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Does Taiwan's Intra-Industry Trade with Mainland China Deviate from the General Pattern?

Nancy Yuh-Jiun Lin

This paper compares Taiwan's intra-industry trade (IIT) with mainland China to its IIT with its fourteen other trading partners to ascertain whether it is qualitatively different. A time-series OLS regression model (modified with the VARIMAX method of factor analysis and cluster analysis) tests the effects on IIT levels across countries in terms of target country income (measured by consumption levels and gross national product); market size; and tariff levels (measured by population and average tariff rates). The model indicates that high IIT levels are correlated with low tariff rates and similar market sizes (the tariff protection effect). Income levels are not significantly correlated with high IIT levels. Furthermore, current IIT levels are determined by the partner's economic conditions in the previous year. Moreover, despite significant market and institutional differences between mainland China and Taiwan's other trading partners, tests with dummy variables show that Taiwan's IIT with the mainland has not deviated from the general pattern.

Keywords: intra-industry trade; statistics; factor analysis; Taiwan; mainland China

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When most people in Taiwan discuss problems concerning Taiwan's relations with mainland China, they tend to pay much more attention to issues from a political point of view. They also frequently neglect to analyze the impact that international political and economic considerations have on these problems. In fact, there are several aspects of the Taiwan and mainland Chinese economies, as well as of the international environment, that may have served to promote trade between Taiwan and mainland China, following a period of little or no contact for some forty years. Taiwan and the mainland

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Nancy Yuh-Jiun Lin received her M.A. in Economics from the University of Illinois in 1984 and is an Associate Research Fellow at the Chung-Hua Institution for Economic Research, Taipei.

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are both members of the international economic community and also must take the international economic environment into consideration when formulating policies. The relations between both sides of the Taiwan Strait and the degree of trade between them thus depend not only on themselves, but also on the local and international political and economic environments, and their effects on Taiwan and the mainland at that time.

To discuss mainland China's problems from the point of view of Taiwan as a whole, and not just with regard to cross-Strait relations, this paper focuses on Taiwan's intra-industry trade (IIT), with the mainland as just one trading partner among many. According to studies by H. G. Grubel, P. L. Lloyd,[1] and P. K. M. Tharakan,[2] economic integration among trading countries will not lead to increased inter-industry specialization. Indeed, it may lead to products of the same classification being imported and exported from one country to another, particularly in the manufacturing sector, where trade overlap and increased product specialization may often result. This is IIT; as economic integration expands between trading countries, IIT will increase.

This phenomenon has occurred with Taiwan and mainland China, as both sides' trade and investment expanded following mainland China's introduction of economic reforms in 1979. Many of Taiwan's exports to the mainland consist of relatively higher-value-added products, whereas it imports (within the same industrial classification) relatively low-value-added products, including raw materials, from the mainland. In some cases, Taiwan exports unfinished products to the mainland, where the products are completed and then exported to the world's markets or traded with Taiwan. All of this has resulted in increased specialization between the two sides of the Taiwan Strait. Moreover, regardless of whether horizontal or vertical integration production processes have been adopted, increased IIT has resulted. Consequently, trade between Taiwan and the mainland has flourished. In 1994, Taiwan exported almost US$15.5 billion and imported around US$1.2-3.5 billion from mainland China. The former amount constituted almost 16.60 percent of Taiwan's total exports, and the latter was no more than 4.2 percent of Taiwan's total import value.

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[1]H. G. Grubel and P. J. Lloyd, *Intra-Industry Trade* (London: Macmillan, 1975).
[2]P. K. M. Tharakan, ed., *Intra-Industry Trade: Empirical and Methodological Aspects* (The Netherlands: Elsevier Science Publishers, 1983).

Is Taiwan's IIT with mainland China any different from its IIT with other trading partners? This study sets up a regression model depicting Taiwan's IIT with its trading partners in an attempt to find reasons for the fluctuations in such trade and also to observe mainland China's status and role in Taiwan's total IIT. That is, from recent history, we can deduce some reasons for Taiwan's IIT fluctuations with mainland China. The question is whether they will reveal any differences between their IIT and that between Taiwan and its other major trading partners.

Estimating the Value of Taiwan's IIT

The concept of IIT has come to be accepted as a result of the efforts of economists including Bela Balassa.[3] The first systematic approach to measuring IIT in terms of the external trade of individual countries was that of Grubel and Lloyd's *Intra-Industry Trade*, which examined three different kinds of flows: total trade, inter-industry trade, and intra-industry trade. The total trade equals the inter-industry trade plus the intra-industry trade. Grubel and Lloyd derived the value of IIT through indexation, and also distinguished between ways to adjust not-considered trade disequilibrium (GLi) and considered trade disequilibrium (Ci). Although the method adopted to estimate GLi seems to be deficient in that it underestimates the value of IIT, according to the empirical findings of Oli Havrylyshyn, Engin Civan, and Kuo-en Hwang,[4] it has been discovered that when the IIT values for different countries are explained, regardless of whether adjustments are made for trade disequilibrium, the IIT values obtained can all be explained in a similar way.

Because the emphasis of this study is on the relative position of the mainland market, and not on its absolute value (although the method used to calculate GLi results in the IIT value being underestimated), the results are not influenced by this bias. This is also the

[3]Bela Balassa, "Tariff Reductions and Trade in Manufactures among the Industrial Countries," *American Economic Review* 56 (1966): 466-73.

[4]Oli Havrylyshyn and Engin Civan, "Intra-Industry Trade and the Stage of Development: A Regression Analysis of Industrial and Developing Countries," in Tharakan, *Intra-Industry Trade*, 111-40; Kuo-en Hwang, "Measurement of and Factors Determining Taiwan's Intra-Industry Trade" (M.A. thesis, Economics Department, Feng Chia University, Taiwan, 1988).

reason why this approach can be used to determine the IIT of different countries.

The approach may be explained as follows:

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

where Xi represents exports of the ith product, and Mi is imports of the ith product.

The GLi index fluctuates between 0 and 100 percent. The closer the index is to 100, the higher the degree of intra-industry trade. The closer the index is to 0, the higher the degree of inter-industry trade. In addition, Grubel and Lloyd go even further to calculate the weighted average value of the GLi index, in order to observe the average level of IIT within the whole or part of a country's industry, or else the average value of IIT within a particular industry encompassing several countries, i.e.,

$$\overline{GLi} = (1 - \frac{\Sigma|Xi-Mi|}{\Sigma(Xi + Mi)})\ \chi\ 100$$

In this study, the Standard International Trade Classification (SITC) is used to calculate the GLi value in Taiwan's external trade. As for the time series adopted, since Taiwan's SITC classifications have been revised on three occasions, in order to ensure consistency in classifications adopted throughout the period under consideration, the 1979-91 period forms the basis of the analysis.

As can be seen in table 1, Taiwan has a very high degree of IIT. In 1979, it had already reached 95.89 percent of its total trade, and the percentage rose even higher in 1980-81. In 1982-83, however, it declined to around 90 percent, and during the 1984-87 period, it fell further to about 75 percent. In 1988-91, it increased back to around 90 percent. The above findings indicate that in Taiwan's external trade as a whole, inter-industry trade has played a far less important role than intra-industry trade (inter-industry trade plus intra-industry trade equals 1). Between 1979 and 1991, inter-industry trade never exceeded 25 percent of total trade, and at one point fell to as low as 1 percent. In contrast, intra-industry trade never fell below 75 percent of total trade. The main reason for this high proportion of IIT was the contribution rate of manufacturing products (IIT among the trade of manufacturing products).

Table 1
Taiwan's Total Intra-Industry Trade, Including Mainland China

Unit: %

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Taiwan's total IIT	95.89	99.15	96.84	91.98	89.47	83.92	79.2	75.71	78.46	90.27	88.57	89.89	90.61
Manufacturing industries	76.11	75.71	72.58	68.97	66.63	62.79	58.87	62.05	65.46	74.32	75.86	77.21	79.21
Shares[a]	79.37	76.35	74.94	74.98	74.47	74.83	74.33	81.95	83.44	82.33	85.65	85.89	87.42
Taiwan's IIT with the mainland	55.24	48.94	32.70	60.34	72.56	46.17	21.02	30.19	38.13	35.19	33.73	37.86	38.87
Manufacturing industries	27.80	5.07	3.94	10.73	18.41	12.98	5.5	13.36	18.19	19.45	21.46	26.65	29.03
Shares[a]	50.32	10.35	12.04	17.77	25.37	28.1	26.15	44.24	47.7	55.27	63.68	70.4	74.67

[a]The numbers are shares of manufacturing sector's IIT among total IIT (as manufacturing sector's IIT/total IIT).
Sources: *Taiwan's External Trade Yearbook*, various issues; and *Hong Kong External Trade*, various issues.

Because manufactured goods (SITC 5-8) tend to be much more diversified than most primary products, intra-industry trade involving manufactured products has been relatively high. In Taiwan, intra-industry trade as a proportion of external trade has been mainly accounted for by the contribution rate, which has resulted from product diversification within the manufacturing sector. This rate reached 87.42 percent of all IIT in 1991. Prior to 1986, it was around 75 percent, and since then, it has always been in excess of 80 percent.

According to an empirical study by Havrylshyn and Civan, the intra-industry trade of newly industrializing countries (NICs) (excluding Taiwan) frequently exceeds the extent of the countries' economic development and product diversification in industry.[5] The main reason for this is that the NICs are often the recipients of direct investment by foreign multinational companies, and serve as points in a production process characterized by vertical and horizontal integration across national boundaries. This is why NIC intra-industry trade levels are higher than one would normally expect, given these countries' levels of economic development. Taiwan's IIT, as can be seen from the results of the analysis of our regression model, confirms such reasoning.

Estimating the Value of Taiwan's IIT with Mainland China

Prior to 1984, trade with the mainland was still illegal in Taiwan, and there was a relatively unstable but high degree of IIT with mainland China, which at one point reached 72.56 percent. This ratio fell to 21.02 percent in 1985 but gradually climbed again, leveling off in 1990-91 at around 38 percent. Nevertheless, the contribution rate of manufactured products to IIT has been relatively high since 1985, and in 1990-91, the share of the manufacturing sector as a proportion of total IIT exceeded 70 percent. Although Taiwan's IIT with the mainland in 1980 was as high as 48.94 percent, the contribution rate of its manufactured products was the lowest recorded, at 10.35 percent (see table 1).

These findings indicate that until 1984, the products that Taiwan's individual industries traded with the mainland were vastly different

[5]See Havrylyshyn and Civan, "Intra-Industry Trade and the Stage of Development" (cited in note 4).

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from those traded with other partners. There were also significant differences between industries with high IIT levels and those with low IIT levels. At that time, since trading with mainland China was illegal, the commodity makeup of the trade structure was very unstable, and manufactured products were not particularly outstanding, but, from 1985 onwards, as Taiwan manufacturers began to invest on the mainland, the IIT share increased. Furthermore, because there was a more or less constant proportion of components sources from Taiwan, the share of IIT attributable to the manufacturing sector as a proportion of total IIT stabilized.

From the above comparison between Taiwan's IIT with its trading partners in general and its IIT with mainland China (in addition to realizing the very significant changes in the structure of trade between the two sides of the Taiwan Strait over the past forty years), it is clear that Taiwan's IIT with mainland China has not maintained as consistent a pattern as its IIT with its other trading partners. Rather, it can be seen that the degree of Taiwan's product specialization in its trade with the mainland (regardless of whether one is concerned with vertical or horizontal specialization) has been unstable and has generally fallen short of the levels achieved between Taiwan and its trading partners as a whole. These findings thus indicate that much room for further improvement still exists.

Our findings indicate that the differences which currently exist between Taiwan's IIT with mainland China and with its other trading partners do not necessarily imply that the factors determining the fluctuations and extent of Taiwan's IIT with the mainland are also different than those affecting other trade. In addition, these determining factors are not different from those relating to the degree of IIT between Taiwan and its trading partners in general, as shown by our regression model.

The Time-Series OLS Regression Model for Taiwan

According to the economic literature, factors that influence the degree of IIT between countries include the following:

1. *The degree of economic development:* The more economically developed a country is, the more product diversification there is and the higher the degree of IIT. Moreover, the greater the similarity in terms of the trading countries' stages of economic development, the closer their respective average incomes are and the higher the level

of IIT between them is.[6]

2. *The size of the domestic market:* A larger domestic market suggests the possibility of a higher level of IIT. However, if countries that have large domestic markets trade with countries with much smaller domestic markets, the huge differences in market sizes will dictate that the countries with small domestic markets and limited demand will be unable to buy a wide variety of products, resulting in a reduction in IIT trade with the countries with bigger domestic markets.[7]

3. *The barriers to trade:* The fewer the barriers to trade between countries, the more suitable the conditions for developing IIT between them. Thus, IIT levels would also tend to be higher. Furthermore, barriers to trade include those caused by natural geographical and cultural considerations, man-made tariff and nontariff barriers as well as frontier trade.[8]

For the purposes of this study, the value of IIT in Taiwan's external trade for the period 1979-91 was used as the dependent variable in the regression analysis. The independent variables used (apart from the time variable) were mostly selected on the basis of their having been used in similar empirical studies in the literature. These included average per capita consumption for each area (to denote the level of economic development),[9] gross national product (GNP),[10] population (to denote the size of the domestic market), and the average tariff rate (to denote the extent of barriers to trade).[11] The results of the regression analysis were then analyzed in order to determine why the

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[6]For details, see ibid.

[7]For details, see D. Loertscher and F. Wolter, "Determinants of Intra-Industry Trade: Among Countries and Across Industries," *Weltwirtschaftliches Archiv* 116 (1980): 280-93.

[8]For details, see ibid.; and E. Pagoulatos and R. Sorenson, "Two-Way International Trade: An Econometric Analysis," *Weltwirtschaftliches Archiv* 111 (1975): 454-65.

[9]In order to achieve uniformity in each country's independent and dependent variables, our data all come from the International Monetary Fund (IMF). Since the IMF data for Indonesia lack information about national income, we substituted data on per capita private consumption.

[10]Although Havrylyshyn and Civan ("Intra-Industry Trade and the Stage of Development") used gross domestic product (GDP) and population to measure market size, on GDP we had to substitute GNP because China was short of data. In addition, the time series data for China was not complete, so we used the growth rate for estimation (e.g., there was no GNP data in 1979, so we used the growth rate of 1980-1981 for estimation; 1990-91 was short on population data, so we used the growth rate of 1989's population).

[11]Since time series data on real tariff rates was difficult to find, we substituted the average tariff rate (the annual tariff revenue divided by the value of import).

IIT level of Taiwan's external trade fluctuated during the period under consideration, and to observe the extent to which Taiwan's IIT with mainland China differed from its IIT with other countries. That is, were the reasons for the fluctuations in Taiwan's IIT with mainland China different from the reasons for fluctuations in trade with its other major trading partners? The major trading partners considered for the purposes of our regression analysis included mainland China, Japan, the United States, Indonesia, Malaysia, Thailand, South Korea, Singapore, Germany, France, Britain, Italy, Denmark, Canada, and Australia, for a total of fifteen countries.

The regression model, which as mentioned before was designed in accordance with past empirical studies carried out by various researchers, is not suitable in its current form for performing OLS operations, owing to the existence of multicollinearity among the independent variables (see table 2). For this reason, it was necessary to use the VARIMAX method of factor analysis to extract independent variables.[12] Once this analysis was performed, two new two-dimensional independent variables are obtained: the effect of tariff protection (combining population and degrees of protection) and the income influence effect (combining the level of economic development and income).

In addition, the cluster analysis method was used to replace the fifteen dummy variables (one for each of fifteen trading regions) with five cluster variables, on the basis of their different influences in Taiwan's IIT. Countries were grouped as follows: mainland China (C1); Japan and Australia (C2); the United States (C3); Indonesia, Malaysia, Thailand, South Korea, and Singapore (C4); and Germany, France, Britain, Italy, Denmark, and Canada (C5). Mainland China and the United States are at opposite ends of the spectrum, as the former particularly stresses the tariff protection effect, while the latter emphasizes the income effect. Japan and Australia have similar cluster characteristics, as do Indonesia, Malaysia, Thailand, South Korea, and Singapore, as well as Germany, France, Britain, Italy, Denmark, and Canada.

One rather interesting finding is that among these five clusters of dummy variables and two new independent variables, multicollinearity

[12]See Rudolph J. Rummel, *Applied Factor Analysis* (Evanston, Ill.: Northwestern University Press, 1970).

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Table 2
Coefficients of Multicollinearity Between Each Independent Variable

	PCON	GNP	DTRATE	POP
PCON	100.00	48.92	-26.2	-23.84
	(0)	(0.0001)	(0.0002)	(0.0008)
GNP	48.92	100	0.09	26.93
	(0.0001)	0	(0.2108)	(0.0001)
DTRATE	-26.2	0.09	100	87.08
	(0.0002)	(0.2108)	0	(0.0001)
POP	-23.84	26.93	87.08	100.00
	(0.0008)	(0.0001)	(0.0001)	0

Notes: PCON denotes the average per capita consumption; DTRADE denotes the average tariff rate; POP denotes the population level.

still exists. This not only shows us that when constructing an IIT regression model for Taiwan, such clusters of dummy variables cannot be included, but also indicates that some of the cluster dummy variables and the newly-explained variables exert almost the same effect on Taiwan's IIT. For these reasons, after modification of the Taiwan IIT regression model covering 1979-91, the results are as shown in table 3:

$$IIT = f(F1, F2, Year)$$

where IIT represents the IIT regression model; F1 is the tariff protection effect; F2 is the income effect; and Year refers to the period under consideration, 1979-91.

Discussion of the Empirical Results

Economic interpretation of the empirical results is as follows: although the IIT regression model for Taiwan was initially influenced by both the two factors, it was not significantly influenced by the income effect factor. This indicates that income effects have not been a major reason for the fluctuations in Taiwan's external IIT. That is, Taiwan's high degree of external IIT has not been the result of its high degree of economic development or its high income level, but has stemmed from other factors.

Table 3
Variables Under the 95% Statistically Significant Level

	Estimated value of coefficient	Standard error	P value	Significant or not
F1	-1.7981	0.6895	0.0099	Yes
F2	-0.0861	0.6512	0.895	No
Year	0.0438	0.1907	0.8189	No
XLAG1	0.8592	0.0332	0.0001	Yes

D-W value	2.310	No. of Obs.	180
R-square	0.8363	Adj R-sqare	0.8326
F value	223.522	Prob > F	0.0001

By contrast, the tariff protection effect factor is significantly negative, indicating that if there is a great difference in terms of the relative sizes of Taiwan's market and those of its trading partners and there is a high degree of tariff protection, as with the mainland and Southeast Asian countries, it will result in Taiwan having a low degree of external IIT. Conversely, if the markets of Taiwan's trading partners are similar in size to Taiwan's market, and the level of tariff protection is low, this will result in Taiwan having a high degree of IIT with those countries.

The above findings indicate that Taiwan's IIT has mostly been influenced by the tariff protection effect factor. Taiwan's IIT levels with its trading partners have been high or low according to the openness of those partners' markets and the similarities in size between their markets and Taiwan's.

There is a high degree of correlation between Taiwan's IIT with mainland China and the tariff protection effect. This suggests that changes in IIT between Taiwan and the mainland have mostly been due to differences in their respective markets' purchasing power and the levels of tariff protection. Furthermore, these factors have been responsible for the varying IIT levels between Taiwan and its other trading partners; thus, the situations with the mainland and other partners are not dissimilar.

The time variable is basically not significant in Taiwan's IIT regression model. However, when more than one time period is considered (by means of the variable XLAG1), the time variable becomes significant. In other words, the trading partner's previous economic environment and conditions will affect the IIT level between that

country and Taiwan in the next period. Thus, when appraising Taiwan's IIT in the current period, it is necessary to examine the trading partner's economic conditions in the previous period.

These results imply that if there is a great difference in terms of the relative sizes of Taiwan's market and those of its trading partners and if there is a high degree of tariff protection (as in mainland China and Southeast Asian countries), this will result in Taiwan eventually having a low degree of IIT.