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Abstract

This paper examines inter-country variations and growing volume of Intra-industry trade for thirty rapidly industrializing Asian and Latin American countries in the 1990s. With rapid industrialisation, intra-industry trade in manufactured products have increased substantially. We find that intra-industry trade: (i) increases with per capita GNP; (ii) has a positive association with total trade to GDP ratio; (iii) grows with the share of manufacturing value-added in GDP and exports. Despite having positive impacts, the effect of regional integration schemes like ASEAN and LAIA is ambiguous depending on the relative strength of trade creation and trade diversion inside and outside the group.

JEL Classification: O1, F02, F15

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1. Introduction: A Conceptual Framework for Analyzing Intra Industry Trade

Participation in international trade provides a variety of benefits to developing countries through resource allocations according to comparative advantage, exploitation of economies of scale, increased capacity utilization and technology upgradation–to name a few. International specialization, according to comparative advantage, facilitates important gains to developing countries. Earlier empirical findings on trade pattern have confirmed the evidence that manufactures exports were the developing countries most dynamic export sector in the 1960s, 1970s and 1980s. The direction of these exports also changed dramatically in recent years. In the 1960s and early 1970s, it was the industrialized countries that became the main recipients of an increased share of developing countries manufactures exports (see Havrylyshyn and Wolf, 1983). Now, the emergence of the Asian and Latin American countries as highly dynamic economies exporting manufactured goods on a global scale is a phenomenon that provokes a re-examination of ideas about international aspects of economic development. Typically, the countries that show high rates of growth of manufactured exports are those having a high share of manufacturing in total output. The major studies of recent upsurge in industrialization, growth and trade have varying criteria for establishing categories of countries at similar, or dissimilar stages of development. Despite the differences in the definitions and categorizations, it is clear that the developing economies are of great interest in the study of dynamic trade and development performance.

The close interlinkage between growth of production, structural change and trade is evident in the dynamic performance of the transitional economies of Pacific Asia and the other economies in Latin America and Mediterranean Europe. It has been observed that the product composition of exports from these economies changes over time due to rapid structural change and this generates a change in trade pattern. The countries in the semi-industrialized group and `new exporting countries' category have different industrial structures. For most of these countries, the imports have shown a significant increase in the shares of mineral resource based goods and technology intensive goods. These shifts in the commodity composition of exports and imports of these countries raise some issues regarding their specializations and pattern of production. Explorations of the product pattern and factor content of intra-industry trade in manufactures is beyond the scope of this study; however, the high rates of growth and structural change in manufacturing are associated with the developing countries achievement of rapid industrialization.

The empirical issue here is whether intra-industry trade (henceforth, IIT) in manufactures has become increasingly important in the developing economies' trade with developed countries and/or other developing country group. In this study, these questions are addressed by developing a conceptual framework to explain changing comparative advantage in manufacturing, intra-industry specialization in production and trade in manufacturing. This has been done in the context of a sample of 30 developing countries.

The countries have been selected for two main reasons. First, they have achieved a relatively high rate of economic growth during the past 20 years and secondly; they have become exporters of manufactures gradually. These countries were predominantly traditional primary commodity exporters and importers of sophisticated manufactured goods. Now, as they have become exporters of the manufactures, there is scope for generation of IIT. At the initial stages of economic development, developing countries, being capital scarce and labor-abundant, export natural resource based products in exchange for manufactures. Over time, with accumulation of capital and rise in income, labour is attracted to the manufacturing sector that expands relative to the natural resource based sector. With the rise in per worker endowment of various forms of capital, there is a gradual shift in comparative advantage within the manufacturing sector towards production activities intensive in various forms of capital. The low wage cost developing countries specializes in the production of standardized, mature product cycle goods, and re-export them to the developed countries (henceforth, DCs). Imports of these developing economies shift toward technology intensive goods. As the process of economic growth and development proceeds, the composition of production and exports of these less-developed economies (LDCs) shifts towards more diversified and technically sophisticated goods. Exports of labour intensive consumer goods begin to decline. Consumer goods industries such as synthetic textiles and motor vehicles, and producer goods industries, producing either intermediate goods such as chemicals, steel and refined petroleum, or capital goods such as machinery and transport equipment--all these industries almost always involve large economies of scale, based either on the scale of the plant, or on the size of the production run. Different factors such as the minimum efficient size of plant, increasing returns to scale, and indivisibilities in the production process play an important role in manufacturing production in these countries.

On the demand side, the incentive comes from growth in income levels. Rising per capita income led by economic growth and development in these countries shifts the demand structure following "Engel's Law". Within the manufacturing sector, final demand shifts from consumption goods to durable goods, leading to a rise in demand for intermediate and producer goods. Moreover, as the countries move up the income ladder, demand for differentiated products or product variety within each product group rises. The demand for `variety' or `attributes' in a vertical or horizontal productive spectrum increases with the level of income per capita (i.e., level of development). With higher income level, consumers can afford goods more nearly representative of their preferred consumption bundle having the desired characteristics.

As economic growth occurs, the differences in per capita incomes between the developing economies and industrial countries tend to decline. This reduction has implications for consumers with regard to their preferences between broad categories of goods and particular "attributes" of goods. It is assumed that goods embody varying characteristics - high income and low-income characteristics [a la Lancaster (1971)]. Consumers can have preferences towards "high income" characteristics. This has been emphasized by Stewart (1984). However, this shift in consumers' preference structure in the developing world towards those of DCs leads to a gradual overlapping of preferences of consumers in these countries and DCs. This, in turn, has implications for trade in differentiated products or IIT. Some of the LDCs may produce differentiated manufactured products under increasing returns and product diversification might occur in these industries as a result of small changes in the basic production process and/or conditions surrounding the sale of the product. This type of "promotional" differentiation leads to a situation where different plants in given industries in these countries and the DCs produce varieties of products which are close substitutes for each other either in terms of factor input requirement or in terms of end-use. Due to scale economies internal to the firms, the countries will benefit from declining average cost of output and hence there will be specialization as all of the firms will not be able to produce all varieties of a given product in each country. Each country will produce a limited subset of products in each differentiated product industry. Only if effective demand for these varieties of products within an industry exists in the LDCs as well as DCs, simultaneous exports and imports of products that are imperfect substitutes could develop and give rise to IIT. Having set the premise of my study, in the following section trends in trade in manufactures of the developing countries is presented. Section 3 surveys the literature and documents the methodology and scope of the present analysis. Section 4 summarizes the major findings whereas section 5 concludes.

2. Trends in Manufactures Trade of Selective Developing Countries

The salient features of trade in manufactures can be summarized as below. Manufactured exports from developing countries to the world increased in real terms in the 1970s, and expanded somewhat more slowly in the first half of the 1980s. While demand for manufactured products from developing economies remained, on average, strong in the United States, the growth of imports into the EEC and Japan slowed down in 1980-85. In 1986-88, both the EEC and Japan recorded a dramatic acceleration in their manufactured imports from developing countries, but the U.S. remained by far the largest importer in value terms. Overall, in the period 1980-1987, manufactured exports from LDCs expanded at a rate roughly similar to that recorded in the 1970s and substantially faster than world trade in manufactures. Some fast growing developing countries have made progress in upgrading the product composition of their manufactured exports, but a large number of them have made little headway over the past two decades (UNCTAD, Handbook of International Trade and Development Statistics, Various Issues).

Among the developing regions, South and South East Asian countries continue to be the major dynamic exporters of manufactures to the DCs. The strong orientation of exports of manufactures from the developing countries in South and South East Asia and Latin America is for the market of the U.S. The European Economic Community (EEC) has relied less than the U.S. and Japan on imports of manufactures from developing countries relative to other foreign sources of supply (excluding intra-EEC trade). Only South and South East Asia have, among the developing regions, gained significant importance as a source of imports of manufactured products for the U.S., the EEC and Japan. Developing countries have been important outlets for manufactured products from the DCs.

[Insert Table 1 here]

From Table 1, it is evident that export expansion of developing countries took place despite near stagnation in world exports of manufactures during 1980-1985. While the volume of the LDCs manufactured exports increased on average by about 13% per year in the 1970s, average annual growth rate of slightly less than 10% was recorded in the first half of the 1980s. Growth has been encouraging in volume terms, with rates of growth of nearly 15% in 1986 and 4% in 1987. Import demand in the developed market economy countries was a strong force in the expansion of manufactured exports from the LDCs.

The developing countries as a group have made further progress towards greater participation in their industrial supply capability in the international market. While their share in world exports of manufactures had amounted to 5.5% in 1970, the figure rose to 14.5% of world manufactured exports in 1987. This shift has continued in the production pattern of merchandise exports from LDCs. Manufactures had represented a proportion of about 29% in LDCs total exports, excluding mineral fuels, in 1970. Their share expanded to 47% in 1980 and reached almost 69% in 1987, reflecting more rapid specialization in manufactured products in the 1980s. Since in our study we are not focusing on product pattern and industry characteristics of trade in manufactures, we are not discussing the changes in the product composition of imports of manufactures into the DCs from LDCs. The manufactured imports by the DCs from South and South-East Asian region has grown from $77 billion in 1985 to $130 billion in 1987 (see Table 2).

[Insert Table 2 here]

Four main countries are Korea (republic), Taiwan, Singapore and Hong Kong. For the ASEAN developing countries: Thailand, Malaysia, Indonesia and the Philippines, the growing export supply capability of the manufacturing sectors is evident from a rise to 8% of the value of manufactured imports by DCs from all LDCs in 1987. For the Latin American countries, the manufactured export from them was lower (16%) in 1987 as compared to 1970 (18%). However, in value terms the imports of manufactures by the DCs from Latin America increased significantly to $9.3 billion up by $6 billion from previous year (see Table 3).

[Insert Table 3 here]

The U.S. has represented the most important export market over the past two decades. One third of the exports of manufactures from the LDCs to the world went to customers in this market in 1987. More recently, the trend is changing, as both the EEC and Japan gained somewhat in importance (relative to the U.S.) as export markets for the developing countries. Historically, there has been a strong orientation of exporting LDCs in South and South East Asia and Latin America towards the market of the U.S. It is clear that this trend is now continuing. Exporters in Latin America have become highly dependent on the U.S. as a market outlet, as half of their manufactured exports went to this market in 1987 compared to about 1/5th in 1980 (UNCTAD, Handbook of International Trade and Development Statistics, Various Issues).

So far as market outlets of LDCs are concerned, the DCs exported in 1987 manufactured products worth $248 billion to LDCs. In 1987, both the U.S. and Japan found customers in LDCs for 31% of their total manufactured exports. In the same year a share of nearly 7% of exports of manufactures from the EEC to world (excluding intra-EEC trade) went to developing economies. The fraction of world trade in manufactures accounted for by the intra-trade of LDCs is negligible: about 3.5% world exports of manufactures in 1987. Dynamic expansion in the 1970s was followed by near stagnation in the first half of the 1980s. While South-South trade in manufactures has recently gained new momentum, with rapid expansion of nearly 28% recorded in 1987, its share in total manufactured exports from the LDCs was smaller in 1987 than it had been more than one and a half decades earlier: South and South-East Asia has been by far the largest exporter of manufactures in South-South trade.

From the above discussion and Table 3, it is evident that the manufactured exports of the DCs increased five fold while developing country manufactured exports rose from only one fifteenth of their total exports in the base year to four tenth of their total exports i.e., almost 20 fold between 1963 and 1984. It shows the extent of transformation in the export structure of the LDCs and the availability of markets in the DCs for their manufactured exports (see Balassa (1991))[2]

The experiences of the developing economies discussed so far indicate the possible favorable effects of exports on economic growth. Trade orientation has also an impact on it. LDCs exporters increasingly shifted to the exportation of products under free trade. Also, a growing part of this trade between DCs and LDCs involves intra-industry trade rather than inter-industry specialization so that changes occur in the product composition of the firm rather than in the industrial structure of the economy. There are further possibilities for increased trade among the developing countries. Such trade may occur for countries at similar levels of industrial development as well as among countries at different levels of industrialization. In the former case, accrual of gains would result through IIT and exploitation of scale economies and from specialization according to comparative advantage. Developing countries increase their imports, *pari passu*, with their exports. In the next section we take up the existing empirical analyses of intra-industry trade to be followed by our analysis in the subsequent sections.

3 Empirical Analysis of Intra Industry Trade:

3.1 Survey of the Previous Studies and Lacunae in the literature

Intra-industry trade remained for a long time an empirical phenomenon in search of a theory. Various hypotheses have been put forward for explaining this phenomenon. However, from survey of the *theoretical* literature on IIT, it is evident that the existence of similar income levels and product differentiation need not by themselves lead to IIT unless the interaction of such product differentiation with scale economies are introduced into the argument. This analysis suggests that variables such as similarity of factor endowment patterns between trading countries, the prevalence of product differentiation, and economies of scale are important determinants of IIT. Moreover, such trade could also arise for other factors like transport costs, protectionist policies, trade-orientation, geographical propinquity between countries in a bilateral trade flow, cross hauling of investments by multinational companies, entrepot arrangements, etc. Inclusion of a variable in an empirical analysis of IIT depends on the nature and objective of the

[2] Balassa, B. (1991, March), Trends in Developing Country Exports, 1963-1988, Policy Research and External Affairs Working Papers, WPSD 634, World Bank. According to him, newly exporting countries (NECs) are those whose share of manufacturing value added in GDP was at least 15% as apposed to 20% for NICs and manufactured export reached 0.03% of world manufactured exports and 0.2% of manufactured exports by the developing countries in 1984.

study. In this section we present an overview of the empirical studies and econometric analysis of IIT that has been done so far, in brief. The basic nature of the econometric analysis of IIT is of two strands: some of the studies have sought to explain the 'commodity composition' of such trade and the product pattern over time, while some others have focused on the 'inter-country variations' of such trade flows. Some other exercises have sought to explain the phenomena by incorporating both these factors in a single model or equation system. Most of the investigation is limited to trade in manufactured goods where product differentiation predominates - in contrast to trade in primary commodities which consists largely of standardized products. Econometric work, in this area, is of recent vintage. The determinants of intra-industry specialization are analyzed either in the bilateral trade flows of every country with every other country in each industry or in aggregate, or in the multilateral trade flows for each country with a group of country specified by level of development or geographical location.

Two types of explanatory variables are used viz:

(i). *Country characteristics* pertain to pairs of countries or a country. These are common pertaining to all countries in a sample (e.g. average per capita income, average country size proxied either by GDP or GNP) size differences, distances, common borders, average trade orientation and specified applying to only some of them (e.g., participation in integration schemes and common language stage of development, etc.).

(ii). *Industry characteristics* pertaining to individual industries, e.g., product differentiation, marketing costs, scale economies, foreign investment, industrial concentration, offshore assembly, tariff dispersion, foreign affiliates—to name a few.

All of these studies apply to different countries, years, and levels of aggregation, sample size and types of trade flows. They also use different dependent variables, different specifications, different proxies for explanatory variables, and different estimation procedures. Given the difficulties of cross sectional studies in this area, one is more concerned with signs on relationships and their statistical significance than with the overall fit of the models. In most cases, the analysis covers manufacturing industries (i.e., SITC 5-8 or its equivalent using domestic industrial classifications or international standard industrial classifications (ISIC). Bergstrand (1983) considers, only on SITC 7 (machinery and transport equivalent). The number of industries concerned by each study, and the number of observations used in each regression, varies considerably according to the level of aggregation used and to the type of trade flows for which IIT is measured. Bergstrand (1983) considered only 3 industries (i.e. 3 second digit groups from SITC 7) but 73 observations. It is a multi-country study, but it measures bilateral IIT flows (91 bilateral IIT coefficients among 14 countries). As opposed to this, Toh (1982) covers 11 industries (of the 4 digit level) measuring IIT multilaterally to produce an equal number of observations. Most of these studies are multi country in framework concentrating only on inter-industry variations in IIT in DCs, OECD or industrialized countries. We now give brief idea of the individual empirical studies.

Pagoulatos and Sorensen (1979) did their analysis using U.S. trade data (at 3-digit SITC) in 102 industries in a multilateral framework for 1965 and 1967. Among the eight exogenous variables used in their specification, four pertained to trade barriers; the U.S.-EEC tariff differential, and the non-tariff barrier differential, average height of tariff barriers, the height of non-tariff barriers. In order to test whether the similarity in per capita income exerts a positive influence on IIT, a variable defined as the percentage of the total OECD-U.S. trade in manufactures in overall U.S. trade in manufactures was used. These variables yielded positive signs and were significant at 1% level. The variable used for taking into account the level of aggregation yielded a positive coefficient implying that some of the observed parts of IIT are an outcome of statistical aggregation.

Loertscher and Wolter (1980) gave an explanation of differences in IIT intensity among countries and across industries simultaneously using a sample of bilateral trade flows among OECD countries. They made a distinction between "country" and "industry" hypothesis. A Grubel Lloyd type measure of IIT and an equivalent of the Aquino correction were tried as alternative dependent variables. Pooling of the country and industry observations have been used and their results indicated that IIT intensity across countries is significantly and negatively correlated with differences in stages of development, differences in market size and the distance between trading partners and it is significantly and positively correlated for the average markets size and the formation of integration schemes like customs union. The product differentiation variables gave neither a consistent nor significant result.

Greenaway and Milner (1984) have explained inter industry variations in IIT in a cross section analysis for the U.K. for 1977. They have calculated both Grubel-Lloyd index and an adjusted index of IIT and tested two samples of 37 and 68 observations using a variety of proxies for features of market concentration, product differentiation and scale economies. Their model confirmed that both supply and demand based features of market structure are relevant in explaining patterns of IIT in the U.K. On the supply side, the `fewness' of firms in the market proxied by five firm net output concentration ratio appears to be negatively related to IIT. On the demand side, product heterogeneity, advertising expenditures as a proportion of sales revenues has an important role on the levels of IIT. The results give strong grounds for supposing that inter-industry variations in IIT are deterministically related to various factors of market structure rather than simply being a result of random measurement problem.

Lundberg (1982) has tested the hypothesis derived from the emerging theoretical models on IIT on data for Swedish trade from 1970 to 1977 in a cross section analysis in different product groups of manufactured products (ISIC 3). The study with different groups of countries has confirmed the hypothesis that the smaller the difference in factor endowments and/or income per capita between Sweden and the trading partner and the smaller the geographical and/or economic and cultural distance to the trading partner, the higher is the share of IIT. He considered Asian NICs, EEC, planned economies, South Europe, other industrial countries and Western Europe, other LDCs including South Asia, South East Asia excluding Singapore, Pacific Islands, etc.

Greenaway (1983) had only measured the extent of intra-industry exchange in Switzerland over 1965-1977 on the basis of Grubel-Lloyd (uncorrected) and `categorical aggregation adjusted' measures of IIT. He concluded that recorded IIT could not solely be explained by categorical aggregation; rather non-factor proportion influences do contribute to determine the product composition of trade flows.

Bergstrand (1983) provides us with an integrated framework for theoretical and econometric determinants of IIT. In his theoretical model, he has shown that in market equilibrium the degree of increasing returns in an industry is an increasing positive function of the degree of product differentiation in that industry. Degree of increasing returns is given by the industries' elasticity of scale and the degree of product differentiation is given by a function of the elasticity of substitution. The independent variables used in his study are variables measuring effects on IIT of tariff and non-tariff barriers, transport costs, the extent of relative factor intensity differences within industries, taste diversity across countries, measure of the degree of increasing returns in the trade between the countries and hence the degree of product differentiation in that trade.

Balassa (1986) has examined the determinants of IIT in bilateral trade among 38 countries including a number of developing countries. The explanatory variables were: inequality of income levels between countries, country size, distance, trade orientation of the countries, plus a number of "Dummy" variables to represent participation in integration arrangements, common language groups and the existence of former colonial ties. The results indicated that the common country characteristics could be determining factors for the extent of IIT.

Havrylyshyn and Civan (1985) considered analysis of IIT among developing countries. In their 1983 study, using a cross section of 6 countries including a large number of developing countries, they demonstrated that the higher the per capita income and the greater the diversity of its manufactured goods, the greater the extent of IIT. They have used a number of proxies for the explanatory variables.

Membership of a successful integration system such as the European Community, LAFTA, ASEAN, also appeared to raise the levels of IIT. Given the multiplicity of determinants, some essential questions regarding its implications for optimal allocation of resources between industries and countries, differences from variables explaining inter-industry trade in their explanatory powers, fundamental causes of such trade are of considerable interest which have been ignored here.

Balassa and Bauwens (1987) have tested various hypothesis about such determinants of intra-industry specialization in manufactured goods, including both country as well as industry characteristics covering 38 countries (18 DCs and 20 LDCs). Calculations have been done for bilateral trade flows among these 38 countries in a multi country and multi industry framework. The hypothesis put forward in the theoretical literature with reference to country features have been supported by the empirical results. Participation in integration arrangements like the European Common Market, the European Free Trade Association, and the Latin American free trade Association are positively correlated.

Y.S. Lee (1988) has also integrated country and industry characteristics to analyze the determinants of IIT for trade among the Pacific Basin Countries. Following Loertscher and Wolter (1980) and Bergstrand (1983), Lee argues that the degree of IIT of a certain product between two countries is determined by the joint interactive effect of industry characteristics of the product and country characteristics of the countries involved and the dependent variable in his study is the bilateral IIT index of a certain industry. The regression analyses confirms the hypothesis concerning country characteristics and the results show the more similar the per capita income and the factor endowment ratios of two countries, the lower the trade barriers, the greater the participation of multi-national corporations in production, the higher the degree of IIT increased.

Manrique (1987) has studied IIT between the US and 7 NICs with respect to industry characteristics like product heterogeneity, Hufbauer's proxy for product differentiation, entry barriers of an industry, trade barriers, scale economies, research and development intensity of an industry, etc., using Grubel-Lloyd's index for IIT. The finding is that U.S. trade with the selected set of 7 newly industrialized countries (NICs) is intra-industry in character corroborating the notion that IIT is now a more extensive phenomenon involving trade between countries at widely divergent levels of development.

Apart from these studies, there are other studies different in their approaches to the problem. For example, Lundberg (1988) developed a two-country, two-factor, multi-sector model of trade with Armington (1969) assumption that `products are differentiated by places of production'. The general conclusion is that there will be inter as well as intra-industry trade in most product groups, the relative degree depending on the relative factor input requirements. For goods having very low or high capital intensity, the cost differences will promote much inter-industry specialization and for sectors with intermediate capital intensity, there will be predominantly IIT.

The above account of the empirical analyses of IIT indicates that the empirical testing and verification of hypothesis of IIT involves several issues that cannot be treated in isolation from one another. The phenomenon of IIT gaining importance over the world and the integration of developing countries with this world have led many to analyze their prospects of trade flows of this type. Most of the studies have concentrated on advanced countries and incorporated various industry and country hypotheses. In the next sections, I concentrate on analyzing IIT of developing countries only with different country groups for 1990. I have done the present study for 30 developing countries at different stages of development. There is no reason, *per se*, for choosing 1990 apart from the fact that it marks the end of a decade after several turbulent years of changes in the sphere of international economic scenarios. Ours is a study different from the earlier ones in the sense that the coverage is different and, moreover, it concentrates on trade of individual countries with different country groups viz., the developed country group, developing economies and the world as a whole. This would help identifying the possible determinants of IIT with different country groups and their relative strength or explanatory power in explaining trade with countries at different levels of development. In present study, as opposed to most of the studies, inter country variations of IIT for a sample of 30 countries for the year 1990 have been analyzed with country features as the explanatory variables. In this regard, ours cross sectional analysis is similar, to some extent, to the analysis done by Havrylyshyn and Civan (1983), Balassa (1986) and Lundberg (1982). But so far as the coverage of country and methodology is concerned ours is also different from them. Havrylyshyn and Civan considered 44 developing economies (including 13 NICs) and 18 industrial countries and Balassa considered 38 countries (also including developed countries along with developing countries) unlike ours where we have focussed on developing countries' trade with developed and developing economies as a whole. While discussing the data and methodology of our analysis to be carried out in the following section, the differences will become clear.

3.2 Present Analysis: Methodology and Data

Efforts at the measurement of the extent of intra-industry specialization, i.e., its relative importance within a country's total trade, have been complemented by research on the theory of intra-industry trade and its determinants. The objective of this analysis is to explain inter country differences in the degree of IIT in manufactured goods and the determinants of such specialization in a cross-country framework. This is a relatively neglected area as most of the contributions have investigated the effects of commodity characteristics on such trade flows, the exceptions being Loertscher and Wolter (1980), Balassa (1986) and Harylyshyn and Cavin (1983). This study covers 30 developing countries at different levels of development that have gradually shifted towards the exports of manufactured goods. Econometric estimates are made for all the countries taken together using different estimation procedures.

3.2.1 Hypotheses

From our survey of the literature on theoretical and empirical aspects of IIT, it is evident that one now finds several new models of IIT based on product differentiation and monopolistic competition, scale economies, as well as transport costs and trade restriction. The industry features study is beyond the scope of our present analysis. Empirical work on IIT, as reviewed in the earlier section, has gone well beyond measuring it and examination of methodological hypotheses such as aggregation and categorization to regression analysis of the determinants of IIT. We are now giving the possible hypotheses suggesting inter country differences in the extent of IIT.

The hypotheses that we postulate are given below. We consider the *macro analogues* of the three core hypotheses from the theories of IIT viz., scale economies, product heterogeneity and/or monopolistic competition and tariff structure, and trade preferences or integration scheme.

With greater degree of product differentiation one might hypothesize that the more sophisticated and advanced an economy the more will be the extent of IIT (a la Lancaster, 1980; Krugman, 1979 and 1980). Now, higher per capita income as a proxy for stage of development results in a more diversified pattern of demand and product diversification as a precondition for giving rise to IIT. Thus, a la Linder (1961), the hypothesis is the extent of IIT will be positively correlated with the level of economic development. This is the demand side of `stages of development' hypothesis.

On the supply side, the hypothesis is the more `diversified' and `advanced' the industrial sector of an economy, the more it is able to produce a diversified range of heterogeneous products. Since the share of manufacturing exports for the developing economies is rising, there will be ample scope for generation of IIT in the manufacturing sector characterized by economies of scale and product differentiation. Hence, for some measure of this rate of industrial development, the higher IIT will be associated with its higher values.

Following Krugman (1979) and Lancaster (1980), in the event of product - heterogeneity, economies of scale will give rise to IIT between countries with identical resource endowments, production functions, and tastes. Krugman (1980) has shown also that in the presence of transport costs, a country with a larger domestic market will be a net exporter of differentiated products subject to scale economies and the country with smaller domestic market will be a net exporter of standardized products subject to constant returns to scale (CRS). The hypothesis is that the extent of IIT will be positively correlated with the size of the domestic markets i.e., the larger the economy, the higher the scope for IIT via the greater opportunities for scale effects. But the effect is not clear. There might be an overestimation of IIT due to cross border trade. The size variables like GNP and GDP in a regression analysis may easily proxy the cross border trade because the smaller countries tend to participate more in such trade in general than larger ones. Following Linders' argument (1961) where IIT emerges as a result of an extension of internal demand through international trade, country size may have a negative effect on IIT offsetting the positive effect of industry specific scale economies and product differentiation. Thus, the sign of the size variables in the regression analysis is not uniformly evident.

So far as the effects of preferential trading arrangements or customs union scheme is concerned, the higher IIT is associated with less trade restrictions. Some of the developing countries may belong to preferential trading arrangements and in that case the effect is ambiguous in the sense that the net outcome depends on the relative strength of trade creation or trade diversions in or out of the groups. Generally, the hypothesis is that participation in integration schemes [like LAFTA (LAIA), ASEAN, SAARC,-to name a few] will have a positive impact on IIT.

Many other variables like the existence of common border with trade partners, transport costs, average level of trade restrictions, common cultural ties and languages, export concentration ratios proxied by Herfindahl index of concentration of manufactured goods exports, cross hauling of investments through transnational corporations underlying manufactured exports from LDCs are also important.[3]

On the basis of these hypotheses discussed above, a cross sectional specification of the relationship between IIT for a country with different country groups and the possible determinants of such trade can be modeled as a functional form [in analogy with Havrylyhyn and Civan (1985)]. This is given by

[3] See Nayyar, Deepak (1978, March): `Transnational Corporations and Manufactured Exports from Poor Countries', Economic Journal, 88, pp. 59-84 for a comprehensive account of this issue. These are beyond the scope of our study as we are only analyzing the evidences of IIT for the exporters of manufactures in the developing world.

IITj = F [Size j, PCYj, SMVAj, INTEGj] (1)

where

IITj = Intraindustry trade for country j with different country groups in manufactured goods.

Size j = Size of the country j proxied by gross national product (GNP) or gross domestic product (GDP).

PCYj =Per capita income (per capita GNP) proxying level of development for country j.

SMVAj = Share of manufacturing value added in GNP as a measure of level of industrial development or importance of manufacturing sector in domestic economy.

INTEGj = Variable representing participation in integration schemes. This is introduced through Dummy variables for membership in major integration schemes like LAFTA (LAIA) and ASEAN.

Having described the hypothesis and cross-sectional relationship, we now turn to the discussion of computation formula and data.

3.2.2 Data

The principal difficulty with computing a meaningful summary statistic of IIT is in unambiguously defining the term "industry". It is measured at a particular level of statistical aggregation, which may be the appropriate level for some activities but not others. Although there is no a priori reason why one particular level of aggregation should necessarily be more accurate than any others, many researchers have used the 3 digit level of the Standard International Trade Classification (SITC) or its equivalent in national classification, as a suitably disaggregated level of empirical analysis. Even at the 3-digit level, however, it is quite possible to find activities with different production functions grouped in the same category. In such situation the index of IIT measures the two-way trade in Heckscher-Ohlin goods rather than in differentiated products, and this might give an erroneous indication of the extent of IIT. The consequence of this misclassification is commonly called "categorical aggregation". This has been a focal point of the critiques of empirical studies on the level of IIT. Detailed examination of the impact of `categorical aggregation' are, however, relatively sparse except Finger's (1975) work on the SITC). This suggests that there may be a great deal of variability in factor input ratios within 3 digit categories. Obviously, where factor ratios differ between subgroups in a given 3-digit category, measurement of IIT at the 3-digit level is meaningless because a high value of the index would be quite consistent with Heckscher-Ohlin trade.

There are, broadly speaking, *three ways* in which to minimize the influence of categorical aggregation viz.:

1. Measurement at a lower level of statistical aggregation;

2. Measurement according to alternative classification systems; and

3. Computation of an adjusted IIT index.

The first of these is most widely adopted procedure. According to Grubel and Lloyd who studied IIT for Australia Op. cit. Grubel and Lloyd (1975), p. 51., over the 2,3 and 5 digit levels of aggregation the patterns of intra-commodity trade are essential,y preserved when the data are aggregated from 5 digit to 3 digit and to 2 digit items. This implies that the industries preserve their relative strength of intra-industry trade through these levels of aggregation, and studies of differences among industries would be insensitive to the level `of aggregation chosen'. Moreover, according to Max Corden (see Corden, W.M. (1979))[4], usually the SITC 3 digit classification is used but, with even narrower definitions, substantial intra-industry trade is apparent.

In our analysis, we have used SITC 2 digit level of aggregation. Recognizing the relationship between the level of aggregation of trade data and measured IIT index, the analysis that follows is based on 2 digit level SITC data on trade in manufactures. Since my basic contention is to trace the evidences of IIT for the developing countries and the possible factors underlying it, the 2-digit level of aggregation (i.e. at a more aggregated level than the conventional 3 digit level) would not prejudice the analysis. The data source used in this analysis is the United Nations trade data classified by the Standard International Trade Classifications at the 2 digit levels of aggregation. In this study, we have focused our attention on the non-fuel manufactured goods only [i.e. SITC 5-8, excluding 3 (fuels)].

United Nations studies define items 5-8 of the revised SITC (the commodity classification of trade is in accordance with the U.N., SITC Revision, 3, series M, No. 34) as manufacturing industry groups or industrial goods. The international trade statistics do not have an "industrial" category. In comparing statistics of international trade with statistics of industrial production, there are problems of comparison due to classifications. In comparing data according to the SITC, revised with data according to national commodity classification, one pertinent point to note is that the same brief descriptions may refer to aggregates differing somewhat in composition. Most of the countries report trade data according to SITC, Revision 3. For the necessity of harmonization of economic classifications, Harmonized commodity description and coding system (HS) was completed by revision of Customs Cooperation

[4] `Intra Industry trade and Factor Proportions Theory', in H. Giersch (ed.) `On the Economies of Intra Industry Trade and Fubingen', J.C.B. Mohr, 1979).

Council Nomenclature (CCCN) i.e., by expansion of its 4 digit categories into HS comprising 5,019 6-digit headings. The SITC Revision 3 is meant for harmonization with the Revised CCCN, the ISIC Revision 3 and a Central Product Classification but general character and structure of SITC Revision 2 is maintained.

The sample consists of 30 countries. Most of them report trade data according to SITC Revision 3 for 1990 except Hong Kong and China. We follow U.N. classification and use U.N. trade data, Series D, Vol. XL, various issues for different countries' commodity trade statistics with different country groups for 1990. For product groups 51-56, there is similarity between SITC Revisions and SITC Revision 3 classifications. For product groups 57,58 & 59, there are changes. SITC No. 57 is Explosives and Pyrotech Products according to Revision 2 and Plastics in primary form according to Revision 3. This is included in group 593 in SITC Revision 3. This was 57 in Revision reported as separate division 57 in Revision. In SITC Revision 3, division 59 includes the explosives and pyrotech products. In order to make comparable, some conversion is necessary. By adding the value figures from SITC Revision 2 for division 57 to the figures for 59 in SITC Revision 2, the conversion is made. The addition will give the figures for the division 59 which will correspond to SITC Revision 3. For division 58, it is ‘Artificial resins and plastic materials and cellulose esters and others’ according to SITC Revision 2 and according to Revision 3 it is plastics in non primary forms. In this case, also the conversion is made following the same rule. What are divisions 57 and 58 in SITC, Revision 3 are agglomerated in one division SITC, Revision 2 in division 58. Only group 57 in Revision corresponds to division 59 in SITC, Revision 3.

The division 54 has 2 groups and 10 subgroups in SITC for each country. For some countries, there is one group 541 and 9 subgroup 541.1 - 541.9 that have been reported in trade data for 1990 commodity trade statistics according to SITC Revision 2. Similarly for division 56, it is reported as group 562 (Fertilizers, Manufactured other than those of group 272 which is fertilizers, crude, other than those of division 56).

The 30 countries that have been chosen are basically developing countries and territories. Selected country composition by economic groupings of developing countries and territories includes the major exporters of manufactures, major petroleum exporters, and the remaining countries of which developing economies.

By income group according to World Bank's `World Development Report', the sample includes three income groups, viz., and high income; upper and lower middle income and lower income groups. Among the high-income categories ($7,910 or more per capita income), Israel, Hong Kong and Singapore are economies classified by the United Nations or otherwise regarded by their authorities as developing (see World Development Report, 1993, World

Bank Publications).

Middle-income group include upper middle income and lower middle-income countries and their per capita income falls in $636 to $ 7,909 category. Low-income groups have per capita income of $635 or less. All these relate to World Development Report, 1993 classification of economies. Table 3.9 below gives the list of countries included in our sample by income group and by major category

The sample included countries from different economic groupings - be it, by major category or by income group and thus included more advanced developing countries and other developing countries as well. In this analysis for all the developing economies, less developed countries (LDCs) are used interchangeably to distinguish them from advanced developed countries (DCs).

The sample does not contain a homogenous set of countries in one sense that no lower limit of per capita income of U.S. $ 635 or so was set in choosing the sample. At the same time, it is not heterogeneous in the sense that it contains all developing countries - though they are at different stages of development, i.e., comprising more advanced developing and less advanced developing in terms of per capita incomes. However, since per capita income reflects the effects of variety of economic processes and is often used as an indicator of a country's level of development, the empirical links between the pattern of trade and level of development can be studied by using per capita income (PCGNP) as a proxy for stages of development.

The GNP and GDP proxy the `size' variable. The data for GNP for 1990 are taken from World Debt Tables (country Tables, Vol. 2) of 1992-93 and 1993-94. GDP figures are taken from World Development Report (WDR, heretofore), various issues. For Cyprus, the GNP figure is calculated by multiplying its population in 1990 (taken from World Bank Development Report) with per capita GNP [op.cit, WDR]. For the countries for which GNP figures were not available in debt tables, it was generated by multiplying GNP per capita (taken from WDR, 1992, table 1) with population (op.cit. Table A.3 on population structure and dynamics). These countries are Greece, Israel, Hong Kong and Singapore. One pertinent point to note is that these data has close correspondence with the data published in Human Development Report, 1993 (UNDP). According to World Development Report of World Bank, GNP per capita in U.S. Dollars are calculated according to the World Bank Atlas Method (for reference vide Technical Notes, op. cit.) for giving a perfect cross country comparability of GNP per capita estimates.

The data for share of manufacturing value added in GDP (SMVA) in 1990 for all those countries are collected from Handbook of Industrial Statistics, 1992 of UNIDO. These are given in percentage terms for 1990.

[Insert Table 4]

In the analysis, a measure of trade policy or trade orientation of the economies has been used. We have used a variable named Trade Concentration Ratio (TCONC) as this measure. It is sum of exports and imports over all commodities i.e., total trade as a percentage ratio of GDP of every country. This gives an idea for comparing the levels of trade restrictions of different countries at same point of time using trade data as circumstantial evidence. There are other measures of trade policy interventions like trade intensity ratios as a proportion of GNP, total trade as a ratio of GNP. These are beyond the scope of our study.[5] All these figures/data are given in Table 5 below.

[Insert Table 5 below]

3.4.3 Computation Formula for IIT Index

The formula that has been used in computation of intra-industry trade share in total trade of a country is that given by Grubel and Lloyd (1975). As discussed earlier in chapter 2 of our study, this involves lots of problems and hence criticism. In my analysis, we have made us of unadjusted Grubel-Lloyd uncorrected index [GL(U)]. Since our contention is to study the empirical evidence of IIT of these countries, not to analyze methodological hypothesis and problems affecting IIT, GL(U) is used for computational purpose.

Suppose

Xi = exports in product category i,

Mi = imports in product category i.

Then, inter industry trade or trade in different goods of different industries is defined as the absolute value of the difference between exports and imports in product category i, i.e., |Xi-Mi|. Thus, intra-industry trade or trade in identical products is the value of total trade remaining upon subtraction of the amount of Heckscher-Ohlin trade

[5] For a comprehensive account of these alternative measures, see Brian J. Aitken's `Measuring Trade Policy Intervention, A Cross Country Index of Relative Price Dispersion", Policy Research Working Papers, A Macro economic Adjustment and Growth, Country Economies Department, The World Bank, January 1992, WPS 838. David Dollar has taken the cases of 95 LDCs for addressing the issue of trade orientation and growth for these countries in his paper `Outward-oriented Developing Economies Really do Grow More Rapidly: Evidence from 95 LDCs, 1976-1985', Economic Development and Cultural Change, 1991, vol. 40.

Thus,

$$IIT = (Xi+Mi) - |Xi-Mi| \qquad (1.a)$$

In percentage terms, GL (U) is given by

$$GL(U) = \frac{[\,(Xi+Mi) - |Xi-Mi|\,]}{(Xi+Mi)} \,.\, 100\% \qquad (1.b)$$

If there is no IIT, one of Xi or Mi will take `zero' value hence GL(U)=0, as Xi or Mi is zero. For Xi=Mi i.e., ³Xi-Mi³=0, all trade is intra-industry trade and hence GL(U)=100%. The above index gives productwise index of IIT. This is used for computations of product-wise index of all SITC 5-8 at 2-digit level for each of the 30 countries.[6] Our purpose is to measure aggregative IIT index for each of the 30 countries. As this has been discussed in Grubel and Lloyd (1975) and Aquino (1978), Michaely (1978), a simple arithmetic mean or average of 2-digit commodity wise IIT, values will overestimate the degree of such trade as it associates equal weight or relative importance to all 2-digit categories. It might be possible that all the product groups might not have equal share or relative importance in total trade for each country. In this case, a simple mean will impart a measurement bias in the calculations of indices. So we make use of weighted formula of Grubel and Lloyd (1975).

For some aggregation level, the IIT index is given for a country j, by

$$IITj = \frac{\sum_{i=1}^{n} (X_i + M_i) - \sum_{i=1}^{n} |X_i - M_i|}{\sum_{i=1}^{n} (X_i + M_i)} \qquad (1.c)$$

It contains all 2-digit i-product groups or components from 1 to n.

Formula (1.b) is used to calculate the IIT value for each 2-digit product category and formula (1.c) is used to compute the aggregate index over all product categories at 2-digit level of SITC. In our analysis, trade of each country with developed and developing country groups are analyzed and IIT with these country groups is calculated separately at the aggregate level. The developed country groups, as given in U.N. commodity trade statistics, include North America Developed, Asia Developed, Europe Developed i.e., European Economic Community (EEC) and European Free Trade Association (EFTA) and Oceania Developed (Australia and New Zealand). The developing country group

[6] The tables of product-wise indexes computed are not reported here for want of space. However, those are available from the author upon request.

includes other America Developing (Latin America Integration Association - LAIA, CACM, etc); Asia developing, other Asia, Oceania developing, Africa developing, Europe developing.

Formula (1.c) is used to calculate aggregative IIT index with these country groups. ID is the IIT index of each country with developed country group, IG is that for each country with developing economies; IW is IIT of each country with world as a whole i.e., at global level. Table 5 gives each of these indices for each country for 1990. These are our dependent variables in regression analysis.

4. Estimation Procedures and Regression Results

4.1 Overview of the Analysis

In the previous sections, we identified a set of hypotheses relating to country features of intra-industry trade that might be inferred from a range of models of IIT and investigated econometrically. Acquainted with the problems of measuring IIT in other econometric works and the problems of proxying the potential independent variables, we are now carrying out our econometric analyses. Testing of the regression model of the form (1) [see section 3] requires a specification of the dependent variable to be explained and a functional form of the equation to be fitted to the data set. In present study, the dependent variable is IITj as given in (1.c) or some variations of it. We have used three alternative estimation procedures viz., Ordinary Least squares (OLS), Weighted Least Squares (WLS) and Nonlinear Least Squares (NLS) utilizing a logistic function, and logit analysis of same logistic function with WLS and OLS (see Technical Appendix at the end of the paper). A simple ordinary least squares estimation for a linear specification using the standard IITj index of (1.d) is the most common approach that has been tried here.

There is rationale behind using alternative approaches. Since our measure of the degree of intra-industry exchange is a pure index with truncations of the continuous distribution from 0 to 1, the direct use of the measure as the dependent variable might yield a biased coefficient estimate. The index takes values within 0 to 1 range and no guarantee, whatsoever, exists that the predicted values of the regression equation will fall within this range when linear or log-linear functions are used. Following this logic and since in the observation of countries and commodity groups, there are values of zero (inter industry specialization) more frequent than 1 (complete IIT) i.e., there is either no trade in a particular product or there is no intra-industry specialization rather inter industry specialization; it indicates the importance of zero observations. Linear or log-linear equation gives values outside 0 and 1. Logistic function does not have this shortcoming.

The logistic function can also be transformed into a logit specification provided the IIT index does not take exactly 0 and 1 values which is the case for our sample countries. In fact, all the values of IIT index fall within 0 and 1, no being exactly equal to either of the extremes. In this case, the logit transformation of IIT; i.e., [ln (IITj/1-IITj)] is the dependent variable. Thus the problem of overestimation where an equation fitted by OLS methods can generate estimates of IIT that are outside the feasible interval is avoided.

Although the OLS method *per se* and the OLS with the logit of the index yield estimates that can avoid some problems mentioned above, in a cross-sectional analysis, the problem of heteroscedasticity (i.e., unequal variances) is always present.[7] In that case, weighted least squares (WLS) are used, where both the dependent and independent variables are weighted by choosing an appropriate weight. This helps in avoiding heteroscedasticity problem. In this study, WLS estimation procedure is used by choosing the proper weights. However, the regression analysis gives some insight about the determinants of IIT in a cross sectional study. In the light of data deficiencies, quality of data and proxy problems for the potential explanatory variables, greater attention and care is needed for technical sophistication that is beyond the scope of the study. We now present the alternative model estimations and results. As mentioned previously, IW, ID and IG are the dependent variables in the regression analysis.

4.2 Regressions and Results

(a) *OLS estimation procedure* using ID (intra industry trade with developed country group) does not give a good overall fit. In the cross section analysis, there is problem of hetrokedasticity because here we deal with members of a population at a given point in time. For example, in present study we are considering different countries of different sizes, levels of development as proxied by per capita GNP, PCGNP. From our calculations of IIT index of these countries with different country groups (i.e., ID, IG and IW as mentioned earlier), it is evident that there is considerable variability in the IIT indices between countries in different income categories. If we were to regress IIT indices on the GNP, PCGNP, we would like to make use of the knowledge that there is considerable intercountry variability in IIT indices among different income groups. In that case, estimation procedure is to be so devised that observations coming from populations with greater variability are given less "weight" than those coming from populations with smaller variability. In fact, by dividing the sample of 30 countries according to PCGNP (i.e., those below or equal to PCGNP U.S. $635, those within the range $365-$7911 and those above $7911) and also according to GNP classes and calculating the standard deviation of IIT indices (ID, IG, IW) over this classes or income groups, we

[7] See Gujarati, D.N., Basic Econometrics, Chapter 11, Part II, MCGraw Hill Book Company, Second Edition, 1988.

have seen that these indices vary over these groups. For PCGNP classes, standard deviation around mean values of ID, IG increases as one moves over to higher PCGNP classes. Variance of IW falls unidirectionally from lower to higher PCGNP classes. For GNP classes, same thing occurs except the case of IW where no discernible pattern is found. This rationalizes the use of Generalized Least Squares estimation procedure of Weighted Least Squares. WLS estimates using different weights give the good overall fit and high values of coefficient of determination (Adjusted R-Squared i.e., R^2). Different weights like GNP, PCGNP, and Square root of them have been used in alternative WLS estimations.[8]

(b) *WLS estimation procedure*: In WLS estimation of linear specifications of regression of ID with GNP, PCGNP, TCONC, SMVA all the important variables are highly significant (except GNP) with expected signs. The result is presented below in Table 6. The WLS estimates improve the overall fit of the equation giving more explanatory power with the coefficient of determination being 0.88. The result is presented below implying all the variables are significant at 5% level except SMVA.

[Insert Table 6 here]

Taking IG (intra-industry trade index with developing country group) as dependent variable and using same set of explanatory variables and weights as SPCGNP we get the results given below in Table 8 where GNP and PCGNP is not significant (although have expected signs) but TCONC and SMVA is highly significant with TCONC having positive sign as opposed to earlier results and R^2=0.82.

[Insert Table 7 here]

Taking IW and IG (IIT of each country with the world as a whole) as the dependent variable and using SGNP and SPCGNP as weights we get the following results. The overall fit is good. Most of the important variables are significant highly with expected signs. Results are presented in Tables 8 and 9 below. TCONC has the negative sign

[8] In OLS the assumption of homoscedasticity means equal variance i.e., E(ui2) r2, Vi=1(1) n, where ui is disturbance term. In Heteroscedasticity problem conditional variance of Yi increases as X (independent) increases. Variances of Yi (Dependent) are not the same). In econometric studies ëi2 is not known (ëi2 is heteroscedastic variance), for using proper weights in WLS some ad hoc, albeit plausible assumptions are made about ëi2. In our case, we can assume (i) ëi2 is proportional to square of explanatory variance PCGNP is GNP. where Xi = PCGNP or GNPi and ë is constant. Thus ëi = ëXi. In this case the weights GNP or PCGNP is appropriate. It assumption is (ii) E(ui) i.e., variance of ui is proportional to PCGNP, GNP itself, then Xi or ëi ûXi, ë=constant. Here weights square root of GNP, (SGNP) or square root of PCGNP (SPCGNP) are appropriate. Thus using some plausible assumptions, which are supported by our observations, about the nature of proper weights are found that can make the disturbances in the transformed data homeoscedstic.

but it is insignificant. Taking log (GNP) and log (PCGNP) in the regression model with TCONC and SMVA, we get R^2=0.97.

[Insert Tables 8 and 9 here]

In above set of regressions, the model includes four explanatory variables viz., GNP, PCGNP, SMVA (share of manufacturing value added in GDP) and TCONC. The variable SMVA has the expected sign and is significant in all the estimations. It follows from the theory per se that SMVA would have a positive effect on IIT share. The point that is worth mentioning is that in these estimations TCONC has the positive sign on its coefficients although the significance level varies. Thus, in using weighted least squares (WLS) estimation procedure, the overall fit and the explanatory power of the fitted equation is good and most of the important variables are significant with expected sign usually. We now present the result of another estimation procedure.

(c) *Non-linear least squares (NLS) using logistic function*. The rationale for using such procedure is described earlier in this section. The functional form of this logistic function is given in the technical appendix. Here we present the results below in Tables 10 and 11 for ID and IG respectively.

[Insert Tables 10 & 11 here]

Since the value of GNP and per capita GNP (PCGNP) are quite large as compared to that of IIT indices, logarithmic values of GNP and PCGNP are taken for compressing the extreme values on outliers. In the estimation, all the variables are significant except TCONC. The important variables have expected sign except for TCONC where negative sign as in earlier studies are found. R^2 for regressions with ID as dependent variable is 0.60 and for IG, however, all the variables are also not significant.[9]

(d) *Logit Analysis with WLS procedure*: In an alternative estimation procedure, the logit analysis of the same logistic with WLS is done. Use of this estimation procedure would involve redefining the dependent variable of the regression equation. The logistic function is more appropriate as the dependent variable takes values between 0 and 1. See *Technical Appendix A*.

Logit transformation of IIT is the dependent variable. Loertscher and Wolter (1980) have applied the WLS method using $\sqrt{\text{IITj(1-IITj)}}$ as the weights for explanatory variables but not weighting the dependent variable. These

[9] Alternative NLS using proportional functional form is given in Appendix A3.

weights have been used in the present study just for comparability of results with estimation procedures of other studies.

The dependent variables are

Z1 = Log (ID/1-ID)
Z2 = Log (IW/1-IW)
and
Z = Log (IG/1-IG)

These are logit transformations of the IIT indices.

Although the ordinary least squares with the logit of the index yield unbiased estimates, they can have the problem of heteroskedasticity in the cross sectional analysis. To avoid this, both dependent and independent variables are weighted by the square root of IITj (1-IITj) at the aggregative level for IIT with each country group before a least square method is performed.

If, in general, the logit transformation of the IIT index is denoted by LIIT = log (IITj/1-IITj), the functional form of weighted regression is as follows:

LIITj* = a1Wj* + a2 PCGNPj* + a3 GNPj* + a4 TCONCj* + a5 SMVAj*

where Wj* = √11Tj (1-IITj) and the superscript '*' denotes that the variable is weighted by Wj*.[10]

The weights used here are

K1 = √ID (1-ID for Z1;

K2 = √IW (1-IW) for Z2;

K = √IG (1-IG) for Z

The results are now presented in tables below.

In Tables 12 below, we give the OLS and corresponding WLS results with these logit transformations. All the variables are significant when the dependent variable is Z with the expected signs quite consistent with the earlier results of alternative estimation procedures.[11]

[Insert Table 12 here]

So far participation in integration schemes has not been introduced in our regression analysis. The

[10] The logit transformation of the index of IIT has a variance of [1/11Tj(1-11Tj)] (see Bergstrand, 1983, pp. 240-242).
[11] We do not report all the results for other specifications. However, those are available from the author upon request.

`INTEGRATION' variable as specified in equation (1) in earlier section is set aside. The sample countries considered participate in preferential trade groupings and/or integration schemes. For example, in our sample, among the `Escap Developing' countries the `ASEAN'. `ASEAN' is `Association for South East Asian Nations' group comprising of Indonesia, Malaysia, Philippines, Singapore, Thailand whereas Bangladesh, Pakistan, India, Sri Lanka falls in the `SAARC'. `SAARC' is the regional grouping "South Asian ASsociation for REgional Cooperation" regions. The `LAIA' is Latin American Integration Association. This group includes Argentina, Brazil, Chile, Mexico, Paraguay. `Bangkok Agreement' includes Bangladesh, India, Korea, Republic and Sri Lanka.

In this study, we focus on two major integration schemes viz., ASEAN and LAIA. Since some of the South Asian countries like India, Bangladesh, Sri Lanka also fall in two groups like SAARC and Bangkok agreement, we do not consider them as the true effect may not be captured. Moreover, these two groups viz. the `ASEAN' and the `LAIA' groups include major exporters of manufactures from developing countries.

We introduce two `Dummy' variables separately in separate regressions. One dummy is dummy for ASEAN (DA) and the other is dummy for LAIA (DL). Dummy takes the value `1' for participation in integration schemes and `0' otherwise. Thus the regression equation to be estimated is of the general form.[12]

$$IITj = \alpha 1+\alpha 2Dj + (\alpha 3+\alpha 4Dj)\ GNP + \alpha 5\ PCGNP + \alpha 6\ TCONC + \alpha 7\ SMVA$$

where

IITj = IIT index of jth country with different country groups - developed and developing.

Dj = DA and DL for the countries concerned.

and

Dj = 1 for being included in ASEAN or LAIA.

= 0, otherwise.

In this equation, $\alpha 2$ is the differential intercept and $\alpha 4$ is differential slope coefficient. The slope dummy is associated with GNP because participation in integration scheme means expansion of market size that is proxied by GNP (and/or GDP). This expansion creates the scale effect. We now present the results in Tabular form. Table 13 below summarizes the result for `DA', where GNPA=Dj.GNP when Dj=DA. All the variables are significant and overall fit is

[12] See Section 6.3, Chapter 6, Econometric Methods, J. Johnston, Third Edition, 1985, McGraw Hill.

given by coefficient of determination R^2=0.89.

[Insert Table 13 here]

With IW as the dependent variable and SGNP and SPCGNP as the weights the results obtained are given in following tables. The important variables are significant and R^2 is as high as 0.93 in both cases.

[Insert Table 14 and 15 here]

For the LAIA - dummy variable, the dummy is DL and GNPL=GNP.DL where Dj=DL. Like the `ASEAN' dummy, this is also significant and the adjusted R squared value is high giving a good overall fit. The results for ID, IG, and IW are presented in the following tables.

[Insert Tables 16 and 17 here]

In the next section, we summarize the implications and interpretations of these results.

5. Principal Findings

It is evident from our analysis that in contradistinction with the Havrylyshyn and Civan (1983, 1985) and Balasa & Bauwens (1987) and Lee (1988) and Bergstrand's (1983) investigation, this analysis has been limited to developing countries exporting manufactured products. These developing countries are not at the same level of development. Some fall in the low income categories and some in the middle income categories (according to World Bank Development Report). As opposed to most of the studies e.g., Tharakan (1984), Balassa and Brauwens (1987), Lee (1988), Bergstrand (1983), etc., which studied either industry features of IIT or a combination of country and industry features, the present study focuses solely on country characteristics of IIT with by reference to hypotheses derived from theories of intra-industry trade. All the hypotheses put forward have been confirmed by the results and the explanatory power (overall goodness of fit) of the regression equation is high in alternative estimation procedures.

Firstly, the extent of intra-industry exchange increases with the level of economic development (proxied by per capita GNP) and the size of the domestic market (proxied by GNP or logarithmic values of GNP. In turn, while according to the Harryhyshyn and Civan study participation in integration schemes contributes to the explanation of intra-industry trade, this does not hold true in all the cases in this study if more appropriate specifications are considered.

Considering the `ASEAN' dummies, its introduction gives the slope coefficient a negative sign [i.e., coefficients of GNPA in the tables] for intra-industry trade with developed, developing countries and world as a whole, although the coefficients are not always statistically significant at a high level of significance.

For the LAIA (successor to LAFTA) dummies, the slope coefficients have negative sign for intra-industry trade with developing countries and with the world except in the case of trade with DCs where it has a positive sign. The interpretations that can be put forward runs as follows. At the micro level, a lower trade barrier implies more IIT. For membership in preferential trade groupings the effect is not obvious as high trade restrictions outside the group may lower the IIT levels a la trade diversion. While internal trade preferences may lead to trade creation, the net effect depends on the relative strength of these two factors viz., trade creation internal to the union and trade diversion external to the `group'. Thus the effect of common market schemes is a mixed one. LAIA scheme does not have a significant impact on ID as opposed to Balassa (1979), Wilmore (1972, 1979).

While these studies found a positive significant effect due to preference and complementation agreements, in this study the sign of the coefficient are negative for IG and IW. It is likely that trade diversion in LAIA cases is much higher so that it offsets the trade creation effect. For trade creation, a rise in bilateral or multilateral IIT index with member countries would cause global IIT to increase (i.e., IW to increase) without causing IIT with outside countries to decline. For trade diversion, the effect is not determinate. For ASEAN dummies, all the slope coefficients have negative sign implying the stronger effect of trade diversion outside the group.

The proliferation of South-South integration arrangements in the postwar years is an indication of desire to promote South-South trade. Of current integration schemes worldwide, fifteen are South-South agreements that affect directly about seventy developing countries. From the economic standpoint, it is believed by the member countries that this would strengthen the bargaining power of small open economies in international markets as there are alleged asymmetries in the distribution of the gains from North-South trade. In fact, the developing economies initiated many of this arrangement as a part of their inward-looking trade strategy. Any positive effect that these trade preferences provides to intra-South trade might displace (as a substitute) an equivalent amount of trade with the developed world and lessen the DC vis-à-vis LDCs trade.

Moreover, the integration scheme creates opportunities for dynamic gains like economies of scale rising with widening of market access. Trade creation occurs when the relatively low cost imports removed the relatively high cost producers in the home market as opposed to trade diversion where the high cost imports replace the otherwise relatively low cost inputs.

Given these issues, the reasons for the apparent inability to stimulate trade expansion via this system of trade preferences are many. These are small market sizes, low incomes and poorer markets, restricted opportunities for regional specialization and economies of scale through an inward-looking development strategy, even when pursuing multi-lateral agreement to liberalize trade by the outward oriented economies such as those of ASEAN.

Thus trade diversion might possibly be more important than trade creation and integration has not yielded scale effects [Willmore, 1978; Carnoy, 1970].

So far as the effect of PCGNP as a proxy for stages of development is concerned, this is always highly significant with expected positive sign in all regressions. This is in conformity with Linders' hypothesis (1961). It is linked to the demand side of product diversification and heterogeneity. Higher PCGNP means more varied demand and it is a pre condition for the product heterogeneity that underlies IIT theory.

SMVA i.e., share of manufacturing value added in GDP gives a simpler extensive aspects of "industrial maturation". The regression result shows that it has the expected positive sign with significant coefficients. This captures the supply side effect of industrial advancement.

Havrylyshyn and Civan (1983) and other studies used Herfindahl index of concentration of manufactured good exports. We have not used that measure due to time limitations. Moreover, since the share of manufactured exports of these countries are increasing (as given by figures in tables in the previous section), the SMVA could as well serve the purpose.

So far as the effect of trade orientation variable is concerned, the sign of the coefficient of TCONC variable is negative for intra-industry trade with developed country groups. This can be analysed as follows: with the rapid industrialization process at work, as all these economies are pursuing an industrialization led growth and gradually shifting towards manufactured production, they are protecting the infant industries by shifting the higher cost regional products from competition outside the region. Thus the protection given to these nascent industries helps creating a mature industry in the long run that through dynamic and static scale economies becomes eventually competitive with foreign producers. Thus this temporary intervention helps establishing industries that could not be established by the private producers in the face of foreign competition (from established firms). After achieving this competitiveness, these countries tend to export manufactured or industrial goods. Contrary to the findings of Balassa (1979), Balassa (1986), Balassa and Bauwens (1987), the trade orientation variable has opposite sign with its coefficients. Thus the establishment of a manufacturing base through less openness to trade via trade restrictions will create potential for intra-industry exchange in manufactured goods.

For the developing country group, TCONC is positively related to IG. This may imply that for intra-developing country trade, there is more scope for intra-industry specialization and exchange to occur in the event of their gradual shifts to production of manufactured goods, the less the trade restrictions between them. This emphasis on enlarging mutual trade in manufactures is not overly stated as there are long term prospect for manufactures as compared to primary products, the economies of scale to be gained in manufacturing rather than in primary production and the possible consequences of South-South trade integration and generalized system of trade preferences in manufactures (see H. Linnenmann, 1992).[13]

Size (proxied by GNP) is less important in the aggregate because it may have a `positive effect' through scale economy effect (large economy may permit greater opportunities for scale economies to occur in individual industries) as well as `negative effect' because larger size means less border trade i.e. small countries tend to do much more trading in general than larger ones. Thus the net effect is not determinate as the negative effect on IIT may balance the positive effect of industry scale economies and product differentiation.

Although the regression equations have high explanatory powers, increased inter-correlation among the explanatory variables (for example, the case of GNP and GNP per capita in the analyses having higher correlation between them) have reduced the statistical significance of the individual regression coefficients. The very high extreme values of GNP and PCGNP have made the coefficients very small. The logarithmic values compress the extreme observations and the coefficients become pretty larger than before when estimated with these logarithmic values. Thus the analysis demonstrates that the developing countries can increasingly participate in intra-industry trade as they reach higher stages of economic development.

TECHNICAL APPENDIX

A.1The Logistic Functional Form:[14]

It is generally given by the following functional form

$$Y = \frac{k}{1 + a.\exp^{-bx}} \qquad (A.1.1)$$

where a, b and k are parameters to be determined. From equation, it is clear that higher b implies higher rate of

[13] Linnenmann, H. ed. `South-South Trade Preferences, The GSTP and Trade in Manufactures', Sage Publications, 1992.

[14] See Johnston, J., `Econometric Methods, Chapter 3, 3rd edition, 1985.

approach of Y to the ceiling k. In our sample Y is the IITj index for each country; and 0<IITj<1. Since IITj never reaches 1, specifying k=1 we get the logistic functional form as

$$IITj = \frac{1}{1+a.exp^{-bx_j}} \qquad (A.1.2)$$

where

IITj =(((intra-industry trade index of country j with different country groups i.e., ID, IG, IW in the study and x_j is the vector of the explanatory variables.

2.Logit Transformation of Logistic Form

Logit transformation of IITj is given by

$$LIITj = \ln\left(\frac{IITj}{1-IITj}\right) \qquad (A.2.1)$$

Following Bergstrand (1983), in a logit model of this type i.e.,

$$\ln\left(\frac{IITj}{1-IITj}\right) = \beta X_j + u_j \qquad (A.2.2)$$

where LIITj varies between $-\infty$ and $+\infty$ and the regression equation is linear (Xj is vector of explanatory variables), OLS implies E(Uj)=0,

but $var\ (Uj) = \dfrac{1}{[IITj\ (1-IITj)]}$

Uj is the error term in an OLS regression of LIITj on a vector of independent variables (assuming IITj is drawn from a sample of one).

In a model like (A.2.2), IITj is an observed proportion say n_j/m_j where

m_j = number of observations corresponding to x_j i.e., generating IITj

n_j = number of "successes" i.e., number of transactions generating IITj (a proportional share).

If m_j is large, U_j has the property

(i) E(Uj) = 0 and

(ii) var (Uj) = $\dfrac{1}{\quad}$

$$mj[IITj\ (1-IITj)]$$

Assuming mj=1 means

$$\text{Var}\ (Uj) = \frac{1}{IITj(1-IITj)}$$

To avoid heteroskedasticity, all the variables are weighted by $\sqrt{IITj\ (1-IITj)}$ i.e., standard deviation of the disturbance and then OLS is applied to the weighted data.

A.3 Non-linear Least Squares Estimation: It is performed by postulating a proportional functional form between the IITj indices ID, IG and the explanatory variables.

The postulated relationship is

$$IITj = A.\ (LG)^{\alpha}\ (LP)^{\beta}\ (SMVA)^{\gamma}\ (TCONC)^{\delta}$$

where

LG = logarithmic values of GNP
LP = logarithmic value of PCGNP
α,β,γ and $\delta$are parameters.

The result is presented below in Tables A.1 and A.2:

[Tables A.1 and A.2]

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