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Measurement and determinants of intra-industry trade in Asian countries

Min, Kyungse, Ph.D.

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U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

MEASUREMENT AND DETERMINANTS OF INTRA-INDUSTRY TRADE IN ASIAN COUNTRIES

by
KYUNGSE MIN

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6/17/92
Date

Robert E. Lipsey
Chair of Examining Committee
Professor Robert E. Lipsey

6/17/92
Date

Michael Grossman
Executive Officer
Professor Michael Grossman

M. Kellman
Professor Mitchell H. Kellman

Peter C. Y. Chow
Professor Peter Chow

Supervisory Committee

The City University of New York

Abstract
MEASUREMENT AND DETERMINANTS OF INTRA-INDUSTRY TRADE IN ASIAN COUNTRIES
by

KYUNGSE MIN

Advisor: Professor Robert E. Lipsey

Since Verdoorn noted the high proportion of international trade that was within the same product categories, (intra-industry trade, or IIT), rather than between different categories of goods, many studies have tried to explain IIT, especially among developed countries. This paper calculates bilateral IIT with developed countries by the Grubel-Lloyd measure for 9 Asian developing countries and analyzes the determinants of IIT for those countries in 101 manufacturing products over time and cross-sectionally. The period covered is from 1965 to 1990.

In the time series analyses, the econometric estimation for those countries showed that IIT increased with the level of their income relative to developed countries and with the openness of an economy to trade. The ratio of consumption to GDP did not explain IIT at all, as it was expected to.

In the cross-sectional analysis, the income ratio was a positive influence on IIT, as in the time series. Openness did not explain IIT differences a cross countries.

We can summarize by saying that IIT is not only a developed-country phenomenon, but appears also in the Asian developing countries. The main influence on its size is the income level of the developing country, and its closeness to developed-country levels.

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Finally, I would like to dedicate this dissertation to my mother and memory of my father. I really really love you, Mother!

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I. Introduction.

I.1. Background.

Traditional trade theory, such as the Heckscher-Ohlin model, is fundamentally a theory of interindustry trade. Each industry is assumed to produce a single homogeneous product which a country either exports or imports, according to whether it has a comparative advantage or disadvantage in its production. If a country exports capital intensive goods, it is presumably a capital abundant country; if a country exports labor intensive goods, it should be a labor abundant country.

About thirty years ago, Verdoorn (1960), studying the changes in the pattern of intra-bloc trade of the Benelux Union, noted the extent of trade that was within the same product categories rather than between different categories of trade. He calculated bilateral trade ratios for a sample of 121 products at comparable levels of international trade classification. The theoretical implications of such trade are different from those associated with the conventional factor proportions model. The Heckscher-Ohlin theory assumes industries characterized by production processes with constant returns to scale, producing perfectly homogeneous goods and selling them in perfectly competitive markets. In this sense, the simultaneous export and import of goods from the same industry has to be ruled out.

The simultaneous export and import of goods from the same industry in a country is now called intra-industry trade (IIT).[1]

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[1]. Grubel & Lloyd (1975).

Other writers have used different terms for IIT : Kojima (1964) called it "horizontal trade", Gray (1973) called it "two-way international trade". Other writers have been skeptical of its importance or even its existence: Finger (1975) referred to it as a "statistical artifact", and Lipsey (1976) wrote that ".... much, although not all, of IIT is a statistical phenomenon". Pomfret (1979) wrote that : "... IIT is a significant empirical phenomenon, but it is impossible to separate ... from ... statistical artifact.". According to Finger, the observed IIT was due to the inclusion within the same product category of items with large differences in factor content, such that if the items were separated, the validity of the Heckscher-Ohlin theory would be confirmed. The early studies of IIT found that the increase in trade among the members of the integration scheme had taken place largely through specialization in production and export of products of the same industries rather than of different industries. Since Verdoorn, many studies have provided theoretical bases for IIT and demonstrated empirically its existence. These include the studies of Grubel and Lloyd (1975), Giersch (1979), Tharakan (1983), Kierzkowski (1984), Helpman and Krugman (1985), Greenaway and Tharakan(1986), and Tharakan and Kol (1989).

I.2. Purposes and scope of paper.

The early studies, up until the early 1980s, focused almost entirely on measurement methods. Recent studies, from the early 1980s, have tried to explain the determinants of IIT.

Most of the studies of IIT have concentrated on the developed

countries. The purposes of this paper are to review the measurement of IIT and to attempt to find the determinants of the IIT of developing Asian countries: NICs (newly industrializing countries) and ODACs(other developing Asian countries).

Many preceding studies[2] on IIT have concentrated on the developed countries, which have similar incomes, tastes, and factor proportions. In contrast, this paper concentrates on the Asian developing countries, which have different incomes and development paths each other. For example, the main trade-increasing factors for Hong Kong have involved intermediary trade, rather than internal industrialization. Korea's economic policies promoted export-led industrialization dominated by a few large conglomerates. Taiwan's economy, in contrast, depends on hundreds of thousands of small shops and factories making everything from clothing and processed foods to electronics and plastics.

This paper calculates the IIT indices by Grubel and Lloyd's measure and examines the determinants of IIT in manufactured goods in bilateral trade between Asian developing countries and developed countries. This decision to confine the study to manufactured goods was made because IIT occurs principally in manufactured goods. The period covered by this study is from 1965 to 1990. This paper covers the leading Asian NICs, (Hong Kong, Korea, Singapore, and Taiwan), and ODACs, (China, Indonesia, Malaysia, Philippines, and Thailand).

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[2]. For example, Pagoulatos & Sorensen (1975), Finger & De Rosa (1979), Loertscher & Wolter (1980), Caves (1981), Lundberg (1982), Toh (1982), Havrylyshyn & Civan (1983), Bergstrand (1983), Greenaway & Milner (1984), etc.

Index-measuring methods are discussed in section II.1 and 2. Corrections for trade imbalances are discussed in section II.3, and some past econometric studies are reviewed in section II.4 and section II.5 summarizes the available formulas and econometric results.

The definition of an industry is discussed in section III.1. The indices used in this paper are described in section III.2 and the data used here in section III.3. The determinants of bilateral IIT are discussed in section III.4.

In section IV.1, the results based on our IIT index measure are reported. The determinants of changes in IIT over time are analyzed in section IV.2 and the determinants of IIT across countries in section IV.3.

Finally, the last section V, provides conclusions.

II. Review of proposed preceding definitions and measures of IIT and of past empirical studies.

II.1. Measures of bilateral IIT.

There have been many proposals for indices measuring the extent of IIT. Verdoorn (1960) proposed measuring the index of IIT in a country's bilateral trade in a single industry, i, by the ratio of exports to imports. For example, the index was defined as:

$$V_i = X_i / M_i$$ [3]

X_i and M_i were Dutch exports to and imports from Belgium and Luxembourg in three-digit industry i. The index can vary between 0 and ∞. When the index for a given industry moves towards unity over time, intra-industry specialization is considered to have taken place, and when the index over time diverges from unity, inter-industry specialization takes place.

Kojima (1964) calculated the degree of IIT, which he called horizontal trade, between two countries for a commodity category as follows;

$$D_i = (X_{iAB} / M_{iAB}) \cdot 100 \qquad \text{if } M_{iAB} > X_{iAB}$$

$$\text{or } = (M_{iAB} / X_{iAB}) \cdot 100 \qquad \text{if } M_{iAB} < X_{iAB}$$

where X_{iAB} is country A's export of commodity i to country B and M_{iAB} is country A's import of the same commodity from country B. The closer D_i is to 100, the higher is the level of horizontal trade. He also proposed an index of aggregate horizontal trade between two countries, which would be a weighted average of D_i for several

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[3]. Here and in other places, the industries' or countries' indices are deleted, for the reason of consistency in notation in this paper.

commodities by using as weights the percentage ratio of the total of X_{iAB} and M_{iAB} in the total trade of the two countries. This was defined as:

$$D = I + II$$

$$\text{where } I = \sum_i \{(X_{iAB} / M_{iAB}) \cdot (X_{iAB} + M_{iAB}) / (M_{AB} + M_{BA})\}$$

$$\text{if } X_{iAB} < M_{iAB}$$

$$II = \sum_i \{(M_{iAB} / X_{iAB}) \cdot (X_{iAB} + M_{iAB}) / (M_{AB} + M_{BA})\}$$

$$\text{if } X_{iAB} > M_{iAB}$$

where M_{AB} represents country A's total imports from country B and M_{BA} represents country B's total imports from country A.

Balassa (1966), examining tariff reduction and trade in manufacturing industries in the EEC, proposed, as a measure for the total inter-industry trade, (that is, trade other than IIT), of a single country with other EC countries:

$$B_i = n^{-1} \cdot [\sum_i \{ |X_i - M_i| / (X_i + M_i)\}]$$

where X_i and M_i refer to the intra-exports and -imports of commodity category i within EEC, and n is the number of commodity categories considered. B_i varies between 0 and 1. If the exports and imports in industry i tended towards equality, B_i would approach 0, which would signify a high proportion of IIT in intra-EC trade. On the other hand, if a country would only either import or export a product, B_i would be unity, indicating that all trade was inter-industry.

Loertscher and Wolter (1980), studying the bilateral trade flows of IIT among OECD countries, proposed the measure:

$$IIT_{ijk} = - |\ln (X_{ijk} / M_{ijk})|$$

where M_{ijk} and X_{ijk} represent country j's imports and exports of

commodity i in trade with country k and ln denotes the natural logarithm. The index ranges between 0 (exclusively IIT) and $-\infty$ (no IIT).

Bergstrand (1983) argued that a theoretically appropriate measure of bilateral IIT should be constructed from bilateral disaggregation of trade flows adjusted to simulate multilateral aggregate trade balance. The index was:

$$IIT^{k*}_{ij} = 1 - \{|X^{k*}_{ij} - X^{k*}_{ji}| \; / \; (X^{k*}_{ij} + X^{k*}_{ji})\}$$

where $X^{k*}_{ij} = (1/2)\cdot\{(X_i + M_i) \; / \; 2X_i + (X_j + M_j) \; / \; 2X_j\}\cdot X^{k}_{ij}$

$$X^{k*}_{ji} = (1/2)\cdot\{(X_j + M_j) \; / \; 2X_j + (X_i + M_i) \; / \; 2X_i\}\cdot X^{k}_{ji}$$

$$X_i = \sum_k \sum_j X^k_{ij}, \quad M_i = \sum_k \sum_j X^k_{ji}$$

$$X_j = \sum_k \sum_j X^k_{ji}, \quad M_j = \sum_k \sum_j X^k_{ij}$$

where X^k_{ij} (X^k_{ji}) is the value of the bilateral trade flow and the summation over k is across all industries, and the asterisk (*) indicates that trade flows reflect correction for overall trade imbalance.

II.2. Multilateral measures.

Grubel and Lloyd (1975) defined the IIT (R_i) for an industry in a country as the value of an industry's trade which was exactly matched by the imports of the same industry. That is,

$$R_i = (X_i + M_i) - |X_i - M_i|$$

where X_i and M_i represent exports and imports of industry i. They also defined inter-industry trade (S_i) as:

$$S_i = |X_i - M_i|$$

Then the IIT is the value of total trade, $(X_i + M_i)$, remaining after subtraction of net exports or imports, $|X_i - M_i|$, or the

interindustry trade of the industry. Alternatively, they calculated an IIT index as a percentage of each industry's combined exports and imports. Their alternative inter-industry measure was :

$$A_i = \{|X_i - M_i| / (X_i + M_i)\} \cdot 100$$

and the IIT measure was :

$$B_i = [\{(X_i + M_i) - |X_i - M_i|\} / (X_i + M_i)] \cdot 100$$

Both of the indices vary between 0 and 100. When the index is zero, either X_i or M_i is zero, so that there is no IIT. When the index is 100, $X_i = M_i$, so that all trade is IIT. When exports are equal to one-half of imports, or vice versa, the measure is 66.6 percent. That is, the value of matching exports and imports is two-thirds of the total value of exports plus imports. Then they measured the mean, using as weights the relative size of exports plus imports of each industry in the total value of exports plus imports of the set of n industries :

$$B_i' = \{ \sum_i B_i (X_i + M_i) / \sum_i (X_i + M_i)\} \cdot 100$$

$$= [\{ \sum_i (X_i + M_i) - \sum_i |X_i - M_i|\} / \sum_i (X_i + M_i)] \cdot 100$$

B_i' measures the average ratio (in percent) of IIT to total (export plus import) trade. The above expression is also equal to the sum of the IIT for all i as a percentage of the export plus import trade of the n industries:

$$B_i' = [\sum_i \{(X_i + M_i) - |X_i - M_i|\} / \sum_i (X_i + M_i)] \cdot 100$$

Aquino (1978) argued that Grubel and Lloyd's B_i' is a downward biased measure[4] of IIT if the country's total trade is unbalanced.

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[4]. It is biased relative to that when the overall trade is balanced. According to Aquino, when we measure aggregate IIT, we implicitly assume that overall trade is balanced even though one country specializes in one industry. For more discussions, see

B_i' is downward biased relative to a measure of IIT based on the structure of exports and imports. A country could appear to have inter-industry trade even if the share of each industry is the same in exports as in imports, if aggregate exports are larger or smaller than aggregate imports. Aquino proposed the estimation of what the values of exports and imports of each commodity would have been if total exports had been equal to total imports.

$$X^{\bullet}_{ij} = X_{ij} \cdot \{(1/2) \cdot \textstyle\sum_i (X_{ij} + M_{ij})\} \; / \; \textstyle\sum_i X_{ij} \; ,$$

$$M^{\bullet}_{ij} = M_{ij} \cdot \{(1/2) \cdot \textstyle\sum_i (X_{ij} + M_{ij})\} \; / \; \textstyle\sum_i M_{ij}$$

where $X^{\bullet}_{ij}$ and $M^{\bullet}_{ij}$ are the theoretical values of exports and imports if total exports had been equal to total imports. He argued that, by using those $X^{\bullet}_{ij}$ and $M^{\bullet}_{ij}$, Grubel and Lloyd's B_i could be purged of the effect of the overall imbalance in j's trade. Then using these, a new IIT index would be:

$$Q_j = [\{ \textstyle\sum_i (X_{ij} + M_{ij}) - \sum_i |X^{\bullet}_{ij} - M^{\bullet}_{ij}| \} \; / \; \sum_i (X_{ij} + M_{ij})] \cdot 100$$

$$\text{since} \quad \textstyle\sum_i (X^{\bullet}_{ij} + M^{\bullet}_{ij}) = \sum_i (X_{ij} + M_{ij})$$

Aquino said that Q_j had a great advantage over Grubel and Lloyd's B_i' and C_i (This is Grubel and Lloyd's adjusted measure; see the next section: trade imbalance). According to Aquino, C_i has the peculiarity that for any subset of commodities for which $X_{ij} < M_{ij}$ for all i or $X_{ij} > M_{ij}$ for all i its value is constantly equal to $|\sum_i X_{ij} - \sum_i M_{ij}|$ whatever the values of X_{ij} and M_{ij}, provided that one of those constraints is respected. In these circumstances, the Grubel and Lloyd's adjusted measure C_i reaches unity, even if not all of the considered industry or country trade is IIT. Therefore,

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Aquino's (1978) example.

he argued that B_i' was a downward biased measure of IIT, C_i was an upward biased measure of IIT. At first glance, this Aquino's index looks like the Grubel and Lloyd's B_i', but if we substitute Aquino's theoretical values into the Q_j, then the index is expressed by:

$$Q_j = 1 - (1/2)\cdot \left| (X_{ij} \ / \ \sum_i X_{ij}) \ - (M_{ij} \ / \ \sum_i M_{ij}) \right|$$

This is just one minus the share of each industry's exports in total exports and of each industry's imports in total imports. If the share in exports is the same as the share in imports, this index identifies all trade as IIT.

II.3. Trade imbalance.

When the IIT is measured at a particular level of aggregation, exports cannot be matched by imports in every industry or grouping. About the trade imbalance, Finger (1975) pointed out that "Grubel and Lloyd's primary measure of IIT involves an adjustment for trade imbalance. But if the results are to be used to evaluate the validity of the factor proportions theory or any other theory, the unadjusted measure is preferable. Any adjustment contains implicit assumptions about the effect on trade patterns of eliminating the phenomena being adjusted for, hence the "adjusted" figures could be misleading because of the invalidity of these implicit assumption."[5]

In their book, Grubel and Lloyd stated that "the mean is a downward biased measure of intra-industry trade if the country's

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[5]. Finger (1975), Footnote 4.

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. With an imbalance between exports and imports, the mean must be less than 100 no matter what the pattern of exports and imports, because exports cannot match imports in every industry. This undesirable feature is due to the fact that it captures both the trade imbalance and the strength of the IIT." When considering all commodity trade, they adjust for the aggregate trade imbalance by expressing IIT as a proportion of total commodity export plus import trade less the trade imbalance. The adjustment measure is expressed as:

$$C_i = (E / F) \cdot 100$$

$$= B_i' \cdot \sum_i(X_i + M_i) \; / \; \{ \sum_i(X_i + M_i) - |\sum_i X_i - \sum_i M_i| \}$$

$$= B_i' \cdot 1/(1-k)$$

where $E = \sum_i(X_i + M_i) - \sum_i|X_i - M_i|$

$F = \sum_i(X_i + M_i) - |\sum_i X_i - \sum_i M_i|$

$k = |\sum_i X_i - \sum_i M_i| \; / \; \sum_i(X_i + M_i)$

Thus the adjustment factor and the adjusted measure increase as the trade imbalance increases as a proportion of total export plus import trade. This adjusted index is measured with respect to total balanced trade and not to total trade. This adjusted measure attempts to provide a measure of what average IIT would have been if there had been overall balance in trade for the set of transactions considered. This adjusted IIT index is measured with respect to total balanced trade and not to total trade; thus Grubel and Lloyd claimed to have corrected the downward bias of the B_i' index.

The B_i is not necessarily a downward biased measure of average IIT when there is aggregate trade imbalance; the industry and specialization characteristics of an economy may induce individual industry and aggregate trade flows that are imbalanced but recurring and consistent with equilibrium. Kol's (1988) example[6], that the aggregate B_i is equal to the adjusted C_i.

Aquino (1978) basically agreed that Grubel and Lloyd's C_i involved a correction for trade imbalance that had to be made in order to measure IIT correctly. But he pointed out two problems: 1) The measure C_i applied to total trade only but not to each industry level, 2) The measure C_i did not provide an improvement over B_i. He argued that "It is evident that Grubel and Lloyd believed that the bias of the summary measure B_i' arises in the process of obtaining it as a mean of the values of B_i (implicitly considered unbiased). But this does not seem to be correct. If i's total trade is imbalanced, B_i' is a downward biased summary measure of IIT just because B_i is a downward biased measure of IIT in each commodity." According to him, his index has two advantages over Grubel and Lloyd's. Firstly, it avoids the problem of the correction for overall trade imbalance. Secondly, it is not dependent on the values of the expression $\sum_i | X_i - M_i |$, which makes the Grubel and

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[6]. Industry I

Sector	X	M
1	80	60
2	60	40
3	40	20

$B_I = .80$
$C_I' = 1.00$

Industry II

Sector	X	M
1	30	50
2	50	70
3	70	90

$B_{II} = .83$
$C_{II}' = 1.00$

But the aggregated B = .82 and C = .82.

Lloyd measure dependent on the level of data aggregation.

But Aquino (1978) was criticized by Greenaway and Milner (1981). They questioned two points which were "1) What set of international trading transactions would be balanced in a situation of twin equilibrium (simultaneous internal and external equilibrium)?, 2) How would full equilibrium influence the total level of a particular set of transactions (e.g. manufacturing trade), and trade in particular industries on a multilateral and bilateral basis?." They argued that "There can be no a priori justification, however, for approximating "equilibrium" with multilateral balance on manufactured trade, and certainly not with matching of manufactured goods on a bilateral basis."

In answer to Greenaway and Milner (1981)'s objection, Aquino (1981) wrote: "It is quite clear that Greenaway and Milner's objections to adjustment for multilateral imbalances (...) stem from the belief that its purpose would be to correct for the effect of "non-equilibrium", and consequently transitory, imbalances in overall trade."[7] He concluded that if one was interested in investigating IIT inside manufactures, one must correct for the bias arising from overall imbalances in trade in manufactures.

Bergstrand (1983) corrected Grubel and Lloyd's measure, too. The correction factor consists of two parts, averaged by the factor 1/2; the first element, $(X_i + M_i) / 2X_i$, displays exports plus imports of country i relative to two times its exports. That shows overall trade, which is aggregate over commodities k and over

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[7]. Aquino (1981).

partner countries j. When overall trade of country i is in deficit, that is when $(X_i + M_i) > 2X_i$, the correction factor shows an impulse to increase exports of country i. The second part, $(X_j + M_j) / 2X_j$, represents overall trade of country j and not of country i. It leads to this effect when country j has a trade surplus. Both elements work in the same direction but tend to decrease exports of country i to country j when the former country run a trade surplus and the latter a deficit. This Bergstrand procedure is different from the factors of correction which are specific with respect to each of the trade partner countries.

II.4. Review of earlier econometric studies.

There have been many studies attempting to explain IIT. Most have been concerned with developed, or industrialized, countries and with manufactured goods. Pagoulatos and Sorensen (1975), Finger and De Rosa (1979), and Toh (1982) covered the USA. Lundberg (1982), Gavelin and Lundberg (1983), Lundberg and Hansson (1986), and Jacobsson (1988) studied Sweden. Loertscher and Wolter (1980), Caves (1981), and Bergstrand (1983) concentrated on the OECD. Greenaway and Milner (1984) studied the UK. Tharakan (1984), Havrylyshyn and Civan (1983), and Balassa (1986.a,b) considered developed and developing countries.

Loertscher and Wolter (1980) studied the bilateral IIT among OECD countries and across industries simultaneously. As the determinants of IIT, they examined country-characteristics and industry-characteristics. The country-characteristics were levels of development, market sizes, and trade barriers. The industry-

characteristics were product differentiation, market entry, transaction costs, and industry classifications by SITC. Their basic findings can be summarized as follows: 1) Both among countries and across industries, IIT intensity is significantly influenced by a number of the determinants tested. Hence, IIT seems not to be a pure statistical artifact, a consequence of inappropriate aggregation. 2) IIT intensity between countries increases with a decreasing development level differential, a decreasing market size differential; increasing average market size; and decreasing distance between trading partners. 3) Across industries, the level of transaction costs, the level of industry aggregation, and scale economies are consistently significant.[8] They concluded that among countries: catching-up by one country an another or a simultaneous growth of domestic markets tends to increase the proportion of IIT. A lowering of transaction costs among trading partners, whether by a relative decrease of prices for transport and communication services or by a removal of policy-imposed trade barriers, also tends to be accompanied by an increase in IIT.

Caves (1981), using Hesse's (1974)[9] measure of IIT, tested for the influences that determine the intersectoral variance of the

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[8]. The signs of the coefficients were as follows:

Variables	IIT_{ijk}	Q_{ijk}
Transaction costs	-	-
Level of aggregation	+	+
Scale economies	-	-

[9]. The measure was $IIT = 1 - |X - M| / (X + M)$, where X and M represented a single sector's exports and imports.

amount of IIT, using as a dependent variable the proportion of IIT found in the exchange of manufactured goods among thirteen industrial countries. His four possible explanations were 1) heterogeneity of the observed categories, 2) product differentiation, 3) elements of jointness in production and distribution, and 4) the presence of trade barriers. He concluded that 1) IIT partly reflected the heterogeneity of the categories of trade that he measured, although heterogeneity accounts for only a small proportion of the variance of IIT, 2) The more extensive were scale economies, the less should be the amount of IIT, 3) IIT bore a complex relation to product differentiation, being increased by its complexity aspect and reduced by its informational aspect, 4) Foreign direct investment, which in the long run should be a substitute for trade, also tends to reduce IIT, but the joint involvement in international trade among affiliated companies was an offsetting factor that increased IIT. He suggested that the oligopolistic interdependence was not readily recognized among firms based in different countries, although it no doubt came more easily among near neighbors than with rivals who were geographically and culturally remote.

Lundberg and Hansson (1986) used Grubel and Lloyd's (1975) measure to analyze the Swedish pattern of IIT in 1978. They compared the Lancaster-Krugman type of explanation of IIT, (based on product differentiation and economies of scale), to the Heckscher-Ohlin trade model, (based on comparative advantage). The hypothesis was that if IIT was mainly a consequence of the exchange of differentiated products according to the Lancaster-Krugman type

of models, then there would be a high intra-industry share in trade between countries with similar relative factor endowments and natural resources. They found that Swedish IIT did not confirm the hypothesis that categorical aggregation was important to explain IIT. On the contrary, IIT seemed to be negatively correlated with various measures of intra-industry dispersion in factor proportions. Moreover, the analysis of the country pattern of IIT strongly confirmed the hypotheses that IIT was explained mainly as an exchange of differentiated products, and that this kind of trade was explained by diversity of preferences, economies of scale, and imperfect competition rather than by comparative costs. They concluded that IIT was likely to lead to less adjustment problems than the traditional type of inter-industry trade and specialization caused by comparative advantage.

Bergstrand (1983) had only three industries, but 273 observations of trade among fourteen OECD countries. He attempted to integrate recent theoretical work into an econometric model explaining sources of IIT, using bilateral measure of IIT. He found that 1) IIT did not appear to be merely an arbitrary consequence of product aggregation of essentially different industries, 2) IIT increases when pairs of countries specialize so as to exploit economies of scale in their trade, 3) greater product differentiation in the trade between two countries in an industry was consistent with a higher degree of IIT, 4) neither geographic adjacency of countries nor taste differences between countries were found to be prominent sources of IIT, 5) trade liberalization between pairs of countries tended to increase the share of IIT.

Tharakan (1984) used Grubel and Lloyd's measure (1975) and studied IIT in manufactures between the industrial countries and the developing countries. He focused on the pattern and determinants of IIT in manufactures between selected OECD countries, (USA, Germany, Japan, UK, and Italy), and the developing countries. His belief was that IIT was likely to take place mostly between countries with similar factor endowment patterns. He suggested that IIT could not be explained away by the level of aggregation. But neither could the variables derived from the theory of IIT consistently and significantly explain the commodity composition of IIT between countries with clearly different factor endowment patterns. He concluded that 1) IIT tended to be less between countries with greater per capita income differences: that is, as the income gap between countries became narrower, the IIT between them tended to increase. 2) trade barriers had an impact on the commodity composition of IIT in manufactures between the industrial countries and the developing countries.

Balassa (1986.a) calculated IIT by Aquino's measure (1978) and examined the determinants of IIT in bilateral trade in manufactured goods. He said this choice had been made because IIT occurred principally in manufactured goods that were characterized by product differentiation. The results showed that 1) the extent of IIT between any two countries increases with their average income level and with their average size, and it decreases with differences in their income level and size, 2) the extent of IIT was positively correlated with the existence of a common border between two countries, and it was negatively correlated with

distance between them, 3) introducing variables for economic integration, common language, and colonial ties increases the explanatory power of the regression equation relatively little, the exception being the equation for trade among developing countries. One of his interesting findings was that the European Community integration variable does not have a statistically significant impact on IIT specialization, while the EFTA (European Free Trade Association) and LAFTA (Latin America Free Trade Association) integration variables do.

II.5. Summary

We can divide the proposed measures into two groups. One measured IIT by trade patterns, the other by trade flows. Verdoorn, Kojima, Balassa, and Aquino belong to the first group, and Bergstrand, Hesse, and Grubel and Lloyd belong to the second group. The first group's measures are based on each industry's share in total imports or exports; the second group's measures are based on trade value.

In dealing with the issue of trade imbalance some authors applied their adjustment to all commodity trade (Grubel and Lloyd); some applied them to imbalances in trade in manufactures (Aquino, Grubel and Lloyd). Some authors corrected for imbalances in multilateral trade (Aquino, Balassa, Bergstrand, Grubel and Lloyd); Others corrected for imbalances in bilateral trade (For example, Loertscher and Wolter, and Bergstrand).Further studies should investigate the levels of data aggregation in all commodity trade, not just in manufactured industry, and in multilateral as well as

bilateral trade. The proposed measures of IIT are summarized in Table 1.

Table 1. Summary of index measures.

Proposer	Index
Bilateral index	
Verdoorn (1960)	$V_i = X_i / M_i$
Kojima (1964)	$D = I + II$
	where $I = \sum_i \{(X_{iAB} / M_{iAB}) \cdot (X_{iAB} + M_{iAB}) / (M_{AB} + M_{BA})\}$ if $X_{iAB} < M_{iAB}$
	$II = \sum_i \{(M_{iAB} / X_{iAB}) \cdot (X_{iAB} + M_{iAB}) / (M_{AB} + M_{BA})\}$ if $X_{iAB} > M_{iAB}$
Balassa (1966)	$B_i = n^{-1} \cdot \sum_i \{\lvert X_i - M_i \rvert / (X_i + M_i)\}$
Loertscher and Wolter (1980)	$IIT_{ijk} = - \lvert \ln (X_{ijk} / M_{ijk}) \rvert$
Bergstrand (1983)	$IIT^{k*}_{ij} = 1 - \{\lvert X^{k*}_{ij} - X^{k*}_{ji} \rvert / (X^{k*}_{ij} + X^{k*}_{ji})\}$
	where $X^{k*}_{ij} = (1/2) \cdot \{(X_i + M_i) / 2X_i + (X_j + M_j) / 2X_j\} \cdot X^k_{ij}$
	$X^{k*}_{ji} = (1/2) \cdot \{(X_j + M_j) / 2X_j + (X_i + M_i) / 2X_i\} \cdot X^k_{ji}$
	$X_i = \sum_k \sum_j X^k_{ij}, \quad M_i = \sum_k \sum_j X^k_{ji}$
	$X_j = \sum_k \sum_j X^k_{ji}, \quad M_j = \sum_k \sum_j X^k_{ij}$
Multilateral index	
Hesse (1974)	$H = \{(X_i + M_i) - \lvert X_i - M_i \rvert\} / (X_i + M_i)$
Grubel & Lloyd (1975)	$B_i' = [\sum_i \{(X_i + M_i) - \lvert X_i - M_i \rvert\} / \sum_i (X_i + M_i)] \cdot 100$
Aquino (1978)	$Q_j = \{1 - (\sum_i \lvert X^*_{ij} - M^*_{ij} \rvert) / \sum_i (X_{ij} + M_{ij})\} \cdot 100$
	where $X^*_{ij} = X_{ij} \cdot \{(1/2) \cdot \sum_i (X_{ij} + M_{ij})\} / \sum_i X_{ij}$
	$M^*_{ij} = M_{ij} \cdot \{(1/2) \cdot \sum_i (X_{ij} + M_{ij})\} / \sum_i M_{ij}$

The various hypotheses on IIT that are obtained from these empirical preceding are divided into two groups. The first group of hypotheses is concerned with the country characteristics that affect IIT: 1) the smaller the difference in factor endowment composition between two countries, the larger the level of IIT, 2) the larger the size of a country, the larger the share of IIT in its total trade, 3) the more similar the per capita income of countries, the higher the level of IIT among them, 4) the more capital abundant a country, the higher the level of IIT, 5) the higher the trade barriers, the lower the level of IIT, and 6) the higher the involvement of multinational corporations in a country's world economy, the higher the level of IIT.

The second group of hypotheses is concerned with the industry characteristics that affect IIT: 1) the more differentiated the commodities in an industry, the higher the level of IIT, 2) the larger the scale economies of an industry, the higher the level of IIT, 3) the longer the production process of an industry, the higher the level of IIT, 4) the more intermediate inputs needed in an industry, the higher the level of IIT, 5) the more capital intensive the technology employed in an industry, the higher the level of IIT, and 6) the larger the involvement of multinational corporations in an industry, the higher the level of IIT.

Loertscher and Wolter, and Caves focused on increasing returns and product differentiation as key determinants of IIT. They found negative coefficients and statistical significance for their increasing returns variable. Gavelin and Lundberg, Lundberg and Hanssen studied mainly industry characteristics. Their major

findings were that IIT was explained by an exchange of differentiated goods and diversity of preference. Bergstrand focused on economies of scale, product differentiation, and trade barriers. Tharakan's results indicate a complementarily between the Hechscher-Ohlin explanations of trade between the industrial and developing countries. His main finding was that the IIT level was decreased between countries with higher income differences.

A summary of econometric studies is in Table 2.

Table 2.Summary of econometric studies.

	Country	Year	Trade flows	Groups	Level	Industry
Loertscher & Wolter (1980)	OECD	1971 1972 1973	Bilateral	SITC 5-8	3-digit	48
Caves (1981)	14 OECD	1970	Within industrial countries	SIC	3-digit	94
Gavelin & Lundberg (1983)	Sweden	1974 1979	Bilateral with 11 industrial countries	ISIC	4-digit	77 (76)
Lundberg & Hansson (1986)	Sweden	1978	Bilateral	Manufactures	3 & 6-digit	77
Bergstrand (1983)	14 OECD countries	1976	Bilateral	SITC 7	2-digit	3-18
Tharakan (1984)	5 industrial countries	1972 1973 1974	With developing countries	SITC	3-digit	102
Balassa (1986.a)	39 developed & developing countries	1979	Bilateral	Manufactures	4-digit	167

III. Description of estimation.

III.1. Definition of industry.

One ground for skepticism about even the existence of IIT arises from the fact that the trade data have been grouped into categories of products that are heterogeneous. One way of defining an industry is by the degree of substitutability between one product and another on the production side and the consumption side.

With respect to the consumption side, any two firm's products in the same type of agriculture or mining are considered by consumers as (almost) perfect substitutes. The number of production steps in manufacturing industry suggests that each firm's product in an industry is supposed to be considered as a different product by customers.

On the production side, manufacturing industry can be defined a group of firms producing goods that are close substitutes and use identical production technologies and combinations of capital and labor. But this definition has problems too. Joint-products may have very different final uses. For example, tar, gasoline, and oils from crude oil are joint products in production but serve very different markets.

We have several reasons for selecting the three-digit Standard International Trade Classification (SITC) as our industry definition. One is that more disaggregated trade data are less reliable because all trade statistics have minimum reporting levels below which trade is unreported. Another is that, according to Grubel and Lloyd (1975) "the three-digit SITC statistics separate

commodities into groups most closely corresponding to the concept of an industry used conventionally in economic analysis."

III.2. Index measure in this paper.

With respect to trade flows, the most popular measure is the Grubel and Lloyd measure. With respect to trade patterns, Aquino's measure is the most frequently used.

We have settled on the former measure for this paper. This paper covers 101 manufacturing industries mainly as defined by United Nations 3-digit SITC codes and considers trade flows rather than trade patterns. Grubel and Lloyd's measure (1975), B_i, will be used bilaterally. Even though it was proposed as a multilateral measure, we can apply it to bilateral trade.

Aquino (1978) argued that Grubel and Lloyd's measure, B_i, was a downward biased measure of IIT, and Grubel and Lloyd's adjusted measure, C_i, was an upward biased measure of IIT. When we consider total trade, we think that B_i is a better measure than Aquino's measure, Q_i. For example[10],

Industry	Export	Import	IIT by industry
I	1	1	1.0
II	2	2	1.0
III	40	0	0
IV	0	40	0

Then the aggregate measures are $B_i = .07$ and $Q_i = .50$.

By giving equal weight to each of the four sectors the Q_i measure

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[10]. Kol (1990) Annex 3.II.

is 50 percent of total trade. But the B_i measure gives 7 percent, because industry I and II get only a small weight according to their small share in total trade, compared to the large industry III and IV.

If we develop Aquino's measure, it will be the value of the share of industry i's export in total export minus the share of i industry's import in total import. Therefore if one country's export and import shares are the same over all the industries, Aquino's measure reveals that all trade is IIT.[11] In this paper, B_i is to be preferred for the measure of IIT. The index is below:

$$B = 1 - \sum_i |X_i - M_i| / \sum_i (X_i + M_i)$$

where X_i and M_i are the value of industry i's the exports and imports in dollars. The index varies between 0 and 1. When the index is zero, either X_i or M_i is zero so that there is no IIT. When the index is 1, the exports are exactly equal to imports so that there is full IIT in the country.

III.3. Data descriptions.

The trade data were obtained by Kellman and Chow from Trade by Commodities, Series C. OECD . Manufactured goods have been defined by reference to the SITC. SITCs 688, 699 and SITC categories ending in 0 from 500 to 900, were deleted because some countries do not

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[11]. For example,

Industry	Export	Import
I	30	24
II	40	32
III	30	24

Then $IIT_I = IIT_{II} = IIT_{III} = 1$ and aggregated IIT = 1 too.

present data. 101 industry categories have been established by merging 3-digit categories. The variables for income differences were calculated from Summers and Heston (1991): "The Penn World Table (Mark 5): An expanded set of international comparisons, 1950-1988.". The consumption ratio (CR), and the openness of the economy (OPEN) were taken from Summers and Heston (1991). Because Summers and Heston did not calculate the openness measure for Singapore and Taiwan, the sum of Singapore's exports and imports in nominal terms was divided by total nominal GDP. The exports, imports, and total GDP values were taken from U.N. International financial statistical yearbook, 1991. For the Taiwanese openness measure, exports, imports, and total GDPs were taken from Council for Economic Planning and Development. 1990. "Taiwan statistical Databook." and all terms were nominal.

The Chow and Kellman estimates of IIT for the 9 countries, based on the U.N. trade data tapes, are given in Table 3. The share of IIT in total trade has increased for all the countries over the last 25 years. Generally, the IIT share of total trade is higher for the NICs than for other Asian developing countries. In 1965, all the Asian countries' IIT levels in manufactured goods, except for Hong Kong, were less than 10 percent. Dramatic increases (more than 30 percent point) in the IIT level took place in Malaysia, Singapore, Taiwan, Philippines, Korea, and Thailand. The IIT level of other Asian countries (Hong Kong, China, and Indonesia) also increased constantly. As we can see in the Table 3, IIT is not just the developed countries' economic phenomenon, but was characteristic of the developing countries too.

Table 3. Bilateral IIT of Asian with Developed countries.

Year	Hok.	Kor.	Sin.	Tai.	Chi.	Ins.	Mal.	Phi.	Tha.
1965	.2551	.0981	na	.0852	.1068	.0180	.0587	.0346	.0169
1966	.2954	.0863	.1129	.1245	.1076	.0405	.0419	.0372	.0154
1967	.2950	.1001	.0810	.1530	.1129	.0193	.0493	.0302	.0242
1968	.2716	.1046	.0811	.1926	.1140	.0221	.0357	.0267	.0249
1969	.2758	.1303	.0947	.2278	.1126	.0512	.0388	.0358	.0263
1970	.2589	.1730	.1506	.2695	.0831	.0258	.0354	.0418	.0272
1971	.2636	.2283	.1944	.2586	.1007	.0225	.0542	.0570	.0409
1972	.2847	.2982	.2864	.2997	.1203	.0292	.0607	.0437	.0492
1973	.3109	.3579	.3445	.2922	.0977	.0307	.1433	.0715	.0821
1974	.3250	.3582	.3432	.2864	.0963	.0314	.2003	.0818	.0967
1975	.3126	.3126	.3407	.2590	.0772	.0214	.2287	.0804	.0746
1976	.3274	.3390	.4033	.2891	.1098	.0234	.2966	.1313	.0964
1977	.3487	.3207	.4168	.3066	.1181	.0333	.3136	.1600	.0990
1978	.3560	.2942	.3669	.3132	.0977	.0374	.2376	.1653	.1164
1979	.3696	.2878	.3853	.3301	.1025	.0462	.2648	.1644	.1037
1980	.3810	.3485	.3759	.3192	.1392	.0488	.2507	.1816	.1289
1981	.4182	.3423	.4007	.3485	.1661	.0387	.2636	.1947	.1420
1982	.4047	.3584	.4375	.3468	.1618	.0426	.4196	.3280	.1608
1983	.4036	.3582	.4536	.3516	.1459	.0687	.4526	.3646	.1629
1984	.4038	.3802	.5103	.3721	.1361	.0769	.5226	.4333	.2231
1985	.4098	.3640	.5303	.3489	.0961	.0669	.5413	.4072	.2355
1986	.4111	.3757	.5148	.3692	.1217	.0639	.5453	.4257	.2908
1987	.4128	.3688	.5109	.3666	.1821	.0906	.5380	.3990	.2621
1988	.4395	.3845	.5045	.4014	.2248	.1098	.5205	.3788	.2738
1989	.4298	.4005	.4605	.4017	.2202	.1135	.5092	.3533	.2860
1990	.4338	.4195	.4543	.4409	.2296	.1011	.5045	.3663	.3003

na : not available
Source: Chow & Kellman. "Trade - The engine of growth in the Pacific Basin." Oxford Univ. Press. Forthcoming.

III.4. Determinants of bilateral IIT.

This paper tests for the determinants of the level of bilateral IIT by time series analyses of 101 three-digit manufacturing industries and by several cross-sections for 21 country combinations. The period starts with 1965. The final date varies, but is usually 1988. This paper examines the hypothesized relationships between various determinants and the IIT indices for trade between the Asian developing countries and developed countries. The regression analysis was done on bilateral trade flows between each of the nine Asian countries and the developed countries as a group. The independent variables studied included:

RI (relative income ratio): The closer to 100 the income per capita ratio between two trading countries, the higher the IIT index. RIs were calculated by each Asian developing country's GDP per capita (GDPC) divided by the developed country average GDPC. GDPCs are measured by the real GDP in 1985 international prices divided by population for each country. This paper follows Lundberg's hypothesis (1982): "The smaller the difference in per capita income levels between the two trading countries, the higher the proportion of intra-industry trade is likely to be." The expected sign of the ID is positive because we have placed the developed country' GDP per capita in the denominator. Since the Asian developing countries almost always have lower per capita incomes than the developed countries, a rise in the value of the variable represents a decrease in the income difference.

CR (consumption ratio in total real GDP): The higher the consumption ratio, the higher IIT. The consumption ratio is measured by the percentage of consumption in real GDP in 1985 international prices.[12] This hypothesis is based on the idea that a country with a higher consumption ratio will demand more differentiated goods. Consumption is the largest single component of aggregate expenditure in most countries. Generally, the higher the consumption level, the more differentiated goods will be demanded by people. The expected sign of the CR is positive.

OPEN (openness of economy): The higher the degree of openness of the economy, the higher the IIT. The basic openness measure is the trade intensity ratio: total trade divided by real GDP. The variables of OPEN were taken from Summers and Heston (1991). If there are no domestic or foreign distortions, trade will be more unconstrained. There will be more apportunities to specialize within industries and to gain economies of scale. The expected sign is positive.

The basic regression equation used to test the model described is:

$$IIT_i = (\alpha_0) + \alpha_1 RI_i + \alpha_2 CR_i + \alpha_3 OPEN_i + u_i$$

$$i = \text{year}$$

This equation is estimated for 101 industries. For most countries the periods are from 1965 to 1988. For Singapore, the period is from 1965 to 1985, because Singapore did not become independent

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[12]. Summers and Heston (1991).

until 1965 and the Summers and Heston data stop at 1985. For China, the period is 1972 to 1988, because trade with China was discouraged or forbidden by some countries until 1972.

IV. Empirical findings.

IV.1. Determinants of the IIT of Asian countries with eight developed countries.

A growing portion of international trade falls in the IIT category and most of it is conducted among the industrial countries, whose factor endowments have become increasingly similar. The preceding studies found that the share of IIT was greatest among countries of similar economic development status. If the findings of these preceding studies are generally applicable, we should find the same results in Asian countries, namely that the share of IIT increased as they approached the characteristics of the developed countries.

Table 4 shows the estimated regression coefficients for the determinants of IIT over time for individual countries. Generally, the adjusted R-squares are high, ranging from about 60 to 90 percent except for China and Philippines.

The coefficients of relative income (RI) are positive, as expected, in all the countries except the Philippines. But the coefficients for two of them (Korea and Malaysia) were not significant at the 95 percent significance level. In Malaysia's case, the coefficient was significant at the 90 percent level. But in Korea's case, even at the 90 percent level, the coefficient was not significant.

The coefficients of the consumption ratio usually did not reveal the expected sign. Four of them were positive and others were negative. Six were significant at the 95 percent level but only two were positive. This means that, generally, the IIT levels

are negatively related to a country's consumption ratio.

The coefficients of openness did better to explain the level of IIT. Four of the coefficients are positive and significant at the 95 percent level and one of them is positive and significant at the 90 percent level. As expected, a higher degree of openness leads to an increase in the IIT level.

When we added a constant term to the equations (Table 4.A), there were only a few changes. The degree of explanation increased substantially for Malaysia, but the IIT changes for the China and Philippines were still not well explained.

Table.4. Equations without Constant Terms for IIT in Trade Between Individual Asian Developing Countries and the Developed Countries, 1965 to 1988.

Country	Det.	Coef.	T-stat.	Adj.R^2
Chi.[1]	RI	.7805	2.758	.3888
	CR	.2833-04	.842	
	OPEN	.7982-02	.753	
HoK.	RI	.3100	12.389	.9438
	CR	.1095-02	4.647	
	OPEN	.4566-03	2.679	
Ins.	RI	.8180	6.582	.5989
	CR	-.4844-03	-2.614	
	OPEN	-.1577-02	-2.832	
Kor.	RI	.3799	1.204	.7056
	CR	.5532-03	.790	
	OPEN	.4540-02	2.695	
Mal.	RI	.2510	1.631	.6409
	CR	-.2881-02	-5.068	
	OPEN	.3114-02	2.334	
Phi.	RI	-5.5748	-2.740	.2087
	CR	.1203-01	3.166	
	OPEN	.2482-01	1.716	
Sin.[2]	RI	.6633	4.444	.8324
	CR	-.1696-02	-3.016	
	OPEN	.5352-04	.147	
Tai.	RI	.3922	3.278	.8627
	CR	-.1696-04	-.048	
	OPEN	.2322	4.632	
Tha.	RI	2.7047	11.606	.8336
	CR	-.4902-02	-4.444	
	OPEN	-.3542-02	-.737	

1. 1972 to 1988.
2. 1966 to 1985.

Table.4.A. Equations with Constant Terms for IIT in Trade Between Individual Asian Developing Countries and the Developed Countries, 1965 to 1988.

Country	Det.	Coef.	T-stat.	Adj. R^2
Chi.[1]	Con	.3237-02	.059	.3419
	RI	.7780	2.622	
	CR	.2580-04	.465	
	OPEN	.7190-02	.413	
HoK.	Con	-.1817-01	-.121	.9411
	RI	.1355-02	.626	
	CR	.4645-03	2.492	
	OPEN	.3706-03	1.280	
Ins.	Con	-.2483-01	.248	.5801
	RI	.8632	3.876	
	CR	-.2051-03	-.179	
	OPEN	-.1411-02	-1.605	
Kor.	Con	.2839	.684	.6980
	RI	.2541	.689	
	CR	-.3286-02	-.581	
	OPEN	.4198-02	2.361	
Mal.	Con	1.4228	3.347	.8335
	RI	.8404	1.779	
	CR	-.2785-01	-5.257	
	OPEN	-.1232-02	-.347	
Phi.	Con	2.1555	2.032	.3113
	RI	-8.3254	-3.571	
	CR	-.9836-02	-.868	
	OPEN	.9195-02	.592	
Sin.[2]	Con	.8119-01	.191	.8223
	RI	.5962	1.551	
	CR	-.2357-02	-.670	
	OPEN	.1004-03	.224	
Tai.	Con	.8194	2.377	.8876
	RI	.3183	2.825	
	CR	-.1192-01	-2.375	
	OPEN	.6301-01	.746	
Tha.	Con	.6563	2.884	.8766
	RI	1.5278	3.359	
	CR	-.9933-02	-5.000	
	OPEN	-.8988-02	-1.975	

1. 1972 to 1988.
2. 1966 to 1985.

Since many studies of bilateral IIT have concluded that differences in real income levels between individual partner countries are the most crucial determinant, we have examined that variable separately for income differences between developing Asian countries and the US, the EC, and the Japan.

DIFI (absolute income difference between countries): The lower the difference in income per capita between pairs of countries, the higher we expected the IIT to be. It is calculated from Summers and Heston (1991): "The Penn World Table (Mark 5): An Expanded set of International Comparisons, 1950-1988." DIFI was calculated as the absolute value of each developing Asian country's GDP per capita (GDPC) minus that of the US, the EC, and Japan. The EC average GDPC is an unweighted average of the GDPC of the six EC countries. The use of this variable is based on the idea that similarities in demand and consumer taste can create markets for differentiated products and increase IIT. It concerns the demand side of product differentiation which is a primary determinant of IIT. The expected sign of the DIFI coefficient is negative.

The equation is:

$$IIT_{ij} = \beta_0 + \beta_1 DIFI_{ij} + v$$

i = China, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand

j = year (1965-1988, except for Singapore: 1965-1985, for China: 1972-1988)

The individual regression results are in Table 5. We expected that

as the absolute income differences between the particular developed countries and developing Asian countries became narrower, the IIT between them should tend to increase. Generally we believed that Asian developing countries' income levels had come closer to those of the developed countries over time, but except in a few cases, Hong Kong and Singapore, the developing Asian countries' income levels did not come closer in absolute terms to those of the developed countries. In many cases, the income gap between Asian developing countries and developed countries increased with time.[13] The coefficient of the absolute income difference produced the expected negative sign in only a few cases, but most cases produced positive signs.

When we use the relative income ratio between Asian developing countries and developed countries, the results are quite different. As the relative income ratio between Asian developing countries and developed countries became narrower, the IIT between them tended to increase with time[14] except a few cases.[15] In this case, RI is each Asian country's GDP per capita (GDPC) divided by that of the US, the EC, and Japan. We expect that the closer to 100 the income per capita between pairs of countries, the higher the IIT level. The individual regression results are in Table 5 A. We have some negative signs for the coefficients of relative income, but they

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[13]. See Appendix III.

[14]. For IIT level see figure 1 and 2, and for income see ID, IDU, IDE, and IDJ in figure 3 to 11.

[15]. See in figure 7, IDJ: relative income ratio between Malaysia and Japan, and in figure 8, IDU (IDE and IDJ): relative income ratio between Philippines and US (EC and Japan).

are not significant at the 95 percent level except Philippines' coefficient with EC and Japan. Aside from a few negative signs, the relative income form of the variable countries confirms earlier studies for other groups of countries.

In Table 5.A, when we used just the relative income ratio, we have very few negative signs and they are not significant except for the Philippines with EC and Japan and for Thailand with Japan. In figure 8, it can be seen that the per capita income of the Philippines relative to the EC and Japan decreased with time. Similarly, in figure 11, Thailand's per capita income fell, relative to that of Japan. So when the income ratios were increasing in Asian countries, all the coefficients revealed the expected positive signs, but declines in the relative income ratios produced some unexpected negative signs. One possibility is that there are some omitted variables in these equations are promoting IIT and offset the effects of the widening income differentials, but add to the measured effect of the more typical narrowing differentials.

Table.5. Equations Relating IIT to Absolute Income Differences between Asian Developing and Developed Countries.

Country		Con. (t-stat)	DIFI.(t-stat)	Adj.R^2
Chi.[1]	US	60.8411(13.773)	-.4281-02(-13.312)	.9168
	EC	.1889(2.181)	-.6967-05(-.738)	-.0293
	Jap	-.1838-01(-.407)	.1513-04(2.774)	.2950
HoK.	US	.3984(13.955)	-.2254-04(-5.982)	.6020
	EC	.3416(25.871)	-.2920-04(-6.005)	.6038
	Jap	.9610-01(10.515)	.1089-04(1.867)	.0976
Ins.	US	-.1003(-1.602)	.1124-04(2.425)	.1750
	EC	.8130-02(.278)	.5365-05(1.520)	.0539
	Jap	-.2270-01(-2.029)	.5960-05(3.949)	.3882
Kor.	US	-.5106(-2.964)	.5911-04(4.087)	.4058
	EC	-.6028(-6.275)	.1125-03(7.816)	.7232
	Jap	-.2102(-4.878)	.8213-04(10.895)	.8388
Mal.	US	-1.1651(-2.290)	.1334-03(2.919)	.2463
	EC	-.4907(-2.859)	.1167-03(4.007)	.3957
	Jap	-.9481-01(-5.194)	.3546-04(9.743)	.8033
Phi.	US	-.9076(-5.339)	.8644-04(6.604)	.6494
	EC	-.4907(-7.917)	.8408-04(10.544)	.8273
	Jap	-.8089-01(-5.519)	.2317-04(10.979)	.8387
Sin.[2]	US	1.0471(6.113)	-.9207-04(-4.306)	.4672
	EC	.4970(10.414)	-.7955-04(-5.142)	.5598
	Jap	.1243(5.897)	-.3632-04(-3.104)	.3015
Tai.	US	.2512(1.603)	-.3320-05(-.244)	-.0426
	EC	.3847-04(.000)	.2895-05(1.378)	.0376
	Jap	-.2861(-8.504)	.8765-04(13.963)	.8940
Tha.	US	-.5308(-9.562)	.4825-04(11.131)	.8424
	EC	-.2517(-3.236)	.4516-04(4.356)	.4387
	Jap	-.5761-01(-4.337)	.1855-04(9.396)	.7915

1. 1972 to 1988.
2. 1965 to 1985.

Table.5.A.Equations Relating IIT to Relative Income Differences between Asian Developing and Developed Countries.

Country		Con. (t-stat)	RI (t-stat)	Adj.R^2
Chi.[1]	US	-.6169-01(-2.417)	1.5626 (5.534)	.6493
	EC	.3749-01(.977)	.6475 (2.368)	.2236
	Jap	.8109-01(3.633)	.1833 (1.164)	.0217
HoK.	US	.1361(7.913)	.1984 (5.684)	.5764
	EC	.9820-01(5.185)	.2401 (9.311)	.7884
	Jap	.1310(3.914)	-.2427-01(-.594)	-.0289
Ins.	US	-.6801-01(-3.733)	1.4818 (6.694)	.6558
	EC	.3467-01(1.643)	.1392 (.839)	-.0131
	Jap	-.1137-01(-.377)	.2224 (1.049)	.0049
Kor.	US	.3952-02(.158)	1.0372 (7.833)	.7241
	EC	-.5381-01(-1.662)	.7014 (6.398)	.6346
	Jap	-.1900(-1.644)	1.4008 (3.877)	.3789
Mal.	US	-.6111(-3.477)	3.8886 (5.375)	.5480
	EC	-.4519(-5.850)	1.7293 (8.455)	.7540
	Jap	.9422-01(.937)	-.4139-01(-.175)	-.0440
Phi.	US	.3519(.930)	-1.2167 (-.386)	-.0384
	EC	1.0779(3.551)	-4.9327 (-3.054)	.2659
	Jap	.2826 (6.989)	-.9717 (-5.270)	.5379
Sin.[2]	US	-.3659-01(-.443)	.8447 (4.686)	.5245
	EC	-.1119(-2.133)	.5876 (7.814)	.7597
	Jap	-.1491(-4.274)	.2821 (6.295)	.6703
Tai.	US	.2335(9.395)	-.9998-01(-.865)	-.0111
	EC	-.4180-04(.002)	.5589 (9.701)	.8019
	Jap	-.3217(-5.783)	1.3913 (9.057)	.7789
Tha.	US	-.7091(-8.384)	6.6498 (10.090)	.8142
	EC	-.3672(-6.605)	2.2612 (8.183)	.7415
	Jap	.2182(2.877)	-.6826 (-2.058)	.1233

1. 1972 to 1988.
2. 1966 to 1985.

IV.3. Cross-sectional studies for selected years.

This paper studied bilateral IIT cross-sectionally for the effects of relative income ratio and openness. The selected years were 1970, 1975, 1980, and 1985. As before, each Asian developing country's openness was taken from Summers and Heston (1991). Because Summers and Heston did not calculate the openness measure for Singapore and Taiwan, the sum of Singapore's exports and imports in nominal terms was divided by total GDP. The exports, imports, and total GDP values were taken from U.N. International financial statistical yearbook, 1991. The total trade and GDP values of Taiwan were taken from Taiwan Statistical Databook, 1990.

The relative income ratio was calculated as each Asian country's GDP per capita divided by each developed country's (US, EC, and Japan) GDP per capita. The GDP per capita were taken from Summers and Heston (1991).

The equation used in this paper was

$$IIT_i = \beta_1 OPEN_i + \beta_2 RI_i + u$$

The summary of cross-sectional studies is in Table.6. The coefficients of openness are always negative but there were never significant. The coefficients of the relative income ratio are always positive and significant at the 90 percent level. This cross-sectional analysis matches the time series for the income ratio. In cross-country analyses, the coefficients of the income ratio are very high and significant.

Table.6. Cross-country Equations Relating IIT to Openness and Relative Income Differences between Asian Developing Countries and Developed Countries, Selected years.

Year	Constant(t-stat)	OPEN(t-stat)	RI(t-stat)	Adj. R^2
'70	.5206-01(1.760)	-.9524-06(-.145)	.1408(1.455)	.0100
'75	.7759-01(1.942)	-.1480-03(-.254)	.2440(2.122)	.0915
'80	.1198 (3.757)	-.9658-04(-.225)	.1617(2.021)	.0849
'85	.2000 (4.004)	-.7512-03(-.907)	.1631 (1.455)	.0101

V. Conclusions.

This paper has focused on understanding developing Asian countries's IIT: How is IIT measured ? What causes IIT ? Can IIT be empirically explained ? This paper attempted to identify factors that were relevant in explaining variations in IIT in Asian countries during 1965 through 1988, using a bilateral measure of IIT. We know that the rate of industrialization in some developing Asian countries has been very rapid. The IIT level has increased rapidly with their development, thus approaching the level in the trade among the developed countries. With their high rate of economic growth and industrialization these Asian countries have been gradually approaching the developed countries in terms of income. And it seems likely that Asian countries have been approaching the developed countries pattern of consumption patterns too.

In the regression results for time series, the change in income levels, (real income per capita), relative to the developed countries played the major role, even when other variables were included in the equation. The higher the relative income of these countries, the greater the proportion of IIT in their trade, the higher degree of openness of the economy also resulted in more IIT. When we used the absolute income difference between partner countries by itself as the explanatory variable, the coefficient were positive, rather than negative, as expected, except when Asian countries' income levels were very close to that of developed countries. When we used the relative income ratio alone, except in a few cases when they decreased, all the coefficients were

positive. We can say that this analyses generally supported the multi-variate time series regressions.

Since preceding econometric studies of IIT concentrated on cross-industry or cross-country variation. One advantage of the cross-sectional analysis is that it tests whether the time series results were the effect of trends over time. Since the income ratios had strong time trends it is hard to distinguish their effect from those of other variables with strong trends. We studied the variation in IIT across countries for openness and the income ratio. The openness variable had little influence, but the coefficient for the income ratio was generally positive and significant. We conclude that the income difference is the major determinant of IIT.

In a multi-product version of the traditional model, IIT may occur as a purely statistical phenomenon if the classification system aggregates single homogeneous products from different ends of the ranking by comparative advantage. Therefore, the higher the dispersion in factor requirements among products in a product group, the more IIT there will appear to be. While this phenomenon exists, most empirical studies have concluded that it does not account for all of IIT, and that there is some genuine exchange of products with similar factor requirements.

Generally, we could sum up the main findings of this studies as follows: the level of IIT in the Asian NICs and developing countries in manufacturing industries increased with their development. IIT appears not only in the case of developed countries where it is very important and growing rapidly, but also

in the trade of Asian developing countries too. And the IIT is a quantitatively important factor in their total trade. The (mainly) export oriented Asian countries's IIT ratio generally follows that of the developed countries. Therefore this study confirms that the IIT patterns of Asian NICs and developing countries follows that of the developed countries.

Appendix.I: Bilateral IIT of Developing Asian Countries with Developed Countries.

	Korea			Taiwan			Singapore		
Year	US	EC	Jp	US	EC	Jp	US	EC	Jp
1965	.0853	.0336	.0428	.1303	.0987	.0146	.0799	.0000	.0000
1966	.0853	.0453	.0391	.1875	.0715	.0183	.0672	.1457	.0032
1967	.0756	.0443	.0873	.2011	.0983	.0375	.0703	.0952	.0115
1968	.0982	.0203	.0787	.2587	.0820	.0391	.0417	.0954	.0056
1969	.1419	.0296	.1076	.2608	.1300	.0598	.1465	.0934	.0066
1970	.1414	.0668	.1707	.2420	.1373	.1166	.3016	.1368	.0101
1971	.1580	.1338	.2176	.2320	.1286	.0932	.3188	.1473	.0332
1972	.1718	.1785	.2497	.2341	.1619	.1112	.4194	.2993	.0457
1973	.1995	.1443	.3047	.2302	.1447	.1633	.4096	.3133	.0724
1974	.2220	.1464	.2975	.2449	.1578	.1732	.4037	.3221	.0683
1975	.2069	.1348	.3126	.2247	.1445	.1629	.4110	.3225	.0655
1976	.2417	.1427	.3337	.2135	.1704	.2055	.4844	.3129	.1361
1977	.2040	.1591	.2809	.2374	.1996	.1923	.5126	.3341	.0856
1978	.1669	.1692	.2159	.1930	.2316	.1866	.2945	.3636	.0878
1979	.1699	.1321	.2631	.1987	.2241	.2402	.2717	.3846	.0983
1980	.1928	.2309	.3608	.2276	.2282	.2151	.2643	.3795	.0806
1981	.1968	.1613	.3878	.2553	.2344	.2251	.3181	.3604	.1078
1982	.3066	.1954	.3691	.2208	.2183	.2650	.4692	.3502	.0822
1983	.2896	.1957	.3398	.1975	.2091	.2498	.4866	.3858	.0793
1984	.2577	.2232	.3233	.1683	.2163	.2632	.4922	.4337	.1294
1985	.2502	.2519	.3246	.1494	.2544	.2980	.5046	.4298	.1453
1986	.2433	.2228	.2911	.1668	.2716	.2579	.4916	.4500	.1479
1987	.2407	.2156	.3127	.1909	.2384	.2802	.4824	.4019	.1609
1988	.2662	.2236	.3584	.2480	.2576	.3382	.5271	.4158	.1713
1989	.2931	.2593	.3684	.2695	.2760	.3637	.4887	.4222	.2164
1990	.3313	.2788	.3810	.3044	.3010	.3715	.4757	.4141	.2171

(Continued)

App.I. Continued.

	Hong Kong			China			Indonesia		
Year	US	EC	Jp	US	EC	Jp	US	EC	Jp
1965	.1739	.1854	.0807	.0000	.1290	.0506	.0256	.0250	.0099
1966	.2242	.2055	.0747	.0000	.1208	.0662	.0551	.0303	.0168
1967	.1957	.2255	.0991	.0112	.1007	.1019	.0096	.0224	.0156
1968	.1874	.2149	.0993	na	.1120	.1033	.0118	.0394	.0088
1969	.2149	.2340	.1010	.0000	.1310	.0857	.0079	.1211	.0162
1970	.1946	.2137	.1246	.0000	.1070	.0533	.0106	.0529	.0099
1971	.1916	.2377	.0968	.0039	.1117	.0798	.0104	.0517	.0089
1972	.1940	.2557	.0892	.0116	.1166	.1117	.0256	.0643	.0120
1973	.2162	.2728	.1810	.0238	.0962	.0929	.0393	.0507	.0149
1974	.2501	.2784	.1309	.0238	.1152	.0721	.0512	.0541	.0102
1975	.2300	.2518	.1192	.0433	.0723	.0722	.0260	.0432	.0072
1976	.2452	.2318	.1280	.0438	.0975	.1038	.0237	.0367	.0097
1977	.2092	.2751	.1059	.0453	.1091	.0961	.0637	.0414	.0108
1978	.1914	.2940	.1211	.0803	.0756	.0932	.0638	.0432	.0138
1979	.2183	.3035	.1364	.0812	.0870	.0955	.0570	.0481	.0182
1980	.2622	.2692	.1055	.0924	.1401	.0998	.0677	.0491	.0177
1981	.2831	.2944	.0959	.1116	.1889	.1152	.1042	.0394	.0110
1982	.2844	.3063	.1061	.0975	.2000	.1516	.0984	.0341	.0141
1983	.2700	.3018	.1122	.1001	.1690	.1286	.1248	.0712	.0279
1984	.2553	.3189	.1064	.0975	.1531	.1086	.1257	.0624	.0251
1985	.2359	.3428	.1008	.0828	.1120	.0676	.0708	.0629	.0316
1986	.2326	.3110	.1153	.0973	.1156	.0978	.0585	.0644	.0365
1987	.2480	.3125	.1204	.1215	.1583	.1439	.0383	.0774	.0473
1988	.3163	.3474	.1208	.1435	.1851	.1574	.0458	.0655	.0878
1989	.3041	.3732	.1368	.1327	.1789	.1967	.0686	.0806	.0982
1990	.2968	.3787	.1238	.1272	.1768	.2518	.0706	.0771	.0800

(Continued)

App.I. Continued.

	Malaysia			Philippines			Thailand		
Year	US	EC	Jp	US	EC	Jp	US	EC	Jp
1965	.0299	.0663	.0000	.0497	.0131	.0154	.1739	.1854	.0807
1966	.0245	.0425	.0032	.0566	.0178	.0082	.2242	.2055	.0747
1967	.0254	.0522	.0115	.0389	.0237	.0108	.1957	.2255	.0991
1968	.0199	.0517	.0056	.0488	.0764	.0146	.1874	.2149	.0993
1969	.0258	.0429	.0066	.0475	.0299	.0108	.2149	.2340	.1010
1970	.0294	.0352	.0101	.0556	.0353	.0248	.1946	.2137	.1246
1971	.0324	.0591	.0332	.0488	.0321	.0145	.1916	.2377	.0968
1972	.0615	.0419	.0457	.0553	.0432	.0180	.1940	.2557	.0892
1973	.2242	.0893	.0724	.0799	.0515	.0583	.2162	.2728	.1810
1974	.3999	.1251	.0683	.1088	.0676	.0506	.2501	.2784	.1309
1975	.3866	.1792	.0655	.1154	.0624	.0330	.2300	.2518	.1192
1976	.4756	.2088	.1361	.1842	.1045	.0676	.2452	.2318	.1280
1977	.5021	.2161	.0856	.2199	.1210	.0779	.2092	.2751	.1059
1978	.1978	.2395	.0878	.1776	.1810	.0675	.1914	.2940	.1211
1979	.2053	.2520	.0938	.1465	.1709	.1093	.2183	.3035	.1364
1980	.1942	.2848	.0806	.1479	.2129	.1434	.2622	.2691	.1055
1981	.1985	.2578	.1078	.1572	.2107	.1242	.2831	.2944	.0959
1982	.6628	.3089	.0822	.4416	.2538	.1070	.2844	.3063	.1061
1983	.7125	.3055	.0793	.5130	.2407	.0956	.2700	.3018	.1122
1984	.6351	.3702	.1294	.4957	.3533	.1449	.2553	.3189	.1064
1985	.6070	.3473	.1453	.4508	.3412	.1425	.2359	.3428	.1008
1986	.6222	.3715	.1479	.4772	.3609	.1413	.2326	.3110	.1153
1987	.6623	.3387	.1609	.4387	.3719	.1289	.2480	.3125	.1204
1988	.6013	.3337	.1713	.3975	.2996	.1416	.3163	.3474	.1208
1989	.5633	.3800	.2164	.3931	.2956	.1624	.3041	.3732	.1368
1990	.5350	.3674	.2171	.3732	.3188	.2150	.2968	.3787	.1238

Source: Chow & Kellman. "Trade - The engine of growth in the Pacific Basin." Oxford Univ. Press. Forthcoming.

Appendix.II. Figure.

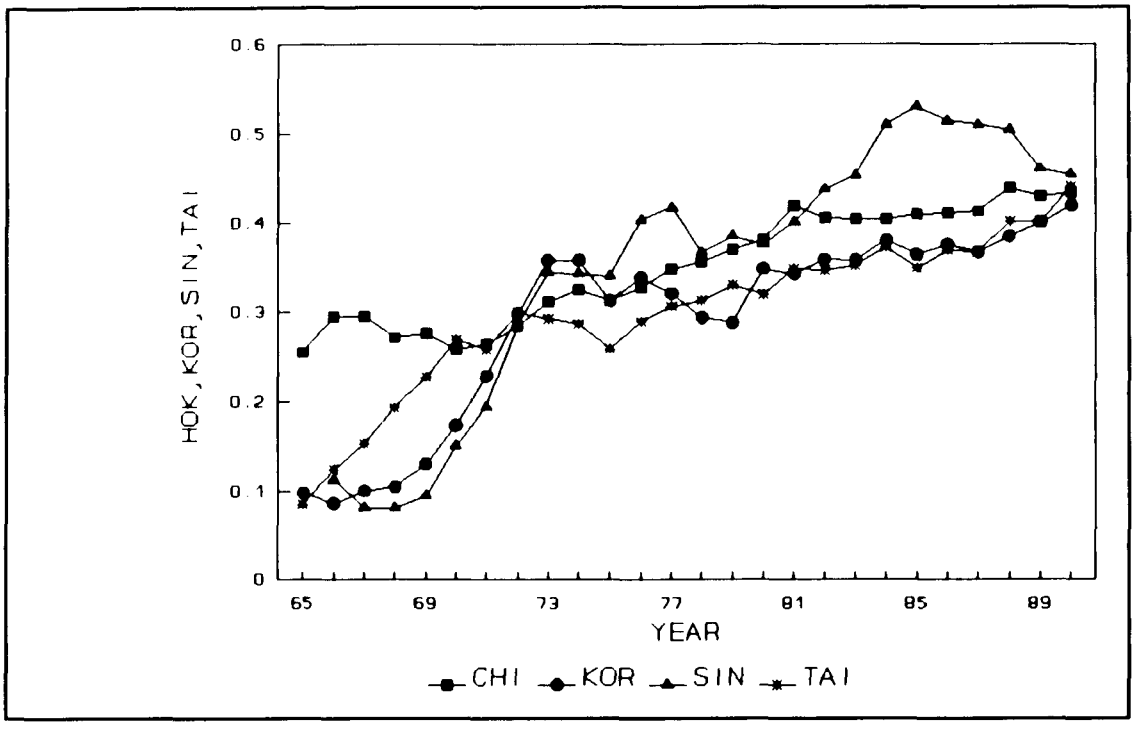

Figure 1. IIT of NICs.

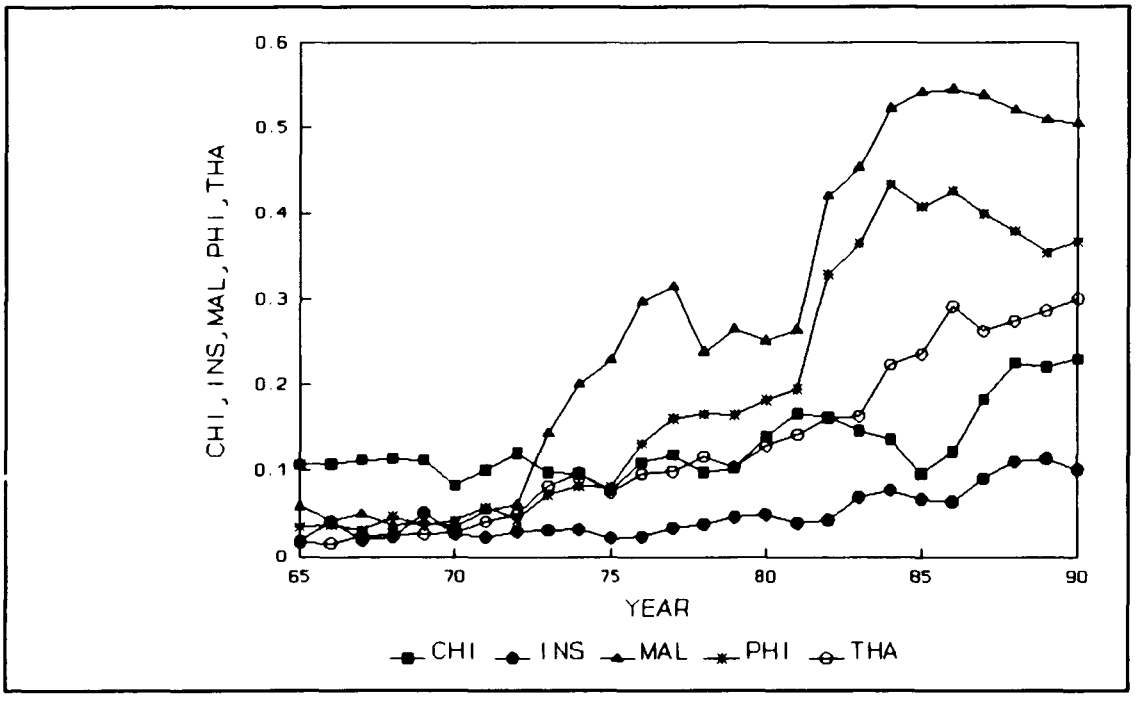

Figure 2. IIT of other Asian countries.

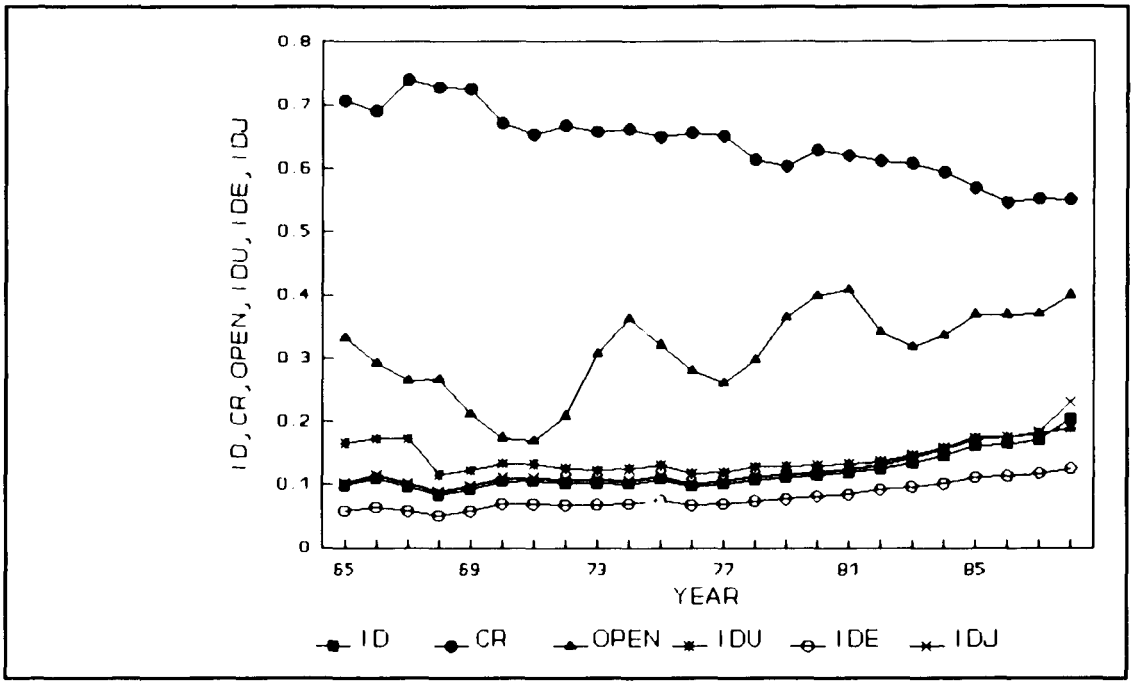

Figure 3. Time trends of independent variables of CHINA

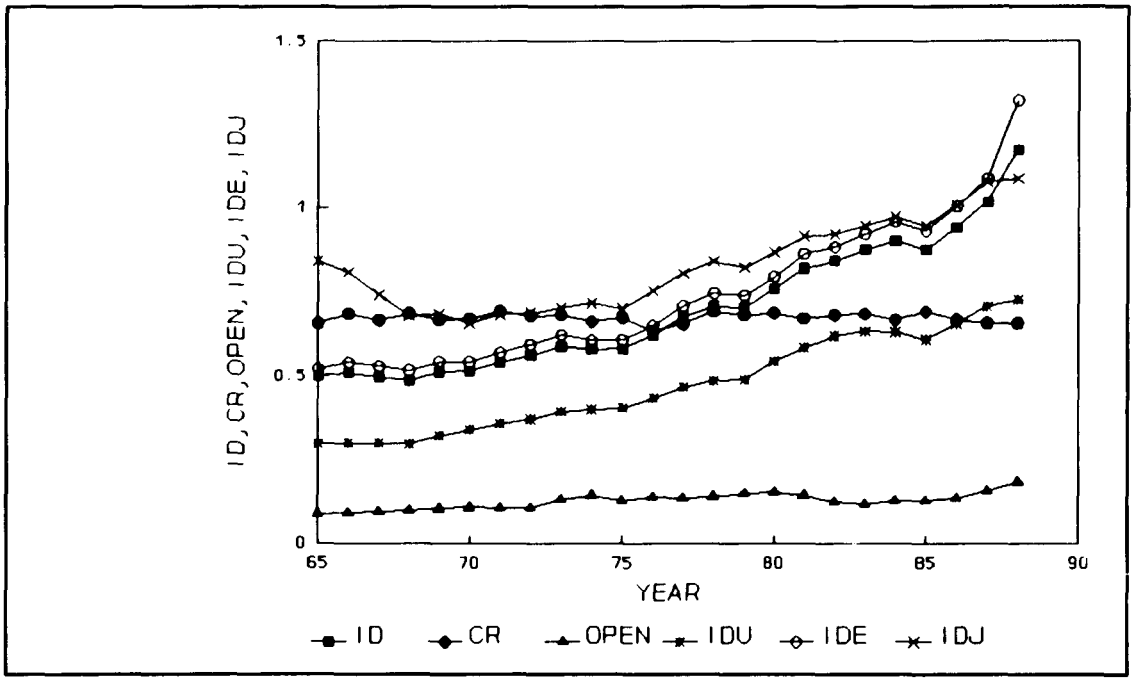

Figure 4. Time trends of independent variables of HONG KONG

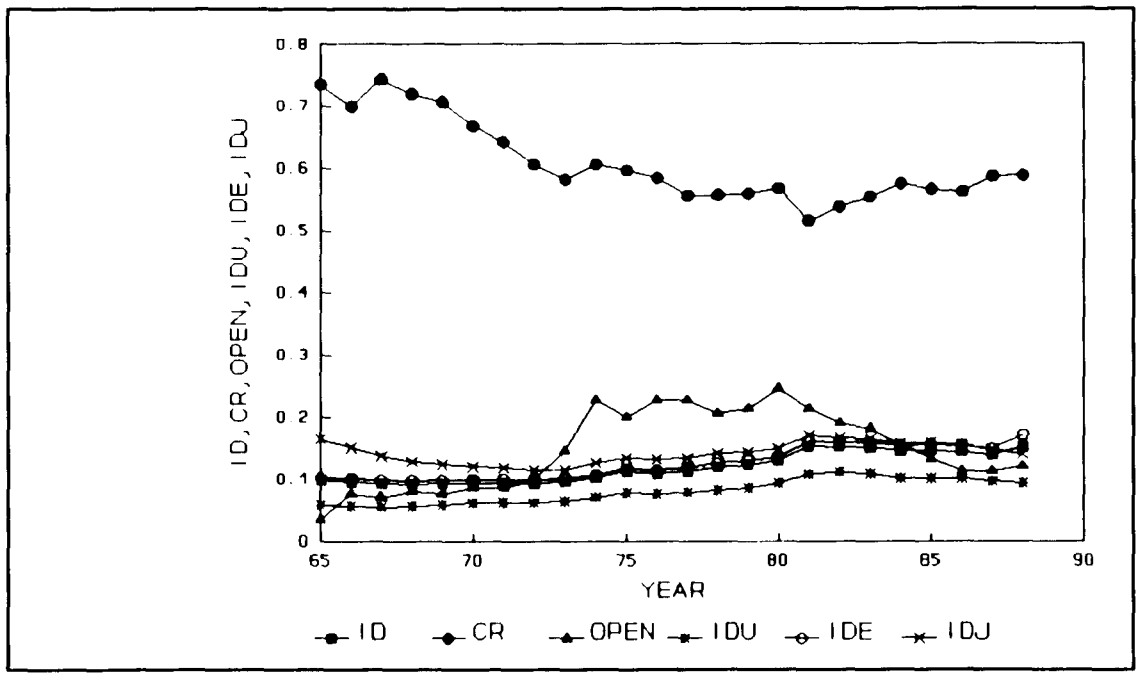

Figure 5. Time trends of independent variables of INDONESIA

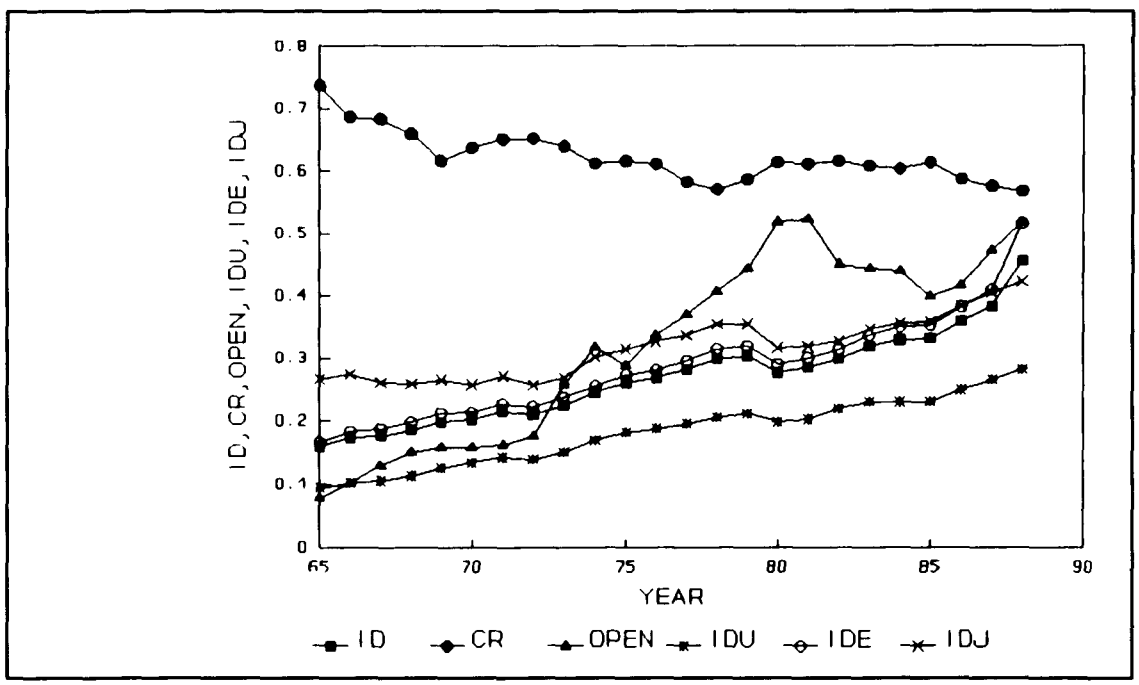

Figure 6. Time trends of independent variables of KOREA

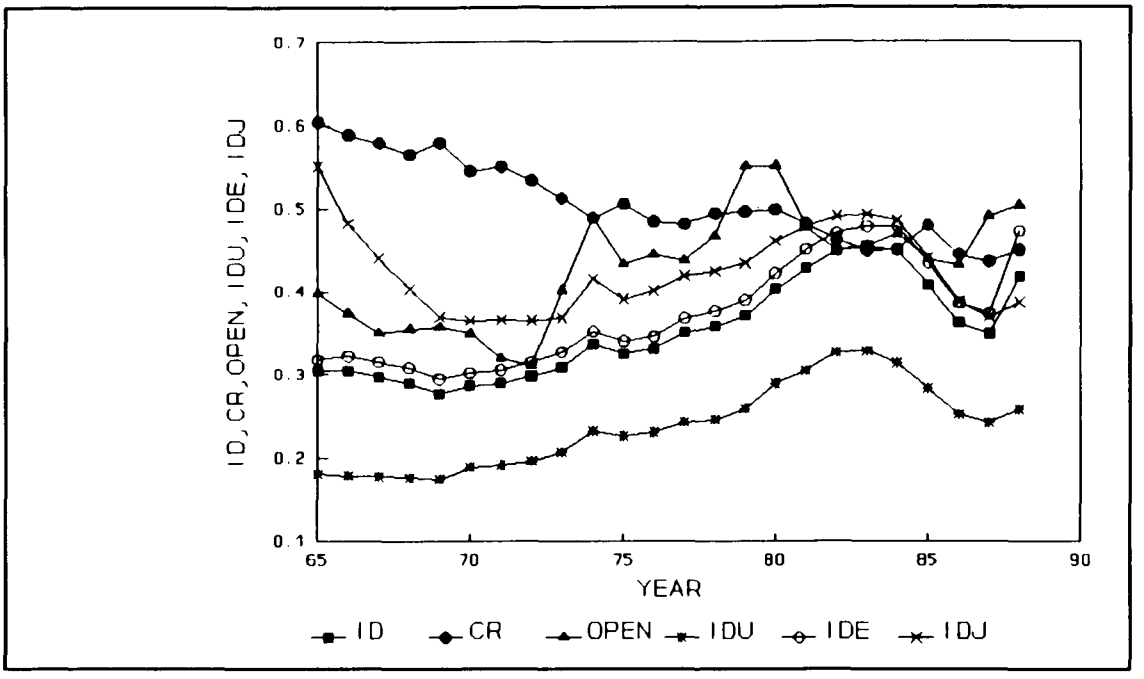

Figure 7. Time trends of independent variables of MALAYSIA

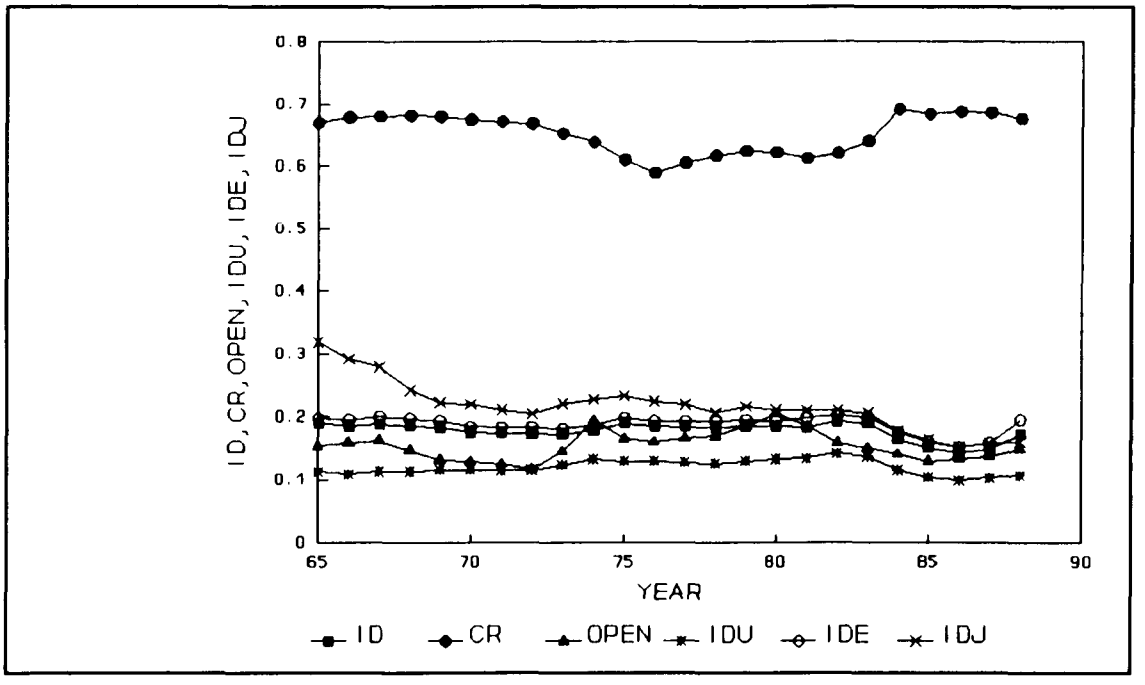

Figure 8. Time trends of independent variables of PHILIPPINES

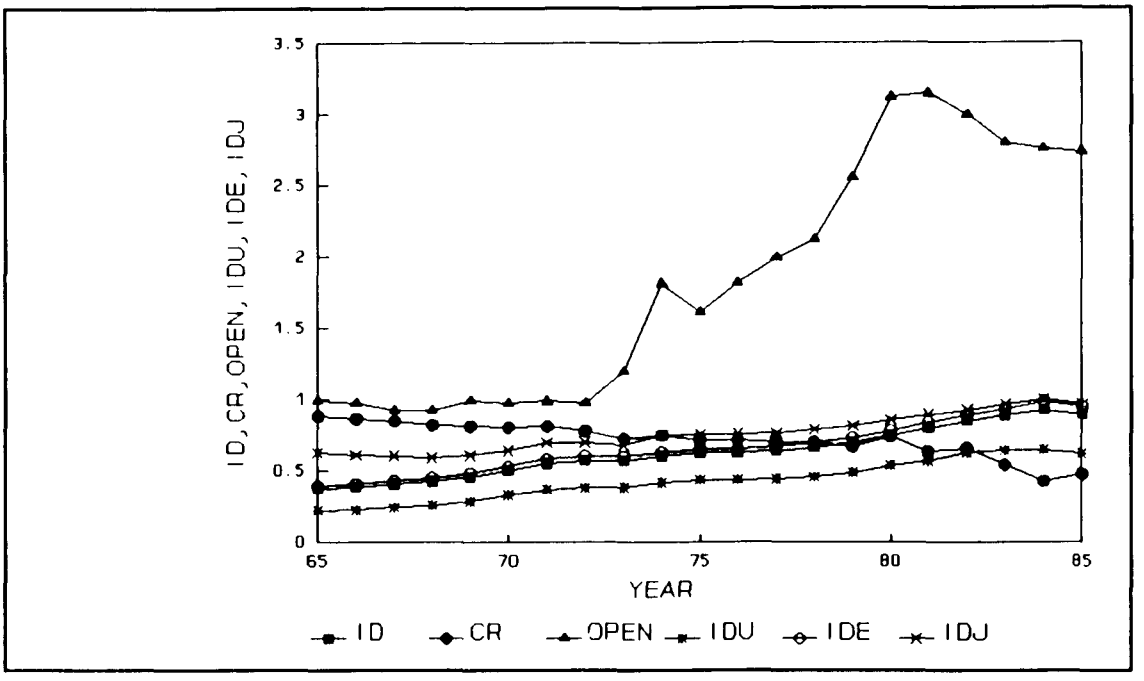

Figure 9. Time trends of independent variables of SINGAPORE

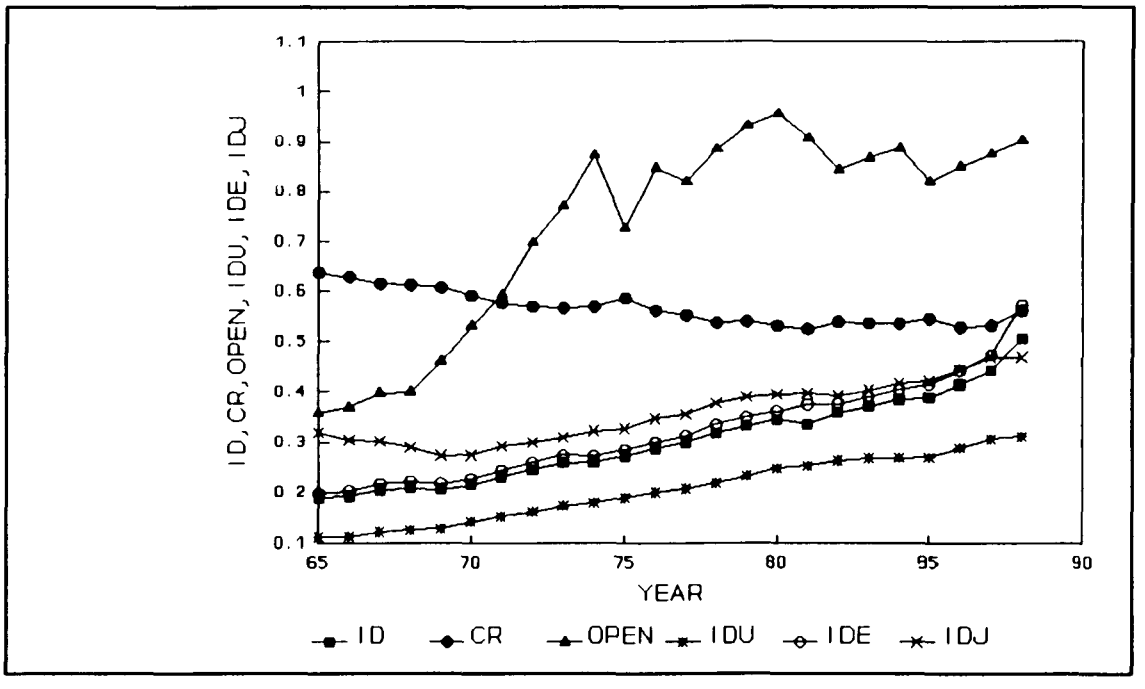

Figure 10. Time trends of independent variables of TAIWAN

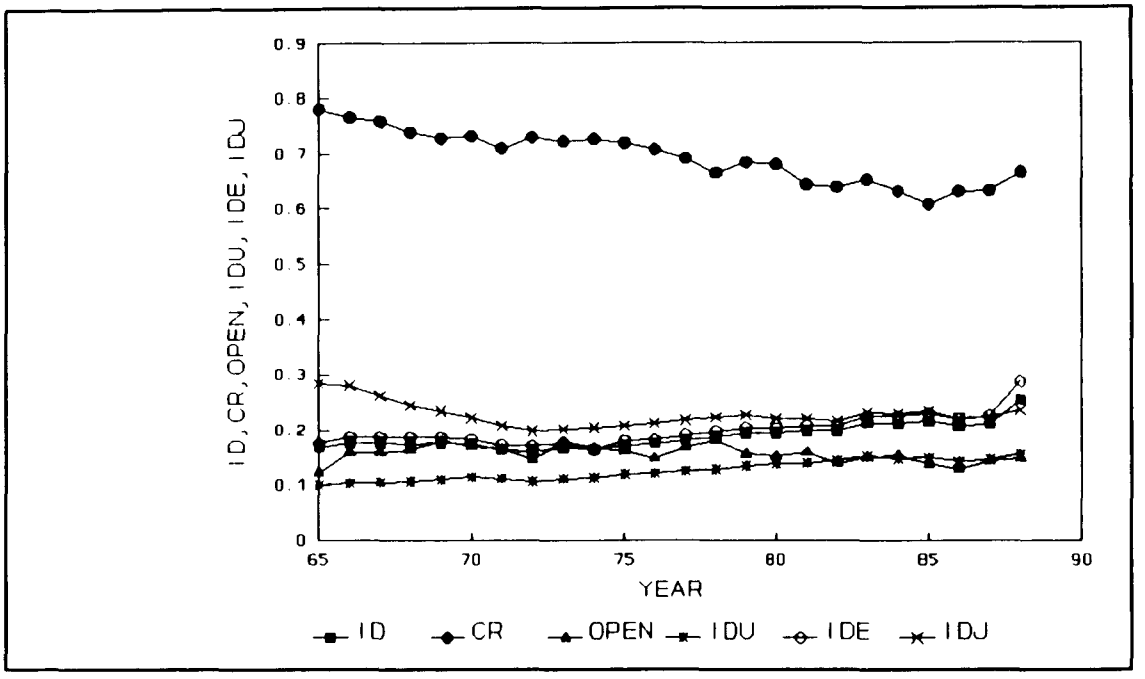

Figure 11. Time trends of independent variables of THAILAND

Note. 1. For the figures 1 and 2, the period covers from 1965 to 1990. For the figures 3-8 and 10-11, it covers from 1965 to 1988. For the figure 9, it covers from 1965 to 1985.

2. For the figures 3-11, the variables (CR and OPEN) taken from **Summers and Heston "The Penn World table (mark 5): An expanded set of international comparison, 1950-1988." Quarterly Journal of Economics, 1991.**
The variable OPEN of Singapore was calculated **"International Financial Statistics Yearbook: 1990".**
The variable OPEN of Taiwan was calculated from **"Taiwan Statistical Databook, 1990".**
In the figures, the variables changed units and CR, and OPEN are after decimal point. (Except China, and Hong Kong).
IDU represents relative income ratio between Asian and developed country.
IDE represents relative income ratio between Asian and developed country.
IDJ represents relative income ratio between Asian and developed country.

Appendix III. Absolute Income Difference between each Asian and Developed countries.

	China			Hong Kong			Indonesia		
Year	US	EC	Jp	US	EC	Jp	US	EC	Jp
1965	10988	5960	3443	8206	3178	661	10991	5963	3446
1966	11403	5993	3746	8530	3120	873	11503	6093	3846
1967	11663	6272	4280	8683	3292	1300	11695	6304	4312
1968	12152	6680	4954	9010	3538	1812	12083	6611	4885
1969	12293	6953	5399	8853	3523	1959	12287	6957	5393
1970	12028	7190	5793	8536	3698	2301	12120	7282	5885
1971	12244	7350	5979	8457	3563	2192	12339	7445	6074
1972	12721	7596	6457	8590	3465	2326	12804	7679	6540
1973	13217	8010	6994	8609	3402	2386	13283	8076	7060
1974	12961	8223	6806	8369	3631	2214	12954	8216	6799
1975	12504	7991	6806	8053	3540	2355	12475	7962	6777
1976	13212	8510	7202	8029	3327	2019	13096	8394	7086
1977	13652	8670	7493	7831	2849	1672	13529	8547	7370
1978	14177	8854	7726	7877	2554	1426	14059	8736	7608
1979	14334	9114	8064	7915	2695	1378	14196	8976	7926
1980	14047	9227	8352	6979	2159	1645	13880	9060	8185
1981	14197	9160	8560	6485	1448	1284	13825	8788	8188
1982	13585	9102	8675	5716	1233	806	13294	8811	8364
1983	13938	9093	8762	5699	854	523	13756	8911	8580
1984	14784	9133	8969	6110	459	295	14793	9142	8978
1985	14896	9064	8898	6110	764	598	15075	9243	9077
1986	15278	9274	9247	5958	46	73	15514	9510	9483
1987	15633	9364	9518	5237	1002	878	16026	9787	9911
1988	16031	7694	9901	5058	1368	1072	16625	10199	10495

(continued)

	Korea			Malaysia			Philippines		
Year	US	EC	Jp	US	EC	Jp	US	EC	Jp
1965	10570	5542	3025	9560	4532	2015	10357	5329	2812
1966	10947	5537	3290	10003	4593	2346	10865	5455	3208
1967	11081	5690	3698	10177	4786	2794	10986	5595	3603
1968	11354	5882	4156	10542	5070	3344	11355	5883	4157
1969	11416	6086	4522	10773	5443	3879	11557	6227	4663
1970	11201	6363	4966	10482	5644	4247	11435	6597	5200
1971	11293	6399	5028	10638	5744	4373	11648	6754	5383
1972	11752	6627	5488	10965	5840	4701	12089	6964	5825
1973	12061	6854	5838	11257	6050	5034	12568	7361	6345
1974	11589	6851	5434	10700	5962	4545	12220	7482	6065
1975	11073	6560	5375	10464	5951	4766	11746	7233	6048
1976	11516	6814	5506	10901	6199	4891	12344	7642	6334
1977	11817	6835	5658	11107	6125	4948	12812	7830	6653
1978	12181	6858	5730	11551	6228	5100	13394	8071	6943
1979	12248	7028	5978	11514	6294	5244	13532	8312	7262
1980	12277	7457	6582	10883	6063	5188	13282	8462	7587
1981	12370	7333	6733	10790	5753	5153	13443	8406	7806
1982	11690	7207	6780	10037	5554	5127	12852	8369	7942
1983	11893	7048	6717	10383	5538	5207	13334	8489	8158
1984	12684	7033	6869	11293	5642	5478	14579	8928	8764
1985	12321	7089	6923	12028	6196	6030	15030	9198	9032
1986	12959	6955	6928	12904	6900	6873	15550	9546	9519
1987	13036	6797	6921	13447	7208	7332	15915	9676	9800
1988	13183	6757	7053	13612	7186	7482	16392	9966	10262

(continued)

	Singapore			Taiwan			Thailand		
Year	US	EC	Jp	US	EC	Jp	US	EC	Jp
1965	9069	4041	1524	10355	5327	2810	10497	5469	2952
1966	9426	4016	1769	10809	5399	3152	10916	5506	3259
1967	9361	3970	1978	10870	5479	3487	11071	5680	3688
1968	9464	4022	2296	11179	5707	3981	11430	5958	4232
1969	9320	3990	2426	11365	6035	4471	11603	6273	4709
1970	8632	3794	2397	11090	6252	4855	11436	6598	5201
1971	8351	3457	2086	11152	6258	4887	11723	6829	5458
1972	8489	3364	2225	11435	6310	5171	12182	7057	5918
1973	8774	3567	2551	11732	6525	5509	12594	7387	6371
1974	8136	3398	1981	11430	6692	5275	12346	7608	6191
1975	7638	3125	1940	10969	6456	5271	11898	7385	6200
1976	7991	3289	1981	11342	6640	5332	12440	7738	6430
1977	8184	3202	2025	11645	6663	5486	12822	7840	6663
1978	8334	3011	1883	11972	6649	5521	13342	8019	6891
1979	7989	2769	1719	11934	6714	5664	13427	8207	7157
1980	7100	2280	1405	11524	6704	5829	13181	8361	7486
1981	6694	1657	1057	11593	6556	5956	13324	8287	7687
1982	5622	1139	712	11033	6550	6123	12785	8302	7875
1983	5549	704	373	11309	6464	6133	13069	8224	7893
1984	5797	146	18	12039	6388	6224	14029	8378	8214
1985	6362	530	364	12255	6423	6257	14263	8431	8265
1986	na	na	na	12290	6286	6259	14767	8763	8736
1987	na	na	na	12316	6077	6201	15144	8902	9026
1988	na	na	na	12631	6205	6501	15460	9034	9330

na : not available.
All values were calculated from **Summers and Heston (1991) "The Penn World Table (Mark 5) : an Expanded Set of International Comparisons, 1950-1988" Quarterly Journal of Economics.**

Appendix IV. Relative Income levels between Developing Asian Countries and Developed Countries.

	China				Hong Kong			
Year	RI	IDU	IDE	IDJ	RI	IDU	IDE	IDJ
1965	.0985	.0584	.1027	.1653	.5004	.2968	.5215	.8398
1966	.1092	.0643	.1156	.1729	.5098	.3000	.5396	.8072
1967	.0968	.0580	.1027	.1729	.4987	.2987	.5290	.7399
1968	.0832	.0507	.0886	.1158	.4862	.2961	.5173	.6766
1969	.0921	.0578	.0977	.1225	.5122	.3215	.5435	.6816
1970	.1051	.0693	.1107	.1338	.5152	.3395	.5426	.6560
1971	.1053	.0697	.1109	.1330	.5402	.3574	.5690	.6821
1972	.1025	.0677	.1085	.1252	.5605	.3705	.5933	.6849
1973	.1027	.0688	.1087	.1226	.5872	.3935	.6215	.7007
1974	.1014	.0700	.1060	.1253	.5791	.3995	.6052	.7155
1975	.1089	.0759	.1139	.1311	.5807	.4048	.6075	.6993
1976	.0972	.0679	.1016	.1178	.6210	.4335	.6488	.7527
1977	.1008	.0698	.1057	.1203	.6731	.4664	.7061	.8037
1978	.1082	.0743	.1139	.1284	.7073	.4857	.7444	.8391
1979	.1106	.0771	.1162	.1293	.7031	.4904	.7387	.8224
1980	.1150	.0825	.1204	.1314	.7585	.5442	.7942	.8665
1981	.1191	.0847	.1254	.1330	.8184	.5819	.8617	.9141
1982	.1258	.0924	.1319	.1375	.8417	.6181	.8824	.9199
1983	.1348	.0973	.1420	.1464	.8736	.6309	.9205	.9461
1984	.1461	.1020	.1554	.1578	.9005	.6289	.9576	.9723
1985	.1616	.1122	.1720	.1747	.8737	.6069	.9302	.9445
1986	.1645	.1144	.1754	.1758	.9416	.6546	.9959[2]	.9935[3]
1987	.1710	.1185	.1828	.1809	.9178[1]	.7047	.9198[2]	.9297[3]
1988	.2039	.1259	.2308	.1890	.9383[1]	.7242	.8970[2]	.9193[3]

(continued)

1. Unweighted average GDPC of developed countries divided by that of Hong Kong.
2. Unweighted average GDPC of EC divided by that of Hong Kong.
3. Japan's GDPC divided by that of Hong Kong.

	Indonesia				Korea			
Year	RI	IDU	IDE	IDJ	RI	IDU	IDE	IDJ
1965	.0981	.0582	.1022	.1646	.1589	.0943	.1656	.2667
1966	.0952	.0560	.1008	.1508	.1728	.1017	.1829	.2736
1967	.0925	.0554	.0981	.1373	.1753	.1050	.1860	.2601
1968	.0921	.0561	.0980	.1281	.1856	.1130	.1974	.2583
1969	.0928	.0583	.0985	.1235	.1982	.1250	.2114	.2651
1970	.0943	.0621	.0993	.1201	.2022	.1333	.2130	.2575
1971	.0944	.0625	.0994	.1192	.2145	.1419	.2260	.2709
1972	.0932	.0616	.0987	.1139	.2099	.1387	.2222	.2565
1973	.0958	.0642	.1014	.1143	.2243	.1503	.2373	.2676
1974	.1026	.0705	.1068	.1262	.2441	.1684	.2552	.3016
1975	.1119	.0780	.1171	.1348	.2605	.1817	.2726	.3138
1976	.1089	.0761	.1138	.1320	.2686	.1875	.2806	.3256
1977	.1129	.0782	.1184	.1348	.2812	.1949	.2950	.3358
1978	.1194	.0820	.1257	.1417	.2980	.2046	.3137	.3536
1979	.1233	.0860	.1296	.1442	.3031	.2114	.3185	.3546
1980	.1302	.0934	.1363	.1487	.2762	.1981	.2891	.3154
1981	.1528	.1086	.1609	.1707	.2847	.2025	.2998	.3180
1982	.1523	.1118	.1597	.1664	.2982	.2190	.3126	.3259
1983	.1511	.1091	.1592	.1642	.3182	.2298	.3353	.3456
1984	.1453	.1015	.1545	.1569	.3288	.2296	.3496	.3550
1985	.1462	.1016	.1557	.1581	.3310	.2299	.3524	.3579
1986	.1448	.1007	.1544	.1548	.3578	.2488	.3816	.3825
1987	.1390	.0964	.1487	.1471	.3823	.2650	.4088	.4044
1988	.1514	.0935	.1714	.1404	.4555	.2811	.5155	.4225

(continued)

	Malaysia				Philippines			
Year	RI	IDU	IDE	IDJ	RI	IDU	IDE	IDJ
1965	.3048	.1808	.3177	.5115	.1897	.1125	.1977	.3183
1966	.3044	.1791	.3222	.4820	.1842	.1084	.1950	.2917
1967	.2972	.1780	.3153	.4410	.1881	.1127	.1996	.2791
1968	.2897	.1765	.3082	.4032	.1854	.1130	.1973	.2422
1969	.2772	.1743	.2947	.3696	.1820	.1151	.1931	.2225
1970	.2867	.1889	.3019	.3650	.1748	.1150	.1840	.2194
1971	.2897	.1917	.3052	.3659	.1737	.1140	.1830	.2108
1972	.2976	.1964	.3146	.3651	.1725	.1146	.1826	.2040
1973	.3088	.2069	.3268	.3685	.1720	.1231	.1809	.2205
1974	.3366	.2322	.3518	.4159	.1785	.1319	.1866	.2279
1975	.3251	.2267	.3401	.3915	.1892	.1291	.1979	.2336
1976	.3307	.2309	.3455	.4009	.1849	.1291	.1932	.2242
1977	.3510	.2432	.3682	.4191	.1834	.1271	.1924	.2189
1978	.3579	.2458	.3767	.4246	.1827	.1254	.1923	.2054
1979	.3709	.2587	.3896	.4338	.1846	.1288	.1939	.2159
1980	.4031	.2892	.4220	.4604	.1846	.1325	.1933	.2109
1981	.4280	.3043	.4507	.4781	.1874	.1333	.1974	.2094
1982	.4486	.3294	.4703	.4903	.1925	.1414	.2018	.2104
1983	.4536	.3276	.4779	.4927	.1890	.1365	.1991	.2053
1984	.4497	.3141	.4782	.4856	.1639	.1145	.1743	.1770
1985	.4076	.2832	.4340	.4407	.1501	.1042	.1598	.1622
1986	.3624	.2520	.3865	.3874	.1418	.0986	.1512	.1516
1987	.3489	.2418	.3730	.3690	.1481	.1026	.1583	.1566
1988	.4176	.2578	.4726	.3872	.1720	.1062	.1947	.1595

(continued)

	Singapore				Taiwan			
Year	RI	IDU	IDE	IDJ	RI	IDU	IDE	IDJ
1965	.3758	.2229	.3916	.6305	.1900	.1127	.1980	.3188
1966	.3849	.2265	.4073	.6094	.1920	.1130	.2032	.3040
1967	.4073	.2439	.4320	.6042	.2038	.1220	.2162	.3023
1968	.4241	.2583	.4512	.5902	.2080	.1267	.2213	.2895
1969	.4552	.2857	.4830	.6057	.2054	.1289	.2180	.2734
1970	.5039	.3320	.5307	.6416	.2153	.1418	.2267	.2741
1971	.5524	.3655	.5818	.6975	.2307	.1526	.2430	.2913
1972	.5717	.3779	.6052	.6986	.2450	.1620	.2594	.2994
1973	.5699	.3819	.6031	.6800	.2589	.1735	.2740	.3089
1974	.6033	.4162	.6306	.7454	.2607	.1798	.2725	.3221
1975	.6247	.4355	.6535	.7524	.2716	.1893	.2841	.3271
1976	.6248	.4362	.3528	.7573	.2862	.1998	.2990	.3469
1977	.6384	.4424	.6697	.7623	.2981	.2066	.3127	.3560
1978	.6638	.4558	.6987	.7876	.3179	.2183	.3346	.3771
1979	.6963	.4856	.7315	.8144	.3321	.2317	.3489	.3885
1980	.7475	.5363	.7827	.8539	.3447	.2473	.3609	.3983
1981	.7994	.5684	.8419	.8929	.3552	.2525	.3740	.3967
1982	.8503	.6244	.8914	.9292	.3580	.2629	.3753	.3912
1983	.8871	.6406	.9347	.9637	.3705	.2676	.3904	.4025
1984	.9276	.6479	.9866	.9983*	.3848	.2688	.4029	.4155
1985	.8938	.6208	.9516	.9662	.3882	.2696	.4133	.4196
1986	na	na	na	na	.4136	.2876	.4411	.4422
1987	na	na	na	na	.4409	.3056	.4714	.4664
1988	na	na	na	na	.5042	.3112	.5707	.4675

(continued)

* Japan's GDPC divided by that of Singapore.

Thailand

Year	RI	IDU	IDE	IDJ
1965	.1695	.1005	.1766	.2844
1966	.1771	.1042	.1874	.2804
1967	.1767	.1058	.1874	.2621
1968	.1758	.1071	.1871	.2447
1969	.1764	.1107	.1871	.2347
1970	.1746	.1151	.1839	.2223
1971	.1651	.1127	.1739	.2085
1972	.1622	.1072	.1717	.1982
1973	.1682	.1127	.1780	.2007
1974	.1654	.1141	.1641	.2043
1975	.1731	.1207	.1811	.2085
1976	.1752	.1223	.1831	.2124
1977	.1824	.1264	.1913	.2178
1978	.1876	.1288	.1975	.2226
1979	.1943	.1355	.2041	.2273
1980	.1938	.1391	.2030	.2214
1981	.1982	.1409	.2087	.2214
1982	.1986	.1458	.2082	.2170
1983	.2127	.1536	.2241	.2311
1984	.2118	.1479	.2252	.2287
1985	.2159	.1499	.2299	.2334
1986	.2071	.1440	.2209	.2214
1987	.2110	.1463	.2256	.2232
1988	.2543	.1570	.2878	.2358

na : not available.
All values were taken from **Summers and Heston (1991) "The Penn World Table (Mark 5) : an Expanded Set of International Comparisons, 1950-1988" Quarterly Journal of Economics.**

Appendix V. Openness of Developing Asian Countries.

Year	Chi	Hok	Ins	Kor	Mal	Phi	Sin	Tai	Tha
1965	.0332	.8858	.0356	.0777	.3977	.1527	.9893	.3577	.1234
1966	.0292	.9028	.0763	.1015	.3740	.1583	.9761	.3683	.1592
1967	.0265	.9360	.0710	.1289	.3498	.1619	.9260	.3974	.1599
1968	.0267	.9850	.0794	.1501	.3552	.1467	.9235	.3997	.1632
1969	.0211	1.0347	.0765	.1575	.3574	.1312	.9941	.4603	.1814
1970	.0174	1.0671	.0860	.1577	.3495	.1290	.9745	.5307	.1708
1971	.0169	1.0422	.0863	.1613	.3195	.1250	.9878	.5930	.1658
1972	.0208	1.0597	.0993	.1748	.3108	.1163	.9723	.6968	.1476
1973	.0307	1.2944	.1457	.2559	.4017	.1439	1.1935	.7695	.1792
1974	.0363	1.4250	.2278	.3166	.4897	.1951	1.8096	.8718	.1682
1975	.0321	1.2679	.2002	.2870	.4327	.1643	1.6089	.7257	.1624
1976	.0280	1.3837	.2279	.3364	.4447	.1593	1.8155	.8465	.1482
1977	.0261	1.3390	.2279	.3689	.4368	.1650	1.9907	.8192	.1677
1978	.0298	1.3932	.2060	.4056	.4662	.1684	2.1196	.8843	.1812
1979	.0364	1.4770	.2135	.4425	.5513	.1848	2.5547	.9301	.1567
1980	.0399	1.5314	.2458	.5181	.5515	.2044	3.1195	.9548	.1526
1981	.0408	1.4295	.2141	.5225	.4770	.1851	3.1448	.9067	.1598
1982	.0342	1.2355	.1906	.4497	.4484	.1579	2.9940	.8423	.1394
1983	.0318	1.1691	.1815	.4431	.4552	.1497	2.7991	.8663	.1515
1984	.0336	1.2641	.1551	.4385	.4647	.1406	2.7544	.8858	.1538
1985	.0369	1.2642	.1332	.3981	.4389	.1295	2.6900	.8185	.1388
1986	.0369	1.3418	.1119	.4159	.4315	.1328	2.5576	.8486	.1287
1987	.0370	1.5604	.1129	.4728	.4906	.1369	2.8766	.8746	.1441
1988	.0400	1.8300	.1198	.5170	.5036	.1470	3.3652	.9014	.1491

Except Singapore and Taiwan, all values taken from **Summers and Heston (1991) "The Penn World Table (Mark 5) : an Expanded Set of International Comparisons, 1950-1988" Quarterly Journal of Economics.**
For Singapore, all values were calculated from **U.N. (1992) "International Financial Statistical Yearbook, 1991."**
For Taiwan, all values were calculated from **Council for Economic Planning and Development (1990) "Taiwan Statistical Databook."**

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