phenomenon being observed largely in the context of advanced industrialized countries, is also found to be significant in India's international trade. The analysis of India's multilateral trade showed that, in agreement with the evidence from other countries, the liberalized policy environment biases trade expansion towards IIT. The growth of IIT in response to economic liberalization is often seen as a manifestation of

the process of resource reallocation taking place within the industry as opposed to between the industries. This, in turn, implies a relatively less adjustment costs, because factors of production are not reallocated to profoundly different locations and lines of work. We also found that, the increased levels of IIT are largely export-led, that is, caused by a faster growth of exports than of imports.

The analysis of the country pattern of IIT showed that some particular features distinguish India's IIT from that of industrial countries. First, it is observed that, there is apparently a greater extent of complementarity in India's overall IIT. This is to say, within the same industry, there are imports from one group of countries and simultaneous export to another. Second, unlike industrialized countries, India is found to be doing relatively less IIT with countries at similar stage of development. India's IIT is more intense with high-income countries than with low and middle income countries. This pattern, however, is consistent with the predictions of vertical IIT models.

The country specific factors found to be influencing the intensity and the probability of IIT in bilateral trade are being analyzed in the framework of a tobit and a probit model respectively. The same sets of explanatory variables are used in both the models and they are found to be influencing the intensity and the probability of IIT in similar directions. Per capita income difference, technology gap and human capital endowment difference are found to have a nonlinear influence on IIT, that is, the relationship is positive up to a threshold level and then it turns out to be negative. While support for the positive relationship is found in the models of vertical IIT, the negative relationship is expected because too much differences of countries in terms of endowment attributes might give rise to relatively more inter-industry trade which suppress IIT. The intensity and the probability of IIT is found to be

increasing as countries become more dissimilar in income distribution and more similar in market size. Similarly, bilateral IIT will be stimulated when the trading partner becomes larger in market size, becomes more open to international trade, and increases the overseas investment in India. In sum, certain country specific factors which are found to be crucial in theory are pertinent in determining the country pattern of India's IIT. Theory also suggests the importance of certain industry specific factors in explaining the levels of IIT. An analysis of this question is a priority area for further research on India's IIT.

Appendix

Data Sources

The model includes 28 leading trade partners of India. Data on gross national product, per capita income and percentage of total trade in gross domestic product are from the World Bank (1997), World Development Report. Data on R&D expenditure as a percentage of GNP and the enrollment ratio of students with a degree in the particular age group are from UNESCO (1998), Statistical Yearbook and data on foreign direct investment are from the CMIE (1999), Monthly Review of Investment Projects (September). The average Gini indices are taken from Deininger and Squire (1996).

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