12-1-1999

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Kishor Sharma

ECONOMIC GROWTH CENTER

YALE UNIVERSITY

P.O. Box 208269
New Haven, Connecticut 06520-8269

CENTER DISCUSSION PAPER NO. 813

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Kishor Sharma
Yale University and Charles Sturt University (Australia)

December 1999

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Abstract

This paper the presents pattern and determinants of intra-industry trade (IIT) in Australian manufacturing since the late 1970s. The results point to a sharp rise in IIT from the mid 1980s which appears to be linked with an outward-oriented policy. Industry level analysis indicates that industries which experienced a sharp fall in protection are the industries with the higher levels of IIT. These include textile, garments, rubber products, and machinery and equipment. An increasing trend in IIT suggests that the short-term adjustment costs associated with trade liberalisation are likely to be lower, and that liberalisation can proceed without huge short-term adjustment costs. Using a logit model the determinants of IIT are investigated. Results indicate that intra-industry trade is positively related to product differentiation and scale economies, and negatively related to the levels of protection and foreign ownership in the pre-liberalisation period. In the post-liberalisation period, however, it is scale economies that explain the inter-industry variations in IIT. R&D intensity and close economic integration appear to have no impact on IIT regardless of the nature of the policy regime.

JEL Classification Codes: F13, F14

Key Words: Intra-industry trade, trade liberealisation, outward-orientation.

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* Forthcoming in the *Australian Economic Review* (September 2000).

I Introduction

There have been a large number of studies examining the phenomena of intra-industry trade (IIT) ie, simultaneous exports and imports of similar products. These studies can be grouped into two groups. One category is concerned with the development of theoretical explanations, primarily emphasising the role of product differentiation and increasing returns to scale, for example, Krugman (1979 and 1980) and Lancaster (1980), while the other examines the determinants of IIT in an econometric framework. The present study belongs to the latter category which examines the pattern and determinants of IIT in Australian manufacturing trade. The investigation of the Australian experience is important as it has the lowest level of IIT among the OECD countries.[1] Since increased IIT can be the additional source of gains from trade arising from increasing returns to scale and product differentiation, it is important to investigate what determines IIT.

Although a few studies have examined the pattern of IIT in Australian manufacturing (see, Grubel and Lloyd 1975; Menon 1994; Ratnayake and Athukorala 1992; Ratnayake and Jayasuriya 1991), econometric investigations of the determinants are extremely limited. For instance, only the latter two studies examine the determinants of IIT in an econometric framework using data for 1985. Their findings, however, must be interpreted with caution as the Australian economy has gone through a substantial liberalisation since the mid 1980s (more about this below). Though Menon's (1994) study is based on the recent year data, his focus is on the analysis of recent trends in IIT in Australia's multilateral and trans-Tasman trade rather than on the econometric evidence of the determinants in the context of trade liberalisation. As such there has not been any study that investigates the determinants of IIT in an econometric framework in the context of trade liberalisation.

Much has changed since the mid 1980s. For instance, the Australian economy has been substantially deregulated since then by dismantling barriers to trade and investment, and liberalising the foreign exchange market. The level of the effective rate of assistance (ERA) to manufacturing has fallen from 22 per cent in the mid 1980s to 9 per cent by 1995 (Industry Commission 1995). Furthermore, economic relations have been strengthened between Australia and New Zealand since the mid 1980s by further dismantling barriers to trade and investment. The resulting structural changes brought about these policy reforms would probably have some impact on the determinants of IIT which has not been modelled in the earlier econometric studies.

The purpose of this study is to investigate the effects of a shift towards outward orientation on the pattern and determinants of IIT in Australian manufacturing trade using an econometric model. We do this using data from both the pre- and post- liberalisation periods. We have access to a rich data set which classifies trade and industry data under the same category (Australian Standard Industry Classification) and thereby reduces the bias emerging from the regrouping of industry data into trade classification or vice versa.[2] Results obtained from this study, therefore, would provide valuable information about the way IIT is generated, and its pattern and determinants in Australia in recent years. The paper is organised as follows. Following an introduction in section I, methodological issues and recent trends in IIT are discussed in section II. A model of IIT is developed in section III, while section IV discusses model estimation procedures and presents econometric results. The paper concludes in section V with concluding remarks.

II Methodological Issues and Recent Trends in IIT

A number of indices have been designed to estimate IIT. However, the Grubel and Lloyd (GL) index is the most popular. The IIT index is calculated as follows:

$$B_j = \left[1 - \frac{\left| X_j - M_j \right|}{(X_j + M_j)} \right] X100 \qquad \text{(Eq. 1)}$$

Where,

X_j = exports of industry j

M_j = imports of industry j

j = 1…n.

The computed value of B_j lies between 0 to 100. If X_j=M_j, then B_j would be 100 indicating that all trade is intra-industry and when either X_j = 0 or M_j = 0 then the value of B_j would be 0 indicating that all trade is inter-industry. The closer the value of the index to 100 the greater is the degree of intra-industry trade. It should be, however, noted that the GL index is influenced by the size of the trade imbalance. The greater the trade imbalances (deficit or surplus), the smaller the value of the measured index. To overcome this bias Aquino (1978) has suggested to adjust X_j and M_j values in equation (1) by a factor representing the aggregate imbalance, before deriving the aggregate index. However, there are no theoretical reasons to adjust trade data. Kol and Mennes (1985) have convincingly demonstrated that as far as measuring trade overlap is concerned the GL index is to be preferred. In a comparison of the GL index with the Aquino index, they have come to the conclusion that the latter index measures the 'similarity' of product shares in total trade, not trade overlap. For these reasons we prefer the GL index.

It has been argued that IIT would not exist at the finest level of disaggegation and that it is a statistical phenomenon arising from improper aggregation of trade data (Lipsey 1976; Finger 1975; Pomfret 1979). While there may be some truth in this view, sufficient empirical evidence is now available to suggest that disaggregation does not cause IIT to disappear.[3] It should be noted that the higher level of disaggregation is not necessarily optimal for studying IIT because at the higher level of disaggregation trade data becomes less representative of an 'industry'.[4] Menon and Dixon (1996) have argued that for the meaningful analysis of IIT 'industry' categories must be neither too fine nor too broad. With these considerations in mind, we estimate IIT at the four-digit Australian Standard Industrial Classification (ASIC) level.[5]

Table 1 reports the frequency distribution of the GL IIT index for selected years.[6]

Table 1: Frequency distribution of IIT index at the four-digit ASIC industries for selected years

	1979/80		1989/90		1992/93	
Range of IIT	Freq	%	Freq	%	Freq	%
0 and below 10	15	19.0	8	10.1	4	5.1
10 and below 20	15	19.0	24	30.4	14	17.7
20 and below 30	14	17.7	15	19.0	18	22.8
30 and below 40	15	19.0	13	16.4	15	19.0
40 and below 50	6	7.6	4	5.1	10	12.6
50 and below 75	10	12.6	11	13.9	14	17.7
75 and below 100	4	5.1	4	5.1	4	5.1
Total sample	79	100	79	100	79	100
Weighted Average[a]	-	28.3	-	31.1	-	37.3

Source: Calculated from data from Industry Commission,1995.
Note: [a] Weighted by the trade share.

As shown in table 1, there has been an increase in the share of IIT, from 28 per cent in 1979/80 to 37 per cent in 1992/93. Much of this growth came mainly from textile, garments, rubber products, and machinery and equipment which had a lower level of IIT in the early years.[7] Intra-industry trade in rubber products rose from about 7 per cent in 1979/80 to 22 per cent in 1992/93, and in motor vehicles and parts it increased from about 17 per cent to about 31 per cent in the same period. The biggest growth was observed in textile and garments which recorded an increase in IIT from 17 per cent in 1979/80 to 37 per cent in 1992/93. Growth in IIT in these industries took place in response to a fall in protection as measured by the ERA. For example, ERA in textiles, clothing, footwear and leather fell from 90 per cent in the late 1970s to 57 per cent by 1992/93, and in transport equipment sector it fell from 59 per cent to 28 per cent in the same period. During this period manufacturing as a whole experienced a decline in ERA from 24 per cent to 11 per cent. A rising trend in IIT suggests that the short-term adjustment costs associated with trade liberalisation are likely to be lower.

In 1979/80, about 19 per cent of industries had a lower level of IIT (ranged between 0-10 per cent) which fell to about 5 per cent by 1992/93, indicating that manufacturing industries are increasingly specialised (see table 1).[8] Higher IIT (over 50 per cent) is found in industries producing chemical products, machinery and equipment, fashion-ware (jewellery etc), and electric and telephone cable. This pattern is in line with the experience of many high income OECD countries as these industries provide greater opportunities for product differentiation. Industries which have a lower level of IIT (less than 10 per cent) are chemical fertilisers, and man-made fibres and yarns (see appendix 1 for industries with high and low IIT during 1979/80 and 1992/93). Although an increasing number of industries- especially textile, garments, rubber products, and motor vehicle and parts- have recorded growth in IIT in recent years, the range of IIT in these industries is still less than 50 per cent.

III A Model of IIT

In this section, based on the theoretical and empirical literature, we develop a model to explain the inter-industry variations in IIT. Our model incorporates industry, country and market-specific characteristics which have an impact on the pattern and determinants of IIT. It should be mentioned that we are not attempting to test any specific theory of IIT but rather ascertaining the determinants of IIT in Australian manufacturing especially in the context of trade liberalisation.

(a) Industry-specific factors

The most obvious explanation for the occurrence of IIT is product differentiation (Krugman 1979, 1980; Lancaster 1980). Product differentiation occurs in a situation where individual firms in an industry produce different varieties of the same product which are close substitute in consumption and/ or production. In the presence of demand similarity between countries and preference diversity between consumers product differentiation generates IIT between countries. Products can differentiate in three main forms: horizontal differentiation (different attributes), vertical differentiation (different qualities) and technological differentiation (improved product range brought about by technical breakthrough). Intra-industry differences in IIT may be influenced by all three forms of differentiation. Most theoretical investigations, however, have focused on trade in horizontally differentiated products (Greenaway 1984). Following Greenaway and Milner (1984) we proxy horizontal product differentiation (PD) as the number of four-digit sub-groups in each three-digit sub-groups. We expect a positive link between PD and IIT.

Krugman (1979, 1980) and Kierzkowski (1984) have argued that a rising trend in IIT is also explained by economies of scale (ES). It is scale economies that prevent each country from producing the full range of products within the same industry. Economies of scale arise from three sources ie., size of firms, size of plants and length of production runs (Gruble and Lloyd 1975, p. 6). When any of these is large enough to result in a reduction in unit costs, a firm may tend to produce selected varieties of a given product rather than all possible varieties. If this is the case then the country in question has to import the other varieties from abroad to satisfy local demand. Simultaneously it may export the varieties produced locally. We, therefore, expect a positive link between economies of scale (ES) and IIT. Various proxies have been used in the literature to measure scale economies. Following Loertscher and Wolter (1980) we proxy economies of scale (ES) as the average value added per establishment.

Firm specific technological know how and production process is an important source of comparative advantage in international markets. Trade by research intensive industries may consist of the intra-industry exchange of technologically differentiated goods. Krugman and Obsfeld (1994) note that IIT tends to be high in sophisticated manufactured goods requiring a high level of R&D. This led us to believe that R&D intensity (RD) has a positive effect on IIT. We estimate R&D intensity as the percentage of the workforce that carry R&D in each category.

(b) Market-specific factors

It has been argued that in the presence of demand for different varieties of the same products the production of which is subject to economies of scale, there may be a tendency for foreign direct investment (FDI) and IIT to go hand in hand (Greenaway and Milner 1986; Grubel and Lloyd 1975).[9] On this ground we expect a positive link between the intensity of foreign direct investment and IIT. However, if the motive behind FDI is to fragment the production process geographically by stage of production (vertical investment) then there would be inter-industry not intra-industry trade (Markusen 1995). Thus, whether FDI promote intra-industry trade or inter-industry trade depends on the motive behind such investment and the nature of the link between FDI and IIT is not clear cut. In the present study FDI intensity is measured as the value-added share of foreign owned company in each category.

The experience of the European Union suggests that close economic integration between trading partners promote intra-industry trade rather than inter-industry trade (Balassa 1975; Grubel and Lloyd 1975). This is in line with theory that suggests that IIT will increase more rapidly when reductions in protective barriers occur simultaneously in all trading partners (Lloyd 1978, pp. 33-34). Since Australia and New Zealand have a long history of close economic relations which have been further strengthened in recent years, we expect growth in IIT in Australian manufacturing trade (Menon 1994). The close economic links between these two nations is represented by New Zealand's trade share in Australia's total trade under each category. On the basis of the above consideration we expect a positive links between IIT and close economic links (CEI).

(c) Country-specific character

There are two types of country specific barriers that influence international trade: (i) *natural trade barriers* (high transport cost resulting from geographic isolation) and (ii) *artificial trade barriers* (resulting from tariff and non-tariff distortions). It has been shown that the high transport costs lead to lower level of IIT (Grubel and Lloyd 1975). This factor may be particularly important in the case of Australia given the relatively greater distance to its trading partner (Ratnayake and Athukorala 1992). Thus, we expect a negative link between transport costs and IIT. In the international trade literature commodity specific transport cost is computed as the ratio of *c.i.f* value of imports to *f.o.b* value of imports minus one. Unfortunately, however, unavailability of disaggregated data preclude inclusion of this variable in our model.

The artificial trade barriers also reduce the volume and the range of products to be traded. Further, in their presence tradable goods become non-tradable (Greenaway and Milner 1984; Falvey 1981). Accordingly, the extent of IIT can be hypothesised to be greater, the lower is the artificial trade barriers. In this study we use the ERA to capture the effects of artificial trade barriers on IIT. The above considerations lead to the following specification of the model. The expected signs are given in parentheses.

$$IIT_i = d_0 + \underset{(+)}{d_1 PD_i} + \underset{(+)}{d_2 ES_i} + \underset{(+)}{d_3 RD_i} + \underset{(?)}{d_4 FDI_i} + \underset{(+)}{d_5 CEI_i} + \underset{(-)}{d_6 ERA_i} + U_i \qquad \text{(Eq. 2)}$$

Where,

IIT = Intra-industry trade

PD = Product differentiation

ES = Economies of scale

RD = Research and development intensity

FDI = Foreign direct investment

CEI= Close economic integration

ERA = Effective rate of assistance

$i = 1, \ldots N$ (sub-sectors)

$\delta_j =$ (j = 0,…..6) are parameters to be estimated.

U is a standard error term.

IV Estimation Procedures and Results

The model specified above is estimated separately for the pre- and post-liberalisation periods using ordinary least squares (OLS) and the logit transformation method.[10] As discussed in the literature, when the value of the dependent variable lies within the range of 0 and 100, like in our case, the estimated regression equation may predict values which lie outside that range. Therefore, to overcome this problem we apply the logit transformation method.[11] On the basis of high explanatory power of the model, we prefer the logit method, but for comparison purposes OLS results are also reported. A major difference between OLS and the logit results is that the coefficient of ERA is not statistically significant when OLS is applied. However, it is statistically significant in the logit model for the pre-reform period.

To ensure the robustness of our estimates we performed heteroskedasticity and RESET tests before estimating the final models. We also carry out test for multicollinearity but it does not seem to be a problem. Both models are statistically significant in terms of the F test, however, the explanatory power of the models is not very high. This is usually expected in cross-sectional analysis. Our preferred logit model explains 38 per cent of the variations in IIT in the pre-liberalisation period and 19 per cent in the post-liberalisation period. Estimates for the both models for the pre-and post-liberalisation periods are reported in table 3.

Table 3: Determinants of inter-industry variations in IIT in Australian manufacturing

	Logit Model		OLS Model	
Independent Variable	Pre-liberalisation	Post-liberalisation	Pre-liberalisation	Post-liberalisation
Intercept	0.106 (1.259)	0.304 (3.450)	8.445 (1.111)	20.174 (2.610)***
PD	0.029 (2.472)***	0.008 (0.705)	1.739 (1.649)*	-0.325 -(0.318)
ES	0.015 (3.665)***	0.002 (2.784)***	1.147 (2.946)***	0.286 (3.096)***
RD	0.027 (1.391)	0.006 (0.556)	1.461 (0.815)	0.421 (0.445)
FDI	-0.002 -(1.793)*	-001 -(0.385)	-0.295 -(1.994)**	-0.193 -(1.309)
CEI	-0.001 -(0.684)	0.001 (0.548)	-0.110 -(0.993)	0.005 (0.034)
ERA	-0.001 -(1.646)*	-0.001 -(0.911)	-0.117 -(1.510)	-0.027 -(0.206)
No. of Observation	79	79	79	79
F (6, 72)	7.279***	2.743**	3.821***	1.917*
R^2	0.38	0.19	0.24	0.14
RESET F (3, 69)	3.284	1.060	2.325	1.119
Heteroskedasticity Test (6, 72)	8.259	6.680	8.258	7.558

Note: t-ratios are given in the parentheses. Heteroskedasticity test refers to the B-P-G test. Significant levels are: *** = 1%, ** = 5%, and *10%.

The coefficient of product differentiation (PD) has a positive sign and is statistically significant at 1% level in the pre-liberalisation period, indicating that industries with the greater product differentiation are the industries with the higher level of IIT. This finding is in line with the theoretical expectation, and is consistent with the earlier work on Australian manufacturing by Ratnayake and Athukorala (1992) and the study by Greenaway and Milner (1984) for U.K. manufacturing. In multi-country studies Loertscher and Wolter (1980) and Caves (1981) also observed similar results for industrialised countries. The coefficient of product differentiation, however, is not statistically significant following liberalisation, indicating that this is not an important factor in explaining the inter-industry variations in IIT with a change in policy regime.

As expected the coefficients of economies of scale (ES) have expected positive signs and are highly significant in both the pre- and post-liberalisation periods. This provides support for the proposition that industries that are able to enjoy economies of scale are the industries with the higher levels of IIT regardless of the nature of the policy regime. The coefficients of R&D intensity (RD) are not statistically significant in both the pre- and post-liberalisation periods, indicating that the inter-industry variations in IIT are not explained by R&D intensity. This is attributed to the fact that the variations in R&D across the industries are not very high in Australia probably due to the predominance of small and medium scale industries.

The coefficient of foreign investment (FDI) is statistically significant at 10% level and has a negative sign in the pre-liberalisation period. This indicates that industries which have a higher level of FDI are the industries with the lower levels of IIT. This may be due tariff jumping type investment by MNCs in the import-substitution industries to bypass protective trade barriers. This finding is similar to Ratnayake and Athukorala (1992). However, the coefficient of FDI is not statistically significant in the post-liberalisation period, indicating that FDI has no real impact on IIT probably due to increased competition. The coefficients of close economic integration (CEI) are not statistically significant in both the pre- and post-liberalisation periods, suggesting that closer economic integration has no impact on IIT regardless of the nature of policy regime. This unexpected result could be due to the fact that New Zealand has such a small share in Australia's overall trade which cannot significantly influence IIT in Australian manufacturing.[12]

As expected the coefficient of artificial trade barriers- measured as the effective rate of assistance - has a negative sign and is statistically significant in the pre-liberalisation period. This provides further support for the view that trade barriers hinder IIT. This finding is similar to the earlier work on Australian manufacturing by Ratnayake and Athukorala (1992). However, the coefficient of ERA is not statistically significant in the post-liberalisation period, indicating that trade barriers have no real impact on IIT when the overall policy environment is liberalised. This may be due to the fact that trade liberalisation is only one component of an outward-looking strategy which may be of less important when the overall policy regime is liberalised.

V Conclusion

In this study we have aimed to achieve two things. Firstly, to investigate the recent trends in intra-industry trade in Australian manufacturing. Secondly, to identify the determinants of inter-industry variations in IIT in the pre- and post- liberalisation periods. We observe a sharp rise in IIT, from 28 per cent in the late 1970s to 38 per cent in the early 1990s. This appears to be linked with the liberalisation program which began in the mid 1980s. Industry level analysis shows that industries which experienced a sharp fall in protection are the industries with the higher levels of IIT. These include textile, garments, rubber products, and machinery and equipment. A rising share of IIT suggests that the short-term adjustment costs associated with trade liberalisation are likely to be lower, and that liberalisation can proceed without a huge short-term adjustment costs even in textile, clothing, footwear and motor car industries which have attracted much policy debate in recent years in Australia.

Econometric evidence suggests that intra-industry trade is positively related to product differentiation and scale economies, and negatively related to the levels of protection and foreign ownership in the pre-liberalisation period. In the post-liberalisation period, however, it is scale economies that explain the intra-industry variations in IIT, suggesting that industries which are able to exploit economies of scale are the industries with the higher levels of IIT. R&D intensity and close economic integration appear to have no impact on IIT in Australian manufacturing regardless of the nature of policy regime. However, these results should be interpreted with some degree of caution due to the following reasons: Firstly, we have to exclude some important explanatory variables from the model due to the lack of appropriate data. Secondly, our dependent variable groups together both horizontal and vertical intra-industry trade. When in fact the determinants of these two different types of IIT may be different.

Acknowledgements

I am grateful to Edward Oczkowski, Sisira Jayasuriya, Prema-Chandra Athukorala and the three anonymous referees of the *Australian Economic Review* for useful suggestions.

Appendix 1: Industries with High and Low IIT, 1979/80 and 1992/93

Industries with High and Low IIT in 1979/80					Industries with High and Low IIT in 1992/93		
ASIC	High IIT industries (50% or more)	ASIC	Low IIT industries (10 % or less)	ASIC	High IIT industries (50% or more)	ASIC	Low IIT industries (10% or less)
2762	Paints	2343	Man-made fibres and yarns	2945	Steel pipes and tubes	2343	Man-made fibres and yarns
2763	Pharmaceutical and veterinary products	2344	Man-made fibres broadoven fabrics	2766	Cosmetics and toilet preparations	2348	Narrow woven and elastic textiles
2941	Iron and steel basic products	2345	Cotton yarns and broadwoven fabrics	2765	Soap and other detergents	2751	Chemical fertilisers
2346	Worsted yarns and broadwoven fabrics	2348	Narrow woven and elastic textiles	3243	Railway rolling stock and locomotives	3486	Writing and marking equipment
3482	Jewellery and silverware	2351	Household textiles	3151	Metal containers		
2765	Soap and other detergents	2459	Knitted goods, underwear and outerwear etc.	3145	Fabricated structural steel, architectural metal products		
3151	Metal containers	2460	Footwear	3451	Leather tanning and fur dressing		
2767	Inks	2442	Cardigans and pullovers	2533	Veneers and manufactured boards of wood		
3481	Ophthalmic articles	3233	Motor vehicles instruments and electric equipment	3169	Sheet metal products, springs & wires and fabricated metal products		
3355	Electric and telephone cable and wire	3241	Ships	2353	Felt and felt products		
3451	Leather tanning and fur dressing	3245	Transport equipment	2762	Paints		
3242	Photographic film processing	3351	Radio and TV receivers and audio-equipment	3363	Materials handling equipment		
3145	Fabricated structural steel, architectural metal products	3352	Electric equipment	3482	Jewellery and silverware		
3354	Water heating systems	3452	Leather and leather substitute goods	2941	Iron and steel basic products		
		3461	Rubber tyres, tubes, belts, hose & sheets	3241	Ships		
				3355	Electric and telephone cable and wire		
				3142	Architectural aluminium products		
				2764	Pesticides		

Source: Calculated from data from Industry Commission (IC) 1995.

Appendix 2: Definition of variables and Their Sources

IIT computed from IC, 1995.

PDD is defined as the number of four-digit sub-groups in each three-digit sub-groups. Data source: IC, 1995.

ES is proxied as the average value added per establishment. Data source: IC , 1995.

RD is measured as the percentage of the workforce that carry R&D in each category. Data source: Australian Bureau of Statistics (ABS), (1981/82 and 1992/93), Research and Experimental Development All Sectors Summary Australia, Catalogue No. 8112.0.

FDI is defined as the value-added share of foreign owned company in each category. Data source: ABS (1982/83 and 1992/93), Foreign Ownership and Control in Manufacturing, Catalogue Nos. 5315.0 and 5314.0.

CEI is defined as New Zealand's trade share in Australia's total trade in each category. Data source: ABS (1981/82 and 1992/93), International Merchandise Trade Australia, Catalogue No. 5422.0.

ERA is defined as the percentage increase in return per unit of output relative to the situation of no assistance. It assesses the net effect of the assistance structure by taking into account assistance to output and value adding factors as well as penalties on inputs. Data source: IC, 1995.

Endnotes

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1 In 1985 among the OECD countries, IIT index was lowest for Australia (0.25) and highest for UK (0.81). For further discussion see Grimwade (1989, p. 127).

2 In the model of IIT, the dependent variable (ie, IIT) is normally computed from the Standard International Trade Classification (SITC) data while most right hand side variables reflecting industry characteristics are constructed from the Standard International Industrial Classification (SIIC) data. Although these two are not comparable classifications, this problem is overcome by regrouping the data from established classifications, usually from the three-digit SITC to the three-digit SIIC. Since there is no established rules of how this should be done, individual researchers to a large extent follow subjective judgement. Consequently, different investigators obtain different results for the same country and the same time period (Hitiris and Bedrossian, 1987). In this study we avoid this problem as trade data is also available in the SIIC classification.

3 For example, Bergstrand (1983) has shown the persistence of IIT even at the eight-digit United States Standard Industry Classification (USSIC).

4 It should be noted that there is no consensus among economists as to the definition of an 'industry' with respect to product homogeneity. For example, Finger (1975) defines an industry as one where the products produced are similar with respect to their factor intensities. Falvey (1981), on the other hand, defines an industry by the range of products that a certain type of equipment can produce. Lancaster (1980), however, focuses on consumption side and defines an industry on the basis of the characteristics of products.

5 Toh (1982) has shown that at the four-digit level of disaggregation bias ought to be of lesser significance.

6 Following the standard practice, food, beverages and tobacco, non-metallic mineral products, and petroleum and coal products are excluded from the analysis as trade in these commodities are predominantly determined by the availability of natural resources in the country in question (Menon 1994; Ratnayake and Athukorala 1992). However, one could argue that these industries should also be included in the analysis as some of these industries are also subject to scale economies and product differentiation.

7 Note that within textile industry there are some sub-sectors which contribute less than 10% to IIT. These include narrow woven and elastic textiles, and man-made fibres and yarns (see appendix 1).

8 It should be noted that a significant portion of manufactured imports in Australia are in the form of intermediate inputs and capital goods which are exported after some processing. Thus, growth in IIT in manufacturing may also include this phenomenon.

9 An excellent example of this would be the production of Ford cars in Europe where each plant produces different varieties of a given model and then exchanges with each other.

10 Data for 1979/80 and 1992/93 are employed. At the experimental stage we tested our model with the pooled data, however, results were disappointing. Thus, we decided to estimate the cross-sectional equations.

11 For further discussion on the logit transformation method see Gujarati (1995, pp. 556-57). However, there is no consensus among the researchers as to the use of OLS and the logit method in the study of IIT. For example, Tharakan (1986) and Cave (1981) support the idea of transforming the dependent variable using the logit method while Greenaway and Milner (1986) argue that there is no need for such transformation when the aim of the research is to investigate the determinants of IIT not the forecasting.

12 New Zealand's share in Australia's total imports and exports are: 4% and 5% respectively.

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