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US multinational companies: empirical investigation of the shares of sales and exports attributable to affiliated and unaffiliated firms

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U.S. multinational companies: Empirical investigation of the shares of Sales and exports attributable to affiliated and unaffiliated firms

By

Mohitur Rahman

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Dedicated to my parents from whom I learnt all that is good in me. The memory of Khokon Da, a teacher and a mentor. Debasish Da and Sabyasachi Da who selflessly helped a person they never knew.

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U.S. multinational companies: Empirical investigation of the shares of Sales and exports attributable to affiliated and unaffiliated firms

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Iowa State University

This dissertation examines the choices of production/marketing strategies used by U.S. multinational corporations (MNCs) in selling and exporting to foreign markets. The varying degree of control a U.S. MNC possesses over its affiliates translates to a varying degree of control it retains over a transaction. A transaction with an unaffiliated firm represents a transaction over which the U.S. MNC has no control; while a transaction with a MOFA represents one over which it has complete control. Transactions with JVs fall in between. Using the shares for unaffiliated parties, MOFAs, and JVs as the three dependent variables, this study tested the empirical relevance of the internalization hypotheses, using both the sales share and the export share model.

The "Amemiya-Tobin" approach of Wales and Woodland was used to estimate the system of share equations. This procedure explicitly builds in the adding-up restriction on shares and allows for the occurrence of zero values for one or two shares in a three-share system. The log likelihood function for the Amemiya-Tobin model was maximized by numerical methods.

Data was collected from the Bureau of Economic Analysis, the Bureau of Census, the World Bank and the Internet (http://www.eiit.org). The final data set was for country-industry pairs, at the lowest level of industry aggregation available.

The results for the sales share and the export share models show the importance of the internalization hypothesis: R&D expenditure, which served as a proxy for the specialized knowledge of U.S. parent, had a significantly positive impact on MOFA sales and exports to MOFAs. It had a negative impact on the sales and exports to unaffiliated parties. Complementary knowledge of foreign enterprises, which was measured by the number of patent applications filed by the residents of a country, was positively related to the share of sales by joint ventures, and negatively related to the share of sales by MOFAs. However, patent applications did not play a significant role in this model. Importantly, these two results together show the influence of the "ownership of knowledge" in determining the organizational form chosen by U.S. MNCs.

CHAPTER 1: INTRODUCTION

1.1 What are Multinational Corporations?

Travelling in a foreign country is never "too foreign." It is easy to find products that one is used to buying at home. Consumer products like Mac-Donalds, Coke, Pepsi and Nike, just to name a few, are available all over the world. *The Economist* even compares the currency exchange rate with a "Mac exchange rate;" that is, using the price of a Big Mac in the U.S. as the numeraire. Products of some companies are so widely available that one confuses the home country of the parent corporation with ones own country. These companies, which span the entire globe, are called "multinational corporations" (MNC).

"Multinational corporations" has been variously defined. Dymsza (1967) defines multinational companies as companies:

1) whose decision-makers consider opportunity globally
2) for which a considerable portion of the firm's assets are invested internationally (at least 20%)
3) that engage in international production and operate plants in several countries
4) for which managerial decision making is based on a world-wide perspective.

Caves (1996, pg. 26) defines a multinational company as " an enterprise that controls and manages production establishments- plants- located in at least two countries. It is simply a subspecies of multi-plant firm."

The Bureau of Economic Analysis (BEA) definition is more technical, but broadly speaking it defines U.S. multinationals as U.S. parents and all their foreign affiliates. A U.S. firm is considered a "parent" of a foreign affiliate if it has more than 10% of the voting security in the foreign business enterprise. The U.S. parent could be any individual, branch, partnership, associated group, association, estate etc.

1.2 The World of Multinational Corporations

1.2.1 Changing attitudes towards MNCs

A quarter of a century ago people feared multinational corporations. Ideas propagated by Lenin and Marx, among others, terrified the politicians and pundits alike about these huge, ruthless, and stateless enterprises. Lenin called the MNCs a distinctive feature of the final stages of capitalism. Thus it is ironic that the dying years of Communism saw the biggest boom in cross-border investment worldwide. Multinational corporations' investment grew four times faster than world output and three times faster than world trade (Multinational Back in Fashion, March 27,1993). Estimates have also shown that the largest 500 MNCs account for over half the world's trade flow and one fifth of the world's GDP (Brainard, 1997).

Today, many governments have bureaus dedicated to seducing MNCs to opening operations in their countries. What changed the politicians' point of view? One of the reasons that has been put forward is that the fear of domination by the MNCs did not materialize. It is estimated that the top 300 MNCs, responsible for approximately 40-50% of all cross-border assets, account for only about 25% of worldwide productive

assets (Multinational Back in Fashion, March 27, 1993). In addition, there is no single country that controls the majority of these companies. In the 70s, of the 7000 MNCs identified by the United Nation (UN), more than half were from the UK and the U.S. Now there are 35,000 firms and only half of them are from the four leading parent countries: America, Japan, Germany and Switzerland, with the UK now occupying the seventh position. Thus the fear of American or British "Imperialism" turned out to be misplaced. The U.S., the most "feared capitalist country" had only 2667 non-bank parent MNCs in 1994 (U.S. Bureau of Economic Analysis, 1998).

One of the other reasons for fewer criticisms of MNCs is that countries have less to fear from MNCs per-se, and more to fear from the global movement of short-term investment capital. Flows of short-term investment capital, moving in and out of currency and securities markets, are many times bigger than direct corporate investment. Noted economist Jeffrey Sachs (Sachs, 1998, pg. 23), commenting on the financial turmoil in Asia said " It was the financial market 'reform' that allowed Thai and South Korean banks to tap into short-term international loans in the early 1990s, ...Now, the panicked flight of such loans is at the root of the emerging market debacle." Furthermore there is an increased realization that economic sovereignty is a myth. Central banks of various countries now act together as a team, rather than individually. This limitation of economic sovereignty was powerfully revealed by the sterling's turmoil before and after leaving Europe's exchange rate mechanism in September 1992 (Sachs, 1998).

1.2.2 Unequal distribution of MNC investment

The integration of world markets is increasing but is not yet perfect. Labor is not mobile and countries don't treat all industries equally. Tariffs, quotas, and other non-

tariff barriers introduce imperfections. But countries are friendlier to capital movements. Here the most rapid progress was made since the most liberal capital markets were those of Britain and the U.S., followed by the rest of the developed world. This resulted in an interesting feature: A disproportionate amount of international capital flows were from a developed country to a developed country. In 1961 about half of the foreign direct investment from the five largest industrialized countries was absorbed by other industrialized countries. This proportion rose to 70% by the year 1998 (Brainard, 1998).

1.2.3 Formation of alliances or joint ventures

Operating outside ones geographical boundaries puts pressure on the resources of a company. Some MNCs overcome these geographical and cultural boundaries by taking on partners or forming joint ventures. MNCs also form joint ventures (JV) to overcome their own limitations in terms of technology, geography, and in other areas. In a survey done by Maastricht Economic Research Institute in Innovation and Technology, part of the University of Limburg in Holland, it was found that such alliances or joint ventures were most common in biotechnology and information technology industries (The Case for Corporate Alliances, 1999). The three most common reasons for joint ventures cited by the survey were to gain access to markets, to exploit complementary technology, and to reduce the time taken for an innovation. The study estimated the number of alliances to be approximately 20,000 for 1996-1998.

As stated above, firms form alliances to learn the local customs and gain access to the market. This is especially important in retailing. Wal-Mart started its expansion in Mexico with Cifra in 1991 and then acquired it in 1997. The British retailing giant, Tesco, started its operation in South Korea with Samsung. Turner Broadcasting Services

(TBS), which is part of Time Warner, has recently completed a deal with Philips, a Dutch company. The big reason for this alliance is so that TBS can learn about European consumers and about the digital communications hardware that is Phillips stock in trade (The Case for Corporate Alliances, 1999).

The two most important things that are pushing alliances or joint ventures are human resources and the speed of technological change. Sometimes the brainpower needed by the large pharmaceutical firm may not be willing to work for them, partly because the sense of excitement and control found in a small start-up company is not found in a large firm (The Case for Corporate Alliances, 1999). Drug research firms now set aside nearly 20 % of their research budget for joint ventures with bio-tech firms. The number of such alliances with biotech firms has risen from 152 in 1988-90 to 375 in 1997-98 (The Case for Corporate Alliances, 1999). The speed of technological change also forces firms to try forming multiple alliances or joint ventures.

Sometimes the alliances are motivated, not so much by commercial logic, as by government regulations. An example would be the airline industry in which most countries have national barriers to foreign ownership. Here the number of alliances was up by 38% to 500 in the year 1998 (The Case for Corporate Alliances, 1999). The huge "Star" alliance that includes Lufthansa and United Airlines started as a loose arrangement to direct passengers to each other and to share booking codes. It is now turning into a quasi-merger with pooled maintenance facilities.

1.2.4 Full control over affiliates

The incentive to economize on transportation costs will tend to encourage a firm to establish a foreign affiliate but the internal organizational structure will depend on the

product and the production process. With everything else constant, the choice of internal organization of a firm is dependent on the need of the firm to control conflicting investment decisions. Integration takes care of that by replacing external markets with "internal markets." One of the advantages of integration is that it avoids the "holdup problem." For example, once a contract between partners is signed, due to the product specificity of their investments, they are locked into each other. Thus production will cease if either of them decides to "hold up" production. It is also possible that there might be an incompatibility between the individual profit maximizing incentives of the joint venture partners and the joint profit maximizing incentives of the combined entity. There could also be a clash of management styles. To avoid such problems, firms might decide to integrate.

There have also been studies, which show that joint ventures are inherently unstable; they are merely "experiments" that are transformed into wholly-owned subsidiaries after a period of learning (Gatignon and Anderson, 1988). The recent failures of two joint ventures between U.S. firms and Indian firms (Proctor and Gamble with Godrej, and Unisys with Tata and Sons) illustrate this point.

"American Consumer products giant Procter and Gamble has announced it will buy out its once celebrated toilet soap venture with Godrej Soaps. Faced with declining market share, Godrej felt its own soap brands were not being marketed aggressively enough. It also demanded compensation from Proctor and Gamble for unused capacity. Stung by the rising bills, Proctor and Gamble felt it was the victim of over-charging by Godrej, which controlled manufacturing cost " (U.S. Multinationals in India, 1996, pg. 102).

"American computer company Unisys says it will sell out its union with Tata Sons, the holding company of India's largest Industrial house" (U.S. Multinationals in India, 1996, pg. 104).

But integration also suffers from problems. They are the problems of incentives; that is, since trade is internal, there might be less incentive on the part of managers to undertake cost cutting measures. This is especially the case with unverifiable effort.

The importance of intangible assets such as brainpower and cross-border cultural differences makes international operations difficult to manage. Cross-border cultural differences lead to many problems as in the merger of Sweden's Pharmacia and the U.S. firm Upjohn, in which conflict arose over "American" practices such as not serving alcohol during lunch (After the Deal, 1999).

The question that arises, therefore, is what are the advantages of integration or mergers of firms? To restate the question more specifically, if a MNC wants to have a presence in a foreign market, under what circumstances will it choose to establish a majority owned affiliate (MOFA), to enter a joint venture with a local partner, or to export directly to unaffiliated parties in the foreign country? This dissertation addresses these questions.

1.3. Research Proposal

Products of U.S. MNCs are found all over the world. These commodities are sometimes manufactured abroad and sometimes exported from the U.S. A MNC's choice can be thought of as a special case of the choice facing a multi-plant firm. It will choose the production level of each plant on the basis of costs associated with each plant. For

the purpose of this dissertation it is assumed that the MNC has three means of supplying a foreign market:[1]

(i) Produce at home and sell in a foreign market through an unaffiliated downstream firm.

(ii) Meet foreign demand by producing the good abroad in a majority owned subsidiary.

(iii) Meet foreign demand by producing the good abroad in a joint venture.

If a MNC establishes a production facility abroad then that facility could be a "majority owned foreign affiliate" (MOFA) or a "joint venture." Following the Bureau of Economic Analysis (BEA), MOFA is defined as "A foreign affiliate in which the combined ownership of all U.S. parents exceeds 50 %." MOFAs comprise the foreign operations of U.S. MNCs over which the parents have unambiguous control. For the purpose of this dissertation, following the literature, a joint venture is defined as a firm in which the combined share of all U.S. parents is below 50 % but greater than 10% (Desai and Hines, 1999).

This dissertation tries to answer two questions (i) What are the factors which affect the division of a MNC's total foreign sales among exports (sales to unaffiliated firms/individuals), joint venture sales, and MOFA sales? and (ii) How do U.S. exports to MOFAs, joint ventures, and unaffiliated parties differ? Thus the choice of ownership structure is central to this study of MNCs.

The first question that this dissertation will investigate is what factors affect the production and sales choices of the MNC? In other words, the paper will attempt to answer the question of the degree of integration the MNC would prefer. Selling a good

[1] Other means of supplying the market, such as licensing, is not considered in this dissertation because of data constraints.

through an unaffiliated party represents the lowest degree of integration while concentrating the production in a MOFA represents the highest degree of integration. Joint ventures fall in between. The second question that is dealt with here, is how integration affects exports?

In answering the above questions, the dissertation will shed light on what a foreign government needs to do to attract foreign direct investment (FDI), and what policy the U.S. government should adopt to keep production facilities from moving out of the country. Affiliate production of U.S. MNCs can be a significant amount of the GDP of a host country. For example in 1991, U.S. MNCs' affiliate production was 14 % of Ireland's GDP, 9 % of Canada's, 8 % of Singapore's, and 7 % of the UK's. Affiliate production of U.S. MNCs accounted for more than 1 % of the GDP for 36 countries. So, for policy purposes, factors affecting these shares are important.

For intra-firm exports, as opposed to arms-length trade between unaffiliated parties, the market does not set a price, but the integrated firm sets a transfer price for accounting purposes. MNCs may manipulate this transfer price to shift their tax liability from the home country to the host country, or vice-versa. The *Wall Street Journal* cites an example of a foreign corporation charging $250 to its affiliates while charging $150 to unaffiliated parties for the same product (Stout, 1990). Such practices are illegal in the U.S.[2] This dissertation will look at how U.S. and foreign taxes affect intra-firm and

[2] Section 482 of the Internal Revenue Code Allocation of Income and Deductions among Tax Payers: In any case of two or more organizations, trades, or businesses (whether or not incorporated, whether or not organized in the United States, and whether or not affiliated) owned or controlled directly or indirectly by the same interests, the Secretary may distribute, apportion, or allocate gross income, deductions, credits, or allowances between or among such organizations, trades or businesses if he determines that such distribution, apportionment, or allocation is necessary in order to prevent evasion of taxes or clearly to reflect the income of any such organizations, trades, or businesses. In the case of any transfer (or license) of

arms-length exports.

The remainder of this dissertation is divided into five chapters. Chapter 2 deals with the theoretical literature on organization, which forms the background on which the answers to both the questions are based. Chapter 3 summarizes the relevant empirical literature. Chapter 4 outlines the empirical model and chapter 5 will explain the estimation technique. Chapter 6 will present information about the data set, results, and conclusions.

Before we discuss the theoretical literature a brief overview of U.S. MNCs' foreign affiliates is provided in the final section of this chapter.

1.4. Survey of U.S. MNCs and their Affiliates

The following survey, based on the data in (USDIA, 1998), of U.S. parent owned foreign affiliates brings out some key characteristics of U.S. affiliates, both MOFAs and JVs, by country.

Table 1 clearly shows the skewed pattern of locational choices made by U.S. MNCs: 48% of the affiliates of U.S. MNCs were located in Europe. There were 8960 affiliates in the European Union, these twelve countries accounted for 40% of all U.S. affiliates in the world. Canada had four times as many affiliates as Africa. Nearly half of the 516 African affiliates were located in three countries: Egypt, Nigeria, and South Africa. Among the 1173 Central American affiliates, 72% were located in Mexico while, in South America, 75% of the affiliates were concentrated in just four countries:

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intangible property (within the meaning of section 936(h)(3)(B)), the income with respect to such transfer or license shall be commensurate with the income attributable to the intangible.

Argentina, Brazil, Chile and Venezuela. Among the Asian and Pacific nations, the bulk of the affiliates were located in Australia (864), Japan (1042) and Hong Kong (600). Thus the most preferred continent for locating affiliates was Europe with Africa being the least favorite continent.

Table 1: Distribution of affiliates of U.S. MNCs by country

Countries	Number of Affiliates	% of Total Affiliates
Canada	2094	9.37
Europe	10781	48.27
Germany	1403	6.28
United Kingdom	2546	11.40
South America	1504	6.73
Central America	1173	5.25
Mexico	846	3.79
Africa	516	2.31
Middle East	354	1.58
Asia and Pacific	4877	21.84
Australia	864	3.87
Japan	1042	4.67
Total	22332	100

Table 2 reproduces the first two columns of Table 1 and adds information about the breakdown of affiliates between MOFAs and JVs. We can see that U.S. MNCs preferred majority owned foreign affiliates to joint ventures 84.8% to 15.2% overall. Finland and Ireland had the highest percentage of MOFAs, at 96.4% and 95.6% respectively, while Bahamas and India had the lowest percentages of MOFAs, at 42% and 40% respectiveiy. Among the OECD countries, Japan and Luxembourg had the lowest percentages of MOFAs, at only 62% and 66 % respectively. But there is no clear pattern of ownership; there is a wide variance even among the OECD countries. The

OECD included the country with the highest percentage of MOFAs (Finland) as well as the one with one of the lowest percentage (Japan).

One fact that is clearly evident in Table 3 below is that the average value of a joint venture was unambiguously larger than that of a MOFA. The worldwide average asset value, for all U.S. affiliates, was $151 million, while the average asset value of

Table 2. Types of affiliates by countries

Countries	Number of Affiliates	Number of MOFA (% of Affiliates that are MOFA.)	Number of Joint Ventures (% of Affiliates that are Joint Venture.)
Canada	2094	1939 (92.6)	155 (7.4)
Europe	10781	9691 (89.9)	1090 (10.1)
Germany	1403	1249 (89)	154 (11)
United Kingdom	2546	2278 (89.5)	268 (10.5)
South America	1504	1187 (78.9)	317 (20.1)
Central America	1173	965 (82.3)	208 (17.7)
Mexico	846	670 (79.2)	176 (20.8)
Africa	516	421 (81.6)	95 (18.4)
Middle East	354	218 (61.6)	136 (38.4)
Asia and Pacific	4877	3740 (76.7)	1137 (23.3)
Australia	864	751 (86.9)	113 (13.1)
Japan	1042	653 (62.7)	389 (37.3)
Total	22332	18929 (84.8)	3403 (15.2)

MOFAs was $107 million. Joint ventures, on the average, were nearly three times larger (in terms of asset value) than MOFAs. In only a handful of countries (namely Finland, Norway, and Indonesia), was the pattern violated. Interestingly enough, the average size (in terms of assets) of affiliates in these countries was small, in Finland the average affiliate size was only $21 million, for Norway it was $79 million and for Indonesia it was $90 million.

Table 3: Distribution of affiliate assets by country (Millions of $)

Countries	Total Assets (In Million $)	Average asset per Affiliate	Average asset per MOFA	Average asset per Joint Venture
Canada	237490	113	107	247
Europe	1837846	170	123	590
Germany	225964	161	124	464
United Kingdom	913546	359	229	1463
South America	117951	78	56	161
Central America	79708	68	47	167
Mexico	59905	71	40	186
Africa	23708	46	41	68
Middle East	66486	188	58	397
Asia and Pacific	731380	150	101	312
Australia	98585	114	77	363
Japan	291922	280	254	324
Total	3380983	151	107	399

Table 4, below shows U.S. MNCs had majority control over 84.8% of their affiliates, and their combined sales accounted for 78.43% of the worldwide affiliate sales. For Europe, 90% of the U.S. affiliates were MOFAs, accounting for 86% of the affiliate sales there. Interestingly, for Japan approximately 49% of the affiliate sales were by MOFAs even though 62.7 % of the affiliates were MOFAs.

Table 5, below shows sales per affiliate, were larger for joint ventures than for MOFAs. In Japan, sales per MOFA is the highest in the world at $149.5 million, followed by Germany with sales per MOFA at $129 million. Singapore and Switzerland were next with $113 and $102 million respectively. For Guatemala, Saudi Arabia, China, Panama, and Ecuador average MOFA sales were below $18 million. Joint ventures of Brazil, Netherlands, Japan, and Germany, in that order, had the highest sales. Guatemala, India and Honduras had the lowest sales per joint venture.

Table 4. Sales of MNCs' Affiliates (in millions of $)

Countries	Total Sales of all Affiliates	Sales of MOFA	Sales of Joint Venture	% of Sales by MOFA	% of Sales by Joint Venture
Canada	212308	194004	18304	91.38	8.62
Europe	925001	796816	128185	86.14	13.86
Germany	200681	160943	39738	80.20	19.80
United Kingdom	242023	209091	32732	86.48	13.52
South America	105897	65446	40451	61.80	38.20
Central America	70330	45911	24419	65.28	34.72
Mexico	63454	39421	24033	62.13	37.87
Africa	17767	14866	2901	83.67	16.33
Middle East	20544	8070	12474	39.28	60.72
Asia and Pacific	438426	281080	157346	64.11	35.89
Australia	62175	42553	19622	68.44	31.56
Japan	200470	97604	102866	48.69	51.31
Total	1830744	1435901	394843	78.43	21.57

Table 5. Sales per Affiliate (in Millions of $)

Countries	Sales per Affiliates	Sales per MOFA	Sales per Joint Venture
Canada	101.39	100.05	118.09
Europe	85.80	82	117.6
Germany	143.04	128.86	258.04
United Kingdom	95.06	91.87	122.13
South America	70.41	55.14	127.61
Central America	59.96	47.58	117.4
Mexico	75.00	58.84	136.55
Africa	34.43	35.32	30.54
Middle East	58.03	37.01	91.72
Asia and Pacific	89.90	75.16	138.39
Australia	71.96	56.66	173.64
Japan	192.39	149.47	264.43
Total	81.98	75.85	116.3

CHAPTER 2: SURVEY OF THEORETICAL LITERATURE

2.1. Introduction

A relatively recent development in the literature on multinational enterprises has been the attempt to explain the existence of MNCs in terms of the ownership, location and internalization, or OLI, framework (Ethier, 1986 and Caves, 1996). Ownership of proprietary assets, such as patents or the ability to organize some specific endeavor, allows the MNC to benefit from certain (usually cost) advantages. Locational considerations that affect MNC behavior include the proximity to customers, factor specialization, and scale economies. Internalization of transactions is the choice of a firm to replace a market transaction with an activity within the firm.

The factor and proximity hypothesis, or the locational choice hypothesis, which focuses on the locational component of the OLI framework, has been rigorously tested in a recent paper by Brainard (1997).[3] The effect of internalization and ownership of proprietary assets on the production strategy of an MNC or on intra-firm trade have not yet, however, been investigated with the same degree of empirical formalization. The main aim of this paper is to fill a gap in the existing literature on MNCs by providing an empirical framework to investigate how ownership and internalization affect the production choices of an MNC. In doing so, we shall also attempt to throw some light on the determinants of intra-firm trade. The natural starting point for a discussion on internalization of transaction is the literature on the theory of the firm.

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[3]Brainard's working paper by the same name was described by Caves (1996 pg 32) as providing ".. a capstone to this line of research ....."

2.2. An Introduction to the Literature on the Theory of the Firm

The standard neoclassical theory describes the firm as a collection or set of feasible production plans with a manager who maximizes profits or expected profits by buying inputs and selling outputs in a spot market. In spite of the widespread acceptance of the neoclassical theory in the past, there is a growing realization among economists that the neoclassical theory suffers from a number of drawbacks. The theory does not explain, for example, how production is organized within a firm or how conflicts of interest within a firm are resolved. The firm is treated, in effect, as a "black box." Little insight is provided about the structure of the firm.

To understand the structure of the firm we turn to a paper by (Coase, 1937) which is generally considered to be the seminal contribution in this area (Cheung, 1983), Hart and Moore, 1990). Coase's paper raised the important question of why firms exist at all, inspiring a number of economists over the years to attempt to come up with a satisfactory answer. Coase's own explanation was that a firm comes into existence if it is profitable to organize a transaction within a firm as opposed to using the market to carry out the transaction. But Coase did not specifically explain what affects this cost of transaction, or, what are the different types of transactions that are likely to be organized within a firm. Williamson then developed Coase's ideas, giving them rigor. Williamson's (1979) explanation of transaction costs on the basis of investments has proved to be particularly influential in explaining why firms (or hierarchies) and markets co-exist. The main focus of Williamson's work was the effect of transactions on costs and the optimal organizational form for different types of transactions. Williamson recognized that there are costs in setting up firms, like the cost of decision-making delays due to "internal

bureaucracy," but he ignored other costs that might be associated with setting up firms. In particular he, ignored the effect integration will have on the incentives of managers/owners. The incentives of managers could play an important part in the success of an enterprise: Grossman and Hart (1986) developed models using an incomplete contract formulation to show how integration impacts the incentives of managers and analyzed the conditions under which integration would be optimal. Hart and Moore (1990) carried the analysis further to show conditions under which joint ownership will be optimal.

The remainder of this chapter explores the theoretical basis for the empirical analysis that follows in subsequent chapters. Section 2 takes a look at various internalization issues, section 3 weighs the pros and cons of ownership, and section 4 delves into the factors that determine the locational choice of new plants.

2.3. Why Do Firms Exist?

Coase's (1937) seminal paper pointed out that firms integrate in order to minimize transaction costs.[4] Reliance on the market forces a firm to negotiate with external suppliers for its production needs and this dependence on other agents is often costly. If the firm chooses to internalize these market transactions, long term contracts with employees replace a series of short-term contracts with other suppliers, and this serves to decrease transaction costs.

Coase's (1937) paper argued that the views prevailing at that time about firms

[4] Institutionalists were concerned with the idea of transaction costs some 40 years ago. Their ideas have been revived by economists recognizing the importance of transactions cost (Williamson, 1975)

were deficient. He believed that the common view that the firm exists due to the extreme complexity of the division of labor is not a tenable one, since advances in economic theory have indicated that an increase in the degree of specialization does not lead to chaos. Moreover it does not explain why coordination by the market should be replaced with coordination by the firm.

The most popular view at that time about the existence of firms was that of Knight (Coase, 1937). Knight espoused the view that firms existed because of uncertainty. In the absence of uncertainty, when every individual in the economy has perfect knowledge, there are no reasons for any one to coordinate productive activities. With perfect knowledge, flows of raw input into the production process are automatic. Agents, after a period of adjustment in which they learn by "trial-and-error," will be able to carry on all transactions without a second thought. The whole production process becomes automated, with very minor imperfections in coordination. Knight believed that under certainty there might be managers who would be performing purely routine work devoid of any responsibility, but in the presence of uncertainty there would be a separate group of managers who would coordinate production. Because decisions would have to be made about what to produce and how to produce it, these coordinators would then direct the actions of others, which Professor Knight believed would not happen unless the individuals gave their consent to the coordinator/manager to control their actions. In this manner, according to Knight a firm emerges.

Coase's paper argued that there were two flaws with this argument. First, managers could just work as advisors or consultants without taking part in production. A second, and a more serious, flaw with this argument was that there was nothing in it that

indicates why a firm is a better alternative than the price system. Coase also disagreed with the premise that to guarantee a definite result one agent must give directions to another. For example, in most contracted jobs it is normal to guarantee a certain amount of money for specified work without any directions on how the work should be done.

According to Coase, the main reason why the firm exists is because it is often more profitable to establish a firm than to use the price mechanism. The most obvious cost of organizing production through the price mechanism is the cost of discovering relevant prices.[5] The emergence of a specialist who can sell information relating to prices may reduce, but not eliminate, the cost of discovering the price. The cost of negotiating and concluding a separate contract for each transaction between the owners of various factors of production employed in the production process will further increase costs. The establishment of a firm reduces the cost of contracting, as each owner of a factor of production would then have to enter into a single contract with the owner/manager of the firm instead of a multitude of contracts with other owners of factors. A firm therefore enhances cooperation between the owners of factors by employing them.

Risk attitudes of agents may also play a part in the formation of firms. Agents may prefer entering into a long-term contract rather than many short term contracts. This would especially be true if the future demand and changes of the state of nature cannot be predicted with certainty and hence there would be costs associated with each mistake. To smooth out the fluctuations in their payoffs, agents may prefer a long-term contract to

[5] It is important to note that Coase is implicitly assuming that the prices are not known to all agents in the economy. Coase cites the work of N. Kaldor (1934) for this assumption.

many short-term contracts. When a long-term contract is preferable, and the services to be provided are expressed in general terms with remaining details left to be determined by the buyer at a later date, then essentially the supplier of the resource is agreeing to be directed by the buyer, within the limits of the contract, and a firm emerges. [6]

The size of the firm is directly related to the number of transactions organized within the firm: As the entrepreneur directs more transactions the firm becomes larger and as he organizes fewer transactions the firm becomes smaller. This raises the question of what limits the size of the firm or, in other words, what prevents the existence of only one big firm with all transactions being carried out internally. Coase discusses several factors that determine the size of the firm. The first relates to the possibility that there are diminishing marginal returns to entrepreneurial functions. Diminishing marginal returns would imply that as the number of transactions internalized by the entrepreneur increases the cost savings decrease. Thus, there will exist a point at which the entrepreneur will be indifferent between organizing one more transaction internally and conducting the same transaction in the market. So a firm will tend to expand until the cost of organizing an extra transaction within the firm is equal to the cost of a market transaction. A second factor limiting the size is the likelihood of mistakes and how this likelihood is affected by the increase in the number of transactions. As the number and dissimilarity of transactions increases, the entrepreneur becomes less familiar with the production process, and hence the probability of mistakes increases as well, which places additional limits on the firm size. Thirdly, as an entrepreneur organizes more and more transactions

[6] " A firm, therefore, consists of the system of relationships which comes into existence when the direction of resources is dependent on an entrepreneur." Coase (1937) pg. 393.

internally, transactions may be less alike and geographically more separated. This may contribute a reason why inefficiency could creep in and limit the size of the firm. Innovations that decrease the spatial dispersion of transactions, such as improvements in managerial skill and the speed of telecommunication, will tend to increase the size of the firm.

2.4. Some Other Factors

Coase's paper offers an answer to the question of why firms exist, but he never explains the type of transactions that are likely to be organized in a firm or what factors might affect transaction cost. Coase also never considered the effects of informational asymmetries among agents. Williamson (1979) develops Coase's ideas to further explain why a firm might exist on the basis of factors that affect transactions cost. Before we delve into Williamson's paper it would be helpful to explain some broad factors that are used by economists to explain why firms come into existence and integrate with other firms.

Williamson (1975) points out some factors that explain why firms (MNCs in our context) would like to internalize transactions. The factors can be broadly classified under three separate headings:

1) Bounded Rationality and Uncertainty/Complexity

2) Opportunism and Small Numbers

3) Information.

These factors are discussed below in order to provide an understanding of the key elements of a firm viewed as a hierarchical structure.

2.4.1 Bounded Rationality and Uncertainty/Complexity

Bounded rationality has been defined as behavior that is 'intendedly rational, but only limitedly so' (Simon, 1957). Bounded rationality places two limits on decision making: (a) 'neurophysical' limits, which refer to the physical limits of humans to store, retrieve, and process information and (b) limits arising from the problems associated with communication. Simon observes that "it is because individual human beings are limited in knowledge, foresight, skill, and time that organizations are useful instruments for achievements of human purpose", Simon (1957, pg 199).

If the market environment is very complex then decision making becomes difficult. The costs of a wrong decision become impossible to compute and risks are hard to distinguish making it impossible to write a meaningful contract among parties. In such a case, internal organization would be favorable. Bounded rationality has not been formally analyzed in the case of the firm because of the difficulty associated in modeling (Tirole, (1994), Hart and Moore (1988)).

Communication problems could develop due to the inability of individuals to successfully communicate ideas by words, graphs or pictures (as a result of problems of the language itself rather than the receiver's failure to comprehend). In such a case, the parties may develop other means of communication such as through demonstration and learning by doing. By working together, the parties involved might be able to summarize complex events in an informal way, making internal organization more attractive.

2.4.2. Opportunism and Small Numbers

Opportunism deals with the conventional assumption that individual agents are guided by self-interest and not group interests. Opportunism arises especially in the case

in which there are informational asymmetries that permit one of the parties to selectively distort information. This problem of opportunism is further aggravated in the case in which performance is not verifiable in a court of law.

Since there are problems in making an ex-ante determination of who is truthful, relying on (external market) contracts exposes firms to principal-agent problems during the period between the signing of a contract and contract renewal. If there are incentives for the agent to be ineffectual in contract execution then the agent has to be monitored by the principal to ensure the successful completion of the terms of the contract. If the cost of monitoring the agent's work is high, the firm might prefer an internal organization.

If there were a competitive market for contracts; that is, if there were a large number of bidders; opportunistic behavior will be ineffectual especially in the case in which the firm can costlessly award the contract to a competitor at the time of contract renewal. The fear of losing the contract will then discourage opportunistic behavior.

There may be fewer temptations to behave in an opportunistic manner within an organization, where a system of incentives could be designed to promote the interests of the firm. With an appropriate system of employee rewards, a firm can better handle the conflict arising between the firm and individual agents.

2.4.3. Information

An issue that has received a lot of attention in the past few years, is the application of information economics to the study of contracts. It is generally conceded that if there are informational asymmetries between contracting parties then the exchange between them is subject to hazards. Williamson (1975, pg. 31) believes that it is not informational asymmetry alone that is important, but it is the interplay with opportunistic

behavior and the high cost of achieving informational parity. In other words if one agent has less information than the other, he can never be sure that the latter is not selectively disclosing information or distorting the information. Even with identical information among parties, there could be disputes since there may be a problem in conveying this information to a court due to its unobservability; that is, the information is unverifiable in a court of law. In the event that information is symmetric and verifiable, conflict between contracting parties may arise if the contract was incomplete (it did not specify the action to be taken in all possible eventualities). Below we discuss Williamson's (1979) paper, which explains how the above factors interplay in the formation of firms.

2.5. Frequency of Transaction, Investment and Governance Structure

Williamson (1979) develops the ideas of Coase to explicitly describe the transactions that should be internalized. In this paper Williamson shows the least cost, or optimal, institutional framework within which to reliably complete a transaction. This institutional framework, which governs a transaction, is described as a governance structure and it could be either a firm or a market. To undertake a particular transaction, an investment is usually required. The characteristic of the investment depends on the nature of the item to be transacted. And, as Williamson shows, the nature of the investment, along with the frequency of transaction, determines the type of governance structure that is optimal.

A firm trying to minimize cost has one goal: to minimize the sum of production and transactions cost. The governance structure can thus be looked upon as an optimization problem. Changes in the governance structure can affect the cost of writing

complex contracts as well as the cost of their execution (e.g. the monitoring costs and other costs associated with opportunism). Therefore understanding governance structure, and factors which affect it, may better help a firm in minimizing its cost.

To help us better understand the different types of transactions, a brief digression into the legal background of contracts, or the laws governing contracts, is attempted here. Contract law of the U.S., according to Williamson (1979)[7], may be classified into three different categories: the classical, neoclassical, and relational contracting law. The laws that fall under classical contract law emphasize legal rules and formal documentation; the nature of the agreements is clearly written without any ambiguity. Not all transactions can be optimally undertaken via contracts based on classical contracting law. This is especially true for long-term contracts in an uncertain environment. A problem that could arise is that a detailed description of all the actions to be taken at every eventuality may be prohibitively expensive if not impossible to write. Secondly, the solution to a problem might not be evident until the problem manifests itself. Finally, if the state of the world is unverifiable then the settlement of the problem becomes even more difficult.

There are three possible solutions to the problems associated with the use of classical contracts to govern the types of transactions described above.

(1) Forgo all transactions all together.

(2) Organize all transactions internally.

(3) Introduce a different contracting relation that preserves trading but provides for additional governance structure like third party arbitration.

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[7] Williamson (1979) cites the work of Ian McNeil, "The Many Futures of Contracts", 47 S. Cal. L. Rev. 691, 783 (1974) for the discussion on the contracting background.

The third solution is what Williamson refers to as neo-classical contracting. In neo-classical contracts not all possible eventualities are stated; that is, there are "gaps" in the contract. Contract planners might give a range of choices to the agents in lieu of leaving gaps in the contract but they are never as rigid and as comprehensive as in classical contracts. To resolve problems arising out of these gaps, or unplanned eventualities, additional governance, like third party arbitration, may be provided for. According to Williamson, third party arbitration is less final than litigation, and leaves the parties less resentful, hence is beneficial for the completion of the contract. Thus the law of neo-classical (or incomplete) contracts, recognizes the following features: (a) the world is complex, (b) agreements are often incomplete, and (c) some contracts will never be reached unless both parties have confidence in the settlement machinery.

The requirement of maintaining an ongoing relationship has resulted in a modification of neo-classical and classical contracts referred to as a relational contract. Contracts allowing for collective bargaining would fall in this genre. The main difference between relational and neo-classical contracts is the reference point. In neo-classical contracts the reference point in a dispute is always the original contract. For the relational contract the reference point is the relationship as it has evolved over time, and any reference to the original contract may be only in passing.

With that digression into the different categories of contract law we move to a discussion of the characteristics of investment. As we shall see below, the characteristics of investment play a key role in the choice of the optimal governance structure. Investments are characterized by varying degrees of transaction specificity (or non-marketability, since very specialized products might have few buyers). When the buyer

or seller makes a transaction specific investment they are "locked into" the relation in the sense that an alternative buyer and seller cannot be found easily. Transactions or investments with a very high degree of relationship specificity are referred to as idiosyncratic transactions or investments. At the other end of the spectrum is the non-specific investment: an investment which can costlessly be transformed to suit another transaction. Mixed investments fall in between. An example of an idiosyncratic investment would be the location of a specialized plant in close proximity to a downstream processing unit. With the additional assumption that there are no other firms, of either type, in the vicinity, there would be strong incentives, on both the buyer's and the seller's part, to continue the relationship. If trade were not consummated between them, then both the buyer and seller would lose their investment since the return from alternate use is approximately zero. A nonspecific investment would be any investment in which the return is nearly the same as in the next best alternative. While for a mixed investment the return from the next best investment lies somewhere in between the idiosyncratic and the non-specific type.

The three essential dimensions for any contract are (1) uncertainty, (2) frequency of transaction and (3) the characteristics of the investment or the degree to which investments are idiosyncratic. To simplify the analysis below, the level of uncertainty is held fixed and only the frequency of transactions and type of investments are analyzed. The frequency of transactions is categorized into occasional and recurrent transactions. The investment characteristics are broken up into 3 types: nonspecific investment, investments that can be readily adapted to suit any transactions; idiosyncratic investment, investments that are transaction specific; and the intermediate case, mixed investment.

Figure 1 diagrammatically shows the transaction cases determined by the frequency of the buyer's purchase (rows) and the characteristic of the seller's investment (columns). The entry in the cell at the intersection of a row and a column gives an example of the particular type of transaction. When the frequency of purchase by the buyer is recurrent then the item purchased would normally be an intermediate good or

		Investment Characteristic		
		Nonspecific	**Mixed**	**Idiosyncratic**
Frequency	**Occasional**	Purchase Standard Equipment	Purchasing Customized Equipment	Constructing a Plant
	Recurrent	Purchasing Standard Material	Purchasing Customized Material	Site- Specific Transfer of Intermediate Product across successive stages

Figure 1. Illustrative Commercial Transactions (Williamson (1979) pg. 243)

raw material. When the purchase is occasional, then the purchase could be a machine or durable equipment. If the investment characteristic of the seller's investment is non-specific then the product is a generic (standard) commodity available from the market. While if the seller's investment is idiosyncratic, then converting the investment to another use will be prohibitively expensive. The construction of a steel plant is an

example. Mixed investments fall in between a non-specific and highly specific investment.

Figure 2 shows the type of governance structure that we could expect to emerge in each of the cases categorized in figure 1.

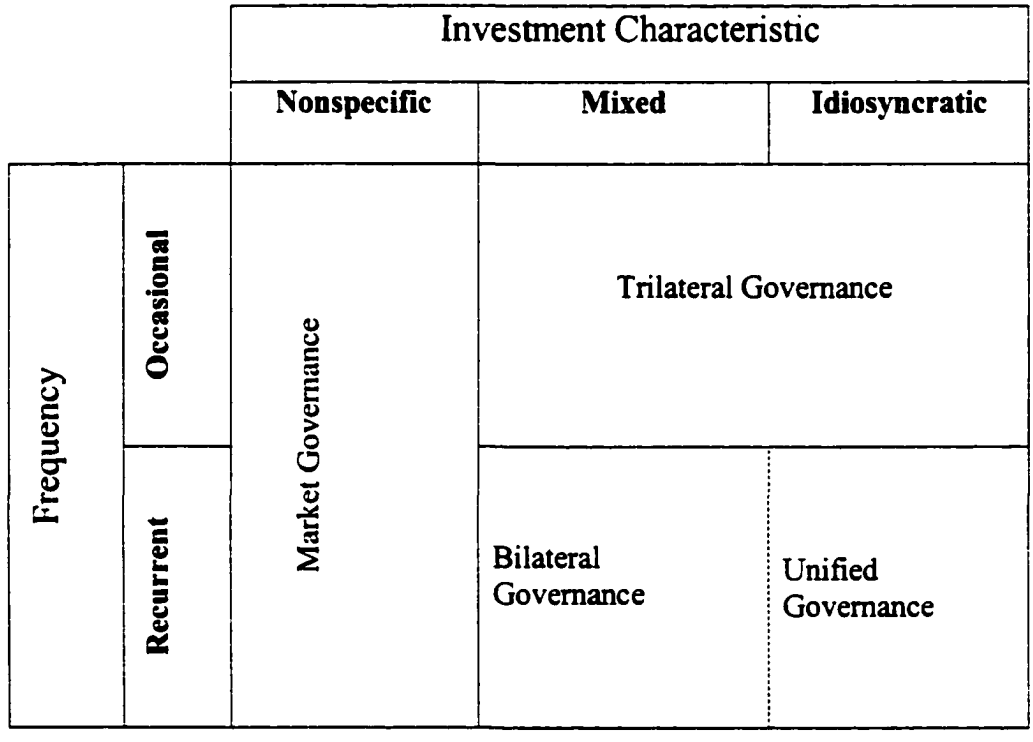

Figure 2. Matching Governance Structure with Commercial Transactions (Williamson (1979) pg. 247).

Four types of governance structure are considered (a) market, (b) bilateral, (c) unified, and (d) trilateral.

A market is the main governance structure when the frequency of transactions is occasional or recurrent for nonspecific investments. Since nonspecific investments are also standardized, alternate supplies are not difficult to find. Buyers can rely on word of mouth or rating agencies to safeguard against opportunism. Thus, for standardized goods

irrespective of the frequency of transactions, market governance is optimal.

Investment of a non-standardized nature will make reliance on the market inappropriate however. If, in addition, transactions are recurrent, it might be possible to build a more specialized governance structure. Two specialized structures designed to handle such transactions are unified governance, in which the transactions are removed from the market and organized within a firm, and bilateral governance, in which the organizational structure falls in between a unified governance and a market; for example, a joint venture.

Bilateral governance is preferred for cases in which the assets, human and physical, are not extensively specialized. In this case, the trading firms would want to maintain the relationship with each other, since by definition the buyer will not be able to procure specialized goods from the open market, and the sellers return from internal trade is greater than the return from market sales. The recurrent nature of the transactions then allows the firms to form a centralized governance structure, in which the identities of the individual firms are maintained, but to a lesser extent than in a market transaction. However, if there are disagreements between contracting parties or if there is some persistent issue about adaptability, then a bilateral governance structure is no longer efficient and a unified governance structure may be preferred.

Unified governance, or internal organization, is optimal when incentives for trade weaken. This usually happens as assets become more idiosyncratic. As assets become more specialized to a single use, and hence less transferable to other uses, economies of scale can be achieved by the buyer as well as the seller. The advantage of vertical integration is that adaptations to the product can be enforced by fiat. Internal adaptation

can be ensured by an order from the central office within a firm but this is not possible when the governance structure is a market or bilateral governance.

If specific investments of either idiosyncratic or mixed variety have to be made for the project, then the interest of the agents to sustain the relation is great. The market is an inappropriate governance structure in this case since alternate suppliers for custom goods are not easy to find. Additionally, if the transactions are occasional, the set up of a specialized governance structure, like unified or bilateral governance, may not be justified. In this case, there is a need for an intermediate governance structure, between unified or bilateral governance, on the one hand, and a market, on the other.

The trilateral governance structure, a neo-classical invention, was introduced to resolve crises among agents who would prefer a continuing relationship due to having transaction specific investments in place. In a trilateral governance structure, an arbitrator's service is utilized to resolve disputes without the contractual breakdown that litigation may cause. Examples of trilateral governance include federal mediation between the workers' union and management to prevent a breakdown in negotiations, and independent architect evaluating construction work for a client to see if all specifications of the contract have been followed by the builder.[8] Thus for these occasional transactions, involving semi-transaction specific investments or idiosyncratic investments, a trilateral governance structure is optimal.

The introduction of uncertainty will have no effect on market transactions since new trading relations can easily be arranged. But in the case of bilateral relationships,

[8] Williamson (1979) distinguishes between arbitration and litigation, the former being described as informal and less severe.

uncertainty requires that there be a machinery to resolve the crisis and to mitigate the cost increases as the degree of uncertainty rises. Two things can happen in such cases: The specific design of the item transacted may be sacrificed in favor of a standardized form or there may be movement toward a more unified governance structure.

2.6. The Effect of Integration on the Incentives of Managers

Coase and Williamson suggest that, through integration, the firm reduces its transaction cost, costs of re-contracting, etc. But they do not consider the effect of integration on the incentives of managers. If an agent does not enjoy the benefits of his innovations, or has to share the benefits of innovations with others, then he will have no incentive, or a lower incentive, to innovate. If the cost of innovation (say the cost of the innovator's effort) can be assigned a monetary value, then the optimal effort by an agent is characterized by equality between the agent's marginal cost and marginal benefit or payoff. If other agents in a multi-unit plant share part of the benefit then the effort by the innovating agent will be lower than if he were the sole beneficiary. Thus there are costs to integration.

Grossman and Hart (1986) forcefully argue this case. They contend that the analysis of Coase and Williamson is too simplistic. They argue that if integration always reduces transactions cost then a buyer and a seller who have a contractual relationship could make themselves better off by taking the following steps.

(1) (Firm) A buys (firm) B and makes the previous owner of B the manager of a new subsidiary.

(2) A sets a transfer price between the subsidiary and itself equal to the contract price that

existed when the firms were separate enterprises and

(3) A gives the manager of B a compensation package equal to the profits of the subsidiary.

Given the above design, integration can never be strictly worse than non-integration.

Grossman and Hart (1986) also question the definition of integration " .. (F)or example, is a firm that calls its retail force employees more integrated than one that calls its retail force independent but exclusive sales agents?" They define integration in terms of ownership of assets. Ownership is an important issue, as Hart (1989) points out: "Ownership of assets goes together with the possession of residual right of control over assets; the owner has the right to use the asset in any way that is not inconsistent with prior contract, customs, or law."

The ownership of residual control rights is important since, in general, contracts cannot specify all contingencies. When some contingencies are left out, the contract is incomplete. A contract will therefore typically assign property rights to one of the firms which then determines who can act and what sort of actions can be taken under these contingencies.

The paper by Grossman and Hart (1986) models the incentives of the owners/managers of firms and shows conditions under which ownership of one firm by the other is optimal. This paper uses incomplete contracts (or "neo-classical contracts," as described above) in which not all eventualities can be explicitly stated in advance. We discuss the paper in detail because it, along with Hart and Moore (1990), forms the basis on which we build several of the hypothesis that are to be tested.

There are two firms involved in a joint production that lasts for two periods. At

date zero, the ex-ante period, the firms (1 and 2) sign a contract and they immediately make product specific investments a_1 and a_2 respectively. At date 1, the ex-post period, some further actions q_1 and q_2 are undertaken and gains from trade are realized. The initial contract at period zero assigns property rights to one of the firms to choose actions q_1 and q_2. It is assumed that q_1, q_2 and a_1, a_2, and hence the payoff's, are not contractible ex-ante, but q_1 and q_2 are ex-post contractible. That is to say that the firms cannot credibly pre-commit to choices q_1, q_2, a_1 or a_2, but once the state of the world is discovered in period 1, the parties can then costlessly negotiate over the values q_1 and q_2. The managers of the firms are also assumed to receive the full return.

The benefits earned by the managers net of investment costs are denoted $B_i[a_i, \phi_i(q_1, q_2)]$ for the managers of firm i = 1,2. It is assumed that B_i is increasing in ϕ_i. An optimal business decision would maximize the joint benefits of the managers

$$\max_{a_1, a_2, q_1, q_2} B_1[a_1, \phi_1(q_1, q_2)] + B_2[a_2, \phi_2(q_1, q_2)].$$

The first best values for q_1, q_2, a_1 and a_2, the values that maximize $B_1 + B_2$, are denoted by a_1^*, a_2^*, q_1^* and q_2^*. The paper shows that the first best solution is possible if q_1 and q_2 are ex-ante contractible, even if a_1, a_2 are not. By assumption, however, q_1 and q_2 are not ex-ante contractible hence we would expect inefficiency.

There are three possible types of organizational forms that are considered (i) non-integration, (ii) firm 1 control, and (iii) firm 2 control. If the firms are not integrated then the initial period zero contract will assign the rights to choose q_1 and q_2 to firm 1 and firm 2 respectively. If the firms are integrated with firm 1 control, then the contract will

specify that firm 1, at date 1, will choose both q_1 and q_2. Integration with firm 2 control results in the choice of q_1 and q_2 being left to the discretion of the manager of firm 2.

The paper proposes the following conditions for non-integration to have the highest possible sum of benefits among the three forms of organization:

$$\phi_1(q_1,q_2)=\alpha(q_1)+\varepsilon_1\beta_1(q_2) \qquad \text{and} \qquad \phi_2(q_1,q_2)=\alpha(q_2)+\varepsilon_2\beta_2(q_1)$$

where $\varepsilon_1,\varepsilon_2$ are "small." In this case, firms will choose approximately the optimal q_1^* and q_2^*, since the benefit from choosing q_1^* accrues mainly to firm 1 while the benefit from choosing q_2^* accrues mainly to firm 2.

Alternatively consider the case in which ϕ_2 hardly depends on q_1 and q_2:

$$\phi_2(q_1,q_2)=\alpha_2+\varepsilon_2\delta_2(q_1,q_2)$$

where ε_2 is "small." In this case, firm 1 control yields the approximate best result.

Similarly if ϕ_1 hardly depends on q_1 and q_2 then we have that:

$$\phi_1(q_1,q_2)=\alpha_1+\varepsilon_1\delta_1(q_1,q_2)$$

where ε_1 is "small." In this case, firm 2 control yields approximately the best result.

The above results follow since in each case all benefits of efficient choices accrue to the firm making the choice. The paper then shows that if marginal and total benefit of investment move together, then under firm 1 control, firm 1 will over-invest and firm 2 will under-invest relative to the first best choice of investments: a_1^* and a_2^*. Similarly, under firm 2 control, firm 2 will over-invest relative to the first best and firm 1 will under-invest. This happens since, under firm 1 control, firm 1 will have vast ex-post power and hence will over invest to receive added benefit in date 1 renegotiations. Firm

2 conversely will have low total and hence marginal benefit so it's investment will be low. Under non-integration the results are dependent on the relation between the first best choice of q_i's and the non-integrated choice of q_i's .

To summarize the conclusions of the paper: Firm 1 (2) control is desirable when firm 1 (2's) investment is more important than firm 2 (1's) and the over investment by firm 1 (2) is less severe than the under investment by firm 1 (2) in any other form of integration. Non-integration is desirable when the investment's of both firms are approximately equally important.

Hart and Moore (1990) build on the previous paper. They extend the arguments of the previous model to a multi-asset and multi-individual economy to analyze the effect of joint ownership. While the Grossman and Hart (1986) paper dealt solely with the incentives of the top management, Hart and Moore remove that restriction and allow multiple people to combine their labor with the services of a particular productive asset. Some of the workers, who are in effect employers, will have ownership rights while others, the employees, will not. The definition of ownership in this paper includes the right to exclude others from the use of an asset. Thus controlling a physical asset will lead to control over human assets. This happens because the workers who need the asset to be productive may be excluded from it if the owners decide to selectively fire workers. Therefore, if we view the firm as a collection of assets, the owner/owners of the firm will have more control over the workers than if they have an arms-length contract with another owner of an asset (firm).

Some key points of this model can be illustrated by a simple example. There is one asset, a luxury yacht along with two workers and one tycoon. Worker 1 is a chef;

worker 2 is a skipper. They combine to provide a service, a dinner cruise (on the yacht) to agent 3 (a consumer) who is a business tycoon. The value of this dinner cruise is 240 to the tycoon and there are no other tycoons in the vicinity. There is, however, a spot market for skippers; that is, the skipper can be costlessly replaced. At period 0, the chef has to take an asset specific action (learning how to cook on a yacht) at an un-reimbursed cost of 100, gains from which are realized in period 1. This skill is non-transferable (there is no other yacht nearby), and it is assumed that no long-term contract can be written in period 0. In period 1, the agents bargain over the benefits; the bargaining solution is a symmetric bargaining solution in which the agents involved equally split the benefits from their investments. This means that agent X who has made an investment in period 0, will share his contribution to the total benefit in period 1 with agents who were required for this benefit to be realized. Required agents can be thought of as agents without whose help the return to agent X's investment would be zero. The model rules out profit sharing agreements, or any other agreements that share period 0 investment cost or period 1 revenue.

The ownership of the yacht will determine whether the chef will undertake the asset specific action (investment), or not. If the skipper owns the yacht the chef will not undertake the investment. Looking ahead, the chef knows that at period 1 the gains are split equally (as a symmetric bargaining solution would predict). The return on his investment, equal to $\frac{1}{3}(240) = 80$, is less than his investment of 100.[9] In contrast, if the tycoon or the chef owns the yacht then the chef will invest since now the gains are going

[9] The chef has to bargain with the tycoon and the skipper; the tycoon since he is indispensable and the skipper since he owns the asset.

to be split only two ways (because the skipper will not have to be a part of the bargain) and the chef's investment cost will be covered; that is $\frac{1}{2}(240) = 120 > 100$ (investment cost).

Now assume that the skipper also has to undertake an action in period 0, at an un-reimbursed cost of 100, which will increase the tycoon's valuation of the cruise by 240 in period 1 (so now the total valuation is 240+240= 480). If both the skipper and the chef have to take actions, specific to the tycoon, then it is better that the tycoon owns the asset. Since the skipper (chef) will have to bargain with only one other person, the tycoon. Let the skipper own the asset (the argument is analogous in the case in which the chef owns the yacht). To realize any benefit from his period 0 investment, the chef will have to reach an agreement with the skipper in period 1, since he owns the yacht, and the tycoon, since he is the only consumer. The chef, in period 0, expects his period 1 return under a symmetric bargaining solution to be $\frac{1}{3}(240) = 80$, less than his investment cost of 100, so he does not invest. If on the other hand the tycoon owned the asset, then the chef (skipper) will have to bargain with the tycoon only, equally sharing profits and getting a return of $\frac{1}{2}(240) = 120$ which is greater than his investment cost of 100. With the tycoon owning the yacht, both the chef and the skipper will invest, and total benefits will be 480. Thus it may be efficient to give ownership of the asset to the agent who is indispensable even though he makes no investment decision.

Another conclusion that can be derived from the example is that assets that are highly complementary should be owned together. Assume now that there are other consumers who can use the yacht and that the tycoon must also undertake an investment.

Let the benefit from each agent's action be 240 and the cost to each agent be c_i (thus the maximum benefit to the tycoon is 720). Now suppose the yacht consists of 2 parts: the hull and the galley. Then the optimal ownership structure is for a single agent to own both parts of the yacht. To see this, first assume that the chef and the skipper owned one part each. The skipper's and the chef's investments each increase total benefit by 240, but they need an asset (jointly owned yacht) to work on, thus the chef has to reach an understanding with the skipper and vice versa to get any benefit from their investment. Looking forward, they know that once they reach an agreement with each other the returns from their investment would be split equally. Thus they would invest if $\frac{1}{2}(240) > c_1$ for the chef and $\frac{1}{2}(240) > c_2$ for the skipper. In this case the tycoon is no longer indispensable, he has to come to an agreement with both the chef and the skipper to enjoy the cruise, hence he would invest if $\frac{1}{3}(240) > c_3$, since the tycoon's investment also increases total benefit by 240. If on the other hand the chef owned both the hull and the galley then he has to reach an agreement with neither the tycoon (there are other consumer/tycoons around) nor the skipper. Hence he would invest if $240 > c_1$. The skipper's incentive is unaffected since he still will have to reach an agreement with the chef to use his (the chef's) asset. The tycoon will now have to reach an agreement with only the chef so he would invest if $\frac{1}{2}(240) > c_3$. Thus giving both pieces of the asset to one individual leads to greater efficiency and fewer hold up problems.

In the context of a general model of asset ownership and investment the paper shows that integration with firm 1 controlling firm 2's assets will increase efficiency under any of the following conditions

(a) the assets are strongly complementary,

(b) 1 is an important trading partner for 2,

(c) firm 2 is dispensable,

(d) firm 1 has important investments.

On the other hand, it will decrease efficiency if

(a) the assets are economically independent,

(b) firm 2 is an important trading partner,

(c) firm 1's investment is not important,

(d) firm 2 has important investments.

2.7. Informational Asymmetry

The final paper reviewed here is by Horstman and Markusen (1996). This paper is not based on incomplete contracts but based on informational asymmetry. The paper deals with the choices that MNCs make while planning their foreign operations. Horstman and Markusen (1996) ask the question why does the MNC make a large investment in a sales operation in a foreign country instead of contracting sales to a local entrepreneur? As discussed above, firms choose internal organization to avoid agency costs that will plague any arms-length transactions. The agency costs could be a local partner's learning from the MNC and then becoming a competitor, as in Ethier and Markusen (1991). Or it could be that the local licensee might not be as conscientious about maintaining the brand reputation as the MNC, as in Horstman and Markusen (1987).

Horstman and Markusen (1996) assume the existence of informational asymmetry

between the agent and the MNC. If the agent has more information than the MNC, the agent has the ability to appropriate some of the rent of the MNC. In this paper the agent is able to appropriate some of the returns since the agent has better knowledge about the size of the market.

The paper considers the situation of a MNC entering a new market. Since the market is new, the MNC is unsure of the revenue it is going to get. It has a choice of setting up its own sales operation or using a local agent to sell its product. The local agent knows the market size but the MNC does not. The MNC knows the distribution of the size of the market; that is, it knows that the market will be "big" with probability ρ and "small" with probability $(1 - \rho)$. The actual number of consumers for the MNC's product is assumed to be a fraction of the total market. The constant of proportionality depends on the effectiveness of the sales force of either the local agent or the MNC. Thus the model implies that there is a tradeoff associated with the MNC's decision to have the local firm sell its product or to have a wholly-owned subsidiary. The local sales agent has better information and lower setup cost than the MNC, which favors a tie-up with the local firm. On the other hand, the local agent may not truthfully reveal the size of the market, or the sales force of the local agent may be less efficient in procuring customers than the MNC, which favors a wholly-owned operation. The tradeoff is analyzed under two frameworks: a one period and a multi-period choice model.

In the one period case, if the MNC does not know the market size, then the local firm may be less than truthful about the market size. This agency cost has to be weighed by the MNC against its own setup costs before it makes a decision on entry. The MNC also has to weigh the sales efficiency of the local agent, vis-à-vis its own sales force.

Thus if the MNC's sales force is more efficient than the local agent, the MNC might be more likely to invest in an owned operation, other things being constant.

The authors show that in the multi-period model the MNC could choose owned operations when the expected market size is large and the variability in the profit is low. It could also temporarily enter into a sales tie-up if entry costs are high and the market size is unknown and there is a high probability that it could be small. This sales tie-up will be permanent if it is found out that the market is actually small and temporary if the market size turns out to be big, in which case it will set up its own operation.

CHAPTER 3: SURVEY OF EMPIRICAL LITERATURE

3.1. Introduction

Most of the empirical research related to MNCs has focused on their foreign investment decisions:

" Empirical research on multinationals has focused mainly on flows of foreign direct investment (FDI). By and large, this literature does not address the relationship between exporting and producing abroad as alternative modes of market penetration" (Brainard, 1997, pg. 520).

Two other aspects of MNC behavior; namely, intra-firm trade (IFT), and the choice of mode of entry, or organizational form, for foreign affiliates; comes a distant second and third respectively. (See Caves (1997) for a survey.) These decisions may be entwined and equally important for the MNC. Thus the popularity of one over the other, as a research topic, is not apriori justified. The most neglected area however, is the choice of affiliate organizational form and how this aspect impacts production in the U.S. and abroad.

The following sections look at some of the empirical literature on MNCs. The papers can be broadly classified into the following three categories, (i) production and trade, discussed in section 2; (ii) organizational form of U.S. MNCs' foreign affiliates, in section 3; and (iii) intra-firm trade, presented in section 4. The firm's choice between exporting from the U.S. versus locating plants abroad is discussed in Brainard (1997). Grubert and Mutti (1991) analyze the impact of taxes on various aspects of MNC

behavior, namely production, trade, and FDI. Choices of affiliates' organizational form by U.S. MNCs are investigated in two excellent papers. The first is by Benjamin Gomes-Casseras (1989), which investigates the factors causing a firm to choose between a joint venture and a majority owned foreign affiliate as an optimal ownership structure. The second by Gatignon and Anderson (1988), categorizes ownership on the basis of U.S. MNCs' equity holdings into four categories, ranging from minority ownership to 100% (equity) owned subsidiary, then, using multinomial logit, it investigates the degree of integration adopted by U.S. MNCs. Intra-firm trade is discussed in the following papers: Kimberley Claussing uses Bureau of Economic Analysis (BEA) data and Anita Benvignati (1990) uses confidential data from the Federal Trade Commission to look at intra-firm exports. Lall (1979) investigates how industry characteristics affect intra-firm exports while Balassa (1986) analyzes country impacts on intra-industry trade.

3.2. Produce in the U.S. or Abroad?

Brainard's (1997) paper empirically tests the proximity-concentration tradeoff. The question is to what extent a firm would like to concentrate production in a plant to achieve plant scale economies at the expense of closeness to consumers? The paper uses MNC data to examine the percentage of foreign sales that can be accounted for by affiliate sales versus exports from the U.S. The data set used is very comprehensive and includes 27 countries and 63 manufacturing and primary industries.[10]

[10] The paper analyses both the U.S. sales share of the U.S. affiliates of foreign owned MNCs, and the foreign sales share of foreign affiliates of U.S. owned MNCs. For the foreign sales share, only the majority owned foreign affiliates are used in the analysis.

U.S. MNCs in industry j can satisfy the demand for their products by foreign country i through either of two means: (1) exports to country i of some of industry j's U.S. production or (2) production and sales by industry j's foreign affiliates in country i. Brainard's paper investigates the factors that influence the shares of total sales, by industry j to country i, attributable to each of these sources. The paper develops new methods to measure several key explanatory variables. Plant scale economies are measured by the number of production workers in the industry's median plant ranked by value added. The data for transport cost, which is a major driving force behind the MNC's decision to locate plants overseas, is derived from the freight and insurance charges reported by importers to the U.S. Bureau of Census. According to Brainard, this series is a significant improvement over those that were used in previous papers. The following list of Brainards' explanatory variables gives the hypothesis connecting each to the dependent variable and, where appropriate, comments briefly on data sources.

FREIGHT: This variable is the log of the freight cost for transporting product j to country i from the U.S. This series is taken from the data reported to the Bureau of Census by importers. It is assumed that the higher the freight charge the greater will be the share of sales attributable to affiliates and the lower will be the export share.

TARIFF: The tariff value used here is the log of the ad valorem tariff imposed by country i on good j. These data were obtained from the 1988/89 database of the General Agreement on Tariffs and Trade. The tariff data were at the 10-digit harmonized trade classification level and were converted to the appropriate SIC industry category by using a concordance provided by the Bureau of Census. It is hypothesized that an increase in the tariff will result in an increase in affiliates sales share and therefore a decline in the

export share.

TAX: The tax rate is measured as the log of the absolute effective tax rate of a country. The data were taken from a Price Waterhouse publication. It is assumed that an increase in tax rate will result in a decline in the affiliate share and a corresponding increase in the export share. This is because the U.S. MNC's affiliate's profit is going to be taxed at the higher rate while the export is going to be taxed at the relatively lower U.S. rate. Thus it might be optimal for the U.S. parent to export from the U.S.

PWGDP: This variable is the log of the absolute value of the difference between per worker GDP in the U.S. and per worker GDP in country i. This variable is designed to capture the difference in factor proportions between countries; that is, the difference in the capital/labor ratios. Most of affiliate sales are in capital intensive industries. Thus the MNC will concentrate production in the U.S. if capital is less abundant in country i, hence it is conjectured that there will be a negative relation between the per-worker income differential and affiliate sales.

TRADE and FDI: Indices of the openness to trade and foreign direct investment were taken from survey data from the World Competitiveness Report (1992). The survey ranks countries according to their openness to trade and FDI. In the survey data, Brazil is the least open to trade followed by Japan, Switzerland, and South Korea. With regard to the openness to foreign direct investment (FDI), Japan and South Korea are the least open while Hong Kong, Ireland, and the United Kingdom were the most open. The openness to trade is supposed to be positively correlated to the export share and openness to FDI will be positively correlated with the share of affiliate sales.

PSCALE: This variable is defined as the log of the index of plant scale economies

for industry j. The plant scale economy index is defined as the number of production employees in the industry's median U.S. plant ranked by value added. The higher the scale economy index, the greater will be the export share.

CSCALE: This variable is defined as the log of the corporate scale economy index, where the corporate scale economy index is measured as the number of non-production workers in an average U.S. firm in industry j. Corporate scale economies are supposed to measure the internalization advantage. It is hypothesized that it will have a positive coefficient in the regression with affiliate sales share as the dependent variable.

There are four dummy variables that are used.

LANG: The dummy LANG takes a value of one if the country's major language is English and 0 otherwise. LANG was used to capture similarities in culture: Dissimilar cultures might make it difficult for U.S. firms to operate an affiliate and hence encourage exports.

COUP: The second dummy, COUP, equaled 1 if the country had a coup in the previous decade and zero otherwise. Political risk, which is supposed to discourage foreign investment, is proxied by COUP.

ADJ: The dummy variable ADJ equaled 1 if the country is adjacent to the U.S. (Canada and Mexico) and 0 otherwise. ADJ is used to capture the saving in freight costs to adjacent countries not already captured by the FREIGHT variable.

EC: The fourth dummy was used to signify membership in the European Union: It equaled 1 if the country was a member and 0 otherwise. The European Union has preferential laws for goods produced in member countries hence it is surmised that this would discourage exports from the U.S. and correspondingly encourage production in

member countries.

The estimation results support the hypotheses associated with FREIGHT, TARIFF, openness to TRADE and FDI, PSCALE, CSCALE and the four dummy variables. The only variable for which the sign was not as expected was TAX.

Brainard (1997) then uses the same set of independent variables to estimate a model explaining the sales share of U.S. based affiliates of foreign MNCs. That is not important for the purpose of this dissertation and hence the results are not reported here. She then uses two stage least squares to analyze the exports of U.S. MNCs in level, rather than share, form. There is no significant difference between these results and the results obtained for the share equation and hence the results are not reported here.

The second paper that looks at the production strategy of U.S. MNCs is by Grubert and Mutti (1991). This paper [11] mainly focuses on the impact of taxation on MNC strategy: It looks at three different avenues through which tax can affect MNCs' decisions. First, the paper investigates whether MNCs take advantage of differential tax rates by shifting profits to a lower tax jurisdiction. Second, the paper endeavors to determine whether the tax policy of the host country affects the investment and production patterns of U.S. MNCs. Finally, the paper looks at how U.S. exports and imports are affected by foreign governments' tax policies.

MNCs can theoretically increase their after tax profits by shifting incomes to their affiliates in low tax countries. There are two strategies that the MNC can use to shift income: (i) debt financing of their plants and equipment (since interest payments on

[11] All variables used in this paper are country specific. No industry specific variables are used in the analysis.

loans are tax deductible) instead of internal financing (with retained earnings) and (ii) manipulation of transfer prices.

The first part of the paper investigates whether there is a negative relation between host country tax rates and profits reported by affiliates located there. Two measures of profitability are used as dependent variables (with similar results): (i) the ratio of book income to sales and (ii) the ratio of book income to equity. Two different measures of tax rate are used: the statutory tax rate and the effective tax rate. The statutory tax rate is the published tax rate of country i, and the effective tax rate is the statutory rate adjusted by investment tax credits and other tax credits that the MNC might have received. To control for the possibility that some countries may be more profitable than others, GDP growth rate is used as a proxy on the assumption that a faster growing country implies more profitable operations. The results indicate that the tax rate has significant explanatory power.[12] As an example, assuming the host country GDP growth is at its sample average level of 3.94%, the results predict a firm would report profits of 5.6%, at a tax rate of 40%, compared to 12.6%, for a tax rate of 20%.

In the second part of the paper, Grubert and Mutti (1991) analyze how taxes affect the allocation of capital. They base their model on economic theory, which suggests that firms will allocate capital globally to equalize risk-adjusted marginal after-tax return. This ability to shift income out of a country might influence the MNC to establish an affiliate in a low tax jurisdiction. Trade barriers are also assumed to encourage foreign investments since they might be the only way to penetrate the market. The average tariff

[12] The regression using the statutory tax rate had a higher R-square.

rates on manufacturers were used as a measure of the tariff barrier.[13] Other independent variables used in the regression are GDP and the GDP growth rate. The authors reasoned that a large GDP means a large market making the MNC more interested in setting up an affiliate in the country. The dependent variable used is the net stock of plant and capital of U.S. affiliates in country i. The results of the estimation bear out the theoretical hypothesis. The results indicate that a reduction in the host country tax rate from 20% to 10% increases U.S. affiliates' net plant and equipment by 65%.

The third effect of taxation examined by the paper is the extent to which taxes abroad displace U.S. exports. To take advantage of lower foreign taxes, U.S. MNCs may locate production facilities abroad instead of exporting from the U.S. This could result in the U.S. economy losing output and employment especially if the plants created abroad are used to service U.S. markets. However, in the event that affiliate production abroad creates a demand for U.S. made intermediate goods, then U.S. output and employment may rise. So there is no clear-cut relation between U.S. trade and foreign direct investment, though there is some evidence that there may be a complementarity between U.S. exports and U.S. foreign direct investment Lipsey and Weiss (1984).

Using taxes, tariffs, and GDP per capita as independent variables, the paper runs two regressions. In the first regression, total exports to MOFAs was used as the dependent variable; in the second regression total U.S. exports was used. For the first equation, the tax variable is highly significant indicating that a disproportionate amount of trade is carried out with affiliates in low tax countries. In the second regression, the tax variable coefficients are smaller but significant. The paper also finds that there is

[13] The authors tried some measures of non-tariff barriers too, but they did not have much success.

some support for the complementarity hypothesis and that affiliates in low tax countries export more than those in high tax countries.

3.3. Mode of Foreign Entry Preferred by U.S. MNCs

The main purpose of the paper by Benjamin Gomes-Casseres (1984) is to shed light on why a MNC might prefer to form an equity joint venture in one case and a MOFA in another. Gomes-Casseres (G-C) cites three reasons for the choice of any particular form of organization: (1) motivation for cooperation or the need for resources, (2) transaction cost of cooperating through contractual means, and (3) organizational costs of equity joint venture.

The organizational form preferred by the MNC would depend on whether the MNC has all the required capability to "go it alone" (form a MOFA). If the MNC lacks some of the capability, and a chosen local firm can provide the requisite knowledge, then there are benefits to cooperation and the MNC might choose a joint venture. If a joint venture is the chosen organizational form, then both the MNC and the local partner will be required to transfer some of the capability to this joint venture.[14] There are costs in sharing control; the two main costs of sharing control being shirking and management conflicts. Shirking arises because the incentives of either firm to contribute to a joint venture decrease due to joint sharing of control. Managerial conflicts may arise due to conflict of interest among partners. This conflict of interest arises especially when partners' perceptions of cost and benefit differ. Thus when the cost of managerial

[14] If a MNC X, and a local firm Y, form a joint venture Z, then they transfer the know-how to the joint venture firm Z. The equity of the firm Z is held by the MNC and the local firm.

conflicts and the cost of shirking outweigh the costs of cooperation, the MNC forms a MOFA. G-C's explanatory variables reflect the MNC's business capabilities and the costs of transferring them.

G-C identifies five types of capability. The first is geographic experience: local firms are likely to have more experience with domestic (local) customs than the MNC. In the case of the MNC, it will most likely be more familiar with some countries than with others, thus preferring joint ventures in some while not in others. The second factor is industry experience. Here the MNC is likely to have a very big edge over the local firm. It has also been argued that MNCs, due to their worldwide experience may even be able to overcome their geographical inexperience. The third point concerns privileged access to inputs. Here the local firms may be in a better position, since governments are more likely to give local firms the control to mining rights of natural resources. This factor may be mitigated, however, by the MNC's control of the export market of intermediate and final goods. The fourth factor is marketing skill: Marketing skills are considered to be one of the most important competitive advantages for U.S. MNCs. At times they (the MNCs) are able to use mass advertising to their benefit overcoming some of their other perceived disadvantages. The fifth capability, technological know-how, gives MNCs an industry specific advantage. These differing capabilities of the MNC and local firms form the basis of the analysis in this paper.

Using a database from the Harvard University Multinational Enterprise Project, the paper applies the binomial logit model of the dicotomous choice, MOFA vs. joint venture, to test the theoretical predictions. Using proxy variables to measure the costs discussed above, G-C finds support for transactions cost theory. The variables used in

the estimation process are discussed below.

The dependent variable takes on a value of 1 if the MNC controled equity of more than 95% in the foreign affiliate in 1975. The following independent variables are used by G-C to test the above mentioned theories.

Restrictive host government: This is a dummy variable, equal to 1 if the subsidiary is in a country where the government restricted foreign ownership. It is hypothesized that restrictive foreign governments are likely to encourage joint ventures.

To capture the effect of industry and geographic experience the following variables are used.

Industry experience: The number of subsidiaries in the U.S. parent's principal industry measures the industry experience of an MNC (by 3 digit SIC code). A greater number of subsidiaries in the MNC's line of business translates into more experience in managing them and, with greater experience, the MNC is hypothesized to prefer MOFA to joint venture. The results of the estimation were in line with this hypothesis.

A dummy variable was defined to equal 1 if the subsidiary and the MNC were in different lines of business, and 0 otherwise. If a subsidiary's product was not the principal business of the MNC then it is conjectured that the MNC would require the help of a joint venture partner to overcome its perceived handicap. This variable did not have significant explanatory power.

The paper used the following variable to proxy for geographic experience:

Familiarity with Host: An index was created to categorize the familiarity of a MNC with a host country. The index was based on how often the MNC entered a particular country between 1900-1976. Theory would predict, based on the discussion above, that the less

familiar a country is to the MNC, the more likely it is to form joint ventures. The estimation results showed that the effect of familiarity with a country is the most important predictor of joint venture formation.

As we discussed above, a MNC might form joint ventures to gain access to the knowledge of the local firm. The industrial GNP of the host country is used as a proxy measure for the industry experience of the local firm. This variable had a significantly positive impact on the probability of forming a joint venture.

Two variables were used to measure the effect of access to markets and inputs: A dummy variable was used to identify industries in the resource-based sector. Since it is assumed that local industry will have better access to agricultural and mineral resources, it is hypothesized that businesses in these sectors would prefer joint ventures. The results of the estimation support this hypothesis. A second variable was used to proxy the MNC's marketing requirements: intra-firm sales. It is hypothesized that high intra-firm sales by an MNC are symptomatic of the firm's need to assure itself of an uninterrupted supply of a crucial (or "idiosyncratic," as in Williamson (1979)) input. To avoid hazards with suppliers or joint venture partners, the MNC might prefer to have a MOFA.[15] The results of the estimation bear this out.

The final set of variables reflects the MNC's marketing and technology skills. If the MNC has superior marketing skills and the product is R&D intensive then it can be expected that the MNC will prefer a MOFA as it will not want to transfer its technical know-how to a joint venture. The marketing intensity was calculated as the ratio of

[15] See chapter 2 of this dissertation or Williamson (1979) for a discussion on the reasons for internalizing recurrent transactions, especially of the idiosyncratic (as defined by Williamson (1979)) type.

marketing expenditure to revenue. Research intensity was measured as the ratio of research expenditure to revenue. The estimated coefficient of market intensity was as predicted but the R&D intensity did not have significant explanatory power, contradicting theory and the above hypothesis. G-C then incorporate separate measures of R&D intensity for subsidiaries outside the core business of the MNC and for subsidiaries in the core industry of the MNC. The results showed that, when the subsidiary was outside the core business of the MNC, R&D intensity encouraged joint ventures, but if it was inside the core business, then R&D intensity discouraged joint ventures. This result is very interesting since, as discussed before, MNCs form joint ventures when they need to tap into the knowledge base of the local firm. When the MNC is functioning outside its core competency/business it needs skills and knowledge developed by others. Thus the MNC will form a joint venture when R&D of the local firm is a substitute for the MNC's R&D. When the MNC is in its own core business then it prefers to form a MOFA since it does not require the technical know-how of the local firm.

The transaction cost literature suggests factors which should affect the optimal governance structure. The paper by Gatignon and Anderson (1988) is concerned with the degree of integration, or the governance structure, preferred by the U.S. MNC based on the transactions cost literature. The paper starts by classifying the continuum of equity holdings into the following four types of governance structure.

(a) Wholly or 100% owned subsidiary.

(b) MNC holds a dominant share of the equity (the MNC equity holding is greater than the largest partner).

(c) Balanced partnership (the MNC holds equity roughly equal to that of the

largest partner).

(d) MNC is a minority shareholder (the MNC holds less equity than the largest partner).

It should be noted that the implications of transactions cost theory for governance structure do not specifically apply to firms in the international context; they apply to all firms. One important difference is that, in the international context, there are more complications than in a domestic setting: host country cultural differences, and government regulations and restrictions, just to name a few. The paper tests the following eight hypotheses derived from transaction cost theory applied to an international context.

Hypothesis 1: A proprietary, or specialized, nature of product and process will increase the degree of integration preferred by the MNC. There are three reasons why a firm might prefer a unified governance structure when proprietary products, knowledge, or processes are involved. First, when a firm possesses proprietary knowledge, using contracts might result in the firm getting less than full benefit from the knowledge. This happens because there is no market for specialized goods hence the determination of the price is difficult. If the proprietary knowledge is revealed to others (for valuation) and if it is easy to copy, it may become valueless to the MNC. The second reason is that proprietary knowledge may be difficult to transmit without unified governance because of communication problems. Thirdly, because of its transaction specific nature, proprietary knowledge, if shared, might result in an increased bilateral dependency and hence raise the possibility of the holdup problem. Thus, it is hypothesized that an increase in proprietary knowledge will result in a more unified or integrated governance

structure. The measure of the proprietary content of the firm's activity is the ratio of R&D expenditure to sales.

Hypothesis 2: Transaction specific assets tie parties together in a bilateral relationship. In this situation, if contracts are incomplete, constant changes in external conditions and adaptations to these changes lead to deterioration in the working relationship. The problem will be exacerbated if the adaptations result in unverifiable increases in cost. If there is disagreement about the actual increase, then trade may not even be consummated. Thus it is hypothesized that the presence of transaction specific assets, accompanied by external uncertainty, will promote an integrated form. Transaction specificity is assumed to increase with R&D content and hence is measured in the same way as proprietary content. To measure uncertainty, countries were separated into three groups: low, high, and moderate risk countries. Gatignon and Anderson base the classification system on a study by Goodnow and Hanz (1972). A set of two dummy variables was created: If a country was considered a high-risk country, the first dummy variable took a value of 1 and 0 otherwise. The second dummy variable took a value of 1 if the country was in the moderate risk category, and 0 otherwise. The two proxy variables used to measure both asset specificity and external uncertainty are thus the product of the R&D intensity with each of the two country risk dummies. In the estimation these variables were not significant.

Hypothesis 3. Country risk will decrease the degree of control. The paper hypothesizes that if the MNC fears that its investment might be appropriated by the national government then it might take on a partner to spread the risk. Again, country risk is captured by the same dummy variables discussed above. The hypothesis is that a

higher control mode will be less likely in the presence of country risk.

Hypothesis 4. Advertising intensity increases the degree of control. If a firm invests money to create brand name loyalty, then the firm would prefer to have a high degree of control to protect the value of the brand name from degradation. It is assumed that the affiliate firm has less to lose from degrading the value of the brand name than the MNC, thus a high degree of control might be more efficient.

Hypothesis 5. Company experience increases the degree of control. Firms might be inexperienced in dealing with unaffiliated supplier incentives. Therefore complete control might be desirable when there are only imperfect measures of the upstream supplier's performance. Dealing in a foreign setting will magnify these imperfections. Firms inexperienced in dealing in an international setting might use an integrated structure. The number of foreign entries made by the MNC measures company experience. It is hypothesized that company experience will have a positive impact on integration.

Hypothesis 6. Socio-cultural distance decreases the degree of control. It has been argued that differences in cultures between the host country, where the affiliate is located, and the home country, where the MNC is based, lower the incentive to use an integrated structure. This is because executives of the MNC may not be comfortable in a foreign culture. Other problems, attributed to socio-cultural distance are high information needs and the difficulty in transferring home management. Proxy dummy variables developed in a paper by Ronen and Shenker (1985) are used to measure the socio-cultural distance. Ronen and Shenker (1985), conducted a study on work-related attitudes of the citizens of various countries. On the basis of factors such as attitudes towards success, sharing of

information etc., they classify countries into nine categories. The present paper (Gatignon and Anderson) uses the same classification but reduces the number of categories to four. The hypothesis, stemming from the discussion above, is that the greater the socio-cultural distance, the more likely is the MNC to choose a low level of control.

Hypothesis 7: Increased size of a foreign operation will decrease the degree of integration. The larger the size of the operation abroad, the greater is the risk undertaken by the MNC. Thus it has been argued that the larger is the operation, the greater is the probability of utilizing a joint venture partner. The number of employees in a firm is used as a measure of firm size.

Hypothesis 8: Legal restrictions will decrease the degree of integration. Legal restrictions imposed by a country might constrain the behavior of a firm. Some countries might have laws which prevent a foreign firm from establishing a wholly-owned subsidiary. The paper uses a dummy variable identifying six countries which have laws preventing majority control of firms by foreigners.

The results indicate that the transactions cost explanation discussed above is relevant for ownership and can successfully explain why an MNC prefers 100% control to being a minority shareholder. The transaction cost explanation, however, does not satisfactorily explain the other choices of integration (dominant shareholding or nearly equal ownership), in the sense that most of the explanatory variables were not statistically significant explainers of those choices.

3.4. Intra-Firm Export and Intra-Industry Trade

In the paper by Lall (1979), the author attempts to explain inter-industry differences in the pattern of intra-firm exports (exports from parent MNCs to affiliates abroad) for US manufacturers. According to Lall, there is little theory that specifically deals with this problem. He argues that the international trade literature does not distinguish between inter-firm and intra-firm trade, and that the literature of vertical integration comes closest to explaining intra-firm trade.

The phenomenon this paper is trying to explain is the variation in U.S. intra-firm exports by industry. The variation across industries is substantial: In industries like soaps, plastics, chemicals, and scientific instruments, intra-firm exports account for over half of total exports by MNCs. For other industries like beverages, industrial chemicals, and wood products, intra-firm exports account for less than 20%.

This paper uses the data set made available by the U.S. Tariff Commission (1973).[16] Using a sample of industries, it estimates a model with dependent variable:
IFX = intra-firm exports as a percentage of total exports by all MNCs in the industry.
Using a sample of U.S. MNCs' majority owned foreign affiliates, it estimates a model with dependent variable:
IFP = intra-firm exports as a percentage of production of the MOFA receiving the exports.
The paper tests the following hypotheses about intra-firm exports:

Hypothesis 1: There is a positive relationship among marketing requirements and

[16] The data sources for this paper are described in appendix 2 of Lall (1979).

the establishment of affiliates and, hence, intra-firm exports to serve the needs of these affiliates. The MNC might rely on an affiliate if after-sales service is extremely profitable. It could also be that there is need for assimilating and communicating information with clients, thus a direct presence of the MNC, in the form of an affiliate, is required. Maintaining contacts with government to monitor and influence policy is another reason why the MNC might prefer a direct presence. The author uses the variable advertisement, as a further, but a negative, indicator of the need for after sales service. It is hypothesized that highly advertised goods are mass produced goods which require no after-sales service, and that products that need a great deal of design and information exchange between buyer and seller have less advertising. Notice that this hypothesis is opposite that of Gatignon and Anderson.

Hypothesis 2: There will be a positive relationship between specificity of products and intra-firm exports. The more specific is the input the more likely is the MNC to internalize the transaction. This will alleviate the hold-up problem that would plague the operation in the case of any disagreement.

Hypothesis 3: If supply of an input in the foreign location is uncertain, then firms will rely more on intra-firm exports. Even for non-specific assets there could be variations in the quality, supply, and price that could lead a firm to rely more on internal markets. Thus uncertainty will increase intra-firm export.

Hypothesis 4: There is a positive relationship between unexploited capacity and/or scale economies, on the one hand, and intra-firm exports, on the other. A parent which, has scale economies or unused capacity might want to use the spare capacity to export to the affiliate. This could also happen for non-economic reasons like trade union

pressure to produce a certain percentage of the good in the home country.

Hypothesis 5: If the production process is divisible, then it will encourage intra-firm exports. Certain production processes might have a component which can be shifted to a different country to save cost. An example would be the shifting of the labor-intensive part of a production process to a cheap labor country like India.

Hypothesis 6: There is a positive relationship between government policy encouraging foreign production and intra-firm exports. The host (foreign) government could provide economic incentives to attract foreign investments.

Hypothesis 7: There will be a positive relation between a MNC's ability to manipulate transfer prices and intra-firm exports. There is always the possibility that MNCs might use the offshore production facility to evade taxes in the home country. In a two-country framework, a MNC, located in a high tax country, might declare a low price for intra-firm exports of goods, decreasing its profitability and hence taxes. The purchasing affiliate, located in a low tax country, will make a higher profit due to the artificially low price it paid. But because profits have been shifted from a high-tax to a low tax regime, after tax profits for the combined firm will increase. If the MNC is able to manipulate the transfer price to shift profit as described above, it will resort to greater intra-firm exports to shift profit to the lower tax country. The author uses the percentage of the MNC's assets that are in a foreign country as a proxy for its ability to manipulate transfer prices. Hypothesizing that the greater the foreign exposure of the MNC, the more likely it is able to resort to such practices.

The results generally agreed with the hypotheses. The paper concludes by saying that to better explain intra-firm exports there is a need to look at other factors, such as

risk, and to get better proxies for variables like scale economies, capacity utilization, and host government policies.

A paper by Bela Balassa (1986) tries to analyze the country effects on intra-industry trade (IIT). This, according to the author, is a neglected area since most papers concentrate on commodity characteristics. This study looks at the effect of size of domestic markets, the level of economic development, transportation costs, common market borders, the level of trade restrictions, and participation in international integration arrangements.

This paper tests the following hypotheses:

Hypothesis 1: The volume of IIT is inversely related to economic development. This is because, if a country is underdeveloped, it will not be able to supply key inputs in a timely fashion. Hence the MNC will tend to export inputs from home. The per-capita GNP of a country is used as a proxy for the level of development.

Hypothesis 2: The volume of IIT is directly related to the size of the downstream market. The larger is the market, the greater will be the demand for goods. Market size is proxied by the GNP of a country.

Hypothesis 3: The volume of IIT is negatively correlated with the average distance from the trading partner. If the market is very far, this will increase transportation cost hence the MNC will export less. The paper uses a complex measure of distance, which is defined as the weighted inverse of geographical distance between the U.S. and the partner country, the weight being the GNP of the partner country.

Hypothesis 4: The volume of IIT is greatest when the parent and affiliate are located in countries sharing a common border. A dummy variable is introduced which

takes a value of 1 if there are common borders and 0 otherwise.

Hypothesis 5: The volume of IIT varies inversely with tariffs. Tariffs increase the cost of imported goods and the MNC will export less to a country that has high tariffs.

The investigation covered the manufacturing exports of 38 countries. All the hypotheses were confirmed except the one pertaining to economic development. The author also splits the countries into two groups of developed and developing countries and conducts the analysis separately for each group. The estimates of the parameters for the developing countries were significant, while those for the developed countries had low precision due to collinearity among the variables.

The final paper reviewed here is by Anita Benvignati (1990). She discusses how intra-firm exports are different from arms-length exports. The paper analyzes confidential data from the U.S. Federal Trade Commission's Line of Business Program for the years 1975-1977.

Trade theory predicts that relative factor proportions can explain bilateral trade. In a two-country framework, the country with the higher capital/labor ratio will export capital-intensive goods and import labor intensive products and vice-versa. Other factors that can affect bilateral trade are tariffs, patents, and other imperfections in the market. It has been argued for the case of intra-firm trade, however, that international trade theory explanations are incomplete and some other explanation is required, since there is the additional question of why transactions are internalized. Arms-length exports may be as profitable as intra-firm exports unless:

> "(1) information needed to consummate production and sale of a certain quality product is too complex or extensive for an efficient or profit maximizing

transaction outside a firm, or

(2) if information is a public good and firms can only cover costs they incurred to develop a proprietary advantage (such as technical knowledge) by keeping the information internal and a closely held secret (Benvignati (1990))."

Factors like patents and R&D expenditure, that give a MNC competitive advantages over other firms, will encourage trade but these factors are hypothesized to have a greater impact on intra-firm trade.

Trade theory and the findings of the empirical trade literature suggest the independent variables used in the paper. They include industry specific measures of capital intensity, human capital, technology, scale economies, and advertising. The dependent variable is the value of exports (both intra-firm and inter-firm) from the U.S. in each of the FTC's 249 Line of Business (LB) industry classifications.

To test whether intra-firm exports and arms-length exports differ, the paper uses the following general methodology. The methodology is explained below for a dependent variable X, which contains pooled observations for both intra-firm and non intra-firm exports, and a single independent variable I. A dummy variable D is defined which takes the value of 1 for observations corresponding to intra-firm exports and 0 otherwise. The following equation is estimated.

$$X = a1 + a2\,(I) + a3\,(I*D) + e.$$

Under such a formulation the additional impact of I on intra-firm trade will be captured by a3.

The paper hypothesizes that R&D and advertising expenditures will encourage intra-firm trade to a greater degree than arms-length trade. The result of the weighted

least square estimation show that there is no difference between the inter-firm and intra-firm exports: In most cases, the coefficient measuring the additional impact (analogous to a3) was not significant. Thus the paper concludes that the internalization hypothesis is deficient. This appears to be the only empirical paper in the literature on intra-firm trade which fails to support the internalization hypothesis.

CHAPTER 4: EMPIRICAL MODEL

4.1. Introduction

The hypotheses developed here are loosely based on the theory of the firm, outlined in chapter 2 of this dissertation. The discussions of Coase (1937) and Williamson (1975, 1979) clarified why, in certain cases, the formation of a firm may be superior to transactions in the market. Coase reasoned that firms exist because there are cost savings in carrying out the transaction internally, rather than through the market. Williamson then postulated that the cost savings are dependent on general uncertainty (for example, the uncertainty associated with predictions of future demand), the frequency of transactions, and the specificity of the investments required for the transaction. Williamson then went on to show how transaction specificity of investment and frequency of transactions affect the optimal governance structure and how the governance structure may adapt to uncertainty.

Grossman and Hart (1986) added an additional element into the analysis of the firm: the incentives of managers. They proceeded to derive conditions, under which integration, or the establishment of unified governance, is better than bilateral governance, where each unit maintains its independence. Hart and Moore (1990) carried this analysis further and explored the conditions required for joint ownership of assets.

The hypotheses, developed from the discussion in chapter 2, are called the "internalization hypotheses." The internalization hypotheses are generally viewed as the "Caesar of the 'OLI' Triumvirate" (Ethier (1986 pg. 805.)). This dissertation is primarily

concerned with empirically testing the validity of the internalization hypotheses in the context of multinational firms in the manufacturing sector, and essentially attempts to answer two questions:

(1) Are the internalization hypotheses consistent with the foreign marketing strategies of U.S. MNCs (as reflected in the breakdown among foreign sales to unaffiliated parties, sales by majority owned foreign affiliates (MOFAs), and sales by joint ventures (JVs))?

(2) Are the internalization hypotheses consistent with the export patterns of U.S. MNCs (as reflected in the breakdown of MNC exports among exports to unaffiliated parties, exports to MOFAs, and exports to JVs)?

Variables measuring ownership and locational considerations, the O and L of the "OLI" triumvirate, will be used as control variables.

Below, in section 2, we explain how the MNCs' degree of control will be measured in our tests of the internalization hypothesis. Section 3 defines the study's dependent variables. In section 4 we discuss the hypotheses.

4.2. Degree of Control

The degree of integration, or control a U.S. parent firm or U.S. MNC has over its affiliates located abroad, is measured by the percentage of voting securities that the parent owns. This method of measuring the degree of control may be imperfect, since even with a minority holding of equity shares the U.S. parent may be able to control all the key decisions taken by an affiliate, because of contracts or understandings with other shareholders. It is an internationally accepted method of measuring control (pg. M-4,

USDIA, 1998), however, and is therefore employed in the analysis in this dissertation as well.

The Bureau of Economic analysis considers an affiliate to be a majority-owned foreign affiliate if the parent company controls more than 50% of its equity; the same classification is used here. In what follows, we classify an affiliate in which the U.S. parent (MNC) controls more than 10% but less than 50% of the voting equity as a joint venture. Foreign firms in which U.S. firms have no equity (or less than 10% equity) holdings are considered to be unaffiliated entities. In a majority-owned foreign affiliate (MOFA), the U.S. parent controls over 50% of the voting security, and it is assumed that the U.S. MNC has complete control over all the affiliate's decisions. For a joint venture (JV), a U.S. parent controls less than 50% but more than 10% of the equity of the affiliate. In this case the U.S. MNC is assumed to have less than full control. The U.S. MNC is assumed to exercise no control over unaffiliated parties. Thus MOFAs and unaffiliated parties represent opposite ends of the integration spectrum with JVs lying in between. Figure 3 below represents the discussion diagrammatically. The numbers below the line indicate equity ownership while the control structure is described above the line.

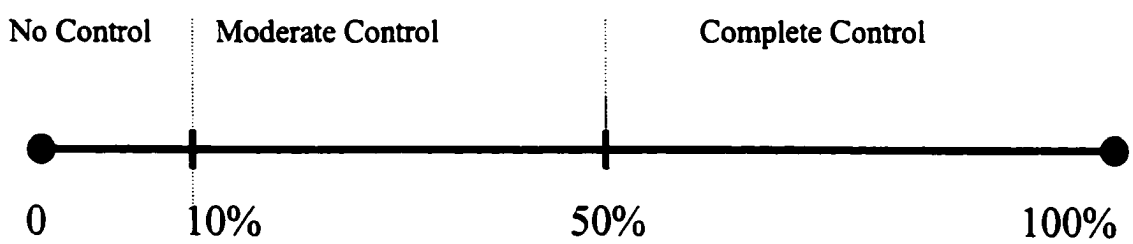

Figure 3. Degree of Control Exercised by the MNC.

4.3. Sales and Exports Associated with U.S. Firms and their Affiliates

The various kinds of sales in country X of products associated with U.S. firms in industry j, are illustrated in figure 4, below. Sales in any country can be broadly classified into two-categories: (i) sales of goods produced in country X and (ii) sales of goods produced in the U.S. and exported to country X. Production in country X can be further broken down as: production by a joint venture or production by a MOFA.

The dissertation investigates the breakdown of U.S. industry j's sales in country X among three components: (i) exports from the U.S. to unaffiliated parties in country X, (ii) production in country X in a MOFA or, (iii) production in a JV. We define the three sales components as:

$S^X_{j,M}$ = Sales, in country X, by MOFAs of U.S. MNCs in industry j.

$S^X_{j,JV}$ = Sales, in country X, by joint ventures of U.S. MNCs by industry j.

$S^X_{j,UF}$ = Unaffiliated sales (exports by U.S. firms to unaffiliated parties) in country X by U.S. firms in industry j.

$TS^X_j = S^X_{j,M} + S^X_{j,JV} + S^X_{j,UF}$ = Total sales in country X associated with U.S. firms in industry j.

The three sales shares can thus be defined as follows.

$s^X_{j,M} = \frac{S^X_{j,M}}{TS^X_j}$ = Share of sales, in country X, of MOFAs of U.S. MNCs in industry j.

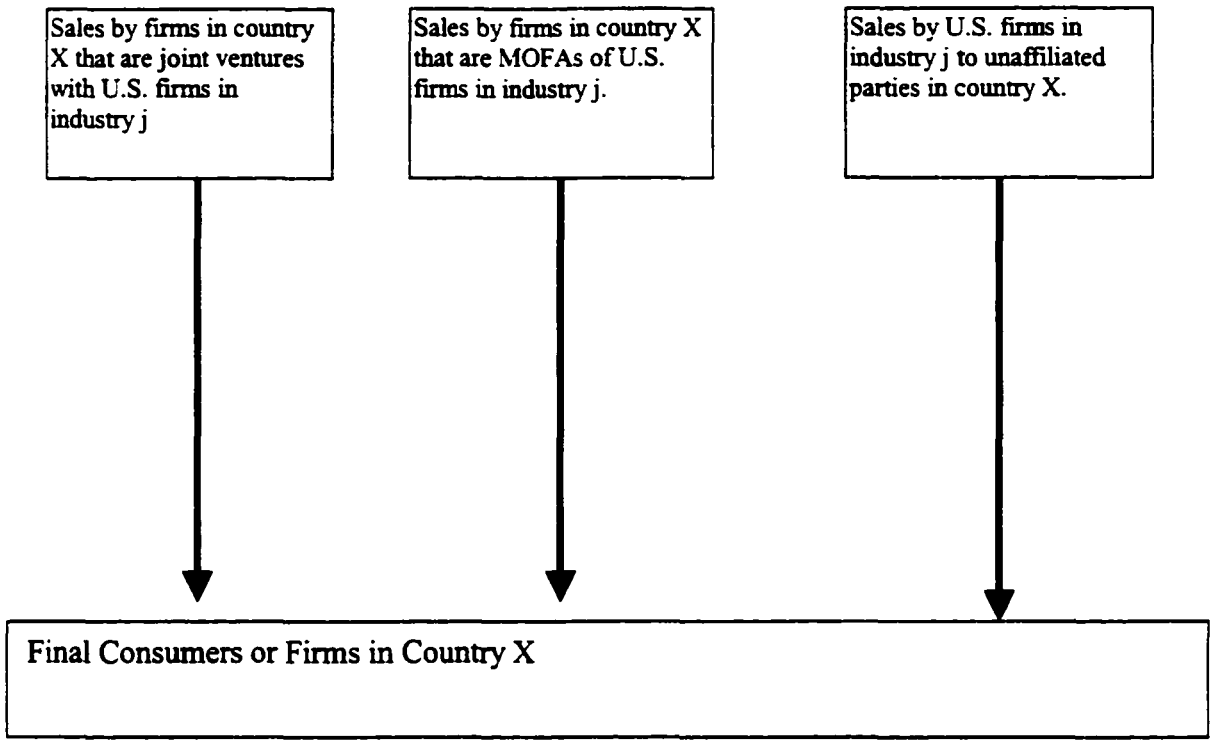

Figure 4. Sales in country X of products associated with U.S. firms in industry j.

$s^{X}_{j.JV} = \frac{S^{X}_{j.JV}}{TS^{X}_{j}}$ = Share of sales, in country X, of joint ventures of U.S. MNCs in industry j.

$s^{X}_{j.UF} = \frac{S^{X}_{j.UF}}{TS^{X}_{j}}$ = Unaffiliated sales share, in country X, of U.S. firm in industry j.

The second issue dealt with in this dissertation is the breakdown of exports by U.S. firms. Exports could be internal or arms-length. Internal exports, for the purpose of this dissertation, are defined as U.S. exports to affiliates of U.S. MNCs.[17] Internal

[17] Internal trade should be defined as trade carried out between U.S. MNCs and *their* affiliates but, due to the unavailability of this data, U.S. exports to affiliates of U.S. MNCs are used instead. U.S. parents account for 85% of the exports to their own affiliates. Thus this omission is not expected to have a serious impact.

exports, or intra-firm exports, have two components; exports to MOFAs and exports to JVs. Arms-length exports are defined as U.S. exports to unaffiliated parties. Arms-length exports are, thus, all U.S. exports which are not carried out with affiliates of U.S. MNCs. This is illustrated in Figure 5.

We define the three export components as:

$E^X_{j,M}$ = Exports by U.S. firms in industry j to MOFAs in country X.

$E^X_{j,JV}$ = Exports by U.S. firms in industry j to joint ventures in country X.

$E^X_{j,UF}$ = Exports by U.S. firms in industry j to unaffiliated parties in country X. [18]

$TE^X_j = E^X_{j,M} + E^X_{j,JV} + E^X_{j,UF}$ = Total exports of U.S. firms in industry j.

The three export shares can then be defined as:

$$e^X_{j,M} = \frac{E^X_{j,M}}{TE^X_j} = \text{Share of U.S. industry j exports to MOFAs in country X.}$$

$$e^X_{j,JV} = \frac{E^X_{j,JV}}{TE^X_j} = \text{Share of U.S. industry j exports to joint ventures in country X.}$$

$$e^X_{j,UF} = \frac{E^X_{j,UF}}{TE^X_j} = \text{Share of U.S. industry j exports to unaffiliated parties in country X.}$$

[18] Thus, in our formulation $S^X_{j,UF} = E^X_{j,UF}$.

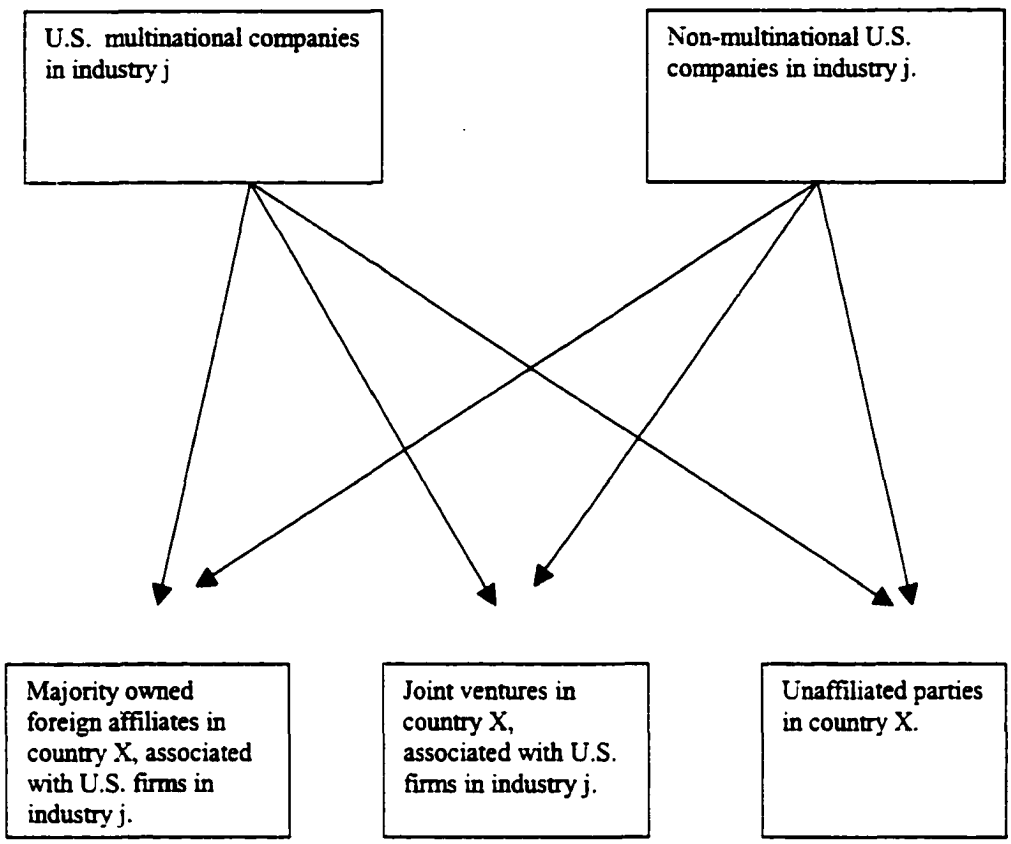

Figure 5. Exports to country X by U.S. firms in industry j.

4.4. Hypotheses

The dissertation investigates the importance of the internalization hypothesis in explaining exports and sales patterns of U.S. firms. The two sets of hypotheses that are presented below, one for export shares and one for sales shares, are based on the same theory. To avoid repetition of the theory behind the hypotheses, the hypotheses are stated together; those relevant for exports are denoted by EX and those relevant for sales are denoted by SA. The hypotheses are followed by explanations of the underlying theory and the intuition on which they are based. Generally speaking, the connection between the sales share hypothesis and the export share hypothesis derives from the assumption

that most manufacturing MNC exports to affiliates are intermediate goods, to which the affiliate adds value in producing the final product. Therefore sales by affiliates will tend to be positively correlated with exports to affiliates.

Hypothesis 1 (SA). Specialized or proprietary knowledge will promote a more integrated organizational form. MOFA sales will be encouraged and sales to unaffiliated parties will be discouraged. Sales by JVs will also be discouraged but not to the same degree as sales to unaffiliated parties.

Hypothesis 1 (EX). Specialized or proprietary knowledge will promote exports to MOFAs and discourage exports to unaffiliated parties and JVs. In the case of JVs, the negative effect will be smaller in magnitude than the effect on unaffiliated parties.

Specialized knowledge for an industry is measured as the ratio of R&D expenditure to exports for U.S. MNCs in that industry (Gatignon and Anderson (1984), Benjamin Gomes-Casseres (1989), and Benvingati (1990)).

Various terms are used in the literature to capture the essence of specialized knowledge - proprietary assets, intangible assets, firm-specific assets, and monopolistic advantage are some examples - and all of these have nearly the same meaning, Caves (1997). Specialized knowledge possesses the following characteristics:

(a) The price or the value of such knowledge may not be known. To discover the relevant price, the knowledge must be revealed, and this allows other firms to have access to the knowledge. Once the information is copied (and often mass-produced), the firm will not get the full benefit from its specialized knowledge. Thus, it may be optimal to internalize transactions which involve specialized knowledge.

(b) The knowledge might not be easily transferable to other firms. This could be because the knowledge is too complex to describe, or because of communication problems. Hence specialized knowledge must often be kept within a firm, promoting a unified governance structure.

(c) Specialized knowledge may make the investment of a firm more productive and hence more important. The discussion of Grossman and Hart (1986) and Hart and Moore (1990), in chapter 2, shows that firm 1 should integrate with firm 2 (firm 1 buys firm 2) if the investment of firm 1 is important relative to the investment of firm 2. Therefore, this attribute of specialized knowledge would encourage complete control and promote MOFA sales at the expense of both unaffiliated and JV sales.

Specialized knowledge will, in a similar manner, decrease exports to both unaffiliated parties as well as to JVs, and increase exports to MOFAs. This happens because specialized knowledge will increase the desire of the MNC to have complete control over the production process and, by assumption, MNCs have complete control over MOFAs. As discussed earlier, a U.S. MNC is assumed to have no control over unaffiliated parties and only partial control over JVs. Hence it is hypothesized that specialized knowledge will have a positive impact on exports to MOFAs and a negative impact on exports to unaffiliated parties and JVs.

Hypothesis 2 (SA). Investments, knowledge, or technology controlled by local firms that complement the MNC's investment should discourage MOFA sales and increase the sales of JVs and sales to unaffiliated parties.

Hypothesis 2 (EX). Investments, knowledge, or technology controlled by the local firms that complement the investments of U.S. MNCs should encourage exports to JVs and discourage exports to MOFAs.

The number of patents applied for, by the residents of that country, across all industries, serves as a measure of the complementary investments of local firms.

If a MNC does not have the required knowledge for operation in country X, then it might form a joint venture with a local firm to complement its knowledge. Grossman and Hart (1986), Hart and Moore (1990), and Aghion and Tirole (1994) show that if the investment of firm 2 (the local firm) is important then firm 1 (the MNC) should not integrate with firm 2. Firm 1's integration with firm 2 would take away the incentives of the managers of firm 2 to innovate. Hart and Moore (1990), however, show that complementary investments must be owned together. If firm 1 and firm 2 make equally important complementary investments, then firm 1 control will decrease firm 2's incentives to invest and vice-versa. In such a situation an intermediate control structure such as a joint venture could be optimal. The joint venture firm, firm 3 (say) will now own the complementary investment, with the equity of firm 3 being owned by firms 1 and 2.

Complementary investments are a difficult concept to measure. Patent applications may be considered to be a measure of important discoveries or inventions. But it is not necessary that an important investment will also be a complementary investment. A discovery or invention, if it complements the U.S. MNC's investment in the sense that it increases their profitability, is hypothesized to promote JV formation and discourage the formation of MOFAs. If the investment is important and not

complementary in nature, then it will increase sales to unaffiliated parties. Considering the breadth of U.S. MNCs, however, it is difficult to envision a patent which would not be complementary to at least one MNC industry.

A similar argument holds for exports: Export shares will decline for MOFAs as U.S. MNCs form more joint ventures. The share of exports to JVs will rise.

Hypothesis 3 (SA). A strategically important or profitable market will encourage the formation of MOFAs as opposed to JVs. An important or profitable market will also decrease sales to unaffiliated parties.

Hypothesis 3 (EX). A strategically important or profitable market will decrease exports from the U.S. to unaffiliated parties and to JVs, while increasing exports to MOFAs.

GDP growth rate for 1994, and the ratio of R&D expenditure undertaken in a country by U.S. MNCs as a proportion of MNC exports to that country, are used to measure profitability and strategic importance of a market.

This hypothesis follows from Horstman and Markusen (1987, chapter 2). If the MNC expects a foreign country's market to be large and profitable, then it will prefer to have a MOFA located in that country, instead of sharing the profits with a joint venture partner. Large and profitable markets will encourage the MNC to set up owned operations, so as to be able to control all aspects of production and marketing. To measure profitability of a market, this dissertation follows Grubert and Mutti (1991) in using GDP growth rate as a measure of profitability. The use of GDP growth rate is based on the assumption that a faster growing economy is more profitable.

A market that is profitable, or strategically important for the MNC because of its profitability, its size, or for other reasons, will further encourage the formation of MOFAs and discourage both JVs and unaffiliated sales. The importance of the market to U.S. MNCs would force them to learn more about the market. Market research to keep abreast with the developments in the local economy and R&D expenditures focussed on adapting their products to suit the taste and preference of the market would then be natural strategies. R&D expenditure by the MNCs in a foreign country would therefore be indicative of the MNCs' subjective beliefs about the importance of such a market. Thus another variable used to measure the importance of a country's market is the ratio of R&D expenditure to exports of U.S. MNCs for that country. The R&D expenditure is the sum of all R&D undertaken in a particular country by U.S owned MOFAs, irrespective of industry.

Exports from the U.S. to unaffiliated parties and JVs will decline with higher profitability or greater importance of the market because MNCs would be encouraged to establish a local presence in the form of MOFAs. Exports to MOFAs should therefore increase due to the additional need to supply the increased foreign presence.

Hypothesis 4 (SA). Tariffs will encourage affiliate production and discourage sales to unaffiliated parties in country X.

Hypothesis 4 (SA). Tariffs will encourage exports to affiliates and discourage exports to unaffiliated parties in country X.

The average weighted tariff charged by country X on manufactures is used as an explanatory variable.

Tariffs impose additional costs on imports into a country, which increase the price of goods being exported from the U.S. and hence discourage exports in general. High tariffs may encourage the export of low priced intermediate products relative to high priced final products. The MNC could then ship the low priced intermediate input abroad and complete the final stages of the production process in affiliates located in the host country, thereby escaping most of the tariff. Thus, we hypothesize that sales to unaffiliated parties will decline while affiliate sales by both MOFAs and JVs will increase.

While all U.S. exports will decline in general due to tariff barriers, U.S. exports to affiliates will decline less than exports to unaffiliated bodies, as U.S. MNCs supply low priced intermediate goods to affiliates located abroad. Thus it is hypothesized that the share of exports to affiliates will increase, and the share of exports to unaffiliated bodies will decline.

Hypothesis 5 (SA). Production scale economies will increase sales to unaffiliated parties and decrease sales by both MOFAs and JVs.

Hypothesis 5 (EX). Production scale economies will promote exports to unaffiliated parties and decrease exports to MOFAs and JVs.

Production scale economies for an industry are measured by the average number of workers in U.S. plants with more than 20 employees.

Firms may want to concentrate production in one plant, as opposed to having multiple plants, in order to achieve economies of scale. Increasing the plant size in the U.S. may also result in the firm remaining domestic, rather than becoming a multinational, and meeting its worldwide demand through U.S. production. Thus, there

would be a negative relationship between the share of affiliate sales and the potential for scale economies.

Exports to unaffiliated parties will increase, with an increase in scale economies, since most of the production will be carried out in the U.S., while exports to both MOFAs and JVs will decline, since the number/size of affiliates abroad will decline.

Hypothesis 6 (SA). Foreign corporate income taxes that are high relative to U.S. corporate income taxes discourage affiliate production and encourage sales to unaffiliated parties.

Hypothesis 6 (EX). Foreign taxes that are high relative to U.S. taxes will discourage exports to MOFAs and to JVs, and increase the share of exports to unaffiliated parties.

Foreign tax is measured by the ratio of the tax paid to income for all affiliates in a country. For U.S. taxes, the proxy is the ratio of taxes paid to income by U.S. parents in an industry.

Economic theory predicts that firms will want to maximize their after-tax profits. One way to achieve that is to minimize its worldwide tax burden for a given level of revenue. If foreign taxes are higher than U.S. taxes, then the MNC can increase its after-tax profit by decreasing affiliate production in the high tax country, and increasing exports from the U.S. Thus high foreign taxes would discourage affiliate production, while encouraging sales to unaffiliated parties, so that the profits are taxed at the lower U.S. rate.

High foreign taxes would discourage exports to affiliates, both MOFAs and JVs, as MNCs complete the value-added portion of the production process in the U.S. rather than in a foreign country. Thus, the share of exports to unaffiliated parties should rise.

Taxation is a very complex issue and the international dimension makes it even more complex. One significant problem is that of ascertaining a unique tax rate measure, because of various bilateral treaties (some of which are specific to industries from a particular country), and the progressive nature of corporate tax rate for some countries. The arguments used here, though intuitive, are merely the proverbial "tip of the iceberg" and in some sense incomplete. But the impact of taxation on U.S. and foreign employment and output is significant and needs to be researched further.

Hypothesis 7 (SA). Average affiliate size is positively related to sales by JVs.

Hypothesis 7 (EX). An increase in the average size of affiliates will encourage exports to JVs.

Average size of an affiliate is measured by the total foreign investment by an industry divided by the number of the industry's affiliates, irrespective of country.

As the average size of affiliates increases there are two effects: First, as affiliate plant sizes grow, financial constraints may force a MNC to take a joint venture partner. Second, the size of investment in a representative affiliate may also increase the MNCs exposure to risk, and hence it might prefer a joint venture partner to spread the risk. Thus, we can expect that an increase in the average size of foreign affiliates will encourage JV sales.

Exports to JVs will increase since the MNCs have larger operations abroad.

Hypothesis 8 (SA). High U.S. labor costs relative to foreign labor costs will increase foreign sales by both MOFAs and JVs, and decrease the sales to unaffiliated parties.

Hypothesis 8 (EX). High U.S. labor costs relative to foreign labor costs will increase the export share of MOFAs and JVs, but decrease the share of unaffiliated parties.

The U.S. cost of labor is measured as the hourly wages of employees of U.S. multinational enterprises by industry. Foreign labor cost is measured as the average hourly wage of employees in affiliates of U.S. MNCs.

As the U.S. labor cost rises, the U.S. multinational firms might move operations overseas to take advantage of cheaper labor abroad. Hence it is hypothesized that the high U.S. labor cost will increase foreign production and decrease the share of sales to unaffiliated parties.

As the cost of U.S. labor rises, U.S. MNCs will find it more profitable to produce abroad rather than at home. This will increase the share of exports to affiliates, both MOFAs and JVs, as MNCs supply intermediate inputs to their foreign affiliates. High cost of U.S. labor will also make the domestically produced goods uncompetitive, thereby decreasing the share of exports to unaffiliated parties. Hence we make the hypothesis that the increase in U.S. labor cost will increase the share of exports to affiliated firms, but decrease the export share to parties not affiliated with U.S. MNCs.

Hypothesis 9 (SA). Sales to unaffiliated parties will be encouraged by the destination country's adjacency to the U.S.

Hypothesis 9 (EX). Exports to unaffiliated parties will increase if the destination country is adjacent to the U.S.

A dummy variable was created which took a value of 1 for countries adjacent to the U.S., namely Canada and Mexico (Brainard (1997)).

A country's adjacency to the U.S. will make it easier for exporters to export from the U.S. Travelling cost and other administrative cost will also decrease, due to the country's proximity to the U.S., opening the door for many small exporters who otherwise would not have found it profitable to export. Decreases in transport cost and the existence of roadways making truck transport feasible, might also mean that even a small quantity could be profitably exported by producers, further increasing the shares of unaffiliated sales and exports.

Hypothesis 10 (SA). An increase in the sociocultural distance between the U.S. and the destination country will increase sales to unaffiliated parties and promote JV formation, but will cause a decline in MOFA sales.

Hypothesis 10 (EX). An increase in the sociocultural distance between the U.S. and the destination country will increase exports from the U.S. to unaffiliated parties and to JV's and will decrease MOFA exports.

A dummy variable was created based on work done by Gatignon and Anderson (1988). Countries "similar" to the U.S. were assigned a value of 1, others were assigned a value of 0.[19] Dissimilar culture is hypothesized to encourage a lower degree of control. Thus sales to unaffiliated parties will increase, as will sales by JVs, but there will be a

[19] The countries which fall in the category of those considered socially and culturally "similar" to the U.S. are: Australia, Canada, Ireland, New Zealand, South Africa, and the United Kingdom.

decline in MOFA sales.

Dissimilar culture will encourage exports to unaffiliated parties and to joint ventures and will discourage exports to MOFA, as MNCs move towards a lower degree of control.

Hypothesis 11 (SA). Familiarity with a country will promote affiliate formation and decrease sales to unaffiliated parties.

Hypothesis 11 (EX). Familiarity with a country will promote exports to MOFAs and JVs but discourage exports to unaffiliated parties.

Country familiarity is measured by the number of foreign affiliates that U.S. MNCs have in a particular country.

This hypothesis follows from the paper by Benjamin Gomes-Casseres (1989). Familiarity with a country will promote formation of affiliates, especially MOFAs. Once the U.S. MNCs become familiar with a country, and learn the market characteristics, they may no longer need to depend on sales to unaffiliated parties and prefer to set up affiliates to take advantage of profit opportunities. Thus MOFA and JV sales are going to be encouraged. U.S. MNCs may also shy away from JVs since their familiarity with a country will allow them to work alone, hence the effect of this variable on MOFA sales will be stronger. Thus we would expect that familiarity with a country would increase MOFA and JV sales, but it will have a greater positive impact on MOFA sales, while having a negative impact on sales to unaffiliated parties.

Exports to MOFAs and JVs will increase and exports to unaffiliated parties will decrease.

Hypothesis 12 (SA). An increase in the destination country's physical distance from the U.S. will have a positive effect on affiliate production and a negative effect on sales to affiliates.

Hypothesis 12 (EX). An increase in the destination country's physical distance from the U.S. will increase exports to affiliates, and decrease the share of exports to unaffiliated parties.

The physical distance between the capitals of the U.S. and the destination country, in kilometers, is used as a measure of distance between the two countries.

As the physical distance between the U.S. and the destination country increases, there is an increase in the cost of transportation of goods from the U.S. to that country. In this case it might be profitable for U.S. MNCs to set up local affiliates that manufacture goods for the domestic markets locally. This will result in an increase in affiliate sales and a decline in the sales to unaffiliated parties.

With an increase in affiliate sales, there will also be an increase in exports of the intermediate inputs needed to support affiliate production.[20] Hence it is hypothesized that there will be a decline in the share of exports to unaffiliated parties and an increase in the share of exports to affiliates.

Hypothesis 13 (SA). A destination country's governmental restrictions on the formation of MOFAs will have a negative impact on sales by MOFAs. It will have a positive effect on sales to unaffiliated parties and sales by JVs.

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[20] An assumption underlying this hypothesis is that freight charges for the intermediate inputs are lower than for the finished manufactured goods.

Hypothesis 13 (EX). A destination country's governmental restrictions on the formation of MOFAs will have a negative impact on exports to MOFAs. It will have a positive effect on exports to unaffiliated parties and exports to JVs.

The ratio of the number of MOFAs to the total number of affiliates in the country served as a proxy for the strength of governmental restrictions on MOFA formation. [21]

If a country has restrictions on majority equity ownership by foreign MNCs, then the MNCs might have to rely on JVs or on sales to unaffiliated parties to supply the market. This kind of restriction is thus hypothesized to increases the sales share of JVs and the share of sales to unaffiliated parties.

A country's restriction on equity ownership by U.S. MNCs will result in a lower level of exports to MOFAs and an increase in the export share of JVs and unaffiliated parties.

[21] Gatignon and Anderson (1984) used a dummy variable which took a value of 1 for the countries with restrictions on foreign ownership and 0 otherwise. The countries in this group were: India, Sri Lanka, Pakistan, Mexico, Spain, and Japan. This variable was not used in this dissertation, since it was not considered to reflect present regulations. As an example, India dismantled all restriction on foreign ownership for most industries starting in 1991.

CHAPTER 5: THE ESTIMATION PROCEDURE

5.1. The Method of Estimation

Estimation requires an econometric specification suitable for modeling a vector of three shares: Y_1, Y_2, and Y_3.[22] The simplest approach specifies each share as a linear function of explanatory variables plus an additive disturbance term:

$$Y_1 = X\beta_1 + \varepsilon_1$$

$$Y_2 = X\beta_2 + \varepsilon_2$$

$$Y_3 = X\beta_3 + \varepsilon_3$$

Where X is a vector of regressors; β_1, β_2, and β_3 are vectors of parameters to be estimated; and ε_1, ε_2, and ε_3 are jointly normally distributed random errors. There would be three problems with this "linear share model." First, the above specification would not confine each share to the meaningful range of [0,1]. Second, it would not allow for a "pile-up" of probability at the share values of 0 and 1.[23] Third, it would not impose the adding up condition, $Y_1 + Y_2 + Y_3 = 1$.

As a solution to these problems, Wales and Woodland (1983) proposed a procedure which builds on Tobin's (1958) limited dependent variable model and

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[22] In our application, these will be the sales shares of MOFAs, JVs, and unaffiliated parties ($s^X_{j,m}$, $s^X_{j,JV}$, $s^X_{j,UF}$) or the export shares of MOFAs, JVs, and unaffiliated parties ($e^X_{j,m}$, $e^X_{j,JV}$, $e^X_{j,UF}$). In this discussion, we refer to these share vectors generically as Y_1, Y_2, Y_3.

[23] The data used in our application contain numerous instances in which one or two of the shares are zero for a given observation.2

Amemiya's (1974) extension of Tobin's model to a multivariate setting. Start with a vector of latent variables thought of as "notional" shares: Y_1^*, Y_2^* and Y_3^* where

$$Y_1^* + Y_2^* + Y_3^* = 1.$$

Because of the adding up condition, the joint distribution is fully characterized by the distribution of any two. Let

$$Y^* = \left[Y_1^*, Y_2^*\right]'$$

we assume that the latent variables are distributed as follows:

$$Y^* = \begin{bmatrix} Y_1^* \\ Y_2^* \end{bmatrix} \sim \mathbf{MVN}\left[\begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix}, \begin{pmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{12} & \sigma_{22} \end{pmatrix}\right];$$

i.e., a multivariate normal distribution with mean $\mu = (\mu_1, \mu_2)'$ and covariance matrix

$$\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{12} & \sigma_{22} \end{bmatrix}.$$

The distribution of Y_3^* is implied by the adding up condition $Y_3^* = 1 - Y_1^* - Y_2^*$. In our application μ_1 and μ_2 will be specified as parametric functions of the explanatory variables:

$$\mu_1 = X\beta_1$$

$$\mu_2 = X\beta_2.$$

The elements of β_1 and β_2 will be the main objects of estimation and hypothesis testing.

Of course, there is no assurance that the elements of the vector (Y_1^*, Y_2^*) will be confined to the unit simplex:

$$S = \{Y_1^*, Y_2^* : Y_1^*, Y_2^* \geq 0, Y_1^* + Y_2^* \leq 1\}.$$

Wales and Woodland's contribution is the following trick for mapping the density that falls outside of the unit simplex onto the boundary: Given notional shares Y_1^*, Y_2^* and Y_3^*, define observed shares as follows: For i = 1, 2, and 3,

$$Y_i = 0 \qquad \text{if} \qquad Y_i^* \leq 0$$

$$Y_i = \frac{Y_i^*}{\sum_{j \in J} Y_j^*} \qquad \text{if} \qquad Y_i^* > 0$$

where $J = \{j: Y_j^* > 0\}$.

The β and σ parameters are estimated by maximum likelihood in Wales and Woodland's "Amemiya-Tobin" approach. Share vectors for different observations are assumed to be independently distributed. It remains to specify the form of the likelihood factor for the typical observation. Suppose we observe the vector of shares

$$Y = [Y_1, Y_2, Y_3]'.$$

Let k = 1, 2 or 3 be the number of strictly positive shares. For notational simplicity we will assume that the strictly positive shares occupy the first elements of the vector. The possibilities are:

$$Y = (1, 0, 0)' \qquad \text{i.e.} \qquad k = 1$$

$$Y = (Y_1, Y_2, 0)'$$

where $Y_1, Y_2 > 0$ and $Y_1 + Y_2 = 1$ i.e. $k = 2$

$$Y = (Y_1, Y_2, Y_3)'$$

where $Y_1 + Y_2 + Y_3 = 1$ and $Y_1, Y_2, Y_3 > 0$ i.e. $k = 3$.

We now evaluate the density for each of the cases.

Case 1; k = 3. In this case all the shares are strictly positive. Each "latent" variable is positive and equal to the corresponding observed share. The density for the observation is:

$$f(Y_1, Y_2, Y_3) = n_{12}(y_1^*, y_2^*),$$

where $n_{12}(y_1^*, y_2^*)$ is the joint density function for a multivariate normal with mean, μ and variance-covariance matrix Σ, i.e.

$$n_{12}(y_1, y_2) = (2\pi)^{-1} (\det \Sigma)^{-\frac{1}{2}} \exp\left(-\frac{1}{2}(y_1 - \mu_1, y_2 - \mu_2)\Sigma^{-1}(y_1 - \mu_1, y_2 - \mu_2)'\right).$$

Case 2; k= 2. In this case, observed share $Y_3 = 0$, hence latent variable $Y_3^* \leq 0$, while Y_1^* and Y_2^* are positive. The observed values of latent variables Y_1^*, Y_2^* are implicitly determined by:

$$Y_1 = \frac{Y_1^*}{Y_1^* + Y_2^*} \qquad \text{and} \qquad Y_2 = \frac{Y_2^*}{Y_1^* + Y_2^*}.$$

Solving yields:

$$Y_2^* = Y_1^* \frac{Y_2}{Y_1}$$

which implies that the latent values (Y_1^*, Y_2^*) lie on the ray labeled A in figure 1. The density in this case is an accumulation of the density along the ray A:

$$f(Y_1, Y_2, 0) = \int_{Y_1}^{\infty} n_{12}(Y_1^*, Y_1^* \frac{Y_2}{Y_1}) J(Y) dY_1^*.$$

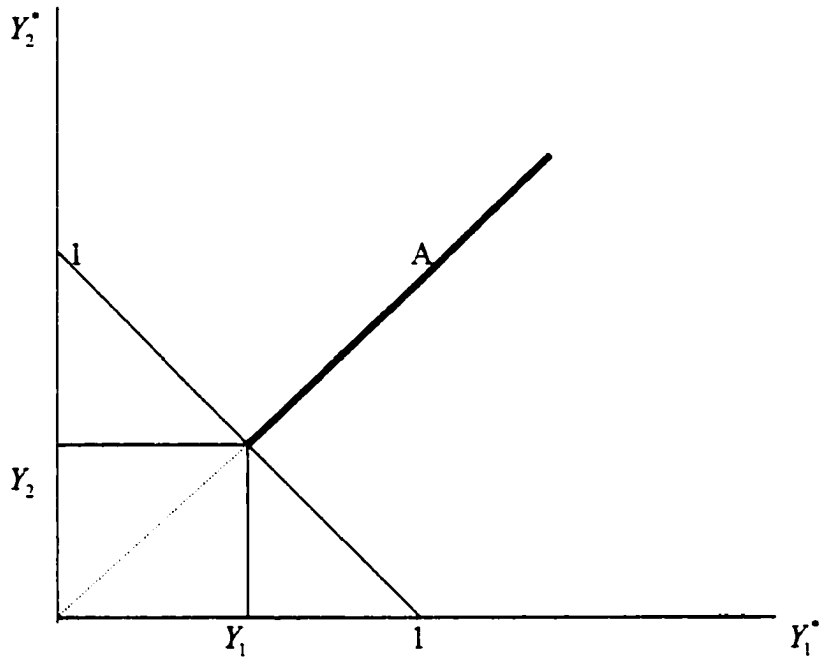

Figure 6. Two Positive Shares

Where $J(Y) = \left[1 + \left(\frac{Y_2}{Y_1}\right)^2\right]^{\frac{1}{2}}$ is a measure of distance along ray A. Figure 6.[24]

Dealing with cases in which the positive shares are not the first elements of the vector can be handled by simply working in an alternate 2-dimensional space. For example

$$f(Y_1, 0, Y_3) = \int_{Y_1}^{\infty} n_{13}(Y_1^*, Y_1^* \frac{Y_3}{Y_1}) J(Y) dY_1^* .$$

[24] See footnote 6 in Wales and Woodland. Note that the J(Y) factors depend only on the data, not on the parameters of the model, hence they can be omitted from the likelihood function.

where $J(Y) = \left[1 + \left(\frac{Y_3}{Y_1}\right)^2\right]^{\frac{1}{2}}$ and $n_{13}(\cdot)$ is the joint density for (Y_1^*, Y_3^*) where

$$\begin{bmatrix} Y_1^* \\ Y_3^* \end{bmatrix} \sim \mathbf{MVN}\left[\begin{pmatrix} \mu_1 \\ 1-\mu_1-\mu_2 \end{pmatrix}, \begin{pmatrix} \sigma_{11} & -\sigma_{11}-\sigma_{12} \\ -\sigma_{11}-\sigma_{12} & \sigma_{11}+2\sigma_{12}+\sigma_{22} \end{pmatrix}\right].$$

Case 3; k = 1. In this case, observed share $Y_1 > 0$ and Y_2 and $Y_3 = 0$. So the latent variables Y_2^*, Y_3^* are less than or equal to zero. This means that (Y_1^*, Y_2^*) falls in the shaded region in figure 7. The density (probability) for this case is given by the integral of $n_{12}(\cdot)$ over the region.

$$f(1, 0, 0) = \int_1^{\infty} \int_{1-Y_1^*}^{0} n_{12}(Y_1^*, Y_2^*)\, dY_2^*\, dY_1^*.$$

If the only non-zero share is one other than Y_1, the density can be calculated by working in an alternate 2-dimensional space. For example

$$f(0, 1, 0) = \int_1^{\infty} \int_{1-Y_2^*}^{0} n_{23}(Y_2^*, Y_3^*)\, dY_3^*\, dY_2^*$$

Once the form of the likelihood factor is determined for each observation, the likelihood function is formed by taking a product:

$$L(\beta_1, \beta_2, \sigma_{11}, \sigma_{12}, \sigma_{22} | Y_i, i = 1, 2, \ldots, n) = \prod_{i=1}^{n} f(Y_{1i}, Y_{2i}, Y_{3i}),$$

where we have added "i" subscripts to index observations. As usual, it is easier to work with the log-likelihood function.

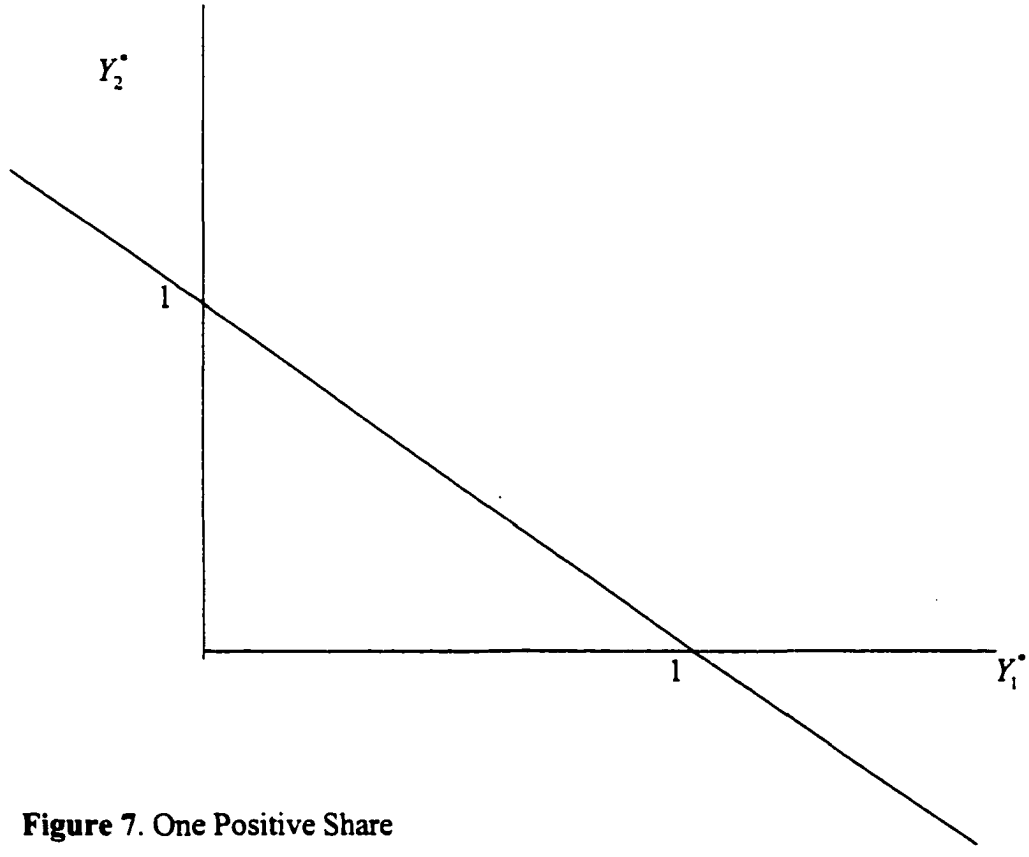

Figure 7. One Positive Share

$$\ln L(\beta_1,\ \beta_2,\ \sigma_{11},\ \sigma_{12},\ \sigma_{22} \mid Y_i,\ i=1,2,\ldots,n) = \sum_{i=1}^{n} \ln f(Y_{1i},\ Y_{2i},\ Y_{3i}).$$

Letting $\Theta = (\beta_1,\ \beta_2,\ \sigma_{11},\ \sigma_{12},\ \sigma_{22})$ denote the parameter vector and letting $\hat{\Theta}$ denote the maximum likelihood estimator of Θ, we have the following properties.[25]

(1) $\hat{\Theta}$ is consistent, i.e. plim $\hat{\Theta} = \Theta$

(2) $\hat{\Theta}$ is asymptotically normal; in particular, $\hat{\Theta} \xrightarrow{a} N[\Theta, \{I(\Theta)\}^{-1}]$ where

$$I(\Theta) = -E\left[\frac{\partial^2 \ln L(\Theta)}{\partial\Theta\partial\Theta'}\right].$$

[25] It is well known that these properties of maximum likelihood estimators follow given certain regularity conditions. See Greene pg. 129 – 40, for example.

Our estimate of the asymptotic covariance matrix is

$$-\left[\frac{\partial^2 \ln L(\hat{\Theta})}{\partial\Theta\partial\Theta'}\right]^{-1};$$

that is, the negative of the inverse of the Hessian of the log-likelihood function evaluated at the maximum likelihood estimate.[26]

5.2. Interpretation of Parameter Estimates

The interpretation of the parameter estimates for Wales and Woodland's Amemiya-Tobin (A-T) model described in the above section requires further discussion. These interpretations are illustrated below for the 2 explanatory variable model, but the discussion can be easily extended to a k explanatory variable framework. We begin by reviewing the calculation of marginal effects and elasticities in the linear share model.

Linear Share Model

A linear model of a three-share system with the adding-up condition ($Y_1 + Y_2 + Y_3 = 1$) imposed can be written as.

$$Y_1 = b_{10} + b_{11}x_1 + b_{12}x_2 + \varepsilon_1$$

$$Y_2 = b_{20} + b_{21}x_1 + b_{22}x_2 + \varepsilon_2$$

$$\text{and } Y_3 = (1 - b_{10} - b_{20}) - (b_{11} + b_{21})x_1 - (b_{12} + b_{22})x_2 - (\varepsilon_1 + \varepsilon_2)$$

The marginal effects are:

[26] The second derivatives in the covariance estimator are approximated using discrete (centered) difference quotients.

$$\frac{\partial Y_1}{\partial x_1} = b_{11}, \quad \frac{\partial Y_2}{\partial x_1} = b_{21}, \quad \frac{\partial Y_3}{\partial x_1} = -(b_{11}+b_{21}).$$

and the elasticities are :

$$\frac{\partial Y_1}{\partial x_1}\frac{x_1}{Y_1} = b_{11}\frac{x_1}{Y_1}, \text{ etc.}$$

Point estimates and standard errors of marginal effects and elasticities (evaluated at sample means, for example) can be calculated from point estimates and the estimated variance-covariance matrix of the estimates of the "bs" .

Wales and Woodland's Amemiya-Tobin model

For the Amemiya-Tobin model of Wales and Woodland, the form of marginal effects and elasticites depends on the number of strictly positive shares. We can write the 3 share equations as follows.

$$Y_1^* = b_{10} + b_{11}x_1 + b_{12}x_2 + \varepsilon_1$$

$$Y_2^* = b_{20} + b_{21}x_1 + b_{22}x_2 + \varepsilon_2$$

$$\text{and } Y_3^* = (1 - b_{10} - b_{20}) - (b_{11} + b_{21})x_1 - (b_{12} + b_{22})x_2 - (\varepsilon_1 + \varepsilon_2)$$

For i = 1, 2, 3: $Y_i = 0$ if $Y_i^* \le 0$

$$Y_i = \frac{Y_i^*}{\sum_{j \in J} Y_j^*} \quad \text{if} \quad Y_i^* > 0$$

where J = {j: $Y_j^* > 0$}.

If $Y_1, Y_2, Y_3 > 0$ then $Y_1 = Y_1^*$, $Y_2 = Y_2^*$, and $Y_3 = Y_3^*$. The marginal effects in this case are:

$$\frac{\partial Y_1}{\partial x_1} = b_{11}, \quad \frac{\partial Y_2}{\partial x_1} = b_{21}, \quad \frac{\partial Y_3}{\partial x_1} = -(b_{11}+b_{21}).$$

The elasticities will be:

$$\frac{\partial Y_1}{\partial x_1}\frac{x_1}{Y_1} = b_{11}\frac{x_1}{Y_1}, \text{ etc.}$$

When these formulas are used to estimate elasticities "evaluated at sample means," the means of x_1, Y_1, etc. should be taken over only those observations for which Y_1, Y_2, and $Y_3 > 0$.

When there is only one positive share, of course, marginal effects and elasticities are zero. There are three additional cases, each with 2 positive shares. One of them is illustrated below. The others are similar.

If $Y_1, Y_2 > 0$ and $Y_3 = 0$:

$$Y_1 = \frac{Y_1^*}{Y_1^* + Y_2^*} = \frac{b_{10} + b_{11}x_1 + b_{12}x_2 + \varepsilon_1}{(b_{10}+b_{20}) + (b_{11}+b_{21})x_1 + (b_{12}+b_{22})x_2 + \varepsilon_1 + \varepsilon_2}$$

$$\frac{\partial Y_1}{\partial x_1} = \frac{b_{11}\left[Y_1^* + Y_2^*\right] - Y_1^*[b_{11}+b_{21}]}{\left[Y_1^* + Y_2^*\right]^2}$$

$$= \frac{Y_2^* b_{11} - Y_1^* b_{21}}{\left[Y_1^* + Y_2^*\right]^2}$$

$$= \frac{Y_2 b_{11} - Y_1 b_{21}}{\left[Y_1^* + Y_2^*\right]}.$$

Similarly,

$$\frac{\partial Y_2}{\partial x_2} = \frac{Y_1 b_{21} - Y_2 b_{11}}{[Y_1^* + Y_2^*]} = -\frac{\partial Y_1}{\partial x_1}.$$

The elasticities are given by:

$$\frac{\partial Y_1}{\partial x_1}\frac{x_1}{Y_1} = \frac{Y_2 b_{11} - Y_1 b_{21}}{Y_1^* + Y_2^*}\frac{x_1(Y_1^* + Y_2^*)}{Y_1^*}$$

$$= \frac{Y_2 b_{11} - Y_1 b_{21}}{Y_1^*} x_1 .$$

Also:

$$\frac{\partial Y_2}{\partial x_1}\frac{x_1}{Y_2} = \frac{Y_1 b_{21} - Y_2 b_{11}}{Y_2^*} x_1 = -\frac{Y_1^*}{Y_2^*}\frac{\partial Y_1}{\partial x_1}\frac{x_1}{Y_1}.$$

When evaluating these expressions "at sample means," one can take the means of Y_1, Y_2, and x_1 over those observations for which Y_1 and Y_2 are greater than zero and $Y_3 = 0$. Y_1^* and Y_2^* pose a greater problem because the values of these variables are latent. Ideally, one would like to use the expected values of these random variables conditional on $Y_1^* > 0$, $Y_2^* > 0$ and 1 - Y_1^* - $Y_2^* < 0$. An acceptable approximation might be to calculate sample means for these variables assuming the conditional means of ε_1 and ε_2 are zero. That is, estimate the sample mean of Y_1^* (for example) by $b_{10} + b_{11}x_1 + b_{12}x_2$ where x_1 and x_2 are set at their mean values within the sub-sample defined by Y_1, $Y_2 > 0$ and $Y_3 = 0$.

CHAPTER 6: RESULTS AND CONCLUSION

In chapter 4, we developed two sets of hypotheses: one for the sales shares of U.S. MNCs, and the other regarding exports from the U.S. The Amemiya-Tobin estimation procedure, outlined in the previous chapter, was used to test both of these sets of hypotheses. The data were compiled mainly from the Bureau of Economic Analysis, 1994 "Benchmark Survey" (See Appendix A for more details.).

The data set used for the estimation of the sales share model covered 35 countries (Appendix A, Table 4) and 63 manufacturing and primary industries; aggregated to the 2 or 3 digit ISI level.[27] (See Appendix A for more details.) Each observation in this data set corresponds to a country-industry pair at the lowest degree of industry aggregation available. (See Appendix A, Table 2, for a complete list of all observations.) There were 191 usable observations; i.e., observations for which data were available on the three sales shares and on all of the 15 independent variables used in the estimation. The export share model covered 35 countries (Appendix A, Table 5) and 63 manufacturing and primary industries, at a similar level of aggregation as in the sales share model. The number of usable observations in this case was 284. (See Appendix A, Table 3, for a complete list of all observations.)

[27] The SIC is a more frequently used classification system. Its relationship to the ISI is explained in Table 4 in Appendix A.

As discussed in the previous chapter, the Amemiya-Tobin procedure models notional shares, for a three share case, using the following system of equations.

$$Y_1^* = b_{10} + \sum_j b_{1j} x_j + \varepsilon_1 ,$$

$$Y_2^* = b_{20} + \sum_j b_{2j} x_j + \varepsilon_2 ,$$

$$\text{and } Y_3^* = (1 - b_{10} - b_{20}) - \sum_j (b_{1j} + b_{2j}) x_j - \varepsilon_1 - \varepsilon_2 ,$$

where ε_1 and ε_2 are jointly normally distributed random errors; Y_1^* = unaffiliated share, Y_2^* = MOFA share, Y_3^* = joint venture share; and the x_j's are the independent variables described in Table 6.[28]

The observed shares are obtained from the notional shares using the following mapping:

For i = 1, 2, 3: $Y_i = 0$ if $Y_i^* \leq 0$

$$Y_i = \frac{Y_i^*}{\sum_{j \in J} Y_j^*} \quad \text{if} \quad Y_i^* > 0$$

where $J = \{j: Y_j^* > 0\}$.

As was discussed in the previous chapter, the above mapping implies that the marginal effects of independent variables depend on the number of strictly positive shares. From that discussion, we know that the observed shares and the notional shares are equal when all three observed shares are strictly positive. In this case the marginal effects on observed shares will be the same as on notional shares, and given, simply, by

[28] Following Brainard (1997), this study expresses most of the independent variables in log form. Preliminary regression results also indicated that the variables were more significant in log form.

Table 6. Independent Variables[a]

Name and (Symbol)	Definition	Hypothesis Number
Intercept (x_0)		
Research and Development (x_1)	Log (ratio of industry j R&D expenditure by U.S. MNCs to industry j exports by U.S. MNCs, both in millions of U.S. Dollars).	Hypothesis 1
Patent (x_2)	Log (number of patent applications filed in country i by the residents of country i in 1995).	Hypothesis 2
Tariff (x_3)	Log (average tariff rate (percent) imposed on imports of manufactures by country i).	Hypothesis 3
Adjacency (x_4)	Dummy variable equal to 1 if country i is Canada or Mexico and 0 otherwise.	Hypothesis 4
Culture (x_5)	Dummy variable equal to 1 if country i is classified as an Anglo country and 0 otherwise.	Hypothesis 5
Restrictions (x_6)	Ratio of the number of MOFAs of U.S. MNCs in country i to the total number of affiliates of U.S. MNCs in country i.	Hypothesis 6
Country Research and Development Expenditure (x_{7A})	Log (ratio of R&D expenditures in millions of U.S. Dollars by MOFAs of U.S. MNCs in country i to the total number of affiliates in country i).	Hypothesis 7
GDP Growth Rate (x_{7B})	Log (growth rate of GDP of country i).	Hypothesis 7
Average Size of Affiliates (x_8)	Log (average value of assets of an affiliate in industry j in millions of U.S. Dollars).	Hypothesis 8
Cost of Labor (x_{9A})	Log (per-hour wage rate of a U.S. parent production worker in industry j in U.S. Dollars).	Hypothesis 9
Foreign Cost of Labor (x_{9B})	Log (hourly wage rate of the employees of affiliates of U.S. MNCs in country i, in U.S. Dollars).	Hypothesis 9
Scale Economy (x_{10})	Log (average number of production workers in industry j plants in the U.S., which employ more than 20 workers).	Hypothesis 10
Foreign Tax (x_{11})	Log(corporate tax rate (percent) for country i).	Hypothesis 11
Country Familiarity (x_{12})	Log (number of U.S. affiliates in country i).	Hypothesis 12
Distance (x_{13})	Log (physical distance between the capitals of the U.S. and destination country i, in kilometers).	Hypothesis 13

[a] Each observation corresponds to a country (i) – industry (j) pair. All data is for 1994 unless otherwise stated.

the corresponding regression parameters. The maximum likelihood estimates of the parameters are presented in Table 2 for the sales share model and Table 4 for the export share model. The Tables show the parameter estimates, standard errors, and the p-values for a two-tailed test of the hypothesis that the parameter is equal to zero. At the bottom of the two Tables, 2 and 4, we also provide the likelihood ratio test statistic. The null hypothesis for this test is that all the slope coefficients are jointly equal to zero versus the alternative that they are not jointly equal to zero. It can be shown that the test statistic: $-2\ln\left(\frac{l_R}{l_U}\right)$ where l_R is the likelihood of the restricted model, and l_U is the likelihood of the unrestricted model, is chi-square, with degrees of freedom equal to the number of restrictions imposed.[29]

The interpretation of the regression results for cases in which only two of the observed shares are positive is more complex. As shown in the previous chapter, if only two of the shares, Y_1^* and Y_2^* (say), are strictly positive, then the marginal effect for x_1 (the others are similar) is calculated as follows:

[29] Greene 3rd edition pg. 161.

$$\frac{\partial Y_2}{\partial x_1} = \frac{Y_1 b_{21} - Y_2 b_{11}}{[Y_1^* + Y_2^*]} = -\frac{\partial Y_1}{\partial x_1}.$$

Our estimate of this marginal effect, evaluated at sample means, is

$$\frac{\bar{Y}_1 \hat{b}_{21} - \bar{Y}_2 \hat{b}_{11}}{\bar{Y}_1^* - \bar{Y}_2^*}$$

where $\hat{b}_{11}$ and $\hat{b}_{21}$ are maximum likelihood estimates; $\bar{Y}_1$ and $\bar{Y}_2$ are the sample means of Y_1 and Y_2 over the subset of observations for which Y_1 and $Y_2 > 0$ and $Y_3 = 0$; and

$$\bar{Y}_1^* = \hat{b}_{10} + \sum_j \hat{b}_{1j} \bar{x}_j$$

$$\bar{Y}_2^* = \hat{b}_{20} + \sum_j \hat{b}_{2j} \bar{x}_j ;$$

where the $\hat{b}_{ij}$'s are maximum likelihood estimates and the $\bar{x}_j$'s are the means of the independent variables over the appropriate subset of observations. The variance of the estimator of the marginal effects at sample means is then given by the following expression:

$$Var\left(\frac{\partial \hat{Y}_2}{\partial x_1}\right) = Var\left(\frac{\partial \hat{Y}_1}{\partial x_1}\right)$$

$$= \left(\frac{\bar{Y}_1}{[\bar{Y}_1^* + \bar{Y}_2^*]}\right)^2 Var(\hat{b}_{21}) + \left(\frac{\bar{Y}_2}{[\bar{Y}_1^* + \bar{Y}_2^*]}\right)^2 Var(\hat{b}_{11}) - 2\left(\frac{\bar{Y}_1}{[\bar{Y}_1^* + \bar{Y}_2^*]}\right)\left(\frac{\bar{Y}_2}{[\bar{Y}_1^* + \bar{Y}_2^*]}\right) Cov(\hat{b}_{11}, \hat{b}_{21}).$$

There are three possible cases in which only two shares are strictly positive: unaffiliated and MOFA share strictly greater than zero (JV share equal to zero); unaffiliated and JV share strictly greater than zero (MOFA share equal to zero); and MOFA and JV share strictly greater than zero (unaffiliated share equal to zero). However, not all of the three cases have a significant number of observations (Appendix

A, Table 6). Tables 3, 5, and 6 report marginal effects, their standard errors, and p-values when only two of the shares are strictly positive. The results when only unaffiliated and MOFA sales share are strictly positive are described in Table 3.[30] Tables 5 and 6 describe the case for the export share model. Table 5 is for the case in which, unaffiliated and MOFA export shares are the only ones strictly greater than zero. Table 6, is for the case in which, the unaffiliated and JV shares are greater than zero. There were no observations with only the MOFA and JV shares strictly greater than zero for the export share model.

6.1. Results of the Sales Share Model

This study used fifteen independent variables to explain the share of sales attributable to MOFAs, JVs, and unaffiliated firms. These independent variables are described in Table 1 above, and the results of estimation are given in Tables 2 and 3 below. In the discussion that follows, attention will focus on the implications of the results for the three-positive share case (Table 7).[31] For the most part, these are consistent with findings for the case in which only unaffiliated and MOFA sales are greater than zero (Table 8).

The results support our hypothesis 1 concerning the effect of specialized knowledge on the organizational decisions made by U.S. MNCs. The results indicate that

[30] There were two additional cases of only two strictly positive shares for the sales share model: unaffiliated and joint venture share strictly greater than zero, and MOFA and joint venture share strictly greater than zero. But the number of observations in each of the two cases was 2 and 1 respectively, hence these results were not considered to convey anything significant and are not reported.

[31] For what follows, a parameter estimate is considered to be "significant" if it is statistically significant at the 10% level for a two-tail test.

as R&D expenditure increases, the sales to unaffiliated firms decrease significantly, the sales of MOFAs increase significantly, and the effect on joint venture sales is positive but not significant. The results therefore show that an increase in proprietary knowledge gradually moves MNCs away from no control toward full control.

In the case of sales to unaffiliated firms (firms over which MNCs have no control), the coefficient was significantly negative. For JVs (firms over which MNCs have intermediate control), the result was not significantly different from zero, while for MOFAs (firms over which MNCs have complete control), specialized knowledge had a significantly positive impact.

Compared to specialized knowledge, the importance of a local firm's investment should have the opposite effect on the organizational form of MNCs, as claimed by hypothesis 2. Patent applications (x_2) by the residents of a foreign country were used to measure the importance of a local firm's investment. The results show that patent applications had a significantly positive impact on joint venture formation and a negative impact on MOFA formation. Patent applications also had a positive effect on sales to unaffiliated firms, though not significant. Thus our hypothesis was supported by the results of the regression.

The imposition of tariffs had its expected effect, as stated in hypothesis 3; it was positively related to the share of sales of MOFAs, and negatively related to sales to unaffiliated firms. Tariffs also had a negative effect on the sales share of JVs. All the results were statistically significant. The result thus supports our hypothesis 3.

Table 7. Maximum Likelihood Estimation of the Sales Shares Model[a]

Description	Unaffiliated			MOFA			JV		
	Estimate	SE	P-Value	Estimate	SE	P-Value	Estimate	SE	P-Value
x_0	0.815	0.833	(0.3275)	2.268	0.886	(0.0105)	-2.084	0.607	(0.0006)
x_1	-0.118	0.032	(0.0002)	0.097	0.034	(0.0042)	0.021	0.023	(0.3627)
x_2	0.012	0.019	(0.5246)	-0.038	0.020	(0.0589)	0.026	0.013	(0.0443)
x_3	-0.118	0.038	(0.0017)	0.165	0.040	(0.0000)	-0.047	0.026	(0.0740)
x_4	0.239	0.167	(0.1518)	-0.542	0.180	(0.0025)	0.303	0.115	(0.0086)
x_5	-0.040	0.080	(0.6125)	0.070	0.086	(0.4144)	-0.030	0.059	(0.6135)
x_6	0.293	0.141	(0.0384)	-0.051	0.154	(0.7390)	-0.242	0.099	(0.0149)
x_{7A}	-0.052	0.022	(0.0170)	0.034	0.023	(0.1358)	0.019	0.015	(0.2300)
x_{7B}	-0.015	0.055	(0.7867)	0.017	0.058	(0.7669)	-0.002	0.039	(0.9498)
x_8	-0.184	0.025	(0.0000)	0.091	0.027	(0.0006)	0.093	0.019	(0.0000)
x_{9A}	0.342	0.101	(0.0007)	-0.416	0.110	(0.0002)	0.074	0.075	(0.3221)
x_{9B}	-0.050	0.106	(0.6352)	0.166	0.114	(0.1454)	-0.116	0.076	(0.1265)
x_{10}	0.381	0.074	(0.0000)	-0.377	0.079	(0.0000)	-0.004	0.051	(0.9397)
x_{11}	0.129	0.086	(0.1356)	-0.330	0.096	(0.0006)	0.201	0.069	(0.0033)
x_{12}	-0.301	0.040	(0.0000)	0.254	0.042	(0.0000)	0.047	0.028	(0.0985)
x_{13}	-0.037	0.058	(0.5189)	-0.017	0.062	(0.7840)	0.054	0.041	(0.1905)

Value of log likelihood function = -93.03 $\quad \chi^2_{30} = 299.76$[b]

[a] The numbers in parenthesis are the p-values for a two-tailed test of the hypothesis: $H_0: b_j = 0$ vs. $H_1: b_j \neq 0$.

[b] The Likelihood Ratio test was carried out to test the hypothesis that all 30 "slope" coefficients are jointly equal to zero versus the alternative that they are not jointly equal to zero. The critical value of χ^2_{30}, at a 1% significance level, is 50.89. Hence we reject the null hypothesis that all the "slope" coefficients are jointly equal to zero.

Table 8. Marginal Effects in the Sales Share Model with Unaffiliated and MOFA share > 0 and Joint Venture share = 0[a].

Description	Unaffiliated			MOFA		
	Estimates	**SE**	**P-Value**	**Estimates**	**SE**	**P-Value**
x_1	-0.096	0.027	(0.0004)	0.096	0.027	(0.0004)
x_2	0.020	0.016	(0.2177)	-0.020	0.016	(0.2177)
x_3	-0.120	0.032	(0.0002)	0.120	0.032	(0.0002)
x_4	0.318	0.143	(0.0259)	-0.318	0.143	(0.0259)
x_5	-0.046	0.068	(0.4958)	0.046	0.068	(0.4958)
x_6	0.171	0.121	(0.1590)	-0.171	0.121	(0.1590)
x_{7A}	-0.039	0.018	(0.0320)	0.039	0.018	(0.0320)
x_{7B}	-0.014	0.046	(0.7643)	0.014	0.046	(0.7643)
x_8	-0.128	0.021	(0.0000)	0.128	0.021	(0.0000)
x_{9A}	0.326	0.086	(0.0001)	-0.326	0.086	(0.0001)
x_{9B}	-0.085	0.090	(0.3435)	0.085	0.090	(0.3435)
x_{10}	0.333	0.063	(0.0000)	-0.333	0.063	(0.0000)
x_{11}	0.185	0.074	(0.0122)	-0.185	0.074	(0.0122)
x_{12}	-0.247	0.034	(0.0000)	0.247	0.034	(0.0000)
x_{13}	-0.013	0.049	(0.7849)	0.013	0.049	(0.7849)

[a] The numbers in parenthesis are the p-values for a two-tailed test of the hypothesis: $H_0: b_j = 0$ vs. $H_1: b_j \neq 0$.

In chapter 4 we hypothesized that adjacency would increase the share of sales to unaffiliated parties. The regression results did not support this hypothesis. The dummy variable serving as a proxy for adjacency was not statistically significant in explaining the share of sales to unaffiliated parties. The regression results suggest, however, that adjacency of the host country discourages MOFA sales, but increases the sales by joint ventures. These results were statistically significant. A possible reason for the increase in JV sales and decline in MOFA sales could be that geographic proximity facilitates greater understanding between MNCs and local firms, hence full control may not be required.

Cultural similarity to the U.S. promoted MOFA sales and discouraged JV sales, and sales to unaffiliated firms, but the results were not significant. Thus the regression results did not support hypothesis 5.

Restrictions on the formation of MOFAs did not significantly effect the MOFA share, however it significantly increased the share of sales to unaffiliated firms and decreased the share of sales by joint ventures. The impact on unaffiliated firms was as hypothesized in hypothesis 6, but the impact on the joint venture share was not as predicted. This could be because MNCs completely shy away from countries which have restrictions on MOFAs. Thus support for hypothesis 6 was mixed.

The size and profitability of markets play an important role in the choice of the organizational form preferred by U.S. MNCs. Two independent variables capture these characteristics: GDP growth rate and country R&D. GDP growth rate, a proxy for profitability, had a positive impact on the sales of MOFAs, and a negative impact on the sales shares of JVs and unaffiliated firms, but the results were not significant. A second independent variable, used to capture the strategic importance of a market, country R&D,

had a marginally significant positive impact on MOFA sales and a significantly negative impact on sales to unaffiliated firms, as hypothesized (hypothesis 7). The effect on JV sales, however, did not turn out to be significant. The results thus find conditional support for the hypothesis that U.S. MNCs prefer MOFAs to unaffiliated firms or JVs, if the market is strategically important or profitable. This result supports the hypothesis developed by Horstman and Markusen (1996).

The coefficient for average size of foreign affiliates was significantly negative for sales to unaffiliated foreign firms, and was significantly positive for both MOFA and JV sales. This result was as hypothesized in hypothesis 8.

The results suggest that the cost of U.S. labor had a positive impact on sales to unaffiliated firms and a negative impact on the sales by MOFAs. These results, though counter intuitive, could be explained on the basis of the efficiency wage hypothesis; that is, there is a positive relationship between wages and worker productivity. The higher productivity of the workers may effectively decrease labor cost. This saving in labor cost could then make exports from the U.S. a cheaper option, promoting exports from the U.S. and decreasing foreign production. U.S. labor cost also had a positive impact on JV sales but it was not significant. As the cost of labor abroad increases, the share of JV and unaffiliated firm sales decrease, while that of MOFA increases. These results, while not statistically significant, were generally inconsistent with hypothesis 9. Thus our hypothesis 9 was not supported by the results of this estimation.

The presence of scale economies had the expected positive effect on the share of sales to unaffiliated firms, and a negative effect on the sales share of MOFAs. However,

the negative effect on joint venture sales was not significant. This result was as hypothesized in hypothesis 10.

The foreign tax variable had a positive effect on the share of sales to unaffiliated firms, but it was only marginally significant. The effect of foreign tax on the share of sales of JVs was positive, and it was negative for MOFAs, both being statistically significant. The effect of foreign tax on JVs was not as hypothesized. Thus the regression results only provide partial support for our hypothesis 11.

An important explanatory variable in the estimation procedure was country familiarity. Country familiarity increased the sales share of both MOFAs and JVs and decreased the share of sales to unaffiliated firms. The results provide support for hypothesis 12.

The variable used to measure physical distance did not significantly explain the share of sales to unaffiliated parties, JVs, or MOFAs. Thus we do not find support for our hypothesis 13.

To summarize, the following conclusions can be drawn: Research and development expenditure promotes a more integrated structure, as does profitability and strategic importance of a market. Joint ventures are promoted by greater innovativeness of the residents of a country, as well as by size of foreign affiliates. Thus the dissertation finds support for the hypotheses developed by Grossman and Hart (1987), Hart and Moore (1990), and Horstman and Markusen (1987).

6.2. Results for the Export Share Model

U.S. MNCs' strategies for serving foreign markets have implications about export shares as well as sales shares. The internalization hypothesis predicts that U.S. MNCs would not export specialized products (products with a high proprietary content) to firms over which they have little or no control. In addition to the need to internalize transactions, U.S. MNCs may also find it profitable to manipulate transfer prices of intra-firm exports, moving profits out of high tax countries to low tax countries (Grubert and Mutti (1991), Clausing (1998)). This section analyses the results relating to MNC exports based on the estimation procedure outlined in chapter 5. As before, commentary will focus on the results for the three-positive-share case (Table 9).[32] The marginal effects reported (in Tables 10 and 11) for the two two-positive-share cases are generally consistent.

As the internalization hypothesis would predict, R&D expenditures significantly increase the share of exports to MOFAs, and decrease exports to unaffiliated firms. The effect of R&D expenditures on joint ventures was positive but only marginally significant. This again shows the importance of the internalization hypothesis in explaining a firm's decisions in the presence of specialized knowledge. Thus hypothesis 1 is supported.

Patent applications by the residents of a country were not very significant in explaining the share of exports from the U.S. to various affiliates of U.S. MNCs. It had a positive impact on the share of exports to unaffiliated firms and a negative effect on

[32] For what follows, a variable is considered to be "significant" if it was statistically significant at the 10% level for a two tail test.

the share of exports to MOFAs, but it was not significant. In the case of JV's it had a positive impact though again it was not significant. Thus hypothesis 2 was not supported by the results of the regression.

Tariffs did not significantly effect the export shares of either MOFAs or unaffiliated firms. However it did significantly decrease the export share of JVs. The result was not as hypothesized in hypothesis 3.

Adjacency to the U.S. did not significantly effect the export shares of unaffiliated firms or exports to MOFAs. The share of exports to JVs though, was significantly positive. Thus hypothesis 4 was not supported.

The results from the estimation procedure did not support hypothesis 5; regarding the coefficient of the dummy variable serving as a proxy for the culture of the host country. From the results we can see that none of the coefficients were significant.

Restrictions on foreign ownership of assets did not have significant explanatory power in the model. This implies that we did not find significant support for hypothesis 6.

The importance of markets, as proxied by research and development expenditures performed by U.S. MNC's in their MOFAs, had a significantly negative impact on exports to unaffiliated firms, and a positive effect on exports to MOFAs. The impact on JVs was negative though it was not significant. GDP growth rate did not have a significant effect on the share of exports to either unaffiliated firms or to MOFAs and JVs. Thus the importance of markets promotes affiliate sales, as claimed by hypothesis 7

Table 9. Maximum Likelihood Estimation of the Export Shares Model[a]

Description	Unaffiliated			MOFA			JV		
	Estimate	SE	P-Value	Estimate	SE	P-Value	Estimate	SE	P-Value
x_0	1.622	0.858	(0.059)	-0.014	0.828	(0.987)	-0.608	0.225	(0.007)
x_1	-0.095	0.031	(0.002)	0.083	0.030	(0.005)	0.012	0.009	(0.147)
x_2	0.007	0.020	(0.740)	-0.013	0.019	(0.507)	0.006	0.005	(0.212)
x_3	0.004	0.046	(0.927)	0.023	0.045	(0.604)	-0.027	0.011	(0.013)
x_4	-0.060	0.204	(0.770)	-0.085	0.198	(0.668)	0.145	0.049	(0.003)
x_5	-0.105	0.085	(0.214)	0.093	0.082	(0.257)	0.012	0.022	(0.570)
x_6	0.021	0.136	(0.880)	0.013	0.131	(0.921)	-0.034	0.040	(0.400)
x_{7A}	-0.049	0.027	(0.075)	0.051	0.027	(0.054)	-0.002	0.007	(0.726)
x_{7B}	0.010	0.068	(0.880)	0.003	0.066	(0.968)	-0.013	0.016	(0.429)
x_8	-0.057	0.026	(0.027)	0.015	0.025	(0.552)	0.042	0.008	(0.000)
x_{9A}	-0.051	0.112	(0.650)	0.049	0.108	(0.653)	0.002	0.029	(0.944)
x_{9B}	0.062	0.127	(0.627)	-0.038	0.124	(0.761)	-0.024	0.031	(0.430)
x_{10}	0.181	0.076	(0.018)	-0.144	0.074	(0.050)	-0.036	0.020	(0.070)
x_{11}	0.198	0.104	(0.057)	-0.176	0.101	(0.082)	-0.022	0.026	(0.403)
x_{12}	-0.211	0.048	(0.000)	0.180	0.046	(0.000)	0.031	0.012	(0.010)
x_{13}	-0.055	0.068	(0.422)	0.004	0.066	(0.947)	0.050	0.017	(0.004)

Value of Log Likelihood Function = -124.18 $\chi^2_{30} = 157.86$[b]

[a] The numbers in parenthesis are the p-values for a two-tailed test of the hypothesis: $H_0: b_j = 0$ vs. $H_1: b_j \neq 0$.

[b] The Likelihood Ratio test was carried out to test the hypothesis that all 30 "slope" coefficients are jointly equal to zero versus the alternative that they are not jointly equal to zero. The critical value of χ^2_{30} at 1% significance level, is 50.89. Hence we reject the null hypothesis that all the "slope" coefficients are jointly equal to zero.

Table 10. Marginal Effects in the Export Share Model with Unaffiliated and MOFA Share > 0 and Joint Venture Share = 0[a].

Description	Unaffiliated			MOFA		
	Estimate	SE	P-Value	Estimate	SE	P-Value
x_1	-0.079	0.029	(0.006)	0.079	0.029	(0.006)
x_2	0.011	0.019	(0.555)	-0.011	0.019	(0.555)
x_3	-0.018	0.043	(0.686)	0.018	0.043	(0.686)
x_4	0.057	0.192	(0.764)	-0.057	0.192	(0.764)
x_5	-0.089	0.080	(0.265)	0.089	0.080	(0.265)
x_6	-0.007	0.127	(0.956)	0.007	0.127	(0.956)
x_{7A}	-0.047	0.026	(0.066)	0.047	0.026	(0.066)
x_{7B}	-0.001	0.064	(0.993)	0.001	0.064	(0.993)
x_8	-0.020	0.024	(0.401)	0.020	0.024	(0.401)
x_{9A}	-0.046	0.105	(0.662)	0.046	0.105	(0.662)
x_{9B}	0.039	0.120	(0.746)	-0.039	0.120	(0.746)
x_{10}	0.140	0.071	(0.049)	-0.140	0.071	(0.049)
x_{11}	0.168	0.098	(0.087)	-0.168	0.098	(0.087)
x_{12}	-0.173	0.045	(0.000)	0.173	0.045	(0.000)
x_{13}	-0.012	0.064	(0.855)	0.012	0.064	(0.855)

[a] The numbers in parenthesis are the p-values for a two-tailed test of the hypothesis: $H_0: b_j = 0$ vs. $H_1: b_j \neq 0$.

Table 11. Marginal Effects in the Export Share Model with Unaffiliated Share > 0, MOFA Share = 0 and Joint Venture Share > 0[a].

Description	Unaffiliated			Joint Venture		
	Estimate	SE	P-Value	Estimate	SE	P-Value
x_1	-0.017	0.008	(0.035)	0.017	0.008	(0.035)
x_2	-0.005	0.005	(0.310)	0.005	0.005	(0.310)
x_3	0.023	0.010	(0.026)	-0.023	0.010	(0.026)
x_4	-0.125	0.047	(0.007)	0.125	0.047	(0.007)
x_5	-0.017	0.020	(0.390)	0.017	0.020	(0.390)
x_6	0.030	0.037	(0.425)	-0.030	0.037	(0.425)
x_{7A}	-0.001	0.007	(0.849)	0.001	0.007	(0.849)
x_{7B}	0.012	0.016	(0.455)	-0.012	0.016	(0.455)
x_8	-0.039	0.007	(0.000)	0.039	0.007	(0.000)
x_{9A}	-0.005	0.027	(0.850)	0.005	0.027	(0.850)
x_{9B}	0.024	0.029	(0.399)	-0.024	0.029	(0.399)
x_{10}	0.043	0.019	(0.023)	-0.043	0.019	(0.023)
x_{11}	0.032	0.024	(0.195)	-0.032	0.024	(0.195)
x_{12}	-0.040	0.011	(0.000)	0.040	0.011	(0.000)
x_{13}	-0.046	0.016	(0.005)	0.046	0.016	(0.005)

[a] The numbers in parenthesis are the p-values for a two-tailed test of the hypothesis: $H_0: b_j = 0$ vs. $H_1: b_j \neq 0$.

As hypothesized, an increase in the average size of foreign affiliates increased exports to MOFAs and joint ventures, and decreased exports to unaffiliated firms. However the effect of foreign affiliate size on MOFA share was not significant. Thus we found partial support for hypothesis 8.

The cost of labor in the U.S. had no impact on any of the export shares. Foreign labor cost also did not significantly impact any of the shares. Hypothesis 9, thus, was not supported.

One independent variable that can significantly explain export shares, is scale economies. Scale economies had a negative impact on the share of exports to affiliates of U.S. MNCs, both JVs and MOFAs, and it had a positive effect on exports to unaffiliated firms. All the results were as hypothesized in hypothesis 10.

The estimation shows that the destination country's tax rate significantly effects the export shares. With an increase in foreign taxes the share of exports to unaffiliated firms increases while the share of exports to MOFAs and JVs declines. The effect on joint venture firms however was not significant. Thus, the results indicate that increases in foreign taxes increase U.S. production at the expense of foreign production as was claimed in hypothesis 11.

The results of the estimation support hypothesis 12, regarding country familiarity. Exports to affiliates of U.S. MNCs increased while the exports to unaffiliated firms decreased.

Physical distance from the U.S. significantly increased the export share of JVs but it did not have a significant impact on the export share of either unaffiliated firms or MOFAs. Thus hypothesis 13 was only partially supported.

The export share model again showed the importance of R&D expenditure and country familiarity in promoting a more integrated organizational form. Scale economies and foreign taxes increased exports to unaffiliated firms while country R&D expenditure and country familiarity discouraged sales to unaffiliated firms. As hypothesized average size of foreign affiliates promoted exports to JVs.

6.3. Conclusions

In this dissertation we undertook a study of the marketing strategies, used by U.S. MNCs in manufacturing industries, to supply foreign markets. Under what circumstances do they chose to establish an affiliate in the destination country as opposed to producing at home for export? If an affiliate is used to supply the market, what degree of ownership/control does the U.S. parent retain? The objective of the study was to determine whether the theory of the firm can help illuminate these issues. This literature emphasizes the importance of knowledge in the optimal organizational form of a firm. As was discussed in chapter 2, specialized knowledge possessed by a U.S. parent will encourage complete control or "internalization" of all transactions; that is, the transactions will be moved away from the market into the firm. The discussion also showed why complementary knowledge possessed by foreign enterprises would promote joint ventures.

The varying degree of control a U.S. MNC possesses over its affiliates translates to a varying degree of control it retains over a transaction. A transaction with an unaffiliated firm represents a transaction over which the U.S. MNC has no control; while

a transaction with a MOFA represents one over which it has complete control. Transactions with JVs fall in between. Using the shares for unaffiliated parties, MOFAs, and JVs as the three dependent variables, this study tested the empirical relevance of the internalization hypotheses, using both the sales share and the export share model.

The "Amemiya-Tobin" approach of Wales and Woodland was used to estimate the system of share equations. This procedure explicitly builds in the adding-up restriction on shares and allows for the occurrence of zero values for one or two shares in a three-share system. The log likelihood function for the Amemiya-Tobin model was maximized by numerical methods. A copy of the Gauss program is attached as Appendix B.

Multinational data of U.S. MNCs are available from the Bureau of Economic Analysis. Data was also collected from the Bureau of Census, the World Bank and the Internet (http://www.eiit.org). The final data set was for country-industry pairs, at the lowest level of industry aggregation available. There were 191 observations for the sales share model and 284 observations for the export share model. The study used 15 independent variables to test 13 hypothesis listed in chapter 4 of this dissertation. R&D expenditures of U.S. MNCs and the patent applications of residents of foreign countries represent the key variables used to test the internalization hypothesis. Other important control variables include physical distance, GDP growth rate, scale economies, and the cost of labor.

The results for the sales share model show the importance of the internalization hypothesis: Complementary knowledge of foreign enterprises, which was measured by the number of patent applications filed by the residents of a country, was positively

related to the share of sales by joint ventures, and negatively related to the share of sales by MOFAs. R&D expenditure, which served as a proxy for the specialized knowledge of U.S. parent, had a significantly positive impact on MOFA sales and negative impact on the sales to unaffiliated parties. While there have been empirical papers, discussed in chapter 3, which also found support for the internalization hypotheses in the form of a positive relationship between specialized knowledge and MOFA sales, no previous papers found evidence of the positive relationship between patent applications and joint ventures sales. Importantly, these two results together show the influence of the "ownership of knowledge" in determining the organizational form chosen by U.S. MNCs.

The results of the export share model were similar. Here too, the importance of specialized knowledge was evident. Specialized knowledge increased the share of exports to MOFAs at the expense of unaffiliated parties, thereby moving transactions out of the market to within a firm. However, patent applications did not play a significant role in this model.

Some of the hypotheses we developed in chapter 4, especially for the export share model, were not supported by our results. Research on multinational firms has always suffered from a lack of data. This study was no different. The data set used in this dissertation contained observations on relatively highly-aggregated industries: industries defined at the 2 or 3 digit ISI level. Furthermore, due to confidentiality requirements, many observations had data that were suppressed. A more disaggregated data set containing more observations will allow us to perform a more powerful test of the role of the internalization hypothesis in determining the foreign marketing strategies of U.S. MNCs.

APPENDIX A: DATA SOURCES AND DATA SET PREPARATION

A.1 Introduction

The data for this dissertation were gathered from numerous sources. All data regarding affiliates of U.S. MNCs and their parent companies are from the Bureau of Economic Analysis (BEA). U.S. export data are from the Bureau of Census (BoC) and country indicators are from a World Bank publication called *Development Indicators*. Below we discuss the specific details of the data.

Table A1. Source of Independent Variables.

Variable	Source
Research and Development (x_1)	BEA
Patent (x_2)	World Bank Development Indicators
Tariff (x_3)	World Bank Development Indicators
Adjacency (x_4)	Obvious Classification
Culture (x_5)	Based on Classification by Gatignon and Anderson (1988).
Restrictions (x_6)	BEA
Country Research and Development Expenditure (x_{7A})	BEA
GDP Growth Rate (x_{7B})	World Bank Development Indicators
Average Size of Affiliates (x_8)	BEA
Cost of Labor (x_{9A})	BEA
Foreign Cost of Labor (x_{9B})	BoC
Scale Economy (x_{10})	BEA
Foreign Tax (x_{11})	Price Waterhouse
Country Familiarity (x_{12})	BEA
Distance (x_{13})	Internet (http://www.eiit.org.)

A.2 The BEA Data[33]

The BEA collects U.S. MNCs' data in a periodic survey called the Benchmark Survey of U.S. Direct Investment Abroad. Reporting in the survey is mandatory for U.S. MNCs under the International Investment and Trade in Services Act. All U.S. parent companies have to provide information about themselves, and about any affiliates that had assets, sales, or net income above $3 million, or owned another affiliate that satisfied the above condition. The data used in this dissertation are from the 1994 Benchmark Survey. Benchmark surveys cover the universe of MNCs and are conducted every 5 years; 1994 is the latest available year. Below we define some of the commonly used terms.

Direct Investment: Direct investment is defined as the ownership of at least 10% of the voting securities in a foreign establishment. Ownership of 10% or more of the voting securities is also considered to be an indication of lasting management control, or degree of influence, over an enterprise.

U.S. Parent: A U.S. parent is defined as a U.S. "person" who has an investment of 10% or more in a foreign business enterprise. A U.S. "person" could be a religious organization, charitable trust, government or business enterprise. Most U.S. parents, however, are business enterprises that exist for the purpose of profit or securing some other economic advantage.

Foreign Affiliates. A foreign affiliate is a foreign (located outside the U.S.) business

[33] The explanations below are to give the reader a general understanding of the data set and the definition and coverage of the variables. Some details are omitted. For complete definitions, see *U.S. Direct Investment Abroad 1994 Benchmark Survey Final Result, May 1998* (hereafter referred to as USDIA); U.S. Department of Commerce, pg. M1-M27.

enterprise in which U.S. interests have more than 10% of the voting securities. Affiliates generally have the following characteristics: They have "substantial" physical presence abroad, in terms of employees or plant and equipment, and pay foreign taxes. If the foreign presence were "limited" in terms of physical assets abroad then the enterprise probably would not be considered an affiliate. Thus, an enterprise involved only in public relations or sales promotion probably would not be considered an affiliate. A majority owned foreign affiliate, or MOFA, is a foreign affiliate in which the combined U.S. interests exceed 50%. For the purpose of this dissertation, joint ventures are defined as affiliates in which combined U.S. interests total more than 10% but less than 50%.

A.2.1. Industry and Country Classification of Data

The BEA reports data for U.S. parents and its affiliates - by industry and by country. Country classification of data is on the basis of the physical presence of the assets of the affiliates. Industry classification, done by the BEA, is more complex and is described below.

Industry classification of the data is based on a three-stage process. At the first stage, an enterprise (either a U.S. parent or an affiliate) is classified into the major industry that accounted for the largest percentage of its sales. The major industries are agriculture; forestry and fishing; mining; petroleum; construction; manufacturing; transportation, communication, and public utilities; wholesale trade; retail trade; finance, insurance and real estate; and services. After the major industry is identified, the enterprise is placed in the two-digit ISI industry classification, in which its sales were the highest. At the third stage, the enterprise is classified in the three digit ISI category in

which it had the maximum sales. The following example (pg. M-11-12, USDIA) illustrates this three-stage process.

Industry Code	Description	Percentage of Sales
	All Industries	100
	Manufacturing	55
35	Industrial machinery and equipment	30
351	Engines and turbines	5
352	Farm and garden machinery	10
353	Construction mining and materials handling machinery	15
36	Electronic and other electric equipment	25
367	Electronic components and accessories	25
	Wholesale trade	45
50	Durable goods	45
508	Machinery, equipment, and supplies	45

In the above example the enterprise's major industry is manufacturing since 55% of its sales were in manufacturing, as compared to 45% in wholesale trade. Within the manufacturing industry, the enterprise had the highest sales in industrial machinery and equipment (35). Within the two digit industry 35, the sub-industry in which the enterprise had the largest sales was 353. Thus the enterprise was classified in the 3-digit sub-industry 353, even though it had larger sales in 3-digit sub-industries 508 and 367. The BEA groups all affiliates by its major industry and country by this process.

Affiliate sales and U.S. exports to affiliates are reported, by the BEA, for each industry and for each country, separately for all U.S. affiliates combined and MOFAs alone. The corresponding differences between the figures for MOFAs and for all affiliates equals JV sales (= sales by all affiliates – sales by MOFAs) and exports to JVs (= exports to all affiliates – exports to MOFAs). The derivation of the third component,

sales (= exports) to unaffiliated parties is done utilizing the BoC data and is described below.

A.3. Bureau of Census Data.

To complete the computation of the models' sales and export shares we also need U.S. firms direct sales (= exports) to unaffiliated foreign parties, for each industry, country pair. To get this, we start with the BoC data on total exports, by industry, by country. Since total exports include exports to affiliates, we subtract exports to affiliates (using the BEA data) to get sales (= export) to unaffiliated parties.

The Bureau of Census, U.S. export data is organized by 10 digit Harmonized Trade Classification (HTC). To perform the above calculations; that is, to make the data conformable to the BEA data; we need to translate the HTC into ISI classification of the BEA. The BoC data was thus converted into ISI classification, first, by converting it into SIC code using a concordance file provided by the BoC. The converted data then was summed to the relevant ISI code using the description provided by the Bureau of Economic Analysis. The relation between ISI and the SIC code is summarized in Table 4 below.

A.3. World Bank Country Data and other Data.

The data for average manufacturing tariff rate and number of patent applications are from a World Bank Publication called *Development Indicators*. Part of this data is also available on the World Bank home page. Data for foreign taxes are from a Price

Waterhouse publication called *Corporate taxes – A World-Wide Summary.* The data for distance from the U.S. to the destination country was from the Internet website http://www.eiit.org. Dr. Jon Haveman of Purdue University maintains the web site.

A.4. Data Set Preparation and Descriptive Statistics.

The data from the BEA, the World Bank, and the BoC were combined to create a data set with observations corresponding to destination country/parent industry pairs. Observations with missing data were dropped. This resulted in different numbers of useable observations for the sales share and export share models. The dependent variables, the industry description and the associated countries are provided in Tables A2 and A3. Table A4 provides the concordance between three digit SIC and ISI data along with the description of the ISI category. Descriptive statistics for the data sets are provided below: for the sales share model in Tables A7-A13 and for the export share model in Tables A14-A18.

Table A2. Classification of Observations and Values of the Dependent Variables for the Sales Share Model.

Country	ISI Description[a]	Unaffiliated Share	MOFA Share	JV Share
Australia	Grain mill and bakery products	0.015	0.985	0.000
Australia	Agricultural chemicals	0.483	0.517	0.000
Australia	Electronic components and accessories	0.804	0.196	0.000
Australia	Electronic and other electric equipment, nec	0.603	0.397	0.000
Australia	Other manufacturing	0.954	0.046	0.000
Australia	Textile products and apparel	0.216	0.784	0.000
Australia	Printing and publishing	0.008	0.992	0.000
Australia	Oil and gas field services	0.000	1.000	0.000

[a] See Table A4.

Table A2. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
Australia	Stone, clay, and other nonmetallic mineral products	0.446	0.554	0.000
Austria	Chemicals and allied products	0.296	0.587	0.116
Austria	Primary and fabricated metals	0.334	0.666	0.000
Austria	Industrial machinery and equipment	0.670	0.330	0.000
Austria	Electronic and other electric equipment	0.329	0.671	0.000
Belgium	Petroleum	0.019	0.969	0.012
Belgium	Chemicals and allied products	0.130	0.802	0.067
Belgium	Transportation equipment	0.309	0.691	0.000
Belgium	Other manufacturing	0.307	0.675	0.017
Brazil	Industrial chemicals and synthetics	0.250	0.590	0.161
Brazil	Drugs	0.070	0.816	0.113
Brazil	Soap, cleaners, and toilet goods	0.039	0.961	0.000
Brazil	Electronic components and accessories	0.732	0.268	0.000
Brazil	Electronic and other electric equipment, nec	0.349	0.651	0.000
Brazil	Textile products and apparel	0.402	0.598	0.000
Brazil	Instruments and related products	0.108	0.892	0.000
Canada	Grain mill and bakery products	0.177	0.717	0.106
Canada	Industrial chemicals and synthetics	0.404	0.556	0.040
Canada	Drugs	0.292	0.704	0.003
Canada	Soap, cleaners, and toilet goods	0.184	0.816	0.000
Canada	Agricultural chemicals	0.487	0.335	0.178
Canada	Chemical products, nec	0.269	0.726	0.005
Canada	Ferrous	0.753	0.221	0.026
Canada	Nonferrous	0.547	0.446	0.007
Canada	Fabricated metal products	0.543	0.453	0.004
Canada	Electronic components and accessories	0.846	0.152	0.002
Canada	Motor vehicles and equipment	0.341	0.639	0.021
Canada	Crude petroleum extraction (no refining) and natural gas	0.026	0.923	0.051
Canada	Textile products and apparel	0.601	0.355	0.044
Canada	Paper and allied products	0.263	0.535	0.202
Canada	Printing and publishing	0.387	0.613	0.000
Canada	Rubber products	0.325	0.657	0.018
Canada	Miscellaneous plastics products	0.597	0.396	0.007
Canada	Glass products	0.804	0.196	0.000
Canada	Oil and gas field services	0.000	0.969	0.031
Canada	Stone, clay, and other nonmetallic mineral products	0.199	0.801	0.000
Canada	Instruments and related products	0.759	0.239	0.001
Canada	Mining	0.362	0.525	0.113
Chile	Food and kindred products	0.166	0.834	0.000
Chile	Chemicals and allied products	0.473	0.493	0.034
Chile	Other manufacturing	0.190	0.400	0.410
China	Chemicals and allied products	0.737	0.213	0.049
China	Electronic and other electric equipment	0.535	0.436	0.029

Table A2. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
Colombia	Food and kindred products	0.159	0.841	0.000
Colombia	Chemicals and allied products	0.366	0.605	0.028
Colombia	Industrial machinery and equipment	0.995	0.005	0.000
Colombia	Electronic and other electric equipment	0.866	0.134	0.000
Colombia	Other Industry	0.348	0.652	0.000
Ecuador	Food and kindred products	0.194	0.806	0.000
Ecuador	Chemicals and allied products	0.678	0.304	0.017
Ecuador	Industrial machinery and equipment	1.000	0.000	0.000
Ecuador	Electronic and other electric equipment	0.976	0.024	0.000
Ecuador	Transportation equipment	0.433	0.000	0.567
Ecuador	Other Industry	0.149	0.851	0.000
Finland	Chemicals and allied products	0.151	0.849	0.000
Finland	Industrial machinery and equipment	0.919	0.081	0.000
Finland	Transportation equipment	1.000	0.000	0.000
Finland	Other manufacturing	0.213	0.787	0.000
France	Drugs	0.049	0.918	0.034
France	Agricultural chemicals	0.030	0.970	0.000
France	Nonferrous	0.529	0.471	0.000
France	Electronic components and accessories	0.213	0.787	0.000
France	Rubber products	0.043	0.957	0.000
France	Glass products	0.050	0.927	0.023
France	Stone, clay, and other nonmetallic mineral products	0.239	0.761	0.000
France	Instruments and related products	0.207	0.787	0.006
Germany	Industrial chemicals and synthetics	0.063	0.876	0.062
Germany	Agricultural chemicals	1.000	0.000	0.000
Germany	Rubber products	0.045	0.955	0.000
Germany	Glass products	0.327	0.370	0.304
Germany	Instruments and related products	0.332	0.654	0.014
Guatemala	Chemicals and allied products	0.707	0.293	0.000
Guatemala	Industrial machinery and equipment	1.000	0.000	0.000
Guatemala	Electronic and other electric equipment	1.000	0.000	0.000
Guatemala	Transportation equipment	1.000	0.000	0.000
Hong Kong	Petroleum	0.007	0.991	0.002
Hong Kong	Chemicals and allied products	0.555	0.393	0.053
Hong Kong	Primary and fabricated metals	0.803	0.198	0.000
Hong Kong	Industrial machinery and equipment	0.566	0.434	0.000
Hong Kong	Other manufacturing	0.324	0.633	0.043
Hong Kong	Other Industry	0.161	0.755	0.084
India	Petroleum	0.363	0.075	0.562
India	Chemicals and allied products	0.326	0.265	0.409
India	Industrial machinery and equipment	0.500	0.159	0.341
Ireland	Petroleum	0.017	0.983	0.000
Ireland	Food and kindred products	0.064	0.936	0.000
Ireland	Chemicals and allied products	0.082	0.903	0.015
Ireland	Primary and fabricated metals	0.221	0.779	0.000
Ireland	Industrial machinery and equipment	0.200	0.800	0.000

Table A2. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
Ireland	Electronic and other electric equipment	0.158	0.842	0.000
Italy	Chemicals and allied products	0.067	0.835	0.098
Italy	Primary and fabricated metals	0.209	0.791	0.000
Italy	Industrial machinery and equipment	0.087	0.865	0.048
Italy	Other manufacturing	0.119	0.739	0.142
Jamaica	Petroleum	0.369	0.631	0.000
Jamaica	Food and kindred products	1.000	0.000	0.000
Jamaica	Primary and fabricated metals	1.000	0.000	0.000
Jamaica	Industrial machinery and equipment	1.000	0.000	0.000
Jamaica	Electronic and other electric equipment	1.000	0.000	0.000
Jamaica	Transportation equipment	1.000	0.000	0.000
Jamaica	Other manufacturing	0.774	0.226	0.000
Japan	Industrial chemicals and synthetics	0.302	0.095	0.604
Japan	Other	0.360	0.162	0.478
Japan	Oil and gas field services	0.000	1.000	0.000
Korea, Republic of	Food and kindred products	0.497	0.165	0.338
Korea, Republic of	Chemicals and allied products	0.576	0.163	0.261
Korea, Republic of	Electronic and other electric equipment	0.722	0.220	0.059
Malaysia	Petroleum	0.003	0.981	0.016
Malaysia	Primary and fabricated metals	0.732	0.268	0.000
Malaysia	Electronic and other electric equipment	0.296	0.704	0.000
Malaysia	Transportation equipment	1.000	0.000	0.000
Mexico	Food and kindred products	0.263	0.527	0.210
Mexico	Chemicals and allied products	0.289	0.507	0.204
Mexico	Primary and fabricated metals	0.862	0.117	0.021
Mexico	Industrial machinery and equipment	0.763	0.203	0.034
Mexico	Other Industry	0.131	0.113	0.756
Netherlands	Grain mill and bakery products	0.235	0.765	0.000
Netherlands	Soap, cleaners, and toilet goods	0.128	0.673	0.199
Netherlands	Chemical products, nec	0.129	0.862	0.009
Netherlands	Ferrous	0.461	0.539	0.000
Netherlands	Nonferrous	0.206	0.794	0.000
Netherlands	Fabricated metal products	0.208	0.792	0.000
Netherlands	Electronic components and accessories	0.516	0.484	0.000
Netherlands	Textile products and apparel	0.494	0.506	0.000
Netherlands	Paper and allied products	0.427	0.573	0.000
Netherlands	Printing and publishing	0.065	0.935	0.000
Netherlands	Rubber products	0.794	0.206	0.000
Netherlands	Mining	1.000	0.000	0.000
New Zealand	Chemicals and allied products	0.410	0.555	0.035
New Zealand	Industrial machinery and equipment	0.863	0.137	0.000
Norway	Petroleum	0.002	0.840	0.158
Norway	Food and kindred products	0.114	0.886	0.000
Norway	Chemicals and allied products	0.263	0.729	0.007

Table A2. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
Norway	Industrial machinery and equipment	0.624	0.376	0.000
Norway	Electronic and other electric equipment	0.640	0.360	0.000
Norway	Transportation equipment	1.000	0.000	0.000
Panama	Chemicals and allied products	0.649	0.351	0.000
Panama	Industrial machinery and equipment	1.000	0.000	0.000
Panama	Electronic and other electric equipment	1.000	0.000	0.000
Panama	Transportation equipment	1.000	0.000	0.000
Panama	Other Industry	0.149	0.823	0.028
Portugal	Food and kindred products	0.118	0.833	0.049
Portugal	Chemicals and allied products	0.069	0.840	0.091
Portugal	Other Industry	0.874	0.126	0.000
Saudi Arabia	Chemicals and allied products	0.124	0.016	0.860
Saudi Arabia	Other manufacturing	0.648	0.000	0.352
Singapore	Petroleum	0.025	0.952	0.022
Singapore	Chemicals and allied products	0.456	0.429	0.115
Singapore	Industrial machinery and equipment	0.105	0.893	0.002
Singapore	Electronic and other electric equipment	0.350	0.650	0.000
South Africa	Food and kindred products	0.151	0.849	0.000
South Africa	Chemicals and allied products	0.260	0.666	0.075
Sweden	Chemicals and allied products	0.192	0.808	0.000
Sweden	Primary and fabricated metals	0.692	0.097	0.211
Sweden	Electronic and other electric equipment	0.475	0.525	0.000
Switzerland	Food and kindred products	0.145	0.639	0.215
Switzerland	Chemicals and allied products	0.442	0.379	0.179
Switzerland	Primary and fabricated metals	0.837	0.163	0.000
Switzerland	Industrial machinery and equipment	0.562	0.438	0.000
Switzerland	Electronic and other electric equipment	0.357	0.643	0.000
Switzerland	Transportation equipment	1.000	0.000	0.000
Switzerland	Other manufacturing	0.030	0.968	0.002
Switzerland	Other Industry	0.135	0.865	0.000
Trinidad and Tobago	Petroleum	0.019	0.974	0.007
Trinidad and Tobago	Food and kindred products	1.000	0.000	0.000
Trinidad and Tobago	Primary and fabricated metals	0.924	0.076	0.000
Trinidad and Tobago	Industrial machinery and equipment	0.982	0.018	0.000
Trinidad and Tobago	Electronic and other electric equipment	1.000	0.000	0.000
Trinidad and Tobago	Transportation equipment	1.000	0.000	0.000
Turkey	Chemicals and allied products	0.299	0.388	0.313
Turkey	Electronic and other electric equipment	0.632	0.368	0.000
United Kingdom	Grain mill and bakery products	0.048	0.751	0.201

Table A2(continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
United Kingdom	Industrial chemicals and synthetics	0.090	0.893	0.017
United Kingdom	Soap, cleaners, and toilet goods	0.023	0.977	0.000
United Kingdom	Ferrous	0.216	0.784	0.000
United Kingdom	Paper and allied products	0.109	0.889	0.001
United Kingdom	Rubber products	0.094	0.906	0.000
United Kingdom	Glass products	0.085	0.789	0.126
United Kingdom	Stone, clay, and other nonmetallic mineral products	0.143	0.857	0.000
United Kingdom	Instruments and related products	0.147	0.785	0.068
United Kingdom	Mining	0.978	0.022	0.000

Table A3. Classification of Observations and Values of the Dependent Variables for the Export Share Model.

Country	ISI Description[a]	Unaffiliated Share	MOFA Share	JV Share
Australia	Grain mill and bakery products	0.801	0.199	0.000
Australia	Industrial chemicals and synthetics	0.540	0.460	0.000
Australia	Drugs	0.850	0.150	0.000
Australia	Soap, cleaners, and toilet goods	0.796	0.204	0.000
Australia	Ferrous	0.893	0.107	0.000
Australia	Nonferrous	1.000	0.000	0.000
Australia	Fabricated metal products	0.786	0.214	0.000
Australia	Other manufacturing	0.810	0.190	0.000
Australia	Electronic components and accessories	0.960	0.040	0.000
Australia	Electronic and other electric equipment, nec	0.948	0.052	0.000
Australia	Other	0.998	0.002	0.000
Australia	Textile products and apparel	0.940	0.060	0.000
Australia	Printing and publishing	0.192	0.809	0.000
Australia	Rubber products	0.970	0.030	0.000
Australia	Miscellaneous plastics products	0.875	0.117	0.007
Australia	Glass products	0.880	0.000	0.120
Australia	Stone, clay, and other nonmetallic mineral products	0.898	0.102	0.000
Australia	Instruments and related products	0.643	0.357	0.000
Austria	Chemical and allied Products	1.000	0.000	0.000
Austria	Primary and fabricated metals	1.000	0.000	0.000
Austria	Industrial machinery and equipment	0.984	0.016	0.000
Austria	Other manufacturing	0.821	0.179	0.000
Austria	Other Industries	1.000	0.000	0.000
Belgium	Food and kindred products	0.852	0.136	0.012
Belgium	Chemical and allied Products	0.544	0.355	0.101
Belgium	Primary and fabricated metals	0.933	0.067	0.000
Belgium	Industrial machinery and equipment	0.907	0.093	0.000

[a] See Table A4.

Table A3. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
Belgium	Electronic and other electric equipment	0.930	0.068	0.002
Belgium	Transportation equipment	0.966	0.016	0.018
Belgium	Other manufacturing	0.890	0.092	0.018
Belgium	Other Industries	1.000	0.000	0.000
Brazil	Grain mill and bakery products	0.928	0.072	0.000
Brazil	Industrial chemicals and synthetics	0.867	0.130	0.003
Brazil	Drugs	0.685	0.315	0.000
Brazil	Soap, cleaners, and toilet goods	0.631	0.369	0.000
Brazil	Agricultural chemicals	0.521	0.479	0.000
Brazil	Ferrous	1.000	0.000	0.000
Brazil	Other	0.880	0.118	0.002
Brazil	Electronic components and accessories	0.980	0.020	0.000
Brazil	Motor vehicles and equipment	0.529	0.340	0.132
Brazil	Crude petroleum extraction (no refining) and natural gas	1.000	0.000	0.000
Brazil	Other	1.000	0.000	0.000
Brazil	Textile products and apparel	0.954	0.046	0.000
Brazil	Paper and allied products	0.531	0.469	0.000
Brazil	Printing and publishing	1.000	0.000	0.000
Brazil	Glass products	0.737	0.263	0.000
Brazil	Stone, clay, and other nonmetallic mineral products	0.968	0.032	0.000
Brazil	Instruments and related products	0.401	0.599	0.000
Brazil	Mining	0.996	0.000	0.004
Canada	Grain mill and bakery products	0.840	0.158	0.001
Canada	Industrial chemicals and synthetics	0.728	0.272	0.000
Canada	Soap, cleaners, and toilet goods	0.477	0.523	0.000
Canada	Ferrous	0.958	0.041	0.001
Canada	Nonferrous	0.899	0.100	0.001
Canada	Fabricated metal products	0.857	0.142	0.001
Canada	Other	0.766	0.234	0.000
Canada	Textile products and apparel	0.904	0.095	0.001
Canada	Printing and publishing	0.830	0.170	0.000
Canada	Rubber products	0.611	0.389	0.000
Canada	Miscellaneous plastics products	0.902	0.098	0.000
Canada	Stone, clay, and other nonmetallic mineral products	0.731	0.269	0.000
Canada	Instruments and related products	0.871	0.129	0.000
Chile	Chemical and allied Products	0.909	0.085	0.006
Chile	Primary and fabricated metals	0.879	0.043	0.078
Chile	Industrial machinery and equipment	0.999	0.000	0.001
Chile	Electronic and other electric equipment	1.000	0.000	0.000
China	Food and kindred products	0.983	0.017	0.000
Colombia	Chemical and allied Products	0.817	0.151	0.031
Colombia	Primary and fabricated metals	0.959	0.041	0.000
Colombia	Industrial machinery and equipment	0.999	0.001	0.000

Table A3. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
Colombia	Electronic and other electric equipment	0.993	0.007	0.000
Ecuador	Food and kindred products	0.814	0.186	0.000
Ecuador	Chemical and allied Products	0.966	0.034	0.000
Ecuador	Primary and fabricated metals	0.912	0.088	0.000
Ecuador	Industrial machinery and equipment	1.000	0.000	0.000
Ecuador	Electronic and other electric equipment	1.000	0.000	0.000
Ecuador	Transportation equipment	1.000	0.000	0.000
Ecuador	Other manufacturing	0.975	0.025	0.000
Ecuador	Other Industries	0.940	0.000	0.060
Finland	Petroleum	1.000	0.000	0.000
Finland	Food and kindred products	0.983	0.017	0.000
Finland	Chemical and allied Products	0.904	0.096	0.000
Finland	Primary and fabricated metals	1.000	0.000	0.000
Finland	Industrial machinery and equipment	0.994	0.006	0.000
Finland	Electronic and other electric equipment	1.000	0.000	0.000
Finland	Transportation equipment	1.000	0.000	0.000
Finland	Other manufacturing	0.875	0.125	0.000
Finland	Other Industries	1.000	0.000	0.000
France	Grain mill and bakery products	0.774	0.226	0.000
France	Industrial chemicals and synthetics	0.641	0.359	0.000
France	Drugs	0.606	0.394	0.000
France	Soap, cleaners, and toilet goods	0.801	0.199	0.000
France	Agricultural chemicals	0.284	0.716	0.000
France	Ferrous	1.000	0.000	0.000
France	Nonferrous	0.981	0.019	0.000
France	Fabricated metal products	0.734	0.225	0.041
France	Other manufacturing	0.858	0.142	0.000
France	Electronic and other electric equipment, nec	0.919	0.081	0.000
France	Crude petroleum extraction (no refining) and natural gas	1.000	0.000	0.000
France	Textile products and apparel	0.984	0.016	0.000
France	Paper and allied products	0.671	0.329	0.000
France	Printing and publishing	0.769	0.231	0.000
France	Miscellaneous plastics products	0.748	0.252	0.000
France	Glass products	0.886	0.114	0.000
France	Stone, clay, and other nonmetallic mineral products	0.965	0.035	0.000
France	Instruments and related products	0.660	0.339	0.001
France	Mining	1.000	0.000	0.000
Germany	Grain mill and bakery products	0.989	0.011	0.000
Germany	Industrial chemicals and synthetics	0.540	0.459	0.001
Germany	Drugs	0.776	0.224	0.000
Germany	Agricultural chemicals	1.000	0.000	0.000
Germany	Ferrous	0.953	0.047	0.000
Germany	Other manufacturing	0.870	0.130	0.000
Germany	Electronic components and accessories	0.698	0.302	0.000

Table A3. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
Germany	Crude petroleum extraction (no refining) and natural gas	1.000	0.000	0.000
Germany	Other	1.000	0.000	0.000
Germany	Paper and allied products	0.649	0.351	0.000
Germany	Printing and publishing	0.952	0.048	0.000
Germany	Rubber products	0.574	0.426	0.000
Germany	Miscellaneous plastics products	0.893	0.107	0.000
Germany	Stone, clay, and other nonmetallic mineral products	0.952	0.048	0.000
Germany	Instruments and related products	0.795	0.203	0.002
Germany	Mining	1.000	0.000	0.000
Guatemala	Food and kindred products	0.966	0.025	0.008
Guatemala	Chemical and allied Products	0.952	0.048	0.000
Guatemala	Industrial machinery and equipment	1.000	0.000	0.000
Guatemala	Electronic and other electric equipment	1.000	0.000	0.000
Guatemala	Transportation equipment	1.000	0.000	0.000
Hong Kong	Petroleum	0.500	0.000	0.500
Hong Kong	Food and kindred products	0.988	0.012	0.000
Hong Kong	Primary and fabricated metals	0.954	0.039	0.008
Hong Kong	Industrial machinery and equipment	0.898	0.102	0.000
Hong Kong	Other Industries	0.899	0.000	0.101
India	Petroleum	0.975	0.000	0.025
India	Food and kindred products	0.957	0.032	0.011
India	Chemical and allied Products	0.960	0.009	0.030
India	Primary and fabricated metals	1.000	0.000	0.000
India	Industrial machinery and equipment	0.982	0.014	0.004
India	Electronic and other electric equipment	0.983	0.006	0.011
India	Transportation equipment	0.997	0.000	0.003
India	Other Industries	1.000	0.000	0.000
Ireland	Petroleum	1.000	0.000	0.000
Ireland	Chemical and allied Products	0.811	0.149	0.039
Ireland	Primary and fabricated metals	0.699	0.252	0.048
Ireland	Industrial machinery and equipment	0.694	0.306	0.000
Ireland	Electronic and other electric equipment	0.569	0.431	0.000
Ireland	Transportation equipment	0.973	0.027	0.000
Ireland	Other Industries	0.972	0.000	0.028
Italy	Petroleum	0.957	0.000	0.043
Italy	Food and kindred products	0.885	0.110	0.005
Italy	Chemical and allied Products	0.776	0.193	0.031
Italy	Primary and fabricated metals	0.982	0.018	0.000
Italy	Industrial machinery and equipment	0.635	0.354	0.011
Italy	Electronic and other electric equipment	0.879	0.121	0.000
Italy	Other Industries	0.985	0.000	0.015
Jamaica	Petroleum	0.980	0.000	0.020
Jamaica	Food and kindred products	1.000	0.000	0.000
Jamaica	Primary and fabricated metals	1.000	0.000	0.000
Jamaica	Industrial machinery and equipment	1.000	0.000	0.000

Table A3. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
Jamaica	Electronic and other electric equipment	1.000	0.000	0.000
Jamaica	Transportation equipment	1.000	0.000	0.000
Japan	Grain mill and bakery products	1.000	0.000	0.000
Japan	Industrial chemicals and synthetics	0.922	0.044	0.034
Japan	Drugs	0.780	0.220	0.000
Japan	Soap, cleaners, and toilet goods	0.922	0.067	0.011
Japan	Agricultural chemicals	0.993	0.007	0.000
Japan	Chemical products, nec	0.535	0.371	0.094
Japan	Ferrous	1.000	0.000	0.000
Japan	Electronic components and accessories	0.637	0.361	0.003
Japan	Electronic and other electric equipment, nec	0.998	0.001	0.001
Japan	Motor vehicles and equipment	0.988	0.003	0.009
Japan	Crude petroleum extraction (no refining) and natural gas	1.000	0.000	0.000
Japan	Other	1.000	0.000	0.000
Japan	Rubber products	0.992	0.003	0.005
Japan	Glass products	0.976	0.024	0.000
Japan	Stone, clay, and other nonmetallic mineral products	0.950	0.036	0.014
Japan	Instruments and related products	0.859	0.113	0.028
Japan	Mining	1.000	0.000	0.000
Korea, Republic of	Petroleum	0.998	0.000	0.002
Korea, Republic of	Chemical and allied Products	0.905	0.050	0.045
Korea, Republic of	Primary and fabricated metals	0.997	0.001	0.001
Korea, Republic of	Electronic and other electric equipment	0.904	0.088	0.009
Malaysia	Food and kindred products	0.980	0.020	0.000
Malaysia	Primary and fabricated metals	1.000	0.000	0.000
Malaysia	Electronic and other electric equipment	0.524	0.463	0.013
Malaysia	Transportation equipment	1.000	0.000	0.000
Malaysia	Other Industries	0.986	0.000	0.014
Mexico	Food and kindred products	0.935	0.046	0.020
Mexico	Chemical and allied Products	0.795	0.119	0.085
Mexico	Primary and fabricated metals	0.961	0.034	0.005
Mexico	Industrial machinery and equipment	0.885	0.105	0.010
Mexico	Other Industries	0.886	0.004	0.110
Netherlands	Soap, cleaners, and toilet goods	1.000	0.000	0.000
Netherlands	Agricultural chemicals	0.969	0.031	0.000
Netherlands	Ferrous	1.000	0.000	0.000
Netherlands	Motor vehicles and equipment	0.997	0.003	0.000
Netherlands	Crude petroleum extraction (no refining) and natural gas	1.000	0.000	0.000
Netherlands	Other manufacturing	1.000	0.000	0.000
Netherlands	Textile products and apparel	1.000	0.000	0.000

Table A3. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
Netherlands	Paper and allied products	0.869	0.131	0.000
Netherlands	Printing and publishing	0.890	0.110	0.000
Netherlands	Rubber products	0.988	0.012	0.000
Netherlands	Glass products	0.959	0.041	0.000
Netherlands	Instruments and related products	0.676	0.324	0.001
Netherlands	Mining	1.000	0.000	0.000
New Zealand	Petroleum	1.000	0.000	0.000
New Zealand	Food and kindred products	0.984	0.000	0.016
New Zealand	Chemical and allied Products	0.918	0.082	0.000
New Zealand	Primary and fabricated metals	0.974	0.026	0.000
New Zealand	Industrial machinery and equipment	0.993	0.007	0.000
New Zealand	Electronic and other electric equipment	0.985	0.015	0.000
New Zealand	Transportation equipment	1.000	0.000	0.000
New Zealand	Other manufacturing	0.722	0.278	0.000
New Zealand	Other Industries	0.679	0.080	0.241
Norway	Chemical and allied Products	0.802	0.198	0.000
Norway	Primary and fabricated metals	1.000	0.000	0.000
Norway	Electronic and other electric equipment	1.000	0.000	0.000
Norway	Transportation equipment	1.000	0.000	0.000
Norway	Other manufacturing	1.000	0.000	0.000
Norway	Other Industries	0.977	0.000	0.023
Panama	Chemical and allied Products	0.904	0.096	0.000
Panama	Primary and fabricated metals	1.000	0.000	0.000
Panama	Industrial machinery and equipment	1.000	0.000	0.000
Panama	Electronic and other electric equipment	1.000	0.000	0.000
Panama	Transportation equipment	1.000	0.000	0.000
Panama	Other manufacturing	0.872	0.128	0.000
Portugal	Petroleum	1.000	0.000	0.000
Portugal	Food and kindred products	1.000	0.000	0.000
Portugal	Chemical and allied Products	0.897	0.103	0.000
Portugal	Primary and fabricated metals	0.935	0.065	0.000
Portugal	Industrial machinery and equipment	1.000	0.000	0.000
Portugal	Transportation equipment	1.000	0.000	0.000
Portugal	Other Industries	1.000	0.000	0.000
Saudi Arabia	Petroleum	0.777	0.000	0.223
Saudi Arabia	Food and kindred products	1.000	0.000	0.000
Saudi Arabia	Industrial machinery and equipment	1.000	0.000	0.000
Saudi Arabia	Transportation equipment	1.000	0.000	0.000
Singapore	Petroleum	0.760	0.017	0.223
Singapore	Food and kindred products	0.954	0.005	0.041
Singapore	Chemical and allied Products	0.886	0.111	0.003
Singapore	Industrial machinery and equipment	0.587	0.408	0.005
Singapore	Electronic and other electric equipment	0.672	0.317	0.010
Singapore	Transportation equipment	0.963	0.037	0.000
South Africa	Petroleum	0.845	0.000	0.155
South Africa	Food and kindred products	1.000	0.000	0.000
South Africa	Industrial machinery and equipment	0.931	0.064	0.005

Table A3. (continued)

Country	ISI Description	Unaffiliated Share	MOFA Share	JV Share
South Africa	Transportation equipment	0.986	0.014	0.000
South Africa	Other Industries	0.991	0.000	0.009
Sweden	Petroleum	0.447	0.442	0.111
Sweden	Food and kindred products	0.992	0.008	0.000
Sweden	Primary and fabricated metals	1.000	0.000	0.000
Sweden	Industrial machinery and equipment	0.978	0.022	0.000
Sweden	Transportation equipment	1.000	0.000	0.000
Sweden	Other manufacturing	0.487	0.363	0.150
Sweden	Other Industries	1.000	0.000	0.000
Switzerland	Food and kindred products	0.991	0.009	0.000
Switzerland	Chemical and allied Products	0.987	0.012	0.001
Switzerland	Primary and fabricated metals	0.994	0.006	0.000
Switzerland	Electronic and other electric equipment	0.878	0.123	0.000
Switzerland	Transportation equipment	1.000	0.000	0.000
Switzerland	Other Industries	0.822	0.000	0.178
Trinidad and Tobago	Food and kindred products	1.000	0.000	0.000
Trinidad and Tobago	Industrial machinery and equipment	1.000	0.000	0.000
Trinidad and Tobago	Electronic and other electric equipment	1.000	0.000	0.000
Trinidad and Tobago	Transportation equipment	1.000	0.000	0.000
Trinidad and Tobago	Other Industries	1.000	0.000	0.000
Turkey	Petroleum	0.784	0.036	0.180
Turkey	Primary and fabricated metals	0.977	0.000	0.023
Turkey	Electronic and other electric equipment	0.994	0.006	0.000
Turkey	Other Industries	1.000	0.000	0.000
United Kingdom	Industrial chemicals and synthetics	0.690	0.310	0.000
United Kingdom	Drugs	0.324	0.676	0.000
United Kingdom	Soap, cleaners, and toilet goods	0.524	0.476	0.000
United Kingdom	Ferrous	0.963	0.037	0.000
United Kingdom	Fabricated metal products	0.567	0.422	0.011
United Kingdom	Crude petroleum extraction (no refining) and natural gas	0.673	0.327	0.000
United Kingdom	Textile products and apparel	0.838	0.162	0.000
United Kingdom	Paper and allied products	0.660	0.340	0.000
United Kingdom	Rubber products	0.843	0.157	0.000
United Kingdom	Miscellaneous plastics products	0.882	0.111	0.007
United Kingdom	Glass products	0.790	0.157	0.052
United Kingdom	Stone, clay, and other nonmetallic mineral products	0.863	0.137	0.000
United Kingdom	Instruments and related products	0.549	0.448	0.003
United Kingdom	Mining	1.000	0.000	0.000

Table A4. Concordance of ISI and SIC.

ISI Category	ISI Description	1987 SIC Category
	Petroleum	
	Oil and Gas Extraction	
133	Crude Petroleum Extraction (no refining) and natural gas	132 and part of 131
138	Oil and Gas field Services	138
	Petroleum and Coal Products	
291	Integrated petroleum refining and extraction	131+291
292	Petroleum refining without extraction	291
299	Petroleum and Coal Products nec.	295+299
517	Petroleum wholesale trade	
	Other	
441	Petroleum tanker trade	
461	Petroleum and natural gas pipeline	
470	Petroleum storage for higher	
554	Gasoline Service Stations	
	Manufacturing	
	Food and Kindred Products	
	Grain Mill and Bakery Product	
204	Grain Mill Products	204
205	Bakery Products	205
208	Beverage	208
	Other	
201	Meat Products	201
202	Dairy Products	202
203	Preserved fruits and vegetables	203
209	Other food and kindred products	206+207+209
	Chemical and Allied Products	
281	Industrial Chemical and Synthetic	281+282+286
283	Drugs	283
284	Soap, Cleaners and toilet Goods	284
287	Agricultural Chemicals	287
289	Chemical products, nec	285+289
	Primary and fabricated metals	
	Primary metal Industry	
331	Ferrous	331+332+339
335	Nonferrous	333+334+335+336

Table A4. (continued)

ISI Category	ISI Description	1987 SIC Category
	Fabricated metal products	
341	Metal cans, forging and stampings	341+346
342	Cutlery, hand tools, and screw products	342+345
343	Heating and plumbing equipment and structural metal products	343+344
349	Fabricated metal products, nec , ordinance and services	347+348+349
	Industrial machinery and equipment	
352	Farms and garden machinery	352
353	Construction, mining and material handling machinery	353
357	Computer and office equipment	357
	Other	
351	Engines and turbines	351
354	Metalworking machinery	354
355	Special industry machinery	355
356	General industry machinery and equipment	356
358	Refrigeration and service industry machinery	358
359	Industrial machinery and equipment nec.	359
	Electronic and other electric equipment	
363	Household appliances	363
366	Household audio and video equipment and communication equipment	365+366
367	Electronic components and accessories	367
369	Electronic and other electric equipment, nec	361+362+364+369
	Transportation equipment	
371	Motor vehicle and equipment	371
379	Other	372+373+374+375+376+379
	Other manufacturing	
210	Tobacco products	21
	Textile products and apparel	
220	Textile mill products	22
230	Apparel and other textile products	23
	Lumber , wood, furniture and fixtures	
240	Lumber and wood products	24
250	Furniture and fixtures	25
	Paper and allied products	

Table A4. (continued)

ISI Category	ISI Description	1987 SIC Category
262	Pulp, paper and board mills	261+262+263
265	Other paper and allied products	265+267
	Printing and Publishing	
271	Newspaper	271
272	Misc. publishing	272+273+274+277
275	Commercial printing and services	275+276+278+279
305	**Rubber products**	301+302+305+306
308	**Misc. plastic products**	308
321	**Glass products**	321+322+323
329	**Stone, clay and other non-metallic mineral products**	324+325+326+327+328+329
	Instruments and related products	
381	Measuring, scientific, and optical instruments	381+382+387
384	Medical instrument and supplies and ophthalmic goods	384+385
386	Photgraphic equipment and supplies	386
	Other	
310	Leather and leather products	31
390	Misc. manufacturing industry	39
	Wholesale trade	
	Durable goods	
501	Motor vehicles and equipment	
503	Lumber and construction materials	
504	Professional and commercial equipment and supplies	
505	Metals and minerals	
506	Electric goods	
507	Hardware, plumbing and heating equipment and supplies	
508	Machinery equipment and supplies, nec	
509	Durable goods, nec	
	Nondurable goods	
511	Paper and paper products	
512	Drugs, proprietaries and sundries	
513	Apparel, pieces goods, and notions	
514	Groceries and related products	
515	Farm products raw materials	
519	Nondurable goods nec	
	Finance (except depository institutions), Insurance and real estate	

Table A4. (continued)

ISI Category	ISI Description	1987 SIC Category
	Finance, except depository institutions	
679	Business franchising	
612	Other	
	Insurance	
631	Life Insurance	
632	Accident and health insurance	
639	Other	
650	Real estate	
671	Holding Companies	
905	Non-business entities except Government	
	Services	
700	Hotels and other lodging places	
	Business franchising	
731	Advertising	
735	Equipment rental (ex automobile and computers)	
	Computer processing and data preparation services	
741	*Computer processing and data preparation*	
742	Information retrieval service	
743	Computer related service, nec	
	Business services, nec	
734	Sevices to buildings	
736	Personnel supply services	
749	Other	
751	Automotive rental and leasing	
780	Motion pictures, including television tape and film	
800	Health service	
871	Engineering, architectural and surveying services	
874	Management and public relations services	
	Other	
752	Automotive parking, repair and other service	
760	Misc. repair services	
790	Amusement and recreation service	
810	Legal Service	
820	Education services	
872	Accounting, auditing and bookkeeping services	

Table A4. (continued)

ISI Category	ISI Description	1987 SIC Category
873	Research and development and testing services	
890	Other services provided on a commercial basis	
	Other Industry	
	Agriculture, forestry and fishing	
010	Agricultural production-crops	01
020	Agricultural production- livestock	020
070	Agricultural services	07
080	Forestry	08
090	Fishing, hunting and trapping	09
	Mining	
	Metal mining	
101	Iron ores	101
102	Copper, lead, zinc, gold, silver ores	102+103+104
107	Other metallic ores	106+109
108	Metal mining services	108
	Nonmetalic minerals	
120	Coal	122+123
124	Coal mining services	124
140	Nonmetalic mineral, except fuels	14 except 148
148	Nonmetallic minerals services,except fuels	148
150	Construction	15+16+17
	Transportation	
401	Railroads	
449	Water transportation	
450	Transportation by air	
462	Pipeline, except petroleum and natural gas	
472	Passenger transportation arrangements	
477	Transportation and related services, nec	
	Communications	
481	Telephone and telegraph communication	
483	Other communications service	
490	Electric, gas, and sanitary service	
	Retail trade	
530	General merchandise stores	
540	Food stores	

Table A4. (continued)

ISI Category	ISI Description	1987 SIC Category
560	Apparel and accessory stores	
580	Eating and drinking places	
590	Retail trade, nec	

Table A5. Countries Covered in the Estimation of the Sales Shares.

Countries	Frequency
Australia	9
Austria	5
Belgium	4
Brazil	7
Canada	22
Chile	3
China	2
Colombia	5
Ecuador	6
Finland	4
France	8
Germany	5
Guatemala	4
Hong Kong	6
India	3
Ireland	6
Italy	4
Jamaica	7
Japan	3
Korea, Republic of	3
Malaysia	4
Mexico	5
Netherlands	12
New Zealand	2
Norway	6
Panama	5
Portugal	3
Saudi Arabia	2
Singapore	4
South Africa	2
Sweden	3
Switzerland	8
Trinidad and Tobago	6
Turkey	2
United Kingdom	11

Table A6. Countries Covered in the Estimation of the Export Shares.

Countries	Frequency
Australia	18
Austria	5
Belgium	8
Brazil	18
Canada	13
Chile	4
China	1
Colombia	4
Ecuador	8
Finland	9
France	19
Germany	16
Guatemala	5
Hong Kong	5
India	8
Ireland	7
Italy	7
Jamaica	6
Japan	17
Korea, Republic of	4
Malaysia	5
Mexico	5
Netherlands	13
New Zealand	9
Norway	6
Panama	6
Portugal	7
Saudi Arabia	4
Singapore	6
South Africa	5
Sweden	7
Switzerland	6
Trinidad and Tobago	5
Turkey	4
United Kingdom	14

Table A7. Frequency of Types of Observations.

Description	Sales Share	Export Share
Unaffiliated, MOFA, and Joint Venture > 0.	81	67
Unaffiliated, MOFA > 0, and Joint Venture = 0.	84	117
Unaffiliated > 0, MOFA=0, and Joint Venture > 0.	2	21
Unaffiliated = 0, MOFA and Joint Venture > 0.	1	0
Unaffiliated > 0, MOFA and Joint Venture = 0.	21	79
Unaffiliated = 0, MOFA > 0 and Joint Venture = 0.	2	0
Unaffiliated = 0, MOFA = 0 and Joint Venture > 0.	0	0
Total # of Observations	191	284

Table A8. Descriptive Statistics for Data used in Estimating Sales Share Model: All Observations.

Description	N	MEAN	S.D	MIN	MAX
Y_1	191	0.422	0.329	0.000	1.000
Y_2	191	0.520	0.335	0.000	1.000
Y_3	191	0.058	0.135	0.000	0.860
x_1	191	-0.031	0.791	-2.694	2.214
x_2	191	6.933	2.741	1.609	12.722
x_3	191	1.879	0.957	-0.511	4.432
x_4	191	0.141	0.349	0.000	1.000
x_5	191	0.272	0.446	0.000	1.000
x_6	191	0.826	0.174	0.143	0.964
x_{7A}	191	-1.218	1.303	-4.754	0.726
x_{7B}	191	8.419	1.070	5.724	10.168
x_8	191	8.833	1.324	5.566	11.202
x_{9A}	191	3.883	0.227	3.291	4.283
x_{9B}	191	3.303	0.649	1.413	4.312
x_{10}	191	4.625	0.324	3.799	5.568
x_{11}	191	3.439	0.286	2.303	4.094
x_{12}	191	5.993	1.274	3.466	7.796
x_{13}	191	8.540	0.846	6.598	9.678

Table A9. Descriptive Statistics for Data used in Estimating Sales Share Model: Observations for which Unaffiliated, MOFA, and JV share > 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	81	0.301	0.232	0.002	0.862
Y_2	81	0.575	0.281	0.016	0.991
Y_3	81	0.125	0.172	0.001	0.860
Industry Specific Variables[a]:					
x_1	28	-0.34894	1.023985	-2.694	1.705547
x_8	28	8.317306	1.265598	5.586815	10.80302
x_{9A}	28	3.86784	0.238127	3.290767	4.282761
x_{10}	28	4.604465	0.361128	3.799303	5.56804
Country Specific Variables[b]:					
x_2	31	6.864827	2.747334	2.079442	12.72207
x_3	31	2.012103	1.016931	-0.51083	4.432007
x_4	31	0.064516	0.249731	0	1
x_5	31	0.16129	0.373878	0	1
x_6	31	0.796251	0.179954	0.143423	0.953177
x_{7A}	31	-1.55113	1.516814	-4.75359	0.726335
x_{7B}	31	8.242095	0.982599	6.047494	10.16818
x_{9B}	31	3.185805	0.746681	1.412908	4.311533
x_{11}	31	3.464123	0.31055	2.302585	4.094345
x_{12}	31	5.726155	1.054924	3.465736	7.796058
x_{13}	31	8.832892	0.613138	6.598365	9.652527

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

Table A10. Descriptive Statistics for Data used in Estimating Sales Share Model: Observations for which Unaffiliated and MOFA > 0, and JV = 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	84	0.406	0.300	0.005	0.995
Y_2	84	0.594	0.300	0.005	0.995
Y_3	84	0.000	0.000	0.000	0.000
Industry Specific Variables[a]:					
x_1	26	-0.15585	0.992315	-2.4998	2.214197
x_8	26	8.14867	1.418002	5.686358	10.7067
x_{9A}	26	3.847431	0.221497	3.290767	4.180883
x_{10}	26	4.64008	0.356109	3.80436	5.438099
Country Specific Variables[b]:					
x_2	29	6.333154	2.712382	1.609438	10.858
x_3	29	1.802989	0.945326	-0.51083	3.054001
x_4	29	0.034483	0.185695	0	1
x_5	29	0.206897	0.412251	0	1
x_6	29	0.845386	0.149438	0.143423	0.963964
x_{7A}	29	-1.53406	1.522474	-4.75359	0.726335
x_{7B}	29	8.306862	1.049787	5.724369	10.16818
x_{9B}	29	3.264815	0.626909	2.096986	4.311533
x_{11}	29	3.410686	0.291887	2.302585	3.806663
x_{12}	29	5.607925	1.170522	3.465736	7.796058
x_{13}	29	8.741014	0.645246	6.598365	9.677719

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

Table A11. Descriptive Statistics for Data used in Estimating Sales Share Model: Observations for which Unaffiliated > 0, MOFA = 0, and JV > 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	2	0.540	0.152	0.433	0.648
Y_2	2	0.000	0.000	0.000	0.000
Y_3	2	0.460	0.152	0.352	0.567
Industry Specific Variables[a]:					
x_1	2	-0.2622	0.357284	-0.51484	-0.00956
x_8	2	10.2704	0.043169	10.23987	10.30092
x_{9A}	2	3.982622	0.280383	3.784362	4.180883
x_{10}	2	4.9796	0.648415	4.521102	5.438099
Country Specific Variables[b]:					
x_2	2	2.705823	0.885837	2.079442	3.332205
x_3	2	1.229794	1.739192	0	2.459589
x_4	2	0	0	0	0
x_5	2	0	0	0	0
x_6	2	0.665839	0.308609	0.447619	0.884058
x_{7A}	2	0	0	0	0
x_{7B}	2	7.554836	1.34982	6.600369	8.509303
x_{9B}	2	2.868812	0.989607	2.169054	3.56857
x_{11}	2	3.512769	0.415628	3.218876	3.806663
x_{12}	2	4.427118	0.293606	4.219508	4.634729
x_{13}	2	8.836006	0.645657	8.379457	9.292554

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

Table A12. Descriptive Statistics for Data used in Estimating Sales Share Model: Observations for which Unaffiliated = 0, MOFA > 0, and JV > 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	1	0.000	.	0.000	0.000
Y_2	1	0.969	.	0.969	0.969
Y_3	1	0.031	.	0.031	0.031
Industry Specific Variables[a]:					
x_1	1	-0.77909	.	-0.77909	-0.77909
x_8	1	7.337337	.	7.337337	7.337337
x_{9A}	1	3.807984	.	3.807984	3.807984
x_{10}	1	4.346156	.	4.346156	4.346156
Country Specific Variables[b]:					
x_2	1	8.019284	.	8.019284	8.019284
x_3	1	2.272126	.	2.272126	2.272126
x_4	1	1	.	1	1
x_5	1	1	.	1	1
x_6	1	0.925979	.	0.925979	0.925979
x_{7A}	1	-0.90764	.	-0.90764	-0.90764
x_{7B}	1	9.849243	.	9.849243	9.849243
x_{9B}	1	3.515968	.	3.515968	3.515968
x_{11}	1	3.433987	.	3.433987	3.433987
x_{12}	1	7.63627	.	7.63627	7.63627
x_{13}	1	6.598365	.	6.598365	6.598365

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

Table A13. Descriptive Statistics for Data used in Estimating Sales Share Model: Observations for which Unaffiliated > 0, MOFA and JV = 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	21	1.000	0.000	1.000	1.000
Y_2	21	0.000	0.000	0.000	0.000
Y_3	21	0.000	0.000	0.000	0.000
Industry Specific Variables[a]:					
x_1	7	-0.67663	1.244218	-2.4998	0.784148
x_8	7	8.847438	1.319693	6.322016	10.17085
x_{9A}	7	3.906958	0.22425	3.456097	4.180883
x_{10}	7	4.679754	0.379415	4.341586	5.438099
Country Specific Variables[b]:					
x_2	11	5.393221	3.271837	1.609438	10.858
x_3	11	1.64009	1.099849	0	2.85647
x_4	11	0	0	0	0
x_5	11	0	0	0	0
x_6	11	0.8685	0.05896	0.757576	0.963964
x_{7A}	11	-1.40447	1.700232	-4.75359	0.726335
x_{7B}	11	8.008421	1.354687	5.724369	10.16818
x_{9B}	11	3.131803	0.855748	2.096986	4.311533
x_{11}	11	3.476996	0.211716	3.218876	3.806663
x_{12}	11	5.034962	1.303672	3.465736	7.228389
x_{13}	11	8.542116	0.520801	7.752024	9.638857

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

Table A14. Descriptive Statistics for Data used in Estimating Sales Share Model: Observations for which Unaffiliated = 0, MOFA > 0, and JV = 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	2	0.000	0.000	0.000	0.000
Y_2	2	1.000	0.000	1.000	1.000
Y_3	2	0.000	0.000	0.000	0.000
Industry Specific Variables[a]:					
x_1	1	-0.77909	.	-0.77909	-0.77909
x_8	1	7.462636	.	7.462636	7.462636
x_{9A}	1	3.807984	.	3.807984	3.807984
x_{10}	1	4.346156	.	4.346156	4.346156
Country Specific Variables[b]:					
x_2	2	10.93126	2.532583	9.140454	12.72207
x_3	2	2.063648	0.559945	1.667707	2.459589
x_4	2	0	0	0	0
x_5	2	0.5	0.707107	0	1
x_6	2	0.747946	0.171497	0.62668	0.869213
x_{7A}	2	-0.59381	0.997138	-1.29889	0.111278
x_{7B}	2	9.043276	0.142599	8.942444	9.144108
x_{9B}	2	3.798901	0.384007	3.527367	4.070435
x_{11}	2	3.560424	0.090392	3.496508	3.624341
x_{12}	2	6.827831	0.128501	6.736967	6.918695
x_{13}	2	9.487589	0.268884	9.29746	9.677719

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

Table A15. Descriptive Statistics for Data used in Estimating Export Share Model: All Observations.

Description	N	MEAN	S.D	MIN	MAX
Y_1	284	0.885	0.155	0.191	1.000
Y_2	284	0.102	0.149	0.000	0.809
Y_3	284	0.013	0.046	0.000	0.500
x_1	284	-0.066	0.924	-2.694	2.214
x_2	284	7.537	2.849	1.609	12.722
x_3	284	1.965	0.887	-0.511	4.432
x_4	284	0.063	0.244	0.000	1.000
x_5	284	0.232	0.423	0.000	1.000
x_6	284	0.790	0.211	0.143	0.964
x_{7A}	284	-1.139	1.365	-4.754	0.726
x_{7B}	284	8.410	0.998	5.724	10.168
x_8	284	8.751	1.358	5.566	11.193
x_{9A}	284	3.872	0.235	3.291	4.283
x_{9B}	284	3.352	0.659	1.413	4.312
x_{10}	284	4.640	0.371	3.799	5.568
x_{11}	284	3.469	0.278	2.303	4.094
x_{12}	284	6.009	1.162	3.466	7.796
x_{13}	284	8.789	0.665	6.598	9.678

Table A16. Descriptive Statistics for Data used in Estimating Export Share model: Observations for which Unaffiliated, MOFA, and JV > 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	67	0.819	0.153	0.447	0.998
Y_2	67	0.149	0.141	0.001	0.463
Y_3	67	0.033	0.053	0.000	0.241
Industry Specific Variables[a]:					
x_1	26	-0.13325	0.648893	-1.75052	0.951316
x_8	26	8.328023	1.316454	5.586815	10.7079
x_{9A}	26	3.844713	0.242441	3.290767	4.282761
x_{10}	26	4.648364	0.38298	3.863168	5.56804
Country Specific Variables[b]:					
x_2	25	7.338872	2.709023	1.609438	12.72207
x_3	25	1.908832	1.067859	-0.51083	4.432007
x_4	25	0.08	0.276888	0	1
x_5	25	0.24	0.43589	0	1
x_6	25	0.801352	0.184096	0.143423	0.953177
x_{7A}	25	-1.5583	1.438338	-4.46591	0.726335
x_{7B}	25	8.254224	1.033681	5.724369	9.849243
x_{9B}	25	3.225163	0.705824	1.412908	4.311533
x_{11}	25	3.436054	0.328923	2.302585	4.094345
x_{12}	25	6.00479	1.028488	3.850148	7.796058
x_{13}	25	8.880288	0.67381	6.598365	9.677719

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

Table A17. Descriptive Statistics for Data used in Estimating Export Share model: Observations for which Unaffiliated and MOFA > 0, and JV = 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	117	0.838	0.170	0.191	0.999
Y_2	117	0.162	0.170	0.001	0.809
Y_3	117	0.000	0.000	0.000	0.000
Industry Specific Variables[a]:					
x_1	29	-0.20459	1.02483	-2.694	2.214197
x_8	29	8.093176	1.274012	5.566106	10.39478
x_{9A}	29	3.872149	0.229007	3.290767	4.282761
x_{10}	29	4.650551	0.420489	3.799303	5.56804
Country Specific Variables[b]:					
x_2	28	6.974214	2.809599	1.609438	12.72207
x_3	28	1.869149	0.93375	-0.51083	3.627004
x_4	28	0.035714	0.188982	0	1
x_5	28	0.214286	0.417855	0	1
x_6	28	0.845157	0.15411	0.143423	0.963964
x_{7A}	28	-1.54931	1.466272	-4.75359	0.726335
x_{7B}	28	8.360419	1.072232	5.724369	10.16818
x_{9B}	28	3.282863	0.718922	1.525957	4.311533
x_{11}	28	3.395249	0.287886	2.302585	3.73767
x_{12}	28	5.815833	1.048092	3.850148	7.796058
x_{13}	28	8.828448	0.629745	6.598365	9.677719

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

Table A18. Descriptive Statistics for Data used in Estimating Export Share model: Observations for which Unaffiliated > 0, MOFA = 0, and JV > 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	21	0.926	0.117	0.500	0.999
Y_2	21	0.000	0.000	0.000	0.000
Y_3	21	0.074	0.117	0.001	0.500
Industry Specific Variables[a]:					
x_1	8	-0.14489	1.088138	-2.4998	0.951316
x_8	8	9.18322	1.26773	6.821949	10.55518
x_{9A}	8	3.855089	0.270253	3.456097	4.180883
x_{10}	8	4.716651	0.390487	4.346369	5.438099
Country Specific Variables[b]:					
x_2	17	6.303505	2.58461	1.94591	10.9895
x_3	17	1.898813	1.238376	0	4.432007
x_4	17	0	0	0	0
x_5	17	0.235294	0.437237	0	1
x_6	17	0.785063	0.154482	0.421569	0.953177
x_{7A}	17	-1.70943	1.455967	-4.46591	0.294439
x_{7B}	17	8.066502	1.065726	6.047494	10.16818
x_{9B}	17	3.062801	0.731213	1.412908	4.311533
x_{11}	17	3.402334	0.390496	2.302585	4.094345
x_{12}	17	5.310275	0.88323	3.496508	6.736967
x_{13}	17	9.050895	0.510682	7.752024	9.677719

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

Table A19. Descriptive Statistics for Data used in Estimating Export Share model: Observations for which Unaffiliated > 0, MOFA = 0, and JV = 0.

Description	N	MEAN	S.D	MIN	MAX
Y_1	79	1.000	0.000	1.000	1.000
Y_2	79	0.000	0.000	0.000	0.000
Y_3	79	0.000	0.000	0.000	0.000
Industry Specific Variables[a]:					
x_1	19	-0.31572	1.242808	-2.694	2.214197
x_8	19	8.46862	1.568199	5.686358	10.7067
x_{9A}	19	3.852819	0.256843	3.290767	4.180883
x_{10}	19	4.593221	0.414029	3.799303	5.438099
Country Specific Variables[b]:					
x_2	27	6.713302	2.91273	1.609438	12.72207
x_3	27	1.934592	0.989617	0	4.432007
x_4	27	0	0	0	0
x_5	27	0.185185	0.395847	0	1
x_6	27	0.800501	0.190888	0.143423	0.963964
x_{7A}	27	-1.46128	1.616414	-4.75359	0.726335
x_{7B}	27	8.220056	1.110455	5.724369	10.16818
x_{9B}	27	3.237403	0.749461	1.412908	4.311533
x_{11}	27	3.476241	0.315913	2.302585	4.094345
x_{12}	27	5.448632	1.163166	3.465736	7.796058
x_{13}	27	8.837317	0.48904	7.752024	9.677719

[a] The means are calculated based on the unique number of industries, represented in this subset of the data.
[b] The means are calculated based on the unique number of countries, represented in this subset of the data.

APPENDIX B: COMPUTER PROGRAMS USED FOR ESTIMATION

Program 1: Maximum Likelihood Estimation.

```
/*  maxlik1.gss   */
/*   Program to calculate maximum likelihood estimates   */
/*    of regression coefficients and variance parameters    */
/*   Uses share data and exogenous variable data read in from
gdata2.txt  */
library optmum ;
optset ;
_opstmth = "bfgs brent" ;
_opmdmth = "newton stepbt" ;
clear _n,_y1,_y2,_y3,_muvec,_yvec,_ivsig,_dsig ;
/*       */
/*   Read in data  */
/*       */
output file = d:\thesis\sic\run1\sales\run3\maxlik3.out reset ;
n = 191 ;
_n = n ;
load data[] = d:\thesis\sic\run1\sales\run3\sales3.txt ;
data = reshape(data, 191, 18) ;
_y1 = data[.,1];
_y2 = data[.,2];
_y3 = data[.,3] ;
_x1 = data[.,4] ;
_x2 = data[.,5] ;
_x3 = data[.,6] ;
_x4 = data[.,7] ;
_x5 = data[.,8] ;
_x6 = data[.,9] ;
_x7 = data[.,10] ;
_x8 = data[.,11] ;
_x9 = data[.,12] ;
_x10 = data[.,13] ;
_x11 = data[.,14] ;
_x12 = data[.,15] ;
_x13 = data[.,16];
_x14 = data[.,17];
_x15 = data[.,18];

/*   Set initial values for parameter vector   */
xx0 = {  0.577,
0.0134,
-0.1206,
0.2237,
-0.0286,
0.309,
-0.0504,
```

```
-0.1152,
-0.0089,
-0.175,
0.3398,
0.3726,
0.1697,
-0.2915,
-0.037,
-0.0719,
2.6249,
-0.0438,
0.1806,
-0.4769,
0.0518,
-0.1351,
0.0257,
0.0959,
-0.0017,
0.0779,
-0.4005,
-0.3672,
-0.4409,
0.2474,
-0.0094,
0.2387,
0.0784,
0.0771,
-0.0664
};



/*   Call optmum    */
{ xx, ff, gg, retcode } = optmum(&fct, xx0) ;
print xx ;
print ff ;
print gg ;
print retcode ;
/*       */
/*   Procedure to evaluate likelihood function   */
/*       */
proc fct(xx) ;
local mu1, mu2, sig11, sig22, sig12, y1, y2, y3, t1, t2, t3,
    n, c1, c2, c3, c4, c5, c6, c7, muvec, obstype, sig13,
  sig23, sig33, mu3, yvec, dsig12, dsig23, dsig31, ivsig12,
    ivsig23, ivsig31, ulim, i, fcttmp, fac,
   x1, x2, x3, x4, x5, x6, x7, x8, x9, x10, x11, x12,x13,x14, x15,
  b10, b11, b12, b13, b14, b15, b16, b17, b18, b19, b110, b111,
b112,b113,b114,
  b115,
  b20, b21, b22, b23, b24, b25, b26, b27, b28, b29, b210, b211,
b212,b213,b214,
   b215;
ulim = 5.0 ;
_intord = 40 ;
```

```
n = _n ;
y1 = _y1 ;
y2 = _y2 ;
y3 = _y3 ;
x1 = _x1 ;
x2 = _x2 ;
x3 = _x3 ;
x4 = _x4 ;
x5 = _x5 ;
x6 = _x6 ;
x7 = _x7 ;
x8 = _x8 ;
x9 = _x9 ;
x10 = _x10 ;
x11 = _x11 ;
x12 = _x12 ;
x13 = _x13;
x14 = _x14;
x15 =_x15;

t1 = y1 .GT zeros(n, 1) ;
t2 = y2 .GT zeros(n, 1) ;
t3 = y3 .GT zeros(n, 1) ;
c1 = t1 .* t2 .* t3 ;
c2 = t1 .* t2 .* (ones(n, 1) - t3) ;
c3 = t1 .* (ones(n ,1) - t2) .* (ones(n, 1) - t3) ;
c4 = (ones(n, 1) - t1) .* t2 .* t3 ;
c5 = (ones(n, 1) - t1) .* t2 .* (ones(n, 1) - t3) ;
c6 = (ones(n, 1) - t1) .* (ones(n, 1) - t2) .* t3 ;
c7 = t1 .* (ones(n, 1) - t2) .* t3 ;
obstype = c1 + 2.0*c2 + 3.0*c3 + 4.0*c4 +
              5.0*c5 + 6.0*c6 + 7.0*c7 ;
b10 = xx[1] ;
b11 = xx[2] ;
b12 = xx[3] ;
b13 = xx[4] ;
b14 = xx[5] ;
b15 = xx[6] ;
b16 = xx[7] ;
b17 = xx[8] ;
b18 = xx[9] ;
b19 = xx[10] ;
b110 = xx[11];
b111 = xx[12];
b112 = xx[13];
b113 = xx[14];
b114 = xx[15] ;
b115 =xx[16];

b20 = xx[17] ;
b21 = xx[18] ;
b22 = xx[19] ;
b23 = xx[20] ;
b24 = xx[21];
b25 = xx[22] ;
```

```
b26 = xx[23] ;
b27 = xx[24] ;
b28 =  xx[25];
b29 =  xx[26];
b210 = xx[27] ;
b211 = xx[28] ;
b212 = xx[29] ;
b213 = xx[30];
b214 = xx[31];
b215 = xx[32];

mu1 = b10.*ones(n, 1) +b11.*x1+b12.*x2+b13.*x3+b14.*x4+b15.*x5+
     b16.*x6+b17.*x7+b18.*x8+b19.*x9
   +b110.*x10+b111.*x11+b112.*x12+b113.*x13+b114.*x14+b115.*x15 ;
mu2 = b20.*ones(n,1) +b21.*x1+b22.*x2+b23.*x3+
     b24.*x4+b25.*x5+b26.*x6+
     b27.*x7+b28.*x8+b29.*x9
   +b210.*x10+b211.*x11+b212.*x12+b213.*x13+b214.*x14+b215.*x15 ;
sig11 = xx[33] ;
sig22 = xx[34] ;
sig12 = xx[35] ;
sig13 = -sig11 - sig12 ;
sig23 = -sig12 - sig22 ;
sig33 = sig11 + 2.0*sig12 + sig22 ;
mu3 = 1.0 - mu1 - mu2 ;
dsig12 = sig11*sig22 - sig12*sig12 ;
dsig23 = sig22*sig33 - sig23*sig23 ;
dsig31 = sig33*sig11 - sig13*sig13 ;
ivsig12 = inv(((sig11 ~ sig12) | (sig12 ~ sig22))) ;
ivsig23 = inv(((sig22 ~ sig23) | (sig23 ~ sig33))) ;
ivsig31 = inv(((sig33 ~ sig13) | (sig13 ~ sig11))) ;
fcttmp = 0.0 ;
   i = 1 ;
do while i LE n ;
   if obstype[i] EQ 1 ;
      yvec = y1[i] | y2[i] ;
      muvec = mu1[i] | mu2[i] ;
      fac = (exp(-0.5*(yvec-muvec)' * ivsig12 *
            (yvec-muvec)))/2.0/pi/dsig12^0.5 ;
   endif ;
   if obstype[i] EQ 2 ;
      _muvec = mu1[i] | mu2[i] ;
      _yvec = y1[i] | y2[i] ;
      _ivsig = ivsig12 ;
      _dsig = dsig12 ;
      fac = intquad1(&f1, ulim | y1[i]) ;
   endif ;
   if obstype[i] EQ 3 ;
      _muvec = mu1[i] | mu2[i] ;
      _ivsig = ivsig12 ;
      _dsig = dsig12 ;
      fac = intgrat2(&f2, ulim | 1, &g1 | &g2) ;
   endif ;
   if obstype[i] EQ 4 ;
      _muvec = mu2[i] | mu3[i] ;
```

```
      _yvec = y2[i] | y3[i] ;
      _ivsig = ivsig23 ;
      _dsig = dsig23 ;
      fac = intquad1(&f1, ulim | y2[i]) ;
   endif ;
   if obstype[i] EQ 5 ;
      _muvec = mu2[i] | mu3[i] ;
      _ivsig = ivsig23 ;
      _dsig = dsig23 ;
      fac = intgrat2(&f2, ulim | 1, &g1 | &g2) ;
   endif ;
   if obstype[i] EQ 6 ;
      _muvec = mu3[i] | mu1[i] ;
      _ivsig = ivsig31 ;
      _dsig = dsig31 ;
      fac = intgrat2(&f2, ulim | 1, &g1 | &g2) ;
   endif ;
   if obstype[i] EQ 7 ;
      _muvec = mu3[i] | mu1[i] ;
      _yvec = y3[i] | y1[i] ;
      _ivsig = ivsig31 ;
      _dsig = dsig31 ;
      fac = intquad1(&f1, ulim | y3[i]) ;
   endif ;
fcttmp = fcttmp - ln(fac) ;
   i = i + 1 ;
endo ;
retp(fcttmp) ;
endp ;
/*         */
/*   Procedure to evaluate integrand required for  */
/*   likelihood factor in k = 2 - type observations    */
/*         */
proc f1(x) ;
local ya, yb, mua, mub ;
ya = _yvec[1] ;
yb = _yvec[2] ;
mua = _muvec[1] ;
mub = _muvec[2] ;
retp((exp(-0.5 .* (_ivsig[1,1] .* (x - mua)^2
      + 2.0 .* _ivsig[1,2] .* (x - mua) .* (x .* yb ./ ya - mub)
     + _ivsig[2,2] .* (x .* yb ./ ya - mub)^2)))
     .* ((1 + (yb ./ ya)^2)^0.5)
    ./ 2.0 ./ pi ./ _dsig^0.5 ) ;
endp ;
/*            */
/*    Procedure to evaluate integrand required for    */
/*    likelihood factor in k = 3 - type observations   */
/*        */
proc f2(x,y) ;
local mua, mub ;
mua = _muvec[1] ;
mub = _muvec[2] ;
retp((exp(-0.5 .* (_ivsig[1,1] .* (x - mua)^2
   + 2.0 .* _ivsig[1,2] .* (x - mua) .* ( y - mub)
```

```
    + _ivsig[2,2] .* (y - mub)^2)))
   ./ 2.0 ./ pi ./ _dsig^0.5) ;
endp ;
/*       */
/*   Procedures to set limits of integration   */
/*     for calls to intgrat2    */
/*        */
proc g1(x) ;
   retp(0) ;
endp ;
proc g2(x) ;
   retp(1 - x) ;
endp ;
```

Program 2: Variance of Maximum Likelihood Estimates.

```
/*  hesn1.gss   */
/*   Program to calculate numerical Hessian   */
/*    of likelihood function using centered differences    */
/*    Likelihood function corresponds to maxlik1.gss estimation program
*/
/*   Uses share data and exogenous variable data read in from
gdata2.txt  */
clear _n,_y1,_y2,_y3,_muvec,_yvec,_ivsig,_dsig ;
/*       */
/*   Read in data  */
/*       */
output file = d:\thesis\sic\run1\sales\run3\hesn3.out reset ;
n = 191 ;
_n = n ;
load data[] = d:\thesis\sic\run1\sales\run3\sales3.txt ;
data = reshape(data, 191, 18) ;
_y1 = data[.,1];
_y2 = data[.,2];
_y3 = data[.,3] ;
_x1 = data[.,4] ;
_x2 = data[.,5] ;
_x3 = data[.,6] ;
_x4 = data[.,7] ;
_x5 = data[.,8] ;
_x6 = data[.,9] ;
_x7 = data[.,10] ;
_x8 = data[.,11] ;
_x9 = data[.,12] ;
_x10 = data[.,13] ;
_x11 = data[.,14] ;
_x12 = data[.,15] ;
_x13 = data[.,16] ;
_x14 = data[.,17] ;
```

```
_x15 = data[.,18] ;

print "Done reading data" ;
/*   Set parameter values at which Hessian is to be evaluated   */
xx = { 0.81536410,
      0.011867943,
      -0.11822585,
       0.23930281,
     -0.040382361,
       0.29284607,
     -0.052348037,
      -0.11811261,
     -0.014788291,
      -0.18410993,
       0.34184878,
       0.38106265,
       0.12896717,
      -0.30094159,
     -0.037324591,
     -0.050239682,
        2.2683245,
     -0.037628549,
       0.16476589,
      -0.54213190,
      0.070149208,
     -0.051252252,
      0.033824438,
      0.097292048,
      0.017268011,
      0.091289298,
      -0.41614409,
      -0.37719727,
      -0.33029918,
       0.25421596,
     -0.016961663,
       0.16624871,
      0.082699186,
      0.095842043,
     -0.072222464
};
print xx ;
loglik = fct(xx) ;
print loglik ;
np = 35 ;
hesn = zeros(np,np) ;
del = 0.001 ;
ic = 1 ;
do while ic <= np ;
jc = 1 ;
do while jc <= np ;
print ic jc ;
xx1 = xx ;
xx2 = xx ;
xx3 = xx ;
xx4 = xx ;
```

```
xx1[ic] = (1.0 + del/2.0)*xx1[ic] ;
xx1[jc] = (1.0 + del/2.0)*xx1[jc] ;
xx2[ic] = (1.0 - del/2.0)*xx2[ic] ;
xx2[jc] = (1.0 + del/2.0)*xx2[jc] ;
xx3[ic] = (1.0 + del/2.0)*xx3[ic] ;
xx3[jc] = (1.0 - del/2.0)*xx3[jc] ;
xx4[ic] = (1.0 - del/2.0)*xx4[ic] ;
xx4[jc] = (1.0 - del/2.0)*xx4[jc] ;
loglik1 = -fct(xx1) ;
loglik2 = -fct(xx2) ;
loglik3 = -fct(xx3) ;
loglik4 = -fct(xx4) ;
hesn[ic,jc] = (loglik1 - loglik2 - loglik3 + loglik4)/xx[ic]/xx[jc]
                    /del/del ;
jc = jc + 1 ;
endo ;
ic = ic + 1 ;
endo ;
covmat = inv(-hesn) ;
pcovmat= (covmat[1,1]-covmat[1,2]-covmat[1,3]);
print covmat;

j = 1 ;
do while j <= np ;
stderr = covmat[j,j]^0.5 ;
/* print covmat ;*/
j = j + 1 ;
endo ;
/*       */
/*   Procedure to evaluate likelihood function   */
/*       */
proc fct(xx) ;
local mu1, mu2, sig11, sig22, sig12, y1, y2, y3, t1, t2, t3,
    n, c1, c2, c3, c4, c5, c6, c7, muvec, obstype, sig13,
  sig23, sig33, mu3, yvec, dsig12, dsig23, dsig31, ivsig12,
    ivsig23, ivsig31, ulim, i, fcttmp, fac,
   x1, x2, x3, x4, x5, x6, x7, x8, x9, x10, x11, x12,x13,x14,x15,
  b10, b11, b12, b13, b14, b15, b16, b17, b18, b19, b110, b111,
b112,b113,b114,
  b115,
  b20, b21, b22, b23, b24, b25, b26, b27, b28, b29, b210, b211,
b212,b213,b214,
  b215;
ulim = 5.0 ;
_intord = 40 ;
n = _n ;
y1 = _y1 ;
y2 = _y2 ;
y3 = _y3 ;
x1 = _x1 ;
x2 = _x2 ;
x3 = _x3 ;
x4 = _x4 ;
x5 = _x5 ;
x6 = _x6 ;
```

```
x7 = _x7 ;
x8 = _x8 ;
x9 = _x9 ;
x10 = _x10 ;
x11 = _x11 ;
x12 = _x12 ;
x13 = _x13;
x14 = _x14;
x15 = _x15;

t1 = y1 .GT zeros(n, 1) ;
t2 = y2 .GT zeros(n, 1) ;
t3 = y3 .GT zeros(n, 1) ;
c1 = t1 .* t2 .* t3 ;
c2 = t1 .* t2 .* (ones(n, 1) - t3) ;
c3 = t1 .* (ones(n ,1) - t2) .* (ones(n, 1) - t3) ;
c4 = (ones(n, 1) - t1) .* t2 .* t3 ;
c5 = (ones(n, 1) - t1) .* t2 .* (ones(n, 1) - t3) ;
c6 = (ones(n, 1) - t1) .* (ones(n, 1) - t2) .* t3 ;
c7 = t1 .* (ones(n, 1) - t2) .* t3 ;
obstype = c1 + 2.0*c2 + 3.0*c3 + 4.0*c4 +
              5.0*c5 + 6.0*c6 + 7.0*c7 ;
b10 = xx[1]  ;
b11 = xx[2]  ;
b12 = xx[3]  ;
b13 = xx[4]  ;
b14 = xx[5]  ;
b15 = xx[6]  ;
b16 = xx[7]  ;
b17 = xx[8]  ;
b18 = xx[9]  ;
b19 = xx[10] ;
b110 = xx[11];
b111 = xx[12] ;
b112 = xx[13] ;
b113 = xx[14] ;
b114 = xx[15] ;
b115 = xx[16];

b20 =  xx[17] ;
b21 =  xx[18] ;
b22 =  xx[19] ;
b23 =  xx[20] ;
b24 =  xx[21] ;
b25 =  xx[22] ;
b26 =  xx[23] ;
b27 =  xx[24] ;
b28 =  xx[25] ;
b29 =  xx[26] ;
b210 = xx[27] ;
b211 = xx[28] ;
b212 = xx[29] ;
b213 = xx[30] ;
b214 = xx[31] ;
b215 = xx[32] ;
```

```
mu1 = b10.*ones(n, 1) +b11.*x1+b12.*x2+b13.*x3+b14.*x4+b15.*x5+
b16.*x6+b17.*x7+b18.*x8+b19.*x9+b110.*x10+b111.*x11+b112.*x12+b113.*x13
+b114.*x14+b115.*x15;
mu2 = b20.*ones(n,1) +b21.*x1+b22.*x2+b23.*x3+
b24.*x4+b25.*x5+b26.*x6+
     b27.*x7+b28.*x8+b29.*x9
   +b210.*x10+b211.*x11+b212.*x12+b213.*x13+b214.*x14+b215.*x15 ;
sig11 = xx[33] ;
sig22 = xx[34] ;
sig12 = xx[35] ;
sig13 = -sig11 - sig12 ;
sig23 = -sig12 - sig22 ;
sig33 = sig11 + 2.0*sig12 + sig22 ;
mu3 = 1.0 - mu1 - mu2 ;
dsig12 = sig11*sig22 - sig12*sig12 ;
dsig23 = sig22*sig33 - sig23*sig23 ;
dsig31 = sig33*sig11 - sig13*sig13 ;
ivsig12 = inv(((sig11 ~ sig12) | (sig12 ~ sig22))) ;
ivsig23 = inv(((sig22 ~ sig23) | (sig23 ~ sig33))) ;
ivsig31 = inv(((sig33 ~ sig13) | (sig13 ~ sig11))) ;
fcttmp = 0.0 ;
   i = 1 ;
do while i LE n ;
   if obstype[i] EQ 1 ;
      yvec = y1[i] | y2[i] ;
      muvec = mu1[i] | mu2[i] ;
      fac = (exp(-0.5*(yvec-muvec)' * ivsig12 *
            (yvec-muvec)))/2.0/pi/dsig12^0.5 ;
   endif ;
   if obstype[i] EQ 2 ;
      _muvec = mu1[i] | mu2[i] ;
      _yvec = y1[i] | y2[i] ;
      _ivsig = ivsig12 ;
      _dsig = dsig12 ;
      fac = intquad1(&f1, ulim | y1[i]) ;
   endif ;
   if obstype[i] EQ 3 ;
      _muvec = mu1[i] | mu2[i] ;
      _ivsig = ivsig12 ;
      _dsig = dsig12 ;
      fac = intgrat2(&f2, ulim | 1, &g1 | &g2) ;
   endif ;
   if obstype[i] EQ 4 ;
      _muvec = mu2[i] | mu3[i] ;
      _yvec = y2[i] | y3[i] ;
      _ivsig = ivsig23 ;
      _dsig = dsig23 ;
      fac = intquad1(&f1, ulim | y2[i]) ;
   endif ;
   if obstype[i] EQ 5 ;
      _muvec = mu2[i] | mu3[i] ;
      _ivsig = ivsig23 ;
      _dsig = dsig23 ;
      fac = intgrat2(&f2, ulim | 1, &g1 | &g2) ;
```

```
   endif ;
   if obstype[i] EQ 6 ;
      _muvec = mu3[i] | mu1[i] ;
      _ivsig = ivsig31 ;
      _dsig = dsig31 ;
      fac = intgrat2(&f2, ulim | 1, &g1 | &g2) ;
   endif ;
   if obstype[i] EQ 7 ;
      _muvec = mu3[i] | mu1[i] ;
      _yvec = y3[i] | y1[i] ;
      _ivsig = ivsig31 ;
      _dsig = dsig31 ;
      fac = intquad1(&f1, ulim | y3[i]) ;
   endif ;
fcttmp = fcttmp - ln(fac) ;
   i = i + 1 ;
endo ;
retp(fcttmp) ;
endp ;
/*         */
/*   Procedure to evaluate integrand required for  */
/*   likelihood factor in k = 2 - type observations    */
/*         */
proc f1(x) ;
local ya, yb, mua, mub ;
ya = _yvec[1] ;
yb = _yvec[2] ;
mua = _muvec[1] ;
mub = _muvec[2] ;
retp((exp(-0.5 .* (_ivsig[1,1] .* (x - mua)^2
      + 2.0 .* _ivsig[1,2] .* (x - mua) .* (x .* yb ./ ya - mub)
     + _ivsig[2,2] .* (x .* yb ./ ya - mub)^2)))
     .* ((1 + (yb ./ ya)^2)^0.5)
    ./ 2.0 ./ pi ./ _dsig^0.5 ) ;
endp ;
/*            */
/*    Procedure to evaluate integrand required for    */
/*    likelihood factor in k = 3 - type observations   */
/*        */
proc f2(x,y) ;
local mua, mub ;
mua = _muvec[1] ;
mub = _muvec[2] ;
retp((exp(-0.5 .* (_ivsig[1,1] .* (x - mua)^2
   + 2.0 .* _ivsig[1,2] .* (x - mua) .* ( y - mub)
    + _ivsig[2,2] .* (y - mub)^2)))
   ./ 2.0 ./ pi ./ _dsig^0.5) ;
endp ;
/*       */
/*   Procedures to set limits of integration   */
/*     for calls to intgrat2    */
/*        */
proc g1(x) ;
   retp(0) ;
endp ;
```

```
proc g2(x) ;
   retp(1 - x) ;
endp ;
```

BIBLIOGRAPHY

"After the Deal (1999)." *The Economist*, January 9, 1999. pp. 21-23.

Aghion, P., and Tirole, J. (1994). "The Management of Innovation." *Quarterly Journal of Economics*, pp. 1185-1209.

Amemiya, T. (1974). "Multivariate Regression and Simultaneous Equation Models when the Dependent Variables are Truncated Normal." *Econometrica*, pp. 999-1012.

Balassa, B. (1986). "Intra-Industry Specialization: A Cross-Country Analysis." *European Economic Review*, pp. 27-42.

Barrell, R. and Pain N. (1996). "An Econometric Analysis of Foreign Direct Investment." *Review of Economics and Statistics*, pp. 200-207.

Bernard, J.-T. and Weiner, R. J. (1990). "Multinational Corporations, Transfer Prices, and Taxes: Evidence from the U.S. Petroleum Industry." in Razin, A. and Slemrod, J. (eds.), *Taxation in the Global Economy*, Chicago: The University of Chicago Press.

Brainard Lael, S. (1997). "An Empirical Assessment of the Proximity-Concentration Trade-off Between Multinational Sales and Trade." *American Economic Review*, pp. 520-544.

Benvignati, A. M. (1990). " Industry Determinants and Differences in U.S. Intrafirm and Arms-Length Exports." *Review of Economics and Statistics*, pp. 481-488.

Caves, R.E (1996). *Multinational Enterprise and Economic Analysis*. Cambridge: Cambridge University Press.

Coase, R. (1937). "The Nature of the Firm." *Economica*, pp. 386-405.

Ethier, W. J. (1986). "The Multinational Firm." *Quarterly Journal of Economics*, pp. 805-833.

Ethier, W. J. and Horn H. (1986). "Managerial Control of International Firms and Pattern of Direct Investment." *International Economic Review*, pp. 25-45.

Galbraith, C. S and Kay N. M. (1986). "Towards a Theory of Multinational Enterprise." *Journal of Law, Economics and Organization*, pp. 3-19.

Gatignon, H. and Anderson, E. (1988). "The Multinational Corporation's Degree of Control over Foreign Subsidiaries: An Empirical Test of a Transactions Cost Explanation." *Journal of Law, Economics and Organization*, pp. 305-336.

Gomes-Casseres, B. (1989). "Ownership Structures of Foreign Subsidiaries: Theory and Evidence." *Journal of Economic Behavior and Organization*, pp 1-25.

Greene W. H (1997). *Econometric Analysis.* 3rd Edition, Upper Saddle River NJ: Prentice Hall.

Greenway, D., Hine R. and Milner C. (1995). "Vertical and Horizontal Intra-Industry Trade: A Cross Industry Analysis for the United Kingdom." *The Economic Journal*, pp.1505-1518.

Grossman, S., and Hart, O. (1986). "The Cost and Benefits of Ownership: A Theory of Vertical and Lateral Integration." *Journal of Political Economy*, pp. 691-719.

Grout, P. (1984). "Investment and Wages in the Absence of Binding Contracts: A Nash Bargaining Approach. "*Econometrica*, pp. 449-60.

Grubert, H. and Mutti J. (1991). "Taxes, Tariffs and Transfer Pricing in Multinational Corporate Decision Making." *Review of Economics and Statistics*, pp. 285-293.

Hart ,O. (1994). "Firms, Contracts and Financial Structure." in *Clarendon Lectures in Economics*, Oxford: Oxford University Press.

Hart, O. (1987). "Incomplete Contracts" in Eatwell J., Milgate M., Newman P.,eds. *The New Palgrave : a Dictionary of Economics.* New York: Stockton Press.

Hart, O., and Moore, J. (1990). "Property Rights and Nature of the Firm." *Journal of Political Economy*, pp. 1119-1158.

Hart, O., and Moore, J. (1988). "Incomplete Contracts and Renegotiation." *Econometrica*, pp. 755-785

Holmstrom,B. and Tirole, J. (1991). Transfer Pricing and the Organizational Form. *Journal of Law, Economics and Organization*, pp. 201-228.

Horstmann, I. J., and Markusen J. R. (1996). "Exploring New Markets: Direct Investment Contractual Relations and the Multinational Enterprise." *International Economics Review*, pp 1-19.

Lall, S. (1979). "The Pattern of Intra-Firm Exports by US Multinationals." *Oxford Bulletin of Economics and Statistics*, pp 209-222.

LaMont, H. (1975). "Multinational Enterprise, Transfer Pricing and the 482 Mess." *Columbia Journal of Transnational Law*, pp. 383-433.

Lipsey R. E. and Weiss M. Y. (1981). "Foreign Production and Exports in Manufacturing Industries." *Review of Economics and Statistics*, pp. 488-494.

Lipsey R. E. and Weiss M. Y. (1981). "Foreign Production and Exports of Individual Firms." *Review of Economics and Statistics*, pp. 304-307.

Mas-Colell, A., Whinston M.D. and Green J. (1995) *Microeconomic Theory*. New York : Oxford University Press

"Multinational Back in Fashion (1993)." *The Economist*, pp. 5-20.

Price Waterhouse (1994). *Corporate taxes – A world-wide Summary*. New York: Price Waterhouse.

Sachs, J. (1998). "Global Capitalism: Making it Work." *The Economist*, pp. 23-25 September 12, 1998.

Segal, I. (1996). "Complexity and Renegotiation: A Foundation for Incomplete Contracts." Working Paper; Department of Economics, University of California, Berkley.

Teece, D. J (1986). "Transactions Cost Economics and the Multinational Enterprise: An Assesment." *Journal of Law Economics and Organization*, pp. 21-45.

"The Case for Corporate Alliances (1999)." *The Economist*, pp. 73-74. May 15 1999.

Tirole, J.(1994). "Incomplete Contracts : Where do we Stand?" Walras-Bowley lecture at 1994 North American Summer meeting of the Econometric Society in Quebec City.

U.S. Bureau of Economic Analysis. "U.S. Direct Investment Abroad, Benchmark Survey 1994." Washington, DC: U.S. Bureau of Economic Analysis.

U.S. Bureau of Census. "Import and Export of Merchandise 1994." Washington, DC: U.S. Bureau of Census.

"U.S. Multinationals in India." *Far Eastern Economic Review*, pp 102-111. August 22 1996.

Wales, T. and Woodland A. (1983). "Estimation of Consumer Demand Systems with Binding Non-negativity Constraints," *Journal of Econometrics*, pp.263-285.

Williamson, O. E. (1990) ed. *Organization Theory: From Chester Barnard to the Present and Beyond*. Oxford: Oxford University Press.

Williamson, O. E. (1985) *The Economic Institution of Capitalism*. New York: Free Press.

Williamson, O. E. (1979) " Transaction-Cost Economics: The Governance of Contractual Relations." *Journal of Law and Economics*, pp. 233-61.

Williamson, O. E. (1975). *Market and Hierarchies: Analysis and Antitrust Implication*. New York: Free Press

World Bank. "Development Indicators 1995." Washington, DC, World Bank.