THE EFFECTS OF GLOBAL LOGISTICS STRATEGIES ON INTERNATIONAL FREIGHT TRANSPORTATION DEMAND

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Abstract: For years, researchers and practitioners have investigated growing business globalization trends and international freight transportation forecasting. However, there are few discussions of the interrelationships between globalized business and its effects on international freight flow. This study reviews the experiences of multinational companies and surveys 152 Taiwanese IT firms to provide a detail picture of existing global logistics operations. It was found that the logistics strategies of the manufacturing supply chain will affect a firm's modal choice, and that the multiple-site of the multinational production logistics strategies will affect the trip generation and distribution. This paper also seeks to highlight gaps in the literature and issues for future research.

Key Words: global logistics strategy, multinational companies, international freight transportation, information technology industry

1. INTRODUCTION

Logistics has been rapidly transforming as a result of the growing globalization of business and changing technology. The globalization of the manufacturing industry refers to the internationalization of the manufacturing supply chain. Changes in geographical location or customers' expectations continually transform the nature of markets, applying pressures that in turn, cause the redirection of product flow within a firm generate. Advanced technologies allow for methods of adjusting the flow of raw materials, semi-finished goods, products, and spare parts. In this process, the demand of freight transportation services that support the delivery of goods also changes. Traditional freight transportation studies assumed that manufacturing activities were concentrated at a single manufacturing location, therefore these studies are inadequate at describing the operations of today's multi-national manufacturing supply chain.

Information-technology (IT) manufacturing firms in Taiwan have realized the changing dynamics of the global market, adjusting their logistics strategies to meet the needs of multiple-site and multinational production and assembly. The adjustment of logistics strategies in Taiwanese IT firms has contributed to the change of international freight transportation demand to and from Taiwan. This study aims to explore the effects of logistics strategies on international freight transportation demand, examining the change of trip generation, trip distribution and modal choice.

This study first explore and categorize the logistics strategies, taken by Taiwanese IT firms.

One Taiwan firm that is worth discussing is the Acer Corporation. This company has set up multiple manufacturing sites in Southeast Asian countries and Mainland China to exploit the comparative advantages of lower land and labor costs. The supply-chain and the movement of all these materials and products lead to the change of transportation demand among Taiwan, offshore factories and marketplaces. Secondly, this study analyze how logistics strategies affect the international freight transportation demand pattern and by what degree. For this analysis, a questionnaire was designed to survey executive managers of 152 IT firms in Taiwan to better understand the approaches that these companies take to implement logistics strategies and the impact of these logistics strategies on transportation demand.

This article is organized as follows. Section 2 briefly examines the literature on logistics strategies and freight transportation demand given an overview of previous research. Section 3 describes logistics strategies as related to Taiwanese IT firms. Section 4 presents the impacts of various logistics strategies on international freight flow. Conclusions and prospects for future research follow.

2. LITERATURE REVIEW

There has been extensive research on logistics and freight transportation. This research has primarily focused on traditional logistics issues, which develop solutions only for implementation at a central location. The Council of Logistics and Management (1993) defines logistics as "the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from a point of origin to a point of consumption for the purpose of conforming to customer requirements." The components of a logistics system may include some or all of the following: suppliers, production facilities, transshipment points, and demand points. Distribution of freight from origin to destination is the core of logistics (Langevin, 1996). Moreover, as industry globalizes, logistics will involve more material flows through a supply chain that extends beyond national borders. The global company seeks to achieve a competitive advantage by identifying world markets for its products and developing a manufacturing and logistics strategy to support its marketing strategy. A successful company in the global marketplace will disperse production and assembly facilities across multiple regions to meet the needs of overseas markets using global logistics channels to supply these facilities (Christopher, 1998).

The cost-efficient arrangement of transportation and storage is a major issue when planning a logistics strategy. Before the first half of the 1990s, the function of logistics was to minimize total distribution costs and maximize profits, while achieving desired levels of service performance (Lambert, 1993; CLM, 1986; Gustin et al., 1995; Langevin, 1996). Today the aim focuses on maximizing manufacturing flexibility both inside and outside the firm towards customization at the minimum cost (Bowersox and Daugherty, 1995a; Novack et al., 1992). This means that logistics is now directed towards supply chain issues. Moreover, the aim of a firm's logistics strategy is to exploit the firm's unique product assembly and delivery features, to maximize profit and service, thus leading to competitive performance (Bowersox and Daugherty, 1995b).

Behind the expanding trend of globalization in logistics, there are several factors reshaping logistics operations and strategies. These factors are (Cooper, 1993): the globalization of markets, cheaper communications, removal of barriers to trade and foreign investment, achieving economies of scale in business, innovation in logistics, and decreasing transportation unit costs. These factors tend to increase world trade and the worldwide specialization of production. This means that freight transportation between continents and between countries will not necessarily increase with the growth of the world economy, but instead grow and diversify with the specific demands of the various regional markets (Lehmusvaara, 1998).

Therefore logistics operations will determine the direction of freight transportation flow. These operations can not only be measured by the yardstick of a nation's gross national product (GNP), but must also be evaluated by the increasing influence that the transportation and distribution of

On the other hand, Qrtuzar (1990), Langevin (1996), Crainic et al. (1997), Feng et al. (2000) and Garrido et al. (2000) all provide reviews on the solution approaches in freight transportation. They indicate that current freight transportation research tends to emphasize the role and importance that freight transportation plays in the overall manufacturing/ distribution processes. However, some of these previous analyses of freight transportation have suffered from a variety of shortcomings. First, most of these studies assume that product manufacturing is done at the factories in a concentrated area. Under the trend of globalized production, firms manufacture their products at diversified multiple-sites. The previous freight transportation studies are incapable of reflecting current manufacturing realities and the demands that firms currently placing on freight transportation services to meet their needs. Second, earlier studies were based on only a limited amount of data, and may not have captured all the effects of the international division of labor. Lastly, part of these previous studies underestimated the transportation demand incurred by the internationalization of production activity, since they do not take into account the dynamics of the interaction between a firm's freight demand, and adjustments in the manufacturing supply chain.

While previous studies have highlighted characteristics of logistics strategy and freight transportation, to the best of our knowledge, none of the previous academic work has researched the influences of global logistics on international freight transportation demand.

3. LOGISTICS OPERATIONS OF TAIWANESE IT FIRMS

Logistics has rapidly changed as a result of the growing globalization of economies. The IT firms in Taiwan have realized changing needs, adjusted their logistics operations and engaged in multiple-site and multinational production and assembly. This study applied Taiwanese IT firms' experiences to categorize the manufacturing firms' logistics operations.

3.1 Types of Logistics Operation Strategy

To establish an efficient international division of labor, Multinational Companies (MNCs) have created a network that addresses various needs when implementing value-added logistics. The experiences of IT industries supply the best cases to illustrate the evolution of logistics. The IT industry in this study refers to the manufacturing activities of firms involved in the following area: information hardware manufacturers (computer systems, peripheral equipment, important precision parts and components), consumer electronic manufacturers (audio products, video products, and other consumptive products) and semiconductor manufacturers (semiconductor manufacturing, semiconductor's raw materials). The IT production supply chain begins with a variety of component producers, each of which specializes in a particular component, usually distributed on the open market or supplied on an Original Equipment Manufacturer (OEM) basis to assemblers. The various components provide different levels of value to the completed system.

Curry et al. (1999) summarized the four types of logistics channels of the PC industry and their possible interactions from component sources to final customers. See Figure 1. Firms often utilized more than one method depending on the products or the markets, and there is much variation from firm to firm.

The first type of logistics strategy is found in the conventional supply chain, parts and components are delivered to warehouses and stored until required for assembly. The finished products are then shipped through conventional distribution channels (i.e. to distributors), and on to value-added resellers (VARs) or to retail stores.

The second type of logistics operation is global logistics. In dealing with global logistics strategies are designed to meet globalized sourcing and distribution. Global logistics strategies

are based on the recognition that system assembly is a low value-added, but time-sensitive, segment of the supply chain. Global logistics systems have been developed to manage the higher-value-added portions of the supply chain involving distribution, marketing, original design manufacturing (ODM), OEM manufacturing, and distribution as a complete service. The majority of the practitioners of global logistics are based in Taiwan. The distance between final markets and manufacturers has created a need for a system that would protect components from depreciation risks. The global logistics system pioneered by Taiwanese firms is a response to opportunities that arose in the mid-1980s to supply U.S. assembly firms with inexpensive components and even finished PCs on an OEM basis.

In an attempt to reduce inventory exposure, a number of the largest PC assemblers are shifting some final assembly operations to distributors, thereby completing the finished product closer to the final customer. Their aim is to decrease inventory and increase responsiveness. The firms handling this work are part of a broad and amorphous category called value-added resellers (VARs). VARs complete the final stage in the third type of logistics operations, which is a delivery-oriented approach. VARs include distributors of relatively large parts, components, and systems and they may perform specialized system integration, partial system assembly services, or even whole system contract assembly for large PC marketers. Channel assembly through VARs resembles the global logistics system, but the critical difference is that the VARs often perform a wider range of downstream functions. Channel assembly has two features that make it superior to the traditional model. First, it shortens inventory-holding periods. Second, once the contract is concluded and the PC specifications are agreed upon, the contractor need not be concerned about value erosion because the final agent in the VAR chain deals directly with the customer's needs.

Direct marketing is the fourth type of logistics operation. The most serious competitive challenge to the established PC companies comes from direct marketers such as Dell Computer. These companies receive customer's orders before they actually build a computer. This means they do not need to hold any inventory, thereby eliminating most inventory and concomitant risk (Curry et al., 1999). As Figure 1 indicates, the direct marketing model reduces the number of activities from the factory to delivery of the finished products to the customer to an absolute minimum.



Note: Broken lines indicate component flows, solid lines are finished systems.

Figure 1. IT products logistics channels

3.2 Acer and Taiwanese IT firms' experiences

Acer Computer, founded in 1976, is the largest PC manufacturer in Taiwan. The company

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developed an order-based supply chain referred to as "Fast Food" operation and the "Client-Server" operating structure. Acer's Fast Food model endeavors to establish an efficient international network of division of labor through its selective use of international freight transportation modal for the operation. Acer's logistics strategy takes account of the rapid pace of change in customer needs using a logistics strategy that protects key parts with high added value from erosion. To eliminate this risk, parts are transported either by air or sea, depending on the degree of added value. Products with low added values, such as housing, power supply units, and floppy disk drives are normally carried by sea in order to reduce transportation costs. On the other hand, key parts with higher added value, such as CPUs, MPUs, hard disk drives, and memory chips are selected according to demand shifts and transported by air immediately prior to assembly if demand indicates the necessity. The selective choice of air or sea transportation services is common in the IT industry. The aim is to maintain the quality of parts used in finished products, ensure customer satisfaction, and at the same time, eliminate the risk of declines in the price of product inventory.

Because logistics strategies are dependent on a firm's supply chain operation, we divided Acer's logistics development into four stages in relation to changes in the supply chain. See Figure 2 and Figure 3. Before the late 1980s, during the first stage of Acer's logistics development, the company concentrated all its production activities at a single geographical location and served its world markets through traditional logistics and marketing networks. At this stage, the main freight transportation demand was from Taiwan to the market countries. Moreover, the value density -- the value of a product in relation to its weight and volume -- was low; as well as time was not considered to be a critical business variable, leading to a large part of the finished products being transported by sea.

Since the 1990s, the second stage of Acer's logistics development, Acer adjusted its supply chain as factories were relocated to Mainland China and Southeast Asian countries to utilize cheaper and cost comparative factors. Materials, semi-finished products, components and finished products were transported to the geographically dispersed manufacturing factories. In this stage, the output of a primary manufacturing factory in one country may simply be the input for a sub-assembly factory of Acer located in another country. The semi-finished products may be transported back to Taiwan for final assembly, then re-export to foreign markets. At this stage, the increment of transportation demand of semi-finished products ΔQ_1 , as illustrated in Figure 3, was generated along with the process of supply chain operation.





In the third stage, each of Acer's offshore manufacturing factories performed an independent operation in the supply chain and ships output to a final assembly factory in Taiwan. After final assembly, the finished products were exported to the markets. Because the offshore factory was operated independently, the increment of transportation demand (ΔQ_2) was fully reflected in the freight flow from Mainland China and Southeast Asian countries to Taiwan.

But in recent years, the ability to respond to customers' requirements in ever-shortening timeframes has become critical, has lead Acer to further adjust their supply chain operation. All of the outputs from each offshore factory are shipped directly to the final assembly factories in locations near the marketplace. This is the fourth stage of Acer's logistics development, the physical flow of components and semi-finished products are not transported to Taiwan, freight flow between the offshore factory to the marketplace has increased and the freight flow to and from Taiwan has decreased ($-\Delta Q_3$). In the decision of modal choice, because the response time of IT industry operation has become shorter, air transportation services demand is increasing and sea transportation demand is decreasing.

Because all of the movements of materials, semi-finished products, components and finishedproducts determine the freight transportation demand, the various stages of logistics development mentioned above will create different freight transportation demands in terms of trip generation and distribution. Table 1 compares the volume - measured in US dollar cost - of the Acer Group's freight transportation between Taiwan factory, offshore factories (Mainland China and Southeast Asian countries) and market places over the years of logistics development from Stage I to Stage IV. The study found that the total freight movement of Acer Group increase in US dollars from 870.4 million USD at Stage I in the years of 1988 through 1990 to a total of 2,536.2 million USD at Stage IV (1997-1999). From Stage I to Stage III, the total freight volume of Acer Group to and from Taiwan increase from 838.3 million USD (815.8 million + 22.5 million), 1,318.5 million USD (1,122.7 million + 195.8 million) to 2,204.2 million USD (1,314.7 million + 889.5 million). In contrast, during Stage IV, freight volume to and from Taiwan decreased to 1,055.9 million USD (838.3 million + 217.6 million) since the products manufactured from offshore factories are shipped directly to the marketplace. Moreover, Table 1 and Figure 4 show that Acer Group's outgoing freight share of Taiwan decreased from 93.7% at Stage I to 33.1% at Stage IV. The incoming freight share of Taiwan increased from 2.6% at Stage I to 38.0% at Stage III but decreased to 10.7% at Stage IV. Considering the changes in Acer's international division of labor and supply chain arrangement in recent years, the flow of freight from Acer's offshore factories to their market places expanded and accelerated from Stage III (4.6%) to Stage IV (51.8%). In Acer's experience, the freight transportation demand to and from Taiwan will indeed fluctuate according to the firm's international division of labor as well as the various supply chain operation models.



Figure 3. Acer's logistics development and freight transportation demand to and from Taiwan

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from	Taiwa	n	Offshore F	actory	Market F	lace	Sub-to	otal
Stage I (1988-1990)	5411 D16	percens, r	o paraite s	क्षा १० जुन	aconique	14/6 (.)	augus alt,	2001/200
Taiwan	0.0	0.0%	5.1	0.6%	810.7	93.1%	815.8	93.7%
Offshore Factory	22.5	2.6%	0.0	0.0%	32.1	3.7%	54.6	6.3%
Sub-total	22.5	2.6%	5.1	0.6%	842.8	96.8%	870.4	100.0%
Stage II (1991-1993)	1 1 1 1		and contrast	and a second second		1.1.00	attice the store	Character and
Taiwan	0.0	0.0%	21.7	1.3%	1,101.0	67.2%	1,122.7	68.5%
Offshore Factory	195.8	11.9%	250.1	15.3%	70.6	4.3%	516.5	31.5%
Sub-total	195.8	11.9%	271.8	16.6%	1,171.6	71.5%	1,639.2	100.0%
Stage III (1994-1996)				the second			HILL CLITTICE	
Taiwan	0.0	0.0%	40.5	1.7%	1,274.2	54.5%	1,314.7	56.2%
Offshore Factory	889.5	38.0%	27.1	1.2%	108.2	4.6%	1,024.8	43.8%
Sub-total	889.5	38.0%	67.6	2.9%	1,382.4	59.1%	2,339.5	100.0%
Stage IV (1997-1999)	aupidu	B.S.de	siomal da	is Lumin	1. 019W ?	VITTIE -	ideal 24	a fistor
Taiwan	0.0	0.0%	91.4	3.6%	746.9	29.4%	838.3	33.1%
Offshore Factory	271.6	10.7%	113.7	4.5%	1,312.6	51.8%	1,697.9	66.9%
Sub-total	271.6	10.7%	205.1	8.1%	2,059.5	81.2%	2,536.2	100.0%

Table 1. The changes in freight movement of the Acer Group: Stage I (1988-1990) -- Stage IV (1997-1999)



Figure 4. Acer Group's outgoing/incoming freight movement to Taiwan

4. THE EFFECTS ON INTERNATIONAL FREIGHT FLOW

Since many of the pervious studies are quite limited by a lack of available data, this study designed and conducted a questionnaire to survey the Taiwan IT manufacturing industry in order to learn the firms' logistics strategies. This section explains the rationale that was used in selecting respondent Taiwanese IT manufacturing industry, empirical research methodology, and the characteristics of the sample.

4.1 Research methodology

In order to explore issues of global logistics in Taiwan business, a survey instrument was sent to 152 IT firms listed on the Taiwan Stock Exchange (TSE). In-depth interviews, desk and file

research, cost and quantitative studies of logistics, and logistics strategies were also conducted. The objective of the interview process was to clarify the related details of firms' logistics operations and to validate findings from the survey analysis. The survey was conducted from July 1998 to June 2000. Before mailing the questionnaire, two companies were asked to pretest the survey and to provide comments regarding the level of clarity and objectivity of the questions, the accuracy and applicability of the answer options, and the amount of time spent on the questionnaire. Suggestions were used to refine some of the questions and to add new answer options. The survey instrument was comprised of three sections. The first section contained questions asking respondents for basic information. The second section included questions regarding the manufacturing activities of the supply chain, including, the respondents' opinions concerning, the reasons driving the decision to establish offshore factories and the number of the factories of the respondents. The final section of the instrument questioned respondents as to the strategies of manufacturing and logistics, including identification of products' characteristics and cost of logistics.

4.2 Sample Analysis

A total of 45 usable surveys were returned each representing a unique firm for an effective overall response rate of 29.61 percent (i.e. 45/152). The low response rate may have been due to the very detailed nature of the survey. Despite the low response rate, it should be noted that the total number of surveys returned represented a very large database for Taiwanese IT industry supply chain research. Table 2 and Table 3 summarized the basic information regarding the respondents.

	Table 2. I	osition	s of surv	veyed respond	lents	2500 -	
	No. of	7		Respor	sibility for lo	gistics open	ration
Title of the Position	Responde	ents	(%)	Yes	%	No	%
Top Management	1		2.22	0	0.00	1000	2.22
Senior Management	4		8.89	3	6.67	1	2.22
Department Managers	philometro 25		55.56	20	44.44	5	11.11
Supervisors & Engineers	12		26.67	12	26.67	0	0.00
Others	3		6.66	0	0.00	3	6.67
Total	45		100.00	35	77.78	10	22.22

Table 3.	Questionnaire survey response profile	
Annual Sales (million USD)	No. of Respondents	(%)
Less than 500 million	debr dear deer deer seer reigine deer deer	68.89
\$501 million – 1 billion	III séals II séals 7 i séals	15.56
\$1 – 1.5 billion	5	11.11
\$1.5 – 2.0 billion	a weet enough southoundation and theight i	2.22
Greater than \$2 billion	1	2.22
Total	THE THE MARKET AS ANT AL AND 21	100.00

As shown in Table 2, the positions held by the people who completed the questionnaire varied from top management to supervisors and engineers. The top management positions (2.22%) included chief executive officers, whereas the senior management positions (8.89%) included general and assistant general managers, technical directors, operations managers, and plant managers. The department managers (55.56%) were derived from control and logistics engineering; product engineering; and marketing and administration personnel, while the supervisors and engineers (26.67%) included those with the responsibility of handling manufacturing activities. Finally, the title of executive assistant and executive secretary are included in the last category (6.66%). Based on the profile of the respondents, it is assumed the sample provides a representative profile and can be used to analyze the general practices

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and views within the Taiwanese IT manufacturing industry. Subsequent to completing the survey, five respondents were contacted for personal interviews to clarify perceived misunderstandings or misinterpretations of the questionnaire, and to get a more in-depth understanding of their opinions. Respondents were asked to provide demographic information related to their individual firms. Annual corporation sales per respondent ranged from \$16 million to \$3.06 billion USD, see Table 3, providing a wide coverage of the industry.

With regards to product lines, many firms may carry multiple products, some of these products accounting for only a small part of the total revenue. To simplify the analysis, only the products that take up to 5 percent of the total revenue will be analyzed. Among the respondents, there were 11 firms that carried a single product, 14 firms that carried two products, 13 firms that carried three products, and 7 firms that carried more than four products. Most Taiwanese IT firms carried three products on average. The vertical integration in the IT industry is obvious, and the degree of specialization is high.

4.3 Survey Results and Analysis

In order to examine the offshore relocation process of the Taiwanese IT industry, the respondents were asked to specify the location of their manufacturing factories. In this survey, the number of respondents and the related number of manufacturing locations were as follows: 9, 11, 11, 8, 6 respondents established their manufacturing factories at single, two, three, four, five and more different locations, respectively. The respondent's factories within Taiwan were considered as at a single location. In addition, the above offshore factory relocation will illustrate the Taiwanese IT firms' international division of labor. About 80 percent (36/45) of the responding companies have already relocated part of their manufacturing activities to overseas countries. In the survey, 92 offshore manufacturing factories is shown in Figure 5. There are 44 offshore factories in China, 13 in the US, 6 in Malaysia, 6 in Singapore, 5 in Thailand, 4 in the United Kingdom, 3 in Japan, 3 in the Philippines, 3 in Mexico, 1 in Hong Kong and 4 in other countries. Figure 6 illustrates the trend of the respondents' foreign investment in recent years. It indicates that the trend of foreign investment is increasing continuously.



Figure 5. The distribution of surveyed IT firms' foreign investment

In addition, Table 4 highlights the reasons for the respondents' choice to relocate their factories offshore. Respectively, about 44.57 percent and 16.30 percent of the respondents agreed that lower labor and land costs were major incentives for relocation providing a long-term cost advantage. Moreover, about 3.26 percent of the respondents indicated that, lower tax and tariffs were the main reasons to relocate. Thus, in total about 64 percent of respondents indicated that labor and land costs as well as tax/tariff savings were the major cost

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considerations for the internationalization of the division of labor. Obviously, most of the firms desired cheaper production input factors with cost advantages while they established their offshore factories. Furthermore, it should be noted that some respondents remarked that there were other reasons for their location selection. The reasons included "proximity to customer markets (23.91%)," "easier access to new technologies (6.52%)," "skilled labor availability (3.26%)," and "others (2.17%)."



Figure 6. The trend of foreign investment

This research also tried to find the relationships between the reasons and the locations of a firm's foreign investment. As shown in Table 5, in general, the reasons given by the respondents for establishing their factories in China and Southeast Asia were "cheaper labor costs," and "lower tax/tariff". On the other hand, the reasons respondents established their factories in the UK, Japan, Singapore, Mexico and the US were "proximity to customer markets," "easier access to new technologies," and " skilled labor availability". For further analyzed, this research categorizes the former countries as Group II and the latter countries as Group I.

Reasons	No. of respondents	%
Cheaper labor cost	41 01	44.57
Proximity of customer markets	22	23.91
Lower land cost	15	16.30
Easier access to new technologies	6	6.52
Skilled labor availability	3	3.26
Lower tax/tariff	3	3.26
Other	2	2.17
Total	92	100.00

Table 4. Reasons for offshore relocation

Note: Only the most major reason is considered for each offshore factory.

4.4 The Changes of Freight Transportation Demand to and from Taiwan

From the survey results of respondents' international division of labor, we find that the strategies and relocating activities of Taiwanese IT firms are similar to the experience of Acer's globalized development. Hence, this study uses respondents' import/export data of electronics commodities to explore the relationship between firms' globalization and the movements of freight demand. From 1990 to 1999, the import/export data of the category of electrical machinery (category of import/export goods used in the HS two-digit code) illustrated as Appendix 1.

The amount of imported and exported electronics commodities has increased since the development of the IT industry. All these products have increased their relative share of total

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freight transportation volume. From 1990 to 1999, the total amount of respondents' imported and exported electronics commodities increased from 422 million USD to 3,379 million USD and 5,603 million USD to 12,223 million USD, respectively. Moreover, from the statistical data analysis, the value of export to Group I countries were more than the value of import from those countries. In contrast, during the 1990-1999 period, the value of export to Group II countries were less than the value of import from those countries.

	N.C. Sec.		-			and service	313	Un	it: firm
Reasons	Mainland China	Thailand	Philippines	Malaysia	Singapore	Mexico	UK	Japan	United States
Cheaper labor cost	29	4	3	5					
Lower land cost	13	2							
Lower tax/tariff	2			- 1					
Easier to access new technologies					1	-		2	3
Skilled labor availability	-				1	Geal.	1		1
Proximity of customer markets	*				4	3	3	1	7
Others									2
Total	44	6	3	6	6	3	4	3	13
1 - D		Gro	oup II			Gr	oup I		

Table 5. The reasons of respondents offshore relocation

Figure 7 and Figure 8 shows the trend of imports and exports by the categories of Group I and Group II. Based on the surveys, it was observed that import volume from the Group II countries' has been growing rapidly from 1990 to 1997 and decreased in 1998-1999. The total import volume from Group II is more than that from Group I, but the total export volume to Group I is much more than the volume exported to Group II. This result could reflect the features of respondents' offshore relocation and globalized manufacturing operation. In addition, the import volume from the Group II countries originated from offshore manufacturing by responding firms. This pattern exhibits characteristics similar to the global logistics development experiences of Acer Group described in Figure 4.





Changes in the flow of goods reflect the freight transportation demand for diversification in the sophistication of handling goods. Figure 9 illustrates changes of freight transportation modal choice. In analyzing the firm's import freight transportation modal choice, the ratio by air is higher than the ratio by sea since 1996. During this same period, firms also exported their products by choosing more air transportation services than sea.

Considering the reasons for different modal choices in exports and imports, the commodity's value density (value/weight ratio) is seen as a key modal choice factor. The average import commodity's value per kilogram was higher than that of the ratio of exports. See Appendix 2. This result is also caused by IT firms' individual global logistics operations.



Source: The Directorate General of Customs, Ministry of Finance, ROC. (1990-2000)

Figure 9. Import/export freight transportation modal choice fluctuation trend

5. CONCLUSIONS AND RECOMMENDATIONS

Traditional freight transportation studies that assume manufacturing activities are concentrated at a single manufacturing location cannot well-describe the operations of today's multi-national manufacturing logistics. In order to explore the effects of various logistics strategies on international freight transportation demand, we utilized Acer's experience to describe a multinational company's global logistics operations and surveyed 152 Taiwanese IT firms to provide a detailed picture of existing global logistics operations. This study found that in Taiwanese IT firms logistics operation, the faster transportation demand increased and the slower transportation demand decreased.

It was also found that the logistics strategies of the manufacturing supply chain will affect a firm's modal choice, and the multiple-site of the multinational production logistics strategies will affect the trip generation and distribution.

This study has taken a step in the direction of defining the relationship between global logistics strategies and international freight transportation in IT industry. It is possible of course that other industries with different characteristics of the global supply chain may produce entirely different results. In addition, it is important to emphasize that methodological problems in the research design limited our interpretations.

The approach outlined in this study should be replicated in other manufacturing firms, as well as in other manufacturing industrial areas, such as the apparel and automobile industry in order to construct a typology of global logistics performance in a variety of industries. In future research, the measure of global manufacturing needs to be improved. Given the differences in application between industries it may be desirable to expand the list of activities further. Finally, other MNCs may be utilized in further studies.

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This study has taken a step in the direction of defining the relationship between global logistics strategies and international fragmi transportation in IT industry. It is possible of course that other industries with different characteristics of the global supply chain may produce entirely different results, in addition, it is important to emphasize that methodological problems in the research design limited our interpretations.

I he approach outlined in this study should be replicated in other manufacturing firms, as well as in other manufacturing industrial areas, such as the apparel and automobile industry in order construct a typology of global logistics performance in a variety of industries. In furne research, the measure of global manufacturing needs to be improved. Given the differences in application between industries it may be desirable to expand the list of activities further. Finally, other MINCs may be utilized in further studies.

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Appendix 1. Commodity Trade Flow with Major Foreign Investment Countries and Marketplace

Import fr	om	New States Lawson		Group I	111 M 413 312.1	1 100 100 1 1 E-100	a transfer a		Group II			
year	N	Japan	UK	Mexico	Singapore	Subtotal	Mainland	Thailand	Philippine	Malaysia	Subtotal	Total
1990	21	43	1	2	Э	70	1	57	54	260	372	442
1991	22	49	L.	З	4	79	1	87	67	482	637	716
1992	26	57	1	4	9	94	1	126	94	650	871	965
1993	30	64	1	4	8	107	61	181	126	616	984	1,091
1994	35	. 70	2	4	10	121	236	217	195	893	1,541	1,662
1995	41	89	З	9	13	152	470	411	264	1,067	2,212	2,364
1996	51	76	2	8	12	149	636	538	427	1,936	3,537	3,686
1997	46	75	З	12	13	149	889	578	800	2,040	4,307	4,456
1998	42	69	З	10	11	135	651	430	619	1,799	3,499	3,634
1999	43	63	2	6	10	127	595	411	589	1,657	3,252	3,379
Export to	distant and			Group I	a state and a state of		and the second second		Group II			
year	N	Japan	UK	Mexico	Singapore	Subtotal	Mainland	Thailand	Philippine	Malaysia	Subtotal	Total
1990	3,129	977	360	31	598	5,095	1	211	97	199	508	5,603
1991	3,644	1,107	391	42	781	5,965	1	209	66	278	587	6,552
1992	3,927	1,087	409	47	833	6,303	1	317	118	270	706	7,009
1993	4,052	1,090	415	68	890	6,515	9	390	150	446	992	7,507
1994	4,991	1,271	497	71	1,401	8,231	10	429	149	679	1,267	9,498
1995	5,887	1,885	539	102	1,774	10,187	87	667	187	871	1,812	11,999
1996	6,079	2,194	609	154	2,379	11,415	129	697	229	918	1,973	13,388
1997	6,529	1,996	681	157	2,260	11,623	209	631	374	849	2,063	13,686
1998	6,308	1,783	581	143	1,703	10,518	349	554	323	677	1,903	12,421
1999	6,150	1,703	572	147	1,894	10,466	301	508	299	649	1,757	12,223

The Effects of Global Logistics Strategies on International Freight Transportation Demand

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yearUSJapanUKMexicoSingaporeSub-AvgMainlandThailiandPinlippine 1990 41.99 39.61 28.90 20.41 40.76 34.33 10.11 22.90 13.37 1991 43.60 38.40 27.99 27.93 27.93 41.52 34.90 9.87 23.24 14.64 1992 41.33 36.61 23.37 47.26 39.16 11.17 18.53 11.65 13.37 1992 49.71 61.11 41.03 26.61 49.67 44.23 12.31 14.63 22.36 1994 49.71 61.14 40.03 26.61 49.67 44.23 12.31 38.61 1996 97.33 81.96 60.61 49.67 44.23 12.31 38.61 1994 97.33 81.96 59.84 49.62 36.67 71.84 73.59 36.67 1999 96.51 90.04 71.84 74.12 71.62 29.66 20.66 36.67 1999 96.51 90.04 71.84 73.59 26.47 20.56 20.66 1999 96.51 90.04 71.84 29.50 20.68 20.66 1999 32.08 34.69 20.96 14.23 21.72 29.68 20.66 1999 32.68 20.73 36.74 21.34 11.72 20.68 20.64 1999 32.68 30.76 20.68 <t< th=""><th>Import f</th><th>rom</th><th>are claimh</th><th>HEIL LAND</th><th>THENEY W</th><th>Group I</th><th>10110106, 121</th><th>NCC 11 Statty N</th><th>andi .</th><th></th><th>Group II</th><th></th><th></th><th></th></t<>	Import f	rom	are claimh	HEIL LAND	THENEY W	Group I	10110106, 121	NCC 11 Statty N	andi .		Group II			
199041.9939.6128.9020.4140.7634.3310.1122.9013.37199143.6038.4027.9927.9927.9923.3741.5234.909.8723.2414.64199247.2141.3336.6123.3747.2639.1611.1718.5318.10199249.7151.1144.0326.6149.6748.3142.7112.0817.5321.98199449.7151.1144.0326.6149.6761.6412.4525.2030.67199559.8461.0330.2753.7746.9612.4525.2030.67199780.8370.1649.6359.8465.9749.6326.9346.95199996.5190.0471.8473.5926.8749.0536.67199996.5190.0471.6471.6229.0650.64199935.6018.9429.6539.6528.4410.9326.97199032.6132.7630.2758.4429.6629.3321.72199033.6932.7128.9018.9429.6528.4410.9323.66199133.6933.75634.7528.4410.9326.6123.7546.05199238.7693.7534.6728.4929.6929.7529.6929.75199735.6933.7633.6123.7628.4929.6623.64	year		US Jap	pan	UK	Mexico	Singapore	Sub-Avg	Mainland	Thailand	Philippine	Malaysia	Sub-Avg	Average
199143.6038.4027.9927.9941.6234.909.8723.2414.64 1992 47.2141.3336.6123.3747.2639.1611.1718.5318.10 1992 48.3446.0841.9728.8648.3142.7112.0817.5321.98 1994 49.7151.1144.0326.6149.6744.2312.3118.8022.35 1994 49.7151.1444.0326.6138.5463.9061.6421.3139.8734.67 1997 80.8370.3661.3351.1474.1267.5625.4049.6236.61 1997 80.8370.3661.3351.1474.1267.5625.4049.6236.61 1997 80.8370.3661.3351.1474.1267.5625.4049.6236.61 1997 80.8370.3661.3351.1474.1267.5625.3748.03 1997 80.8450.9771.8473.5926.8749.6236.61 1990 32.0859.4450.9771.6229.0852.2748.03 1990 32.0832.7128.9018.9429.6526.8410.9926.61 1990 33.6932.7128.9018.9473.6629.3620.68 1990 33.6932.6123.6123.6123.6124.6820.68 1990 38.9429.6539.602	1990	41.	99 39.	.61	28.90	20.41	40.76	34.33	10.11	22.90	13.37	17.74	16.03	25.18
199247.2141.3336.6123.3747.2639.1611.1718.5318.10199348.3446.0841.9728.8648.3142.7112.0817.5321.98199449.7151.1144.0326.6149.6744.2312.3118.8022.35199559.8450.0940.8230.2753.7746.9612.4625.2030.67199559.8370.3661.3351.1474.1267.6625.4040.5334.87199780.8370.3661.3351.1474.1267.6725.4040.5336.61199780.8370.3661.3351.1474.1267.6625.4040.5336.61199780.8370.3661.3351.1474.1267.6625.4040.5336.61199896.5190.0471.6449.5280.2777.6229.0852.2748.03199932.0850.0471.8473.5926.8410.3620.5636.61199032.0852.7128.9018.9429.6628.4410.9918.6626.67199133.6932.6123.5624.5236.6171.6226.6123.6623.66199238.2429.1923.6634.5234.6725.6123.6623.66199337.6834.6937.6634.5236.4110.3926.6123.66 <td< td=""><td>1991</td><td>43.</td><td>60 38.</td><td>.40</td><td>27.99</td><td>22.98</td><td>41.52</td><td>34.90</td><td>9.87</td><td>23.24</td><td>14.64</td><td>20.12</td><td>16.97</td><td>25.93</td></td<>	1991	43.	60 38.	.40	27.99	22.98	41.52	34.90	9.87	23.24	14.64	20.12	16.97	25.93
199348.3446.0841.9728.8648.3142.7112.0817.5321.98199499.7151.1144.0326.6149.6744.2312.4625.2030.67199559.8450.0940.8230.2753.7746.9612.4525.2030.671996 \circ 74.1371.1460.5138.5463.9061.6421.3139.8734.87199780.8370.3661.3351.1474.1267.5625.4049.6238.61199897.3387.9659.8450.9771.8473.5926.8749.6238.61199896.5190.0471.6449.6280.2777.6229.0845.2148.03199996.5190.0471.6449.6280.2777.6229.0852.7748.03199933.0449.6280.2777.6229.0850.6733.6177.62199033.6123.7128.9081.9410.9918.6720.6820.68199133.6932.7128.9080.4732.9531.4220.3621.72199238.2433.6123.7623.6624.4232.9524.4410.9918.6723.66199337.6833.7633.7633.7634.5234.6123.3624.5223.6623.75199238.2433.6723.6623.6623.6524.4110.99	1992	47.	21 41.	.33	36.61	23.37	47.26	39.16	11.17	18.53	18.10	26.54	18.58	28.87
1994 49.71 51.11 44.03 26.61 49.67 44.23 12.31 18.80 22.35 1995 59.84 50.09 40.82 30.27 53.77 46.96 12.45 25.20 30.67 1997 80.83 71.14 60.51 38.54 63.90 61.64 21.31 39.87 34.87 1997 80.83 70.36 61.33 51.14 74.12 67.56 25.40 40.59 45.21 1998 97.33 87.96 59.84 50.97 71.84 73.59 26.87 49.62 38.61 1998 96.51 90.04 71.64 49.62 80.27 77.62 29.08 45.21 48.03 1999 96.51 90.04 71.64 49.62 38.61 48.03 46.23 49.62 38.61 1999 32.04 71.64 49.62 80.24 29.56 28.44 10.99 18.65 20.68 1990 32.08 32.71 28.90 18.94 20.43 31.61 1.72 20.33 21.72 1991 33.69 32.61 23.66 34.52 34.61 32.71 23.66 23.66 23.66 1991 33.69 32.71 28.96 34.62 38.41 11.32 20.33 21.72 1992 38.24 32.71 28.94 32.91 31.81 11.32 20.33 21.72 1992 38.26 32.76 <td< td=""><td>1993</td><td>48.</td><td>34 46.</td><td>.08</td><td>41.97</td><td>28.86</td><td>48.31</td><td>42.71</td><td>12.08</td><td>17.53</td><td>21.98</td><td>25.88</td><td>19.37</td><td>31.04</td></td<>	1993	48.	34 46.	.08	41.97	28.86	48.31	42.71	12.08	17.53	21.98	25.88	19.37	31.04
1995 69.84 60.09 40.82 30.27 53.77 46.96 12.45 25.20 30.67 1996 \circ 74.13 71.14 60.51 38.54 63.90 61.64 21.31 39.87 34.87 1997 80.83 70.36 61.33 51.14 74.12 67.56 25.40 49.59 45.21 1998 97.33 87.96 59.84 50.97 71.84 73.59 26.87 49.62 38.61 1998 96.51 90.04 71.64 49.62 80.27 77.62 29.08 52.27 48.03 1999 96.51 90.04 71.64 80.27 77.62 29.08 52.27 48.03 1999 32.01 20.96 58.67 38.54 73.59 26.87 49.62 38.61 1990 32.08 32.71 28.90 18.94 10.99 18.66 20.33 21.72 1991 33.69 32.61 23.66 34.52 31.81 11.70 24.52 23.64 1992 38.24 37.16 37.16 32.60 32.60 12.95 26.31 23.66 1993 37.58 39.18 34.72 38.41 11.30 24.52 23.64 1993 37.66 39.70 37.16 37.16 23.66 24.52 20.33 21.72 1993 55.57 43.50 35.60 11.70 24.52 23.64 20.68 1994 41.6	1994	49.	71 51.	11 4	44.03	26.61	49.67	44.23	12.31	18.80	22.35	26.73	20.05	32.14
1996 \sim 74.1371.1460.5138.5463.3061.6421.3139.8734.87199780.8370.3661.3351.1474.1267.6625.4040.5945.21199897.3387.9659.8450.9771.8473.5926.8749.6238.61199896.5190.0471.6449.6280.2777.6229.0852.2748.03199996.5190.0471.6449.6280.2777.6229.0852.2748.03199996.5190.0471.6480.5777.6229.0852.2748.03199032.0832.7128.9018.9410.9918.6520.68199133.6934.6932.6123.5634.5231.8111.7024.5223.64199238.2439.1834.0727.6539.5035.6011.7024.5223.64199337.5839.1834.0727.6539.5035.6011.7024.5223.64199441.3934.0727.6539.5035.6011.7024.5223.64199565.5748.5733.4013.4113.1423.6624.52199669.3039.6031.2244.1013.1423.6624.52199765.6733.6634.5234.1011.7024.5223.64199669.3069.3036.6733.4012.4624	1995	59	84 50.	60	40.82	30.27	53.77	46.96	12.45	25.20	30.67	33.64	25.49	36.22
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1998 97.33 87.96 59.44 50.97 71.84 73.59 26.87 49.62 38.61 1999 96.51 90.04 71.64 49.62 80.27 77.62 29.08 52.27 48.03 Export LGroup IGroup IExport LGroup I 77.62 29.08 52.27 48.03 yearUSJour IGroup IyearUSJour IGroup I 1990 32.08 32.71 28.96 28.44 10.99 18.67 Group II 1990 32.08 32.71 28.96 28.44 10.92 20.33 20.33 21.72 1990 32.08 32.71 28.96 28.44 10.92 20.33 21.72 1992 32.61 23.66 28.47 32.66 28.66 28.66 28.66 28.61 29.56 1992 38.241 32.61 23.66 28.64 23.66 1993 55.61 23.66 23.6423.	1997	80.	83 70.	.36	61.33	51.14	74.12	67.56	25.40	40.59	45.21	43.37	38.64	53.10
199996.5190.0471.64 49.62 80.27 77.62 29.08 52.27 48.03 Export toGroup 1YearUSJapanUKMexico $8ingapore$ $8ub-Avg$ Mainland $1hailand$ $1hailand$ $1ainand$ YearUSJapanUKMexico $8ingapore$ $8ub-Avg$ Mainland $1hailand$ $1hailand$ $1hailand$ YearUS 32.08 32.71 28.90 18.94 29.56 28.44 10.99 18.65 20.68 1990 32.08 32.61 23.56 28.44 10.99 18.65 20.33 21.72 1992 38.24 36.76 28.46 38.47 32.95 11.70 24.52 23.64 1993 37.68 39.18 34.07 27.65 39.50 35.60 11.70 24.52 23.64 1994 41.39 42.61 37.16 23.46 42.23 38.41 13.14 25.08 24.52 1994 69.30 69.73 39.50 44.10 42.80 16.44 28.37 26.61 1995 69.30 69.33 60.73 39.50 49.76 50.21 17.98 28.99 30.18 1997 75.64 69.33 60.73 39.50 49.76 50.21 17.98 28.99 30.18 1998 87.96 69.30 65.71 24.50 36.08 30.64 31.09 1998 87.96	1998	97.	33 87.	96	59.84	50.97	71.84	73.59	26.87	49.62	38.61	50.25	41.34	57.46
Group IGroup IYearGroup IGroup IyearUSJapanUKMexicoSingaporeSub-AvgMainlandThailandPhilippine199032.0832.7128.9018.9429.5628.4410.9918.6520.68199133.6934.6932.6123.5634.5231.8111.3220.3321.72199238.2436.7629.1924.0836.4732.9511.7024.5223.64199441.3942.6137.1628.6642.2338.4113.1425.0824.62199441.3942.6137.1628.6642.2338.4113.1425.0824.62199565.5743.5039.5044.1042.8016.4428.3726.61199669.3051.2748.5733.4048.5050.2117.9828.9930.18199775.6463.3960.7339.5049.7650.2117.9828.9930.18199775.6463.3960.7339.5049.7650.2117.9828.9930.16199775.6463.3960.7339.5049.7657.8023.7630.6431.06199775.6463.3960.7339.5049.7657.8023.7736.6431.06199775.6463.9963.2845.2262.0965.7124.	1999	96	51 90.	.04	71.64	49.62	80.27	77.62	29.08	52.27	48.03	56.29	46.42	62.02
Year US Japan UK Mexico Singapore Sub-Avg Mainland Thailand Phailand Phaila	Export t	0		and the second second second	the second	Group I	the second second	-			Group II			
1990 32.08 32.71 28.90 18.94 29.56 28.44 10.99 18.65 20.68 1991 33.69 34.69 32.61 23.56 34.52 31.81 11.32 20.33 21.72 1992 38.24 36.75 29.19 23.66 34.52 31.81 11.70 24.52 23.64 1992 38.24 36.75 29.19 24.08 36.47 32.95 11.70 24.52 23.64 1993 37.58 39.18 34.07 27.65 39.50 35.60 12.76 24.52 23.64 1994 41.39 42.61 37.16 28.66 42.23 38.41 13.14 25.08 24.55 1994 55.57 43.50 39.50 44.10 42.60 16.74 28.37 26.61 1995 69.30 51.27 48.50 50.21 17.98 28.99 30.18 1997 75.64 53.340 48.50 50.21	year		US Jap	pan	UK	México	Singapore	Sub-Avg	Mainland	Thailand	Philippine	Malaysia	Sub-Avg	Average
797 33.69 34.69 32.61 23.56 34.52 31.81 11.32 20.33 21.72 7992 38.24 36.75 29.19 24.08 36.47 32.95 11.70 24.52 23.64 7993 37.58 39.18 34.07 27.65 39.50 35.60 11.70 24.52 23.64 7994 41.39 42.61 37.16 28.66 42.23 38.41 13.14 25.08 24.52 7996 65.57 43.50 39.62 31.22 44.10 42.80 16.44 28.37 26.61 7996 69.30 51.27 48.57 33.40 48.50 50.21 17.98 28.99 30.18 7997 75.64 63.39 60.73 39.50 49.76 57.80 22.37 35.64 31.09 7998 87.96 69.39 63.28 45.22 62.09 65.71 24.50 36.08 33.64	1990	32.	08 32.	.71	28.90	18.94	29.56	28.44	10.99	18.65	20.68	19.38	17.43	22.93
7992 38.24 36.75 29.19 24.08 36.47 32.95 11.70 24.52 23.64 7993 37.68 39.18 34.07 27.65 39.50 35.60 12.55 25.61 23.09 7994 41.39 42.61 37.16 28.66 42.23 38.41 13.14 25.08 24.52 7995 55.57 43.50 39.62 31.22 44.10 42.80 16.44 28.37 26.61 7996 69.30 51.27 48.50 33.40 48.50 50.21 17.98 28.99 30.18 7997 75.64 63.39 60.73 39.50 49.76 57.80 22.37 35.64 31.09 7998 87.96 69.99 63.28 45.22 62.09 65.71 24.50 36.08 33.64	1991	33.	69 34.	.69	32.61	23.56	34.52	31.81	11.32	20.33	21.72	23.54	19.23	25.52
1993 37.58 39.18 34.07 27.65 39.50 35.60 12.55 25.61 23.09 1994 41.39 42.61 37.16 28.66 42.23 38.41 13.14 25.08 24.52 1995 55.57 43.50 39.62 31.22 44.10 42.80 16.44 28.37 26.61 1996 69.30 51.27 48.57 33.40 48.50 50.21 17.98 28.39 30.18 1997 75.64 63.39 60.73 33.50 49.76 57.80 22.37 35.64 31.09 1998 87.96 69.99 63.28 45.22 62.09 65.71 24.50 36.08 33.64	1992	38	24 36.	.75	29.19	24.08	36.47	32.95	11.70	24.52	23.64	26.33	21.55	27.25
1994 41.39 42.61 37.16 28.66 42.23 38.41 13.14 25.08 24.52 1995 55.57 43.50 39.62 31.22 44.10 42.80 16.44 28.37 26.61 1996 69.30 51.27 48.57 33.40 48.50 50.21 17.98 28.39 30.18 1997 75.64 63.39 60.73 39.50 49.76 57.80 22.37 35.64 31.09 1997 75.64 63.39 60.73 39.50 49.76 57.80 22.37 35.64 31.09 1998 87.96 69.99 63.28 45.22 62.09 65.71 24.50 36.08 33.64	1993	37.	58 39.	.18	34.07	27.65	39.50	35.60	12.55	25.61	23.09	28.50	22.44	29.02
1995 55.57 43.50 39.62 31.22 44.10 42.80 16.44 28.37 26.61 1996 69.30 51.27 48.57 33.40 48.50 50.21 17.98 28.99 30.18 1997 75.64 63.39 60.73 39.50 49.76 57.80 22.37 35.64 31.09 1997 75.64 63.39 60.73 39.50 49.76 57.80 22.37 35.64 31.09 1998 87.96 69.99 63.28 45.22 62.09 65.71 24.50 36.08 33.64	1994	41.	39 42	.61	37.16	28.66	42.23	38.41	13.14	25.08	24.52	31.57	23.58	30.99
1996 69.30 51.27 48.57 33.40 48.50 50.21 17.98 28.99 30.18 1997 75.64 63.39 60.73 39.50 49.76 57.80 22.37 35.64 31.09 1998 87.96 69.39 63.28 45.22 62.09 65.71 24.50 36.08 33.64	1995	55	57 43.	.50	39.62	31.22	44.10	42.80	16.44	28.37	26.61	36.49	26.98	34.89
1997 75.64 63.39 60.73 39.50 49.76 57.80 22.37 35.64 31.09 1998 87.96 69.99 63.28 45.22 62.09 65.71 24.50 36.08 33.64	1996	69	30 51.	.27	48.57	33.40	. 48.50	50.21	17.98	28.99	30.18	46.33	30.87	40.54
<i>1998</i> 87.96 69.99 63.28 45.22 62.09 65.71 24.50 36.08 33.64	1997	75.	64 63.	.39 (60.73	39.50	49.76	57.80	22.37	35.64	31.09	48.50	34.40	46.10
	1998	87.	96 69) 66.	63.28	45.22	62.09	65.71	24.50	36.08	33.64	50.28	36.13	50.92

Kai-Chieh CHIA, Cheng-Min FENG and Chia-Juch CHANG

53.86

39.40

59.80

35.20

37.52

25.09

68.33

61.77

45.98

60.24

75.81

97.83

1999

Source: The Directorate General of Customs, Ministry of Finance, ROC. (1990-2000)

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