INTRA-FIRM TRADE AND TRANSFER PRICING IN MULTINATIONAL AGRIBUSINESS FIRMS

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PREFACE

Multinational firms (MNFs) have been a favorite target of political criticism from both the political left and the political right. To be sure, the pervasive economic power of large MNFs has from time to time been abused in both the political and economic arenas (see Kindleberger [1984]). When sufficient evidence of abuse has been exposed, national governments and supranational institutions have been quick to act in promulgating regulations and conventions to curb irresponsible corporate practices. One such practice of MNFs that has been noted since the middle 1960's is manipulative transfer pricing -- the use of intra-firm prices for intermediate products traded between divisions of an MNF to avoid tax payments. Regulating transfer pricing has grown more complex since the problem was first recognized as have the structure of MNFs and the environment in which they operate. Concomitantly, the complexity of economic models of MNF issues has increased.

Several economics articles have attempted to model different aspects of intra-firm trade and transfer pricing. They have done so in a variety of ways and have succeeded in describing MNF behavior for a number of rather specific situations. In reviewing the literature on transfer pricing, it became apparent to me that the trend was toward

developing a "theory of the multinational firm" but that the body of works lacked generality. I was also disturbed by the lack of discussion of intra-firm trade issues in the agricultural economics literature.

This thesis is intended to bring some order to the discussion of these issues and to propose a more general model of the multinational firqm, more along the lines of traditional economic firm theory. The approach is purely economic: the political, financial, and managerial issues surrounding intra-firm trade and transfer pricing are not paid the attention they would deserve in a more comprehensive analysis of MNF behavior. My hope is that the dissemination of this work will encourage more discussion among agricultural economists on the issues I address here. Reactions from those with whom I have discussed the topic have been very encouraging in this regard.

Sage advice from economists is a rare thing. It is especially rare when it comes from a young economist. Dr. Shida Henneberry has been a fount of such advice in the two years she has advised me and directed the progress of this thesis. I owe her a great debt for this advice and for her enduring patience and optimism through the endless drafts of chapters, journal articles, and mathematical models that have culminated in what follows. Dr. Jim Russell, now at the University of Maryland, provided the idea for this topic and supervised the initial work. His encouragement, foresight, and honesty in introducing me to graduate study were

invaliable as were his continued interest and suggestions since his departure from Oklahoma State.

I must also express my appreciation for the advice, direction, and encouragement of Drs. David Henneberry, Bob Oehrtman, and David Pyles, who have served as members of my thesis committee. This endeavor has certainly been more enjoyable with them and would have been impossible without them. I am also particularly grateful to Dr. Francis Epplin for his lucid instruction in several areas and for his friendship. The financial support of Oklahoma State University and the Oklahoma Agricultural Experiment Station -- ultimately, the taxpayers of Oklahoma -- has made my study and this thesis possible. I hope their return on investment has been as great as my benefit from their trust.

My greatest debt, though, is to my parents and brother, who have always been careful to provide me with the best environment and choice of opportunities. Their love and support have been my inspiration and motivation, and it is to them that this work is dedicated.

To err is human, and I am irrepressibly human. Several faculty have been involved in reviewing and helping me edit this work (chapters I and IV have also benefited from the suggestions of two anonymous reviewers for Agribusiness). They have been diligent in ferreting out my errors and in sharpening my ambiguities and can safely be absolved from blame for any anomalies that remain.

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CHAPTER I

INTRODUCTION

Multinational firms (MNFs) -- defined here as publicly or privately owned firms with wholly or partially owned subsidiary or affiliate divisions in at least one foreign country -- conduct a substantial portion of world trade. A few have sales larger than the gross national products of some countries and many developing countries depend heavily on duties, tariffs, and income tax revenue collected from MNF activity, as well as the investment capital and employment MNFs contribute. The competition among less developed countries (LDCs) for foreign direct investment is often fierce, and liberal tax policies are one means LDCs have of attracting MNFs. Transfer pricing policies can have significant impacts on host-country tax revenues from MNF activity. International tax and trade policies, as well, are linked to some degree by transfer prices, especially when MNFs have the ability to arbitrarily allocate profits among divisions in several countries by manipulating transfer prices. It is important, then, for host-country governments, multinational managers, and the public at large to understand MNF pricing behavior and tax minimization strategies to the fullest degree possible.

There is relatively little discussion of MNF activity in the agricultural economics literature and even less of transfer pricing specifically (Henneberry discusses transfer pricing briefly). However, research into foreign direct investment and other development topics involving multinational agribusiness firm activity are becoming more important as developing countries compete for MNF investment and as the role of MNFs in the international trade of agricultural products continues to grow. Transfer pricing is only one of many MNF issues, but it deserves particular attention because of the potential impact on host-country revenues that government policies affecting MNF transfer pricing may have.

Transfer Pricing Defined

Transfer pricing arises from the divisional structure of MNFs and the international dispersion of MNF divisions. MNFs may be viewed, simplistically, as consisting of two types of divisions: primary divisions, which extract or produce an intermediate product, and final divisions, which obtain that intermediate product for further processing, marketing or distribution. Transfer prices are the artificially assigned prices primary divisions charge for selling their output to final divisions within the same firm. They are artificial in that transfer prices are administered by MNF management and not necessarily determined in market transactions: no money need be exchanged and no market transaction need take place. Company policy may, however,

tie transfer prices to some market criteria, which is often the case. Financially, transfer prices may serve only as declared values on transfers for tax and tariff purposes. Indeed, in the absence of government policy, transfer prices would serve only to allocate production among divisions of a decentralized MNF. Transfer prices also serve managerial functions -- such as divisional performance evaluation -- and are essential to any economic analysis of MNFs.

The role of transfer prices within a firm is largely determined by the degree of decentralization in a MNF. Cook sets forth three characteristics that define decentralization: (1) separate income and expense statements for various divisions of the firm; (2) authority of divisional managers to make decisions that will materially affect the profit shown on their statements; and (3) an understanding that divisional managers are to be evaluated in terms of the profit they should be able to achieve given the level of autonomy they have been granted.

The degree of decentralization of a MNF determines the extent to which its transfer prices act the same as market prices would in determining primary division output and final division purchases of the intermediate product. If divisions are completely autonomous and divisional management are the decision-makers, then transfer prices are analytically indistinguishable from market prices, especially if external markets are available for the intermediate good. If production and pricing decisions are centrally dictated, transfer prices may serve only to allocate profits

for tax purposes and may have little effect on marginal decision-making.

Transfer pricing, aside from being a necessary accounting practice, serves important managerial functions. In general, transfer pricing policies aim to simultaneously (1) motivate management to achieve divisional goals, (2) provide divisional management sufficient flexibility to achieve its goals, and (3) further overall organizational profit goals (Keegan). Transfer pricing policies must be constructed to reflect the relative importance of these goals while observing stringently enforced home- and host-country tax regulations.

In a MNF, reported divisional profits can be manipulated with arbitrary transfer price adjustments to artificially shift reported profits from divisions in countries with high tax rates to those in countries with lower tax rates. Transfer price manipulations may also be used to reduce tariff and duty payments, circumvent profit and dividend repatriation restrictions, and reduce exposure to exchange rate and political risks. Transfer pricing arrangements can also boost reported divisional earnings to improve local credit standings and the competitive positions of foreign divisions (Robock, et al., p.465). Vertically integrated MNFs with sufficient market power in an input market are able to "squeeze" non-integrated rivals in that market by supplying their own divisions at transfer prices below the market prices faced by the non-integrated rivals. Such exercises of monopoly power through transfer pricing can

have important consequences for market structure (Scherer, pp. 304,5). In joint foreign ventures, parent companies may use artificially high transfer prices to retain large real profit shares.

Because unregulated transfer pricing would provide great potential for tax evasion and other malfeasance, U.S. and foreign governments supervise MNF pricing activity closely. Under Section 482 of the Internal Revenue Code (IRS), IRS regularly audits MNF accounts to determine conformity to IRS pricing and reporting standards. Section 482 establishes three arm's-length pricing methods for intra-company exports, each requiring reference to similar transactions between unrelated parties. Section 482 requires that these options be considered in the following order: (1) comparable uncontrolled price, (2) resale price, and (3) cost plus a reasonable markup.

The first method (market value) is the one most often applied. It is applicable any time that a MNF also sells a similar product to unrelated parties outside of the parent company. The resale method is usually applied to finished goods, but only when they are not also sold to unrelated parties, i.e., they are traded only within the MNF. The third method (cost-plus) is used when unfinished goods or component parts are traded between divisions of the same MNF and no outside or unrelated party transactions take place (Burns). It will be noted later that MNFs generally have some flexibility in setting these transfer prices and that the transfer prices declared at the time of transaction are

evaluated and often modified later by government agencies for tax computations.

Objectives

The general intent of this thesis is to analyze the behavior of MNFs with regard to transfer pricing and intra-firm trade and the consequences of that behavior for government policies. The specific objectives are to

1. describe the economic importance of MNF activity in the U.S. and Oklahoma;
2. examine the empirical evidence of MNF objectives, policies, and procedures regarding transfer pricing and intra-firm trade;
3. review the theoretical treatment of transfer pricing and intra-firm trade in the literature;
4. analyze the production and distribution decisions of centralized, profit maximizing MNFs when transfer prices are not independent of intermediate production and extra-firm trade is allowed for both primary and final divisions.

Procedures and Organization

The economic importance of MNF activity is examined in chapter II, which presents published data on MNF operations in Oklahoma and intra-firm trade in the United States.

If the availability of data is the principle impediment to comprehensive economic analyses, that is especially true of MNF analysis. The secretive nature of multinationals and the legal sensitivity of transfer price data most likely preclude an exhaustive econometric study of MNF behavior (although Fowler is able to draw some conclusions from an aggregate model of Canadian MNF activity) and thus leave some of the theories presented here and elsewhere at best unobservable, if not practicably untestable.

Fortunately, several surveys of multinational executives have been published that give us some insight into the nature of MNF objectives and practices. To some extent, the results of these surveys, discussed in detail in the first part of chapter III, can be used as proxy data for the more desirable but inaccessible price and quantity data.

The literature review in chapter III is a survey and analysis of published works covering empirical analyses of objectives, policies, and practices of MNFs and the theoretical development of transfer pricing and intra-firm trade in economics journals.

The fourth objective is approached in Chapter IV with a Kuhn-Tucker analysis. The analysis is both a synthesis and an extension of prior theoretical work reviewed in chapter III. Production-dependent transfer prices and extra-firm trade of intermediate products have both been covered in previous articles. As becomes apparent in the literature review, though, these mathematical treatments have been limited either by the number of divisions, the degree of

firm centralization, or the scope of government policy in the models. The most contemporary of these models, it will be noted, do not account well for the marginal effects on transfer costs of changes in production. Transfer prices are generally modelled as parameters with the assumption that the firm cannot allow them to exceed market price or fall below their marginal production cost. The model in chapter IV is presented and analyzed with particular attention to the effects of marginal changes in the cost of producing and transferring intermediate product between divisions when those quantities change. The model is also presented in a more general framework than in the previous literature; no limits are placed on the number of divisions within the MNF or on the number of markets each division may trade in.

The thesis concludes with a summary of the work accomplished and results achieved in the analysis. Some suggestions for further research using the model of chapter IV are also made in the final chapter. The bibliography contains references to many unpublished dissertations and other works not explicitly covered in the body of this thesis. The reader interested in pursuing related research should find this extended bibliography a valuable tool.

CHAPTER II

MULTINATIONAL INTRA-FIRM TRADE IN OKLAHOMA AND THE UNITED STATES

Multinational Operations in Oklahoma

Since the decline of the petroleum industry in the Southwest during the 1980's, Oklahoma and neighboring states have competed fiercely to attract new investment in other industries. A major source of this new investment has been multinational firms (MNFs) -- foreign owned firms that establish affiliate operations in the U.S. MNFs conduct a significant portion of world trade. They also have substantial assets in the state of Oklahoma and employ several thousand Oklahoma workers (U.S. Department of Commerce). In 1985, the U.S. affiliates of foreign-owned MNFs employed 26,987 Oklahomans and held property, plant, and equipment in the state with a gross book value of $4.835 billion. Two-thirds of the property, plant, and equipment value was in the petroleum and chemical industries and Canadian and European MNFs had the largest share of employment among the 355 MNFs with physical assets in Oklahoma (U.S. Department of Commerce). Of the 329 foreign-owned affiliates employing people in Oklahoma, almost half employ only one to five people each. However, there are five firms that each employ at least 1000

people (Figure 1). Fifteen foreign-owned affiliates in Oklahoma have plant, property, and equipment worth more than $50 million, however most MNF affiliates in the state have assets between $50,000 and $10 million dollars (Figure 2). Many Oklahoma based MNFs also have affiliate operations based overseas which contrib- ute income to the state and provide access to foreign markets for Oklahoma products.

Foreign MNF investment and employment in Oklahoma is less substantial than in some other states (Jadlow and Bumpass). But, because Oklahoma's export industries such as agriculture, petroleum, and chemicals ultimately depend on MNFs for access to world markets, it is important that multinational firm behavior be understood as fully as possible.

MNF Intra-firm Trade in the United States

Tables I-IV present statistics on intra-firm trade. Aggregate data for all U.S. industries is listed along with data for specific industries involving U.S. firms engaged in agriculture, petroleum, and chemical trade, industries particularly important to Oklahoma. Tables I and II deal with U.S. based MNFs and their foreign affiliates, while Tables III and IV present data for foreign-owned MNFs and their affiliates in the U.S. The U.S. Commerce Department defines a U.S. parent Company as a domestically incorporated MNF with at least 10 percent ownership in a foreign affiliate, and a foreign-owned U.S. affiliate as one of which at least 10 percent is owned by a foreign based parent company.

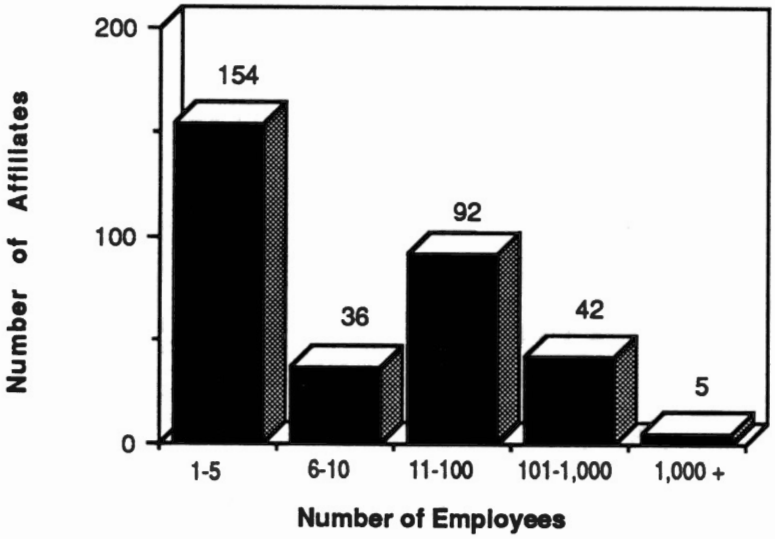

Figure 1. Oklahoma MNF Affiliates with Employment, 1985

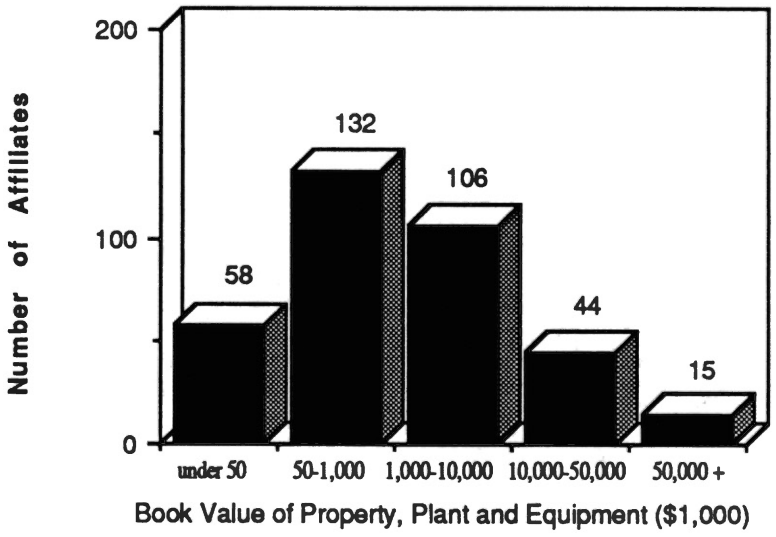

Figure 2. Oklahoma MNF Affiliates with Property, Plant and Equipment, 1985

TABLE I

U.S. INTRA-FIRM EXPORTS TO FOREIGN AFFILIATES
FOR SELECTED INDUSTRIES
1982-1985

	1985	1984	1983	1982	avg.
	(million dollars)				
All industries	61,882	56,706	49,397	47,126	53,778
Food & kindred products	1,261	1,017	1,013	756	1,012
Grain mill & bakery products	794	514	600	131	510
Beverages	99	55	46	51	63
Other food & kindred products	367	448	367	575	439
Farm & garden machinery	687	748	631	606	668
Agricultural production and services, forestry, and fishing	75	103	95	116	97
Petroleum	2,657	1,951	2,507	2,875	2,498
Oil & gas extraction	222	202	170	338	233
Petroleum & coal products	1,815	1,294	1,825	2,175	1,777
Petroleum wholesale trade	621	456	513	358	487
Chemicals & allied products	7,214	6,521	6,305	6,079	6,530
Industrial chemicals & synthetics	3,770	3,361	3,295	3,147	3,393
Drugs	2,291	2,285	2,027	1,777	2,095
Soap, cleaners, & toilet goods	706	558	506	671	612
Agricultural chemicals	94	92	118	118	106
Other	353	328	298	366	336

Source: U.S. Department of Commerce, Bureau of Economic Analysis. U.S. Direct Investment Abroad: Operations of U.S. Parent Companies and their Foreign Affiliates, 1982 Benchmark Survey Data, Revised 1983,1984 Estimates, Preliminary 1985 Estimates. Washington, D.C.: 1985 - 1987.

TABLE II

U.S. INTRA-FIRM IMPORTS FROM FOREIGN AFFILIATES
FOR SELECTED INDUSTRIES
1982-1985

	1985	1984	1983	1982	avg.
	(million dollars)				
All industries	54,297	52,793	43,632	39,288	47,503
Food & kindred products	771	613	347	651	596
Grain mill & bakery products	333	157	96	72	164
Beverages	125	121	106	[a]	117
Other food & kindred products	313	335	145	467	315
Farm & garden machinery	234	234	310	[a]	259
Petroleum	9,885	10,425	10,100	11,027	10,359
Chemicals & allied products	2,146	2,553	1,904	1,848	2,113
Industrial chemicals & synthetics	959	1,334	947	963	1,051
Drugs	497	467	299	240	376
Soap, cleaners, & toilet goods	227	196	132	237	198
Agricultural chemicals	248	355	259	272	284
Other	215	201	[a]	137	184

Source: U.S. Department of Commerce, Bureau of Economic Analysis. U.S. Direct Investment Abroad: Operations of U.S. Parent Companies and their Foreign Affiliates, 1982 Benchmark Survey, Revised 1983,1984 Estimates, Preliminary 1985 Estimates. Washington, D.C.: 1985 - 1987.

[a] Indicates that data were suppressed to protect the identity of individual firms. Averages do not include suppressed data.

TABLE III

U.S. INTRA-FIRM EXPORTS TO FOREIGN PARENTS
FOR SELECTED INDUSTRIES
1982-1985

	1985	1984	1983	1982	avg.
	(million dollars)				
All industries	26,967	27,072	22,577	25,024	25,410
Food & kindred products	110	123	90	102	106
Wholesale trade of agricultural commoditiesa	10,459	10,751	8,564	9,776	9,888
Food stores, eating and drinking places, (retail trade)	3	2	2	2	2
Agricultural production & services	4	4	4	4	4
Forestry & fishing	5	4	4	b	4
Petroleum	556	481	597	670	576
Chemicals & allied products	1,333	1,242	1,076	982	1,158
Industrial chemicals	869	840	706	652	767
Drugs	321	244	239	209	253
Soap, cleaners, & toilet goods	144	127	105	94	118
Agricultural chemicals	9	5	4	b	6
Other	24	25	21	b	23

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies, Revised 1983,1984 Estimates, Preliminary 1985 Estimates. Washington, D.C.: Several issues, 1986 - 1987.

[a] Listed as Wholesale trade, nondurable goods, farm-product raw materials. Includes "wholesale buying and/or marketing of cotton, grain, livestock, ... , hides, furs, hops, and leaf tobacco."

[b] Indicates that data were suppressed to protect the identity of individual firms. Averages do not include suppressed data.

TABLE IV
U.S. INTRA-FIRM IMPORTS FROM FOREIGN PARENTS
FOR SELECTED INDUSTRIES
1982-1985

	1985	1984	1983	1982	avg.
	(million dollars)				
All industries	81,091	70,451	54,802	51,915	64,565
Food & kindred products	726	848	762	614	738
Wholesale trade of agricultural commoditiesa	4,709	2,221	2,246	2,509	2,921
Food stores, eating and drinking places, (retail trade)	9	9	8	b	9
Agricultural production & services	5	2	3	2	3
Petroleum	1,227	1,062	1,699	2,597	1,646
Chemicals & allied products	2,487	2,379	1,810	1,539	2,054
Industrial chemicals	1,736	1,679	1,312	1,110	1,459
Drugs	438	391	289	205	331
Soap, cleaners, & toilet goods	124	116	58	73	93
Agricultural chemicals	87	114	95	b	99
Other	102	79	56	b	79

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies, Revised 1983,1984 Estimates, Preliminary 1985 Estimates. Washington, D.C.: 1986 - 1987.

[a] Listed as Wholesale trade, nondurable goods, farm-product raw materials. Includes "wholesale buying and/or marketing of cotton, grain, livestock, ... , hides, furs, hops, and leaf tobacco."

[b] Indicates that data were suppressed to protect the identity of individual firms. Averages do not include suppressed data.

In all industries, U.S. parent companies exported over $60 billion to their foreign affiliates in 1985 (Table I) and imported almost $55 billion from overseas affiliates (Table II). Total 1985 U.S. affiliate intra-firm exports to foreign parents were almost $27 billion (Table III) while U.S. affiliate imports from foreign parents were more than $80 billion that year (Table IV). The greatest average growth in U.S. intra-firm trade from 1982 to 1985 was in affiliate imports from foreign parents (16.4 percent[1] per year calculated from Table IV) and in U.S. parent imports from foreign affiliates (11.6 percent per year calculated from Table II). The average annual growth in U.S. parent exports to foreign affiliates was also strong, 9.6 percent, but intra-firm exports from U.S. affiliates to foreign parents grew only 3.2 percent annually over the period.

U.S. parent companies have a relatively high volume of intra-firm trade in petroleum and chemical products. On the average, from 1982 to 1985, U.S. based chemical companies exported over $6.5 billion in chemical products to their foreign affiliates (Table I). U.S. based petroleum MNFs imported annually from their foreign affiliates more than $10 billion on average over the same period (Table II).

While the intra-firm trade of U.S. parent companies in raw agricultural commodities (grains, cotton, and livestock) may have been substantial, those data were not available as a

[1]Computed as the mean of three annual percentage changes: 1982-83, 1983-84, and 1984-85.

distinct group. The intra-firm imports and exports of foreign-owned MNFs that trade these raw agricultural commodities with U.S. affiliates, however, are listed separately and comprise a significant volume of trade. From 1982 to 1985, exports in the wholesale trade of agricultural commodities by U.S. based affiliates to their foreign parents averaged almost $10 billion (Table III) and imports almost $3.0 billion (Table IV).

Summary

Transfer pricing in intra-firm trade is a controversial topic in the discussion of multinational firms, particularly in the developing countries. Several firms located in Oklahoma are affiliated with U.S. and foreign MNFs and participate in intra-firm trade. Most of the economic activity associated with Oklahoma MNF affiliates is in the petroleum and chemical industries, but firms in other industries, particularly agriculture, ultimately depend on MNFs for access to foreign markets, directly or indirectly.

As Oklahoma seeks to attract foreign investment to the state and to expand export markets for its products, it becomes important to understand the role that MNFs play in our increasingly international economy. Although compliance to transfer pricing regulations is well enforced in the U.S., it is important to understand the practices and objectives of MNFs so that state government and business enterprises may better conduct their relationships with new investors in the state. A review of several studies that have emperically

examined these practices and objectives as they apply to U.S. and Canadian MNFs operating in both industrial and developing countries follows in the first section of the next chapter.

CHAPTER III

LITERATURE REVIEW

Introduction

The first part of this review concentrates on some recent survey results published in business and finance journals since 1979. These five survey articles cover the usage and appropriateness of transfer pricing methods and the objectives and environmental influences affecting transfer pricing policies of U.S. and Canadian firms. The final part of the review summarizes the theoretical development of transfer pricing analysis in economics journals since 1955. Although the theoretical articles reviewed here represent the most significant contributions to the genre, some works have necessarily been omitted to avoid redundancy or to maintain focus.

The performance evaluation function of transfer prices is another issue that has received much attention in the management and accounting journals. These journals and others have also given some attention to applied computational methods in international transfer pricing systems (linear programming, multiple goal programming, etc.). These topics are not reviewed here; this chapter concentrates

instead on the more general business and economic issues.

Transfer Pricing in Practice

Five recent surveys of MNFs in the United States and Canada provide data and conclusions concerning environmental factors, objectives, and practices in international transfer pricing systems. The results are summarized in Table V.

Kim and Miller surveyed 52 U.S. parent companies with at least one subsidiary in two of eight developing countries (Korea, Philippines, Malaysia, Taiwan, Brazil, Colombia, Mexico, and Peru). Each participant was asked to assign a weight of one to four to each of nine factors potentially affecting transfer pricing decisions, with a weight of one indicating a high degree of importance and four no importance. The surveys were followed up by interviews with big-eight accountants and MNF executives.

Profit repatriation restrictions and exchange controls were the two most important factors, dramatizing the fact that developing countries use such controls to retard capital outflow. Joint venture constraints ranked third. Kim and Miller point out that, in general, host countries require fifty percent domestic ownership, but are lenient on transfers through royalties and fees for technical or managerial skills, which are often not viewed as earnings repatriation, i.e, they may be used as alternative transfer methods when other regulations are too restrictive. Host-country tariffs

TABLE V

SUMMARY OF SURVEY RESULTS IDENTIFYING INFLUENCES ON AND OBJECTIVES OF MULTINATIONAL CORPORATE TRANSFER PRICING POLICIES

Study	Sample Population	Criteria and Rankings
Kim and Miller	U.S. MNFs with LDC divisions	1. profit repatriation restrictions 2. exchange controls 3. joint venture 4. tariffs customs duties 5. foreign income tax
Burns (1980b)	U.S. MNFs	1. host-country competition 2/3 host-country market conditions securing reasonable affiliate profit 4. U.S. federal income taxes 5. host-country taxes
Tang (1979)	Canadian MNFs	1. overall firm profit 2. host-country customs duties and regulations 3. host-country competition 4. profits repatriation restrictions 5. host-country government relations
Yunker	U.S. MNFs	1. increase overall firm profit 2. simplicity and ease of application 3. facilitate performance evaluation 4. increase overall corporate sales 5. other

and customs duties ranked fourth; MNFs will suppress research, administration, and other overhead costs in establishing transfer prices in high tariff/duty host countries.

Significantly, host country and U.S. tax liabilities were considered only fifth and sixth in importance, contra-

dicting much of the prior literature (Arpan; Conference Board). The authors state that tax liabilities are probably viewed as short run charges against current earnings and that in using lower tax countries to defer U.S. taxes, MNFs must consider the present value of cash flow benefits against the opportunity cost of using funds elsewhere; they must also consider working capital in the host country. In short, tax liability considerations must be congruent with overall organizational financial objectives. They assign the lower rating of tax liabilities to two factors: that prior studies viewed transfer price objectives from a developed country perspective and that the international business climate had changed significantly since the late 1960s and early '70s, the period of prior studies.

U.S. quota restrictions and U.S. and foreign divisional credit standings were the least important of the nine factors considered, probably because of their previous consideration in the original decisions to open foreign subsidiaries.

In summary, Kim and Miller found that factors affecting capital outflow from developing countries are the most important in firms' transfer price policy-making and that policy must conform to overall long term corporate goals. Also, the effect of floating exchange rates was omitted from the survey, but found to be considered very important in the follow-up interviews.

Burns (1980a) questioned 130 U.S.-based industrial Fortune 500 MNFs on transfer pricing practices in exporting their goods from the U.S. Participants were given fourteen

factors and asked to strongly agree, agree, be undecided, disagree, or strongly disagree that the factor substantially influenced the firm's transfer pricing decisions. Each factor was ranked on weights of one to five in descending degree and a mean rank was computed for each. Participants were then asked to choose those five factors most important to their organization's transfer pricing decisions. (See Burns [1980a], pp. 310, 311 for actual questions.)

In both questions, market conditions and competition in the foreign country and securing a reasonable profit for the foreign affiliate received the three highest mean rankings. Sixty-six percent listed foreign market conditions among the five most influential environmental factors and sixty-four percent listed competition in the foreign market and/or a reasonable profit for the foreign affiliate.

U.S. federal income taxes were ranked fourth in both questions and foreign taxation ranked ninth in the first question, but fifth in the second. Import restrictions, price controls, customs duties, and exchange controls received medium ranks. U.S. export incentives, floating exchange rates, and management of cash flows received low rankings, and other U.S. taxes ranked last in both questions. Rankings in the two questions were highly correlated when applied to a Spearman rank correlation test.

The data were factor analyzed to assess differences by firm type and size. Five factors emerged from the original fourteen: internal foreign environment, influence on cash flows, artificial barriers, taxes, and economic structure.

When responses were separated into groups with sales of more or less than $25 million to foreign subsidiaries and factor analyzed, taxes and cash flow management were more important to the $25 million-plus group at a .05 significance level. Likewise, when responses were separated into groups with more or less than fifty percent of total export sales to foreign affiliates, taxes and artificial barriers were more important to those with most export sales to foreign affiliates. Only the internal foreign environment factor was significantly more important to the top 150 ranked Fortune 500 companies than to the lower 151-500 ranked companies. On the other hand, taxes were more significant to those companies qualifying for market based transfer pricing under Section 482 than for those qualifying for cost-plus methods.

In addition, Burns (1980b) found that fifty-nine percent of the surveyed MNFs were in a position to lower their overall tax burden by setting transfer prices for exports to subsidiaries artificially low. This was because either (1) MNF sales were to Domestic International Sales Corps., Western Hemisphere Trading Corps., or to U.S. Possessions Corps. -- all of which receive special U.S. tax breaks -- or (2) their foreign affiliates were otherwise taxed at rates lower than U.S. rates. The remaining forty-one percent had affiliates taxed at rates equal to or greater than U.S. rates.

Tang (1980) surveyed 171 Canadian firms on pricing methods, environmental influences, and objectives in transfer pricing policies. He found that market pricing was the most common method, followed by negotiated pricing, full cost plus

a profit allowance, and market price less selling expenses. The most important environmental variables over all companies were, in descending degree of importance, overall company profit, customs duties, subsidiaries' competitive position, earnings repatriation restrictions, and differentials in income tax rates.

In the twenty food industry companies included in the 171 MNFs, the most important variables, in descending order, were overall company profit, relationship with host governments and fee and royalty payment restrictions (tie), foreign governments' antidumping legislation, profit repatriation restrictions, and the competitive position of subsidiaries. Tang (1980) found differentials in host country tax rates to be the least important of nineteen variables among food industry companies. The study does not, however, indicate the extent to which food industry exports are destined to the United States or to developing countries.

Among all 171 companies considered, performance evaluation was the most often cited dominant transfer pricing objective, followed by overall profit, sales volume maximization, and, lastly, government payments. The dominant objectives of the twenty food industry companies followed the same order as above, but minimization of government payments received no response as a dominant objective.

Yunker uses survey responses from fifty-two corporations in a study on multinational transfer pricing and performance evaluation. The study revealed data on both transfer pricing

method usage and the objectives of transfer pricing policies in MNFs.

Transfer pricing objectives were ranked on a basis of dominantly important (three), very important (two), somewhat important (one), or not important (zero). According to mean rank scores, the most important objective was to increase overall corporate profit, followed by simplicity and ease of application, performance evaluation capacity, and potential to increase overall corporate sales. Yunker does not mention tax minimization as a specific objective.

Twenty possible transfer pricing methods were listed and respondents were asked to indicate the relative frequency with which each method was used on a scale of four (always used) to zero (never used). Market pricing received the highest mean rank, followed by standard unit full cost plus fixed markup, cost plus negotiated markup, adjusted market price (less selling cost), actual unit full cost plus fixed markup, instrumental pricing (case-by-case), and the remaining fourteen methods. In general, the theoretical pricing methods were used the least, e.g., marginal cost, opportunity cost, dual pricing, and mathematical programming optimal pricing.

Yunker gives particular attention to instrumental transfer pricing, where prices are determined on a case-by-case basis. Using the same weights as above, she found that the six most important objectives in instrumental transfer pricing were to (1) maintain good host country relations, (2/3 tie) reduce corporate income and profits

taxes and avoid restrictions on earnings repatriation, (4) stabilize the competitive position of a subsidiary, (5) reduce customs duties payments, and (6) take advantage of economies of scale in production.

As mentioned in the previous chapter, Burns (1980a) also surveyed MNFs on the appropriateness and reasonableness of Section 482 transfer pricing methods. Questions were asked regarding the three transfer pricing methods allowed under Section 482 -- comparable uncontrolled (market), resale, and cost-plus -- and a fourth "other" pricing method category (some exceptions are made under Section 482). When asked which method appeared appropriate according to types of exports, eighty percent of the respondents indicated comparable uncontrolled, thirteen percent cost-plus, and the remaining seven percent resale.

Sixty-four percent believed that the cost-plus method was reasonable for their firm, forty-three percent that the comparable uncontrolled method was reasonable for their firm, and thirty percent that the resale method was reasonable (several firms indicated more than one method was reasonable). However, when asked which method was reasonable for their firm's exports according to Section 482 rankings (methods must be considered in the order listed, so only one method may apply to any one respondent), forty-three percent listed comparable uncontrolled, thirty-seven percent listed cost-plus, and the remaining fifteen percent listed resale. Another five per- cent listed other methods as reasonable.

Transfer Pricing in Theory

The focus of published economic literature on transfer pricing has been the determination of appropriate output levels and transfer prices in decentralized firms (domestic and multinational). The central question is how to value the transferred product so that resources and production are allocated optimally and divisional performance is measured accurately. The question is complicated, first, when an outside market exists for the intermediate good, and, second, when the firm's divisional facilities are located in different tax jurisdictions and are subject to tariffs as well as potentially different tax rates. the earliest works on transfer pricing (Cook, Dean, Hirschleifer and Gould) viewed the problem from the perspective of a multidivisional firm (not necessarily a multinational) and ignored questions about tax and tariff rates. Hirschleifer and Gould laid the basic theoretical foundation for following works. Bond, Copithorne, Booth and Jensen, Itagaki (1979), and Horst, build upon their assumptions and analyses when they take up the multinational case.

Multidivisional Domestic Firms

Cook and Dean were among the first to draw attention to the problem of decentralization and transfer pricing, discussing the issue in more operational than theoretical terms. Cook argues that transfer pricing policies are fundamentally important to the success of decentralization in

boosting total firm profits; that is, that appropriate policies discourage division managers from increasing their own profit -- the criterion managers are usually judged on -- at the expense of decreasing overall firm profit by acting monopolistically. He also discusses how transfer pricing policies are important in determining the appropriate form of decentralization and the extent to which it may be successfully implemented. Dean discusses the need for sound transfer pricing policies and the mechanics of operating such policies. Although neither author developed a rigorous model for transfer price determination, Cook recommends market prices where possible and Dean negotiated competitive prices.

Hirschleifer follows up on Cook and Dean's discussion with a more rigorous analysis using the traditional theory of the firm. He argues that market price is appropriate only under competitive conditions when an outside market exists for the product being transferred. If an imperfectly competitive market exists, transfer price should be at the marginal cost of the selling (primary) division.

Similarly, the transfer price should be set at the marginal cost of the selling division in cases where no outside market exists and a joint output level must be determined. Optimal output and transfer price would be determined by the primary division's supply schedule (its marginal cost curve) and the final product division's demand schedule (as a function of transfer price). This solution insures that the sum of the divisional marginal costs is equated with the marginal revenue from sales of the final

product. In either case, Hirschleifer argues, output is the same as if decision-making were centralized; Bond later found that in MNFs facing different divisional tax rates this may no longer be true.

Hirschleifer's analysis assumes that the intermediate and final products are technically independent (the production costs of each are unaffected by the production levels of the other) and that there is no demand dependence between the two (sales of one to an outside source has no effect on the external demand of the other). In the case of demand dependence, Hirschleifer says, the optimal transfer price generally falls between seller's marginal cost and the market price, with some room for negotiation. It is also important to note a necessary condition that neither division be allowed to exercise undo "market power" on the other so that the primary division does not extract monopoly profits from the final division or the final division does not act as a monopsonist in dealing with the primary division. Furthermore, these results give optimal output adjustments only at the margin.

Cook noted the special case where an outside market exists for the intermediate product and a disparity exists between the selling price the primary division offers to the final division and to external sources -- because of selling expenses, credit terms, bad debt expense, etc. Gould, in a more rigorous analysis, takes up the problem of transfer price determination when costs exist of selling the intermediate product externally. In the presence of these costs,

the final division will face a higher market price than will the primary division. Gould's determination is that transfer price should be set at the market price faced by the division that has incentive to trade on the open market.

If both market prices are above the firm's internal optimum (where the primary division's supply schedule would intersect the final division's demand schedule for the intermediate product in the absence of external market opportunities), then the primary division would rationally produce up to the point where its marginal cost just equals its available market price. The primary division would sell to the final division at that price a quantity corresponding to the final division's demand schedule, and then market the surplus externally.

Similarly, if both market prices are below the firm's internal optimum, then the final division will purchase intermediate product at its available market price. Since the primary division faces a lower price, it will supply the final division's needs up to the point that its marginal costs are just covered by the transfer price. The final division would then obtain any further requirements on the open market.

Obviously, Gould argues, if the primary division could sell externally only at a price below the internal optimum and the final division could buy from the open market only at a price above the internal optimum, neither division would have an incentive to deal outside of the firm. Hirschleifer's rule would then obtain and the internal supply and

demand schedules would determine optimal output and internal pricing.

Multinational Firms

Following this initial groundwork (and that of others), several authors examine the transfer pricing problem in a multinational context with emphasis on the impacts of government policies, particularly tax and tariff rates.

Bond expands on Hirschleifer and Gould's studies, maintaining most of their assumptions, in analyzing the transfer pricing problem for the MNF facing differing tax rates in countries hosting primary and final divisions. MNFs often use separate transfer prices for production decisions and for tax accounting. Bond aims to analyze transfer pricing in decentralized MNFs where a central authority controls only transfer price and divisional managers individually determine output so that each division independently maximizes its own after-tax profit. Under this organization, a single transfer price may be used for both allocative and tax purposes. Bond's conclusion is that the more decentralized firm facing different tax rates will achieve a lower optimal profit than if it were centralized. He also concludes that only when all divisions face the same tax rate is marginal cost the optimal transfer price.

Bond shows that a MNF's global after-tax earnings -- in the absence of external trade -- will be increased by deviating from marginal cost in setting transfer price to divert profits from the division facing the higher tax rate.

He goes on to identify the optimal markup rate for transfer price when the final division faces the higher tax rate. That markup rate depends on the difference in tax rates that the two divisions face and the elasticity of demand for the intermediate product. If the demand elasticity is zero, then transfer price should be set as high as possible. If tax rates are equal, there should be no markup above the primary division's marginal cost. The optimal markdown of transfer price when the primary division faces the higher rate is similarly determined and dependent on the difference in tax rates and the supply elasticity of the primary division.

Bond next modifies Gould's analysis, which included the possibility of costs in conducting external trade, to allow for differing tax rates. When the division able to exploit external market opportunities faces the lower tax rate, Bond's results depart from Gould's. If the firm's internal before-tax optimal transfer price is below the market prices each division faces, then the seller's market price is no longer the optimal transfer price (Gould's solution), but will lie between the two market prices. This results in an output distortion caused by a reduction in the final division's output. When the internal before-tax optimal transfer price is greater than either market price, Gould's result is that transfer price be set at the buying division's market price. Bond's result is that transfer price should be set between the two market prices, causing a similar distortion in firm output since the primary division will reduce its production. In both cases, the division facing the lower tax

rate will not change its output level from the pre-tax optimum.

In decentralized firms, Bond concludes, transfer prices will generally favor the divisions facing the lower tax rate and act to shift profits there. The more favorable price will encourage a non-optimal global production level (which negates Hirschleifer's argument in the multinational case). These output "distortions" impose losses on the firm that the more centralized firm using two prices would avoid. Ultimately, the firm able to use marginal cost to dictate divisional production and trade levels and then a transfer price to later allocate profits will achieve higher global after-tax profits than the firm delegating output and trade decisions to divisional management.

Whereas Bond examined decentralized, multinational firm behavior, Copithorne analyzes transfer prices and government policy for centralized, international firms. His model incorporates three divisions: one primary division which produces the intermediate good, and two secondary divisions which process and sell the final good. Multinational firms are differentiated from international firms in that multinationals seek to simultaneously maximize profits in each division, with individual rates of return for each division (the case in Bond's analysis), while international firms seek to maximize global profit, with all divisions achieving identical marginal rates of return (see Kindleberger for a more complete description). From the start, Copithorne asserts that multinationals lack the central decision making

power to set optimal transfer prices, but rather, that divisions will exercise as much monopoly power when dealing with each other as possible.

He concludes that international firm transfer prices are generally indeterminate, and therefore arbitrary; they have no bearing on output levels or final product prices and only serve to allocate profit between divisions. Only in the case of national firms with overseas operations are transfer prices uniquely determined. Since the national firm tries to maximize the parent division's profit through repatriating divisional profits, transfer prices are essentially the average profit per unit in the non-parent divisions, after some minimum profit level in each country is subtracted out.

With taxes on pure profits, if rates are constant, international firm profits are allocated through transfer price manipulation to the division facing the lowest tax rate, ceteris paribus. If the divisions instead face progressive tax rates, profits are allocated such that marginal tax rates are identical for all divisions.

In the case of proportional sales or excise taxes or tariffs in the country of final production, the net marginal revenue of the final division is reduced at all levels so that the demand for the intermediate product is reduced. Optimality would require a leftward (or downward) movement along the primary division's marginal cost curve and, assuming increasing marginal costs, lower intermediate production levels. Transfer price is affected only inasmuch as it reflects the primary division's marginal cost.

If an excise, sales, or export tax is imposed on the intermediate good, the incentive will exist for the primary division to charge lower transfer prices, particularly in the case of an ad valorem tax, and then repatriate profits from the final division to the primary division.

If price discrimination is prevented in multi-division firms acting as monopolists, profits may still be shifted through transfer price manipulation from primary divisions to final divisions or vice versa, but not among primary divisions or among final divisions. The freedom a firm has in setting transfer prices is then reduced inasmuch as it must charge the same transfer price to each division performing the same task. Copithorne does not discuss the ability of such firms to circumvent some of these constraints by using alternative transfer methods, such as loans, fees and royalties for management, technology and other intangibles, etc.

Booth and Jensen show that in some cases where Copithorne thought transfer prices to be indeterminate they are either indeed determinate or are bounded by the cost and revenue conditions and minimum profit constraints set for each division. Their model describes a "global" firm, with one primary and two final divisions, that maximizes net global after-tax profit subject to some minimum profit constraints for each division. They set up the Lagrangian model and solve the Kuhn-Tucker conditions for optimal output, allocation, and transfer prices under different tax scenarios.

In the case of constant tax rates across countries, transfer prices are still arbitrary, but are identifiably bounded. If equally progressive tax rates apply in all countries, however, transfer prices can be uniquely determined. Even if progressivity differs across countries the solution for optimal transfer prices falls within identifiable bounds. They also discussed the bounds on transfer price when price discrimination is prohibited.

Itagaki (1979) analyzes the impacts of several government policies on both MNF behavior and government accounts for the firm able to produce an intermediate product abroad for use in the production of a final good produced and sold in both the foreign and home countries. Transfer price determination and taxation is discussed primarily in terms of model formulation. Itagaki (1979) reasons that transfer prices will be set as low as possible (usually at marginal cost) when the firm is able to reduce its global tax payment by doing so. That the lower bound of transfer price is affected by changes in production is neglected in his model, as are external market opportunities. Itagaki (1979) does find, though, that the magnitude of transfer price in relation to marginal cost is very important in determining the impact of tax and currency changes on government revenue and the balances of trade (importation of the intermediate good) and services (repatriation of profits).

If transfer price is above the marginal cost of the intermediate product and the exporting division faces the higher tax rate, Itagaki (1979) shows that the importing

division is forced to show a loss at the margin. The result of a tax increase in the importing country is to encourage production of the final good in the importing country (thus reducing the marginal loss there) and discourage final good production in the exporting country. The increase in imports of the intermediate product adversely affects the importing country's balance of trade but, at the same time, shifts profits from the exporting country to the importing country. Itagaki (1979) determines that the increase in the balance of services is less than the decrease in the balance of trade, so that the importing country's total balance of trade and services position is diminished by the tax increase. Under the same assumptions, if the exporting country's tax rate is raised, its production of the final good falls and the importing country's final good production rises; profits will thus shift to the importing country and the total balance of trade and services in the exporting country falls. However, if transfer price is below marginal cost, the exporting division shows the marginal loss on final good production, and all of the above results are reversed. This follows from an assumption that the difference between transfer price and marginal cost represents a reasonable markup for the intermediate product. A transfer price below marginal cost would mean a negative markup on the intermediate good and would obviously result in a net loss for the primary (exporting) division, thus reversing the flow of profits and trade in the above cases.

When the currency of the importing country is devalued and transfer price is above marginal cost, the MNF is enticed to shift profits to the exporting country, reducing its balance of services through repatriation of profits, but because production in the importing country rises, its balance of trade is affected positively. Once again, Itagaki's (1979) results are reversed if transfer price is allowed to fall below marginal cost. The importance of transfer price (in relation to marginal cost) in these examples illustrates the international linkages that MNF pricing policies can create.

Horst, in a partial equilibrium framework, examines MNFs producing and selling a single product in two countries. The transfer price is that charged when product is exported from a division in one country to that in another. There is no technological constraint on the flow of trade since neither division performs a processing function unique to the other. He examines MNF behavior, including transfer prices, and government policy for a monopolist MNF able to produce and sell in two national markets to maximize global after-tax profits. He finds that production, intra-firm exports and transfer prices are sensitive to the direction of marginal cost and the level of tariffs faced in each country.

In the case where both countries place constant tax rates on profits and an ad valorem tariff is placed on transfers from one country to the other (and trade flows only in that direction), the transfer price depends on the relationship between the relative tax rate differential and the importer's tariff rate. If the relative tax rate differ-

ential is less than the tariff rate, the firm is inclined to set the transfer price as low as possible; if the inequality is reversed, transfer price is set as high as possible. Generally, Horst assumes, transfer prices will be set between marginal cost and the selling price in the exporting country. Essentially, the firm will use transfer prices to shift profits to the division facing the lower rate of government payments. The analysis goes no further than this in discussing transfer prices, but does go into substantial detail in discussing the impacts of tax and tariff policy on production levels, trade flows and final product prices.

Summary and Conclusions

Surveys on transfer pricing methods reveal that among U.S. and Canadian multinational firms (MNFs) exporting to foreign divisions, market or comparable uncontrolled prices were the most commonly used transfer prices. Studies do not agree, however, on what factors most influence transfer pricing policies. The only consensus seems to be that transfer price policies should advance overall firm profit goals. The degree to which differences in tax rates are considered in achieving this objective is not always clear. With the exception of Canadian firms, respondents generally consider tax considerations, when specifically mentioned, as fairly important influences. Burns (1980b) finds that tax considerations are more important to large U.S. MNFs, to those highly

dependent on exports to foreign divisions, and to those using market based pricing.

From a theoretical perspective, transfer prices are shown to depend on differences in tax and tariff rates, access to and costs in using intermediate product markets, final product market organization, MNF global strategy, and the ability to price-discriminate between divisions. The degree to which transfer prices determine global output and ultimately firm profit depends in part on whether the firm is vertically or horizontally integrated. That is, in firms where all stages of production may take place in any division or where there is no processing, e.g., grain trading companies, transfer prices serve only to allocate profit between the divisions. In vertically integrated firms where some unique production or processing must take place in different divisions, e.g., food processing firms, transfer prices may serve both to allocate production and sales to each division as well as to apportion profits for tax purposes. In many cases, appropriate transfer prices are not specifically identifiable, but do at least fall within identifiable bounds.

What becomes obvious in reviewing transfer pricing in the literature selected (there are many more theoretic, practical, and survey works than those discussed here), is that no single method of transfer pricing may be universally recommended as optimal. Indeed, MNFs may find that the appropriateness of particular systems will vary among activities and over time. The number of accounting, finan-

cial, and management treatments of multinational transfer pricing is already prodigious. Moreover, Yunker's survey reveals that large MNFs tend to not use theoretical or mathematically involved methods of transfer price determination. There are simply too many qualitative factors to consider, too many masters to serve (global and divisional management, and tax, customs, and antitrust authorities) and the costs involved are perhaps greater than the perceived benefits of staffing and employing such systems, especially for smaller MNFs. Transfer pricing and other MNF issues have been somewhat neglected in the agricultural economics literature but are becoming increasingly relevant in a world where MNFs dominate international agricultural trade and the indebted less developed countries seek MNF investment.

CHAPTER IV

A KUHN-TUCKER ANALYSIS OF MNF INTRA-FIRM TRADE

Introduction

Yunker's study indicates that U.S. MNF's frequently use cost-plus transfer pricing methods; only market pricing was more frequently cited among the respondents to her survey. A microeconomic framework for analyzing multinational intra-firm trade in a centralized MNF using such a transfer pricing system is set forth in this chapter. In this model, production, pricing, and intermediate product allocation decisions are dictated by a central management that seeks to maximize global MNF profit without concern for the profits of individual divisions. Because we are not immediately concerned with final production, the objective function is expressed only in terms of intermediate product quantities. Transfer prices are determined by the average cost function for producing intermediate products. In addition, primary divisions can sell intermediate product outside of the firm and final divisions can purchase intermediate product from outside sources.

The discussion begins with a statement of the model and definition of terms. The conditions implied by profit

maximization are then identified for the general case. This sets up the framework for determining the feasibility of a profit maximizing solution and for describing the process by which the MNF may determine such a solution for its production, sales, and purchases of an intermediate product by potentially many divisions.

Model

There are D divisions within the firm of which m primary divisions produce the intermediate product and n final divisions produce the final product. Since any single division may produce both final and intermediate products, we have $D \leq m+n$. Each final division has a net revenue product function, R_j, expressed in terms of its total utilization of intermediate product. The j^{th} final division may obtain its intermediate product from extra-firm sources as y_j and from intra-firm sources as $\Sigma_i x_{ij}$ -- the sum of intermediate product quantities x_{ij} sent from all $i = 1,\ldots,m$ primary divisions to final division j. Net revenue product is the total receipts to the MNF from sales of the final product less final processing and sales costs and is given by $R_j = R_j(y_j + \Sigma_i x_{ij})$.

Quantities of y_j are purchased externally at prices $b_j = b_j(y_j)$ so that division j's total factor cost of purchasing intermediate product from outside sources is $b_j y_j$. If the division faces an imperfectly competitive input market, its marginal factor cost for y_j is $b'_j(y_j)y_j + b_j$ where $b'_j(y_j) < 0$. On the other hand, if

division j faces a perfectly competitive input market for y_j, then $b'_j(y_j) = 0$ and its marginal factor cost of y_j is just b_j.

The internally traded intermediate (transfer) product x_{ij} is obtained from primary division i by final division j at primary division i's average total cost, ρ_i, of producing its total intermediate product output; ρ_i is then a cost-plus transfer price. The average total cost is the sum of the division's average variable and average fixed costs, where average fixed cost is a "reasonable" markup on the transfer price, representing a normal average profit per unit.

Primary divisions may also sell intermediate product externally. The quantity z_i is the intermediate product sold by primary division i to extra-firm sources at prices $s_i = s_i(z_i)$. To facilitate the analysis, define division i's total production of transfer product as $\bar{x}_i = \Sigma_j x_{ij}$. The transfer price for all intermediate product quantities transferred from division i is then given by $\rho_i = \rho_i(z_i + \bar{x}_i)$. Primary division i's total production cost is $(z_i + \bar{x}_i)\rho_i$, which can be divided into total variable cost, $(z_i + \bar{x}_i)c_i$, and total fixed cost, C_i^o. The marginal cost to primary division i of producing intermediate product is then $(z_i + \bar{x}_i)c'_i + c_i$. Marginal transfer cost will be defined later, in the description of the firm's decision rules. Finally, the total factor cost of final division j may now be defined as $b_j y_j + \Sigma_i \rho_i x_{ij}$ and its marginal factor cost as $b'_j y_j + b_j + \Sigma_i(\rho'_i x_{ij} + \rho_i)$.

Division i's total revenue from outside sales is $s_i z_i$ and its marginal revenue from outside sales is $s'_i z_i + s_i$, where $s'_i > 0$ if the division faces an imperfectly competitive output market and $s'_i = 0$ if that division is a price-taker. Total revenue from intra-firm trade for division i is $\Sigma_j \rho_i x_{ij} = \rho_i \bar{x}_i$ with marginal intra-firm revenue of $\rho'_i \bar{x}_i + \rho_i$. Finally, its total revenue from all sales is $s_i z_i + \rho_i \bar{x}_i$.

To account for taxes, tariffs, etc., on intra-firm transfers, let $\gamma_{ij} \in [0,1]$ represent the net (tariffs in j less subsidies in i) ad valorem tax on transfers between divisions i and j and let Ψ_{ij} represent the net per unit tax on transfers. Total transfer costs for the MNF -- not for individual divisions -- applicable to x_{ij} are then $(\gamma_{ij}\rho_i + \Psi_{ij})x_{ij}$. For the time being, assume no profit taxes are levied.

The MNF maximizes global profits with respect to the intermediate product quantities, x_{ij}, $\bar{x}_i$, y_j, and z_i as follows:

$$\max \pi = \Sigma_j R_j - \Sigma_j b_j y_j + \Sigma_i s_i z_i - \Sigma_i \Sigma_j (\gamma_{ij}\rho_i + \Psi_{ij})x_{ij} - \Sigma_i (z_i + \bar{x}_i)c_i - \Sigma_i C_i^{\circ} \qquad (4.0)$$

subject to

$$\bar{x}_i = \Sigma_j x_{ij}$$

where:

R_j = final division total revenue ($j = 1,\ldots,n$);

b_j = market price for extra-firm purchases of intermediate product by final division j;

y_j = extra-firm purchases of intermediate product;

s_i = market price for extra-firm sales of intermediate product by primary division i (i = 1,...,m);

z_i = production of intermediate product for extra-firm sale;

τ_{ij} = net ad valorem tax on intra-firm transfers;

ψ_{ij} = net per unit tax on intra-firm transfers;

x_{ij} = intra-firm transfers of intermediate product from primary division i to final division j;

$\bar{x}_i$ = division i's total production of intermediate product for intra-firm trade;

ρ_i = average total cost of producing $\bar{x}_i + z_i$, used as the transfer price for all intra-firm shipments from division i;

c_i = average variable cost of producing $\bar{x}_i + z_i$; and

C_i° = total fixed costs of primary division i.

The constraint to (4.0) is not the usual fixed resource or income type constraint seen in most economic optimization problems. The variables $\bar{x}_i$ are <u>not</u> fixed quantities, but linear, homogeneous functions of the x_{ij}. The constraint is definitional only, and is always binding. It is imposed only to facilitate the analysis of first-order conditions and does not analytically effect the profit maximizing solution when imposed as an equality constraint in a Lagrangian formulation. The corresponding Lagrangian function is given by

$$\mathcal{L} = \Sigma_j R_j - \Sigma_j b_j y_j + \Sigma_i s_i z_i - \Sigma_i \Sigma_j (\tau_{ij}\rho_i + \psi_{ij})x_{ij} - \Sigma_i (z_i + \bar{x}_i)c_i + \Sigma_i \lambda_i (\bar{x}_i - \Sigma_j x_{ij}) \qquad (4.1)$$

where λ_i are the Lagrangian multipliers.

There are (3m + mn + n) choice variables: x_{ij}, $\bar{x}_i$, y_j, z_i, and λ_i for all $i = 1,\ldots,m$ and $j = 1,\ldots,n$.

Analysis

The analysis begins with a statement of the first-order necessary conditions for profit maximization under a minimal set of assumptions. The feasibility of a solution to this system of equations under alternate assumptions about divisional market scenarios and costs is then discussed. Finally, after showing feasibility, firm behavior is described in terms of the first-order conditions.

First-order Necessary Conditions

Global profit maximization implies that the following conditions be met for all $i = 1,\ldots,m$ and $j = 1,\ldots,n$ divisions:

$$\partial \pi/\partial x_{ij} = R'_j - \gamma_{ij}\rho_i - \psi_{ij} - \lambda_i \leq 0 \qquad (4.2)$$

$$\partial \pi/\partial y_j = R'_j - b'_j y_j - b_j \leq 0 \qquad (4.3)$$

$$\partial \pi/\partial z_i = s'_i z_i + s_i - \Sigma_j \gamma_{ij}\rho'_i x_{ij} - (z_i + \bar{x}_i)c'_i - c_i \leq 0 \qquad (4.4)$$

$$\partial \pi/\partial \bar{x}_i = \lambda_i - \Sigma_j \gamma_{ij}\rho'_i x_{ij} - (z_i + \bar{x}_i)c'_i - c_i \leq 0 \qquad (4.5)$$

$$\partial \pi/\partial \lambda_i = \bar{x}_i - \Sigma_j x_{ij} = 0 \qquad (4.6)$$

$$x_{ij},\ \bar{x}_i,\ y_j,\ z_i,\ \lambda_i \geq 0 \qquad (4.7)$$

$$(\partial \pi/\partial x_{ij})x_{ij} = 0 \qquad (4.8)$$

$$(\partial \pi/\partial y_j)y_j = 0 \qquad (4.9)$$

$$(\partial \pi/\partial z_i)z_i = 0 \qquad (4.10)$$

$$(\partial \pi/\partial \bar{x}_i)\bar{x}_i = 0 \qquad (4.11)$$

Equations (4.2) through (4.6) are the marginal conditions for maximization. The conditions implied in

(4.7) impose non-negativity on the choice variables, but allow for corner solutions. Finally, equations (4.8) through (4.11) ensure complementary slackness; that is, either the value of a choice variable is zero (corner solution) or the associated partial derivative is zero (interior solution). Thus, for example, if the value of the choice variable x_{ij} is positive, then strict equality holds in (4.2). Also, because $x_{ij} > 0$ implies $\bar{x}_i > 0$, equality would hold in (4.5) as well. But if $x_{ij} = 0$, the strict inequality holds in (4.2); however strict inequality in (4.5) might or might not hold because the primary division could still produce intermediate product for other final divisions in the firm.

Feasibility

Before rationalizing MNF behavior with the model, it is necessary to check the feasibility of an interior solution with respect to all variables. The case of all intermediate product markets being perfectly competitive is the simplest to analyze and the extension to monopoly and monopsony power is fairly straightforward.

In the absence of transport costs, pure competition implies all intermediate product market prices are equal to a world market price p, so that $b_j = s_i = p$, and that all divisions are price takers, i.e., $b'_j = s'_i = 0$. Initially, assume free trade for the extra-firm products and no transport costs, but maintain the positive taxes on intra-firm trade. The purpose of analyzing this particular

scenario is mainly pedagogic, but such conditions might exist when there are nearby domestic agents in the divisional intermediate product markets and international transfers are subject to tariffs or sales taxes.

If all choice variables are positive then the following relationships corresponding to (4.2) through (4.5) result:

$$R'_j = \gamma_{ij}\rho_i + \psi_{ij} + \lambda_i \qquad (4.12)$$

$$R'_j = p \qquad (4.13)$$

$$p = \Sigma_j \gamma_{ij}\rho'_i x_{ij} + (z_i + \bar{x}_i)c'_i + c_i \qquad (4.14)$$

$$\lambda_i = \Sigma_j \gamma_{ij}\rho'_i x_{ij} + (z_i + \bar{x}_i)c'_i + c_i \qquad (4.15)$$

From (4.14) and (4.15), it is clear that $\lambda_i = p$, the common market price faced by all divisions for the intermediate product. Substituting this equality into (4.13) yields

$$R'_j = \lambda_i \qquad (4.16)$$

which contradicts (4.12). This contradiction means that x_{ij}, y_j, and z_i cannot all simultaneously be positive. Moreover, since $R'_j = p = \lambda_i$ is constant, the contradiction implies that no such interior solution exists for any pair (i,j) of divisions. Therefore, if pure competition and free trade exist in the intermediate product market and transfers are taxed, no final division would purchase intermediate product from both intra-firm and extra-firm sources when primary divisions sell some intermediate product on the open market. Similarly, no primary division would sell intermediate product both internally and externally when final divisions find it optimal to purchase some intermediate product on the open market.

Given this conclusion, would a primary division produce intermediate product for both intra-firm and extra-firm sale if final divisions did not make extra-firm purchases? Assume that x_{ij} and z_i are both positive quantities but that $y_j = 0$. Then (4.14) and (4.15) still hold so that $\lambda_i = p$. The relationship in (4.16) also applies, but because $y_j = 0$, we have, corresponding to (4.3) and (4.13),

$$R'_j < p \tag{4.17}$$

which contradicts (4.16), so that x_{ij} and z_i cannot both be positive when $y_j = 0$. In other words: under the stated conditions it is not optimal for primary divisions to produce intermediate product for both intra-firm and extra-firm sale, even when final divisions do not purchase from other suppliers. Again, this result holds for all pairs (i,j) of divisions.

Would it then be optimal for final divisions to purchase both internally and externally when no extra-firm sales of z_i are made? Assume that $x_{ij} > 0$ and $y_j > 0$, but that $z_i = 0$. Then (4.12), (4.14), and (4.15) still obtain, but (4.13) becomes

$$p < \Sigma_j \gamma_{ij} p'_i x_{ij} + (z_i + \bar{x}_i) c'_i + c_i \tag{4.18}$$

From (4.15) and (4.18) it is then clear that $\lambda_i > p$. Substituting this inequality into (4.12) gives the relationship

$$R'_j = \gamma_{ij} p_i + \Psi_{ij} + \lambda_i > p \tag{4.19}$$

But $\partial \mathcal{L} / \partial y_j = 0$ by (4.9) because $y_i > 0$, so that

$$R'_j = p \tag{4.20}$$

which contradicts (4.19). The answer to our last question is clearly no.

It is clear then, from these three conclusions, that no profit maximizing MNF would conduct intra-firm trade under pure competition and free (extra-firm) trade when only intra-firm trade is taxed and no transport costs are taken into account. The firm could not overcome the tax burden with gains from internal economies. If domestic sources exist for primary division sales and for final division purchases -- and there is no domestic tax -- then intra-firm trade would be unprofitable. The remaining case, where no intra-firm trade occurs, is trivial: y_j and z_i would be produced so that

$$R'_j = c'_i z_i + c_i = p \qquad \forall\ i,j \qquad (4.21)$$

We can then conclude that an interior solution does not exist for all choice variables simultaneously, but only for all y_j and z_i simultaneously.

The validity of the zero transport costs assumption is questionable at best, but the implausibility conclusion allows us to make stronger statements in cases where transport costs are taken into account. The analysis turns now to that case. Under free trade, intermediate product prices in their respective markets will differ according only to transport costs if no externalities exist. If the pure competition assumption is maintained, then $b'_j = s'_i = 0$, but b_j and s_i are not necessarily identical as in the previous scenario. Transport costs for x_{ij} can be accounted

for explicitly in either γ_{ij} or ψ_{ij}, depending on how they are calculated by the firm.

Although it can be shown that an interior solution exists for this scenario, it is more useful to describe firm behavior when subsidies, tariffs, or other taxes are also accounted for; the former is just a special case of the latter. To do so, define $\beta_j \in [0, 1]$ to be a net ad valorem tariff on intermediate product imported by final division j from either primary divisions or from the open market. Also define $\sigma_i \in [-1, 1]$ to be a tax (if positive) or subsidy (if negative) on sales of intermediate product by primary divisions or on the open market. Note that σ_i may be applied as a sales tax or subsidy if a domestic market exists for division i. As well, ad valorem taxes on profits can be accounted for by adding the marginal tax rates t_i and t_j to any ad valorem tariffs or subsidies and by incorporating them into the divisional net revenue and variable cost functions. Also define net ad valorem charges on intra-firm transfers as

$$\Gamma_{ij} = \sigma_i + \beta_j + \gamma_{ij} \tag{4.22}$$

where γ_{ij}, as noted above, accounts for any ad valorem transport costs and/or special taxes on intra-firm trade and β_j and s_i account for both tax and trade policies. The Lagrangian function restated to account for these parameters is:

$$\begin{aligned} \mathcal{L} = {} & \Sigma_j R_j - \Sigma_j \beta_j b_j y_j + \Sigma_i \sigma_i s_i z_i - \Sigma_i \Sigma_j (\Gamma_{ij} p_i + \psi_{ij}) x_{ij} \\ & - \Sigma_i (z_i + \bar{x}_i) c_i + \Sigma_i \lambda_i (\bar{x}_i - \Sigma_j x_{ij}) \end{aligned} \tag{4.23}$$

Assume $x_{ij} > 0$, $y_j > 0$, and $z_i > 0$ for all i and j. Then the relevant first-order conditions corresponding to (4.2) through (4.5), are

$$\partial \mathcal{L}/\partial x_{ij} = R'_j - \Gamma_{ij}\rho_i - \psi_{ij} - \lambda_i = 0 \qquad (4.24)$$

$$\partial \mathcal{L}/\partial y_j = R'_j - (1 + \beta_j)b_j = 0 \qquad (4.25)$$

$$\partial \mathcal{L}/\partial z_i = (1 - \sigma_i)s_i - \Sigma_j \Gamma_{ij} x_{ij} \rho'_i - (z_i + \bar{x}_i)c'_i - c_i = 0 \qquad (4.26)$$

$$\partial \mathcal{L}/\partial \bar{x}_i = \lambda_i - \Sigma_j \Gamma_{ij} x_{ij} \rho'_i - (z_i + \bar{x}_i)c'_i - c_i = 0 \qquad (4.27)$$

Equating (4.26) and (4.27) gives

$$\lambda_i = (1 - \sigma_i)s_i = \Sigma_j \Gamma_{ij} x_{ij} \rho'_i + (z_i + \bar{x}_i)c'_i + c_i \qquad (4.28)$$

Substituting the first equality in (4.28) for λ_i into (4.24) and equating this to (4.25) yields

$$R'_j = \Gamma_{ij}\rho_i + \psi_{ij} + (1 - \sigma_i)s_i = (1 + \beta_j)b_j \qquad (4.29)$$

No contradiction is evident. Because we have the required number of equations and choice variables and can show no contradictions, it can now be assumed that an interior solution for all choice variables is possible.

By assuming that the MNF maximizes profits, we have implicitly assumed that second-order sufficient conditions about concavity of the global profit function are satisfied by the simultaneous solution to conditions (4.24) through (4.27): if the hessian of the global profit function is negative definite in a feasible neighborhood about the optimal solution, then the optimal solution will maximize firm profits. Also note the second-order necessary condition: if a profit maximizing solution exists, then the hessian of the global profit function is at least locally negative semidefinite. Satisfaction of these conditions

insure that the hessian is non-singular and, with one additional assumption, allow us to use the implicit function theorem. Assuming that equations (4.2) through (4.6) are continuously differentiable with respect to the choice variables, the implicit function theorem guarantees the existence of a maximal solution. Hence, we can reasonably assume that an interior solution is not only possible, but that it indeed exists.

Moreover, because it was shown that such a solution does not exist when market prices do not differ, we can assume that an interior solution exists if and only if the model reflects differences in transportation costs. Having shown the existence of a profit maximizing solution, we now turn to a description of the MNF's behavior.

Firm Behavior

The firm's determination of utilization, production, purchases, and sales of intermediate product can best be described by looking at the first-order conditions as they apply to a primary division u and final division v. Profit maximization suggests that the firm's decision rules for all x_{uv}, $\bar{x}_u$, y_v, and z_u are given by the following three relationships, which must be satisfied simultaneously:

$$R'_v \equiv \partial R_v/\partial y_v = (1 + \beta_v)b_v \qquad (4.30)$$

$$R'_v \equiv \partial R_v/\partial x_{uv} = \Gamma_{uv}\rho_u + \Psi_{uv} + \Sigma_j\Gamma_{uj}\rho'_u + (z_u + \bar{x}_u)c'_u + c_u \qquad (4.31)$$

$$(1 - \sigma_u)s_u = \Sigma_j\Gamma_{uj}x_{uj}\rho'_u + (z_u + \bar{x}_u)c'_u + c_u = 0 \qquad (4.32)$$

Equation (4.30) says that, when all other variables are held constant, intermediate product will be procured by final division v as y_v up to the point that the additional cost of purchasing that unit of y_v just equals the additional net revenue from utilizing it in the production of the final product. In other words, the optimal purchase of y_v is given by the equality of marginal net revenue product and marginal factor cost of y_v.

Equation (4.31) has a similar interpretation. Holding constant extra-firm trade in the intermediate product, final division v and primary division u will trade x_{uv} up to the point that the additional net revenue to be gained by using the last unit of x_{uv} in the production and sale of the final product just equals the additional cost of producing and transferring that last unit. Thus, the optimal level of x_{uv} is given by the equality of marginal net revenue product to marginal factor cost of x_{uv}. Moreover, final division v's utilization of y_v and x_{uv} are jointly determined so that the marginal factor cost of each is identical and equal to the marginal net revenue product of the intermediate good for final division v.

That the right-hand side of (4.31) is the marginal cost of producing and transferring x_{uv} is not immediately obvious. (Because the x_{ij} are both inputs and outputs, we can use the terms marginal cost and marginal factor cost interchangeably here.) That it is indeed marginal cost can be more readily seen when the equation is rewritten to identify the direct and indirect marginal production and

marginal transfer cost effects. Holding extra-firm sales constant at $z_u = z_u^\circ$ and transfers to all final divisions except division v constant at $x_{uj} = x_{uj}^\circ$ for all $j \neq v$, (4.31) may be rewritten as

$$R'_v = \Gamma_{uv}(\rho_u + \rho'_u x_{uv}) + \psi_{uv} \tag{4.33a}$$

$$+ x_{uv}c'_u + c_u \tag{4.33b}$$

$$+ \Sigma_{j\neq v}\Gamma_{uj}x_{uj}^\circ\rho'_i \tag{4.33c}$$

$$+ (z_u^\circ + \Sigma_{j\neq v}x_{uj}^\circ)c'_u \tag{4.33d}$$

It is now more nearly obvious that the right-hand side of (4.33a) is the direct marginal effect on the transfer cost of x_{uv} and (4.33b) is the direct marginal effect on the production cost of x_{uv}. But because increasing x_{uv} may increase the cost function for all x_{uj} ($j = 1,\ldots,n$), the firm must take into account the indirect marginal effects on transfer costs in (4.33c) for transfers to other divisions and the indirect marginal effects on production costs in (4.33d) for all intermediate production in that division. One could then define the sum of (4.33a) plus (4.33c) as the marginal transfer cost of x_{uv} and also define the sum of (4.33b) plus (4.33d) as the marginal production cost of x_{uv}.

Equation (4.32) tells us that to maximize profits, primary division u will produce units of z_u for sale on the open market up to the point where the additional cost of producing another unit of intermediate product for external sale just equals the additional revenue from selling that unit. The division equates its marginal revenue for z_u to its marginal cost of z_u, holding all transfers constant at

$x_{uj}=x^{\circ}_{uj}$. This result for division u parallels the familiar MR=MC condition for a profit maximizing multi-product firm.

The left-hand side of (4.32) is obviously the marginal revenue of z_u after accounting for the direct effect of σ_i. To see the direct and indirect marginal cost effects of z_u more clearly, we rewrite (4.32) as

$$(1 - \sigma_i)s_i = c_u + z_u c'_u \qquad (4.34a)$$

$$+ \bar{x}^{\circ}_u c'_u \qquad (4.34b)$$

$$+ \Sigma_j \Gamma_{uj} x^{\circ}_{uj} \rho'_u \qquad (4.34c)$$

Here, the right-hand side of (4.34a) is the direct marginal production cost of an addition unit of z_u. Changes in the level of z_u also affect indirectly the marginal production cost (4.34b) and marginal transfer cost (4.34c) of all intermediate output produced by the division for intra-firm trade through the cost function. The sum of (4.34a) plus (4.34b) is then the marginal production cost of z_u and (4.34c) is the indirect marginal transfer cost of z_u. Although z_u is not transferred to final divisions within the firm, its effects on the divisonal cost function are carried through to transfer price ρ_u, and thus to transfer costs.

We have seen how y_v and x_{uv} are jointly determined. Similarly, $\bar{x}_u$ and z_u are determined jointly through (4.28). The expression for λ_u given by (4.27) is the derivative of the Lagrangian function with respect to division u's total production of intermediate product, $\bar{x}_u$, and can therefore be interpreted as the (direct plus indirect) marginal production cost of $\bar{x}_u$ plus the "indirect" marginal transfer

cost of all x_{ij}, holding any particular x_{uv} constant. By the relationship of (4.28), the rule for determining the divisional production of all intermediate product $(z_u + \bar{x}_u)$ is that the marginal cost of z_u equal the marginal cost of $\bar{x}_u$, and that both marginal costs equal the marginal revenue of z_u.

Notice that the marginal revenue of $\bar{x}_u$ has not been explicitly defined and does not immediately appear to play a role in the firm's decision-making. This is because the change in total revenue to the firm corresponding to a change in the level of $\bar{x}_u$ is not, at all levels of x_u, expressible as a function of the specific transfer quantity x_{uv}. The firm's marginal revenue of x_{uv} is identical to the marginal revenue product of x_{uv}, which is R'_j less the marginal cost of processing and selling the final product. However, the last unit of $\bar{x}_u$ may be transferred to some other final division $j \neq v$. We might be able to show that the marginal revenue to the firm of all x_{uv} are identical at the optimal levels x^*_{uv}, and hence that this is the marginal product of $\bar{x}_u$ at the optimum level $\bar{x}^*_u$. This expression, though, would still be contingent upon all $x_{uj} = x^*_{uj}$ constant for $j \neq v$. Alternatively, we could implicitly define this marginal revenue as the opportunity cost of transferring the last unit of the intermediate good produced rather than selling it on the open market. This expression would be the constant $(1 - \sigma_i)s_i$ and would also be valid only at the optimal level $\bar{x}^*_u$. At this point in the analysis, such expressions provide no additional insight

into the firm's short run behavior. They could be useful in a comparative statics analysis of the firm's longer run behavior. For now, the expression of the marginal revenue product for x_{uv} is sufficient for our purposes.

Conditional Factor Demand and Supply

As mentioned earlier, the implicit function theorem guarantees a maximal solution for each choice variable under the conditions of differentiability and negative semidefiniteness assumed. At this optimal solution to the global profit function, the system of first-order conditions (4.24) to (4.27) are identically equal to zero and define a corresponding set of implicit functions for some neighborhood about the optimal solution:

$$x_{uv}^{*} = x_{uv}^{*}(s_i, b_j, \sigma_i, \beta_j, \gamma_{ij}, \psi_{ij}) \tag{4.35}$$

$$y_{v}^{*} = y_{v}^{*}(s_i, b_j, \sigma_i, \beta_j, \gamma_{ij}, \psi_{ij}) \tag{4.36}$$

$$z_{u}^{*} = z_{u}^{*}(s_i, b_j, \sigma_i, \beta_j, \gamma_{ij}, \psi_{ij}) \tag{4.37}$$

$$\bar{x}_{u}^{*} = \bar{x}_{u}^{*}(s_i, b_j, \sigma_i, \beta_j, \gamma_{ij}, \psi_{ij}) \tag{4.38}$$

$$\lambda_{u}^{*} = \lambda_{u}^{*}(s_i, b_j, \sigma_i, \beta_j, \gamma_{ij}, \psi_{ij}) \tag{4.39}$$

for each pair (u,v) of divisions, where i = 1,...,m and j = 1,...,n. It can be shown, using the envelope theorem and Hotelling's lemma, that these implicit functions give the conditional factor demand functions for x_{uv} (4.35) and y_v (4.36) and the conditional supply functions for z_u (4.37) and $\bar{x}_u$ (4.38). Moreover, the conditions allowing us to apply the implicit function theorem tell us that these functions are continuously differentiable for all possible

values of the choice variables in some feasible neighborhood about the optimal solution. Substitution of (4.36) through (4.39) into the global profit function yields the indirect profit function

$$\pi^* = \pi^*(s_i, b_j, \sigma_i, \beta_j, \gamma_{ij}, \psi_{ij}) \tag{4.40}$$

A comparative statics analysis for the effects of changes in prices and policy parameters may then be carried out after totally differentiating (4.40) with respect to the non-choice variables indicated in its argument. Such an analysis, however, exceeds the scope of this thesis and is not carried out here. In the final chapter, some questions of special importance that could be addressed in such an analysis are identified and discussed.

Summary

This chapter has introduced a framework for analyzing intra-firm trade in centralized, vertically and horizontally integrated MNFs. It is specifically designed to be a tool for analyzing intra-firm trade in MNFs using a cost-plus transfer pricing system, but can be easily adapted for analyzing other transfer pricing schemes. The transfer price defined in this model uses the average total cost of producing all intermediate product in a given primary division, but there is no reason that ρ_i could not represent some other functional form of transfer pricing.

The main benefit of such a construction is that the model can explicitly account for the impacts of continuous

changes in the value of transfer prices, a quality lacking in some other models presented in the literature (Horst, Bond, and Itagaki for example). Thus, the choice nature of transfer prices is also more accurately reflected here.

The assumptions on firm structure most closely resemble those of Itagaki (1979), with the important distinction that more than one supplier of the intermediate product may exist in the MNF, and thus, more than one transfer price. These comparisons are not meant to be taken as a blanket criticism of the articles cited; their analyses fit their stated objectives well. Rather, the model presented here is proposed as an alternative tool for analysis when the impacts of changes in transfer prices must be accounted for. With proper modifications to fit particular policy analyses, these impacts can be identified with the direct and indirect marginal transfer cost effects shown in (4.33) and (4.34).

The complement of policy variables has also been expanded to include ad valorem taxes and subsidies on intermediate product exports. The impacts of specific policies have not been derived here and the definitions of the policy variables are rather general. These general definitions, however, make the model very flexible for analyzing specific policies. Some suggestions for further use of this model are discussed in the following chapter.

CHAPTER V

SUMMARY AND CONCLUSIONS

Multinational agribusiness firms play an important role in the world agricultural economy and a crucial role in the national economies of many developing countries. The issues and controversies surrounding multinational activity are abundant and complex: abundant because multinationals are involved in almost every country and thus subject to a myriad of cultural and political, as well as economic, institutional constraints; complex because the multinational firm is itself a complex creature dealing in a complex environment. Intra-firm trade and transfer pricing comprise one such complex and often controversial issue.

The general intent of this study has been to broaden our understanding of MNF intra-firm trade and transfer pricing, specifically by developing a logical framework in which the issues may be described and analyzed. Because the firm level behavior of multinational agribusiness firms has received relatively little attention in the agricultural economics literature, this work has been largely exploratory and, for the most part, descriptive.

The literature review of the second chapter serves both to define the firm level and government policy issues of transfer pricing -- as a basis for the succeeding model --

and to summarize prior work in the economic analysis of intra-firm trade. It is impossible to ascertain the impact of MNF intra-firm trade on the economy. But even if the published trade and investment data presented in chapter II do not provide an adequate picture, it is clear that, at least for small and developing economies depending on MNF activity, policies designed to regulate intra-firm trade can have significant consequences. Because transfer pricing data, as presented in chapter II and available elsewhere, is scarce and of questionable reliability, economic analysis of transfer pricing is best accomplished in theoretic rather than econometric terms, as this study endeavors to do.

Chapter IV proposes a model describing the intra-firm production, distribution, and economic processes of a centralized multinational firm. The model incorporates the more important factors suggested in the literature first into as general a framework as possible. The results of a Kuhn-Tucker analysis of this model indicate that marginal impacts on intra-firm trade of changes in production and the policy environment can be modelled. Moreover, inferences about MNF behavior are not limited by firm structure, e.g., the number of final and primary divisions in a firm, or by the existence of external market opportunities for the intermediate product.

Kim and Miller (as discussed in the literature review) identified several policy factors related to transfer pricing that are important to MNFs operating in developing countries. Among these were

- profit repatriation controls,
- exchange rate controls,
- joint venture constraints, and
- tariffs, customs, and taxes.

Burns (1980a) also identified several factors that significantly influence transfer pricing policies for U.S. MNFs:

- market conditions and competition,
- securing reasonable profits for each division,
- U.S. taxes,
- price controls,
- customs duties, and
- exchange rate controls.

To some extent, all of these factors can be accounted for in the model presented in chapter IV; most can be accounted for outright. Tang (1980) also identified restrictions on intra-firm management fees and royalty payments as important influences on Canadian transfer pricing. These costs are not accounted for explicitly in the framework presented here, but doing should not be impracticable if such charges are treated as allocable fixed costs.

The model has potential for analyzing several specific policies and consequences of MNF actions in a comparative statics framework. One logical extension of the analysis presented in chapter IV would be to derive the comparative statics results of changes in the firm's optimal output when prices and policy variables fluctuate. Similarly, the analysis can be extended to cover imperfectly competetive markets

and, with additional assumptions, impacts on divisional output of the final product.

There are many more MNF issues that deserve scrutiny by agricultural economists. Of particular importance is the impact of exchange rate restrictions and volatility. Initial work in this area by Itagaki (1982) indicates that the frame-work presented here could be successfully modified to further analyze MNF behavior under exchange rate uncertainty. Analysis in other areas of uncertainty, including commodity price uncertainty, could also provide interesting and useful results. Finally, the changing international political economy (Europe 1992, integration of the Eastern bloc countries into the world economy, GATT reforms, changes in the international financial order, etc.) provides fertile ground for identifying MNF issues which need to be addressed.

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