

EXCHANGE RATE FLUCTUATIONS AND THE CANADIAN PORK TRADE

by

Dhurvanand Chadee

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ABSTRACT

Canada adopted the flexible exchange rates system in the early 1970's. Since then there have been wide fluctuations in the value of the Canadian dollar relative to other major currencies. One of the consequences of fluctuations in the exchange rates is on trade flows between different countries.

Between 1970 and 1984, Canadian exports of live hogs and pork have grown tremendously. Exports of live hogs grew by an amazing 800 percent while pork exports more than doubled. Live hogs and pork are exported to two major destinations; the U.S. and Japan. Over the same period of time the Canadian dollar depreciated by about 70 percent and 27 percent relative to the Yen and the U.S. dollar respectively. Hence an important question arises as to how important was the impact of the dollar depreciation on pork exports.

The major objective of this thesis was to estimate empirically the effects of the Canadian dollar depreciation on Canadian pork prices and pork exports. A partial equilibrium econometric model of the pork trade sector was specified and estimated. The structural relationships explain the export supply and the import demand for Canadian pork. The model was estimated as a system of simultaneous equations using three-stage least squares technique. Quarterly data for the period 1970 to 1984 were used.

The estimated parameters of the structural equations were used to compute the exchange rate elasticities of exports and prices. The results show that the depreciation of the Canadian dollar relative to the Yen and the U.S. dollar had a modest impact on Canadian pork prices and pork exports.

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Chapter I

INTRODUCTION

With the breakdown of the Bretton Woods Agreement in the 1960's, a regime of floating exchange rates was adopted by most countries. Canada switched to the floating exchange rate system in the early 1970's. Since then there have been wide fluctuations in the value of the Canadian dollar vis-à-vis other currencies.¹ One of the immediate effects of such changes in exchange rates between different countries is on the trade flow between these countries. Between 1970 and 1984, the value of the Canadian dollar relative to the value of the currencies of her major trading partners, the United States and Japan, has varied widely. For example, the Canadian-U.S. exchange rate has fluctuated from a low of 0.96 in the second quarter of 1974 to a high of 1.29 in the last quarter of 1984, amounting to almost 34 percent depreciation of the Canadian dollar relative to the currency of her single most important trade partner. Studies by Takayama and Judge(1964), Schuh(1975) and Grennes(1975) among others, consider a currency devaluation to be analogous to subsidizing the export sector of the country devaluing its currency. Therefore, there are reasons to believe that between 1970 and 1984 the Canadian export industry has benefited from the currency depreciation.

¹ Referred to the exchange rate thereafter.

1.1 STATEMENT OF THE PROBLEM.

Between 1970 and 1984, Canadian exports of live hogs and pork grew tremendously. The data in Table 1.1 shows that the total exports of pork and pork products increased from 622 thousand hundredweight in 1970 to more than 3.7 million hundredweight in 1984. This represents an increase of over 200 percent over a 15 year period. A similar trend developed in the exports of live hogs. A total of 1.4 million head were exported in 1984 compared to only 80 thousand head in 1970.

While live hogs have traditionally been exported almost exclusively to the United States, pork and pork products have generally found their way to a number of overseas markets. However, over the last decade, the United States and Japan have established themselves as the two single most important importers of Canadian pork. In 1984, for instance, 81 percent of the total Canadian pork exports went to the United States, 17 percent to Japan and a mere 2 percent to the rest of the world.

Exports of both live hogs and pork and pork products to the United States have grown tremendously over the last decade. In 1984, 3 million hundredweight of pork were exported to the U.S. compared to only 529 thousand hundredweight in 1970. Similarly, 1.4 million hogs were shipped to the U.S. in 1984 compared to only 71 thousand head in 1970 (Table 1.1).

The influx of Canadian live hogs and pork into the U.S. recently led to an investigation by the U.S. International Trade Commission regarding the conditions of competition between the U.S. and Canadian live hog and pork product industries. U.S. hog producers alleged that Canadian ex-

ports are only made possible by the various government programs which in their opinion, constitute export subsidies for hogs and pork.

It is strongly believed in Canada that increased pork exports to the U.S. are a direct response to the depreciation of the Canadian dollar. The Canadian dollar has depreciated by as much as 27 percent vis-à-vis the U.S. dollar and by about 71 percent relative to the Japanese Yen between 1970 and 1984 (Table 1.1). Given the magnitude of the currency depreciation and the substantial increase in the volume of Canadian pork trade over the same period of time, an important question arises as to how significant was the impact of the exchange rate on Canadian pork trade.

Table 1.1
Canadian Live Hogs and Pork Exports and the Exchange Rates

Year	Canadian Exports of Live Hogs to U.S.	Canadian Exports of Pork		Exchange Rates	
		Total	to U.S. to Japan	Canada/U.S.	Canada/Japan
	---No. of Head---	Cwt---			
1970	71,465	622,233	529,500	63,769	1.0440
1971	83,356	882,090	610,837	200,950	1.0098
1972	86,621	1,049,116	549,111	454,042	0.9905
1973	87,389	1,142,538	604,887	449,346	1.0001
1974	195,477	815,972	413,737	287,993	0.9780
1975	28,777	815,411	254,773	537,306	1.0173
1976	43,330	786,795	177,977	590,105	0.9861
1977	40,875	934,948	186,602	739,614	1.0635
1978	185,069	1,147,637	422,495	699,704	1.1402
1979	128,635	1,653,600	830,796	701,078	1.1715
1980	235,724	2,482,029	1,620,412	701,658	1.1690
1981	143,830	2,710,485	1,656,242	933,894	1.1990
1982	302,454	3,452,663	2,376,665	964,791	1.2341
1983	453,938	3,323,382	2,314,654	918,361	1.2324
1984	1,343,470	3,712,394	3,018,999	631,129	1.2948
					0.002916
					0.002912
					0.002912
					0.003696
					0.003354
					0.003430
					0.003327
					0.003980
					0.005480
					0.005375
					0.005183
					0.005450
					0.004966
					0.005190
					0.005457

Source: Statistics Canada, Exports by Commodities, Catalogue No. 65-004.

Bank of Canada Review, various issues.

1.2 OBJECTIVES OF THE STUDY.

The overall objective of this study is to examine the impacts of fluctuations in the exchange rate on the Canadian pork industry.

Specifically the objectives are:

1. To review the trend in Canada's trade of live hogs and pork over the 1970 to 1984 period and relate it to exchange rate movements.
2. To review the literature related to both trade theory and exchange rate theory in order to develop a basis for evaluating the impacts of fluctuations in exchange rates on both the price level and the volume of exports of Canadian pork.
3. Based on 2 above, develop a conceptual model and an empirical model to estimate the effects of changes in exchange rates on the prices and exports of Canadian pork.
4. To draw the policy implications of the empirical findings.

1.3 PROCEDURE.

This study will be limited to the Canadian Pork Industry. Taking into account the data which are available, this study will be further restricted to Canadian trade with the U.S. and Japan in live hogs and fresh and chilled pork as defined by Agriculture Canada, (Statistics Canada classification 3-49 for live hogs and 11-22, 11-24, 11-29 for fresh, frozen and chilled pork and pork products). Live hogs will be converted to a dressed weight basis by using the appropriate indices as reported by Agriculture Canada. The exports of live hogs and fresh frozen and chilled pork constitute the bulk of the export of the Canadian pork industry.

The general procedure of this study includes the specification and estimation of the export supply and import demand schedules for Canadian pork. Exchange rates will be incorporated in the model such that the structural form takes into account behavioural relations for pork prices and quantities in both the exporting and importing countries. Exchange rates elasticities with respect to Canadian pork prices and Canadian export supply will be estimated and used for analyses which satisfy the stated objectives of the study.

1.4 ORGANIZATION OF THE STUDY.

Chapter II briefly describes the Canadian Pork industry. The developments that have taken place over the last fifteen years on the export side are also reviewed. A brief outline of Canada's major pork importers' market, the U.S. and Japan, will be examined in terms of production, consumption and export in order to have a better understanding of the whole pork export sector.

Chapter III is a review of the theoretical and empirical studies on the exchange rate question as it relates to agricultural trade between different nations. Chapter IV provides the conceptual framework of the study. Trade theory and exchange rate theory are discussed with regards to the effects of a devaluation in the currency of an exporting country on prices and exports of that country.

Chapter V specifies the structural form of the pork econometric model following the conceptual model developed in chapter IV. A description of the data and its sources and the estimation techniques employed in this study are also examined.

Chapter VI estimates the model developed in Chapter V . Tests are performed to determine if exchange rate fluctuations have had any significant effects on prices and on the volume of exports of Canadian pork.

Chapter VII summarizes the results of the study and draws conclusions based on these results. Recommendations for policy formulation regarding the marketing of live hogs and pork products will be made. In addition, suggestions are made for possible further research.

Chapter II

RECENT TRENDS IN THE CANADIAN PORK INDUSTRY: AN OVERVIEW

2.1 INTRODUCTION

The hog industry in Canada has undergone unprecedented growth over the last fifteen years. This chapter reviews the evolution of the pork industry since 1970 and attempts to relate the growth of the export sector of this industry to changes in the exchange rates over the last fifteen years. The hog industry of the two major importers of Canadian pork, the U.S. and Japan will also be briefly analysed in terms of recent production and consumption trends and their potential for future imports.

2.2 THE IMPORTANCE OF THE HOG INDUSTRY IN CANADA

One way of assessing the role of the Canadian hog industry is by considering it within the context of Canadian agriculture in general and within the context of the Canadian livestock industry in particular.

The livestock industry has traditionally been an important sector of Canadian agriculture. The bulk of farm cash receipts over the last fifteen years has originated from the livestock industry although grains and oilseed constitute Canada's major exports. Table 2.1 shows that between 1970 and 1984, the livestock industry in Canada contributed an annual average of 53 percent of total farm cash receipts; with a high of

62 percent in 1970 and a low of 48 percent in 1975, 1981, 1983 and 1984 respectively.

Between 1970 and 1984, cash receipts from hogs has represented, on average, about 9 percent of the total farm cash receipts and about 16 percent of the total cash receipts of the livestock industry in particular. While the total cash receipts of the livestock sector increased by about 265 percent between 1970 and 1984, farm cash receipts from hogs increased by more than 285 percent over the same period. This indicates that between 1970 and 1984, the hog sector has performed relatively better than its counterparts of the livestock industry

It should also be noted from Table 2.1 that in 1983 cash receipts from hogs declined by 12.3 percent from the previous year. This was mostly attributable to low prices that prevailed throughout 1983. Prices across Canada were generally 15 percent lower than in 1982. However, higher prices reversed the trend in 1984 and resulted in a 9.6 percent increase in total cash receipts to hog producers.

Hence, it is clear that livestock represents an important sector of Canadian agriculture. At the same time, it also becomes evident that although the proportion of total farm income derived from hogs has declined over the years, hog farming still represents an important source of income to Canadian farmers. The hog sector performed relatively better than the other sectors of the livestock industry between 1970 and 1984.

TABLE 2.1

Farm Cash Receipts From Farming Operations Canada, 1970-1984.

	Total Farm Cash Receipts	Farm Income From Livestock	Income From Hogs	Percent of Total From		Percent of Livestock
				Livestock	Hogs	
	-----Million \$-----			-----Percent-----		
1970	4,251	2,626	485	62	11	18
1971	4,563	2,662	429	58	09	16
1972	5,463	3,099	590	57	11	19
1973	6,801	3,931	832	58	12	21
1974	8,448	4,141	783	49	09	19
1975	10,028	4,818	886	48	09	18
1976	9,975	4,984	840	50	08	17
1977	10,071	5,195	839	52	08	16
1978	11,899	6,542	1,156	55	10	18
1979	13,947	7,654	1,306	55	09	17
1980	15,639	8,318	1,403	53	09	17
1981	18,544	8,991	1,637	48	09	09
1982	19,043	9,638	1,954	51	10	10
1983	18,746	9,083	1,713	48	09	10
1984	20,052	9,676	1,879	48	09	09
Average	11,831	6,091	1,115	53	09	16

Source: Statistics Canada, "Farm Net Income", Cat. No. 21-002, 1983.
 _____, "Farm Cash Receipts", cat. No. 21-001.

2.3 RECENT PRODUCTION AND CONSUMPTION TRENDS IN CANADA.

The dominant influence of the U.S. on the North American hog industry coupled with the relatively free trade relationship between Canada and the United States means that the Canadian hog industry is highly influenced by its U.S. counterpart.

Hog production in Canada between 1970 and 1984 has followed more or less a similar trend to that in the U.S.. Figure 2.1 illustrates the hog cycle of the two countries between 1970 and 1984. Both countries have generally followed the same production cycle since 1970 except for short periods of time (1971-1973 and the latter part of 1984) when the hog cycle of the two countries have diverged.

Pork production in Canada can be measured at two levels; the farm level and at the slaughter level. Table 2.2 shows the hog population and the number of hogs slaughtered in Canada between 1970 and 1983. The number of pigs on farms in Canada declined from 7.7 million head in 1970 to 5.6 million head in 1975. From 1976 to 1983, the hog inventory increased rather steadily to 10.3 million. Overall, the number of hogs on farms declined by 27 percent between 1970 and 1975 and increased by 69 percent between 1976 and 1983.

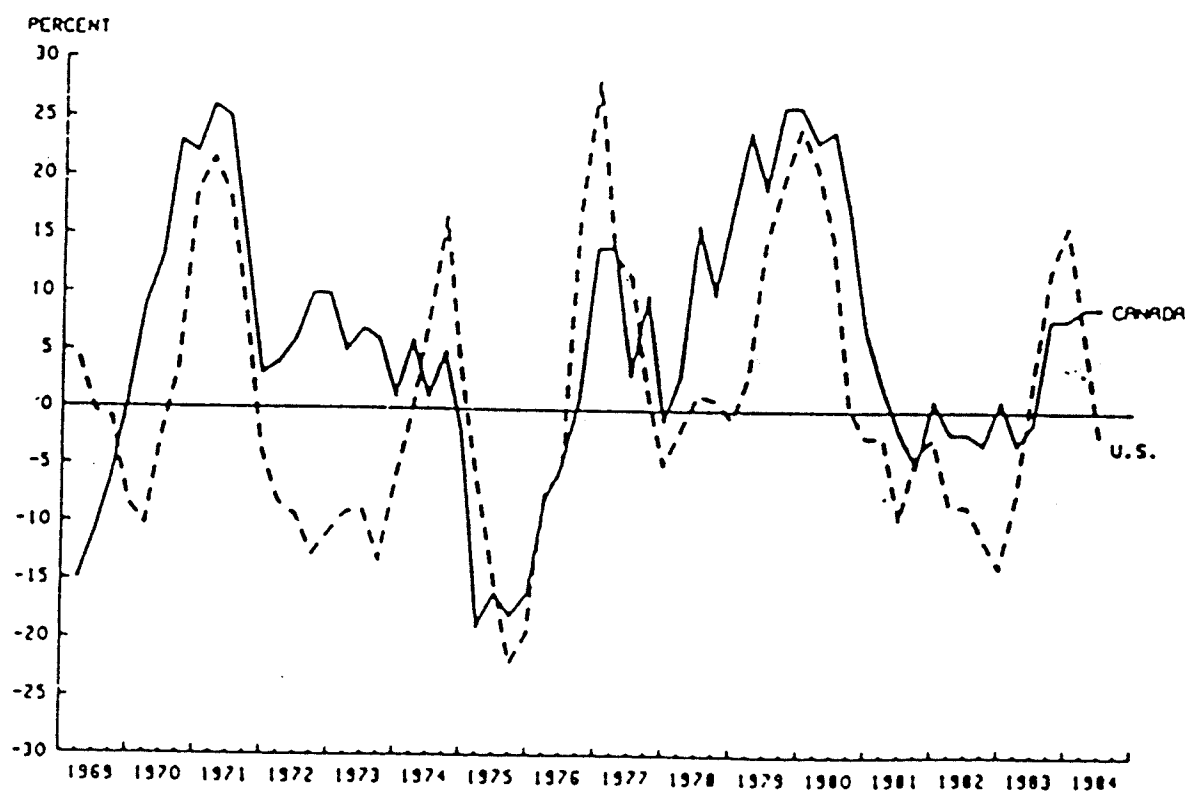
Hog marketings in Canada also followed two distinct phases of growth between 1970 and 1983. The total number of hogs marketed, comprising of both live exports and hogs slaughtered domestically for commercial purposes, increased from 8.8 million head in 1970 to 10.2 million head in 1971 before declining to 7.7 million head in 1976. Between 1971 and 1976, commercial hog marketings registered a 24 percent decrease. How-

ever, between 1977 and 1983, hog marketings in Canada increased by 64 percent, from 8.2 million head in 1977 to 13.5 million head in 1983.

The estimated volume of pork production, comprising domestic slaughter plus live exports (expressed in cold, trimmed carcass weight), increased by 45 percent between 1974 and 1983 (see table 2.3). Pork production increased from a 5-year (1974-1979) average of 1,275 million pounds to an average of 1,850 million pounds for the period 1979-1983.

Figure 2.1

HOG CYCLE* - CANADA AND U.S.



* QUARTERLY YEAR-OVER-YEAR CHANGE IN HOG MARKETINGS

Source: Agriculture Canada. Market Commentary, December 1984.

TABLE 2.2

Hog Population, Slaughter and Marketing in Canada

1970-1983

Year	Hog Population (Oct.1)(1)	Local Slaughter (2)	Live Exports (3)	Total Marketing (2+3)
.....'000 head				
1970	7,720**	8,648	80.81	8,729
1971	7,388**	10,113	87.28	10,200
1972	6,994*	9,357	87.49	9,444
1973	6,991*	9,041	88.35	9,129
1974	5,865*	9,269	196.03	9,465
1975	5,632	7,913	29.40	7,942
1976	6,115	7,679	44.16	7,723
1977	6,555	8,166	41.65	8,208
1978	7,775	9,085	185.80	9,271
1979	9,801	11,236	129.39	11,365
1980	10,186	13,151	236.52	13,388
1981	10,211	13,046	145.03	13,191
1982	10,140	12,886	303.70	13,190
1983	10,298	13,117	456.43	13,537
5 Year Average				
1974-1978	6,388	8,422	99.4	8,522
1979-1983	10,127	12,687	254.2	12,934

* January 1st.

** December 1st.

Source:(1)(2) Livestock Market Review, Economics and Marketing
Branch, Agriculture Canada.(various issues).
(3) Statistics Canada: Export by Commodities, Cat.No. 65-004.
(Various Issues).

Domestic disappearance of pork in Canada between 1970 and 1983 has fluctuated between a low of 1,208.5 million pounds in 1975 and a high of 1,660.8 million pounds in 1980 (see table 2.3) Based on a five year centered average, the domestic disappearance of pork increased by 21 percent between 1974 and 1983; from an average of 1,301 million pounds for the 1974-1978 period to 1,577 million pounds for the 1979-1983 period.

Expressed in per capita terms, the annual pork consumption in Canada has varied between 24.12 kg in 1975 and 32.3 kg in 1980. Over the last five years (1979-1983), per capita pork consumption has generally been higher than the average consumption levels of previous years and has also shown signs of a slight upward trend. This can readily be observed from figure 2.2 which shows the per capita consumption of major meats in Canada for the period 1970-1982. While the per capita consumption of chicken has been rather stable over the last decade, the per capita consumption of beef increased steadily from 1970 to 1976 before declining back to the 1970 level of consumption in 1982. Pork consumption however, has generally been trending upward slightly compared to the other meat, over the last decade.

TABLE 2.3
Pork Production and Disappearance

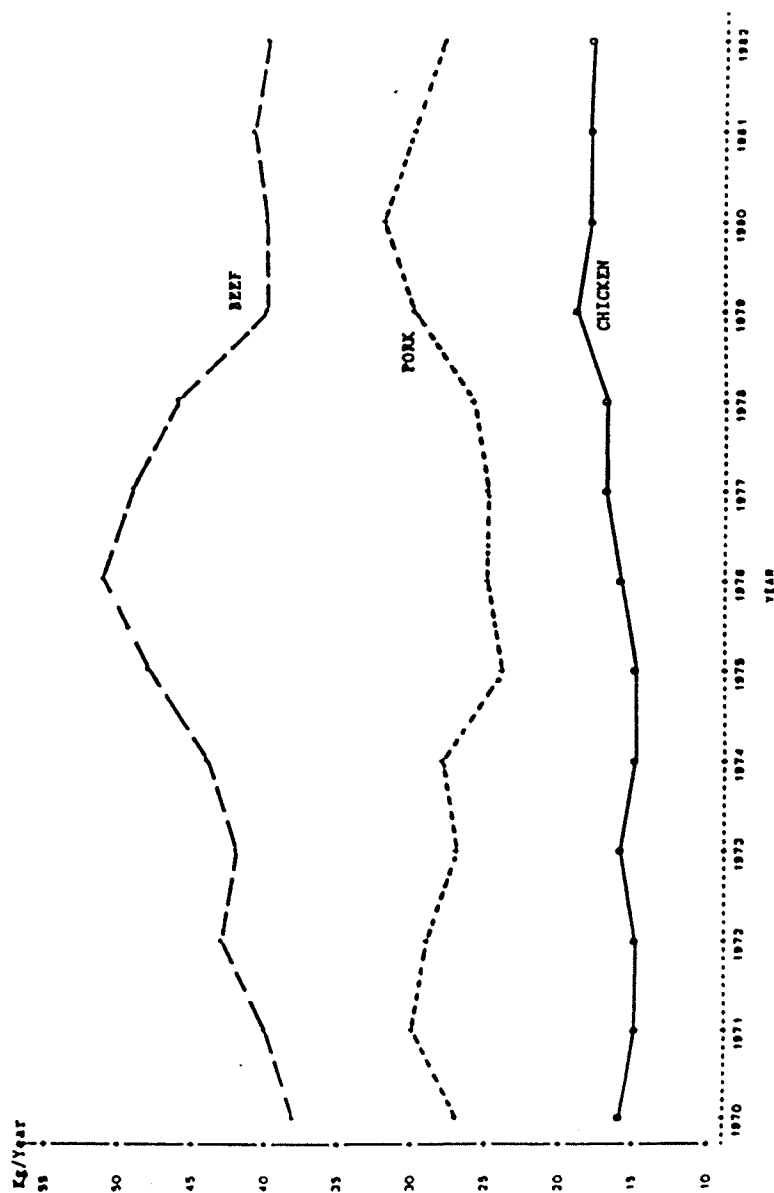
1970-1983

Year	Estimated Pork Production (1)	Domestic Disappearance	Per Capita Consumption
	(Mil. lb.).....		...Kg...
1970	1,371.6	1,252.7	26.65
1971	1,496.3	1,403.0	29.47
1972	1,449.0	1,377.1	28.63
1973	1,405.9	1,308.2	26.88
1974	1,427.4	1,391.4	28.18
1975	1,199.5	1,208.5	24.18
1976	1,180.6	1,273.8	25.10
1977	1,188.5	1,289.1	25.18
1978	1,379.1	1,345.0	26.19
1979	1,641.5	1,522.2	29.70
1980	1,919.7	1,660.8	31.05
1981	1,872.1	1,617.6	29.88
1982	1,876.3	1,513.6	27.67
1983	1,940.5	1,572.4	29.07
5-Year average			
1974-1978	1,275.0	1,301.6	25.77
1979-1983	1,850.0	1,577.2	29.47

(1) Domestic slaughter plus live exports, all expressed in cold, trimmed carcass weight and assuming 135 pounds of carcass weight per live hog exported.

Source: Statistics Canada: Exports by Commodities, Cat.No. 64-007.

Figure 2.2: Per Capita Consumption Of Major Meats In Canada:1970-1982



Source: Computed from data from Agriculture Canada, Handbook of Food Expenditures, Prices and Consumption, 1983.

2.3.1 Trends in Regional Hog Production in Canada

Major shifts in the regional production of hogs have taken place in Canada since 1971. The western provincial share of national hog production declined from 46 percent in 1971 to a low of 28 percent in 1983 before increasing slightly to 30 percent in 1984 (Table 2.4). By contrast, the eastern provinces increased their share of production from 54 percent in 1971 to as high as 73 percent in 1982.

The slaughter rate, on a regional basis, has also undergone major changes. The western provinces have seen their slaughter rate drop from 4.6 million hogs in 1971 to a low of 2.5 million hogs in 1976 before recovering to 4.0 million hogs in 1984. By contrast, the eastern provinces increased the number of hogs slaughtered by almost 71 percent; from 5.4 million in 1971 to 9.3 million in 1984. Most striking are the major gains by Quebec where production increased from 1.9 million head in 1971 to more than 4.97 million head in 1984; representing an increase of more than 150 percent over a period of 14 years (Table 2.5).

The dramatic increase in the level of hog production in eastern Canada have been described as being the direct result of a number of factors. These include both provincial and federal programs which have favoured hog production in the east. As a result of these programs, both Ontario and Quebec producers have moved quickly to specialization and larger production units.² This has not been the case in the western provinces.

² Weisgerber, Pat. "Canada's Position in the North American Hog Industry" International Economic Division Staff Report, USDA, December 1981.

TABLE 2.4
Provincial Shares of Hog Production

1970-1984

	B.C.	Alta.	Sask.	Man.	West	Ont.	Que.	Mar.	East
	-----percent-----								
1971	1	20	12	13	46	31	19	4	54
1972	1	20	12	13	46	31	20	3	54
1973	1	19	12	14	46	30	21	4	55
1974	1	18	11	13	43	30	25	3	58
1975	1	16	8	11	36	31	29	4	64
1976	1	14	7	11	33	33	30	4	67
1977	1	14	7	10	32	32	32	4	68
1978	1	13	6	9	29	33	34	4	71
1979	1	13	6	9	29	34	34	4	72
1980	2	12	6	9	29	32	36	4	72
1981	2	13	4	9	28	30	38	4	71
1982	2	12	4	8	27	31	37	4	73
1983	2	12	4	9	28	32	36	4	72
1984	4	11	5	10	30	28	38	4	70

Source: Dawson, Dau and Associates, Limited, Impact of Government Programs on the Regional Location of Meat Production in Canada (Data for 1971-80).

Agriculture Canada, Livestock Market Review, 1984 (Data for 1981-84).

In Quebec, especially, the average number of hogs marketed per unit increased from 52 head in 1966 to an estimated 633 head in 1981.³ In addition, it is estimated that more than 80 percent of Quebec's hogs were from vertically integrated production units in 1981. Likewise, contract producers in Ontario marketed an average of 509 hogs compared to only 144 by non-contract producers in 1976.

Federal government feed grain policies have also been held responsible for the regional shift in hog production in Canada over the last decade. Weisgerber summarizes the situation as follows:

Since 1976 federal policy has required the Canadian Wheat Board to sell feed grains in eastern Canada at corn competitive prices and also required that transportation be available to move nonboard feed grains to the east. This policy has assured the east livestock producer of the best of two worlds. He has had the advantage of low prices when quotas and grain stocks resulted in heavy nonboard deliveries.

The eastern feeder also is protected against high prices when western feed grains command a premium such as during periods of brisk export demand⁴.

The national supply management programs in both the poultry and dairy industries are also believed to be partially responsible for the substantial expansion in hog production in the eastern provinces. Supply management in both the poultry and dairy sectors has apparently resulted in underemployed resources. For instance, in Quebec, dairy producers have had to cut down their production in view of the declining consumption in dairy products. As a consequence, unemployed resources have been channeled into the hog industry where no quotas apply.

³ Ibid.

⁴ Ibid.

TABLE 2.5

Hog Slaughter by Province of Origin
1971-84

	B.C.	Alberta	Sask.	Manitoba	West	Ontario	Quebec	Mar.	East	Canada
1971	83,077	2,015,440	1,249,869	1,331,218	4,679,604	3,141,090	1,927,518	365,269	5,433,877	10,113,481
1972	57,395	1,878,503	1,094,251	1,197,268	4,227,417	2,927,908	1,881,155	320,663	5,129,726	9,357,143
1973	50,333	1,717,613	1,072,820	1,221,164	4,061,930	2,749,612	1,910,066	319,612	4,979,290	9,041,220
1974	70,306	1,626,778	1,028,609	1,188,309	3,914,002	2,767,988	2,278,431	309,070	5,355,489	9,269,491
1975	68,692	1,242,259	615,283	873,650	2,799,884	2,491,263	2,326,541	285,461	5,103,265	7,913,149
1976	65,724	1,085,925	535,183	819,025	2,505,857	2,549,727	2,335,322	288,481	5,173,530	7,679,387
1977	78,835	1,172,253	534,341	841,165	2,626,594	2,630,320	2,604,690	304,976	5,539,986	8,166,580
1978	97,098	1,179,253	557,329	842,649	2,676,329	3,025,568	3,044,616	338,437	6,408,621	9,084,950
1979	139,718	1,406,129	644,219	1,054,012	3,244,078	3,775,958	3,817,036	399,051	7,992,045	11,236,123
1980	260,962	1,629,258	740,081	1,171,778	3,802,079	4,191,697	4,685,312	472,021	9,349,030	13,151,109
1981	333,018	1,707,743	534,345	1,146,014	3,721,120	3,890,846	4,935,415	493,342	9,324,613	13,045,732
1982	298,075	1,589,373	549,187	1,094,516	3,531,151	4,080,176	4,748,681	526,096	9,354,953	12,886,106
1983	326,729	1,626,628	548,758	1,191,678	3,693,793	4,233,533	4,689,401	499,795	9,422,729	13,116,522
1984	504,625	1,526,011	663,422	1,268,817	3,962,875	3,764,798	4,977,515	548,977	9,291,290	13,254,165

Source: Dawson, Dau and Associates Limited, Impact of Government Programs on the Regional Location of Meat Production in Canada, (1971-80).

Agriculture Canada, Livestock Market Review, 1984, (1981-84).

More recently, anticipation of a national supply management program have been a major incentive for existing producers to expand their production and new producers to enter the industry. This is because producers are aware of the possibility of capitalizing on quotas should supply management be implemented for hogs.

2.4 THE HOG/PORK TRADE SECTOR

This section describes recent patterns in the international trade of Canadian hogs. The growing importance of the U.S. and Japanese market is reviewed. A number of factors which could affect the hog/pork trade will be highlighted.

2.4.1 Canada's Trade in Live Hogs

Canada's trade in live hogs has traditionally been with the U.S.. The size and the proximity of the U.S market are probably the two most important factors that have contributed towards making it the single most important market for Canadian live hogs.

Between 1970 and 1983, trade in live hogs between the two countries has been characterised by a one way flow with Canada being the major exporter. However, Canada does import a small number of live swine annually for breeding purposes rather than for slaughter. Such imports will not be taken into consideration here since the focus of the study is on the trade of live hogs for slaughter purposes only. Table 2.6 shows Canada's export of live hogs between 1970 and 1984 and the dominant position of the U.S. as an importer during that period.

Besides exporting to the US, a small number of live hogs have also been shipped to Cuba and St. Pierre-Miquelon and to a lesser extent to the Caribbean. Exports to these regions will be aggregated and referred to as exports to the rest of the world (ROW).

TABLE 2.6

Canadian Exports of Live Hogs and U.S. Slaughter:1970-1984.

Year	Total Exports	Export to U.S.	U.S. Slaughter	Exports to U.S. as % of Total	Exports to US as % of U.S. Slaughter
	NO. of Head....		('000s)	percent.....	
1970	80,313	71,465	85,817	88.97	0.08
1971	87,282	83,356	94,438	95.50	0.09
1972	87,495	86,621	84,707	99.00	0.10
1973	88,352	87,389	76,795	98.91	0.11
1974	196,030	195,477	81,762	97.70	0.24
1975	29,403	28,777	68,687	97.87	0.04
1976	44,162	43,330	73,784	98.12	0.06
1977	41,657	40,875	77,303	98.12	0.05
1978	185,807	185,315	77,315	99.60	0.24
1979	129,399	128,635	89,099	99.40	0.14
1980	236,522	235,724	96,074	99.66	0.25
1981	145,037	143,830	91,575	99.16	0.16
1982	303,702	302,454	82,190	99.58	0.37
1983	456,432	453,938	87,584	99.45	0.52
1984	1,344,464	1,343,470	84,700	99.92	1.59
5-Year Average					
1975-1979	86,085	85,337	77,237	98.62	0.11
1980-1984	497,231	495,883	88,424	99.55	0.56

Source:a) Statistics Canada, Exports by Commodities, Cat.No. 64-004.

b) Canadian Pork Council "Submission of the Canadian Pork Council to the US International Trade Commission, Aug.28, 1984."

Between 1970 and 1984, Canadian exports of live hogs has generally been on an upward trend except for 1975 when the level of exports to the U.S. declined significantly to 28,777 head compared to the 1974 level of 195,477 head. This decline was directly related to the establishment of an import quota on Canadian live hogs by the U.S. At the same time, the Canadian hog prices were generally higher than the U.S. hog prices.

It is also clear from table 2.6 that the U.S. has remained the single most important export market for Canadian live hogs. Between 1975 and 1984, an annual average of 99.00 percent of the total number of live hogs exported went to the United States. The total number of live hogs exported to the US over the last decade has increased by about 480 percent, from an annual five year (1975-1979) average of 85,337 head to an annual average of 495,883 head for the period 1980-1984. Exports of live hogs to the US reached an all time high of 1.3 million head in 1984.

Despite such a phenomenal increase, the number of live hogs exported to the U.S. still represent a very small proportion of the U.S. hog slaughter. Table 2.6 shows that Canadian live hog exports to the U.S. represented on average only about 0.11 percent of the total annual average number of hogs slaughtered in the U.S. between 1975 and 1979. Through the five years up to and including 1984, US imports of live hogs from Canada averaged only 0.56 percent of American slaughter.

Exports to the rest of the world (ROW), have declined steadily over the last decade. On a five year average, exports to ROW declined from 1.18 to 0.45 percent of the total number of live hogs exported.

In 1970 the total exports of live hogs were valued at \$4.7 million with sales to the U.S. alone amounting to \$4.3 million. The value of total exports of live hogs increased to a record level of \$201 million in 1984 with as much as 99.95 percent of this sum originating from exports to the United States (see Table 2.7).

TABLE 2.7
Value of Canadian Exports of Live Hogs.
(selected Years)

Year	Value of Total Exports	Value of Exports to US	Export to US as Percent of Total
	\$ 000's (Cdn.).....		percent.....
1970	4,687	4,263	90.95
1974	15,827	15,798	99.81
1979	18,588	18,422	99.10
1984	201,361	201,265	99.95

Source: Statistics Canada: Exports by Commodities, Cat. No. 64-004.

2.4.2 Canada's Trade in Pork and Pork Products

2.4.2.1 Imports of Pork

Canadian pork imports are primarily processed products originating from the U.S. and to a lesser extent from the European Economic Community (EEC). The data in Table 2.8 shows that on average, from 1970 to 1984 more than 90 percent of Canadian pork imports came from the United States. The only exception was during 1984 when about a third of Canadian imports originated from the EEC. These were primarily highly subsidized pork products from Denmark and the Netherlands. However, in the fall of 1984 a Canadian anti-dumping enquiry found that the imports of subsidized pork and pork products from Denmark and the Netherlands caused material injury to the Canadian pork industry. Countervailing duties were then imposed on imports of pork from Denmark and the Netherlands. Duties of the order of 24.3 cents and 31.1 cents per pound were imposed on Danish canned ham and canned luncheon meat respectively. As regards imports from the Netherlands, duties amounting to 12.7 cents per pound and 17.5 cents per pound were imposed on cured ham and luncheon meat respectively.⁵

The total imports of pork have decreased substantially over the last ten years. Total imports fell by 77 percent between 1975 and 1984; from a five year average of 125 million pounds for the 1975-1979 period to an average of 28.3 million pounds for the 1980-1984 period. Imports from the U.S. followed a similar trend; declining from an annual average of 123 million pounds for 1975-1979 to 26.2 million pounds for the period 1980-1984.

⁵ Agriculture Canada. "Market Commentary" December 1984.

Imports from the rest of the world (ROW) have increased slightly from an annual average of 1.12 percent of total imports for the period 1975-1979 to over 8.5 percent for the period 1980-1984. It should be noted, however that the 1980-1984 average import from ROW was heavily influenced by an unusually high level of imports from Denmark.

TABLE 2.8
Canadian Pork Imports: 1970-1984.

YEAR	-----Imports-----		--Percent of Total from--	
	Total	from US	US	ROW
	Cwt.....		Percent.....	
1970	171,012	149,692	87.53	12.47
1971	103,297	83,780	81.10	18.90
1972	283,426	278,366	98.21	1.79
1973	365,190	361,770	99.06	0.94
1974	571,067	566,411	99.18	0.82
1975	884,417	881,856	99.71	0.29
1976	1,822,865	1,726,958	94.73	5.27
1977	1,874,157	1,874,157	100.00	0.00
1978	1,060,932	1,060,688	99.97	0.03
1979	617,677	617,669	99.99	0.01
1980	290,485	288,857	99.43	0.57
1981	355,650	333,756	93.84	6.16
1982	261,955	257,251	98.20	1.80
1983	280,229	280,229	100.00	0.00
1984	230,946	150,168	65.10	34.90
5-Year Average				
1975-1979	1,252,009	1,232,265	98.88	1.12
1980-1984	283,853	262,052	91.31	8.68

Source: Statistics Canada: Imports by Commodities, Cat. No. 65-007.

2.4.2.2 Exports of Pork

Canadian pork and pork products are sold in two major international markets, namely the U.S. and Japan. Occasionally, a small amount of pork has also been exported to a number of other countries. These include the United Kingdom, St. Pierre-Miquelon, Portugal, New-Zealand, South Africa, Jamaica, Bahamas, Puerto Rico, Cuba, Barbados and several other small countries.

Total exports of pork have increased rather steadily between 1970 and 1984. Total exports reached more than 370 million pounds in 1984, up 500 percent from 1970 export volume of 62 million pounds. Table 2.9 shows the volume of exports of Canadian pork by major country of destination.

Between 1970-1974 and 1980-1984, the United States has been the major importer of Canadian pork. For instance, an average of 69.23 percent of total Canadian pork export were shipped to the US between 1980 and 1984. This represents an annual average of 219 million pounds. Between 1975-1979, shipment to the US represented an average of 32.14 percent of total Canadian pork exports, or about 37.4 million pounds annually.

Between 1975 and 1979, Japan was the major market for Canadian pork. Japan imported an average of 65.4 million pounds annually during that period; or about 64.6 percent of total Canadian exports. In terms of volume, Canada's exports to Japan increased from a 5-year average of 65.3 million pounds between 1975 and 1979 to more than 82.9 million pounds for the period 1980-1984.

TABLE 2.9
Canadian Pork Exports:1970-1984.

Year	-----Export of Pork-----			--Percent of Total to--		
	Total	US	Japan	US	Japan	ROW
	Cwt.....			Percent.....		
1970	622,233	529,500	63,769	85.10	12.04	2.86
1971	882,090	610,837	200,950	69.24	22.78	7.97
1972	1,049,116	549,111	454,042	52.34	43.28	4.38
1973	1,142,538	604,887	449,346	52.94	39.32	7.74
1974	815,972	413,737	287,993	50.70	35.29	14.01
1975	815,411	254,773	537,306	31.09	65.57	3.34
1976	786,795	177,977	590,105	22.62	75.00	2.38
1977	934,948	186,602	739,614	19.96	79.10	0.94
1978	1,147,637	422,495	699,704	36.81	60.96	2.23
1979	1,653,600	830,796	701,078	50.24	42.39	7.37
1980	2,482,029	1,620,412	701,658	65.28	28.26	6.46
1981	2,710,485	1,656,242	933,894	61.10	34.45	4.45
1982	3,452,663	2,376,665	964,791	68.83	27.94	3.23
1983	3,323,382	2,314,654	918,361	69.64	27.63	2.73
1984	3,712,394	3,018,999	631,129	81.32	17.00	1.68
5-Year Average						
1975-1979	1,068,478	374,528	653,561	32.14	64.60	3.25
1980-1984	3,136,190	2,199,194	829,966	69.23	27.05	3.71

Pork exports include the following classes of exports as defined by Statistics Canada: 11-22, 11-24, 11-29.

Source: Statistics Canada, Exports by Commodities. Cat.No. 65-004.

Canadian pork exports to the ROW have been, on average, rather stable over the last decade. The proportion of total pork exports to ROW increased slightly from an average of 3.25 percent of total exports for the period 1975-1979 to an average of 3.70 percent for the period 1980-1984. Past trends therefore indicate that the ROW remains a small market for Canadian pork.

2.4.3 Canada's Net Trade with the United States.

Unlike live hogs, pork and pork products have traditionally moved both ways across the Canadian-U.S. border. Figure 2.1 shows that between 1970 and 1984, the net trade balance shifted three times between the two countries. Canada was in a net export position between 1970 and 1973. The trade balance between 1974 and 1978 switched to the U.S. before shifting back to Canada's favour again between 1979 and 1984.

Hence, in five of the last 15 years, the trade balance favoured the United States while in the other 10 years, Canada was a net exporter of pork to the U.S.. Table 2.10 shows that in the last five years, Canadian shipments of pork and pork products(excluding live hogs) to the U.S. averaged 220 million pounds annually. During the same period(1980-1984) imports from the U.S. averaged only 26 million pounds; resulting in an average net trade surplus for Canada of about 194 million pounds a year. In 1984, exports to the US reached an all time high of 292 million pounds with net exports of 276 million pounds.

Although the volume of Canadian exports of pork and pork products to the U.S. reached a record level during recent years, it still represents a very small proportion of the U.S. domestic production. At its highest point, in 1984, Canada's net exports of pork to the U.S. represented a mere 1.9 percent of the U.S. production. On average, between 1980 and 1984 when Canada dominated the pork trade, Canadian net exports to the US represented only about 1.3 percent of U.S. production (Table 2.10).

In contrast, past U.S. exports of pork to Canada have represented a significant proportion of Canada's pork production. Between 1974 and

1978, when Canada was in a net import position, the annual volume of U.S. exports to Canada represented an average level of 8 percent of total Canadian pork production, with a high of 14.2 percent in 1977.

For Canada, the favourable net trade balance is very important. Canada's combined hog/pork trade with the US represented between 15 to 20 percent of Canada's total pork production between 1979 and 1983. It should be pointed out, however, that while there has generally been free trade in hogs and pork between the two countries, there exist a number of non-tariff barriers. These constraints relate mainly to health rather than economic considerations. Some of the constraints that are referred to most frequently by the industry relate to animal health regulations, transportation, label approval, USDA plant inspection and USDA border inspection.⁶

More recently, however, the U.S. government has intervened in the Canadian-U.S. pork trade.⁷ After conducting an anti-dumping enquiry, the U.S. International Trade Commission recommended that countervailing duties of the order of \$5.38 /cwt be imposed on Canadian live hogs and pork entering the U.S. The consequences of such drastic measures from one of Canada's major trade partners are already being felt by Canadian hog producers.

⁶ These and other export constraints are discussed in length in the following publications: (1) "Export Market Development Task Force," Working paper, Processed Meat Products, Agriculture Canada, 1978; (2) Elmer L. Menzie and Barry E. Prentice, "Barriers to Trade in Agricultural Products Between Canada and the United States," International Economics Division Staff Report, USDA, April 1983.

⁷ Details of recent developments in the Canadian-U.S. pork trade relationship are documented in Appendix A.

TABLE 2.10

Canada - United States Pork Trade Balance.

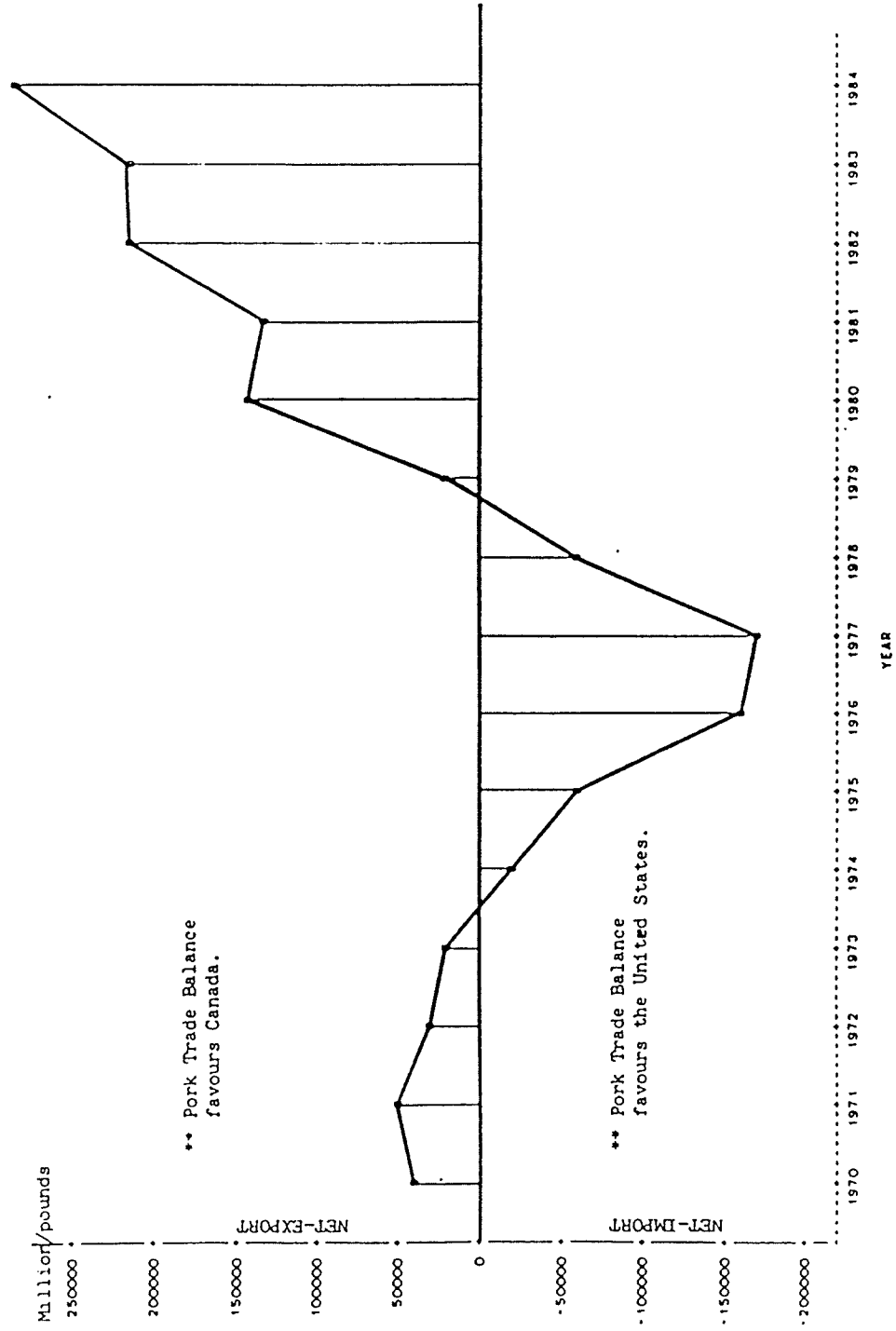
1970-1984

Year	-----Fresh and Frozen Pork-----			Net Export as Percent	
	Imports From U.States	Exports TO U.States	Net Exports Can.to US	Of Production of Net Importing Country Canada	U.States
	thousand pounds.....			percent.....	
1970	14,969	53,150	38,181	-	0.3
1971	8,378	61,646	53,268	-	0.4
1972	27,837	55,001	27,164	-	0.3
1973	36,177	60,708	24,531	-	0.2
1974	56,641	41,458	-15,183	1.1	-
1975	88,186	25,648	-62,538	5.2	-
1976	181,912	17,919	-163,993	13.9	-
1977	187,290	18,884	-168,406	14.2	-
1978	106,049	42,953	-63,096	4.6	-
1979	61,767	84,138	22,371	-	0.2
1980	28,885	164,850	135,965	-	0.8
1981	33,376	167,326	133,950	-	0.9
1982	25,735	240,379	214,644	-	1.5
1983	28,023	235,158	207,135	-	1.4
1984	15,016	291,500	276,484	-	1.9
5 Year Average					
1980-84	26,207	219,842	193,635	-	1.3

Source: Canadian Pork Council.

"Submission of the Canadian Pork Council to the US International Trade Commission". Aug. 28, 1984.

Figure 2.3: Canada-US Pork Trade Balance:1970-1984.



1) Does not include trade in live hogs.

Source: Computed.

2.4.4 Trade with Japan

Over the last ten years, Japan has been importing about 15 percent of its pork and pork products in order to meet domestic demand (Table 2.11). In terms of volume, however, imports have increased by a rather substantial 39 percent over the last 10 years, from an average of 150.5 thousand tons to 209.3 thousand tons for the periods 1974-1978 and 1979-1983 respectively.

Japanese pork production has also been trending upwards since 1970, increasing by 26 percent between 1974 and 1983. Between 1979 and 1983 an average of 1,431.6 thousand tons of pork were produced in Japan, compared to an average of 1,129.5 thousand tons for the five years preceding 1979 (table 2.11).

TABLE 2.11

Japanese Pork Supply and Consumption: 1970-1983.

Year	Total Production (1)	Exports (2)	Imports (3)	Imports as % of production (4)	Domestic Consumption (5)*
	tons.....			..percent..	...tons...
1970	734,294	17	24,499	3	758,776
1971	843,244	26	38,863	4.6	882,081
1972	885,306	10	97,046	10.9	982,342
1973	970,520	4	179,629	18.5	1,150,143
1974	1,097,924	21	59,909	5.5	1,157,812
1975	1,039,642	3	177,875	17.1	1,217,514
1976	1,056,229	1	212,531	20.1	1,268,759
1977	1,169,465	18	154,443	13.2	1,323,890
1978	1,284,473	3	147,880	11.5	1,432,350
1979	1,429,928	64	188,802	13.2	1,618,666
1980	1,475,684	89	154,554	10.5	1,630,149
1981	1,395,843	--	265,353	19.1	1,661,196
1982	1,427,626	--	201,437	14.1	1,629,063
1983	1,428,824	--	236,358	16.5	1,665,180
5-Year Average					
1974-78	1,129,547	9.2	150,527	13.5	1,280,065
1979-83	1,431,581	31	209,300	14.67	1,640,850

*(1)+(3)-(2)=(5)

Source: Meat Statistics, Ministry of Agriculture, Forestry and Fisheries.

According to Japanese forecasts⁸ such an upward trend will be maintained to 1990. Table 2.12 shows the predicted production, consumption and self-sufficiency levels of major meats in Japan. Pork is clearly the major red meat in Japan with a predicted production of 1,940 thousand tons and consumption level ranging between 1,960 to 2,100 thousand tons by 1990. The self-sufficiency level is predicted to increase from 90 in 1978 percent to 95 percent by 1990.

On a per capita basis, consumption of meat in general is also projected to increase slightly by 1990. The per capita consumption of pork, however, is predicted to increase by a greater proportion relative to other meat; increasing from 8.7 Kg to between 10.7 and 11.4 Kg by 1990.

Therefore there are indications that both production and consumption of pork in Japan will increase for the rest of this century. Although Japan is planning to reach the very optimistic target of 95 percent level of self-sufficiency in pork, it will still have to import at least 100 million Kg of pork annually over the next decade in order to meet its domestic demand for pork. Hence the opportunities for Canada for continuing pork exports to that country should not be overlooked.

Japan has traditionally been importing pork and pork products from a number of countries. Table 2.13 shows Japanese pork imports between 1970 and 1983 by major country of origin. Among the major pork suppliers, Canada has been successful in maintaining a rather stable share (25 percent of all imports) of the market over the last decade or so. Japanese pork imports from Canada increased from an average of 25.9 thousand tons

⁸ Livestock Bureau, (MAFF), Japan Vol. 56, No. 1, 1981.

Table 2.12

Projected Levels of Pork Consumption, Production and Self-sufficiency
for Japan

	1978				1990			
	Domestic Consumption	Domestic Production	Self- Sufficiency	Per Capita Consumption	Domestic Consumption	Domestic Production	Self- Sufficiency	Per Capita Consumption
	-----'000 tons-----	-----'000 tons-----	-----(%)-----	-----kg-----	-----'000 tons-----	-----'000 tons-----	-----(%)-----	-----kg-----
Total Meat	3,470	2,760	80	20.8	4,730-5,030	4,030	83	26.28
Beef	560	410	73	3.3	850- 920	630	71	4.6 - 5.0
Pork	1,470	1,320	90	8.7	1,960-2,100	1,940	95	10.7 -11.1
Chicken	1,090	1,020	94	7.7	1,470-1,550	1,460	96	8.8 - 9.3
Other Meat	n/a	n/a	n/a	1.7	n/a	n/a	n/a	1.9 - 2.4

Source: The Meat Statistics in Japan, MOAFF, Vol. 56.1.1, 1981.

between 1974 and 1978 to about 38.3 thousand tons for the period 1979-1983; representing an increase of about 48 percent in the volume of Japanese pork imports from Canada over a ten year period.

The most significant increase in Japanese pork imports has been from Denmark. Import volume from that country increased by 132 percent between 1974 and 1983, from an average of 18.5 thousand tons for the period 1974-1978 to over 36 thousand tons for the period 1979-1983. It should however, be noted that pork imports from Denmark dropped substantially from a high of 73 thousand tons in 1981 to a mere 17 thousand tons in 1983. This was the direct consequence of the outbreak of foot and mouth disease in Denmark in late 1981. During that period, lower pork import levels from Denmark gave Canadian pork a competitive edge on the Japanese market. Imports from Canada reached an all time high of over 40 thousand tons a year until Denmark resumed exports in the mid 1984.

A release from the Federal Department of Industry, Trade and Commerce in October, 1977, placed the opportunities for Canadian pork export to Japan in perspective:

"...Japanese trading companies and the processing industry have indicated preference for Canadian pork to the extent that they will pay a premium. It is essential that the product be properly trimmed for the Japanese market and that quality standards are maintained..."⁹

⁹ Trade News, Food and Agriculture, Industry, Trade and Commerce, October 1977, Ottawa.

TABLE 2.13

Japanese Pork Imports by Major Country of Origin.

1970-1983

Year	Taiwan	Denmark	USA.	Canada	(1) Others	Total	Canada as Percent of Total
.....tons.....							
1970	n/a	n/a	7,589	2,929	6,630	17,148	17.08
1971	n/a	n/a	14,264	9,264	3,675	27,203	34.05
1972	10,928	n/a	21,823	19,029	16,152	67,932	28.01
1973	33,758	30	41,096	20,202	30,653	125,739	16.07
1974	15,907	1,262	5,562	11,553	7,652	41,936	27.55
1975	7,597	23,640	43,032	25,687	24,556	124,512	20.63
1976	25,795	15,114	60,039	26,555	21,269	148,772	17.85
1977	17,910	15,562	24,591	34,959	15,088	108,110	32.34
1978	15,056	22,053	25,507	30,968	9,931	103,515	29.91
1979	15,315	41,097	32,657	32,536	10,557	132,162	24.62
1980	16,710	29,199	29,734	30,056	2,488	108,187	27.78
1981	19,906	73,053	39,761	43,286	9,741	185,747	23.30
1982	19,787	18,998	33,318	44,020	24,883	141,006	31.22
1983	32,860	17,767	35,413	41,828	37,674	165,451	25.28
5-Year Average							
1974-1978	16,453	15,526	31,746	25,944	15,699	105,369	25.65
1979-1983	20,916	36,004	34,182	38,345	17,068	146,510	26.44

(1) Others include the Peoples' Republic of China, Thailand, Norway, Sweden, Ireland, U.Kingdom, Finland, F.R Germany and Australia.

Source: The Meat Statistics in Japan, MOAFF, (various issues)

However, as pointed out by Gilson,¹⁰ an important consideration in exporting pork to Japan "relates to the Japanese tariff system¹¹ and

¹⁰ Gilson, J.C.; The Pork Industry in Manitoba. Manitoba Department of Agriculture, Winnipeg, Manitoba, July 27, 1979.

¹¹ The Japanese import tariff system regarding pork and pork products is explained in greater detail in Appendix B.

certain non-tariff barriers relating to agricultural policies in Japan". Of particular importance, according to Lowe,¹² is the ... "Japanese Pork Stabilization Policy". The pork import system is based on a lower and an upper Stabilization price for Skinned Carcasses which is set by the government. A Standard Import Price (SIP) which is the average of the floor and the ceiling stabilization prices is then determined and the regular duty which is assessed on pork imports may be increased or waived depending on the unit value of imports relative to the SIP. Currently the regular duty is 6.9 percent ad valorem, CIF basis.

The floor and ceiling prices for skinned carcasses set under the Japanese Pork Stabilization Policy are shown in table 2.14. Column 3 shows the SIP (calculated as the average of the lower and upper stabilization prices) between 1970 and 1984. Column 4 shows the SIP for pork cuts. This is calculated on an assumed yield of 75 percent carcass pork.

¹² Lowe, J.C.; The Japanese Hog-Pork Sector: Some Implications for Canadian Pork Exports. Canadian Farm Economics; Vol.9 No.4. Aug. 1974.

TABLE 2.14
Japan's Pork Stabilization Prices

1970-1984

=====				
Year	-----skinned carcass-----		Standard Import Price(1)	SIP for Cuts(2)
	Lower Price	Upper Price		

.....Yen per Kg.....				
1970	345	422	383.5	511.4
1971	355	434	394.5	526.0
1972	360	440	400.0	533.4
1973	380	465	422.5	563.4
1974	507	620	563.5	751.4
1975	556	680	618.0	824.0
1976	601	734	667.5	890.0
1977	627	766	696.5	928.7
1978	627	766	696.5	928.7
1979	601	735	668.0	890.7
1980	588	764	676.0	901.4
1981	600	779	689.5	919.4
1982	600	780	690.0	920.0
1983	600	780	690.0	920.0
1984	600	780	690.0	920.0

(1) Calculated as the average of the lower and the upper Stabilization prices from column 1 and 2 respectively.

(2) The SIP for pork cuts is calculated on an assumed yield of 75% of carcass pork; thus the current applicable SIP for 1984 is Yen920; (Yen690/0.75).

Source: Livestock Bureau, Ministry of Agriculture and Forestry.
"The Meat Statistics in Japan." (various issues).

2.5 FACTORS ENCOURAGING HOG PRODUCTION AND EXPORTS

2.5.1 Canadian - U.S. Exchange Rate and Pork Trade

In its submission to the International Trade Commission, the Canadian Pork Council pointed out that the recent increases in U.S. imports of Canadian hogs and pork are the normal response to a number of factors such as the exchange rate, the price differential between the two countries and labour dispute problems in both the U.S. and Canada. Hence, exchange rate movements since 1970 are crucial to any analysis of the growth of the Canadian live hog and pork trade since that period.

As noted from Table 1.1 (chapter I), the Canadian dollar depreciated by about 27 percent vis-à-vis the U.S. dollar, and by about 71 percent vis-à-vis the Japanese yen. At the same time, the volume of exports of live hogs and pork to these countries also increased by a substantial amount. Total exports of pork increased by about 215 percent between 1970 and 1984. Similarly, exports of live hogs to the U.S. increased by about eight fold over a 15 year period.

Buyers of hogs bid or negotiate a price per hundredweight on an index 100 basis. In Ontario for instance, the U.S. packers are actually buyers within the provincial selling system. In western Canada, and particularly in Manitoba, the producer marketing agencies make direct sales to the packers in the U.S.¹³ The price, in the case of Manitoba, is negotiated between the U.S. buyer and the Manitoba Hog Producers Marketing Board (MHPMB) on the basis of U.S. hog market prices. Table 2.15 shows an example of a typical transaction between the MHPMB and a U.S.

¹³ Submission of the CPC to the U.S. International Trade Commission, August 29, 1984.

packer. It is clear that the two factors that made this transaction possible for the MHPMB were the favourable exchange rate (1.3081) and the relatively higher U.S. market price, thus allowing the U.S. buyer to outbid Canadian buyers of hogs.

TABLE 2.15

Example of Export Sales of Live Hogs by the Manitoba Hog Producers
Marketing Board

=====

Date of Sale: July 26, 1984

MHPMB Daily Average (domestic sales)	\$79.34/cwt. dressed wt.
Live Weight Conversion	
(Based on 103 Index + 79% yld.)	\$64.55/cwt.
No. of Hogs	211
Hog Cost	\$28,283.13
Freight Cost	\$ 1,300.00
Shrink Cost	\$ 1,257.00
Total Cost	<u>\$30,840.14</u>

Purchaser - U.S. Plant	
(Bid Price \$52.50 G + Y)	
Hog Value - U.S. \$	\$23,656.25
Currency Gain	
Basis Exchange Rate at 1.3081	\$ 7,288.50 (34.54/hog)
Net Returns	<u>\$30,944.75</u>
Net Profit (Canadian \$)	\$ 104.61 (\$.50/hog)

=====

Source: Submission of the CPC to the U.S. International Trade
Commission, August 28, 1984.

It should be further noted that the currency gain from the exchange rate accounted for about 24 percent of the whole transaction (\$7,288 out of \$30,944). Without the exchange rate component (this would have been the case if the two currencies were at parity), such a transaction would probably have never taken place. Hence, as long as the magnitude of the difference between the Canada-U.S. price is enough to cover the costs of transportation and handling to U.S. centers, as well as some shrinkage costs, Canadian live hogs and pork will continue to flow to the U.S. While Canadian sellers found they could realize a higher return on hogs sold to U.S. packers, the latter was also assured of a reliable and convenient source of supply of much needed raw material at prices that were competitive to U.S. prices.¹⁴

The trends between the Canada-U.S. and Canada-Japan exchange rates and Canadian pork export to these countries are shown in Figure 2.4 and 2.5, respectively. It is clear from Figure 2.4 that as the value of the U.S. dollar appreciated against the Canadian dollar, the volume of pork exports to the U.S. also increased. Hence, a devaluation of the Canadian dollar vis-à-vis the U.S. dollar is believed to be partly responsible for the substantial increase in the volume of Canadian pork exports to the U.S. over the last few years.

¹⁴ Submission of the CPC to the U.S. International Trade Commission, August 29, 1984.

Figure 2.4: Canada-US Exchange Rates and Pork Trade:1970-1984

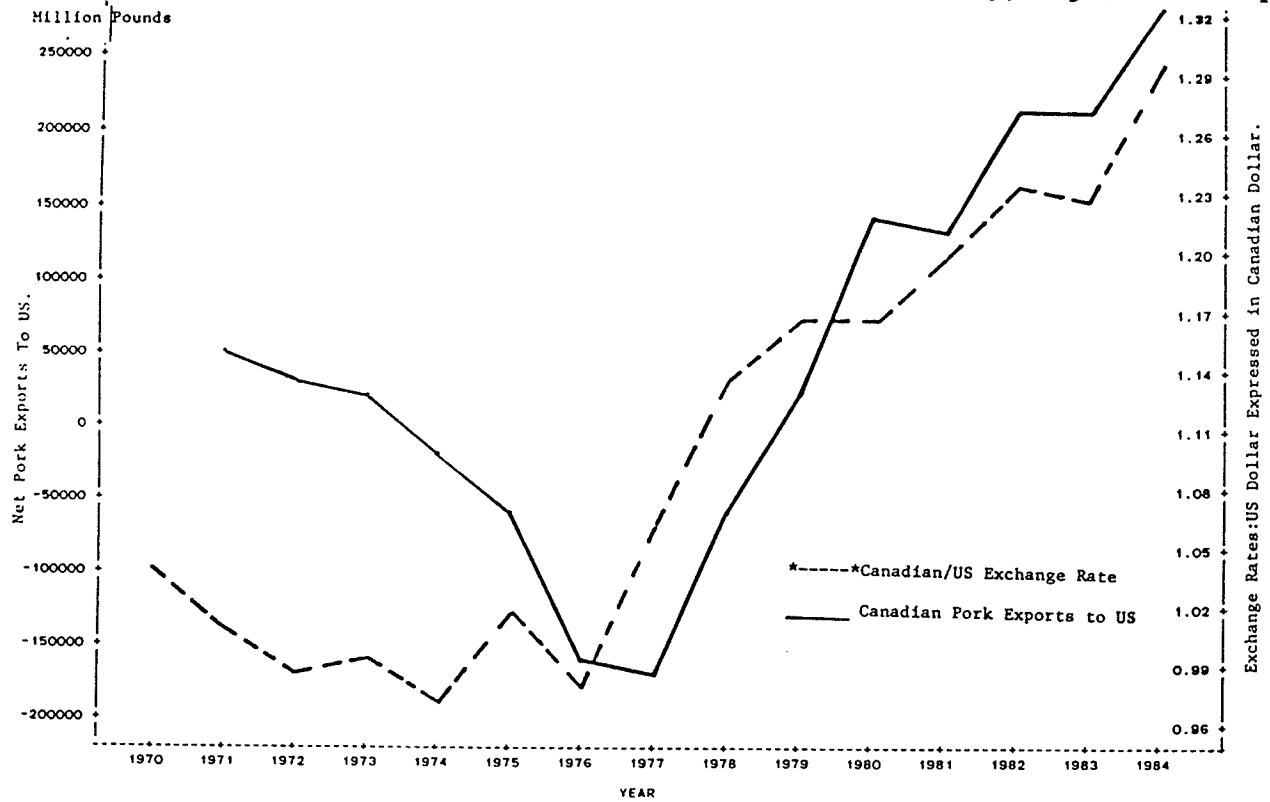
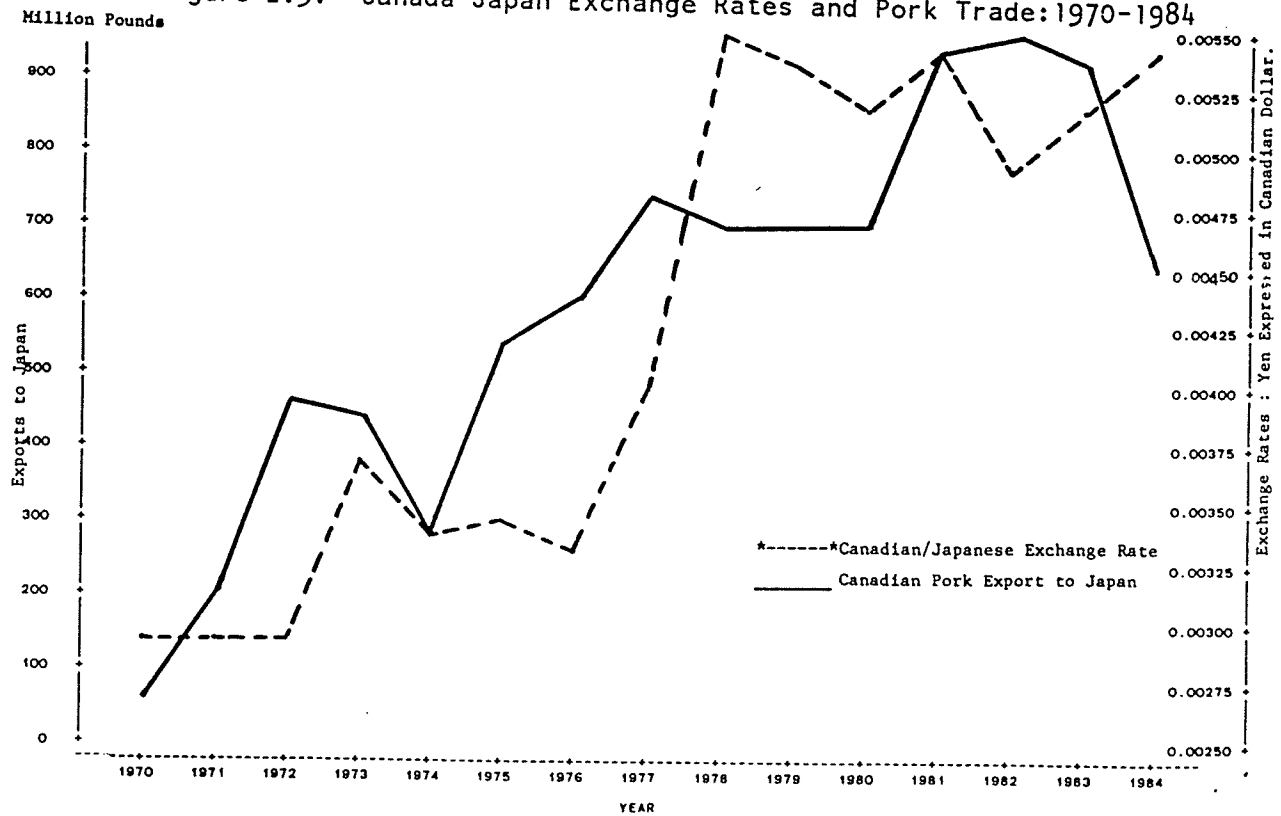


Figure 2.5: Canada-Japan Exchange Rates and Pork Trade:1970-1984



As far as pork trade with Japan is concerned, the relationship between the exchange rate and pork exports is less pronounced (Figure 2.5). It is true, however, that between 1970 and 1983 the Canadian dollar devalued by almost 71 percent against the Japanese yen. At the same time, Canadian pork exports to Japan nearly tripled. Although the overall trend between 1970 and 1983 does suggest some correlation between Canadian pork exports to Japan and the exchange rates between these two countries, it is widely believed by those who are involved in the Canadian-Japanese pork trade that the exchange rate is not a determining factor in pork trade between the two countries.

2.5.2 The Canadian-U.S. Hog Price Difference

Another important factor affecting the level of Canadian pork exports to the U.S. is the price level. The economic theory behind spatial price relationships and the principles underlying price differences between regions is summarized by Tomek and Robinson as follows:

1. Price differences between any two regions that trade with each other will just equal transfer costs.
2. Price differences between any two regions that do not engage in trade with each other will be less than or equal to transfer costs.

Tomek and Robinson further state that whenever the price differences between trading regions exceed transfer costs, arbitrage will take place until the price difference is equal to the transfer costs.¹⁵

¹⁵ Tomek W.G. and K.L. Robinson, Agricultural Product Prices, Cornell University Press, Ithaca, 1972.

Under free trade conditions, this means that goods will be normally exported from the low-priced market to the higher-priced market as long as the transfer costs and other miscellaneous costs are fully covered by the price differences between the two markets.

This has generally been the situation in the pork trade between Canada and the U.S.. In recent years, the U.S. hog prices, adjusted for the exchange rate, have been well above the Canadian hog prices on average. Given free trade in hogs between the two countries, arbitrage is bound to take place.

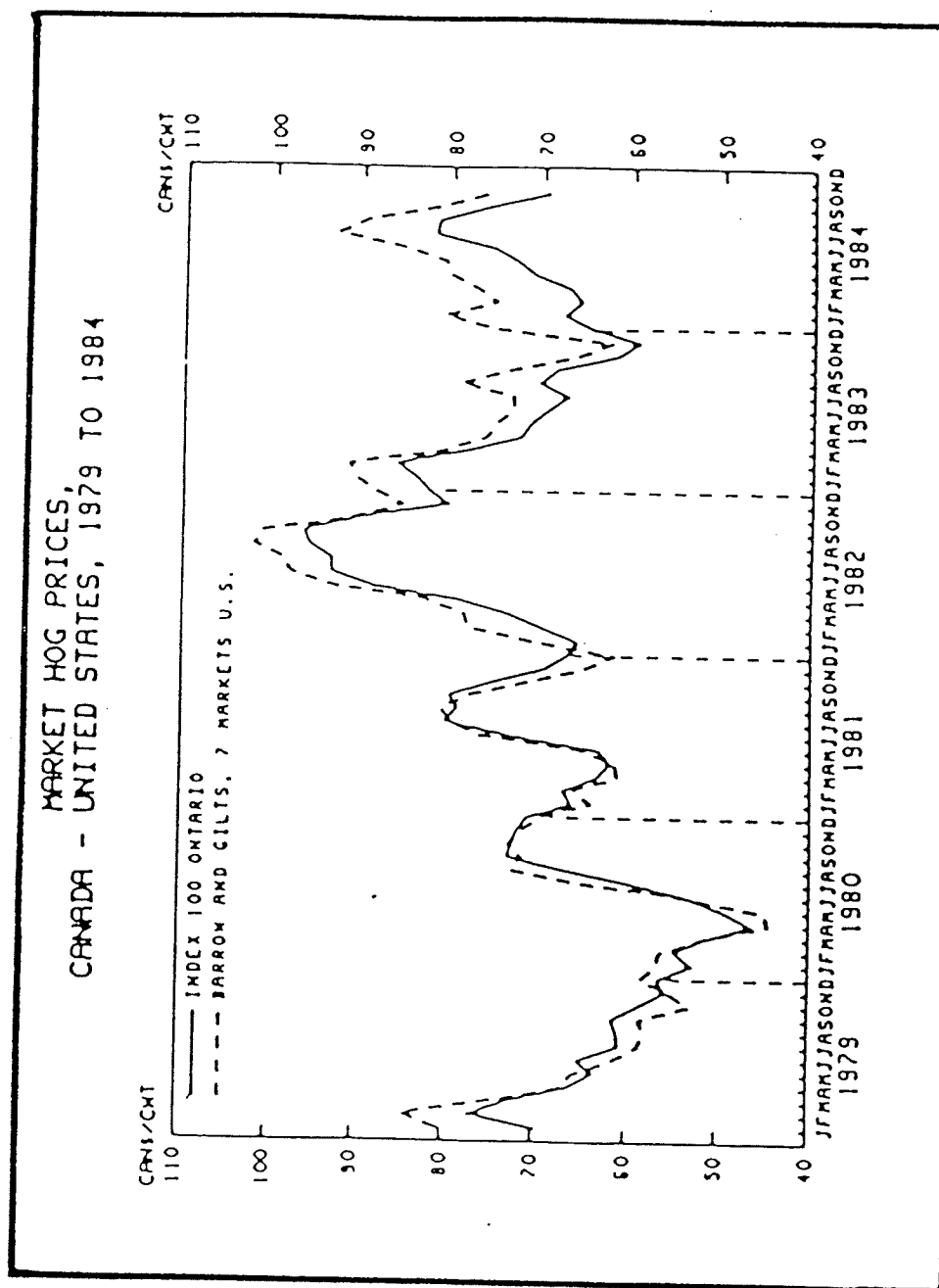
Figure 2.6 shows the monthly hog prices (in Canadian dollars) for the U.S. and Canada between 1979 and 1984. Except for short periods of time, the US hog prices have generally been well above the Canadian hog prices. As long as such price differences are sufficient to cover the transfer costs, trade will take place. As shown in Table 2.15, such differences are at times far greater than freight and other miscellaneous costs associated with the export of hogs and pork to the U.S. This situation has been described as being the direct consequence of the following:

. . . In the face of a number of structural changes within the U.S. slaughtering industry, many firms were competing vigorously for market share. Secondly, in the face of reduced hog output, slaughterers were attempting to maintain volume to preserve the advantages of kill size and efficiency.¹⁶

Such pressure on the U.S. hog market resulted in substantial increases in U.S. hog prices. As a result, a large number of hogs from Canada were exported to the U.S.

¹⁶ Canadian Meat Council, Submission to the U.S. International Trade Commission, September 4, 1985.

Figure 2.6



Source: Agriculture Canada. Market Commentary, December 1984.

2.5.3 Income Stabilization Program

One of the main issue in the recent Canadian-U.S. hog war was that hog producers in Canada are subsidized through various government programs and that increased hog production were a direct result of such subsidies. Income Stabilization programs are the most visible form of assistance available to hog producers. Such programs are operated by both the Federal and the Provincial governments.¹⁷

The Federal income stabilization program is operated under the Agricultural Stabilization Act, 1958. Until 1975, the level of support was set to a minimum of 80 percent of the national average price over the previous ten years. Under this plan, only one payment was made in 1971. In 1975 the legislation was changed to provide for a support level equal to a minimum of 90 percent of the previous five year average. Provision exists for the support level to be adjusted to a 95 percent level.

Table 2.16 shows the payments made since 1980 under the ASA, as amended in 1975. It should be noted that between 1971 and 1980-81 there were no support payments. The level of payout is usually adjusted in provinces where evidence exists that the provincial government is attempting to bottom-load the federal program. It is clear from table 2.16 that hog producers have received significant assistance from the Federal government since 1980-81.

¹⁷ see Clements and Carter for a survey of government programs in the swine industry.

TABLE 2.16
Payments Under the A.S.A for Hogs

Year	Payments(Dollars)
1980 - 81	41,281,496
1981 - 82	107,277,121
1982 - 83	844,000
1983 - 84	12,056
1984 - 85(a)	142,353,560

(a) estimated

Source: Agriculture Canada,
Annual Report of the Agricultural Stabilization Board,
Ottawa, various issues.

The Federal program however, has some weaknesses which led to the various provinces to operate their own stabilization plans. The most common plan is the income insurance plan. These programs are usually administered by the provincial hog

Marketing Board. Producers registered in the plan usually contribute financially when market prices for hogs are above the support level. The provincial governments also provide direct financial assistance towards the program. All major hog producing provinces, except Newfoundland, had a provincial income insurance plan by the end of 1983.

2.6 SUMMARY

The development of the Canadian hog industry since 1970 was addressed in this chapter. The importance of the hog industry within Canadian agriculture and within the livestock sector in particular, was analysed. The trend over the last fifteen years regarding prices, production and consumption was also described. Finally, the trade sector was analysed in depth.

The major conclusions of this chapter are that the hog industry has grown tremendously over the last decade and it continues to represent a key sector of the livestock industry. Prices and production trends in Canada were identified to be closely related to the US production and price level.

Regarding the trade sector, the United States and Japan remain by far the two most important markets for Canadian pork and live hogs. While Canada has enjoyed free trade relations with the US in pork and live hogs (despite some practical constraints that still exist), trade with Japan was found to be highly constrained by the Japanese import tariff system.

Finally, despite trade restrictions, the potential still exists for Canada to sell pork in both Japan and the U.S. The growth of this industry in the future is highly dependent on Canada's ability to maintain and expand its export markets.

Chapter III

A REVIEW OF THE LITERATURE

3.1 INTRODUCTION

Previous attempts to model the Canadian pork sector have assumed a closed economy. Exports and imports have either been ignored or treated exogenously. However, ignoring the trade sector of the Canadian pork industry is no longer realistic. A significant proportion of the industry's cash revenue is attributed to export sales. During the last decade, the Canadian pork industry has been exporting between 25 percent to 30 percent of its annual production.

An important factor influencing the pork trade is the exchange rate. Schuh¹⁸ pointed out the important role of the exchange rate on both the domestic sector and the foreign sector of agriculture. Following his seminal article, a number of studies have been conducted in this area. Generally, empirical findings support Schuh's view that the exchange rates have had an effect on agricultural trade and prices but disagree on the magnitude of such effects.

The purpose of this chapter is to review critically both the theory and the empirical results in the recent agricultural economics literature on the effects of exchange rate changes on prices and trade.

¹⁸ Schuh, G. Edward. "The Exchange Rate and U.S. Agriculture". American Journal of Agricultural Economics, Vol.56(1974):1-13.

3.2 A SURVEY OF RECENT STUDIES

The debate on the effects of exchange rate changes on prices and trade flows is one of the most controversial debates the agricultural economics profession has known since the early 1970's. Schuh¹⁹ argued that the exchange rate had been an important omitted variable in past interpretations of U.S. agricultural development and trade problems. One of his main contentions was that the two currency devaluations²⁰ of the U.S. dollar during the early 1970's were important determinants of rising agricultural prices and exports.

One of the first criticisms of Schuh's thesis came from Vellianitis-Fidas.²¹ She challenged Schuh on the grounds that the assumptions behind his thesis were unproven. Vellianitis-Fidas pointed out that while Schuh failed to provide empirical proofs of his argument, his thesis is also contrary to the evidence. She then presented the results of two studies²² to support her argument.

The first study was a cross-sectional analysis of the demand for U.S. agricultural exports by major U.S. trading partners in 1971-1973. The second study was an analysis of exchange rate changes in other countries

¹⁹ Schuh, G. Edward. "The Exchange Rate and U.S. Agriculture". American Journal of Agricultural Economics, Vol. 56, (1974): 1-13.

²⁰ The author here refers to the 1971 and 1973 devaluations of the U.S. dollar by 8% and 10% respectively in relation to gold.

²¹ Vellianitis-Fidas, Amalia. "The Exchange Rate and U.S. Agriculture: Comment." American Journal of Agricultural Economics, Vol. 57 (Nov. 1975): 692-695.

²² Vellianitis-Fidas, Amalia. "The Impact of Devaluation on U.S. Agriculture." Agricultural Economics Research. Vol. 28, No. 3 (July 1976): 107-116.

and their demand for five agricultural commodities imported from the U.S. during the period 1954-1969. The results show that exchange rate changes were not significant explanatory variables for both the cross-sectional and the time-series analysis. The exports of the U.S. wheat, corn and soybeans in the 1971-1973 period do not seem to have been responsive to exchange rate changes. Further, exchange rate changes by the other countries during the 1960-1969 period failed to explain the variation in U.S. exports of wheat, corn, cotton, tobacco and oilseed. Vellianitis-Fidas concludes her study by noting that Schuh's argument is not convincing and that both the theory of exchange rate and empirical analyses applied specifically to agriculture strongly indicate that the effect of exchange rate changes on U.S. exports and on domestic prices of agricultural products is at most minimal.

Responding to Vellianitis-Fidas criticisms, Schuh commented on some of the weaknesses of her simplistic model and pointed out that:

"... Not surprisingly, Vellianitis-Fidas finds little evidence for an exchange rate effect. The world is just a great deal more complicated...Her model does not have the power to discriminate an exchange rate effect and therefore her results should be taken with a grain of salt."²³

In an effort to provide empirical support to his hypothesis, the author attempted to derive both long run and short run estimates of the elasticity of export demand and export supply based on Tweeten's²⁴ estimates of domestic elasticity of demand and supply. He pointed out that even in the extreme case, export supply elasticities of 2.86 and 6.48

²³ Schuh, G. Edward. "The Exchange Rate and U.S. Agriculture: Reply" American Journal of Agricultural Economics, Vol. 57, No.4 (Nov.1975): 696-700.

²⁴ Ibid.

were estimated for the short-term and the long run respectively.

Fletcher, Just and Schmitz²⁵ also support Schuh's thesis by arguing that exchange rate variations were by far the most important force affecting prices between 1970-1971 and 1972-1973. The authors estimate that at least \$1.11 to \$1.13 of the observed \$1.23 increase in the real U.S. wheat price per bushel was the direct result of the devaluation.²⁶

Other authors who have supported Schuh's thesis include Konandreas, Bushnell and Green. In a study on the export demand for U.S. wheat, the above authors conclude that:

"...exchange rate changes...have had substantial impact on agricultural exports in general and on wheat in particular."²⁷

However, in 1978 Vellianitis-Fidas returned to the debate with an updated study. The results of this second study seem to support the fact that changes in the U.S. dollar have had little influence over trade and prices of agricultural products in general. Unfortunately, this second study has been criticized quite severely on theoretical grounds by Chambers and Just who pointed out that:

²⁵ Fletcher, S.M., Just, R.E., and Schmitz, A. "The Impact of Exchange Rates and Other Factors on North American Wheat Export Demand". Working Paper No.12 (Dec.1976): California Agricultural Experimental Station, Giannini Foundation of Agricultural Economics, University of California.

²⁶ Paris, K.P. and Peter, G.H., "Agricultural Commodity Trade in a Regime of Floating Exchange Rate - A Review of the Literature." Institute of Agricultural Economics, University of Oxford, Vol.25, No.4 (1983): p 251.

²⁷ Konandreas, P., Bushnell, P. and Green, R. "Estimation of Export Demand Functions for U.S. Wheat." Western Journal of Agricultural Economics, Vol.3 (July 1978): 38-49.

"...Vellianitis-Fidas results appear to have limited significance because her empirical investigation has no underlying theoretical structure.²⁸

Johnson, Greenes and Thursby also attempted to investigate the effects of the currency devaluation of the early 1970's on the price of wheat in the United States. Generally, the authors agree that there had been an exchange rate effect but also noted that:

"...many distortions can be found in the international pricing of grains...and that the dollar devaluation was of lesser importance for the U.S. domestic price than foreign commercial policy.²⁹

Hence, it is obvious that there is little consensus within the agricultural economics profession on the orders of the magnitude of estimates of the effects of currency devaluation on both the domestic price level and the trade flows of agricultural products of an exporting country. According to Thompson,³⁰ the debate revolves on basically an empirical question. The profession has generated few estimates of the relevant elasticities and many of those are subject to criticism on methodological grounds. Supporting this view, Chambers and Just argue that:

"...the divergence in the results may be due to the alternative specification of export or excess demand and supply equa-

²⁸ Chambers, R.G. and Just, R.E. "A Critique of Exchange Rate Treatment in Agricultural Trade Models." American Journal of Agricultural Economics, Vol. 61, (May 1979):249-257.

²⁹ Johnson, R.Paul, Thomas, Grennes, and Marie Thursby. "Foreign Trade Controls and Domestic Wheat Price." Amer.J. Agr.Econ. Vol.59, (Nov.1977):619-627.

³⁰ Thompson, R.L. Structural Relationships for Agricultural Trade Policy. Proceedings of 1977 Annual Meeting of Amer. Statistical Association, Business and Economic Statistics Section, Chicago, Aug.14-17:1977.

tions."³¹

In an attempt to "resolve this issue", the authors claim that "a much closer look at the underlying theoretical issues is instructive".

By using a two-country, one commodity free-trade equilibrium model, Kost showed through both graphical analysis and mathematical proofs that:

"the apparent shift in the supply and demand curves in the importing country and the resulting shift in the import demand curve each equal the percentage change in the exchange rate."³²

Kost's then derived algebraic expressions for the elasticity of excess supply for the exporting region and the elasticity of import demand for the importing region as follows:³³

$$Ees = (EsQs - EdQd) / (Qs - Qd)$$

$$Eed = (EdQd - EsQs) / (Qd - Qs)$$

where Ees and Eed are the elasticity of excess supply and import demand respectively and the elasticities Es and Ed and the quantities Qs and Qd refer to the exporting and importing regions. On the assumption that

³¹ Chambers, G. Robert and Just, E. Richard. "A Critique of Exchange Rate treatment in Agricultural Trade Models" Amer. J. Agr. Econ., Vol.61, No.2(May 1979): 249-252.

³² Kost, William. "The Effects of an Exchange Rate Change on Agricultural Trade." American Economics Research, 28(3) (July 1975), pp. 99-106.

³³ Ibid. p.105

the elasticity of both supply and demand is low for agricultural products in the U.S., Kost argued that the proportional increases in the price or quantity of traded goods following a currency devaluation was restricted to being less than or equal to the magnitude of the devaluation. On this basis, Kost rejected Schuh's thesis by concluding that:

"...we can only expect a small impact on agricultural trade as a result of a change in exchange rate."³⁴

In a comment to Kost's paper, Bredahl and Gallagher³⁵ rejected his argument that the percentage change in quantity traded was restricted by the percentage change in the exchange rate. However the authors do support Kost's conclusion that the effects of an exchange rate change depend on the elasticities of the underlying excess demand and supply relationships.

Bredahl and Gallagher provide both graphical illustrations and algebraic proofs that reject Kost's argument. The elasticity of price (of the exporting region) with respect to the exchange rate and the elasticity of quantity traded with respect to the exchange rate as derived by Bredahl and Gallagher are represented as follows:³⁶

³⁴ Ibid. p.104

³⁵ Bredahl, E. Maury and Gallagher, Paul. "Comment on: Effects of Exchange Rate Changes on Agricultural Trade." Agricultural Economics Research, Vol.29, No.3 (1977): 45-48.

³⁶ Ibid. p.47

$$E_{p,r} = -E_{ed} / (E_{ed} - E_{es})$$

$$E_{q,r} = (E_{p,r})(E_{es})$$

where:

$E_{p,r}$: represents the elasticity of exporter's price with respect to the exchange rate

$E_{q,r}$: represents the elasticity of export supply with respect to the exchange rate.

E_{ed} : represents the elasticity of import demand with respect to the exporter's price

E_{es} : represents the elasticity of export supply with respect to the price in terms of the exporter's currency.

Accepting the fact that while $-1 < E_{p,r} < 0$ (i.e the change in price is at least equal to the percent change in devaluation), $E_{q,r}$ has no a priori lower bound. The net elasticity may be less than -1 , depending on the elasticities of the excess supply and demand relationships. Similarly E_{es} may be greater than one even if the exporter's domestic supply and demand are inelastic. Hence Kost's earlier results do not hold.

An obvious empirical issue in modeling exchange rate effects in agriculture relates to the magnitude of such effects. Although the models presented by Bredahl and Gallagher and Kost helped to clarify the problem at hand, they are still believed to be simple and abstract representations of the real world. Chambers and Just³⁷ have shown that there

³⁷ Chambers, R.G. and R.E. Just "A Critique of Exchange Rate Treatment in Agricultural Trade Models" American Journal of Agricultural Economics

are no a priori reasons to restrict either the exchange rate elasticity of price or the exchange rate elasticity of export to any closed interval. The authors provide mathematical proofs to show that previous studies³⁸ were not correct to restrict the value of the elasticity of price with respect to exchange rate between the closed interval $[0,1]$. Chambers & Just recognize the underlying assumption of the model developed by Kost, Bredahl and Gallagher but argue that conclusions and empirical tests are carried out in seeming ignorance of their implications.³⁹

The authors point out that the excess demand relation specified by Bredahl and Gallagher and Kost can be derived only under the assumption of zero cross-price elasticities between the traded agricultural commodity and all other goods for which prices are not constant. However, neo-classical demand functions are obtained by maximizing an individual's preference function subject to a budget constraint. The individual's demand for any commodity is thus a function of all other prices and the consumer's income. Therefore, any model that does not take into account the cross price effects would tend to underestimate the effect of exchange rate changes on the price level.

61(2), 1979.

³⁸ These include studies by Kost, Bredahl & Gallagher

³⁹ Ibid. p.251

By using a more extended model that takes into account cross-price effects, Chambers and Just derive the following expression for the exchange rate elasticity of price of the i -th good as follows:

$$\tilde{E}_{pi,r} = E_{pi,r} - \frac{\sum_{\substack{j=1 \\ j \neq i}}^n E_{pj,r} [e_{Dj} - e_{Sj}] - [w_i + e_{Di}]}{e_{Di} + \sum_{\substack{j=1 \\ j \neq i}}^n e_{Sj}}$$

where:

$E_{pi,r}$ is the elasticity of price p_i with respect to the exchange rate (expressed here as a partial elasticity)

$E_{pj,r}$ is the elasticity of the j -th cross price (in exporter's currency) with respect to the exchange rate.

e_{Dj} is the elasticity of excess demand (Importer's for the j -th good)

e_{Sj} is the elasticity of excess supply (Exporter's for the j -th good)

w_i is the income elasticity of excess demand for good i .

While lacking the ease of interpretation, the above expression shows there is no basis to claim a priori that $-1 \leq E_{pi,r} \leq 0$. Hence, Chambers and Just conclude that previous models ignoring cross price effects have tended to underestimate the effects of exchange rate changes on the price level.

However, estimation of the above expression empirically is an almost impossible task. Even Chambers and Just acknowledge the difficulty of including cross price effects of all other commodities in estimating any demand equation. They further note that in order to estimate the exchange rate impact while taking into account the cross price effects requires knowledge of the elasticity of demand of the good under consideration with respect to price indices of all groups of goods, the union of which exhausts the entire commodity set.⁴⁰

In order to bypass this problem, Chambers and Just⁴¹ have suggested the use of the exchange rate as a separate regressor to represent the prices of all traded goods. In a subsequent paper they used their extended model to show that exchange rate changes have had significant impacts on U.S. agricultural prices and exports. Specifically, the authors examine the impacts of exchange rate fluctuations on prices and exports of U.S. corn, wheat and soybeans. The results indicate that exchange rate fluctuations have had a significant real impact on agricultural markets by altering the volume of exports and the relative split between exports and domestic use. Most important, their results support their argument that restriction of the exchange rate elasticity of price to the closed interval $(0, -1)$ may be incorrect.

However, the authors did not discuss one apparent weakness of their paper. This relates to the specification of their export function. Based on a priori economic reasoning, export supply and own prices are

⁴⁰ Ibid. Chambers and Just, 62(2):1980, p. 257.

⁴¹ Chambers, G. Robert and Just, Richard E., "Effects of Exchange Rate changes on U.S. Agriculture: A Dynamic Analysis," American J. Agric. Economics, vol.63, No.1, (Feb 1981) 32:46

expected to be directly related to each other and therefore a positive sign is expected to be associated with the price variable. However, interestingly enough, according to Chambers and Just's model, a negative relationship exists between the export supply and own prices of the commodities considered. Hence, their results should be interpreted with caution.

In an attempt to examine the effects of exchange rate changes on agricultural prices and trade, Zenko⁴² applied a model similar to the one developed by Bredahl and Gallagher. Specifically, Zenko attempted to estimate the effect that average monthly fluctuations of the exchange rate have had on average monthly hog prices and on monthly trade flows of Canadian pork products during the period 1970 to 1979.

Zenko proceeded by decomposing the exchange rate effect into a price effect and a quantity effect. In order to estimate the price effect, Zenko specified the Canadian price of hogs as follows:

$$P_{can} = f (P_{us} , R , X)$$

where:

P_{can} represents the price of hogs in Canada

P_{us} represents the price of hogs in the United States

R represents the exchange rate between the two countries

X represents the rate of Canadian hog slaughter.

⁴² Zenko, E.Victor. "Exchange Rate Effects on Agricultural Prices and Trade with Special Reference to the Canadian Pork Industry" University of Alberta, Unpublished MSc. Thesis, 1981.

He then estimated different forms of this model by using Ordinary Least Squares and Cochrane-Orcutt Iterative technique. The conclusion was that the best estimate for the exchange rate elasticity of price was in the order of 0.396.

Regarding the effects of fluctuations on the volume of pork exports, the author estimated a number of structural equations of the following general specification:

$$\text{NETX} = f(\text{PRODc}, \text{PRODus}, \text{STKc}, \text{STKus}, \text{Xrow}, \text{R})$$

where:

NETX is the net export of Canadian pork to the U.S.

PROD refers to the level of pork production.

STK refers to the level of pork stock

Xrow refers to exports to the rest of the world

R represents the exchange rate between the two trading countries and subscript c and us refer to the two trading countries, Canada and the United States.

He then used a similar estimation technique to estimate different forms of the above equation and arrived at exchange rate elasticity of export supply ranging between 4.45 and 8.46 for the monthly exports of dressed pork.

Zenko's results are interesting in that they imply that the exchange rate has had little impact on hog prices in Canada while the impacts on exports were found to be high and variable. This led Zenko to conclude

that the estimated elasticities should not be interpreted as being "the" elasticities of quantity traded⁴³ This is not surprising however, since Zenko's analysis seems to have very limited underlying theoretical basis.

Two points need consideration. First, the omission of a price variable in the export function introduces some bias in the elasticity estimates since, according to Chambers and Just,⁴⁴ there exist a significant differential effect between exchange rate and a price movements. The second point is best summarized by Chambers and Just as follows:

"...Classical statistical theory suggests that a variable cannot be declared significant or insignificant without having any clear idea of the true model since Ordinary Least Squares procedures are not always valid".⁴⁵

In his conceptual model, Zenko showed that the export supply function is derived from the domestic demand and supply functions of the exporting country. This implies that the export supply function rely strictly on the elements of the domestic demand and supply functions. However, this is not the case with his model. Besides missing the price variable, his export supply function for Canadian pork included some elements that explain the U.S. pork sector. Hence, there are reasons to believe that his results are inconsistent as a result of model misspecification.

⁴³ Ibid. p.131

⁴⁴ Chambers, R.G. and R.E. Just, "Effects of Exchange Rate Changes on US Agriculture: A Dynamic Analysis." American Journal of Agricultural Economics Vol.63. (Feb.1981):32-46.

⁴⁵ Chambers, R.G. and R.E. Just, "A Critique of Exchange Rate Treatment in Agricultural Trade Models," Amer. J. Agr.Econ., 61(2) (1979) pp.253.

Finally, Binkley and McKinzie⁴⁶ and Thompson⁴⁷ argue that in international commodity modelling prices and quantities are determined simultaneously and therefore it would be inappropriate to utilize the Ordinary Least Squares estimator as this might give inconsistent estimates. Instead, the above authors suggest a more appropriate estimation technique such as two-stage least squares for estimation purposes. Again, on this ground, Zenko's estimates are clearly biased upwards.

3.3 SUMMARY

While it is obvious that there is little consensus on the magnitude of estimates of the elasticity of export supply and the elasticity of price with respect to changes in the exchange rate, it is also clear that this is partly due to different modelling and estimation techniques. The weaknesses of different studies were analysed in this chapter and it was suggested that the response to changes in the exchange rate of both price and quantity exported can be greater (or less) than some of the overly restrictive models suggest. However, the practical limitations of the more extended model were also obvious. Finally, it was recognized that in international commodity modelling a simultaneous system of equation is more appropriate. The next chapter will expand on this point in building a conceptual model to analyze the effects of the Canadian dollar depreciation on the domestic pork industry.

⁴⁶ Binkley, K.J. and Mc Kinzie, L. Alternative Methods of Estimating Export Demand: A Monte Carlo Comparison." Canadian Journal of Agricultural Economics: Vol.28, 1981.

⁴⁷ Thompson, R.L. "Structural Relationships for Agricultural Trade Policy." Proceeding of 1977 Annual Meeting of the American Statistical Association, Business and Economic Statistics Section, Chicago, (Aug.14-17):1977.

Chapter IV

THE CONCEPTUAL MODEL

4.1 INTRODUCTION

This chapter reviews trade theory and exchange rate theory as they relate to prices and trade flows within a partial equilibrium model. A simple two-country one-commodity trade model is developed to analyse the impact of a currency devaluation on the domestic price level and on exports of a traded commodity. This model takes explicit account of the exchange rate variable. The mathematical form of the trade model followed by the derivation of elasticity measures are also presented.

4.2 SUPPLY AND DEMAND IN INTERNATIONAL TRADE

The level of domestic production and consumption of a particular commodity determine how much of that commodity a country will import or export. Whenever production exceeds consumption, a surplus occurs and the amount of the surplus is usually the amount that a country is willing to export at the prevailing export price. In the case where the consumption of a commodity exceeds its domestic production level, then a shortage is created and the amount of the shortage is the amount which a country is willing to import at the existing import price. Finally, an international commodity market is in equilibrium when at the prevailing price, the volume of exports exactly matches the volume of imports.

However, in order to fully understand how equilibrium is established in international commodity markets, it is instructive first to look at how the demand-for-imports schedule and the supply-of-exports schedule are derived.

4.2.1 The Import Demand Schedule

The import demand schedule, also called the excess demand curve in price theory, gives the quantities of a commodity that a particular country is willing to import at alternative prices expressed in the country's own domestic currency.⁴⁸ Figure 4.1 below shows how the excess demand curve of a commodity for a particular country can be derived. Panel (a) of Figure 4.1 shows the domestic demand curve (DD') and the domestic supply curve (SS') of commodity 'A' in a particular country. Panel (b) shows the excess demand curve (ED) of that commodity. In panel (a), market equilibrium is achieved at price P_e with quantity supplied and demanded equal to Q_e . This is the 'market clearing' situation ; meaning that at the equilibrium price P_e , there is neither a shortage nor a surplus of commodity 'A' on the market, thus corresponding to zero excess demand at that price. However, for any price level below P_e , a shortage will develop in the market. This is because for any price level below P_e , the quantity demanded of commodity 'A' exceeds the quantity supplied of that commodity. For example, at price P_1 , the quantity demanded is Q_2 and the quantity supplied is Q_1 , thereby thus resulting in a shortage by the amount of $Q_2 - Q_1$. This amount ($Q_2 - Q_1$) at price P_1 is precisely the amount of commodity 'A' that the country in

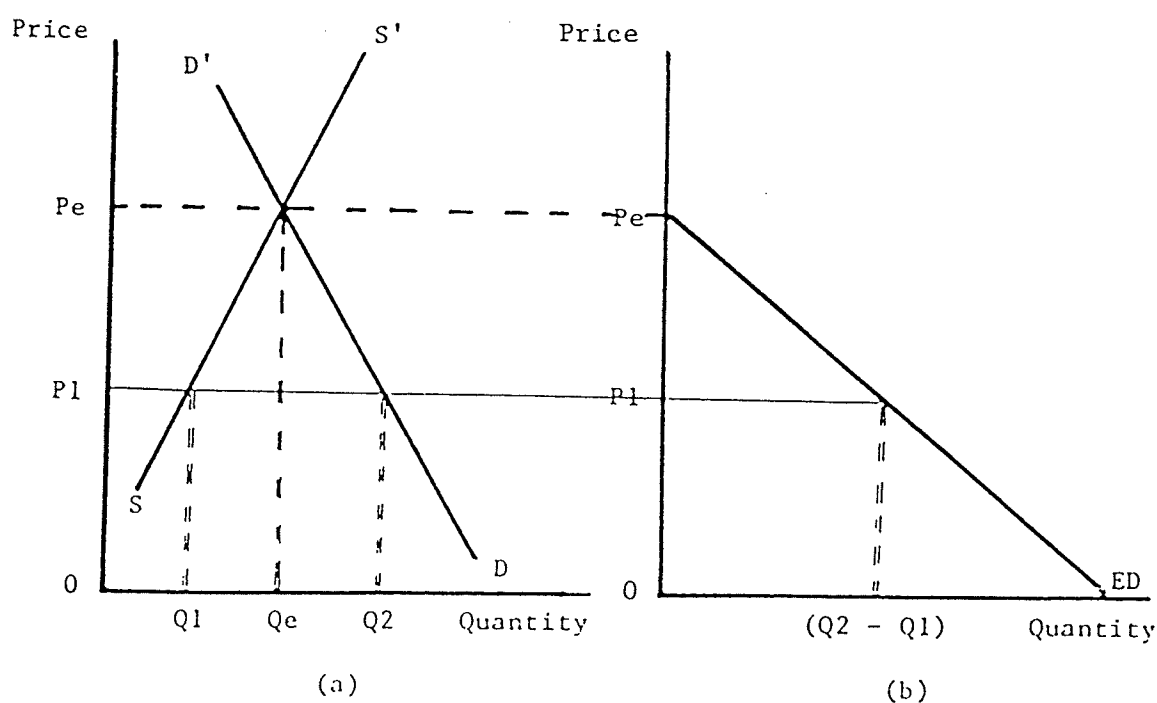
⁴⁸ Chacholiades, Miltiades. Principles of International Economics. Mc Graw-Hill, Inc. New-York. 1981.

$Q_2 - Q_1$. This amount ($Q_2 - Q_1$) at price P_1 is precisely the amount of commodity 'A' that the country in question is willing to import in order to restore domestic price equilibrium. Similarly, there are different quantities that correspond to different price levels below P_e and when these quantities are plotted against their respective price levels, an excess demand curve is derived.

The excess demand curve (ED) is therefore nothing more than the horizontal difference between the domestic demand and supply curves for all possible prices below the equilibrium price level. The excess demand curve depends on all the properties and parameters that lie behind the domestic demand and supply schedule.

Figure 4.1

Derivation of an Excess Demand Schedule

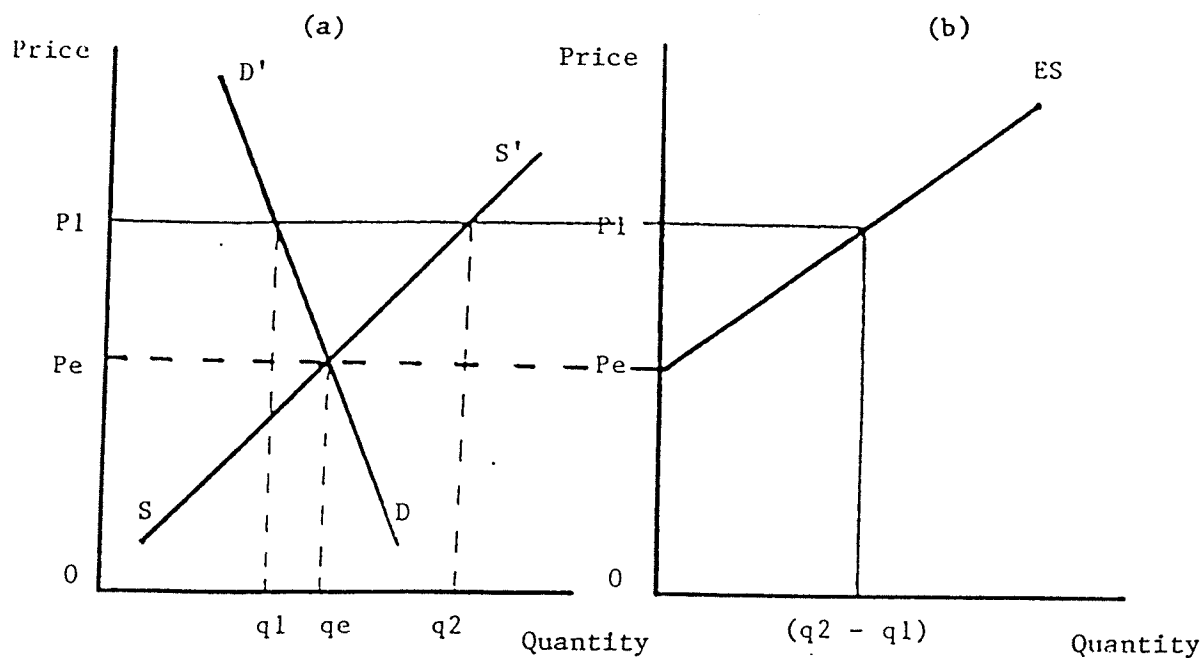


4.2.2 The Export Supply Schedule

The export supply schedule, also called the excess supply curve in price theory, shows the quantities of a commodity that a particular country is willing to export at alternative prices expressed in the country's own domestic currency. Figure 4.2 below shows the derivation of the excess supply curve of commodity 'A' for a particular country. Panel (a) of figure 4.2 shows the domestic supply (SS') and the domestic demand (DD') curves for commodity 'A'. Panel (b) shows the resulting export supply curve (ES). The derivation of the excess supply curve follows the same analogy as the derivation of the excess demand curve in the last section, except that in the present case, the exporting country has a surplus production at the prevailing market price (P_1) which is above the equilibrium market price P_e . At price P_1 , the surplus is equal to the amount $q_2 - q_1$ and the country under consideration is willing to export this amount.

Figure 4.2

Derivation of an Export Supply Schedule



Hence for every price level above P_e , a corresponding excess supply exists and by plotting the horizontal differences between the domestic demand and supply curves for all possible prices above the equilibrium price P_e , the excess supply curve can be derived for commodity 'A'. Again it is worth noting that the excess supply curve depends on all the properties and parameters of the domestic supply and demand curves.

4.2.3 Equilibrium in the International Commodity Market

Equilibrium in the international commodity market can now be determined with the excess supply and demand schedules. As stated earlier, equilibrium in the commodity market is established when, at the prevailing price, the volume of exports from one region exactly matches the volume of imports by the other region. In a multi-region model where a homogeneous currency is used by all the trading partners, the determination of equilibrium presents no major problem since the excess supply and demand schedules of the different countries express prices in the same unit of currency. Equilibrium, in such a case, can be determined graphically by simply superimposing one region's excess demand curve over another region's excess supply curve.

However, the determination of commodity market equilibrium is more complicated when the different trading regions use different domestic currencies. In this case, the excess supply and excess demand schedules are expressed in different currencies and therefore, presents some problems for comparison purpose. This problem can be solved by converting all prices expressed in the excess supply and excess demand schedules to a common currency. In the case where there are only two countries for

instance, this can be achieved by converting one country's currency in terms of the other country's currency. It is only then that the excess supply and excess demand curves of the two countries are helpful for the determination of equilibrium in the commodity market.

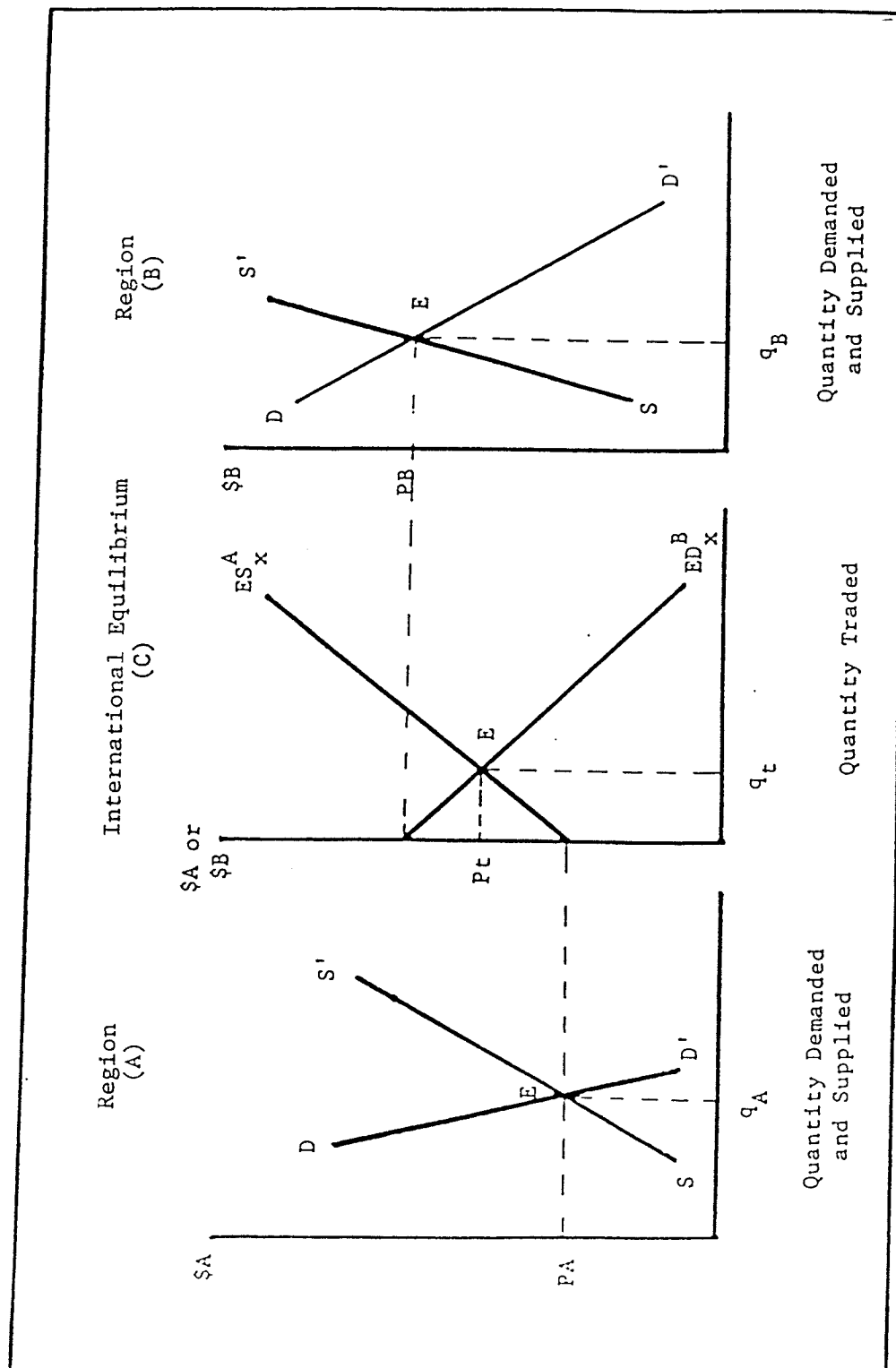
4.3 A SIMPLE TWO-REGION TRADE MODEL

This model assumes the world to consist of two regions , A and B, and only one commodity being traded. To keep the model simple, it is further assumed that the currencies used in both regions are of equal value (i.e., one \$A=one \$B) and that transportation cost is negligible between the two regions. The trade equilibrium of a simplistic model such as this one is illustrated graphically in Figure 4.3 below.

Panel (a) and (b) of Figure 4.3 show the domestic demand (DD') and domestic supply (SS') curves of region A and region B respectively. The corresponding excess supply curve (ES) and excess demand (ED) curves are shown in panel (c). Panel (c) also shows the equilibrium trade model with equilibrium quantity q_t being traded at equilibrium price P_t . Since the two currencies are of equal value, the vertical axis of panel (c) can be represented by either region A's or region B's currency.

Figure 4.3

Determination of Trade Equilibrium:
The Case of a Two-Region Model



4.4 EFFECTS OF A DEVALUATION BY AN EXPORTING COUNTRY.

The simple two-region, one commodity trade model in the previous section can now be used to assess the impacts of a currency devaluation by an exporting country on the price level and quantity traded of the exportable good. This can be done by relaxing the previous assumption made about the values of the currencies of the two trading regions (i.e., one \$A=one \$B). If the value of one currency is assumed to change relative to the other, it should be obvious that the equilibria (E) shown in Figure 4.3(b) can no longer exist.

Chacholiades⁴⁹ lists eight general possible effects of a currency devaluation. In order to meet the stated objectives of this study, the analysis will be limited to only two of these effects. These are:

- 1)the effect on commodity flows
- 2)the effect on domestic prices

The following assumptions are necessary in order to analyse both of these effects:

- a) A is the Exporting Region
- b) B is the Importing region
- c) there exists free trade between the two regions
- d) there are no transportation costs involved

⁴⁹ Ibid. p. 368.

By introducing the currency exchange sector implicitly into the previous model, the effects of a currency devaluation on both domestic prices of the exporter and on trade flows can be analyzed. Chambers and Just⁵⁰ have pointed out that by changing other prices, a devaluation will cause shifts of both the supply and the demand curves. Kost takes the same position by noting that:

From the point of view of the exporting country which devalues, the importing country appears to have simultaneously increased demand and decreased supply. What seems to be shifts in the supply and demand curves for the importing country will result in an actual increase (shift to the right) in the import demand curve.⁵¹

Another way of viewing devaluation, according to Kost, is

"...to see it as making the price of the import good cheaper in the importing country, relative to the price of the same good produced domestically, than before the devaluation occurred. With a cheaper relative price for the imported goods, there will be a shift away from purchases of domestic product toward imports."⁵²

In short, a devaluation results in an increase in the demand for the commodity being imported. This translates into an increase in the quantity exported followed by a rise in the domestic price of the product expressed in terms of the exporting country's currency. On one hand, higher domestic price acts as an incentive to boost production while on the other hand it has the tendency to curb consumption. This will result in the exporting country to produce more, consume less and export

⁵⁰ Chambers, R.G. and Just, R.E. "A Critique of Exchange Rate Treatment In Agricultural Trade Models." American Journal of Agricultural Economics, Vol. 61, (May 1979):249-257.

⁵¹ Kost, William. "The Effects of an Exchange Rate Change on Agricultural Trade." American Economics Research, 28(3) (July 1975) p. 101.

⁵² Ibid.

more.⁵³

On the importer's side, cheaper imports as a consequence of the devaluation results in higher demand of the imported product. At the same time, domestic production falls as depressed prices in the importing country will drive some producers out of business. However, the simultaneous increase in the price of the product in the exporting country will tend to offset this effect to some extent. The net effect will be a lower price in the importing country, a higher price in the exporting country and an increase in the volume of trade.

Figure 4.4 illustrates, graphically, the effect of a devaluation by an exporting country 'A' on the equilibrium trade pattern. This is achieved by explicitly introducing the currency exchange sector (panel c) into the simple two region trade model.

The currency exchange sector shows the relationship between the value of the currencies of the two trading regions, country A and country b. Line 'A', panel C, shows that the exchange rate is at par, that is $\$A = \B . Under such a situation, equilibrium in the trade sector occurs at price P_e and quantity Q_t . However, when the value of one currency changes relative to the other, the situation becomes rather more complex.

Figure 4.4 assumes that country A devalues its currency by 50 percent vis-à-vis country's B currency. The new exchange rate is therefore $\$0.5B = \A . This is represented by a new currency exchange curve 'B'.

⁵³ Ibid. p. 102

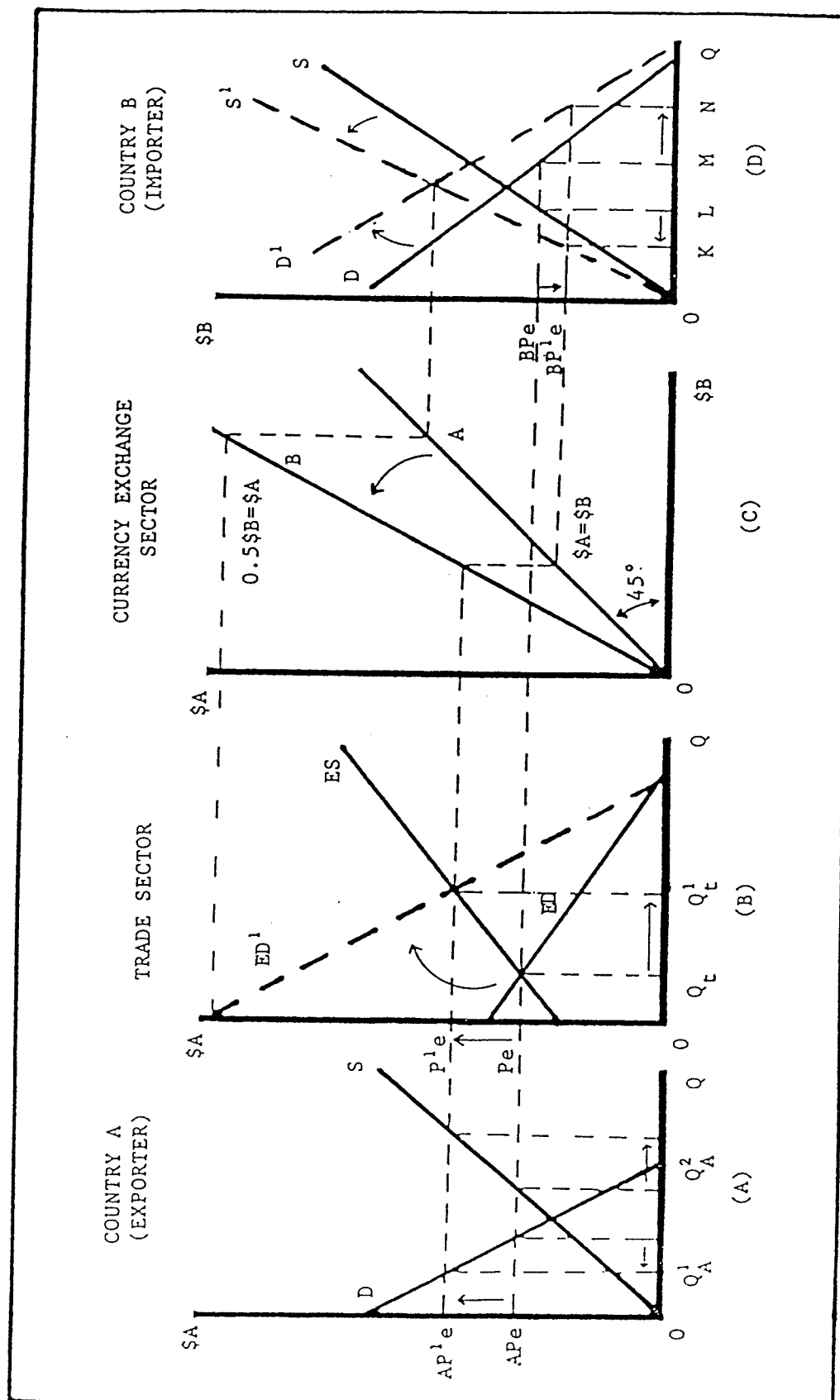
Responding to the new exchange rate, the importing country's domestic demand and supply curves will shift from their initial position D and S to D' and S' respectively. This is because goods and services in country 'A' are relatively cheaper in terms of country B's currency after the devaluation. The result will be an increase in the volume of imports from LM to KN as the domestic price in the importing country falls from BPe to BPe'.

Regarding the exporting country, the domestic price of the commodity under consideration will increase from APe to AP'e as the price level in the trade sector increases from Pe to P'e. The quantity traded increases from OQt to OQt'. This is equal to the now higher volume of imports, KN. Hence, both the equilibrium price level and quantity exported increase following a devaluation by the exporting country.

The price effect and the commodity flows effect occur almost simultaneously. However, the interesting point to note is that prices move in opposite directions in the two regions. effects occur in almost the opposite direction to the other. On the one hand, a currency devaluation by the exporting region, will result in the prices of goods in terms of the importer's currency to fall thereby resulting in an increase in the volume of trade. On the other hand, increasing pressure on exports in the exporting country causes the domestic price of the traded commodity to increase.

Hence, the amount by which the volume of exports increases following a currency devaluation depends purely on the magnitude of the increases in the level of domestic prices of the traded product as a result of the

Figure 4.4
Effects of Devaluation by an Exporting Country on
Exports and on the Price Level



Source: Adapted from Bredahl and Gallagher, 1977 (Modified Version).

currency devaluation. In the next section, mathematical expressions measuring the magnitude of these changes will be derived.

4.5 THE MATHEMATICAL FORM OF THE MODEL

Both the price effect and the commodity flows effect will now be shown through algebraic proofs. The simple, one-commodity, two-country world can be represented by the following model:⁵⁴

$$QS_1 = S_1(P_1, V_1) \quad \text{Exporter's Supply} \dots\dots\dots(4.1)$$

$$QD_1 = D_1(P_1, V_2) \quad \text{Exporter's Demand} \dots\dots\dots(4.2)$$

$$QS_2 = S_2(P_2, V_3) \quad \text{Importer's Supply} \dots\dots\dots(4.3)$$

$$QD_2 = D_2(P_2, V_4) \quad \text{Importer's Demand} \dots\dots\dots(4.4)$$

$$QM_2 = QD_2 - QS_2 \quad \text{Import Demand} \dots\dots\dots(4.5)$$

$$QX_1 = QS_1 - QD_1 \quad \text{Export Supply} \dots\dots\dots(4.6)$$

$$QM_2 = QX_1 \quad \text{Market Clearing Condition} \dots\dots\dots(4.7)$$

$$P_2 = r(P_1 + Z_1) + Z_2 \quad \text{Price Linkage Equation} \dots\dots\dots(4.8)$$

Where:

QSi : represent the quantities supplied of the commodity
in country $i \dots(i=1, 2)$.

QDi : represent the quantities demanded of the commodity
in country $i \dots(i=1, 2)$.

P_i : is the commodity's price in country $i \dots(i=1, 2)$.

⁵⁴ The mathematical form of the model presented follows closely the work by Thompson, R.L. "Structural Relationships For Agricultural Trade Policy." Proceeding of 1977 Annual Meeting of the American Statistical Association, Business and Economic Statistics Section, Chicago, Aug.14-17:1977.

V_i : are vectors of exogeneous supply and demand shifters
for country $i \dots (i=1, 2)$.

QM_2 : represent the import quantities

QX_1 : represent the export quantities

r : is the exchange rate between the two countries

Z_i : represent factors that link the prices in the
two countries

and Country 1 is the exporting country

Country 2 is the importing country

Equation (4.8) links the prices of the exporting and importing countries. For example:

$$Z_1 = g (L_1 + T)$$

Where:

Z_1 : represent factors in the exporting country (expressed in the exporter's currency) that link the prices of the two countries .

L_1 : represents an export tax or any type of export subsidy on the traded commodity expressed in the exporting country's currency.

T : represents the transportation costs between the two countries in terms of the exporters' currency.

From equation (8), Z_2 might represent any form of import duties (tariffs) imposed by the importing country expressed in the importing country's currency.

The above model will be kept as simple as possible. Hence the model assumes there are no transportation costs, tariffs, or inventories. Al-

though these variables are ignored here, they will be explicitly introduced in the econometric model. It should be noted at the same time that their omission at this stage do not alter the final results.

The equations of interest for the purpose of showing the effects of a currency depreciation by an exporter on the price level of the exportable commodity and on the level of exports, are equations (4.5-4.8). These represent the export supply, the import demand and the price linkage functions.

For simplicity, it is assumed that the currency exchange rate is the only factor between the prices of the two countries. Hence, the simplified model can be written as follows:

$$QM_2 = QD_2 - QS_2 \quad (4.5)$$

$$QX_1 = QS_1 - QD_1 \quad (4.6)$$

$$QM_2 = QX_1 \quad (4.7)$$

$$P_2 = rP_1 \quad (4.9)$$

Where QM_2 is the importing region's import demand function and QX_1 is the exporters' export supply function.

Initially, both functions are expressed in terms of their respective domestic currencies. However, in order to determine equilibrium in the commodity market, prices have to be expressed in a common currency. Since the main concern here is with the exporting region, then the importing region's excess demand function is expressed in terms of the exporting region's currency by using the exchange rate prevailing between the two regions. This is done by multiplying the slope of the excess

demand function (QM_2) of the importing region by the appropriate exchange rate.⁵⁵ In simple notational form, such a two-country, one-commodity trade model can be represented in the following alternative way:⁵⁶

$$(4.10) \quad QM_2 = a_2 + [\beta_2 \cdot r] P_1 \quad \dots \beta_2 \leq 0$$

$$(4.11) \quad QX_1 = a_1 + \beta_1 P_1 \quad \dots \beta_1 \geq 0$$

$$(4.7) \quad QM_2 = QX_1 = Q. \quad (\text{in equilibrium})$$

$$(4.9) \quad P_2 = rP_1 \quad (\text{price linkage})$$

Where: a_i : is a constant term

β_i : represents the slope of the function

P_1 : represents the price in the exporting region's currency

P_2 : represents the price in the importing country.

r : is the exchange rate

The effect of a change in the exchange rate (r) on the domestic price level (P_1) can be determined by taking the total derivative of equation (4.7) with respect to price and solve for dP_1 . Hence:

$$(4.12) \quad dQ = \beta_2 r dP_1 + \beta_2 P_1 dr = \beta_1 dP_1$$

⁵⁵ The technique used here follows that suggested by Bjarnason, F. Harold., McGarry, Micheal J. and Andrew Schmitz., "Converting Price Series of Internationally Traded Commodities to a Common Currency Prior to estimating National Supply and Demand Equations," American Journal of Agricultural Economics, Vol. 51 No.1. (Feb. 1967): 189-192.

⁵⁶ The rest of this section follows the work of Bredahl and Gallagher: 1977.

Rearranging Equation 4.12 gives:

$$(4.13a) \quad dP_1(\beta_2 r - \beta_1) + \beta_2 P_1 dr = 0$$

$$(4.13b) \quad dP_1 = \frac{-\beta_2 P_1 dr}{\beta_2 r - \beta_1} \quad \text{or} \quad \frac{\beta_2 P_1 dr}{\beta_1 - \beta_2 r}$$

Recall that $\beta_2 \leq 0$, $\beta_1 \geq 0$, and $P_1 \geq 0$, the value of dP_1 in equation (4.13b) is negative if it is assumed that $r=1$ (i.e., one \$A = one \$B). However, if it is assumed that there is a devaluation in region A's currency (say, 1\$A=0.5\$B), then the value of r changes from 1 to 0.5 thereby resulting in $dr=-0.5$. If these new values are substituted in equation (4.13b), dP_1 turns out to be positive. This implies that a currency devaluation leads to an increase in the domestic price of the commodity being traded.

Similarly, by using equation (4.12), the effect of a change in the exchange rate on the quantity traded can be determined. It is known from equation (4.12) and (4.13b) that:

$$(4.12) \quad dQ = \beta_1 dP_1$$

and

$$(4.13b) \quad dP_1 = \frac{\beta_2 P_1 dr}{\beta_1 - \beta_2 r}$$

By substituting equation (4.13b) into equation (4.12) and rearranging terms gives the following expression:

$$(4.14) \quad dQ = \frac{\beta_1 \beta_2 P_1}{\beta_1 - \beta_2 r} dr$$

Recall that $\beta_2 \leq 0$, $\beta_1 \geq 0$, $P_1 \geq 0$ and initially $r=1$. A devaluation in the exchange rate (for example when r changes from 1 to 0.5) will result in $dr = -0.5$. Substituting this value into equation 4.14 the value of dQ changes from negative to positive. This implies that a currency devaluation leads to an increase in the equilibrium quantity traded.

4.6 ELASTICITY OF EQUILIBRIUM PRICE AND QUANTITY FOR THE EXCHANGE RATE

So far only the direction of the changes in the level of prices and exports as a result of changes in the exchange rates are known. Nothing is known yet regarding the magnitude of such changes which would be given by an elasticity measure. For the problem at hand, two measures of elasticity are needed in order to meet the objectives of this study. These are:

- 1) The exchange rate elasticity of price expressed in terms of the exporter's currency.
- 2) The exchange rate elasticity of exports.

The exchange rate elasticity of price, $E_{p,r}$, measures the effect that a one percent change in the exchange rate is likely to have on the domestic price level of the product under consideration. Similarly, the exchange rate elasticity of export, $E_{q,r}$, measures the effect that a one percent change in the exchange rate is likely to have on the volume of export of the commodity being considered.

There has been much debate about how to estimate both of these measures. By using the simple two-country trade model represented by equations (4.7) and (4.9-4.11), the expressions for the two measures of elasticity can be derived as follows:

$$(4.15) \quad E_{p,r} = (dp_1 / dr) \cdot (r / p_1)$$

But the expression for dp_1/dr is known from equation (4.13) and substituting equation (4.13b) into equation (4.15) gives:

$$(4.16a) \quad E_{p,r} = \frac{-\beta_2 P_1}{\beta_2 r - \beta_1} \cdot \frac{r}{P_1}$$

Rearranging equation (4.16a) gives:

$$(4.16b) \quad E_{p,r} = \frac{-\beta_2 r}{\beta_2 r - \beta_1} \quad \text{or} \quad \frac{-1}{1 - (\beta_1/r \beta_2)}$$

Expression (4.16b) can be expressed in terms of the price elasticity of excess demand and excess supply. From equation (4.10) the price elasticity of excess demand (U_{ed}) is defined as:

$$U_{ed} = (dQ / dP_1) (P_1/Q) = \beta_2 r (P_1/Q)$$

From equation (4.11) the elasticity of excess supply with respect to price in the exporter's currency [U_{es}] is defined as:

$$U_{es} = (dQ / dP_1) (P_1 / Q) = \beta_1 (P_1 / Q)$$

Hence,

$$(4.17) \quad U_{es} / U_{ed} = (\beta_1 / \beta_2 r)$$

Therefore substituting equation (4.17) into equation (4.16b) gives the following expression for the exchange rate elasticity of price:

$$(4.18) \quad E_{p,r} = -1 / 1 - (U_{es} / U_{ed})$$

Where,

$E_{p,r}$: is the exchange rate elasticity of price.

U_{ed} : is the elasticity of import demand with respect

to price in the importer's currency.

U_{es} : is the elasticity of export supply with respect
to price in the exporter's currency.

and β_1 , β_2 , P_1 and r are defined as before.

From equation (4.18)

If $U_{es} / U_{ed} \implies \infty$; then, $E_{p,r} \implies 0$;

If $U_{es} / U_{ed} \implies 0$; then, $E_{p,r} \implies -1$;

Hence, the elasticity of price with respect to the exchange rate takes values between $[0, -1]$. This implies that a one percent depreciation in the exchange rate will likely result in a minimum of zero percent change in the price level and a maximum of 1 percent change in the price level of the exportable commodity.

The elasticity of excess supply with respect to the exchange rate ($E_{q,r}$), can be determined in a similar way. The exchange rate elasticity of export shows the proportion by which the quantity traded is likely to change following a currency depreciation of 1 percent. Algebraically, the exchange rate elasticity of export can be derived as follows:

$$(4.19) \quad E_{q,r} = (dQ / dr) (r / Q)$$

Recall from equation (4.14) that:

$$dQ / dr = (\beta_1 \beta_2 P_1) / (\beta_1 - \beta_2 r)$$

substituting equation (4.14) into equation (4.19) gives:

$$(4.20) \quad E_{q,r} = \frac{\beta_1 \beta_2 P_1}{\beta_1 - \beta_2 r} \cdot \frac{r}{Q}$$

Recall that $E_{p,r} = (U_{ed}/U_{es}-U_{ed})$.

Re-arranging terms result in the following expression for the exchange rate elasticity of export $[Eq,r]$.

$$(4.21) \quad \begin{aligned} Eq,r &= (Ued \cdot Ues) / (Ues - Ued) \\ &= Ep,r \cdot Ues \end{aligned}$$

Where:

Eq,r is the exchange rate elasticity of export.

and

Ues , Ued , β_1 , β_2 , P_1 and r are defined as before.

Given that $0 \leq Ep,r \leq -1$ and that $Ues \geq 0$, then Eq,r can take any value between zero and infinity depending on the values of Ues and Ep,r . This implies that a currency depreciation of one percent is likely to result in an increase in the volume of exports and the magnitude of this increase can be anything ranging between zero and infinity.

4.7 SUMMARY

This chapter showed how the export supply and import demand functions are related to the domestic supply and demand functions respectively. A simple two-country, one-commodity trade model was presented and the effects of a currency depreciation on the domestic price and on the volume of exports was shown graphically. It was shown that a currency devaluation by an exporting country results in an increase in the price level and in the quantity exported of a particular commodity. It was also concluded that while the effect of a currency devaluation on the price

level is restricted within the bounds $[0,-1]$, the effects on the quantity exported has no upper bound restriction. While the limitations of partial equilibrium analysis are fully recognized, the model developed in this section is still thought to be a powerful analytical tool for trade policy analysis.

Chapter V

THE ECONOMETRIC PORK TRADE MODEL

5.1 INTRODUCTION

This chapter develops a quarterly econometric model for the Canadian pork trade sector which examines the effects of changes in the exchange rate on both the domestic price level of pork and on the export supply of Canadian pork. The econometric model follows the conceptual model described by equations (4.7) and (4.9)-(4.11) in the previous chapter. The econometric model consists of four endogenous variables and twenty four exogenous variables contained in five equations, one of which is an identity. These equations explain the export supply of Canadian pork, the export price of Canadian pork, and the import demand for pork by the two major importers, the United States and Japan.

In the next section, the structural form of the econometric model is presented. Specifically, the behavioural equations are first specified and the structural form of each equation discussed. A brief description of the variables incorporated in the model and their hypothesized relationship to the dependent variable is also included. Section 5.3 briefly describes the technique employed for the estimation of the pork trade model. This is followed by a description of the endogenous and exogenous variables used in the model and the sources of the data for this study.

5.2 MODEL SPECIFICATION

In previous chapters, it was established that the amount of pork available for export at any point in time depends on the levels of domestic supply and demand in the exporting country. However, it is well known that the production of hogs is cyclical in nature.⁵⁷ Therefore in order to determine the level of pork exports for a given quarter it is important to determine the time lag that characterizes hog production. For this study, the most appropriate lag was found to be four quarters. This represents the time elapsed between the decision to change the level of hog production and the final response as measured by the level of hog slaughter.⁵⁸ Hence, in this study, the factors that explain hog production are lagged four quarters wherever appropriate. In addition, dummy variables are included in the export, import and price functions in order to capture seasonality in the model.

Finally, all prices are deflated by the wholesale price indices of the respective regions. Prices are therefore expressed in real terms (1971=100). Similarly, wherever included, the income variables are deflated by the consumer price indices of the different countries studied. Income variables are therefore expressed in real terms (1971=100).

⁵⁷ Zwart, C. Anthony and Larry Martin. "The North American Pork Sector-Analysis of its Economic Interrelationships and a Model for Policy Evaluation," School of Agricultural Economics and Extension Education, Ontario Agricultural College, University of Guelph, 1974.

⁵⁸ *ibid.*

5.2.1 The Export Price Equation

The export price of Canadian pork is expressed following the Nerlovi-an partial adjustment model in which the current pork export price depends on the export price observed in the previous quarter plus or minus adjustments resulting from changes in the stock levels and the production levels. Seasonal dummy variables are also included. Hence:

$$PHOG = f_1 (LPHOG, CSTK, CPROD, SPR, SUM, FALL) \quad (5.1)$$

where:

PHOG is the dependent variable and represents the average Winnipeg-Toronto price of index 100 hogs (F.O.B. Canada). The price of pork is expressed in cents per pound on a quarterly basis.

STK is the level of cold storage holding of pork in Canada expressed in pounds per quarter.

CPROD is the level of pork production in Canada expressed in pounds per quarter.

LPHOG is a one quarter lagged dependent variable.

SPR, SUM and FALL represent dummy variables to account for seasonality. These seasonal dummy variables are defined as follows:

SPR = 1 for the second quarter (spring)
 = 0 otherwise
 SUM = 1 for the third quarter (summer)
 = 0 otherwise
 FALL = 1 for the last quarter (Fall)
 = 0 otherwise

The lagged dependent variable (LPHOG) is expected to be directly related to the dependent variable (PHOG) i.e., $(\partial PHOG / \partial LPHOG > 0)$. However, the stock variable and the production are expected to be inversely related to the dependent variable (PHOG) i.e. $(\partial PHOG / \partial CSTK < 0$ and $\partial PHOG / \partial CPROD < 0)$.

5.2.2 The Canadian Pork Export Supply Equation

The export supply function for Canadian pork is based on the assumption that the current level of Canadian pork exports depend on the factors that influence the domestic demand and supply for Canadian pork. The theoretical reasoning supporting this assumption traces back to the derivation of the export supply curve of a particular commodity which was illustrated in figure 4.2. Hence, the Canadian pork export supply (CPX) function is specified as follows:

$$\text{CPX} = f_2(\text{PHOG}, \text{CSTK}, \text{L4FEED}, \text{CYD}, \text{CPROD}, \text{LPHOG}, \text{D83/84}, \text{SPR}, \text{SUM}, \text{FALL}) \quad (5.2)$$

where:

- CPX is the dependent variable and represents the total quarterly exports of Canadian pork in pounds.
- PHOG is the price of pork defined in equation 5.1
- LPHOG is the price of pork lagged one quarter.
- CSTK is the end of quarter cold storage holding of pork in Canada expressed in pounds.
- L4FEED is the feed grain price index lagged four quarters.
- CYD is the real disposable income for Canada.
- D83/84 is a dummy variable to account for the 1983 strike in the hog slaughtering and processing industry. This dummy variable is defined as follows:

$$\begin{aligned} \text{D83/84} &= 1 \text{ for } 1983-84 \\ &= 0 \text{ otherwise} \end{aligned}$$

SPR, SUM and FALL are seasonal dummy variables and are similar to the ones defined in Equation 5.1

Since the primary focus of this study is to measure the effects of exchange rate changes on the export supply and export price of Canadian pork, the explanatory variable that is of major importance in equation 5.2 is the price variable (PHOG). Based on a priori economic reasoning, this is expected to be positively related to the dependent variable (CPX), (i.e., $\partial \text{CPX} / \partial \text{PHOG} > 0$).

The dummy variable (D83/84) is expected to be directly related to the dependent variable (CPX). This is because a strike in the Canadian slaughtering and meat processing is expected to result in an increase in the volume of pork exports as more live hogs are expected to be moved to the United States for slaughtering and processing under such a situation. Hence $(\partial \text{CPX} / \partial \text{D83/84} > 0)$.

Finally, both the stock and the production variables are expected to be positively related to the dependent variable (CPX). Higher levels of pork stock and production are expected to result in higher levels of pork exports. Hence, $\partial \text{CPX} / \partial \text{CSTK} > 0$ and $\partial \text{CPX} / \partial \text{CPROD} > 0$.

5.2.3 The Pork Import Demand Equations

The pork import demand functions for both the United States and Japan are specified based on the assumption that the level of pork imports in any given quarter depends on the domestic demand and supply positions conditions in each of these two regions. This assumption relates back to the derivation of the import demand curve for a particular commodity illustrated in Figure 4.1 (Chapter 4). Therefore, the demand for imported pork is specified as a function of the price of pork, and demand and supply shifters in the respective regions.

5.2.3.1 The United States Pork Import Demand Equation

The United States import demand function for Canadian pork is specified as follows:

$$\text{USPM} = f3 (\text{PHOG}, \text{LPHOG}, \text{USTK}, \text{L4CORN}, \text{USPROD}, \text{USYD}, \text{USPB}, \text{USPOP}, \text{D75/76}, \text{USMROW}, \text{SPR}, \text{SUM}, \text{FALL}) \quad (5.3)$$

where:

USPM represents the amount of pork imports from Canada by the United States expressed in pounds per quarter.

PHOG is the F.O.B. price of Canadian pork as defined in equation 5.1.

LPHOG is a one quarter lag of the price of pork (PHOG) variable.

USTK is the U.S. storage holding of fresh, frozen, and chilled pork expressed in pounds per quarter.

L4CORN is the United States Feed Grain price index (1971-100). This variable is lagged four quarters for reasons discussed previously.

USPROD is the United States quarterly production of pork expressed in pounds.

USYD is the U.S. real disposable income on a quarterly basis.

USPB is the real price of beef in the U.S. expressed in \$US per pound on a quarterly basis.

USPOP is the U.S. population - expressed in millions.

D75/76 is a dummy variable included to account for the import quota imposed on Canadian pork and hog imports by the U.S. in 1975-1976. D75/76 is defined as follows.

$$\begin{aligned} \text{D75/76} &= 1 \text{ for } 1975-1976 \\ &= 0 \text{ otherwise} \end{aligned}$$

USMROW is the U.S. pork imports from countries other than Canada. This is expressed in pounds per quarter.

SPR, SUM and FALL are seasonal dummy variables and have the same meaning as the ones described in Equation 5.1.

The explanatory variable that is of major importance in Equation 5.3 as far as the objectives of this study are concerned is the price of pork price variable (PHOG). This variable is expected to be inversely related to the dependent variable (USPM), (i.e. $\partial \text{USPM} / \partial \text{PHOG} < 0$). This is supported by the fact that the import demand curve, as derived in Chapter 4, is expected to be downward sloping.

Besides the import price, the following variables are also expected to be inversely related to the dependent variable (USPM): the feed cost (L4CORN), stocks (USTK), production (USPROD), D75/76, and imports from the rest of the world (USMROW). The dummy variable D75/76, representing the import quota on Canadian pork imports in 1975-1976 is expected to have a negative sign since imports of Canadian pork during the 1975-1976 period dropped to unusually low levels as a direct consequence of the quota.

However, the variable representing the U.S. price of beef (USPB), is expected to be directly related to the dependent variable (USPM). Higher prices of beef in the U.S. is likely to result in a shift in the demand for pork, which is a close substitute for beef. Higher demand for pork is likely to result in higher imports of pork in the short run.

5.2.3.2 The Japanese Pork Import Demand Equation

Because the Japanese pork market is highly protected by a variable tariff system (see Chapter 2) the Canadian-Japanese pork trade is influenced more heavily by the variable tariff system than by demand and supply factors as would be the case in a free trade situation. Hence, the

import demand function includes a variable for the tariff system. The Japanese Pork import demand (JPM) function is specified as follows:⁵⁹

$$\text{JPM} = f_4 (\text{PHOG}, \text{JYD}, \text{JPROD}, \text{JSIP}, \text{JPOP}, \text{D81/83}, \text{JPB}, \text{JMROW}, \text{SPR}, \text{SUM}, \text{FALL}) \quad (5.4)$$

where:

- JPM is the dependent variable and represents the quarterly Japanese imports of pork from Canada and is expressed in pounds.
- PHOG is the quarterly F.O.B. price of pork, Canada as described in Equation 5.1.
- JYD is the Japanese gross national product. This variable is used as a proxy for the Japanese level of income.
- JPROD is the Japanese quarterly pork production expressed in pounds.
- JSIP is the standard import price of imported pork in Japan. The standard import price is the average between the ceiling and the floor price on pork import and is used as a basis in determining the level of import tariff on pork (see Appendix B).
- JPOP is the Japanese population in millions.
- D81/83 is a dummy variable included in the model to account for unusually high levels of pork imports following the ban on Danish pork on health grounds. This variable is defined as follows:
 $\text{D81/83} = 1$ for 1981-83
 $= 0$ otherwise
- JPB is the wholesale price index of beef in Japan.
- JMROW Japanese pork imports from countries other than Canada.
- SPR, SUM, FALL are seasonal dummy variables as described previously.

⁵⁹ Data on stocks of pork in Japan was not available and therefore the stock variable is excluded from this model.

The variable that is of major importance regarding the objective of this study is the price of pork variable, (PHOG). This variable is expected to have a negative sign attached to it i.e., the price variable (PHOG) is expected to be inversely related to the dependent variable (JPM), (i.e., $\partial JPM / \partial PHOG < 0$).

The dummy variable D81/83 is included to account for the unusually high levels of pork exports to Japan as a result of a ban imposed on Danish pork imports. The ban came into effect following the outbreak of foot and mouth disease in the Danish hog industry. The variable D81/83 is expected to be positively related to the dependent variable (JPM) (i.e. $\partial JPM / \partial D81/83 > 0$).

The standard import price (JSIP) is also expected to be directly related to the dependent variable (JPM). This is because a higher SIP means more access for Canadian pork in the Japanese market. Hence ($\partial JPM / \partial JSIP > 0$). Similarly, as the price beef in Japan increases, ceteris paribus, there will be a shift towards pork consumption, hence higher pork imports i.e. $\partial JPM / \partial JPB > 0$).

The production (JPROD) and the imports for the rest of the world (JMROW) are both expected to be inversely related to the dependent variable i.e. $\partial JPM / \partial JPROD < 0$ and $\partial JPM / \partial JMROW < 0$).

Finally, to complete the econometric model two identities are necessary. First, it is assumed that the price of pork in the importing country is equal to the price of pork in the exporting country adjusted by the appropriate exchange rate. This implies that transportation costs are treated as being constant over the period of study.

Second, it is assumed that the amount of pork exported by Canada in a given quarter is equal to the amount of pork imported by the U.S. and Japan from Canada. Hence the following identities complete the model.

$$P_m = P_{HOG} \cdot r \quad (5.5)$$

$$CPX = USPM + JPM \quad (5.6)$$

where: P_m is the price of pork in the importing country in terms of the importing country's currency.

P_{HOG} is the price of pork in the exporting country.

r is the exchange rate

CPX , $USPM$ and JPM are as defined before.

TABLE 5.1

Summary of Endogenous and Exogenous Variables of the Empirical Model

Endogenous Variables

PHOG	This variable represents the average quarterly prices of index 100 hogs in Winnipeg and Toronto expressed in dollars per pound. Source: Agriculture Canada: "Livestock Market Review" (Various Issues)
CPX	This variable is a measure of the total exports of Canadian pork expressed in pounds per quarter. The total exports of pork consists of exports of fresh, frozen and chilled products (export category 11-22, 11-24 and 11-29) and the export of live hogs (export category 3-49). The number of slaughter hogs exported each quarter was first multiplied by the quarterly warm dressed weight and then multiplied by 0.97 to get the chilled weight equivalent. Source: Agriculture Canada, "Livestock Market Review" (various issues) and Statistics Canada "Exports by Commodities" (various issues)
USPM	This is the amount of U.S. imports of pork from Canada on a quarterly basis expressed in pounds. The data for this variable was obtained from Statistics Canada "Exports by Commodities" and includes the imports of both live hogs converted to a chilled weight equivalent and the imports of fresh, frozen, and chilled products as described above.
JPM	This variable represents the amount of quarterly imports of Canadian pork by Japan and is expressed in pounds. Source: Statistics Canada: "Exports by Commodities", (various issues).

Exogenous Variables

LPHOG	This is a lagged dependent variable and is treated exogenously in this model. This variable is a one quarter lag of the endogenous price variable (PHOG) defined above.
CSTK	This variable represents the end of quarter cold storage holding of pork in Canada and is reported in thousand pounds. Source: Statistics Canada "Livestock and Animal Product Statistics" (various issues).
L4FEED	This variable represents the quarterly feed grain price index (1971 = 100) and is lagged four quarters.

Source: Statistics Canada "Farm Input Price Index" Cat#62-004, (various issues).

- CPROD This is the quarterly production of pork in Canada expressed in pounds. The total number of slaughter hogs (including live hogs exported for slaughter purposes) were first converted to their warm dressed weight equivalent and then into their chilled weight equivalent using the procedure described for the variable (CPX) above.
Source: Agriculture Canada "Livestock Market Review" (various issues).
- CYD This variable represents the total real disposable income in Canada on a quarterly basis.
Source: Statistics Canada.
- D83/84 is a dummy variable included in the model to account for the strike in the Canadian meat packing and processing industry during 1984. This dummy variable is defined as follows:

D83/84 =1 for 1984
 =0 otherwise
- L4CORN This variable represents the quarterly feed grain price index for the United States, lagged four quarters.
Source: Survey of Current Business, USDC Bureau of Economic Analysis (various issues)
- USTK This is the United States end of quarter cold storage holding of pork expressed in pounds.
Source: Livestock and Meat Outlook and Situation, USDA, quarterly (various issues).
- USYD This is the total real personal income in the U.S. used as a proxy for the real disposable income. This was necessary because seasonally unadjusted disposable income were not available.
Source: Survey of Current Business, U.S.D.C., Bureau of Economic Analysis (various issues).
- USPOP This is the quarterly U.S. population expressed in millions.
Source: Survey of Current Business, U.S.D.C., Bureau of Economic Analysis (various issues).
- USPROD This variable is a measure of the quarterly production of pork in the United States reported in million pounds.
Source: Livestock and Meat: Outlook and Situation, U.S.D.A., quarterly (various issues).
- USPB This is the United States wholesale price index of beef. Beef prices are reported in U.S.\$ per 100 pounds, omaha.
Source: Survey of Current Business, U.S.D.C., Bureau of Economic Analysis, (various issues).

- USMROW This variable represents the quarterly United States imports of pork from countries other than Canada. This variable was obtained by subtracting the U.S. imports of Canadian pork from the total pork imports
Source: Survey of Current Business, U.S.D.C., Bureau of Economic Analysis, (various issues).
- D75/76 This variable is included to capture the effects of the 1975-1976 import quota on Canadian hogs imposed by the United States. This variable is defined as follows:
- $$\begin{aligned} D75/76 &= 1 \text{ for } 1975-1976 \\ &= 0 \text{ otherwise} \end{aligned}$$
- JYD This is the Japanese real gross national product. This variable is used as a proxy for the Japanese disposable income which were not readily available for this study.
Source: Main Economic Indicators, O.E.C.D., Dept. of Economics and Statistics.
- JPROD This is the Japanese quarterly pork production expressed in pounds (carcass weight).
Source: "The Meat Statistics in Japan," Livestock Bureau, Ministry of Agriculture and Forestry, (various issues).
- JSIP This is the Japanese Standard Import Price for pork. This variable is used as a proxy for the Japanese variable import tariff system. A more detailed explanation can be seen in appendix B.
Source: The meat Statistics in Japan, MOAF., (various issues).
- SPR, SUM are seasonal dummy variables included in the model to represent the following seasons respectively: Spring, Summer and FALL corresponding to the second, third and fourth quarter respectively.
- JPOP is the Japanese quarterly population estimate expressed in millions.
Source: Main Economic Indicators, O.E.C.D., Dept. of Economics and Statistics.
- D81/83 is a dummy variable accounting for unusually high levels of pork exports to Japan as a result of a ban on Danish pork imports. This dummy variable is defined as:
- $$\begin{aligned} D81/83 &= 1 \text{ for } 1981-1983 \\ &= 0 \text{ otherwise} \end{aligned}$$
- JMROW This is the amount of Japanese pork imports from countries other than Canada.
Source: The Meat Statistics in Japan, "Livestock Bureau, M.O.A.F.F." (various issues).

5.3 ESTIMATION PROCEDURE

The choice of a proper estimation technique for the pork econometric model depends on both the nature of the problem at hand and the objectives to be achieved. Since the major objective is to estimate the exchange rate elasticities of export and price, consistency of the estimates is of major importance.

Dhrymes⁶⁰ has pointed out that in any sectoral equilibrium model where a number of explanatory variables in one equation are themselves determined by other equations of the system, the ordinary least squares technique fails. Thus, application of the OLS technique in estimating excess supply and demand function as described by equations (5.1)-(5.6) is likely to generate biased and inconsistent estimates. As such, alternative techniques that yield at least consistent and possibly efficient estimates will be used.

Thompson,⁶¹ and Binkley and McKinzie⁶² have shown that Two Stage Least Squares (2SLS) technique generally yield better estimates than OLS in international commodity modelling. Originally developed by Theil (1953) 2SLS is applied to a single equation within a system and eliminates as much simultaneous equation bias as possible.⁶³ The regression is carried out in two stages.⁶⁴ In the first stage, each endogenous

⁶⁰ Dhrymes, P.J., Econometrics: Statistical Foundations and Applications, Harper and Row, Publishers Incorporated, New York, 1970.

⁶¹ *ibid.*

⁶² *ibid.*

⁶³ Koutsoyiannis, A., Theory of Econometrics, Macmillan Publishing Co., 1984, pp.384.

variable is regressed on all the exogenous variables of the system to obtain estimates of the endogenous variables. In the second stage, the estimated values of the endogenous variables included in the specific equation act as regressors in the estimation of the single equation of the system.

However, Binkley and McKinzie⁶⁵ have also pointed out that while simultaneous estimation method may yield biased estimates, a biased estimate with a small variance may often be preferred to one with less bias but with greater variance. With this in mind, the present analysis is extended to Three Stage Least Squares (3SLS) estimation technique, the estimates of which have the properties of being:

1. biased but consistent
2. More efficient than 2SLS since 3SLS use more information than 2SLS and therefore 3SLS estimates have smaller variances than their 2SLS counterparts.

3SLS was developed by Zellner and Theil⁶⁶ as an extension of Theil's 2SLS. 3SLS is a system method and is applied to all the equations of the model at the same time and give estimates of all the parameters simultaneously. It involves the application of the method of least squares in three successive stages. The first two stages are the same as 2SLS. The third stage involves the application of generalized least

⁶⁴ Kennedy, Peter, A Guide to Econometrics, MIT Press, Cambridge Mass., 1979, pp.114-116.

⁶⁵ *ibid*

⁶⁶ Zellner, A., and Theil, H., "Three-State Least, Squares: Simultaneous Estimation of Simultaneous Equations," Econometrica, vol.30, 1962, pp.54-78.

squares. The underlying assumptions of 3SLS are:⁶⁷

1. The random term of each equation is serially independent.
2. The random variables of the various relations of the system are contemporaneously dependent. If the random variables are independent, then 3SLS reduces to 2SLS.
3. The system is overidentified.

The application of the order and rank conditions⁶⁸ led to the conclusion that all relations of the model described by equation (5.1)-(5.6) are overidentified.

Hence, Two Stage Least Squares (2SLS) and Three Stage Least Squares (3SLS) regression techniques will be used to estimate the econometric model for the Canadian pork trade sector which is formulated as a system of simultaneous equations.

Further, because the main objective of this study is to estimate elasticities, each equation of the system and the system as a whole is estimated in the log-linear form. The log-linear model, also called the double log model is of the following general form:

Consider the following model:

$$(a) \quad Y_i = \beta_0 X_1^{\beta} e$$

which may be expressed alternatively as:

$$(b) \quad \ln Y_i = \ln \beta_0 + \beta_1 \ln X_1 + U_i$$

⁶⁷ Koutsoyiannis, pp.475.

⁶⁸ For a detailed explanation of the order and rank conditions for identification, the reader is referred to a. Koutsoyiannis pp.351-362, and b. Pindyck and Rubinfeld, pp.341-344.

Where $\ln$ =natural log. The above equation can be rewritten as:

$$(c) \quad \tilde{Y}_i = a + \beta_1 \tilde{X}_1 + U_i$$

where $a = \ln \beta_0$, $\tilde{Y}_i = \ln Y_i$ and $\tilde{X}_1 = \ln X_1$. This model is linear in the parameters a and β_1 and linear in the logarithms of the variables Y and X .

One attractive feature of the log-linear model of the type described by equation (c) above is that the slope coefficient β_1 measures the elasticity of Y with respect to X , i.e., the percentage change in Y for a given percentage change in X . Regarding the pork econometric model, the use of the log-linear model greatly simplifies the estimation process and subsequent analysis.

Although heteroscedasticity is not a major concern here, one added advantage of the log-linear model is that log transformation very often reduces heteroscedasticity. This is because log transformations compress the scales in which the variables are measured.⁶⁹

Finally, the use of lagged dependent variables as regressors in the price equation rules out the use of the Durbin-Watson statistics as a suitable test for autocorrelation. This is because the computed 'd' statistics in such models are generally asymptotically biased toward two, which is the value of 'd' expected in a truly random sequence.⁷⁰ Instead Durbin himself proposed a large sample test of first order serial correlation in autoregressive models. This is the h-test.

⁶⁹ Gujarati, Damodar., Basic Econometrics, McGraw Hill Book Company, New York, 1978, pp.210.

⁷⁰ *ibid* pp.269.

5.4 SUMMARY

This chapter has presented the structural form of the econometric model for the Canadian pork trade sector. The model is formulated as a system of simultaneous equations with export price, export supply and import demand as being endogenous. The endogenous and exogenous variables used in the model were briefly described followed by the sources of the data for each variable. After a brief discussion of the estimation procedure to be used, it was concluded that Two-Stage Least Squares and Three-Stage Least Squares are the appropriate techniques for the problem at hand.

Chapter VI

EMPIRICAL RESULTS

6.1 INTRODUCTION

The empirical analysis conducted in this study involves the estimation of the system of simultaneous equations described by equations (5.1)-(5.6) inclusive. Two techniques, the two stage least squares (2SLS) and the three stage least squares (3SLS), are utilized for estimation purpose. This chapter presents the estimated model using both of the above techniques and discusses the hypothesis concerning the exports and imports of Canadian pork. Based on the estimates for the pork trade model, inference will be made regarding the effects of changes in the exchange rates on the export supply and export price of Canadian pork.

6.2 DISCUSSION OF RESULTS

6.2.1 The Canadian Pork Export Price Equation

The estimated equation and related statistics for the Canadian pork export price equation (equation 5.1) are summarized in Table 6.1 and Table 6.5 respectively. Table 6.1 gives the 2SLS results while Table 6.5 gives the 3SLS results.

The empirical results show that the export price of pork in the previous quarter is directly related to the current export price level. Also confirming to a priori expectations is the inverse relationship of

the dependent variable to the stock variable (CSTK) and the production variable (CPROD). Both of these variables are also significant at the 5 percent level.

The statistically significant dummy variable for the second quarter representing 'summer' suggest that export prices tend to be higher during the summer quarter relative to the other quarters. The Durbin-h statistics indicated a statistically non-significant first order autocorrelation test. Further, the correlation matrix (Appendix C) indicated no severe multicollinearity.

TABLE 6.1

Canadian Pork Export Price Equation: 2SLS Results

Variable	Parameter Estimate	Standard Error	T-Ratio	Approx. Prob> T
Dependent Variable: PHOG				
Intercept	7.639	2.284	3.34	0.0016
LPHOG	0.635	0.094	6.76	0.0001
CSTK	-0.081	0.060	-1.35	0.1822
CPROD	-0.337	0.093	-3.61	0.0007
SPR	0.001	0.037	0.04	0.9676
SUM	0.102	0.038	2.67	0.0102
FALL	-0.023	0.037	-0.64	0.5225
Durbin-h Statistics=1.26			MSE = 0.00937	
R-Square = 0.8626			F-Ratio = 51.29	
N=60			DF = 49	

6.2.2 The Canadian Pork Export Supply Equation

The Canadian pork export supply equation performed reasonably well as all of the explanatory variables were of the expected sign. The export price variable which is of major importance here, has the expected sign and was statistically significant at the 5 percent level. The correlation matrix indicates no severe multicollinearity associated with this variable, (Appendix C). The Durbin-Watson statistics (1.50) indicate that the model is free of autocorrelation. Since the pork export supply equation was estimated in the log-linear form, the estimated coefficients also represent elasticity measures. Hence, the price elasticity of export supply for Canadian pork was estimated to be 1.35 (Table 6.2). This means that a one percent change in the export price of pork is likely to result in 1.35 percent change in the export supply of Canadian pork. Table 6.5 presents the 3SLS results and the price elasticity of export supply was estimated to be 1.43 with this alternative estimation technique.

The results also indicate that the 1983-1984 strike in the Canadian slaughtering and meat processing industry resulted in unusually high levels of exports during that year. This is explained by the fact that as a result of the strike, large number of hogs were moved to U.S. packing plants for slaughter.

TABLE 6.2

The Canadian Pork Export Supply Equation: 2SLS Results

Variable	Parameter Estimate	Standard Error	T-Ratio	Approx. Prob> T
Dependent Variable: CPX				
Intercept	-37.24	10.091	-3.69	0.0006
PHOG	1.35	0.293	4.62	0.0001
CSTK	0.180	0.148	1.21	0.2317
L4FEED	0.400	0.172	2.35	0.0229
CYD	-0.050	0.522	-0.09	0.9236
CPROD	2.590	0.253	10.25	0.0001
LPHOG	-0.540	0.263	-2.05	0.0465
D83/84	0.200	0.094	2.11	0.0406
SPR	0.190	0.086	2.21	0.0321
SUM	0.009	0.132	0.68	0.4993
FALL	-0.001	0.075	-0.02	0.9848
Durbin-Watson Statistics=1.50			MSE = 0.03230	
R-Square = 0.9318			F-Ratio = 61.47	
N=60			DF = 45	

6.2.3 The United States Import Demand Equation for Canadian Pork

The United States Import demand for Canadian pork performed reasonably well with an R-square of 0.898. The 3SLS results are summarized in Table 6.5. Since these estimates have smaller variances, statistical tests and subsequent economic analysis will therefore be based on the 3SLS estimates.

The Durbin-Watson statistic (1.41) indicates that the import demand equation is free from autocorrelation at the 1 percent level. Also, the correlation matrix does not indicate any severe multicollinearity⁷¹ (Appendix C).

As expected, the price of pork variable (PHOG) has a negative sign attached to it. This relates back to the derivation of the import demand curve in Chapter 4 where the quantity imported and price were found to be inversely related. The U.S. import demand for Canadian pork has an elasticity of 2.82 with respect to the import price. This implies that a one percent change in the price of Canadian pork is likely to result in a 2.82 (2.24 in the case of 2SLS) percent change in the import demand for pork by the United States.

Finally, the dummy variable (D75/76) was included to capture the effects of the 1975-1976 import quota on the U.S. imports of Canadian pork. As expected, this variable is inversely related to the dependent variable and is also statistically significant at the 5 percent level. This implies that the 1975-1976 import quota resulted in significantly

⁷¹ The U.S. feed grain price index (L4CORN) was dropped from the empirical model because this variable exhibited severe multicollinearity with the price of pork variable (PHOG).

low levels of U.S. pork imports from Canada over that period. Besides having the correct sign, both the price of beef variable and the population variable were statistically significant at the 5 percent level.

Imports from the rest of the world (USMROW) had the correct sign but was not statistically significant. The stock of pork, however, did not have the expected sign and therefore no inference may be drawn regarding its economic interpretation.

TABLE 6.3

The United States Pork Import Demand Equation: 2SLS Results

Variable	Parameter Estimate	Standard Error	T-Ratio	Approx. Prob> T
Dependent Variable: USPM				
Intercept	-138.55	53.90	-5.90	0.0001
PHOG	-2.24	0.975	-2.29	0.0266
LPHOG	1.23	0.570	2.12	0.3950
USTK	1.25	0.390	3.21	0.0025
USYD	-2.83	1.880	-1.51	0.1396
USPROD	-2.54	1.400	-1.81	0.0766
USPB	2.18	0.460	4.77	0.0001
USPOP	22.96	2.31	9.92	0.0001
D75/76	-0.67	0.19	-3.41	0.0014
USMROW	-3.7E-9	4.6E-9	0.82	0.4171
SPR	-0.20	0.14	-1.47	0.1493
SUM	-0.09	0.17	-0.59	0.5531
FALL	0.34	0.18	1.89	0.0658
Durbin-WATSON Statistics=1.41				
R-Square = 0.8984			MSE = 0.124	
N=60			F-Ratio = 31.69	
			DF = 43	

6.2.4 The Japanese Pork Import Demand Function

The results for the estimated Japanese pork import demand function (Equation 5.4) indicate a weak statistical relationship between the dependent and the explanatory variables (Table 6.4).⁷² The weakness of the statistical results may be due to the highly protective policy of the Japanese Government towards its pork industry. The Japanese Government has a complex variable tariff system in place designed to isolate its domestic market from external competition and most price variations in the international pork market are not reflected in the Japanese domestic pork market.

The variable that is of major interest in the Japanese import demand function is the price of pork. Although of the expected sign, this variable lacked statistical significance. The estimated price elasticity of import demand for pork was estimated to be 0.55. This indicates that a one percent change in the price of Canadian pork would result to only 0.55 percent change in the quantity of pork imported by Japan from Canada. The unresponsiveness of Japanese pork importers to the import price of pork is not surprising. Japan not only imports high quality pork from Canada but is also willing to pay a premium price in order to meet certain quality standard.⁷³ Hence, the quality of the product is actually more important than the price of the product.

⁷² The 3SLS results are summarized in Tables 6.5

⁷³ This is well documented by Hay and Lovatt in "Freight Rate Adjustment Implications for Canada's Pork Trade with Japan," Agriculture Canada Working Paper 7/84.

The Japanese wholesale price index for beef (JPB) was excluded from the empirical model because of the presence of multicollinearity. The choice of the variable (JPB) for deletion was based on the highest coefficient of correlation between this variable and the price of hog (PHOG) variable. As expected D81/83 has a positive sign and is also statistically significant at the 10 percent level.

The variable (JSIP) representing the Japanese standard import price is as a proxy for the complicated variable import tariff system. The standard import price is used as a basis to assess the tariff to be imposed on imported pork. Normally, a different tariff structure is applied on the difference between the SIP and the landed price of pork(Japan) depending on whether the landed price exceeds the SIP, or is less than or equal to the SIP (see Appendix B). One way of getting around the complexity of the tariff system in this study, the SIP was used as a proxy for the variable tariff system in Japan. The higher the SIP, the higher will be the expected volume of pork imports since a high SIP is designed to attract imports.⁷⁴ Hence, as expected the variable SIP is directly related to the dependent variable (JPM) and is also statistically significant at the 10 percent level.

Finally, imports from the rest of the world (JMROW) had the wrong sign and therefore no inference will be drawn regarding its economic interpretation.

⁷⁴ See details in Chapter 4.

TABLE 6.4

The Japanese Pork Import Demand Equation: 2SLS Results

Variable	Parameter Estimate	Standard Error	T-Ratio	Approx. Prob> T
Dependent Variable: JPM				
Intercept	47.49	219.33	0.22	0.8295
PHOG	0.03	0.740	0.04	0.9688
JYD	5.86	4.170	1.40	0.1672
JPOP	-11.42	18.820	-0.61	0.5470
JPROD	-1.86	0.980	-1.89	0.0657
JSIP	2.66	1.690	1.60	0.1230
D81/83	0.39	0.240	1.60	0.1200
JMROW	0.36	0.20	1.77	0.0828
SPR	0.45	0.25	1.80	0.0789
SUM	0.28	0.24	1.16	0.2504
FALL	0.37	0.27	1.36	0.1817
Durbin-Watson Statistics=1.69			MSE = 0.338	
R-Square = 0.5870			F-Ratio = 6.40	
N=60			DF = 45	

TABLE 6.5

Summary of The 3SLS Results for the Pork Trade Model.

The Canadian Pork Export Price Equation				
Variable	Parameter Estimate	Standard Error	T-Ratio	Approx. Prob> T
Dependent Variable: PHOG				
Intercept	8.487	2.220	3.82	0.0004
LPHOG	0.611	0.092	6.64	0.0001
CSTK	-0.097	0.059	-1.68	0.1016
CPROD	-0.367	0.092	-4.01	0.0002
SPR	0.003	0.037	0.07	0.9408
SUM	0.102	0.038	2.67	0.0107
FALL	-0.025	0.037	-0.67	0.5041

The Canadian Pork Export Supply Equation (3SLS Results)				
Variable	Parameter Estimate	Standard Error	T-Ratio	Approx. Prob> T
Dependent Variable: CPX				
Intercept	-36.86	9.868	-3.73	0.0005
PHOG	1.430	0.286	4.99	0.0001
CSTK	0.163	0.143	1.14	0.2601
L4FEED	0.400	0.167	2.39	0.0213
CYD	-0.050	0.509	-0.11	0.9116
CPROD	2.590	0.249	10.39	0.0001
LPHOG	-0.590	0.255	-2.35	0.0232
D83/84	0.213	0.091	2.32	0.0250
SPR	0.194	0.085	2.26	0.0283
SUM	0.084	0.130	0.65	0.5182
FALL	-0.001	0.075	-0.20	0.9851

Summary of The 3SLS Results For The Pork Trade Model(continued)

The United States Pork Import Demand Equation

Variable	Parameter Estimate	Standard Error	T-Ratio	Approx. Prob> T
Dependent Variable: USPM				
Intercept	-304.80	52.85	-5.76	0.0001
PHOG	-2.82	0.950	-2.96	0.0049
LPHOG	1.63	0.570	2.86	0.0065
USTK	2.21	0.384	3.18	0.0028
USYD	-2.65	1.840	-1.44	0.1568
USPROD	-2.54	1.36	1.86	0.0700
USPB	2.09	0.44	4.70	0.0001
USPOP	22.00	2.28	9.63	0.0001
D75/76	-0.63	0.19	-3.26	0.0022
USMROW	-3.4E-9	4.4E-9	-0.77	0.4430
SPR	-0.20	0.14	-0.44	0.1575
SUM	-0.02	0.16	-0.13	0.8983
FALL	0.32	0.18	1.82	0.0750

The Japanese Pork Import Demand Equation
(3SLS Results)

Variable	Parameter Estimate	Standard Error	T-Ratio	Approx. Prob> T
Dependent Variable: JPM				
Intercept	58.66	206.61	0.28	0.7778
PHOG	-0.34	0.700	-1.48	0.6372
JYD	6.10	3.940	1.55	0.1284
JPOP	-12.05	17.690	-0.68	0.4993
JPROD	-2.38	0.930	-2.56	0.0137
JSIP	3.49	1.600	2.18	0.0346
D81/83	0.29	0.230	1.27	0.2113
JMROW	0.24	0.19	1.28	0.2071
SPR	0.52	0.24	2.11	0.0401
SUM	0.36	0.23	1.53	0.1336
FALL	0.48	0.26	1.80	0.0782

The weighted MSE for the system is equal to 1.16 with 182 degrees of freedom. The weighted R-square for the system is equal to 0.8916. This is the R-square that corresponds to the approximate F-test on all non-intercept parameters in the system.

6.3 ECONOMIC ANALYSIS

The discussion in this section will focus on the implication of changes in the exchange rates on Canada's pork trade with the United States and Japan. Since the 3SLS estimates have small variances and are also more consistent, all subsequent analysis will be based on the 3SLS estimates.

Between 1970 and 1984, the Canadian dollar has devalued by as much as 27 percent against the U.S. dollar and by about 71 percent vis-à-vis the Japanese Yen. This means that the purchasing power of both the U.S. dollar and the Yen increased by 27% and 71% respectively relative to the Canadian dollar. In the present context, a devaluation of the Canadian dollar is expected to have resulted in an increase in the demand for Canadian pork by the U.S. and Japan. However, at the same time, pressure on the Canadian pork market is believed to have resulted in higher prices for pork in Canada.

The extent to which the volume of pork exports and the level of pork prices have increased following changes in the relative exchange rates are related to the nature and magnitude of the price elasticities of export and import for the trading regions considered.

In order to evaluate the impacts of a currency depreciation on the price of pork and on exports the following elasticity measures were derived.

1. the elasticity of excess supply with respect to the price of pork in terms of the exports currency (Ues).

2. The elasticity of excess demand with respect to the price of pork in terms of importer's currency (Ued).

The elasticity of excess supply with respect to the price of pork in terms of the exporter's currency is actually the coefficient attached to the price variable in the export supply equation. However, in order to calculate the price elasticity of excess demand in terms of the importer's currency, the coefficient of the price variable should first be multiplied by the exchange rate of the respective importing countries.⁷⁵ This technique relates back to the conceptual model developed in Chapter 4. Further, as suggested by Bjarnason et al., exchange rate indices will be used instead of the actual exchange rates. Hence, in converting the actual exchange rate into indices, 1971 was used as a base year (i.e., 1971=100).

Table 6.6 summarizes the short run price elasticity of export for Canadian pork and the price elasticity of import demand for both the United States and Japan.

⁷⁵ This technique has been suggested by Bjarnason et al. [1967] and Elliot [1972]

TABLE 6.6

Short Run Elasticities of Exports and Imports of Canadian Pork

	Price Elasticity of Exports of Canadian Pork(a)	Price Elasticity of Imports of Canadian Pork(b)
Canada	1.43	--
United States	--	-3.08
Japan	--	-0.46

Elasticities were estimated at means.

(a) expressed in terms of the exporter's currency.

(b) expressed in terms of the importer's currency.

6.3.1 Effects of Exchange Rate Changes on the Domestic Price of Pork in Canada.

As discussed before, it is expected that the Canadian dollar devaluation has resulted in an increase in the domestic price of pork. The mathematical expression measuring the percentage increase in the domestic price of pork due to one percent change in the exchange rate is:⁷⁶

$$|E_{p,r}| = \frac{-U_{ed}}{U_{ed} - U_{es}} \quad (4.18)$$

where:

$E_{p,r}$ is the exchange rate elasticity of price

U_{ed} is the elasticity of export supply w.r.t. the price of pork in the exporter's country.

⁷⁶ The reader should refer to Chapter 4 for the derivation of expression 4.17.

Ues is the elasticity of import demand w.r.t. the price of pork in terms of the importing country's currency.

Using the above expression (4.18), the percentage increase in the domestic price of pork as a result of changes in the Canadian-U.S. and Canadian - Japanese exchange rates were calculated. The estimates are summarized in Table 6.7.

The estimated exchange rate elasticities for the price of Canadian pork show that devaluations of the Canadian dollar resulted in an increase in the price of pork in Canada. However, the magnitude of these increases are rather small (Table 6.7). For instance, a one percent devaluation of the Canadian dollar vis-à-vis the U.S. dollar is likely to increase the domestic price of pork by 0.68 percent. Similarly, a one percent devaluation in the Canadian-Japanese exchange rate is likely to increase the Canadian price of pork by only 0.24 percent. Disregarding the magnitude of these increases, Canadian pork producers are believed to have gained from higher prices.

Hence between 1970 and 1984, pork prices in Canada have increased by at least 18 percent as a direct consequence of the 27 percent dollar devaluation relative to the U.S.dollar. Similarly, since the Yen devalued by about 71%, it can reasonably be inferred that as a result of such devaluation, pork prices in Canada increased by about 17 percent.

6.3.2 Effects of Exchange Rate Changes on Canadian Pork Exports

A devaluation of the Canadian dollar is expected to increase the exports of Canadian pork. The magnitude of increases in the exports of pork as a result of changes in the exchange rate can be estimated from the following expression for the exchange rate elasticity of export, derived in chapter 4:

$$|E_{q,r}| = \frac{U_{ed} \cdot U_{es}}{U_{es} - U_{ed}} \quad (4.21)$$

where:

$E_{q,r}$ is the absolute value of the exchange rate elasticity of export

and U_{es} and U_{ed} are defined as before.

Using expression 4.21, exchange rate elasticities of 0.98 and 0.35 were estimated for the exports of Canadian pork to the United States and Japan respectively (Table 6.7). These estimates indicate that a one percent devaluation of the Canadian dollar vis-à-vis the U.S. dollar would result in approximately a 0.98 percent increase in Canadian pork exports to the U.S. Similarly, exports of pork to Japan are likely to increase by 0.35 percent following a one percent devaluation of the Canadian dollar relative to the Japanese Yen.

In evaluating the impacts of a devaluation on the export supply of Canadian pork, it becomes obvious that pork exports did increase as a result of changes in the exchange rates between 1970 and 1984. However, the magnitudes of the increases in pork exports as a result of changes

in the exchange rates are estimated to be rather modest. Using the above estimates for the exchange rate elasticity of exports, it implies that, at most, exports to the U.S. and Japan increased by 26.5 percent and 25 percent respectively as a direct consequence of changes in the exchange rate.

Between 1970 and 1984 pork exports to U.S. increased by 2.5 million hundredweight. Exports to Japan increased by 576.4 thousand hundredweight. Further exports of live hogs to U.S increased by 1.3 million head. Using these changes and the computed elasticities, it can reasonably be inferred that as a direct result of the Canadian dollar depreciation, exports of pork to the U.S increased by 65.8 million pounds and exports to Japan increased by 14 million pounds over the last fifteen years. Exports of live hogs increased by about 336 thousand head over the same period of time as a direct result of the depreciation of the dollar. Hence the total impact of the currency depreciation on Canadian pork exports is roughly in the order of 80 million pounds for the last fifteen years.

TABLE 6.7

Exchange Rate Elasticity for the Price and Export of Canadian Pork

	Exchange Rate Elasticity of Price	Exchange Rate Elasticity of Exports
United States	0.68	0.98
Japan	0.24	0.35

The elasticities of price and exports were estimated at the mean and are in absolute values.

6.4 SUMMARY

In this chapter, the econometric model for the Canadian pork trade sector was estimated empirically. Both 2SLS and the 3SLS regression techniques were used and results reported. However, as the 3SLS estimates had smaller variance and were more consistent, statistical tests and subsequent analysis and inference were based on the 3SLS estimates.

Generally, the results show that exchange rate changes between 1970 and 1984 had a rather modest impact on pork trade. Pork exports to the U.S. and Japan are believed to have increased by about only 26.5 and 25 percent respectively as a direct consequence of exchange rate changes. Regarding the effects of exchange rate changes in pork prices, it was found that pork prices increased by approximately 18 percent as a direct consequence of fluctuations in the Canadian exchange rate relative to the U.S. dollar and the Japanese Yen.

Chapter VII

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 SUMMARY

Between 1970 and 1984, the value of the Canadian dollar has declined considerably relative to the U.S. dollar and the Japanese Yen. During the same period, the exports of pork to these two countries, which alone import about 95 percent of Canadian pork, have also increased considerably. Hence, it is widely believed that the expansion in pork exports over the last decade were a direct consequence of fluctuations in the exchange rate.

The general objective of this study was to analyze the effects that fluctuations in the Canadian exchange rates might have had on the domestic price of pork and consequently on the exports of pork. Specifically, the objectives were:

1. to review the trend in Canada's pork trade over the period 1970-1984.
2. to develop a conceptual model that relates fluctuations in the exchange rate to variations in pork prices and exports.
3. to empirically estimate the effects of changes in the Canadian exchange rates on the domestic price of pork and on the export supply of Canadian pork.

The first objective of this study was met in Chapter II. First, the structure of the Canadian pork sector was briefly described followed by an analysis of recent trends within this sector. The major conclusions of this chapter were that major changes have taken place within the hog industry over the last 15 years. It was also found out that the United States and Japan have confirmed their positions as being the two major international markets for Canadian pork.

The second objective of this study was met in Chapter III and Chapter IV respectively. Chapter III briefly reviewed the literature on exchange rate fluctuations as they relate to the agricultural sector in general and agricultural trade in particular. From the review of literature, it became obvious that although much work has been done in this area, there has been little consensus regarding the effects of exchange rate fluctuations on agricultural prices and trade. This is partly due to different modelling and estimation techniques.

Chapter IV developed a conceptual model for the Canadian pork trade sector. The exchange rate was incorporated explicitly into the trade model as it relates to trade flows and the domestic price level of pork. The trade model was first illustrated graphically followed by the derivation of mathematical expressions to show the effects of exchange rate fluctuations on prices and exports. In addition, algebraic expressions measuring the magnitude of such changes [elasticities] with respect to the domestic price of pork and the export supply of pork were derived.

The major conclusions of this chapter were that a devaluation of the Canadian dollar would indeed lead to an increase in the domestic price and the exports of Canadian pork.

The empirical section of this study is contained in Chapters V and VI. In Chapter V, the econometric model for estimating the effects of quarterly exchange rate changes on prices and exports was specified. Specifically, the behavioural equations were first described followed by a brief discussion of the hypothesized relationship of the explanatory variables to the dependent variables. The econometric model was specified as a system of simultaneous equations where the price of pork and the quantities exported and imported are treated endogenously. The estimation techniques [2SLS and 3SLS] for estimating the pork trade model were also described briefly followed by a summary of the data used in the model and their sources.

Chapter VI presents the empirical and statistical results. Both 2SLS and 3SLS results are reported. However, as 3SLS produced more efficient estimates the economic interpretation was based on the 3SLS estimates.

7.2 FINDINGS

The results for the Canadian pork export equation indicated that pork exports are sensitive to price changes. A price elasticity of exports of 1.43 was estimated. The results also confirmed that the 1983-1984 strike in the Canadian slaughtering and meat processing industry resulted in significantly higher levels of pork exports during that period.

The United States pork import demand function performed relatively well. As expected the price of pork was inversely related to the import demand for pork. The results also show that U.S. pork importers are very responsive to changes in the price of pork. The price elasticity of imports was estimated to be 2.82.

The Japanese pork import demand function performed rather poorly. First, the 2SLS estimates were not at all reliable as the price of pork (PHOG) and imports from the rest of the world (JMROW) did not have the expected sign. However, the 3SLS results showed a significant improvement. The price of pork (PHOG) had the correct sign but lacked statistical significance. Further, the Japanese standard import price was found to be directly related to import levels. This can be rationalized on the grounds that Japan imports primarily high quality pork and expensive cuts from Canada. However, the tariff system in Japan works in such a way that if the landed price (JAPAN) exceeds the SIP then a variable tariff is imposed on the difference between the SIP and the CIF price. Therefore, the incidence of tax decreases as the SIP increases. Hence, under such circumstances, an increase in the SIP would actually lead to higher imports from Canada.

Having estimated the pork trade model, the next step was to estimate the effects that the devaluation of the Canadian dollar has had on pork prices and pork exports. The results indicate that devaluations of the Canadian dollar relative to the U.S. dollar and the Yen had a positive impact on both the domestic price of pork and the exports of pork from Canada. However, such impacts were found to be generally moderate. Table 7.1 summarizes the estimated short run exchange rate elasticities of Canadian pork for both the U.S. and Japan and the resulting impact on Canadian pork exports.

TABLE 7.1

Summary of Results

	United States	Japan
Exchange Rate Elasticity of price	0.68	0.24
Exchange Rate Elasticity of Exports	0.98	0.35
Average Change in Exchange Rate (percent)	27	71
Change in Price of Pork as a direct result of Dollar Depreciation (percent)	18	17
Average Change in pork Exports (cwt) 1970-84.	2,489,500	567,360
Average Change in Exports of Live Hogs (No. head)	1,272,005	-
Change in Pork Exports as a Direct Result of Dollar depreciation	658,722	140,989
Change in Exports of Live hogs as a Direct Result of Dollar Depreciation	336,572	-

The results indicate that between 1970-1984, the devaluation of the Canadian dollar relative to the U.S. dollar resulted in 18 percent increase in the domestic price of pork. However, as a direct consequence of the 27 percent dollar devaluation between 1970 and 1984, exports to U.S. increased by approximately 26.5 percent or by 65.8 million pounds.

The devaluation of the dollar vis-à-vis to the Japanese Yen had a relatively smaller impact on Canadian pork prices and exports. The Can-

adian dollar devalued by approximately 71 percent vis-à-vis the Yen between 1970-1984. This led to a modest 17 percent increase in the price of pork in Canada and approximately 25 percent increase in exports of pork to Japan. In terms of volume this amounts to approximately 14 million pounds of pork. The total increase in pork exports as a direct result of the depreciation of the dollar was about 80 million pounds for the period 1970 to 1984.

7.3 CONCLUSION AND RECOMMENDATIONS

This study has investigated the effects of fluctuations in the exchange rates on the domestic price and the export supply of Canadian pork. The general conclusion is that the devaluation of the Canadian dollar relative to the U.S. dollar and the Yen between 1970-1984, resulted in a positive though moderate impact on both the domestic price and the exports of Canadian pork, ceteris paribus.

The findings of this study are interesting in that they challenge the conventional wisdom that the rapid increase in Canadian pork exports over the past decade were due to the depreciation of the Canadian dollar. The effects of the exchange rates on pork exports and on pork prices were estimated to be small. Between 1980 and 1984 alone pork exports almost doubled. Clearly there are other factors that are responsible for the rapid rise in pork exports.

It is believed that both provincial and federal income stabilization programs for hogs have had an important impact on hog production. As discussed earlier, by their very nature, such programs are believed to

have encouraged hog production in Canada and pork exports from Canada. It should therefore be interesting to evaluate the effects of the different income stabilization programs on both production, exports and the price of Canadian pork.

Further, it is also believed that between 1980-1984, there has been anticipation on the part of farmers about the implementation of a national supply management programs in the red meat sector. As a consequence, hog production increased considerably as existing producers increased their production capacity and new producers entered the industry. At the same time as a normal response to higher pork prices on the U.S. market, unusually large amounts of pork were being shipped to the U.S. between 1980 and 1984.

The limitations of any study are related to the set of assumptions underlying the conceptual model. This study is a partial equilibrium analysis. However, changes in the exchange rates are expected to induce changes throughout the whole economy thereby affecting the prices of most goods and services as well as the level of income. A Partial equilibrium model such as the one used in this study does not take into account the effects of fluctuations in the exchange rate on the rest of the economy. It is therefore suggested that future research analyzing the impact of exchange rate changes on agricultural trade should attempt to do so within a general equilibrium framework whereby the exchange rate variable is treated endogenously.

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Appendix A

RECENT DEVELOPMENTS IN THE CANADIAN-U.S. PORK TRADE RELATIONSHIP

On June 26, 1984, the United States International Trade Commission issued a notice for the institution of an investigation into the conditions of competition between the U.S. and Canadian live hog and pork product industries.⁷⁷ On November 2, 1984, the National Pork Producers Council (NPPC), an association of over 110,000 commercial hog producers in the U.S., filed a petition for the imposition of countervailing duties on the imports of Canadian live hogs and fresh, chilled and frozen products.⁷⁸ The petitioners allege that Canadian exports are only made possible by the various Canadian federal and provincial stabilization programs which they say constitute export subsidies for hogs and pork.⁷⁹

On November 15, 1984, a preliminary investigation regarding the imposition of countervailing duties on Canadian live swine and pork imports was instituted by the U.S. International Trade Commission. Canadian hog producers were represented by the Canadian Pork Council while the U.S. petitioners were represented by the National Pork Producers Council. After hearing the arguments from both parties, the U.S. Department of

⁷⁷ Canadian Pork Council, Submission of the CPC to the U.S. International Trade Commission, April 28, 1984.

⁷⁸ Canadian Pork Council, Post Conference Brief on behalf of the CPC, November 28, 1984.

⁷⁹ Brad Gilmour and Cliff Merritt, "Canadian Stabilization Initiatives and Their Effects on the Welfare of American Pork Producers," Commodity Market Analysis Division, Agriculture Canada, February 1985.

Commerce announced a temporary duty on Canadian pork and live swine entering the U.S. on March 26, 1985. Such a temporary duty was instituted to counteract government subsidy paid to Canadian hog producers. Effective April 3, 1985, Canadian live hogs and fresh and frozen pork were not allowed to enter the U.S. except under a bond deposit of 3.8 cents (Canadian) per pound for hogs and 5.3 cents (Canadian) per pound for fresh and frozen pork.⁸⁰ This tariff was supposed to be preliminary and temporary in nature until more concrete evidence is available as to whether Canadian stabilization programs do in fact constitute a subsidy to Canadian hog producers. Whether final countervailing duties will be imposed on Canadian hogs and pork and what will be the magnitude of such duties will be known in early July 1985 when the ITC is planning to have a final hearing on this matter. In the meantime, hog producers, pork processors and the public in general have expressed much interest on the Canadian-U.S. hog trade issue. Economists and policy analysts in particular have expressed their concern about the present situation in the industry and the possible future implications of any action taken by the United States on both the Canadian and the U.S. pork industry. A number of studies have been done in a relatively short period of time on the economic implications of policy changes that would alter the Canadian-U.S. pork trade relationship.

In a presentation to the ITC regarding Canadian pork imports into the U.S., Grimes⁸¹ attempted to estimate the full impact that Canadian exports have on the American market under three different scenarios. The

⁸⁰ Western Hog Journal, spring 1985.

⁸¹ G. Grimes, "Remarks Before the International Trade Commission Dealing With the Pork Industry," Cedar Rapids, Iowa, September 21, 1984.

first scenario assumes that U.S. pork supply is perfectly elastic. This implies that imports from Canada do not result in depressed U.S. prices but rather result in a reduction in U.S. supply. However, the Canadian Pork Council have noted that this is a rather unrealistic assumption and should not be taken too seriously.⁸²

The second scenario assumes that pork supply is totally unresponsive to prices. This implies that the major impact of Canadian imports is on the price level of pork in the U.S. In this case, Grimes estimates U.S. hog prices would have been higher by \$4.80/cwt live hog basis if there were no imports from Canada. While this case rests on more reasonable assumptions, still, the CPC argues, the results are relevant only to a very short run analysis.⁸³

The third scenario assumes that both the U.S. demand and supply elasticities are nonzero but he never makes the actual values explicit. However, the result is an estimated loss of some \$377 million for the U.S. pork producers during the January to July period of 1984. This is roughly equivalent to \$3.25/cwt for hogs produced in the U.S. The CPC contends that while the above analysis is still relevant to a very short-run situation, the analysis is based on rather unrealistic values of elasticity.

Interestingly enough, while the major debate is on the effects of Canadian stabilization programs on trade flows, Grimes only attempted to assess the full impact without attempting to demonstrate the effects

⁸² Canadian Pork Council, Post Conference Brief on behalf of the CPC, November 28, 1984.

⁸³ Ibid.

that Canadian stabilization initiatives have had on the American market. Also, Grimes used the period January to July 1984, a period considered to be exceptional because the major Canadian slaughter and processing industry establishments were on strike and unusually high levels of live hogs were moved to the U.S. for slaughter. Hence, there is really no solid proof as to whether stabilization programs in Canada have, in fact, injured the U.S. hog industry.

The second study that is worth noting is that by Martin.⁸⁴ In an attempt to test the hypothesis that Canadian production has been affected by stabilization payments between 1975 and 1984, the author argues that there is no statistical evidence of causality. Although limited evidence was found for the Manitoba and the Atlantic Provinces, it was estimated that even the highest payments made within the period under study could have resulted in a mere 0.13 percent increase in North American hog production during that quarter. By using the appropriate elasticity measures, such an increase would have lowered prices by 0.26 percent for that quarter.

In its submission to the ITC, the Canadian Pork Council emphasized that the increases in U.S. imports of Canadian hogs and pork are a normal response to a number of factors in the open North American pork market.⁸⁵ The CPC indicated that the recent increases might be explained by a number of factors other than the Canadian stabilization programs.

⁸⁴ Larry J. Martin, "Opportunities for Canadian Pork in Domestic and Export Markets," Paper presented at the Annual Meeting of the Manitoba Hog Producers Marketing Board, held in Winnipeg, Manitoba, April 17, 1985.

⁸⁵ Manitoba Hog Producers Marketing Board, "Hog Market News," No. 25, October 1984.

Among these are:

1. Canadian-U.S. exchange rate.
2. The ability of U.S. packers to outbid Canadian buyers for hogs.
3. Packing plant closures in the Canadian processing industry--especially in 1984.
4. The consistently good quality of high yielding Canadian hogs.
5. U.S. processing industry operating at less than full capacity.
6. Locational advantages of some northeastern U.S. markets to Canadian producers.

As far as stabilization programs are concerned, the CPC noted that out of the 25 years since the enactment of the Agricultural Stabilization Act (1958), payments have been made once in 1971 and only a few times over the last decade. It should also be noted that only hogs for local consumption are eligible under the current program and, therefore, payments were made net of exports. In addition, provincial payments are netted out of the federal payments and, therefore, are not supplementary to them.

Appendix B

THE JAPANESE PORK IMPORT SYSTEM: HOW IT WORKS.

1.1 Introduction.

Because of the gap between Japanese prices and those in the world market place, Japan must artificially adjust domestic supply in order to maintain hog production profitability while trying to minimize increases in retail prices.

The Ministry of Agriculture, Forestry and Fisheries (MOAFF) operates a price stabilization system for pork which is designed to encourage a high level of domestic production by the maintenance of prices within a specified range. An essential part of this program is the system of tariffs which are used to ensure that imported pork is not offered at prices which would disrupt the stabilization scheme.

1.2 The Domestic Stabilization Policy.

The principal features of the domestic stabilization system are the upper and lower stabilization prices which are established by the government and, in effect, constitute a market range for domestic pork.

During periods when prices fall below the lower limit, the Ministry may take action to buoy up the price by:

- a) financing the storage of pork by agricultural co-operatives .
- b) instructing the Livestock Industry Promotion Corporation (LIPCO) to purchase stocks of domestic pork and hold them in storage.

Stocks held under either arrangement may be released slowly to the trade when prices return to the specified market range. On the other hand, when prices exceed the upper limit, the system encourages importation of additional supplies by waiving the duty.

As of April 1, 1982, the upper stabilization price is Yen 780 per kilo for skinned carcass and Yen 725 per kilo for scalded carcass. The lower stabilization price is set at Yen 600 per kilo for skinned carcass and Yen 560 per kilo for scalded carcass.

1.3 Import System

The pork import system is based on the upper and lower stabilization prices for skinned carcasses(see above), plus a further designation known as the Standard Import Price (S.I.P) which is the average of these two stabilization prices. Under this system, the regular duty which is assessed on pork (currently 6.9% ad valorem, cif basis) may be increased or waived, depending on the unit value of imports relative to the three designated price levels. The following examples illustrate the working of the system when the objective is:

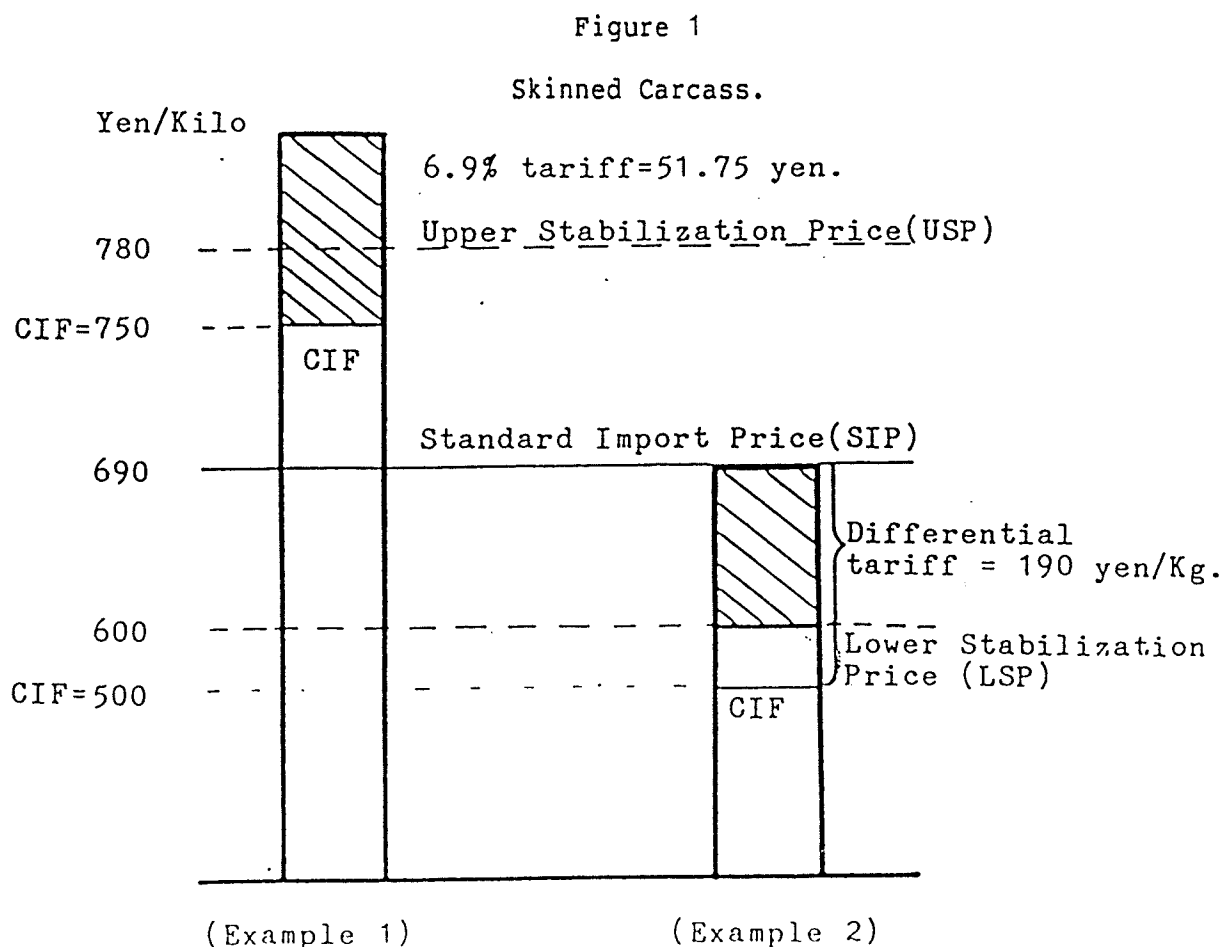
- a) to maintain price and
- b) to encourage imports.

In both instances, the current designated price levels of Yen690 as the Lower Stabilization Price, Yen780 for the Upper Stabilization Price and Yen690 for the Standard Import Price, are utilized.

A. To Maintain Standard Import Price.

1. Skinned Carcasses.

Example 1 of Figure 1 covers situation in which the CIF price of pork exceeds the Standard Import Price(Yen690). In this instance, with a landed cost of Yen 750 per kilo for skinned carcasses, the product is subjected to the regular tariff of 6.9% or Yen51.75 per kilo. In example 2, in which the CIF costs of pork at Yen500 per kilo is below the lower stabilization price, the product is subject to a differential tariff to bring the price up to the standard import price of Yen690 per kilo. Thus the differential tariff is Yen190 per kilo.



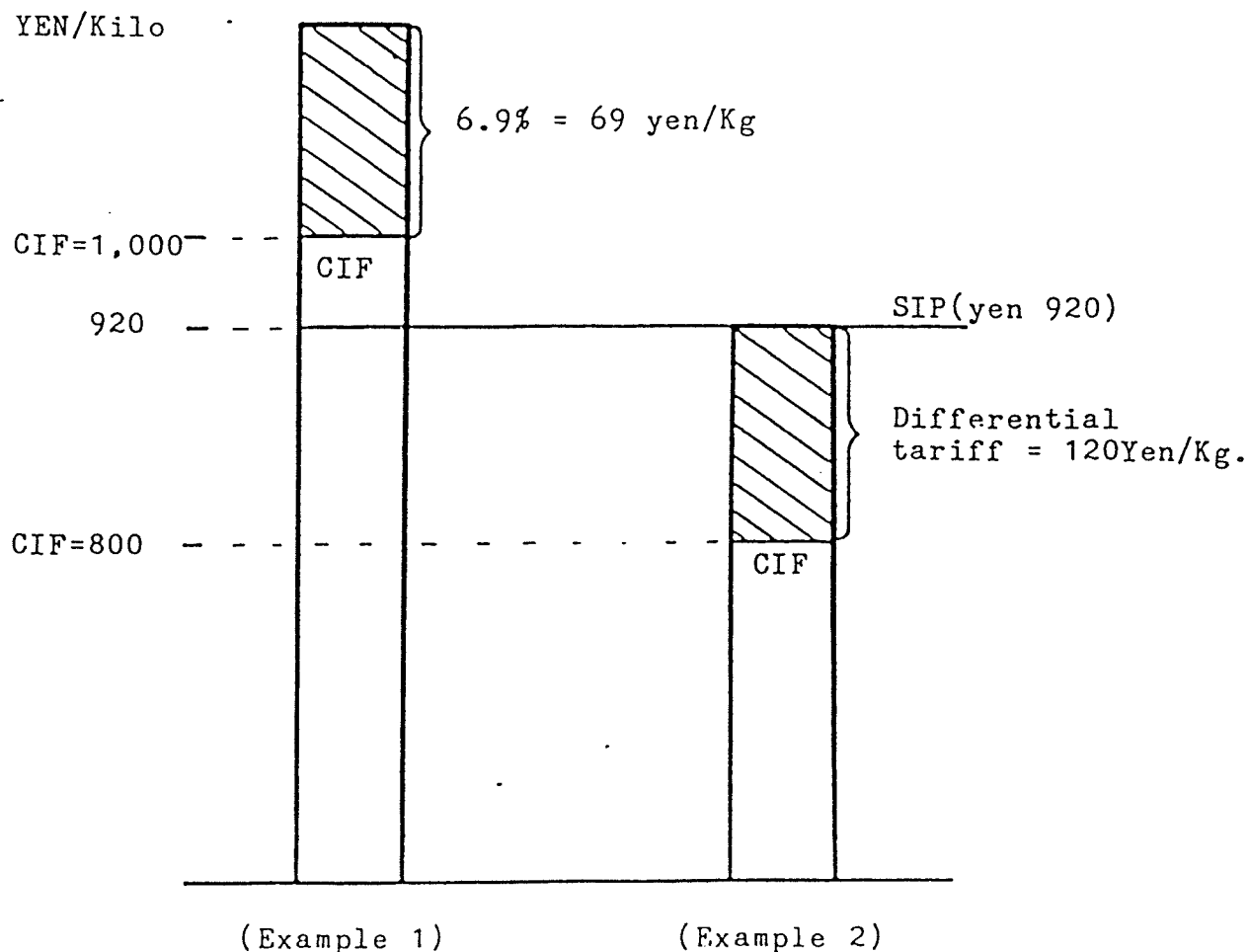
Source: Information supplied by the Canadian Embassy in Tokyo, Japan.

2. Pork Cuts.

The SIP for cut pork is calculated on an assumed yield of 75% of carcass pork; thus the current applicable SIP is Yen920 (Yen690-0.75). In example 1 (figure 2), where the CIF value is Yen1000 per kilo and above the SIP, a duty of 6.9% is imposed. In example 2 (figure 2) where the CIF value is Yen800 per kilo, a differential tariff (of Yen 120 per kilo) is imposed to bring the value up to SIP.

Figure 2

Pork Cuts



Note: It is apparent that the most desirable price at which pork can be imported is one at which the combination of CIF price plus duty equals the SIP. At this level, the amount of duty will be the lowest without incurring a differential tariff charge. At current tariff rates and S.I.P, this value is Yen860.62 (Yen920-1.069).

B. To Encourage Imports.

Under certain market conditions, the Government may wish to encourage imports and, to accomodate such action, provision is made for waiver of duties. When this occurs, a new element known as the proclaimed price is introduced for major cuts i.e. loin, shoulder, bellies, ham, tenderloin, trimmings as well as skinned and scalded carcass. This will occur under two conditions:

- a) when CIF value exceeds the proclaimed price(in which case all duty is waived.)
- b) when the CIF value plus duty exceeds the proclaimed price. Under these circumstances, the amount in excess of the proclaimed price is waived.

The following examples (figure 3), illustrate the duties which will apply under various circumstances when a proclaimed price is in effect. In these examples, the proclaimed price is assumed to be Yen 950/Kg for loin.

This set of examples pertains to pork cuts, in this instance loins. In example 1, the CIF value(Yen1000) exceeds the proclaimed price(Yen950) for loins and the duty is exempted. In example 2, the CIF value(Yen900) is below the proclaimed price and a 6.9% duty(Yen 62.1) is

applied to bring the value up to the proclaimed price; however, the duty in excess of the proclaimed price(Yen12.1) is waived.

In example 3, the CIF value of Yen850 per kilo is below the Standard Import Price and the full 6.9% tariff is applied. Example 4 is a situation in which the CIF value of Yen850/kilo is below the Yen920 kilo SIP. Application of the 6.9% tariff(Yen58.65) is inadequate to bring the value up to the Standard import price and under these circumstances, a differential tariff of Yen70 is applied.

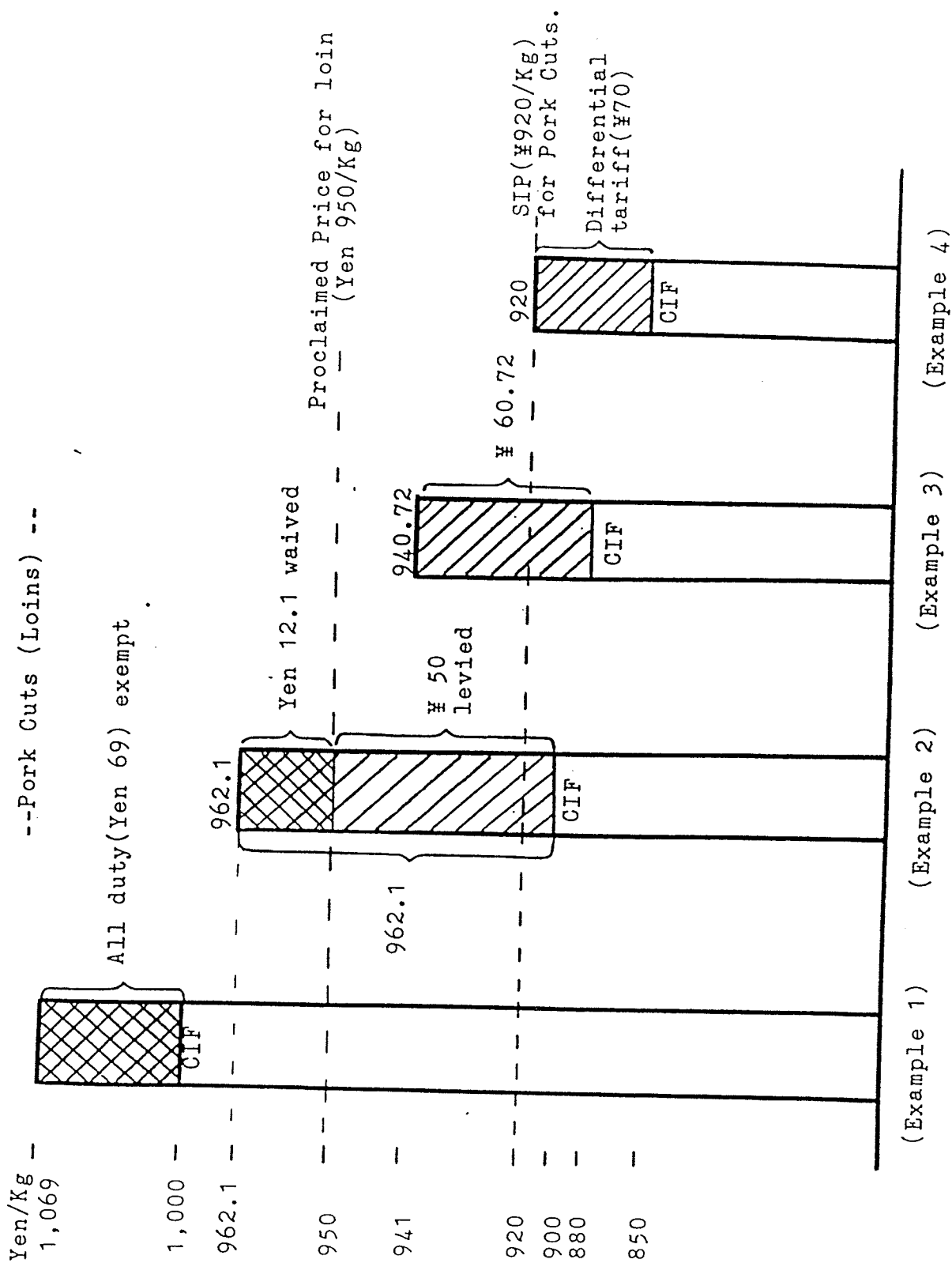
At the time of writing, the Japanese Government announced the reduction of tariffs on imported pork. As of April 1st 1985, the regular duty which is assessed on pork imports was reduced from 6.9% to 5% ad valorem, CIF basis. Hence, with the SIP at 920Yen/Kg, the most desirable price at which pork can be imported while keeping to a minimum the duty applicable, increases from Yen 860.1 ($920/1.069$) to Yen876.2 ($920/1.05$).

Sources:

The above information has been compiled from the following sources:

- (1) Correspondence material from the Canadian Embassy in Tokyo, Japan.
- (2) Hausamann, Arthur. "Japan's Pork Imports Head Downward as Domestic Supply Gains" Foreign Agriculture, July 1980.

Figure 3



Appendix C
CORRELATION MATRICES

TABLE C.1
Correlation Matrices

Export Price Equation: Correlation Matrix.

	LPHOG	CSTK	CPROD	SPR	SUM	FALL
LPHOG	1.00					
CSTK	-0.22	1.000				
CPROD	-0.75	0.005	1.00			
SPR	-0.02	0.220	0.02	1.00		
SUM	-0.10	0.272	-0.09	-0.33	1.00	
FALL	0.12	-0.346	0.03	-0.33	-0.33	1.00

The Canadian Pork Export Supply Equation

	PHOG	CSTK	L4FEED	CYD	CPROD	LPHOG	D83/84
PHOG	1.00						
CSTK	-0.14	1.00					
L4FEED	-0.32	-0.40	1.00				
CYD	-0.27	-0.06	0.86	1.00			
CPROD	-0.81	0.03	0.41	0.50	1.00		
LPHOG	0.81	-0.22	-0.28	-0.31	-0.76	1.00	
D83/84	0.47	0.28	-0.36	0.37	0.49	-0.47	1.00

The United States Pork Import Demand Equation

	PHOG	LPHOG	USTK	USYD	USPROD	USPB	USPOP	D75/76	USMROW
PHOG	1.00								
LPHOG	0.86	1.00							
USTK	-0.19	-0.46	1.00						
USYD	-0.14	-0.09	-0.02	1.00					
USPROD	-0.84	-0.64	0.01	0.12	1.00				
USPB	0.32	0.24	0.14	-0.35	-0.14	1.00			
USPOP	-0.53	-0.53	-0.01	0.71	0.04	-0.58	1.00		
D75/76	0.44	0.47	-0.08	-0.10	-0.54	-0.22	-0.19	1.00	
USMROW	0.43	0.42	-0.13	-0.20	-0.24	0.24	0.39	0.18	1.00

Japan's Pork Import Demand Equation: Correlation Matrix

	PHOG	JYD	JPOP	JPROD	JSIP	D81/83	JMROW
PHOG	1.00						
JYD	-0.35	1.00					
JPOP	-0.43	0.85	1.00				
JPROD	-0.50	0.83	0.91	1.00			
JSIP	-0.21	0.79	0.90	0.87	1.00		
D81/83	0.39	0.50	0.53	0.46	0.36	1.00	
JMROW	-0.03	0.78	0.75	0.65	0.69	0.35	1.00