IMPACTS OF U.S. COUNTERVAILING DUTIES ON THE CANADIAN HOG-PORK SECTOR: A POLICY SIMULATION APPROACH

by

© DHURVANAND CHADEE

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A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

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ABSTRACT

The United States represents the single most important market for Canadian live hogs and pork. In recent years, the exports of both of these products to the U.S. have increased reapidly. As a result, in 1985, the U.S. International Trade Commission used countervailing duties (CVD's) to control the imports of subsidized live hogs and pork from Canada. This study assesses the economic impacts of CVD's on the Canadian hog-pork economy to the year 1991.

The procedures followed include the specification and estimation of econometric models describing the dynamics of the hog-pork sectors. The models are specified on a regional basis and take explicit account of hog stabilization programs thereby directly addressing issues related to subsidies and CVD's. The estimated models are simulated over the 1986-1991 period under different assumptions about CVD's, the model's major policy variable. The various scenarios are compared to a base scenario to assess the economic impacts of CVD's.

The general results indicate that over the 1987-1991 perioe, CVD's of $4.39/cwt on live hogs result in annual gains of approximately $31 million to consumers and financial losses of about $73 million to hog producers. The net losses from CVD's on both live hogs and pork are evaluated to be roughly $77 million annually. Finally, a reduction of the CVD's on live hogs by 25 percent to $3.30/cwt results in positive but modest gains to hog producers.

The findings of this study show clearly that because Canada is so highly dependent on the U.S. market for its excess live hogs and pork, CVD actions by the U.S. can have important economic repercussion on the Canadian hog industry. Unfortunately, many questions remain unanswered regarding the definition of subsidies and the application of U.S. CVD legislation. It is hoped that under the Canada-U.S. Free Trade Agreement, the binational panel for the settlement of trade disputes will address these issues.

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TO

Prakash, Preeta and Amica

ABBREVIATIONS

Please note the following abbreviations.

CVD	:	Countervailing Duty
EC	:	European Community
GATT	:	General Agreement on Tariffs and Trade
MTN	:	Multilateral Trade Negotiations
NPPC	:	National Pork Producers Council
NTSP	:	National Tripartite Stabilization Program
TTA	:	Trade and Tariff Act, 1930
USDC	:	United States Department of Commerce
USITC	:	United States International Trade Commission
VER	:	Voluntary Export Restraint

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CHAPTER I

INTRODUCTION

International trade is of vital importance to the Canadian economy. In 1986 for instance, Canada exported $120 billion worth of goods. On average exports represent about 30 percent of the country's Gross National Product. While Canadian goods are generally exported to the entire world, the United States (US) remains by far the single most important market for Canadian exports. The data in Table 1.1 shows that on average between 1982 and 1987, 75 percent of Canada's exports went to the US. Besides the US, the other major destinations for Canadian exports include the European Community (EC) and Japan. Each of these regions takes an average of 5 percent of Canadian exports every year.

The proportion of Canadian exports to the US market has grown appreciably over the last decade. From Table 1.1 it can be seen that Canadian exports to the US increased from an annual 5-year average of 68 percent for the period 1977 to 1981 to about 75 percent for the period 1982 to 1986. The concentration and growth of Canadian exports in a single market can be explained by a number of factors. The most important ones are probably related to the closeness and easy access to a market which is approximately ten times the size of the Canadian economy. Historically and until recently, there has not been any major trade

Table 1.1

Canadian Merchandise and Agricultural Exports: 1977 to 1986

Year	Merchandise Exports			Agricultural Exports[a]		
	Total	To US	US as Percent of Total	Total	To US	US as Percent of Total
	(million $)		(percent)	(million $)		(percent)
Average						
77-81	64,910	43,834	68.0	3,684	1,836	50.0
1982	84,393	58,097	68.8	5,159	2,769	53.6
1983	90,556	66,388	73.3	5,085	2,973	58.5
1984	111,730	84,943	76.0	5,693	3,584	61.6
1985	119,566	94,013	78.6	5,924	3,793	64.0
1986	120,593	93,818	77.8	6,682	3,964	59.4
Average						
82-86	105,367	79,451	75.0	5,703	3,417	59.4

[a]Does not include the exports of wheat and other grains.

Source: Bank of Canada Review, Bank of Canada, September 1987.

conflicts between the two countries.[1] This is partly due to safeguards that exist under the General Agreement on Tariffs and Trade (GATT) to which both Canada and the US are signatories.[2] As a result, tariff levels have been reduced substantially between the two countries over the last 40 years (Greenaway, 1983).

However, since the early 1980's, world economic conditions have resulted in most industrial countries becoming much more protectionist minded than a decade earlier. The US, like many other industrial economies, adopted trade restrictive measures in order to protect its local industries. However, because of GATT safeguards, protectionism during the 1980's has been characterized much more by the use of non-tariff barriers (NTB's) as opposed to the conventional use of tariffs.

More recently, the US has made extensive use of countervailing duties (CVD's) as a means of restricting imports to that country. Although, strictly speaking, CVD's do represent a form of tariff barrier, they are still permissible under GATT when subsidized imports threaten the domestic industries in the importing country.

The number of CVD actions taken by the US against imports over the last few years have soared to record levels; about 252 cases between 1980-85 (Finger and Nogues, 1987). This trend represents major concerns for the Canadian economy in general and for Canadian agricultural exports in particular. The proportion of Canada's total agricultural exports to the US has increased from a five year average of 50 percent for the period 1977 to 1981 to about 60 percent for the period 1982 to 1986 (Table 1.1). Besides becoming increasingly dependent on the US market, Canadian agricultural exports seem to be particularly vulnerable to US CVD actions. This is so because of the integral role of the government in Canadian agriculture.

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[1] There have been instances when either government have restricted the imports of goods from the other on a temporary basis. Cases like these have usually been dealt with quickly by both parties.

[2] Both Canada and the US became signatories to the GATT in 1947.

Agricultural producers in Canada are known to benefit from a number of government programs. Under US trade laws, any such programs can be subject to CVD investigations by US authorities if the importation into the US, of products benefitting from government programs, is harmful to the US industry (Section 701(a) Tariff Act, 1930).

Recent trade disputes with the US have indicated that Canadian agricultural exports are indeed quite vulnerable to US CVD laws. The widespread application of CVD actions against agricultural imports from Canada has seriously threatened the continued unimpeded access of Canadian agricultural products to the US market. Table 1.2 summarizes the salient features of some of the recent agricultural exports that have been threatened by US protectionism between 1980-86. The information from Table 1.2 clearly indicates the magnitude and seriousness of the problem.

Hence, on one hand, the evidence shows that over the years Canada has become increasingly dependent upon the US market for her exports. At the same time, on the other hand, the US has become increasingly protectionist minded and, has used measures that have seriously threatened the free access of Canadian goods to that market. Therefore, an opportunity exists to analyze the implications of these new developments for the Canadian agricultural exports sector.

1.1. Statement of Problem

Over the last few years, the US has established itself as the most important importer of Canadian live hogs and pork. For example, about 70 percent of total Canadian pork exports went to the US for the period 1980-1984 compared to an average of only 32 percent for the period 1975-1979 (Carter and Chadee, 1986). By contrast, Canadian live hogs have always been exported almost exclusively to the United States.

Table 1.2

Canadian Agricultural Exports Threatened by US Protectionism 1983-1986

Product	Value of Exports 1986 Million C $	Type of Action	Date Instituted	Outcome
Softwood Lumber	3271	Legislative attempt to reduce imports from Canada	1985	Injury found and Canada agreed to impose export tax
Atlantic Fish	754	Countervail investigation	Aug. 1985	Duty imposed March 1986 5.82%
Fresh Ground Fish			Nov. 1984	No duty on pork[a]
Hogs and Pork	700	Countervail investigation		duty on hogs—4.39% June 1985
Softwood Shingles and Shakes	260	Escape clause investigation	1985	ITC ruled injury Feb. 1986
Sugar and Products	164	Quota imposed to protect US price support system	1984/1985	Quotas still in effect
Dried Salt Cod Fish	20-30	Anti-dumping investigation	July 1984	Duties imposed 16.3% and 20.75%
Raspberries	6-9	Anti-dumping and countervail investigation	Dec. 1984	Duties imposed 0.99% revoked January 1986
Sugar and Syrups	28.4	Anti-dumping	1980	Anti-dumping found
Canadian Softwood[b]	-	CVD	Oct. 1986	Injury found - Canada signed memorandum to impose 15% export tax as of January 1987

[a] In the preliminary ruling duties were imposed on both hogs and pork. Duties on pork were revoked in the final ruling.

[b] In 1983 an investigation on softwood product found no injury.

Source: 1. Rugman, Alan. "US Protectionism and Canadian Trade Policy", Journal of World Trade Law, 20(No. 4,July 1986).

Since the early 1980's, however, a new phenomenon developed in Canadian-US hog-pork trade: exports of both live hogs and pork increased rapidly over a relatively short period of time. The data in Table 1.3 shows the annual exports of live hogs and pork and the prices of index 100 hogs for the period 1980-1986. The number of live hogs exported to the US increased from a low of 143,830 head in 1981 to 1.3 million head in 1984; an increase of over 350 percent in just three years. Similarly, but to a lesser extent, the exports of pork to the US increased by about 75 percent between 1981 and 1984.

The unprecedented high levels of live hog and pork exports to the US raised serious concerns among hog producers in that country. Generally, hog producers in the US felt threatened by the high levels of imports of hogs and pork from Canada which they perceived as being only possible because hog producers in Canada were benefiting from government subsidies.

Responding to their concerns, the National Pork Producers Council (NPPC), an organization of US hog producers and packers, filed a petition with the International Trade Commission (ITC) in November 1984, regarding the imports of live hogs and pork from Canada. The petitioners alleged that:

> "producers and exporters of live hogs and fresh, frozen and chilled pork were receiving benefits which under Section 701 of the Tariff Act, 1930 constitute subsidies and that these imports materially injure or threaten material injury to a US industry"[3].

Following the petition, the US Department of Commerce (USDC) initiated a countervailing duty investigation under Section 705(b) of the Tariff Act, 1930 to determine whether there was material injury or threat of material injury to an

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[3] United States Department of Commerce Document C-122-404. "Final Affirmative Countervailing Duty Determination: Live Swine and Fresh, Chilled and Frozen Pork from Canada", 1985, p. 4.

Table 1.3

Canadian Live Hog and Pork Exports to the US: 1980 to 1986

Year (Quarter)	Live Hogs Exports (number of head)	% Change	Pork Exports	% Change	Hog Prices[a]	% Change
	(cwt)		($/cwt)			
1980	235,724	-	1,620,412	-	59.08	-
1981	143,830	-39.0	1,656,242	+2.2	70.01	+18.5
1982	302,454	+110.3	2,376,665	+43.5	83.32	+19.0
1983	453,938	+50.0	2,314,654	-2.6	70.75	-15.0
1984	1,343,470	+196.0	3,018,099	+30.4	72.65	+2.7
1985	1,148,467	-14.5	1,913,770	-36.6	68.51	-5.7
1986	498,080	-56.6	2,075,970	+8.5	81.37	+18.8

[a] Toronto Index 100 Hogs, Dressed.

Source:Agriculture Canada, "Livestock Market Review", various issues.

industry in the US. A series of investigation was then undertaken by the ITC into the competitiveness of the Canadian live hog and pork industry. As a result, in March 1985 a preliminary countervailing duty (CVD) was imposed on all Canadian live hog and pork entering the US. The amount of the net subsidy that the Canadian live hog and pork industry was benefiting from was calculated to be c$3.272/cwt dressed weight and c$2.602/cwt live weight.[4] Consequently, effective April 3, 1985, all Canadian live hogs and pork exported to the US were subject to a bonding rate of c$4.39/cwt and c$5.52/cwt respectively, awaiting the final determination for injury.

In its final determination in June 1985, the US Department of Commerce (USDC) ruled that the imports of subsidized live hogs from Canada were indeed causing material injury to the US hog industry. In order to offset the advantages available to Canadian hog producers in the form of subsidies and in an attempt to establish a more competitive environment in the North American hog sector, the USDC imposed a permanent CVD on Canadian live hogs entering the US. The CVD was maintained at c$4.39/cwt. At the same time, however, the temporary duty on fresh, chilled and frozen pork was removed. The reason for lifting the CVD on pork was that no sufficient evidence existed regarding the threat of material injury to the US pork sector as a result of increased imports of pork from Canada[5].

The impacts of the CVD on hogs were immediately felt in Canada mainly because the US represents the single most important market for both live hogs and pork. Figure 1.1 shows that the preliminary CVD on live hogs in March 1985

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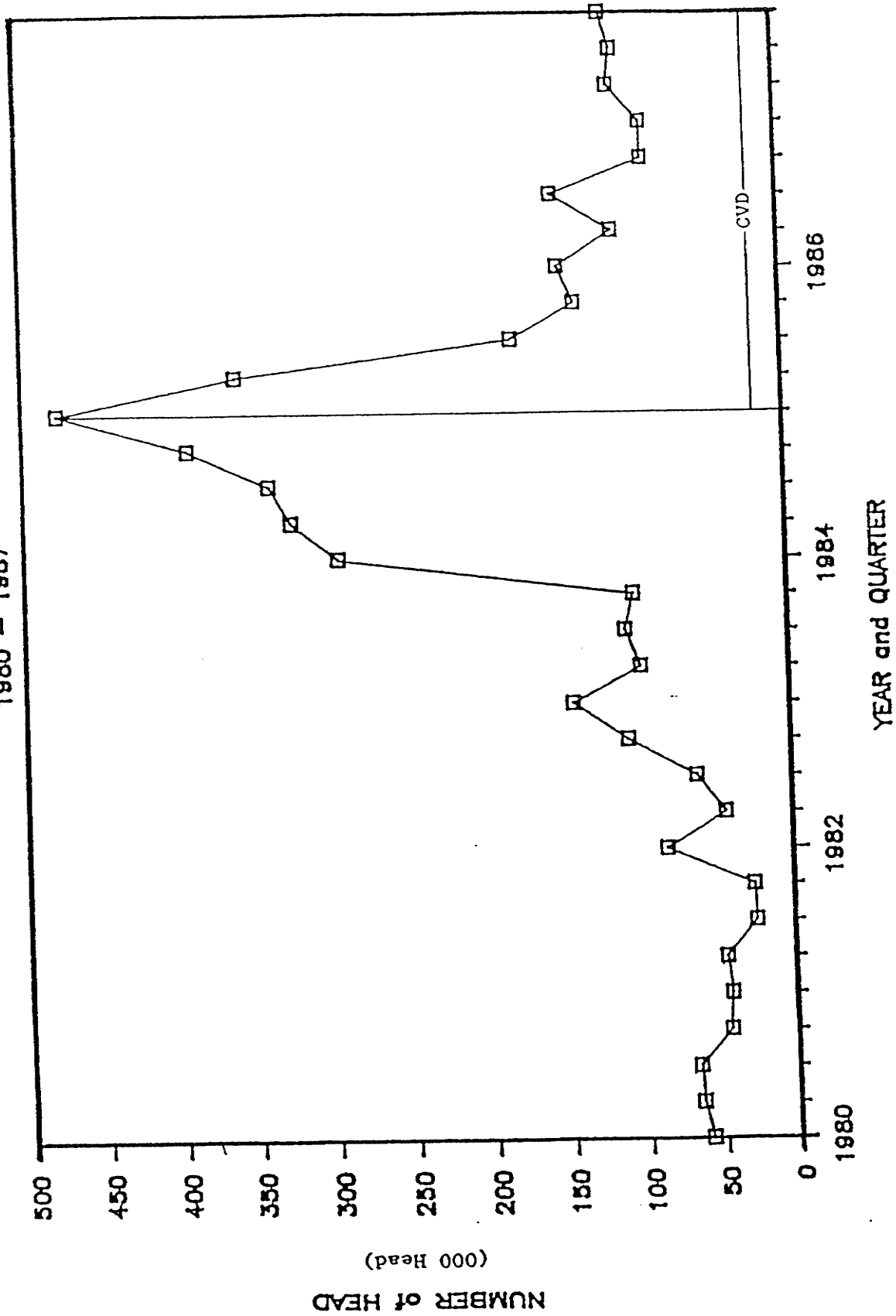
[4] The net subsidy was calculated for the fiscal year from April 1, 1983 to March 31, 1984. A summary of the provincial and federal programs included in calculating the subsidy is given in Appendix A.

[5] United States International Trade Commission Publication 1733. "Live Swine and Pork from Canada", July 1985, p. 1.

Figure 1.1 CANADIAN EXPORTS of LIVE HOGS to US

1980 – 1987



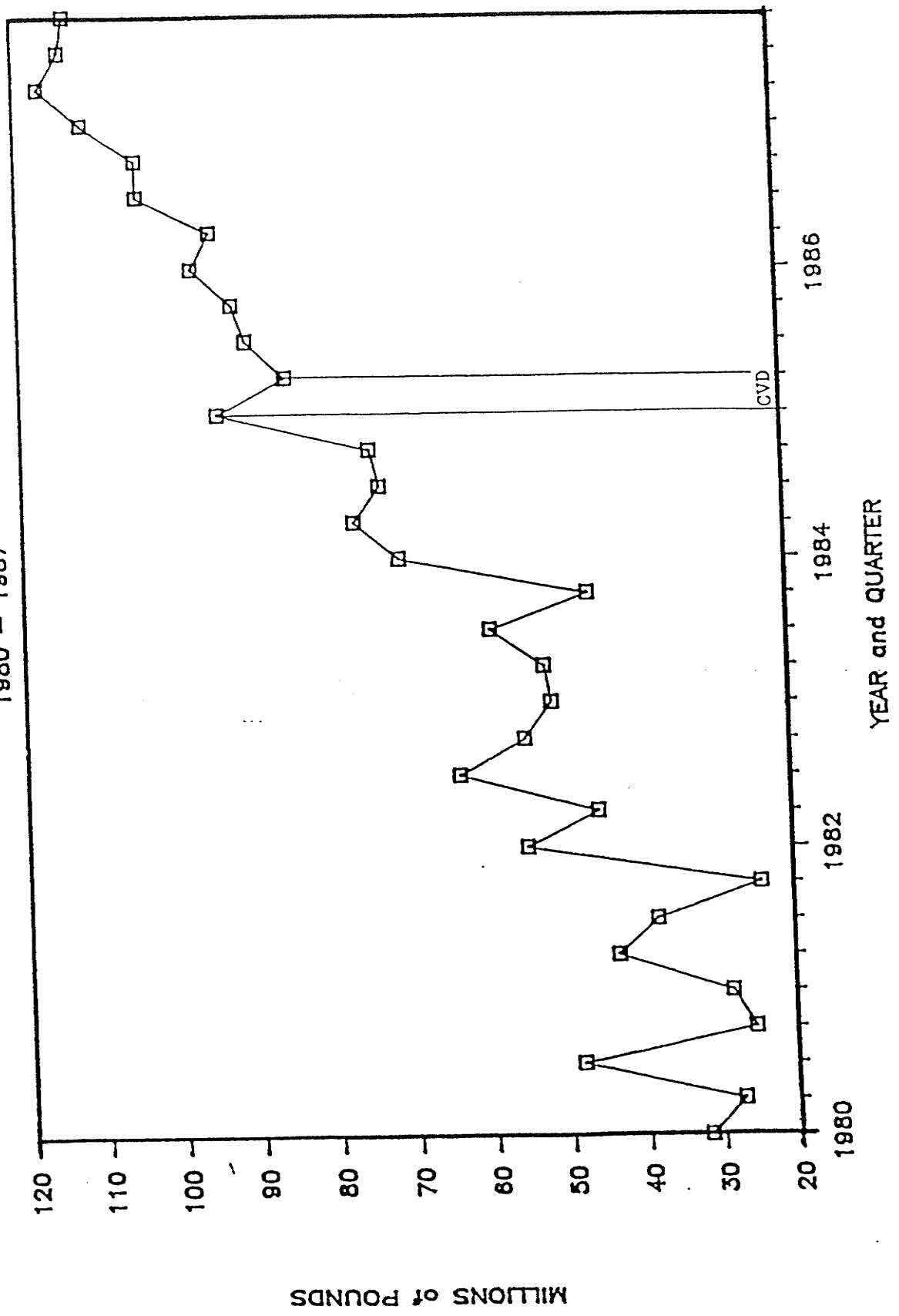

CANADIAN NET EXPORTS of PORK to US
1980 – 1987
CVD
MILLIONS of POUNDS
YEAR and QUARTER
120
110
100
90
80
70
60
50
40
30
20
1980
1982
1984
1986

Figure 1.2

resulted in the number of live hogs exported to the US declining significantly thereafter. Similarly, the preliminary CVD's on pork resulted in a significant drop in pork exports to the US in the second quarter of 1985 (Figure 1.2). However the lifting of the CVD's on pork in June 1985 resulted in the export volume of pork to almost double in the third quarter of 1985. By contrast, by making the CVD's on live hogs permanent, the number of live hogs exported to the US declined further in 1985. Overall, live hog exports in 1985 fell by about 15 percent compared to export levels in 1984 and in 1986 exports of live hogs to the US fell by another 57 percent compared to 1985 levels (Table 1.1).

The imposition of the temporary CVD's on pork resulted in lower volumes of pork exports; in 1985 pork exports fell by about 36 percent over 1984 export levels. However, in 1986 exports were up again and improved by about 9 percent over 1985 export levels (Table 1.1).

The effects of the CVD's on hog prices are less clear because quarterly prices can fluctuate as a result of a number of factors. However, one interesting phenomenon is that pork prices were generally lower in 1985 ($68.51/cwt) compared to the previous 5-year (1980-1984) average price of $71.16/cwt. (Table 1.1). Compared to 1984, the price of Index 100 hogs in Canada fell by about 6 percent in 1985. However, in 1986 the price of index 100 hogs increased by about 19 percent over 1985 prices. How much of these price fluctuations can be attributed to the CVD's is an empirical question which will be explicitly addressed in this study.

The above picture shows that the US CVD's had an immediate negative effect on the Canadian hog-pork sector. Export volumes of both live hogs and pork fell tremendously followed by lower market prices. Several studies[6] have estimated the

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[6] See for example (a) Charlebois and Cluff (1986), (b) Gilson and Saint-Louis (1986), and (c) Moschini and Meilke (1987).

losses to the Canadian hog-pork industry resulting from US countervailing duties to be very important.

However, from the time the US first imposed CVD's on Canadian live hogs in early 1985, several developments have taken place which have changed the environment within which the Canadian hog-pork sector operates. The implementation of the National Tripartite Stabilization Program is just one example. Given the recent developments, some changes with respect to the current US CVD's seem imminent. It should therefore be constructive to investigate the impacts of the various policy options which the industry might soon have to confront. To date, no comprehensive study has been undertaken that fully addresses these issues.

1.2. Objectives and General Procedures

The major objectives of this study are:

(1) to assess the possible economic effects of US CVD's on the Canadian live hog-pork sectors over the 1987 to 1990-91 period, and

(2) to draw the implications of US CVD policies for the Canadian hog-pork sector and to make recommendations regarding policy alternatives.

In order to fulfill these two objectives, the first step involves the estimation of the econometric models describing the Canadian hog-pork sector. Data for the period 1975 to 1985 (quarterly) are used wherever available. As such, the model takes into account the CVD's on live hogs and pork which came into effect early in 1985. In addition, the model also takes explicit account of all the provincial stabilization programs in existence during the 1975 to 1985 period. Once estimated, the hog-pork econometric models are then validated in order to assess how well they perform.

The next step involves defining the baseline scenario against which all subsequent experiments are compared. In this study the baseline scenario assumes:

(1) that the national tripartite stabilization program for hogs (NTSP) replaces all provincial and federal stabilization programs for hogs. This is accomplished by setting all endogenous and exogenous variables explaining provincial stabilization programs equal to zero as from the first quarter of 1986 for provinces that already participate in the program. For those provinces that were not participating in the national program by the first quarter of 1986, their hog programs are eliminated with no phasing out scheme. This is somewhat unrealistic but this assumption greatly simplifies the modeling and estimation procedures in this study; and (2) that the CVD's on live hogs ($439 cwt) prevail.

Having established the baseline scenario, the next step involves simulating the hog-pork model under various assumptions about the major policy variable; the US CVD's. The experiments conducted relate to potential trade policies that the US is likely to adopt regarding countervailing duties on Canadian live hogs and pork entering that country. The different scenarios considered are:

a. Free Trade in Live Hogs and Pork

   This scenario assesses the impact of removing the current CVD's on live hogs, i.e. live hogs and pork are allowed to enter the US freely while assuming that all provinces join the NTSP.

b. Revised CVD's on Live Hogs

   In this scenario it is assumed that Canada and the US come to a consensus through trade negotiations to reduce the current CVD's on live hogs by 25 percent. The impacts on the Canadian hog-pork industry are evaluated while assuming all provinces participate in the NTSP over the 1987 to 1990 period.

c. Extension of CVD's to Pork

   In this scenario it is assumed that concurrently with the CVD's on live hogs, the US imposes equivalent CVD's on pork imports from Canada. As before, the effects of such a rise in protectionism are evaluated under the assumption that all provinces join the NTSP.

For each of the above scenarios, the effects of the CVD's or their removal will be assessed on a selected number of endogenous variables. Examples include

pork and hog prices, production levels, export volumes, farm income, pork consumption and so on. Additionally, the gains and losses to both consumers and producers from each scenario will be evaluated based on the model's estimates.

The econometric model used for this study is adapted from the most recent version (1985) of Agriculture Canada's Food and Agriculture Regional Model (FARM). This model seems particularly suitable for the problem at hand because of its regional characteristics and also because of its ability to take full account of the different provincial stabilization programs thereby explicitly addressing issues related to subsidies and countervailing duties in the hog industry.

1.3. Scope and Organization of the Study

The major focus of this study will be on the effects of countervailing duties on the Canadian hog-pork sectors under the national tripartite program. As such, pork and live hogs are considered as two different but related products. To the extent that government programs for hogs differ among the provinces, this study treats hog production on a provincial basis. However, in the final analysis, the focus is on the east-west regional effects.

The rest of this study is contained in four chapters. The theory related to subsidies and countervailing duties are discussed in the next chapter. Chapter III presents the econometric hog-pork model together with a discussion of the estimated behavioural equations and their validation.

Model simulations and policy analyses are carried in Chapter IV. This chapter discusses the effects of alternative US policies with respect to CVD's on the dynamics of the Canadian hog-pork sector.

The summary and conclusions to this study are contained in the last chapter. The implications of US CVD's policies for the Canadian hog-pork sector are fully addressed followed by policy recommendations.

CHAPTER II

THEORETICAL CONSIDERATIONS AND THE CONCEPTUAL MODEL

2.1. Introduction

The use of countervailing duties [CVD's] as measures for restricting trade has spread only recently. As such, not much theoretical and empirical work has been done in this area and some confusion still prevails as to their exact economic meaning and their impacts. To the extent that countervailing duties are similar to per unit tariffs, one can abstract from the theory of tariffs to better comprehend the economics of CVD's.

The purpose of this chapter is to discuss some of the theoretical issues underlying the use of subsidies and countervailing duties as trade restrictive measures. The next section will discuss the theory of the gains from trade. Section three looks at subsidies and analyses their impacts on trade. Section four discusses the economic effects of countervailing duties followed by a brief illustration of a mathematical model that can capture this effect. A review of recent empirical studies on the effects of trade protection measures related to agricultural exports are presented in Section six followed by the summary to this chapter in the last section.

2.2. The Case for Trade Liberalization

As early as the 18th century, the notion that there are gains to be made from trade was advanced by Adam Smith (1776) in the Wealth of Nations.[7] During

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[7] Smith, Adam (1776) The Wealth of Nations, (London, Dent Edition 1975).

the early 19th century this idea gained popularity with Ricardo's[8] concept of "comparative advantage". He showed that by trading with each other, different regions can only gain by doing so.

However, the great depression of the 1930's and the economic difficulties experienced by most countries during World War II, made many countries highly protectionist minded. The use of tariffs became so prevalent that in 1947 a group of industrial economies formed the GATT[9] in order to regulate international trade. One of the major objectives of signatories to the General Agreement was to liberalize trade through the gradual elimination of tariffs through different rounds of Multilateral Trade Negotiations.

The Kennedy Round of negotiations (1964-67) marked a cornerstone in the process of trade liberalization under the GATT. Substantial tariff reductions among the major industrial countries were achieved. However, the tariff reductions affected mostly the manufacturing sector thereby still leaving agriculture as a highly protected sector. The tariff reductions of the Kennedy Round prompted many studies on the economic impacts of trade liberalization.

The rationale for trade liberalization under the GATT is based on the general notion that freer trade necessarily results in welfare gains. The negative economic impacts of a tariff can be shown using the conventional indifference curve and production possibility curve approach.

Figure 2.1 illustrates the example of a small open economy which produces and consumes two goods, X and Y. X'Y' represents the production possibility frontier and Pw represents the free trade relative world prices. Hence the profit

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[8] Ricardo, David, "On the Principles of Political Economy and Taxation", Works and Correspondences, ed. Piero Sraffa, Cambridge University Press 1(1951):133-49.

[9] The General Agreement on Tariffs and Trade came into existence in 1947.

maximizing producer producers at Po. Given society's indifference curve CC, consumption takes place at Co. This leaves the country under consideration to export Y and import X. The trade triangle is represented by $P_0A_0C_0$.

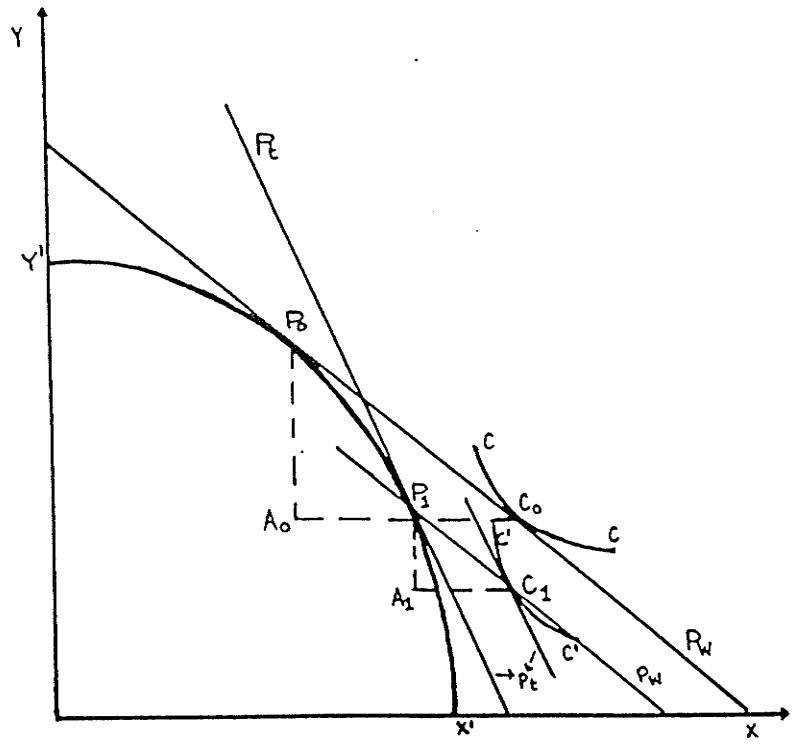
Assume now that this country decides to impose a tariff on imports. The result is that imported goods become more expensive than domestically produced ones. For the domestic producers and consumers, the world price ratio is not valid any more. The new tariff distorted prices will result in a steeper domestic price line represented by Pt. At this price, production takes place at P_1 where the marginal costs of producing the two goods are in line with the new price line. Some resources will be shifted out of the production of exportable into the production of importables.

Regarding the utility maximizing consumer, some substitution will occur between the more expensive imports and the relatively cheaper domestically produced goods. Consumers are now faced with the domestic price line because of the tariff and consumption takes place at C_1 where the ratio of the marginal utilities of the two goods are equal to the ratio of the prices of the two goods (i.e. $MU_x/MU_y = P_x/P_y$). Consuming at C_1 obviously puts the consumer on a lower indifference curve C'C'. The new trade triangle is $P_1A_1C_1$.

A comparison of the pre-tariff situation with the post-tariff case clearly shows that the volume of trade has shrunk and this implyies a welfare loss. By the same analogy, if one starts with an initial situation where there is a tariff on imports and then proceed to liberalize trade by removing the tariff, the volume of trade expands from the trade triangle $P_1A_1C_1$ to $P_0A_0C_0$. In addition, the

Figure 2.1

Impact of a Tariff in the Small Country Case



consumer moves to a higher indifference curve, implying greater welfare. Hence, using this framework, it is shown that tariffs have a welfare cost. Although the exact measurement of such costs are difficult to derive using this framework, it does help to portray the general implications of policies that are trade restrictive in nature.

Many distortions exist that can potentially disturb the ideal situation where there is free trade between different countries and welfare is at its optimal level. Examples of policies that can have a distortionary effect on trade include the imposition of tariffs, quotas, export and import duties, the provision of subsidies and the existence of non-tariff barriers. The focus of this study will be on two of

the above policies; namely subsidies and countervailing duties (or import tax). These are the subject of the next sections.

2.3. Subsidies

Subsidies very often represent an integral part of the domestic economic policies of most industrial countries. Given of its vulnerability to weather conditions and other natural hazards, the agricultural sector in most countries is assisted by domestic government policies. One common form of assistance afforded to the agricultural sector is through the provision of subsidies. A subsidy can be defined as any form of financial assistance or support provided by the government of a country to producers as a means of increasing the market competitiveness of the product benefiting from the subsidy.

The two most common types of subsidies generally available to producers and exporters of agricultural products are: (1) production subsidies and (2) export subsidies. For the purpose of the present analysis, a production subsidy is defined as a measurable economic advantage afforded to an enterprise by or at the discretion of a government, without adequate recompense, and in a way which discriminates against other enterprises or economic activities in the same country (McGovern, 1986).

An export subsidy, however, is any government assistance provided to exporters in order to enhance exports.[10] The major difference between the two types of subsidies is that production subsidies generally apply to every single unit

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[10] This definition is adopted only for the purpose of this study. However, it is recognized that there exists no comprehensive definition of what constitutes a subsidy in international trade literature. This area in itself is quite broad and is beyond the scope of this study. The definitional problem has been circumvented by GATT to some extent through the establishment of an illustrative list of export subsidies in 1979. For the analytical part of this paper the assumption that production subsidies apply to all units of production, whether sold domestically or abroad, will be maintained.

being produced whereas export subsidies apply only to the units of the products that are destined for exports. The economic effects of each type of subsidy are analyzed below.

2.3.1. Production Subsidies

The effects of production subsidies are analyzed using the static partial equilibrium model shown in Figure 2.2. This example illustrates the case of a country that attempts to use production subsidies to increase domestic production levels in order to reduce its dependence on imports. The demand and supply functions are shown as D_d and S_d. At the world prices P_w, quantity demanded is OM_2 whereas domestic production is only OM_1. Therefore quantity M_1M_2 has to be imported to meet domestic demand.

Suppose now that this country decides to reduce its dependence on imports by giving incentive to local producers to increase their output. One way of achieving this would be through subsidy programs. Subsidizing domestic production, through a production subsidy program will result in shifting the domestic supply curve to the right; indicating that at each price level more will now be supplied as a result of the incentive provided by the subsidy. The position of the new supply curve is shown by S_d^s. The magnitude of the subsidy will dictate the extent of the shift.[11]

The economic effects of subsidization are easily derived. Consumers still face the world price P_w while producers now receive P_s, the subsidized price. Given the

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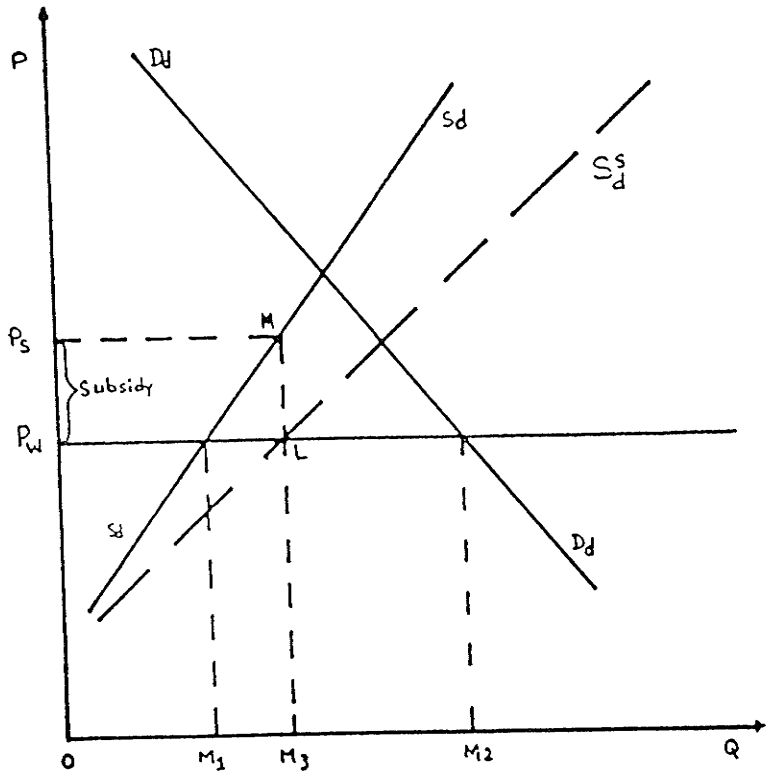
[11] Note that a unit subsidy will result in a parallel shift of the supply curve to the right by the amount of the subsidy while a subsidy provided as a percentage of the gross value of the exported product results in a rotation of the supply curve to the right.

Figure 2.2

Economic Effects of Production Subsidies



world price, the demand condition and the new supply curve, the new level of imports can be determined in a straight forward fashion. Domestic production increases to OM_3 by M_1M_3. Therefore import levels drop from M_1M_2 to M_3M_2. The amount of the subsidy is just the difference between the world price P_W and the subsidized price P_S. The total amount of subsidy payments is represented by the unit subsidy cost multiplied by the total production level. This is represented by the area P_WLMP_S and is financed by the domestic treasury.

A final note relates to the consumer. Since the domestic consumer still faces the world price P_W, there is no change in consumer surplus. However, in the final count because the subsidy program is financed out of taxes, domestic taxpayers end up subsidizing domestic producers.

Before concluding the discussion on production subsidies it should be noted that as an extreme case, it can be shown that production subsidies can be used effectively to turn an importer of agricultural products into a net exporter. This is an important case since it explains the mechanisms through which some countries have switched from being importers of agricultural products in the 1960's to net exporters in the 1980's.[12]

Consider the simple case illustrated in Figure 2.3. At the world price P_w, this country imports quantity M_1M_2 given the original domestic demand and supply conditions Dd and Sd respectively. However, a production subsidy high enough to shift the supply curve to a position like S_d^s is likely to turn this country into an exporter. The amount of the production subsidy here is given by P_wP_s. Consumers still face price P_w but producers receive P_s. Production increases from OM_1 to OM_3 while consumption is still at OM_2. Hence the surplus production M_2M_3 has to be exported.

One interesting point here relates to the total cost of the subsidy program. As before, this is equal to the total number of units produced times the unit subsidy cost. From Figure 2.3 this is represented by area P_sP_wLM. However, of the quantity OM_3 produced, only OM_2 is consumed domestically and M_2M_3 is exported. Therefore an interesting question that arises is whether in such a case, a production subsidy also constitute an export subsidy? It is clear from Figure 2.3 that domestic taxpayers, via the treasury, end up subsidizing not only domestic producers, but also, to a certain extent, consumers in the importing country. The amount of subsidy transfer from consumers in the exporting country to foreign consumers is represented by the area KLMN.

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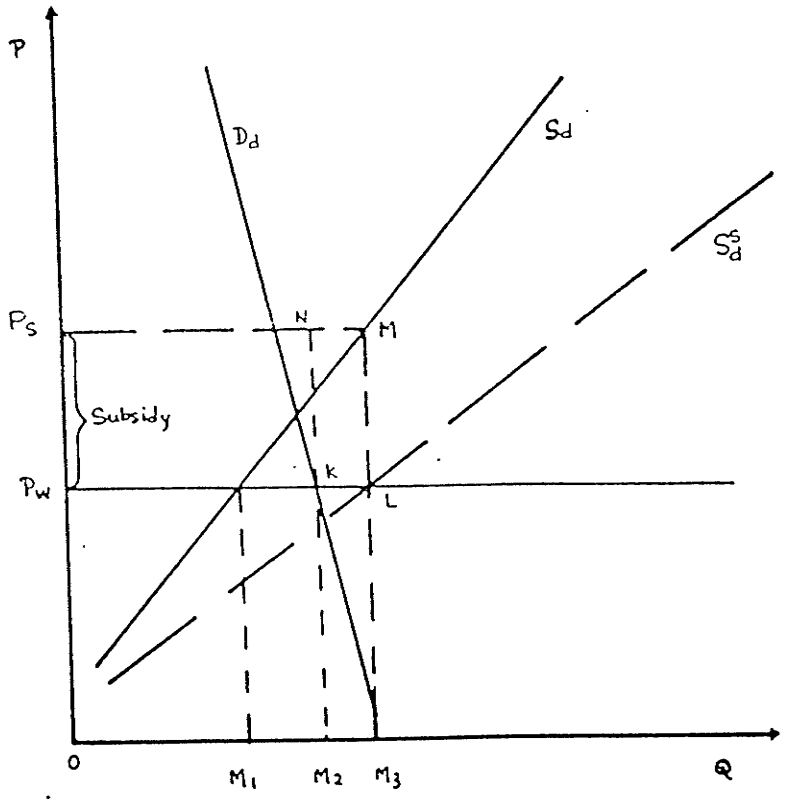
12 The provision of input (production) subsidies to the agricultural sector is most common in developing countries where the authorities subsidise exports like fertilizer, seed, etc.

Figure 2.3

Illustration of Production Subsidies to Increase Exports



2.3.2. Export Subsidies

Export subsidies are used to encourage the exports of goods which in the absence of such subsidies, would be unable to compete on the world market under free market conditions. In this sense, export subsidies are distortional. The economic implications of using subsidies to promote exports can be analyzed within the conventional static partial equilibrium framework shown in Figure 2.4.

Under free market conditions, the domestic demand and supply curves are shown as D_d and S_d respectively. At the prevailing price OP_1, quantity OX_1 is demanded and quantity OX_2 is produced; leaving the excess supply x_1x_2 for exports.

Suppose now that the domestic government decides to increase the volume of exports for some reason.[13] This can be achieved by providing export subsidies to exporters. If, for example, an export subsidy of "S" percent is provided to exporters, the result will be a rotation of the domestic supply curve to the right by the magnitude of the subsidy (see Figure 2.4). The position of the new supply curve is shown by S_d^s. At the prevailing domestic price OP_1 the volume of exports increases from X_1X_2 to X_1X_3. However, because the export price P_2 is higher than the domestic price P_1, (i.e. $P_2=P_1(1+S)$ and $S>O$ it implies that $P_2>P_1$), there is no incentive for producers to sell at all on the domestic market and receive the price P_1. However, pressure on the domestic market will force prices up by the amount of the subsidy such that part of domestic production will still be available for domestic consumption. At the new domestic price OP_2, consumption falls to OX_4 and production is at OX_3. The final export level is increased to X_4X_3 compared to the pre-subsidy price level of X_1X_2.

To summarize, therefore, an export subsidy increases exports but this is achieved only at certain costs. The domestic price level is increased above the world price. Domestic consumers now pay more and consume less. Finally, the net revenue loss as a result of an export subsidy is represented by area KLMN. Domestic taxpayers end up subsidizing consumers in the importing country by that amount.

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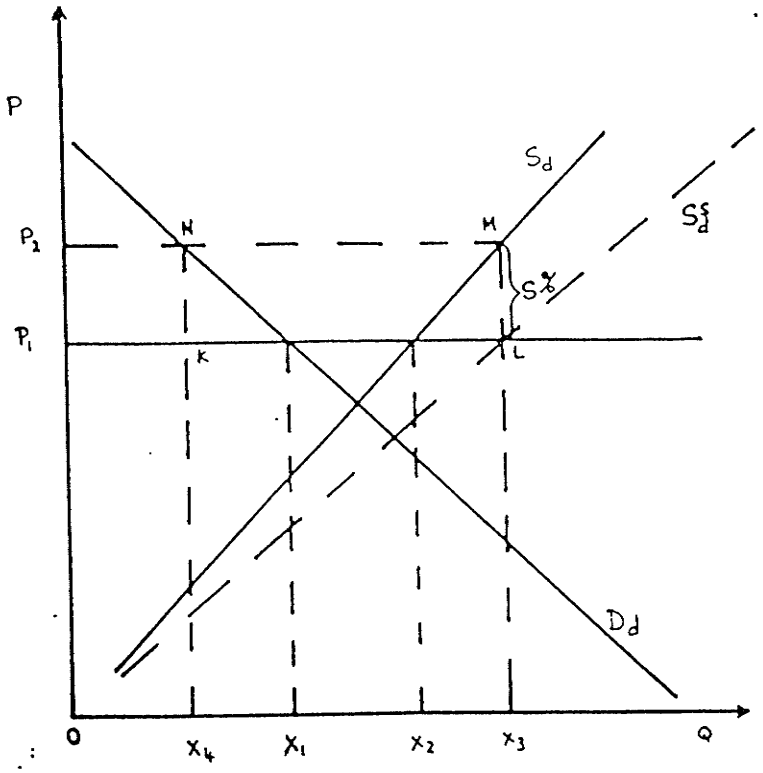
[13] A country can decide to increase its volume of exports deliberately for several reasons. The most common ones, however are: (a) to establish oneself as a major exporter of a given product, (b) to increase its world market share, (c) to generate foreign exchange, and (d) to foster the development of domestic industries.

Figure 2.4

Effects of Export Subsidies on an Exporter



Paarlberg (1984) argues that export subsidies may be used as an optimal policy tool when the objective is to increase producer's welfare more than consumer's welfare. This can be achieved by assigning higher weights to the producers objective function. However, both Orden (1985) and Gardner (1985) refute this argument and maintain that export subsidies are still irrational. Accordingly, producers, consumers and taxpayers are all worse off with an export subsidy than under other appropriate alternative policies. Gardner (1985) argues that more can be transferred to producers by using other domestic distortions than by using export subsidies.

Yeh (1986) has shown that for both the case of the small and the large country, a production subsidy appears to be better than an export subsidy from a welfare viewpoint. Both production and export subsidies would impose a production cost on the exporter, but an export subsidy would in addition impose a consumption cost on the country (Yeh p. 71). Therefore, a country wishing to expand its exports is better off to use a production subsidy rather than an export subsidy.

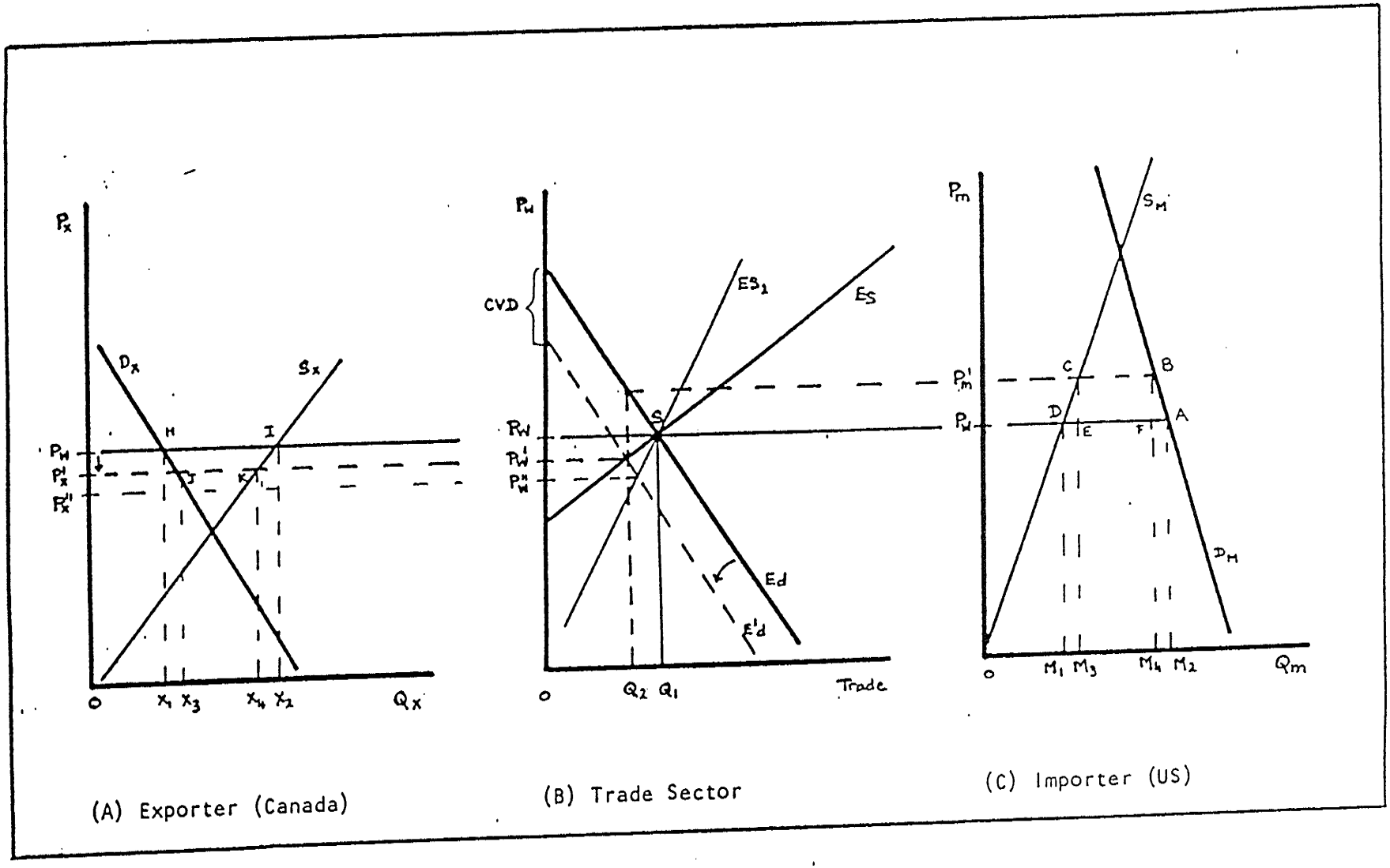
2.4. Countervailing Duties (CVD's)

Countervailing duties are used by importing countries as means of offsetting the competitive advantages of subsidised imports. CVD's are imposed by the governments of the importing countries. The amount of the duty usually depends on the amount of the subsidy and generally the duty does not exceed the amount of the subsidy. The imposition of countervailing duties by an importing country has serious implications for the domestic markets of both the importer and the exporter. In order to analyze the economic impacts of countervailing duties, a two-country one-commodity partial equilibrium trade model is used. Figure 2.5 shows the domestic demand and supply positions of an exporter and an importer. The trade sector is in equilibrium with price P_w and quantity traded OQ_1. The quantity exported is equal to X_1X_2 which is equal to the quantity imported M_1M_2. Hence in equilibrium $X_1X_2 = M_1M_2 = OQ_1$.

The effects of the imposition of a countervailing duty by the importer are analogous to the effects of imposing a tariff on imports. Suppose, from Figure 2.5, the authorities in the importing country decide to impose a tariff (or a CVD of equal amount on each unit of imports) in order to offset the effects of subsidization. The result is a shift of the importer's excess demand curve downward by the amount of the CVD to E'd. Consequently, world price level falls

Figure 2.5

Impacts of Countervailing Duties on Trade Flows



to P'_w Similarly the price level in the exporting country falls to P'_x The price of the commodity being traded rises to P'_min the importing country. The difference between the price in the exporting region and that in the importing region is essentially the amount of the tariff; i.e. $P'_m=(P'_x+CVD)$. The volume of trade for the traded commodity falls from OQ_1 to OQ_2. The price level in the importing country increases to P'_m.

The net loss to consumers in the importing country as a result of the CVD can be approximated by the area P'_mBAP_w. This represents the loss in consumer surplus as a result of the increase in the price level. However, the higher price level means gains to producers in the importing country by taxing the imported product. Higher prices result in an increase in revenue by the amount P'_mCDP_w.

The final result for the importing region is that consumers lose area P'_mBAP_w and producers gain area P'_mCDP_w. This leaves area ABCD unaccounted. Since quantity M_3M_4 is still being imported, the government ends up collecting CVD's of the amount BCEF (i.e. $M_3M_4 * P_wP'_m$). The area CDE is paid to domestic resource owners. Hence, the net total loss to the importing country as a whole is represented by area ABF.

As far as the exporter is concerned, lower levels of exports (as a result of lower demand for imports in the importing region) means a surplus on the domestic market of the exporter. Pressure on the domestic market as a result of the surplus forces the price of the exportable down to P'_x in the exporting country. At this price level, quantity X_3X_4 is exported. This is clearly less than the pre-countervail level of exports X_1X_2.

The economic impacts of CVD's on the exporter can be derived in a straight forward fashion. The lower price in the exporting country implies consumer gains. This amounts to the area $P_wHJP'_x$ Domestic consumption also increases from OX_1

to OX_3. Lower prices however mean losses to producers. These losses are represented by the area $P_wIKP'_x$. The area HIJK (the difference between consumer gains and the producer losses) is the net loss to the exporting region.

From Figure 2.5 it is clear that the final volume of trade following the imposition of a CVD depends crucially on the price elasticities of demand and supply for the traded good in both the importing and exporting region. These price elasticities are especially important for the exporting region since their magnitudes will determine the extent by which the price of the traded goods will fall as a result of the CVD.

Consider the case of the excess supply curve "ES_1" which is more inelastic than the original excess supply curve "ES".[14] It is easy to see that by feeding the effect of the CVD back through the trade sector, the impact on the price level in the exporting country is much greater than in the case of the less inelastic excess supply function. In the example from Figure 2.5, the price level falls to P''_w Hence, the following observations can be drawn regarding the effects of a CVD on the exporter's price level: the more elastic (inelastic) the excess supply function, the smaller (greater) is the magnitude of the effects of the CVD on the exporter's price level.

This implies that with an inelastic export supply function, the CVD will result in the exporter's price falling by a greater magnitude than with a more elastic export supply function. However, the maximum effect of the CVD on the exporter's price is restricted to the full amount of the CVD. This occurs where the export supply function is completely price inelastic. In such a case, the exporter assumes

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[14] It should be noted that although ES_1 is derived from a different set of demand and supply functions facing the exporter, the quantity exported at price P_w is still OQ_1. Note also that ES_1 passes through point "S".

the full cost of the CVD and the volume of exports is not affected. Only the export price falls by the full amount of the CVD.

Conversely, with an infinitely elastic export supply function, only the volume of trade is affected. Export volume decline but there is no effect on the exporter's price level. The importer bears the full cost of the CVD.

To summarize then, it has been shown that the imposition of a CVD results in lower domestic prices for the exporter but that the magnitude of the drop does not necessarily have to be equal to the amount of the CVD. The price of the exportable in the exporting region can fall by either the full amount of the CVD or by less than the amount of the CVD depending on the slope of the excess supply curve. Overall, from the standpoint of an exporting region, consumers gain and producers lose from a CVD.

2.5. Impacts of CVD's on the Canadian Hog-Pork Sector: A Conceptual Model

The foregoing partial equilibrium analysis implicitly assumes: (1) that the two trading regions are more or less of the same sizes and that the excess demand and supply functions are not inelastic; and (2) treats live hogs and pork as similar products. However, for the problem at hand these assumptions are not realistic given that: (1) the US market is approximately ten times the size of the Canadian market; and (2) live hogs and pork are related but differentiated products. In this respect, consideration of the small exporting country and the treatment of live hogs and pork as two different but related products seem more appropriate.

The case of a small exporting country is characterized by a more elastic excess demand curve for its exports, i.e. the exporter is faced with a horizontal excess demand curve for its exports. In such a situation, the entire amount of the tariff (CVD) is borne by the exporter since raising the price of its exportable

product slightly might result in loosing export sales. This would be the case if the excess demand curve, ED [Figure 2.5] is horizontal.

However, in the case of live hog and pork exports, previous research at Agriculture Canada has shown that the excess demand curve faced by Canada for its live hogs and pork is not horizontal. Rather, there are indications that because the amount exported (of pork and live hogs) decreases with the distance between the exporting and the importing markets, the excess demand function tends to be slightly curve linear. This is illustrated in Figure 2.6. The assumption that the excess demand and supply for Canadian live hog and pork exports is of the above shape is used here to derive, conceptually, the impacts of CVD's on both the live hog and the pork sectors.

From the previous analysis, it was concluded that the imposition (removal) of CVD's causes:

1. the price of the exportable in the exporting country to decline (increase);
2. the importer's excess demand curve to shift inwards (outwards); and
3. the volume of trade to decrease (increase).

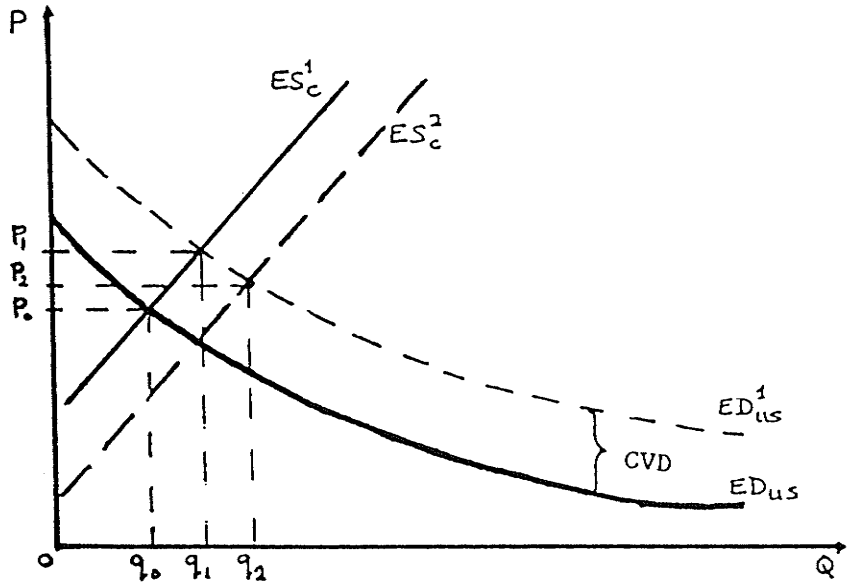
Using these general conclusions, the example below assesses the economic impacts on both the live hog and the pork sectors of the elimination of CVD's on live hogs.

The elimination of CVD's on live hogs has the immediate effect of shifting the excess demand curve of the importer outwards by the amount of the CVD. This is shown in Figure 2.6(a). The position of the new excess demand curve is shown by ED^{1}_{us}. The result is an increase in the price of live hogs from P_0 to P_1 and an increase in the quantity exported from q_0 to q_1.

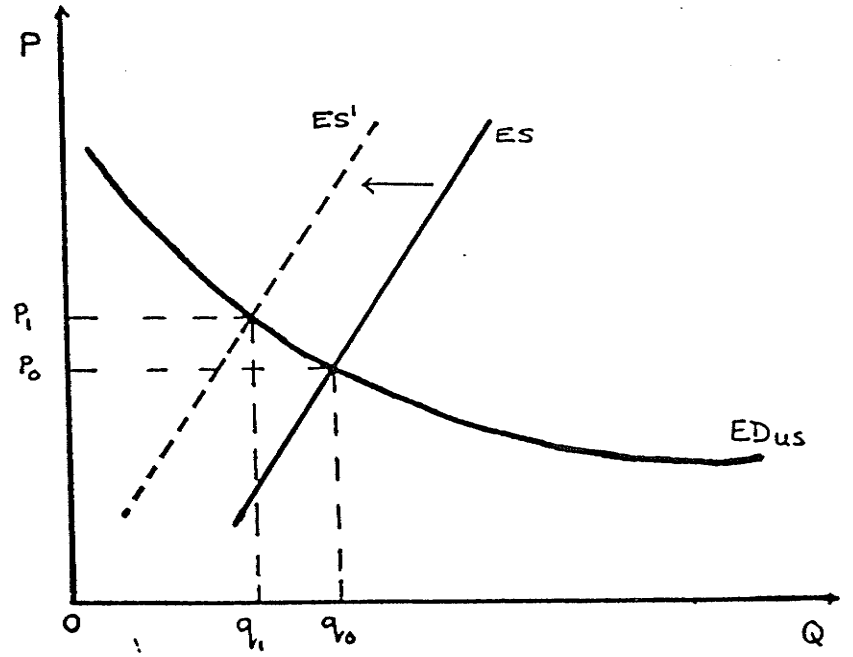
Figure 2.6

Impacts of CVD's on the Hog-Pork Sector: The Small-Country Example

(a) Live Hog Sector



(b) Pork Sector



The corresponding effects on the pork sector can also be derived. It should be kept in mind that live hogs represent the major input of pork suppliers. Therefore an increase in the price of live hogs, following the elimination of the CVD, results in the supply of pork to fall. This situation is shown in Figure 2.6(b), which shows the exporter's excess supply of pork to shift inwards from ES to ES^1 as a result of an increase in input cost. The result is an increase in the price of pork from P_0 to P_1 and a decrease in the volume of trade from q_0 to q_1 [Figure 2.6(b)].

The demand for live hogs is derived from the demand from pork and an increase in the price of pork consequently results in a decrease in the demand for live hogs. As less live hogs are demanded for domestic slaughter, the excess supply curve (representing the amount available for export) will shift to the right, from ES_c^1 to ES_c^2 [Figure 2.6(a)]. After sufficient adjustments in the live hog sector, equilibrium is reached at price P_2 and quantity q_2 where the new excess supply curve, ES_c^2 intersects the post CVD excess demand curve ED_{us}^1.

Hence, to summarize, the removal of CVD's on live hogs results in the price of pork to increase and the quantity traded to fall. However, in the live hog sector, initially the price of live hogs rises by the full amount of the CVD less transportation costs. However, given sufficient time for the industry to adjust to new market conditions, live hog prices eventually fall. However because of the shape of the importer's excess demand curve, which in this case is not perfectly elastic, and because the demand for live hogs is derived from the demand for pork, live hog prices are unlikely to increase by the full amount of the CVD immediately following its elimination.

The conceptual model presented above provides a useful framework for the development of the mathematical form of the hog-pork simulation model. In its

simplest form, and following the conceptual model represented in figure 2.6, one can derive the effects of CVD's on both the live hog and the pork sectors if the excess demand and supply functions for both live hogs and pork are known. However, such a model will strictly yield the impacts of CVD's on trade flows and prices. To the extent that the major objective of the present study is to assess the sectoral effects, a more general model that explains both the domestic and the export components of the hog-pork sectors appears to be more appropriate. The development of such a more general model will be the objective of the next chapter.

The partial equilibrium framework developed in this chapter has been used by a number of studies to estimate the impacts of tariffs. Officer and Hurtubise (1969) are among the first ones to estimate the impact of tariff reductions following the Kennedy Round (of GATT negotiations) on Canadian imports and exports for a number of sectors. Their general results show that the Canadian export sector gained substantially from the tariff cuts of the Kennedy Round of trade negotiations.

Hayami (1979) uses estimates from an econometric model to calculate the gains from lowering the Japanese tariffs on beef imports. The findings of this paper show that all parties, both in the exporting and in the importing country can gain by adequate redistribution of gains from trade liberalization. Other empirical studies on the effects of tariffs include those of Krause (1962), Leamer (1974), and Griffith and Meilke (1982). The latter study uses an econometric model to estimate the impacts of the elimination of the Japanese import tariff on rapeseed oil and soybean oil. The results indicate that reduction in the Japanese tariffs on these products leads to an increase in their exports from Canada thereby indicating some net gains for Canada.

2.6. Summary

The economic effects of two major export enhancement devices were analyzed in the first part of this chapter. These are: (1) production subsidies and (2) export subsidies. It was shown that production subsidies increase domestic production without directly affecting the consumer. In addition an extreme case (but which is operationally implementable) was presented whereby production subsidies can be used effectively to turn an importer into a net exporter. Export subsidies, on the other hand, were found to result in higher export levels. This, however, is achieved at the cost of raising the domestic price above the world price and represents a burden on domestic consumers. However, both production and export subsidies were found to represent distortions in the economic system and both have some costs associated with them.

The application of countervailing duties as a means of offsetting the effects of subsidized imports by an importer was shown to have important economic implications on the exporting region. The price of the exportable in the exporting region falls following the imposition of the CVD. As a result, consumers gain and producers lose. Depending on the elasticity of the excess supply curve, some exports still take place. Consequently, taxpayers in the exporting country continue to subsidize consumers in the importing region by the amount of the export subsidy which in the first place resulted in the imposition of the CVD.

CHAPTER III

THE ECONOMETRIC HOG-PORK MODEL AND EMPIRICAL RESULTS

3.1. Introduction

The econometric hog-pork model used in this study is a modified version of the hog-pork component of the Food and Agriculture Regional Model[15] currently used by Agriculture Canada. Some modifications to the original FARM were necessary in order to adapt the model to deal with the specific problem at hand. The models used in this study take explicit account of all provincial stabilization programs for hogs in Canada. This represents a major departure from previous attempts to model the Canadian hog-pork sector.

Briefly, the models developed in this chapter describe the dynamics of the hog and pork sectors on a regional basis. The demand, supply, price, inventory and trade relationships for hogs and pork are specified for both eastern and western Canada.[16] A set of linkages that bring together these two regions are also included to assess the national impacts. Finally a set of "institutional"[17] equations are

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[15] For a detailed description of the Food and Agriculture Regional Model in general the reader is referred to "FARM, Food and Agriculture Regional Model", Agriculture Canada, February 1983. Some discussion on the livestock component can be found in "Modeling Livestock Stabilization", Agriculture Canada, 1986.

[16] Western Canada is comprised of the four provinces west of Ontario,namely British Columbia, Alberta, Saskatchewan and Manitoba whereas Eastern Canada comprises the provinces of Ontario, Quebec and the Atlantic region.

[17] Salathe et al. (1982) describe three broad categories of relationships in a model. These are definitional, behavioral and institutional relationships. Definitional relationships are also known as accounting identities. Institutional equations are used to describe the operation of government programs. Examples of these are equations to calculate stabilization payments based on a given formula as described under the particular program. Behavioral relationships are formulated to satisfy economic theory. These are also known as stochastic equations.

specified for each province in order to make hog stabilization programs in each province an integral part of the hog-pork sectors.

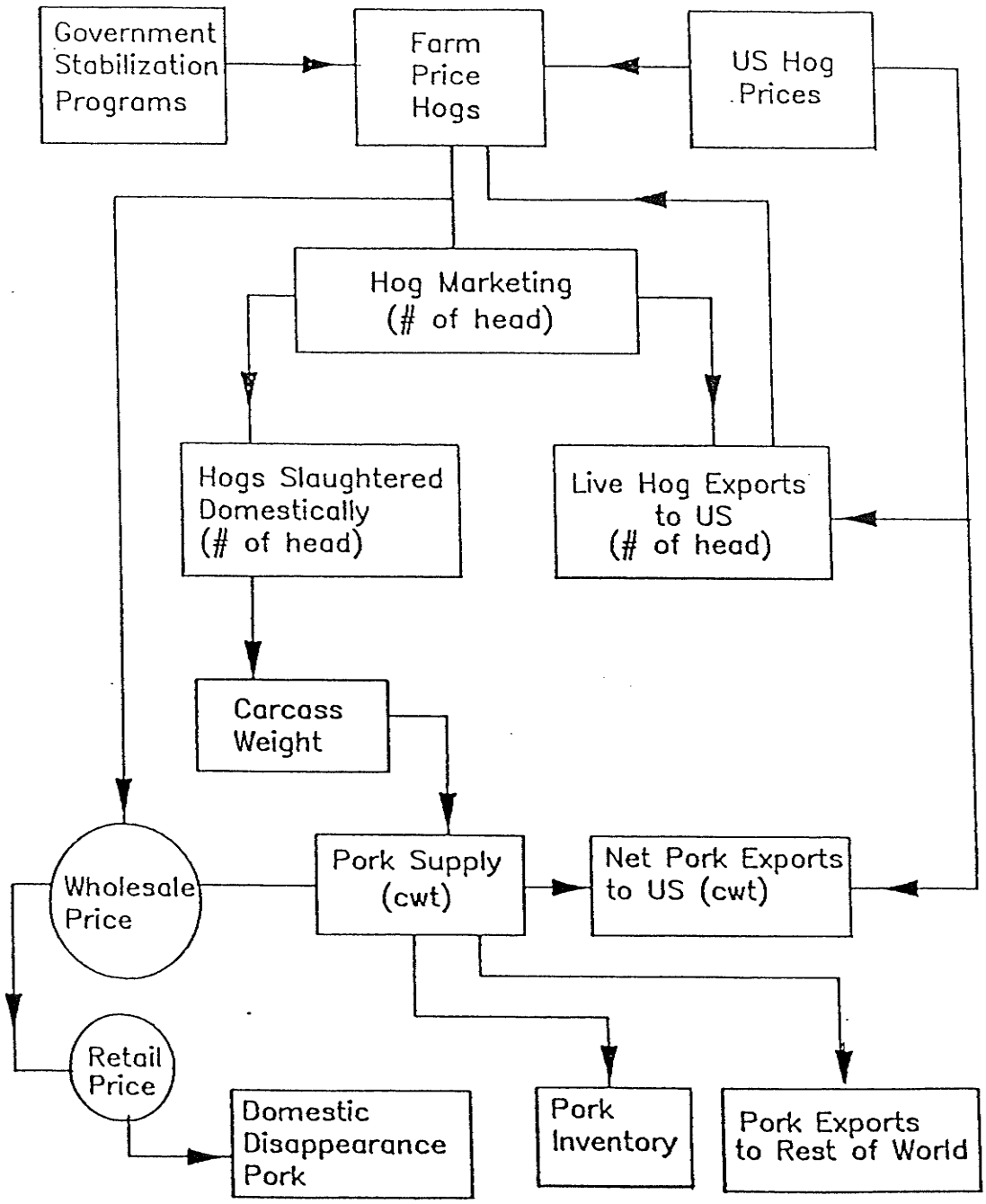
This chapter describes the simulation model used in this study and discusses the structural equations of the econometric models. To the extent that many of the equations for one region are similar to those for the other regions included in the model and in order to avoid repetition, the focus of the discussion will be on the general form of the empirical model only. However, a summary of the complete model, including all the definitional, institutional and behavioral relationships, followed by a description of all the endogenous and exogenous variables are presented in Appendix B. Data sources and the estimation procedures are briefly discussed in Section 3. A description of the behavioural equations and the empirical results are presented in Section 4. Model validations are contained in Section 5 followed by a summary to this chapter in the last section.

3.2. General Overview of the Canadian Hog-Pork Simulation Model

A schematic representation of the general model used for this study is given in Figure 3.1. The model first determines hog marketing in both eastern and western Canada. From the total number of hogs marketed, some are exported (live) to the U.S. for slaughter. The rest are slaughtered domestically. Pork supply is then determined by multiplying the number of hogs slaughtered by the hog carcass weight. The total supply of pork is disposed of in three ways. These are: (1) domestic disappearance; (2) demand for inventory; and (3) exports. A set of behavioral equations determine each of these for the respective regions.

Figure 3.1

General Components of the Canadian Hog-Pork Model



In addition, hog prices at various levels are also determined behaviorally. Finally a set of "institutional" relationships describing the operation of provincial and federal hog stabilization programs are included to complete the model.

A brief description of the major components making up the hog-pork econometric model as illustrated in Figure 3.1 is presented here. For simplicity of exposition, only the general structural form of the model is discussed. The complete model is summarized in Appendix B. In its simplest form, the hog-pork econometric model can be summarized, mathematically as follows:

Hog marketing (supply) in region (i) is determined behaviorally as:

(1) $SHG_i = g(PHG_i, X_1)$

where,

SHG_i = number of hogs marketed in the ith region

PHG_i = price of hogs in the ith region

X_1 = exogenous shifter

The number of hogs marketed in each region is disposed of in two ways: these are exports and domestic slaughter. Live hog exports in each region is determined behaviorally as:

(2) $EXHG_i = f(PHG_i, X_2)$

where,

$EXHG_i$ = number of live hogs exported from the ith region

X_2 = exogenous shifter

Having estimated (1) and (2) the number of hogs slaughtered domestically is then derived as follows:

(3) $DHG_i = SHG_i - EXHG_i$

where,

DHG_i = the number of hogs slaughtered domestically in the ith region

The supply of pork in each region is derived simply as the number of hogs slaughtered (DHG_i) in each region times the average hog carcass weight. The average hog carcass weight ($CWHG_i$) for region i is determined behaviorally as:

(4) $CWHG_i = f(PHG_i, X_3)$

The total pork supply is then derived by multiplying the number of hogs slaughtered by the average hog carcass weight as follows:

(5) $QPK_i = CWHG_i * DHG_i$

The total pork supply in the ith region can be disposed of in three ways. These are: (a) domestic consumption, (b) demand for inventory, and (c) exports. Each of these are determined behaviorally as follows:

(6) $DPK_i = f(RPPK_i, X_4)$

(7) $IPK_i = f(RPE_i, X_5)$

(8) $NTPK_i = f(WPPK_i, X_6)$

Where DPK_i, IPK_i and $NTPK_i$ define domestic consumption, inventory and exports of pork for the ith region respectively. $RPPK_i$ and $WPPK_i$ are the retail and wholesale price of pork respectively and RPE_i represents the storage cost associated with holding inventory. X_is are exogenous shifters.

Finally, the following identity closes the model for each region:

(9) $DPK_i = QPK_i + IPK_i(-1) - IPK_i - NTPK_i$

In addition, given the structure of the North American hog market, it is assumed that hog prices in Canada are influenced by hog prices in the US and other factors that link prices in the two countries[18]; one such factor include

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[18] It should be noted that US hog prices influence Canadian hog prices which in turn influence hog marketing in Canada. This relationship in the model is illustrated in Figure 3.1 where US hog prices are linked to Canadian hog prices and indirectly to hog marketing.

transportation costs. Following Thompson (1977), a price linkage equation is specified as follows:

(10) $PHG_i = f(PHOGUS + Z_1) * ER - Z_2$

where,

PHG_i and PHOGUS = hog prices in Canada and in the US respectively and where Canada is the exporter and US is the importer

ER = the exchange rate

Z_i = factors that link the two prices together

Z_1 = any factors in the importing country which influence the prices in the two regions. Examples of such factors include import taxes and import subsidies and are expressed in terms of the importer's currency.

Z_2 = any factors in the exporting country that relate the prices of the tradeable together.

For example: $Z_2 = g(L_1 + T)$

where,

L_1 = any factors in the exporting country which influence the price relationship. Examples include export taxes and export subsidies. To the extent that CVD's are expressed in terms of the exporter's currency, they form part of the above relationship.

T = the transportation cost between the two regions and is expressed in terms of the exporter's currency

The simple model described by equations (1) to (10) can be used for policy analysis in a straight forward fashion. The endogenous variables of this model are SHG_i, $EXHG_i$, DHG_i, $CWHG_i$, QPK_i, DPK_i, IPK_i, $NTPK_i$ and PHG_i. The exogenous

variables include the shifters X_i's and the variables PHOGUS, ER and Z_i. The effects of changes in any of the exogenous variables can be evaluated on the endogenous variables given the necessary data for all the variables exist. The CVD, which enters equation (10) can be treated as a policy variable and the model can be simulated under various assumptions about the CVD and the impacts on the endogenous variables under each assumption can then be evaluated.

The overall model consists of 64 equations (see Appendix B). Of this, 21 equations are estimated behaviorally. These equations describe live hog marketing and exports, pork supply, inventory, prices and trade for both regions. In addition, there are 20 accounting identities to yield national impacts from provincial and regional data. Furthermore, 23 institutional relationships are included to describe the various provincial hog stabilization programs and the recent national tripartite program for hogs.

3.3. Estimation Procedures and Data Sources

Before proceeding with the discussion of the structural equations and the empirical results, it is instructive, first, to discuss the model's estimation procedures and the sources of the data.

The choice of a proper estimation technique for the general model presented in the preceding section depends on both the nature of the problem at hand and the objectives for which the model is being used. In the present case, the major objective is for forecasting and for policy analysis. Hence, as pointed out by Pindyck and Rubinfeld (p. 361, 1981), in such cases efforts should be directed towards having a small standard error of forecast as possible rather than trying to have significant t-statistics which are more relevant in the calculation of elasticity measures.

Meilke and Coleman (1986) provide a thorough discussion on the choice of the proper estimation procedure for "macro" simulation models similar to the one used in this study. In this context, their remarks are also relevant for the present study. They note that despite the simultaneous nature of their model, Ordinary Least Squares (OLS) still remained the most preferred technique. The authors compared both OLS and Two Stage Least Squares (2SLS) estimates and conclude that the two estimators are very similar. Charlebois and Cluff (1986) also chose OLS over a systems method for its computational simplicity and point out that OLS estimators tend to be less sensitive than other estimators to problems such as multicollinearity, errors in variables and misspecification in small samples.

Summers (1965) also showed, using Monte Carlo simulation methods, that the bias of OLS tends to be only slightly larger than those of consistent estimators in small samples. Quandt (1962) further showed that OLS bias is most of the time less than the 2SLS bias when there is substantial multicollinearity among regressors.

An additional problem which can arise with the use of a systems method to solve a big econometric model as the one used in this study is that the number of exogenous variables far exceeds the number of observations covering the time period over which the model is estimated. Hence, there is a problem with degrees of freedom. Although there are techniques to bypass such problems, these techniques are still arbitrary (Meilke and Coleman, 1986). Therefore, the sheer size of the present model further limits the choice of an appropriate estimation technique.

Based on the above observations, and given:

(1) the nature of the present model,

(2) that high multicollinearity among regressors is unavoidable,

(3) the small sample size, and,

(4) the thorough testing of the different estimation techniques in the past;

OLS seems to be the most appropriate estimation technique for the present models.

The structural equations forming the hog-pork model are estimated using quarterly data over the 1971 to 1985 period, wherever available. The historical data are from Agriculture Canada's data bank.

3.4. Structural Equations and Empirical Results

This section presents the various relationships forming the hog-pork econometric simulation model. The structural form of each equation is presented followed by a brief discussion of the estimated parameters. Further discussion relating to the specification of some of the more conventional relationships like domestic disappearance, marketing, inventory and so on, can be found in previous studies that have used Agriculture Canada's Food and Agricultural Regional Model.

3.4.1. Pork Price Equations

Two different prices for pork are used in this model. These are the retail price of pork and the wholesale price of pork. Consumers face the retail price, while in the trade sector, the wholesale price is more relevant. Research in this area includes previous work by Freebaín and Rausser (1975), Arzak and Wilkinson (1979), and Meilke and Coleman (1986). In most of these studies the retail price is specified as a function of the wholesale price and the wage rate. Following these works, the following specifications were adopted for the retail and the wholesale price of pork:

RPPK3 = f(WPPK2, WPPK2(-1), WAPK3, JSi)

WPPK2 = f(PHG21, WAPK3, JSi)

where,

RPPK3 = retail price of pork in Canada

WPPK2 = wholesale price of pork in eastern Canada

WAPK3 = wages in meat packing and slaughtering industry

PHG21 = price of index 100 hogs in Ontario

JSi = seasonal dummy variables.

JS1 = 1 if quarter = 1

= 0 otherwise

JS2 = 1 if quarter = 2

= 0 otherwise

JS3 = 1 if quarter = 3

= 0 otherwise.

It is expected that both the wholesale price variable and the wage rate variable be directly related to the dependent variable, i.e.: dRPPK3/dWPPK2 > 0 and dRPPK3/dWAPK2 > 0.[19] Similarly, the price of hogs and wages are both expected to be directly related to the wholesale price. Hence dWPPK2/dPHG21 > 0 and dWPPK2/dWAPK3 > 0. In both equations, a set of seasonal dummy variables are included to capture seasonal price variations which are known characteristics of the pork market. The estimated retail and wholesale price of pork equations are presented below:[20]

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19 Throughout the text, a "*d*" preceding any variable denotes the partial derivative of that variable.

20 Numbers in parenthesis following each variable indicate the maximum lag used for that variable. For example, WPPK2(-1) indicate a one quarter lag of the variable WPPK2. Numbers in parenthesis below each estimated coefficient represent t-values. This conventional way of reporting regression results will be maintained throughout the entire study.

Estimated Retail Price Equations:

$$(3.1)\ RPPK3 = \underset{(3.5)}{-17.0} + \underset{(9.4)}{0.33\ WPPK2} + \underset{(9.5)}{0.19\ WPPK2(-1)} + \underset{(0.1)}{0.17\ WAPK3} + \underset{(3.5)}{0.62JS1} - \underset{(9.4)}{1.8JS2} + \underset{(5.2)}{0.07JS3}$$

$R^2 = 0.99$; DW = 1.9; F = 703; Rho = 0.70; Range: 1971.1-1985.4

Estimated Wholesale Price Equations:

$$(3.2)\ WPPK2 = \underset{(1.8)}{15.7} + \underset{(12.5)}{1.17PHG21} + \underset{(1.8)}{0.03WAPK3} - \underset{(2.1)}{2.49JS1} - \underset{(1.4)}{1.88JS2} + \underset{(0.4)}{0.42JS3}$$

$R^2 = 0.94$; DW = 2.2; F = 94; Rho = 0.73; Range: 1971.1-1985.4

The reported results indicate that both equations perform satisfactorily with R^2 values of 0.99 and 0.94 for the retail and wholesale price equation respectively. All coefficients have the expected signs. It should be noted that preliminary estimates of both equations indicated the presence of first order serial correlation. The Cochrane-Orcutt iterative procedure was used in both cases to correct for the problem of autocorrellation.

For the retail price equation, the results show that the wholesale price of pork and the wage rate are both highly significant in explaining variations in the dependent variable. However, it appears that the retail price of pork is more responsive to charges in the wage rate variable than to charges in the wholesale price variable. The respective elasticities (at means) are 0.60 for the wage rate variable and 0.37 for the wholesale price variable.

Regarding the wholesale price of pork equation, the price of index 100 hogs appears to be the most important variable in explaining changes in the dependent variable. The elasticity at means for the price of index 100 hogs with respect to the wholesale price variable is 0.75. This indicates that for every percent change in the index 100 hog price variable, there is a corresponding 0.75 percent change in the wholesale price.

3.4.2. Domestic Disappearance Equation

In this study the per capita disappearance of pork is first estimated for the whole country and then multiplied by the size of the population in each region to yield the regional disappearance of pork. This procedure is followed because data on the regional per capita disappearance of pork is not readily available. The procedure adopted here implicitly assumes that consumer's behaviour are not much different in the two regions.

The per capita disappearance of pork is specified following the neoclassical consumer demand theory. Accordingly, consumers try to maximize utility subject to a budget constraint. Based on such a maximization problem, the conventional practice in economics literature has been to specify the demand for a particular product as a function of its own price, the price of substitutes and the level of disposable income. Specifications like these have been tried previously for consumer demand for pork in Canada (Meilke and Coleman (1986), Hassan and Katz (1975), Charlebois and Cluff (1986), Hassan and Johnson (1984)). Hence the estimated equation for the domestic disappearance of pork is:

$$\begin{aligned}(3.3)\ PCDPK3 = {} & 14.6 - \underset{(9.7)}{9.27}RPPK3 + \underset{(.93)}{3.55}RPLBF3 + \underset{(3.1)}{0.32}PCDY3 \\ & - \underset{(.07)}{0.16}JS1 - \underset{(7.4)}{1.4}JS2 - \underset{(5.2)}{1.8}JS3\end{aligned}$$

$R^2 = 0.94$; DW = 1.6; F = 107; Range: 1975.1-1985.4

where:

PCDPK3 = per capita disappearance of pork in Canada

RPPK3 = real price of pork in Canada

RPLBF3 = real price of beef in Canada - used as a proxy for the price of substitutes

PCDY3 = per capita disposable income in Canada

JSi = seasonal dummy variables.

The estimated equation for domestic disappearance appears satisfactory with R^2 value of 0.94 and F statistics of 107. Besides the dummy variable for the first quarter, all coefficient have the correct sign and are statistically significant at the 95 percent level. Specifically, the own price variable is inversely related to the dependent variable, i.e. dPCDPK3/dRPPK3 < 0. However, both the price of beef and the level of income are directly related to the dependent variable, i.e. dPCDPK3/dRPLBF3 > 0 and dPCDPK3/dPCDY3 > 0.

The computed own price and income elasticity of demand are -0.70 and 0.52 respectively. Both elasticity measures compare favourably to those in recent studies (e.g. Meilke and Coleman (1986) and Young (1987).

Having estimated the per capita disappearance of pork, the regional and national amount of pork consumed each quarter is calculated by multiplying the per capita disappearance by the size of the population in each region. Hence:

$DPK_i = PCDPK3 * POP_i$ (west, east)

DPK3 = DPK1 + DPK2 (Canada)

where DPK1 and DPK2 are the amount of pork consumed in western and eastern Canada respectively and DPK3 is the total pork disappearance in Canada. The variable POP stands for the size of the population in eastern and western Canada.

3.4.3. Demand for Closing Inventory of Pork

Much work has been done to-date on the demand for pork inventory in Canada. While most previous works do recognize that the demand for inventories arises from both speculative and transactionary motives, yet it does not seem that there is any consensus as to the choice of explanatory variables to capture these effects. Zwart and Martin (1974) use the supply and the price of pork as regressors plus a lagged dependent variable and seasonal dummies. Robertson (1980) followed the same specification with the exclusion of the price variable. Meilke and Coleman (1986) use a lagged dependent variable, the price of hogs, the production of pork and seasonal dummies as explanatory variables. The latter argue that the transactions demand is captured by the price variable. However a close examination of Meilke and Coleman's results show the price of pork variable to be statistically insignificant in both the Canadian and the US inventory equations. This raises some doubts about the importance of the price variable as a regressor.

Following these works, the following specification is postulated for the demand for closing inventory of pork in both eastern and western Canada.

$IPK_i = f(QPK_i, IPK_i(-1), RPEN3, JSi)$ (west, east)

where,

IPK_i = closing stock of pork

QPK_i = supply of pork

RPEN3 = storage cost

JSi = seasonal dummy variables as defined before.

The total supply of pork variable does not include pork imports since these represent a relatively small proportion of total stocks. Instead of including a price variable the storage cost is included as a regressor following Charlebois and Cluff

(1986). The inclusion of this variable proves to yield much better results. Based on a priori reasoning, the supply of pork is expected to be directly related to the dependent variable, i.e. dIPK/dQPK > 0. The storage cost variable, however, is expected to be inversely related to the dependent variable. As storage costs rise, there is a tendency to liquidate inventories; hence dIPK/dRPEN3 < 0.

The estimated equations for the closing stock of pork in western and eastern Canada are:

Western Canada:

(3.4) IPK1 = 0.64 + 0.05QPK1 + 0.48IPK(-1) - 0.03RPEN3
(0.37) (3.2) (4.3) (2.9)

+ 2.5JS1 + 0.52JS2 - 2.5JS3
(2.7) (0.52) (2.4)

R^2 = 0.73; DW = 1.6; F = 24; Range: 1971.1-1985.4

Eastern Canada:

(3.5) IPK2 = 5.35 + 0.03QPK2 + 0.52IPK2(-1) - 0.06RPEN3
(3.5) (3.0) (4.0) (3.3)

+ 0.24JS1 - 1.51JS2 - 3.2JS3
(0.3) (1.5) (3.4)

R^2 - 0.78; DW = 2.0; F = 22; Range: 1975.1-1985.4

Both equations perform satisfactorily with R^2 of 0.73 and 0.78. All variables have the correct signs and are statistically significant (with the exception of two of the seasonal dummy variables).

The national inventory levels are derived from the regional inventory level from the following accounting identity:

IPK3 = IPK1 + IPK2

where,

IPK3 is the national inventory level of pork

IPK1 and IPK2 are the western and the eastern closing stocks of pork, respectively.

3.4.4. Net Pork Trade Equations

The net exports of pork are estimated behaviorally for both eastern and western Canada and then aggregated through an identity to give the total Canadian net pork exports to the U.S.. Pork has generally been traded between the two countries and the direction of trade depends largely on the relative prices in the two countries. The shipment of pork is therefore specified as a function of the landed price of pork to the importer, the price of pork in the importing country expressed in the exporter's currency, a lagged dependent variable and seasonal dummy variables.[21]

As most pork exported from western Canada goes to the Western U.S., the wholesale price of pork in San Francisco is used to represent the prevailing wholesale price of pork in western U.S. However, the wholesale price in New York is used as a proxy for the price of pork prevailing in the eastern U.S. region. Most pork from eastern Canada is destined to the north eastern region of the U.S..

It is expected that as the landed price facing the importer increases, the volume of trade will be affected adversely; i.e. dNTiPK4/dWPPK + CVD < 0. Conversely, as the domestic price of pork in the US, expressed in Canadian dollars, increases relative to the price of imported pork, the volume of trade increases. This is because imported pork became relatively cheaper than domestically produced US pork; i.e. dNTiPK4/dWPPKUS * ER > 0.

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[21] It is common practice to use the ratio of the prices prevailing in the importing and in the exporting region as an explanatory variable in trade equations. However, to the extent that such a variable can lead to the problem of spurious correlation, this specification is not used here.

The estimated net exports of pork equations for western and eastern Canada are:

Western Canada:

$$(3.6)\ NT1PK4 = \underset{(1.4)}{-6.3} + \underset{(2.88)}{0.32}(WPPKSF*ER) - \underset{(2.52)}{0.28}(WPPK2 + CVD)$$
$$+ \underset{(20.79)}{0.98}NT1PK4(-1) - \underset{(2.3)}{6.0}D84.3 + \underset{(4.3)}{6.2}JS1 + \underset{(2.6)}{3.8}JS2 + \underset{(1.07)}{1.7}JS3$$

$R^2 = 0.95$; DW = 1.84; F = 105; Range: 1975.1-1985.4

Eastern Canada:

$$(3.7)\ NT2PK4 = \underset{(1.26)}{-14.3} - \underset{(3.3)}{0.68}(WPPK2+CVD) + \underset{(3.96)}{0.79}(WPPKNY*ER)$$
$$+ \underset{(10.87)}{0.76}NT2PK4(-1) + \underset{(3.9)}{13.4}JS1 + \underset{(1.9)}{6.6}JS2 + \underset{(3.4)}{12.3}JS3$$

$R^2 = 0.94$; DW = 2.5; F = 112; Range: 1975.1-1985.4

The total net trade of pork between Canada and the US is then derived by the following identity.

NT3PK4 = NT1PK4 + NT2PK4

where NT1PK4, NT2PK4 and NT3PK4 are the net trade of pork between the US and western and eastern Canada and the whole country respectively.

Both equations performed well with R^2 values of 0.95 and 0.94 for western and eastern Canada respectively and all coefficients had the expected signs. Several measures of elasticity can be computed from the estimates of equation 3.6 and 3.7. The own price elasticity of exports[22] is -1.75 and -1.3 for the western and eastern

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[22] The exporter's own price elasticity of pork export is defined as:

$$E_{p,x} = (d\text{NTiPK4}/d\text{WPPK2+CVD}) * (\overline{\text{WPPK2+CVD}}/\overline{\text{NTiPK4}})$$

regions respectively. This implies that as the landed price of pork to the importer increases (decreases) by one percent, the net shipment of pork from Canada to the U.S. is likely to decrease (increase) by 1.75 percent for western Canada and 1.3 percent for eastern Canada. It should, however, be pointed out right away that these elasticity measures are composite elasticities in the sense that they also take into account the effect of the CVD.

Conversely the elasticity of export with respect to the importer's price[23], expressed in domestic currency, indicates that for every percent increase (decrease) of the price in the importing region, there is a corresponding 2 percent and 1.5 percent increase (decrease) in the net volume of pork shipment to western and eastern U.S. respectively.

3.4.5. Pork Supply Equations

Having defined the domestic disappearance, inventory and net trade situations for pork for eastern and western Canada, two market clearing identities are needed to close the model and also to solve for the supply of pork (variable QPK_i) in both regions. These identities are:

(3.8) DPK1 = QPK1 + IPK1(-1) - IPK1 - NT1PK2 - NT1PK4 - NT1PK9 (west)

(3.9) DPK2 = QPK2 + IPK2(-1) - IPK2 + NT1PK2 - NT1PK4 - NT1PK9 (east)

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[23] The elasticity of pork export W.R.T. the importer's price is defined as:

$E_{p,m}$ = (dNT1PK4/dWPPKSF*ER) * ($\overline{\text{WPPKSF*ER}}/\overline{\text{NT1PK4}}$)..(west)

$E_{p,m}$ = (dNT2PK4/dWPPKNY*ER) * ($\overline{\text{WPPKNY}}*\overline{\text{ER}}/\overline{\text{NT2PK4}}$)..(east)

where,

NT1PK9 and NT2PK9 are exogenously determined net exports of pork from western and eastern Canada respectively, to the rest of the world.

NT1PK2 is the net exports of pork from western Canada to eastern Canada and is treated exogenously.

All other variables are similar to those defined previously. Once the pork supply in both eastern and western Canada are determined, the total national supply of pork is defined as:

QPK3 = QPK1 + QPK2.

3.4.6. Stabilization Equations

So far, the models describe the pork sector only. The last identity ensures that the pork sector is always in balance. However, for sectoral equilibrium, the pork sector has to be linked to the live hog sector. It should be pointed out that the live hog sector represents the major input into the pork sector.

Modeling the Canadian live hog sector without explicitly taking into account stabilization programs leaves one with an incomplete model. Stabilization programs are an integral part of the Canadian hog-pork system and are incorporated into the present model through a set of accounting or institutional relationship. These equations can be classified into four broad categories. A first set of equations derive the stabilization support prices for hogs. A second set of equations calculate the market price for hogs under the stabilization program. Based on the two sets of information, a third set of equations derive the producer's payments whenever the market price is below the support price. If the market price is above the support price, producers have to contribute to their respective hog stabilization

plans and the amount of their contributions are determined through a fourth set of equations.

The above equations are derived for each participating province based on the provision of the respective provincial programs. Provinces operate different programs and therefore the support levels, the market price and producer's contribution or benefits differ from province to province. The specification of the relationships explaining Provincial Stabilization Programs are mostly those of Agriculture Canada, (1986) and are summarized by equations 42-61 in Appendix B.

The variables associated with the stabilization programs (e.g. support price and producer levy) represent a major set of the model's policy instrument. The level of support is one of the most important factor determining hog prices which in turn influence hog supply, marketing, exports, slaughter and so on. The amount of support determine the net price received by hog producers and this affect farmer's decision regarding production. The demand for pork is also affected because the net price received by farmers influence the wholesale price which in turn influences the retail price of pork.

Finally because in this study the objective is to replace all the provincial programs by one uniform national stabilization program for hogs, another set of equations are needed to describe the characteristic of the new program. The elimination of provincial programs and the institution of the National Tripartite Stabilization Program (NTSP)[24] is currently under way in most provinces in Canada. Equations 62-64 accommodate these changes in the present model.

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[24] For a detailed description of the National Tripartite Program for hogs, see Tan, M.H. "The National Tripartite Stabilization Program for Red Meats: Hog Model", Agriculture Canada, Working Paper No.5, June 1985.

The national tripartite price stabilization scheme for hogs is designed to stabilize prices in order to reduce income losses of hog producers. The federal government, the provincial government and the participating producers contribute equally into the stabilization funds. The support price is equal to the estimated national current cash cost of production in a given quarter plus 95 percent of the difference between the cash cost and the national average market price of hogs in the same quarter for the preceding five years, i.e.

$$\text{support price} = \text{current cash cost} + 95\% * \sum_{t=-5}^{-1} \left[\left(\frac{\text{Market price - cash cost}}{5}\right)\right]$$

Stabilization payments are triggered whenever the average market price falls below the support price. Three equations are included to describe the National Tripartite Program. These explain: (1) the tripartite support price for hogs (equation 62), (2) the tripartite stabilization payments (equation 63), and, (3) the tripartite national cash cost of production (equation 64). These equations essentially describe the operational aspects of the national tripartite price stabilization program for hogs.

3.4.7. Hog Marketing Equations

Hog marketing in Canada depends largely on the price received by farmers for live hogs. Since each province has a complex system of stabilization programs to which hog producers contribute and from which they receive payments, the net price received for hogs in any one period, therefore depends on the market price for hogs, the amount of support farmers receive and the amount of contribution hog producers make to the specific provincial stabilization programs.

The net price received by hog producers for a given quarter is defined as the market price of hogs lagged four quarters [PHG(-4)] plus any payments the farmer received from stabilization programs over the preceding four quarters less any contribution the farmer made to these programs over the same period of time. Hog producers who do not participate in the provincial programs are eligible for support under the ASA program for hogs.[25] Hence the net price variable is defined as:

$$NPHOG = PHG(-4) + \left[\begin{array}{l} \text{Provincial} \\ \text{Payment}(-4) \end{array} - \begin{array}{l} \text{Producer} \\ \text{levy}(-4) \end{array} \right] * \left[\begin{array}{c} \text{\% of hogs} \\ \text{eligible under} \\ \text{prov. program} \end{array} \right]$$

$$+ \left[\begin{array}{l} \text{A.S.A.} \\ \text{Payment}(-4) \end{array} * \left[\begin{array}{l} \text{1-\% of hogs eligible} \\ \text{under prov. program} \end{array} \right] \right]$$

The right hand side of the above equation defines the hog producer's contribution or benefits from participating in either the national or provincial program over the period between the time the decision to produce hogs is made and the time they are marketed. Four quarters represents the approximate length of time elapsed between the decision to change the level of hog production and the final response as measured by the level of hog slaughter (Zwart and Martin, 1974).

Hog marketing (supply) is specified based on the notion that hog producers are profit maximizers and that the product market is perfectly competitive. A profit maximizing firm's supply function can be easily derived from the first order conditions for profit maximization. Let the representative firm's profit function be:

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25 A comprehensive documentation and discussion of the various provincial and federal programs for hogs in Canada can be found in Clements and Carter, 1986.

$$\text{Max}\Pi = PY - C(r_1, r_2, Y)$$

where:

Π = the level of profit

P = the price of the product

Y = the level of output

C(.) = the cost function where r_1, r_2 are exogenous variables

The first order condition sets price equal to marginal cost (MC); i.e.

$$d\Pi / dY = P - dC(.)/dY = P - MC = 0$$

Since marginal cost is generally a function of the level of output Y, the inverse of the above expression gives the firm's supply function as:

$$y = y(P, r_1, r_2)$$

Hence the supply for the representative firm's product depends on the price of the product and a set of exogenous variables that explain the cost structure of the firm.

The general specification of the hog marketing equations follow earlier work by Charlebois and Cluff (1986). The number of hogs marketed in each province is specified as a function of the net price received by hog producers (NPHOG), the costs of producing hogs lagged four quarters[26], a lagged dependent variable and

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[26] The relevant costs are those that prevail at the time farmers make their decision to produce hogs and a four quarter lag allows the model to capture these costs since this is the approximate length of time it takes to raise pigs from farrow to finish.

dummy variables to account for seasonability. Additionally, previous work (Gilson and Saint-Louis, 1986) has found that for the eastern provinces, hog marketing is influenced by the industrial milk quota situation, and for the western provinces, the availability of feed grain in the prairie region. Hence an explanatory variable for milk quota, lagged six quarters[27], was included for the eastern provinces, and a variable describing the farm closing inventory of feed grain for the west. The general specification of hog marketing equation is as follows:

$$SHGi = f(NPHOG_i, COST_i(-4), SHG_i(-1), \quad FIGR3, XMSQ(-6), JSi$$

where,

SHGi = number of hogs marketed every quarter

$NPHOG_i$ = net price of index 100 hogs

$COST_i(-4)$= the costs of producing hogs lagged four quarters

XMSQ(-6)= industrial milk quota lagged six quarters

FIGR3 = feed grain inventory in the west during the previous year

JSi = seasonal dummy variables defined as:

As discussed earlier the net price variable (NPHOG) is determined by the market price, the level of support farmers receive and/or the amount of contribution farmers make to the stabilization programs. Generally, the higher the net price the higher the number of hogs marketed, i.e. $dSHG_i/dNPHOG > 0$.

Regarding the costs of production variable involved in producing hogs, the number of hogs marketed is expected to decline with an increase in the costs of

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[27] The milk quota variable is lagged six quarters to allow for some transition period in shifting resources between dairy operation and hog production.

production and therefore an inverse relationship is expected between the cost variable and the dependent variable, i.e. $d\text{SHG}_i/d\text{COST}(-4) < 0$.

The milk quota variable which appears in the hog marketing equations for eastern Canada represents the opportunity costs of producing hogs. The higher the milk quota allocation, the greater is the amount of resources diverted into milk production and this is expected to have an adverse effect on hog production. Hence it is expected that $d\text{SHG}/d\text{XMSQ}(-6) < 0$.

As far as the feed grain stock variable is concerned, it is expected that an increase in the availability of feed grain is likely to result in an increase in the hog herd size which eventually leads to an increase in live hog marketing. Hence, a positive relationship is expected between the feed grain variable and the dependent variable i.e. $d\text{SHGi}/d\text{FIGR3} > 0$.

There are ten equations in this model that explain hog marketing in Canada, three of which are accounting identities. The seven behavioural equations describe hog marketing on a provincial basis. The estimated behavioural equations are summarized below:

(3.10) Hog Marketing in British Columbia: (1971.1-1985.4)

$$\begin{aligned}\text{SHG11} = {} & \underset{(1.69)}{3.6} + \underset{(3.36)}{0.18}\text{NPHOG11} - \underset{(2.78)}{0.30}\text{TCCHG11}(-4) + \underset{(1.75)}{10.15}\text{PIMQ21}(-6) \\ & + \underset{(30.0)}{0.96}\text{SHG11}(-1) - \underset{(2.3)}{3.13}\text{JS1} - \underset{(2.4)}{3.3}\text{JS2} - \underset{(3.4)}{4.6}\text{JS3}\end{aligned}$$

$R^2 = 0.99$; DW = 1.85; F = 663

(3.11) Hog Marketing in Alberta: (1971.1-1985.4)

$$\begin{aligned} SHG12 = {} & -73.2 + 0.89NPHOG12 + 5.17UR12(-4) \\ & (2.5) \quad (2.23) \quad (2.16) \\ & + 0.72SHG12(-1) + 4.82FIGR3 + 42.3JS1 \\ & (8.33) \quad (3.55) \quad (4.13) \\ & + 16.0JS2 - 18.1JS3 \\ & (1.54) \quad (7.73) \end{aligned}$$

$R^2 = 0.90$; DW = 1.96; F = 73.8

(3.12) Hog Marketing in Saskatchewan: (1971.1-1985.4)

$$\begin{aligned} SHG13 = {} & -39.0 + 0.192NPHOG13 + 2.68FIGR3 + 0.81SHG13(-1) \\ & (2.09) \quad (0.69) \quad (3.28) \quad (13.4) \\ & + 23.4JS1 + 7.78JS2 - 26.3JS3 \\ & (3.64) \quad (1.18) \quad (3.89) \end{aligned}$$

$R^2 = 0.91$; DW = 1.64; F = 110

(3.13) Hog Marketing in Manitoba: (1971.1-1985.4)

$$\begin{aligned} SHG14 = {} & -26.0 + 0.792NPHOG14 + 0.94FIGR3 + 1.36SHG14(-1) \\ & (1.4) \quad (2.96) \quad (21.1) \quad (1.84) \\ & + 4.5JS1 - 15.6JS2 - 33.2JS3 \\ & (0.65) \quad (2.24) \quad (4.76) \end{aligned}$$

$R^2 = 0.93$; DW = 1.91; F = 119

(3.14) Hog Marketing in Ontario: (1971.1-1985.4)

$$\begin{aligned} SHG21 = {} & 253 + 0.75NPHOG21 - 0.97TCCHG21(-4) \\ & (3.2) \quad (1.71) \quad (2.67) \\ & - 9.83XMSQ21(-6) + 0.93SHG21(-1) - 36.6JS1 \\ & (2.77) \quad (2.68) \quad (3.0) \\ & - 89.5JS2 - 89.11JS3 \\ & (7.2) \quad (7.3) \end{aligned}$$

$R^2 = 0.97$; DW = 2.3; F = 321

(3.15) Hog Marketing in Quebec: (1971.1-1985.4)

$$\begin{aligned} SHG22 = {} & 355 + 1.18NPHOG22 - 1.15TCCHG22(-4) \\ & (3.5) \quad (2.11) \quad (1.08) \\ & + 0.93SHG22(-1) - 11.5XMSQ22(-6) - 53JS1 \\ & (2.15) \quad (2.92) \quad (3.7) \\ & - 82JS2 - 102JS3 \\ & (5.67) \quad (7.0) \end{aligned}$$

$R^2 = 0.98$; DW = 2.6; F = 489

(3.16) Hog Marketing in Atlantic Provinces: (1971.1-1985.4)

$$\begin{aligned} SHG27 = {} & 14.3 + 0.20NPHOG27 + 0.99SHG27(-1) \\ & (1.6) \quad (2.9) \quad (54.1) \\ & - 7.59XMSQ27(-6) + 1.58JS1 - 6.5JS2 - 8.6JS3 \\ & (1.64) \quad (1.14) \quad (4.7) \quad (6.2) \end{aligned}$$

$R^2 = 0.98$; DW = 1.71; F = 619

Finally, three accounting identities aggregate the provincial hog marketing to give the regional and national hog marketing as follows:

West: SHG1 = sum (SHG11, SHG12, SHG13, SHG14)

East: SHG2 = sum (SHG21, SHG22, SHG27)

National: SHG3 = SHG1 + SHG2.

The results show that all seven equations perform well as evidenced by the large R^2 for each equation together with the high F - statistics. All coefficients have the expected signs. The Durbin-h statistics[28] also rule out the possibility of the existence of first order serial correlation in the data.

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[28] The Durbin-h test is used here instead of the conventional Durbin-Watson test, because of the presence of lagged dependent variables in the estimated equations.

More specifically, the net price variables have the correct sign and are statistically significant at the 95 percent confidence level (except for the province of Saskatchewan where the associated t-value is only 0.69). Both the cost of production variable (TCCHG) and the feed grain stock variable (FIGR3) have the correct signs and are, in general, statistically significant in explaining variation in the level of hog marketing in the different regions.

The price of industrial milk quota also appears to explain some of the variations in hog marketing. As expected, an increase in the price of milk quotas in British Columbia leads to in increase in hog marketing. In Eastern Canada, the milk quota allocation seems to have resulted in a major reallocation of resources out of milk production into hog production. For Alberta, the quarterly average unemployment rate, lagged one year is significant at the 95 percent confidence level.

Most of the seasonal dummy variables are statistically significant and the results show that in general hog marketing tends to be higher in the fourth quarter. The coefficient on the lagged dependent variable is generally large ($0.72 < \lambda < 1.36$) and this indicates a slow adjustment process in hog marketing.

3.4.8. Hog Carcass Weight Equations

The average hog carcass weight tends to vary depending on past prices of hogs and the costs of feed grain. Agriculture Canada (1983) and Meilke and Coleman (1986) specified the carcass weight for steers as a function of the deflated price of steers and corn prices lagged one quarter, a lagged dependent variable and seasonal dummies. A similar specification is followed in this study to determine hog carcass weight. Hence,

CWHGi = f (PHG(-1), PFEED(-1), CWHG(-1), JSi)

where,

CWHG = average quarterly carcass weight of hogs

PFEED = price of feed grain

PHG(-1) = lagged price of index 100 hogs

JSi = seasonal dummy variables.

If producers expect hog prices relative to feed prices to rise, hogs are kept on feed for a longer period to be slaughtered at heavier weights (Meilke and Coleman, 1986). Hence a positive sign is expected with the lagged price variable, i.e. dCWHG/dPHG(-1) > 0. However, if the price of feeding hogs is increasing, ceteris paribus, producers have the tendency to liquidate thin herds at an earlier stage rather than further fattening the animals. Hence, carcass weight is likely to fall, i.e. dCWHG/dPFEED(-1) < 0. For eastern Canada, corn prices (FPOC2) are used for feed prices since corn constitutes the main feed grain. For similar reasons, the off board price of barley (variable OPBA1) is used as feed cost for western Canada.

The estimated equations for the average hog carcass weight for western and eastern Canada are:

Hog Carcass Weight: Western Canada:

(3.17) CWHG1= 20.6 + 0.02PHG12(-1) - 0.0009OPBA1(-1)
(2.0) (1.43) (0.11)

+ 0.85CWHG1(-1) - 0.96JS1 - 1.4JS2 - 1.8JS3
(11.1) (2.3) (3.3) (4.3)

R^2 = 0.82; DW = 1.97; F = 28; Range 1975.1-1985.1

Hog Carcass Weight: Eastern Canada:

(3.18) CWHG2= 3.54 + 0.01PGH21(-1) - 0.01FPCO2(-1)
(0.49) (0.62) (1.6)

+ 0.98CWHG2(-1) + 0.03JS1 - 2.5JS2 - 1.5JS3
(16.9) (0.08) (5.8) (3.9)

R^2 = 0.92; DW = 1.7; F = 80.1; Range: 1975.1-1985.1

Judging from the R^2 values, both hog carcass weight equations are satisfactory. All other explanatory variables have signs that conform to prior expectations. The most significant explanatory variable appears to be the lagged dependent variable. The high value of the coefficient attached to this variable (0.895 and 0.98 for the west and east respectively) indicate that there is little variation in hog carcass weight from quarter to quarter.

3.4.9. Domestic Slaughter Equations

Once the regional hog carcass weight equations are estimated and with the quantity of pork supply known [from equation 3.8 to 3.9], the number of live hogs slaughtered domestically can be derived directly from the following identity:

(3.19) QPKi = CWHGi * DHGi i = 1, west; 2 = east.

where:

QPKi = the supply of pork

DHGi = the number of hogs slaughtered

CWHGi = the hog carcass weight

The domestic hog slaughter in each region is then aggregated to arrive at the national hog slaughter as follows:

DHG3 = DHG1 + DHG2

3.4.10. Live Hog Exports

In view of the fact that there is some movement of live hogs from western Canada to eastern Canada and given the structure of the simulation model, the exports of live hogs to the US is derived from both a behavioural equation, (for the west) and from an identity (for the east). The exports of live hogs from eastern Canada to the US is derived residually as:

(3.20) EXHG2 = SHG2 - DHG2

where,

EXHG2 = number of live hogs exported to the US

SHG2 = total number of hogs marketed (east)

DHG2 = number of hogs slaughtered (east)

This procedure was necessary in order to balance the west-east flows of live hogs and also to ensure that the econometric model is properly identified.

The export of live hog equation for western Canada is specified based on previous work by Agriculture Canada (1986). It is very common in international trade literature to use the ratio for domestic prices to foreign prices as an explanatory variable in export or import functions.[29] Again, to avoid the problem of spurious correlation and because the focus of this study is on countervailing duty (CVD), this specification is not used. Instead, the real prices in both the importing and the exporting regions are used as separate regressors.

In order to explicitly take into account the CVD on Canadian live hogs entering the US, the exports of live hogs to the US is estimated as an export demand function rather than as an export supply function. The export demand function takes into account the landed price of imported hog and the price

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[29] For a literature review see Stern et al.(1976).

prevailing in the US adjusted by the exchange rate. Hence the following specification is followed:

EXHG1 = f(PHG12 + CVD, PHG4 * ER, EXHG1(-1), JSi)

where,

EXHG1 = quarterly number of live hogs exported to the US from western Canada.

PHG12 = price of index 100 hogs in the exporting region

CVD = countervailing duty on Canadian live hogs entering US ($Canadian).

PHG4 = price of hogs in US (7-markets)

ER = Canadian-US exchange rate

JSi = seasonal dummy variables as defined earlier.

The variable (PHG12 + CVD) represents the price faced by the importer since it is the latter who bears the onus of the CVD. Since the CVD is constant, it is expected that an increase (decrease) in the Canadian price of hogs will lead to a decrease (increase) in the export demand for hogs. Hence dEXHG1/dPHG12 + CVD < 0. The variable describing the US price expressed into the equivalent of Canadian dollars represents the cost of imported hogs relative to domestically produced hogs in the US. An increase (decrease) in the US price of hogs expressed in Canadian dollars relative to the landed price of Canadian hogs in the US is likely to result in an increase (decrease) in the export demand for Canadian hogs. Therefore it is expected that dEXHG1/dPHG4 * ER > 0.

The estimated equation for the exports of live hogs from western Canada to the US is:

(3.21) EXHG1 = 20.2 - 4.74(PHG12+CVD) + 5.99(PHG4*ER)
(0.67) (3.49) (3.96)

+ 75.3D84.3 + 0.51EXHG1(-1) + 6.1JS1
(3.85) (5.32) (0.55)

- 14.8JS2 - 11.7JS3
(1.36) (1.04)

$R^2 = 0.87$; DW = 1.84; F = 35.4; Range: 1975.1-1985.4

All the estimated coefficients have the expected signs and the R^2 and F-statistics suggest that the model performed satisfactorily. The major explanatory variables were all statistically significant (with the exception of the seasonal dummy intercept variables).

The computed own price elasticity is -6.0. This implies that if the Canadian price of live hogs raises by 1 percent, the exports of live hogs to the US will decline by about 6 percent. The elasticity of exports with respect to the US price also indicates that the shipment of live hogs is highly responsive to variations in the US price. One percent change in the US price of live hogs leads to approximately 6.1 percent change in the volume of live hog shipment from Canada.

The dummy variable explaining labour dispute in the Canadian meat packing industry (D84.3) is also highly statistically significant and suggests that as a result of the labour dispute at least 75 thousand extra hogs were shipped to the US for slaughter during the dispute period.

After estimating the number of live hogs exported to the US from both eastern and western Canada, an accounting identity determines the total Canadian live hog exports to the US as follows:

EXHG3 = EXHG1 + EXHG2.

3.4.11. Price Linkage Equations

Two sets of linkages are included in this model. First, the Ontario price of index 100 hogs is linked to the US price of hogs. The second step involves linking western Canadian hog prices to the Ontario price. It is assumed in this study that the closeness and the size of the US market plus the volume of trade in both live hogs and pork with the US make the Canadian hog sector closely tied to the US hog sector. It is further assumed that the US market influences the Ontario price of index 100 hogs which in turn has an influence on the rest of the Canadian hog sector. This assumption is justified based on the fact that Ontario is by far the single dominant exporter of both live hogs and pork to the US from Canada.

A number of studies have investigated different specifications for international price linkage equations.[30] Bredahl et al. (1979) specifies the domestic price as a function of the world price, the exchange rate and other relevant variables affecting the domestic price. Although this specification has been widely adopted, the recent debate has been on the issue of whether the exchange rate should be included in a multiplicative fashion or as a separate regressor (Thompson 1980). Other unresolved issues in the literature relate to the question of whether the policy variable (in this case the CVD) should be made endogenous and not just part of the price linkage equation. This study does not attempt to resolve these issues. Rather, the price linkage equation used here is one which has been thoroughly tested by Agriculture Canada (1986) for its ability to replicate the dependent variable.[31] Hence the following price linkage equation:

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[30] These include the work of Bredahl, Meyers and Collins (1979); Chambers and Just (1979); and Fletcher, S.M., R.E. Just and A. Schmitz (1982).

[31] Moschini and Meilke (1987) also use a variant of the above price linkage equation.

Canada-US Price Linkage Equation

$$
\begin{aligned}
(3.22)\ PHG21 = {} & 16.6 + 1.09(PHG4*ER\text{-}CVD) - 2.23 \log EXHG2 \\
& (5.9) \qquad (2.15) \qquad\qquad (5.96) \\
& - 0.07NT2PK4 - 2.69JS2 - 1.51JS2 - 0.05JS3 \\
& \quad (1.5) \qquad\ (2.6) \qquad (1.5) \qquad (0.05)
\end{aligned}
$$

$R^2 = 0.94$; DW = 1.3; F = 99; Range: 1975.1-1985.4.

All variables are as defined previously. As expected the US price (converted in Canadian dollars in the present case) is positively related to the Canadian price. However, both the live hog export variable and the net pork export variable are inversely related to the dependent variable. This is explained by the fact that an increase in both live hogs and pork shipments from Canada to the US depresses the US price which in turn exert downward pressure on Canadian hog prices. Hence dPHG21/dEXHG2 < 0 and dPHG21/dNT2PK4 < 0.

It should also be noted that in the above price linkage equation, the logarithmic form of the hog export variable was used. This specification was adopted after having investigated several other formulations. Furthermore, the use of the logarithmic form of this variable can be justified on the ground that the number of live hogs exported is inversely related to the distance of the market. Due to its perishable nature, the volume of live hog exports increases at a decreasing rate when the distance to the export market gets larger. The use of the logarithmic of the variable EXHG2 captures this effect.

Having linked the Canadian price to the US price, the next task is to link western prices to the eastern price (PHG21). This is done through three behavioral equations explaining Manitoba, Saskatchewan and Alberta's price relationship to the eastern price. To the extent that British Columbia is a relatively small hog

producing province, it is assumed that Alberta prices prevail in that province. Prices in the three western provinces are linked to the Ontario price as follow:

PHG(west) = f(PHG21, Xi, JSi)

where,

PHG(west)	=	prices of index 100 hogs in each of the three provinces
PHG21	=	Ontario price of index 100 hogs
Xi	=	represents some exogenous factors that explain the price transmission. One example is transportation cost.
JSi	=	seasonal dummy variables.

Generally it is expected that dPHG(west)/dPHG21 > 0.

The estimated results for the equations relating the regional prices of hogs are given below:

Price of Index 100 hogs in Alberta: 1975.1-1985.4

(3.23) PHG12 = -1.69 + 1.01PHG21 - 0.08NT1PK2 - 0.009RPGAS3
(0.5) (21.9) (0.94) (0.66)

+ 0.88JS1 - 0.23JS2 - 0.51JS3
(1.44) (0.31) (0.77)

R^2 = 0.97; DW = 2.05; F = 175; Rho: 0.50

Price of Index 100 hogs in Saskatchewan: 1975.1-1985.4

(3.24) PHG13= 0.10 + 0.69 PHG14 + 0.30 PHG12 - 0.17JS1
(0.07) (13.0) (5.87) (0.27)

- 0.28JS2 - 0.04JS3
(1.62) (0.19)

R^2 = 0.99; DW = 2.2; F = 2600; Rho: 0.37

Price of Index 100 hogs in Manitoba: 1975.1-1985.4

(3.25) PHG14 = -3.4 + 1.0PHG21 + 0.63JS1 + 0.001JS2 - 0.14JS3
(1.5) (30.3) (1.4) (0.004) (0.32)

$R^2 = 0.98$; DW = 2.2; F = 397; Rho: 0.61

In view of the relatively larger and dominant hog sector in eastern Canada, hog prices in western Canada are assumed to be influenced by hog prices from eastern Canada. Equation 3.20 postulates that hog prices in Alberta depend on hog prices in Toronto, net pork trade between the western and eastern regions, the real price of gasoline acting as a proxy for transportation cost and seasonal dummy variables. The price of hogs in Toronto appears to be the most important explanatory variable. After correcting for autocorrelation (with Rho = 0.50) the estimated coefficient of 1.01 associated with the Toronto hog price variable suggests that Alberta hog prices adjust fully to changes in Toronto hog prices.

The price of hogs in Manitoba is specified as a function of the price of hogs in Toronto and a set of seasonal dummy variables. Preliminary estimates indicated the presence of serial correlation in the data. After correcting for autocorrelation by the Cochrane-Orcutt iterative procedure (with Rho = 0.61), the equation explaining Manitoba hog prices performed satisfactorily, with R^2 value of 0.98. The Toronto hog price variable appears to be, statistically, the most important explanatory variable. As in the Alberta hog price equation, Manitoba hog prices respond fully to changes in Toronto hog prices.

For, the Saskatchewan hog price equation, satisfactory results could not be obtained by following the conventional specification. Saskatchewan hog prices are influenced by hog prices primarily in both Alberta and Manitoba. However, only a first difference form of this specification seems to produce reasonable results.

Again, it was necessary to correct for autocorrelation using similar procedures as before (with Rho = 0.37). The results show that both the changes in Manitoba and in Alberta hog prices are statistically important in explaining changes in hog prices in Saskatchewan. However, it appears that hog prices in Saskatchewan respond more to changes in hog prices in Manitoba than in Alberta.

Having estimated the price of index 100 hogs in both eastern and western Canada, the national average price of index 100 hogs is then derived; weighted by each region's share of the national hog production as follows:

$$(3.26) \quad PHG3 = PHG21 * (SHG2/SHG3) + PHG12 * (SHG11 + SHG12/SHG3) + PHG13 * (SHG13/SHG3) + SHG14 * (SHG14/SHG3)$$

3.5. Model Validation

So far the behavioural equations forming the hog-pork model have been estimated and the performance of each model were based on statistical tests like the t-test for individual coefficients and the R^2 and F test for the significance of the different models. Although statistically the individual models are acceptable, it is instructive to evaluate the whole model more thoroughly before proceeding with policy analyses. More specifically, an investigation into how well each model is capable of tracking the historical values of its dependent variable and the suitability of the model as a whole is required. Different validation methods and tests are performed in this section.

A simple way of verifying how well an econometric model performs in replicating the historical values of the dependent variable is by comparing the actual (historical) mean values to the model's mean values of the dependent

variable. This information is contained in Table 3.1. Although in most cases the model's mean values for the dependent variable compare favourably with the historical mean values, this method provides only a crude judgement of how well a model performs. For example the observed and estimated mean values for a given variable might be the same although the values for each observation could be quite different.

Several other measures or tests are common in applied econometric literature for the validation of econometric models. One of the most popular measures is the mean simulating error (MSE) test. The mean simulation error is defined as:

$$(3.27) \qquad MSE = \frac{1}{N} \sum_{t=1}^{N} (P_t - A_t)^2$$

where:

Pi = the predicted value of the endogenous variable

Ai = the actual/observed value of the endogenous variable

n = the number of observations.

However, as noted by Pindyck and Rubinfeld (1981) this measure may be misleading in the sense that mean errors may be close to zero if large positive errors cancel out large negative errors (p.362). Because of this weakness, it is customary to use the root mean square simulation error instead. The root mean square error is defined as:

$$(3.28) \qquad RMSE = \sqrt{\frac{1}{N} \sum_{t=1}^{N} (P_t - A_t)^2}$$

The RMSE is a measure of the deviation of the predicted (estimated) values from the historical (actual) values. Both the MSE and the RMSE for selected endogenous variables are summarized in Table 3.1[32]. The RMSE can only be compared with the mean of the actual historical values of the individual endogenous variables. For most of the endegenous values, the RMSE appears to be small relative to the average values of these variables. The possible exceptions are for the variables EXHG1 and the variables explaining hog marketing.

A more meaningful measure, however, is the root mean square percent error (RMSPE). As the name suggests, the RMSPE shows the deviation of the simulated values from the historical values as a percentage of the actual values. The RMSPE's are summarized in Table 3.1. In 62 percent of the behavioural equations, the RMSPE's are less than 10 percent. This is considered satisfactory when one analyzes the reasons why some of the equations have high RMSPE's. The net pork trade variable for example (NT1PK4 and NT2PK4) have exceptionally high RMSPE's because over the historical period these variables assume the value of zero for several quarters. Similarly, the simulated values for the variable EXHG1 at the beginning of the simulation period are zero. The problem with the RMSPE measure is that it is biased upwards by observations which assume the value zero. When a variable takes a value of zero in any one period, this gives rise to a 100 percent simulation error during that period.

An additional simulation statistics that shows how well a model performs is the Theil's inequality coefficient. This coefficient is defined as:

$$U = \frac{}{} + \sqrt{\frac{\Sigma (P_i - A_i)^2/N}{\Sigma A_i^2/N}} \qquad (3.29)$$

32 Note that for convenience, only the behavioural equations are presented. However, validation tests were done for the entire model and are summarized in Appendix C.

Table 3.1

Validation Statistics for Selected Endogenous Variables

Endogenous Variable*	Actual Mean	Model's Mean	MSE	RMSE	RMSPE	THEIL
CWHG1	136.01	136.27	1.82	1.35	1.0	0.298
CWHG2	136.44	137.98	3.71	1.92	1.44	0.014
EXHG1	52.98	57.68	833.4	28.8	177.2	0.351
IPK1	7.95	8.59	5.95	2.43	36.7	0.298
IPK2	16.87	15.74	5.85	2.41	14.4	0.140
NT1PK4	0.79	-0.82	112.2	10.5	2286.2	0.760
NT2PK4	19.67	13.93	82.6	9.0	377.5	0.240
PCDPK3	14.24	14.13	0.21	0.45	3.3	0.032
PHG12	66.26	66.90	15.1	3.88	6.4	0.058
PHG13	65.71	67.43	16.0	4.0	6.4	0.060
PHG14	65.71	66.88	14.9	3.8	6.3	0.058
PHG21	68.42	69.64	13.6	3.7	5.5	0.053
RPPK3	96.43	97.43	4.5	2.1	2.3	0.021
SHG11	55.89	51.08	133.2	11.5	22.0	0.180
SHG12	377.48	383.58	1203.7	34.6	10.0	0.089
SHG13	161.12	157.82	351.8	18.7	11.9	0.114
SHG14	297.68	336.45	2080.7	46.3	18.3	0.149
SHG21	928.90	882.61	3748.4	61.2	6.2	0.060
SHG22	957.69	893.29	6662.8	81.6	8.1	0.082
SHG27	112.25	111.75	77.4	8.8	8.3	0.075
WPPK2	107.42	109.37	21.2	4.6	4.4	0.042

* Variable definitions are in Appendix B.
The root mean square percent errors for the variables EXHG1, NT1PK4 and NT2PK4 are exceptionally high because the conputation of the RMSPE is biased upward whenever the variable in question takes values of zero. This is precisely the problem with the export and net trade equations since Canada switched from being a net importer to a net exporter of pork between 1975 and 1978-79.

Source: Estimated.

By construction, $0 \leq U \leq 1$. The smaller the value of the U coefficient, the better the ability of the model to replicate the historical values of the endogenous variable. For example, a perfect model would generate simulated values which exactly match the actual or observed values of the endogenous variable; i.e. Pi = Ai. In such a case U = 0. Conversely, the larger the value of 'U', the poorer the ability of the model to replicate the historical values the endogenous variable.

The Theil inequality coefficients are computed for the endogenous variables of the hog-pork model and are presented in Table 3.1. It can be seen that in most cases, the value of U is well below 1 and close to zero. In only one case (for the variable NT1PK4) U = 0.76. However, this is not alarming since it is only when U = 1 that the model's forecast is no better than a 'naive' zero change prediction (Koutsoyiannis, p. 493). In this situation the model's forecasts are always zero when actual values are non-zero or non-zero predictions have been made when the actual values are zero (Pindyck and Rubinfeld, p. 365).

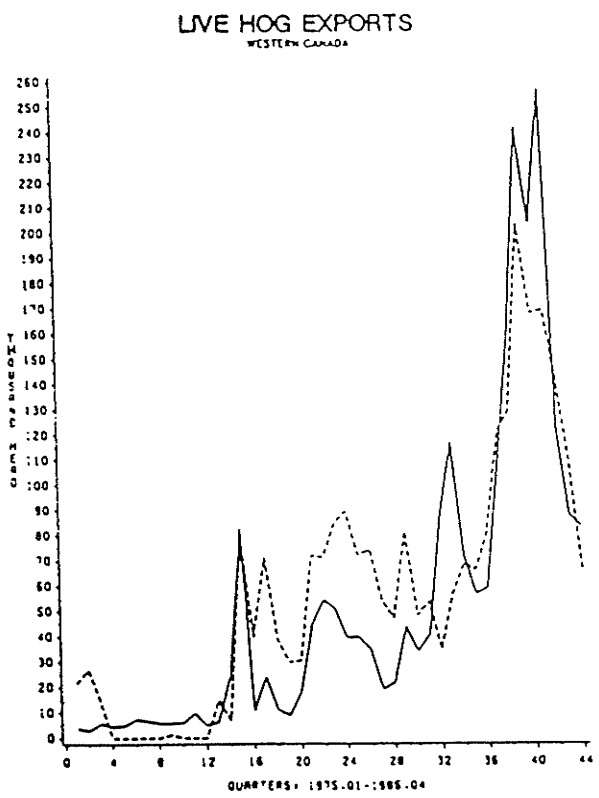
So far, statistical criteria have been used to assess the ability of the model to track its historical values of the endogenous variables. It has been shown that low RMSE, low RMSPE and low U-statistics are all indicatory that a particular model performs satisfactorily. However, none of these measures give any indication how successful a model is in simulating turning points.

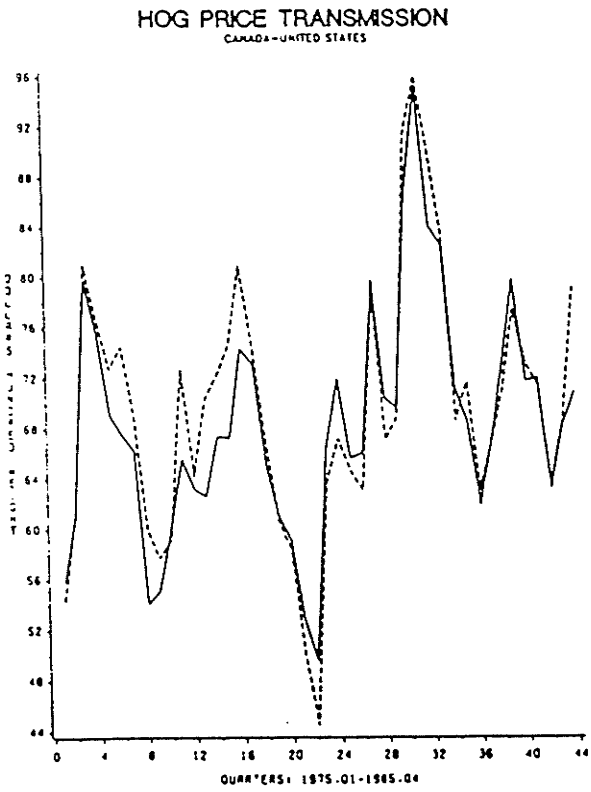
Several tests exist for testing the ability of a model to simulate turning points. For the present case, the most simple and probably the most widely used method is presented. This involves the visual inspection of plots of actual and simulated values. This method allows for a quick way of assessing how successfully a model tracks its historical values over the entire period of the simulation. The plots of actual versus simulated values of the most important endogenous variables are presented in Figure 3.2. An inspection of these plots reveal that in most cases

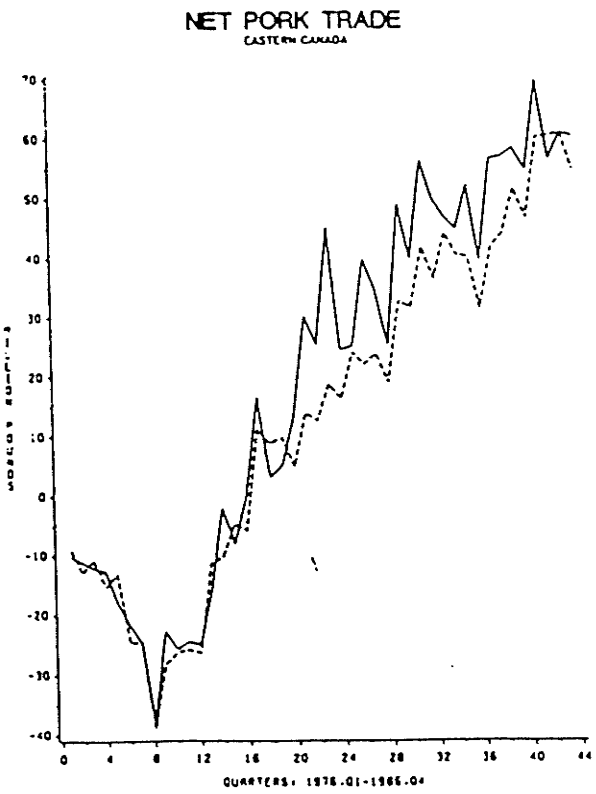
Figure 3.2

Actual vs. Simulated Values for Major Endogenous Variables

———: Actual Values - - - - -: Simulated Values







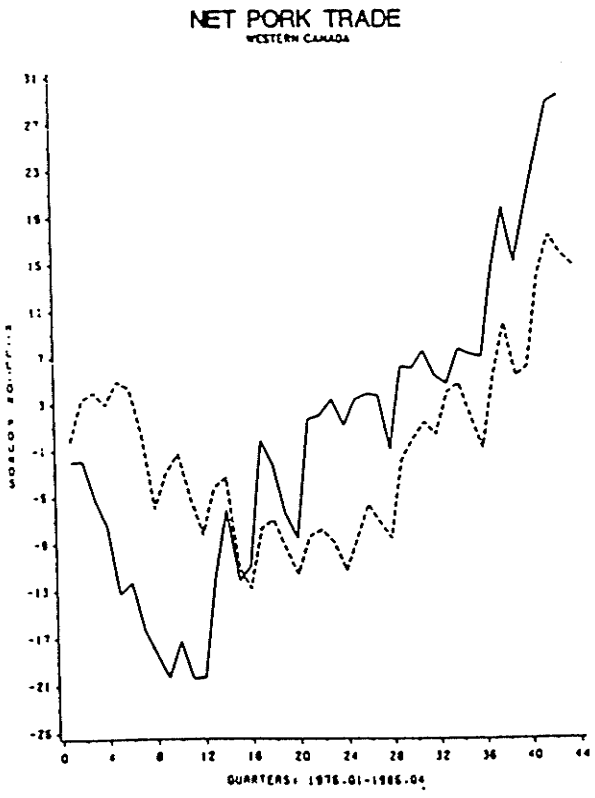
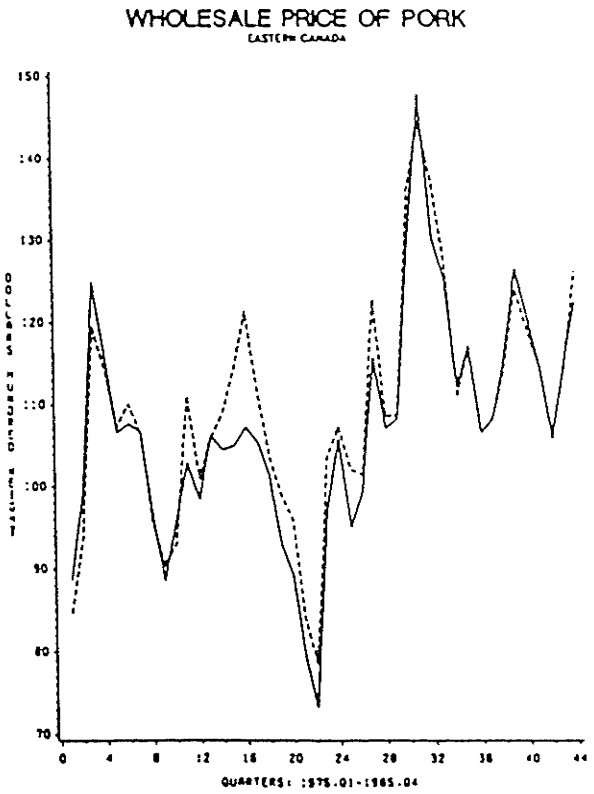
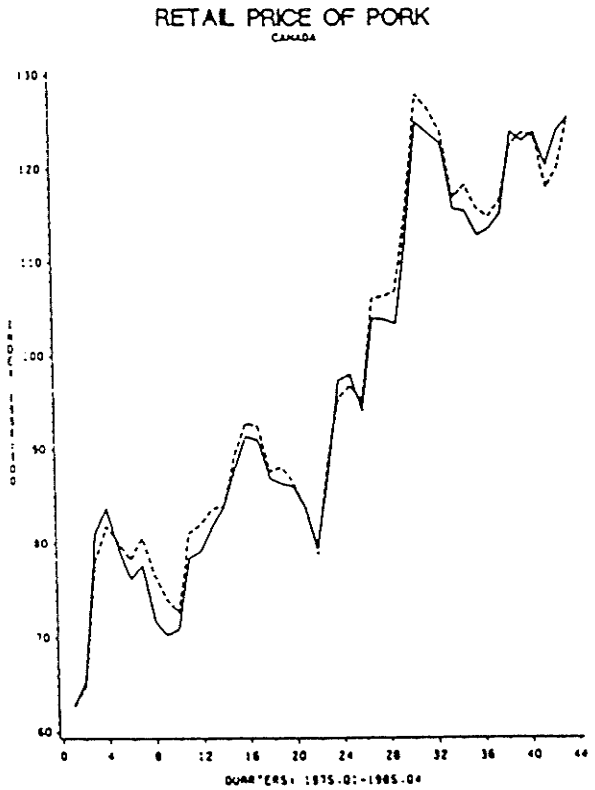


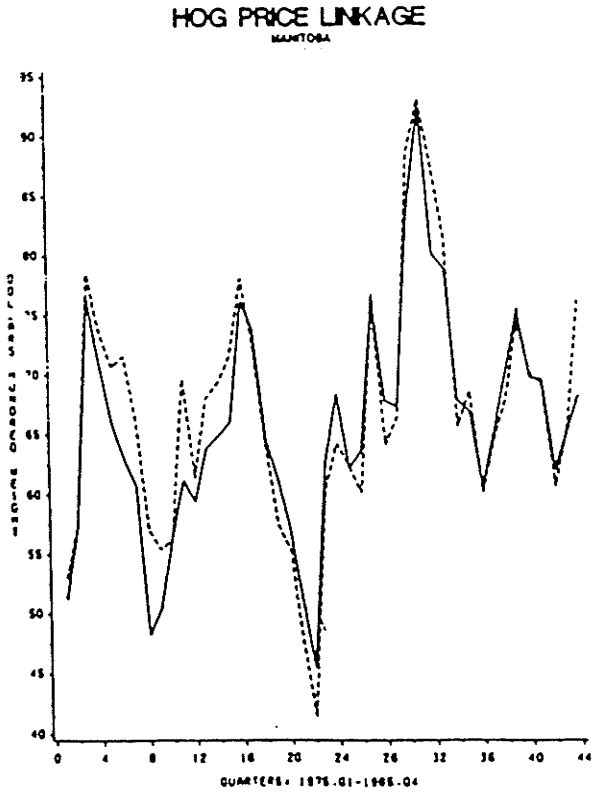
Figure 3.2 (Continued)

Actual vs. Simulated Values for Major Endogenous Variables

———: Actual Values - - - - -: Simulated Values







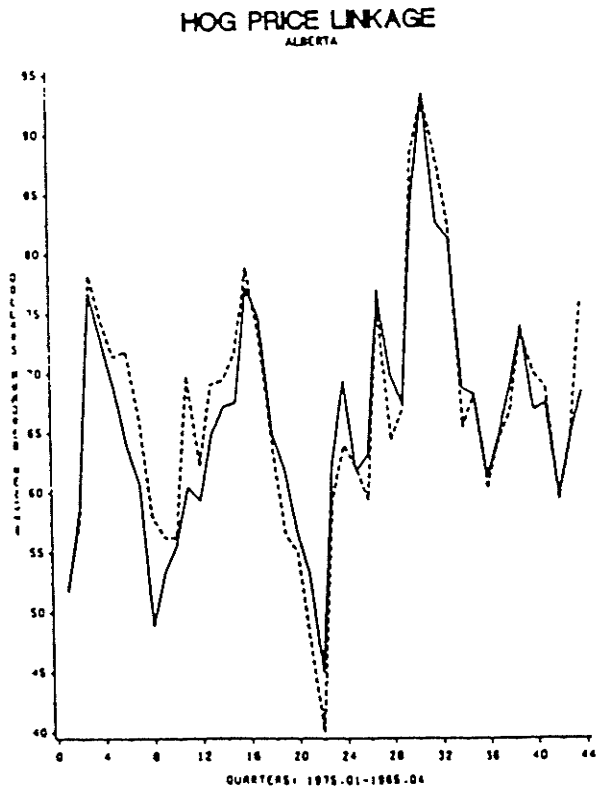
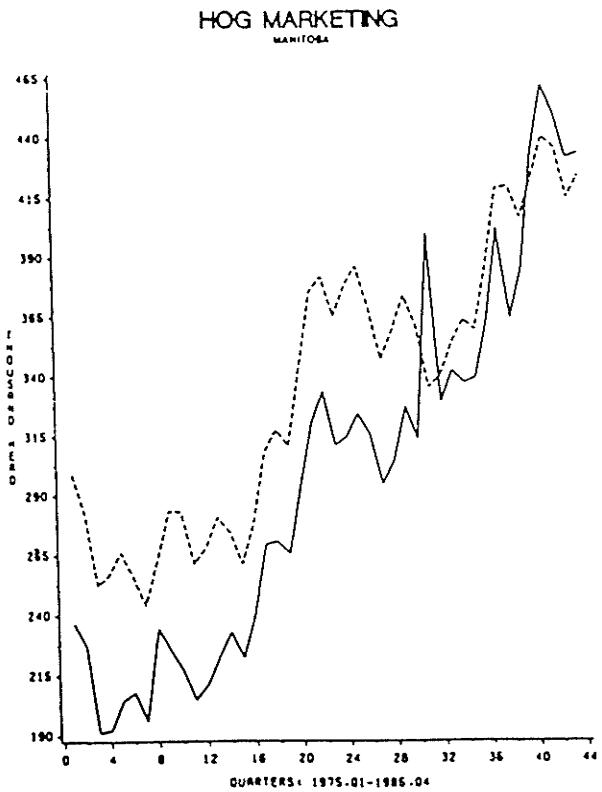
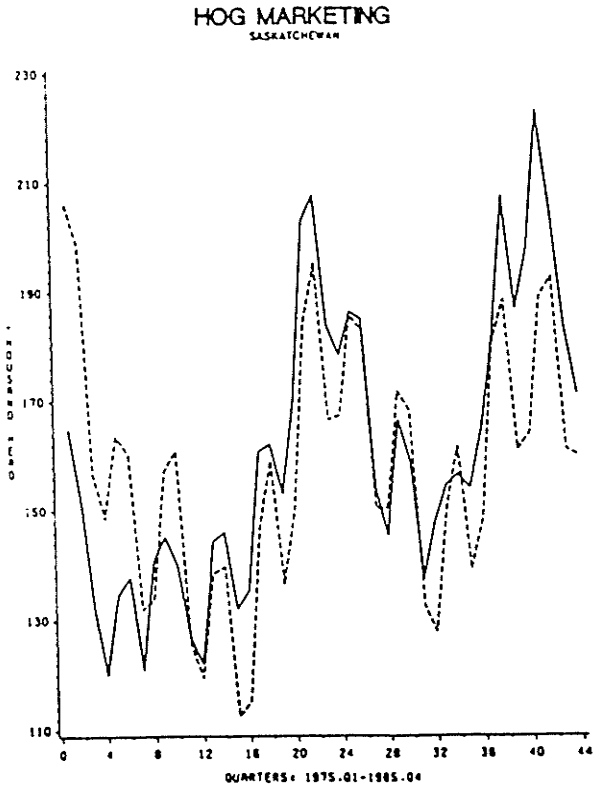


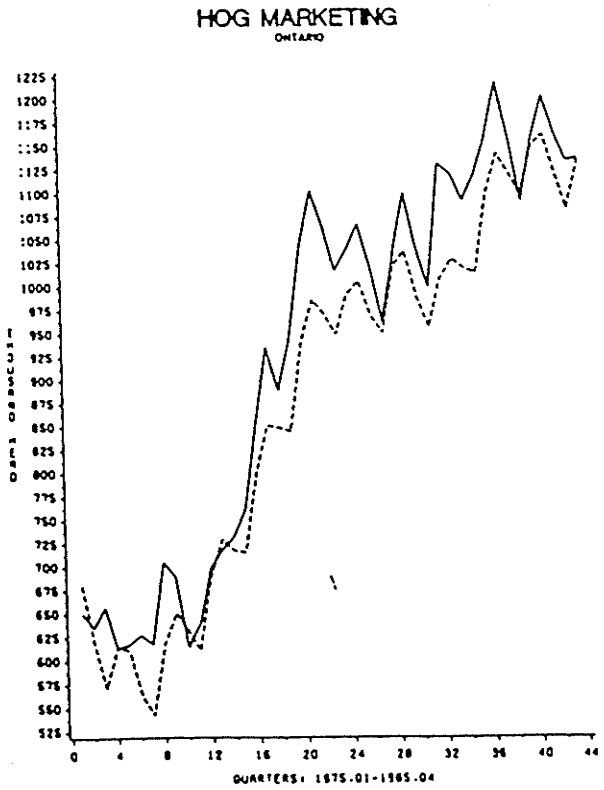
Figure 3.2 (Continued)

Actual vs. Simulated Values for Major Endogenous Variables

———: Actual Values - - - - -: Simulated Values







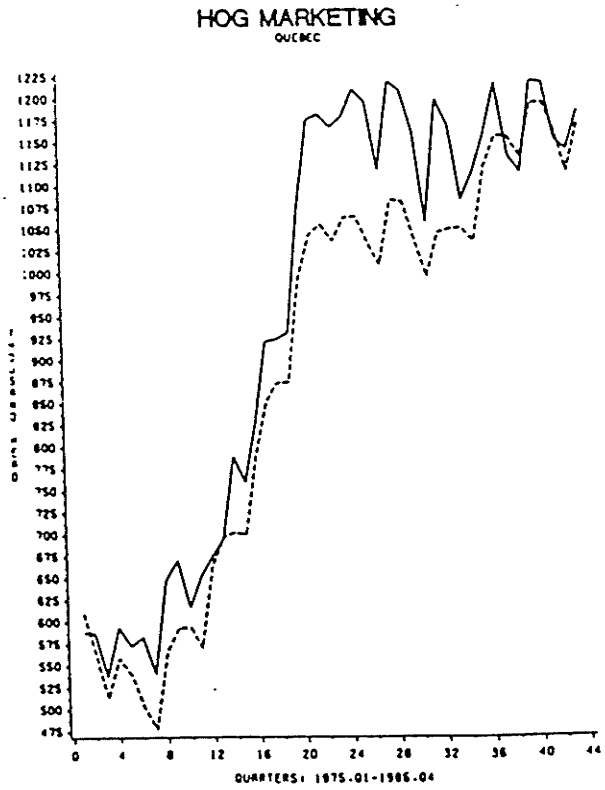
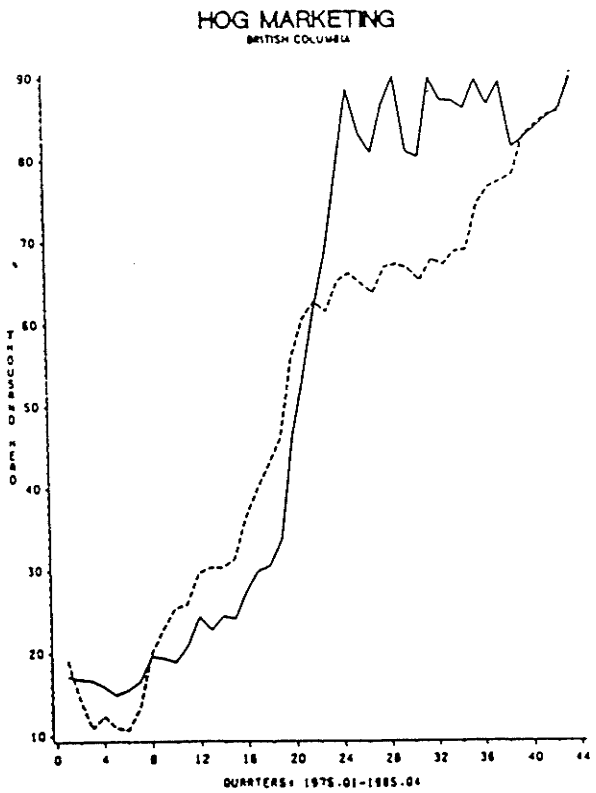
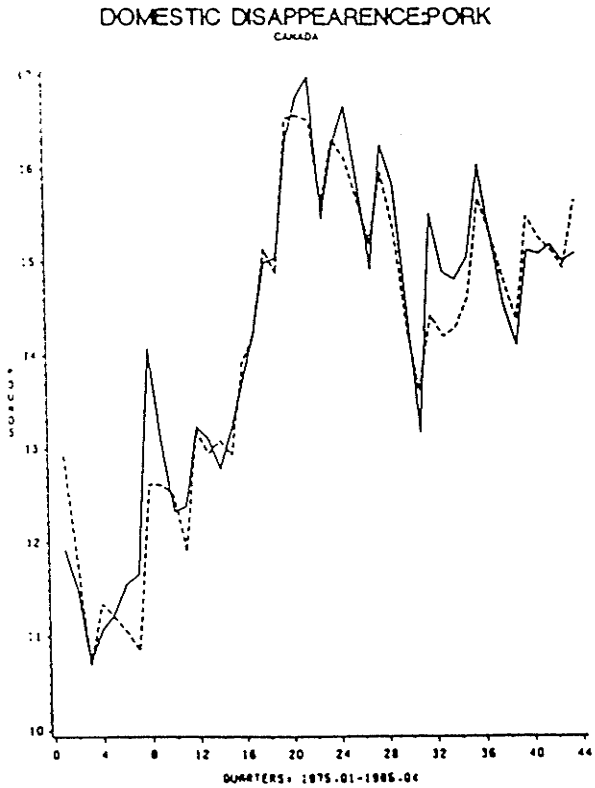


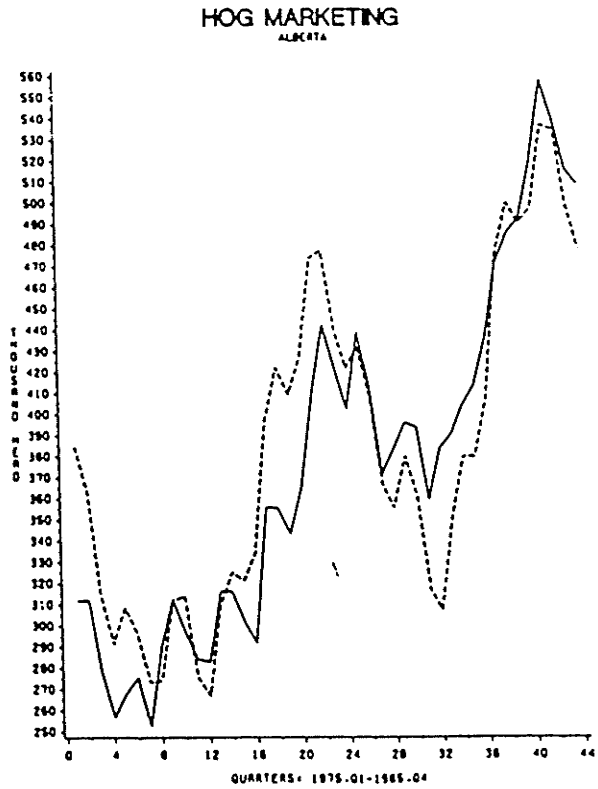
Figure 3.2 (Continued)

Actual vs. Simulated Values for Major Endogenous Variables

———: Actual Values - - - - -: Simulated Values







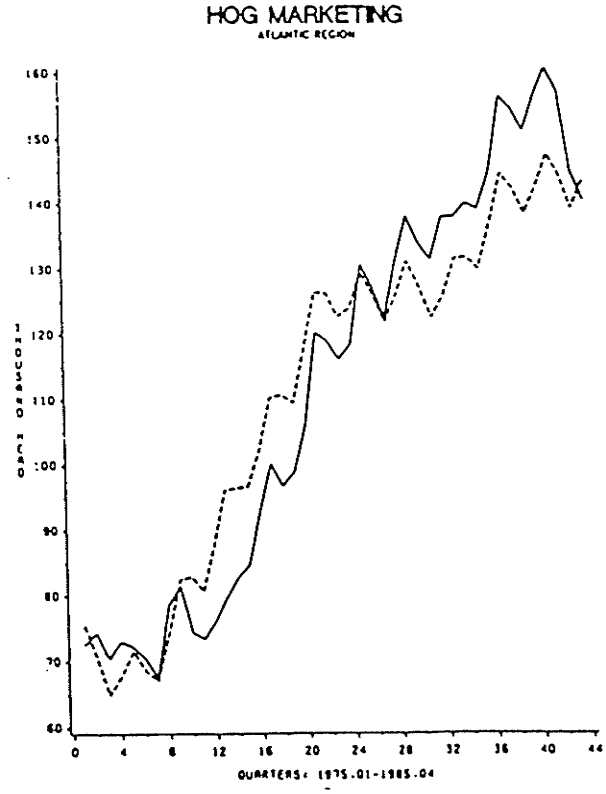
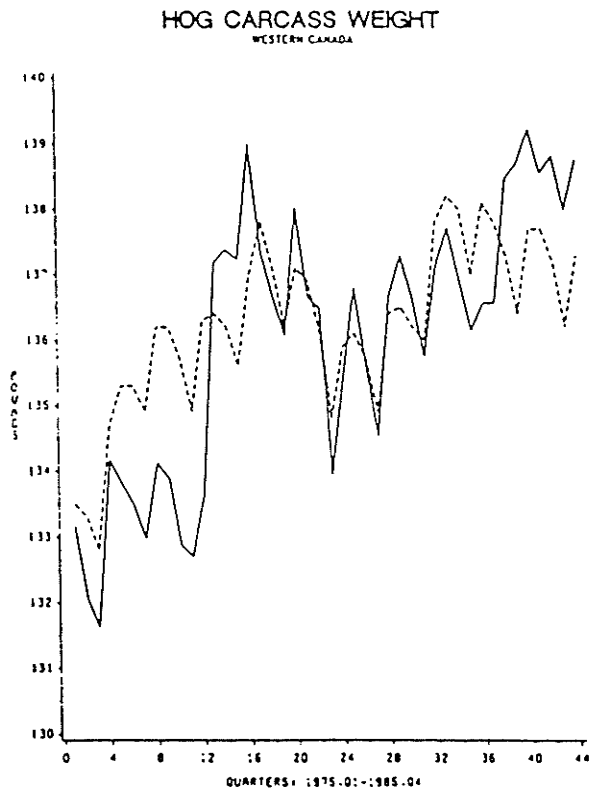
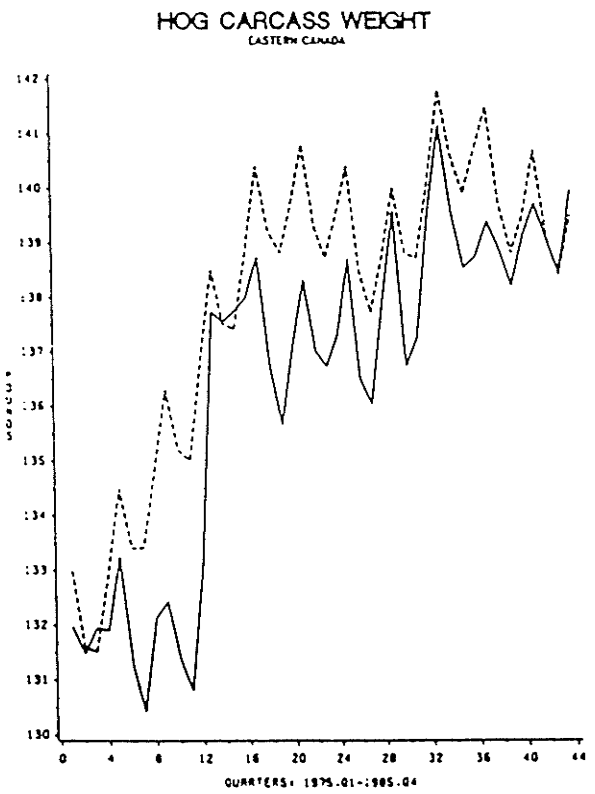


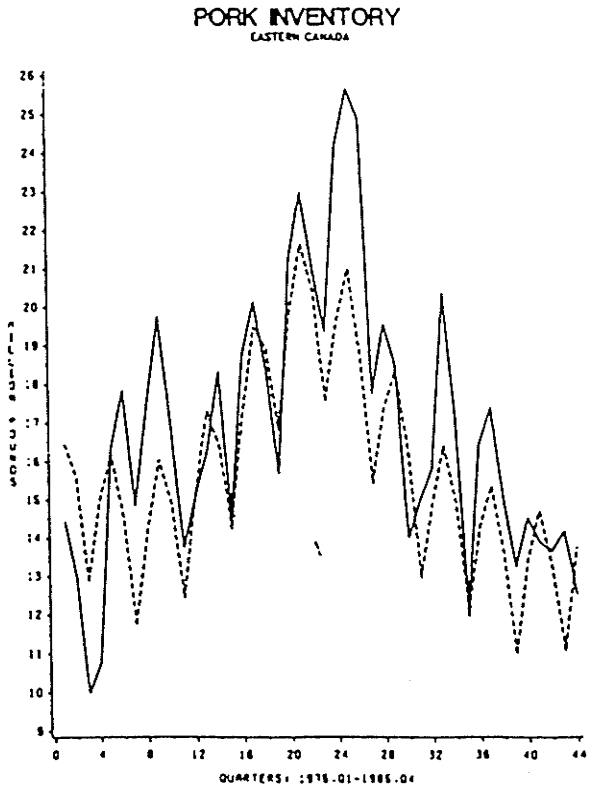
Figure 3.2 (Continued)

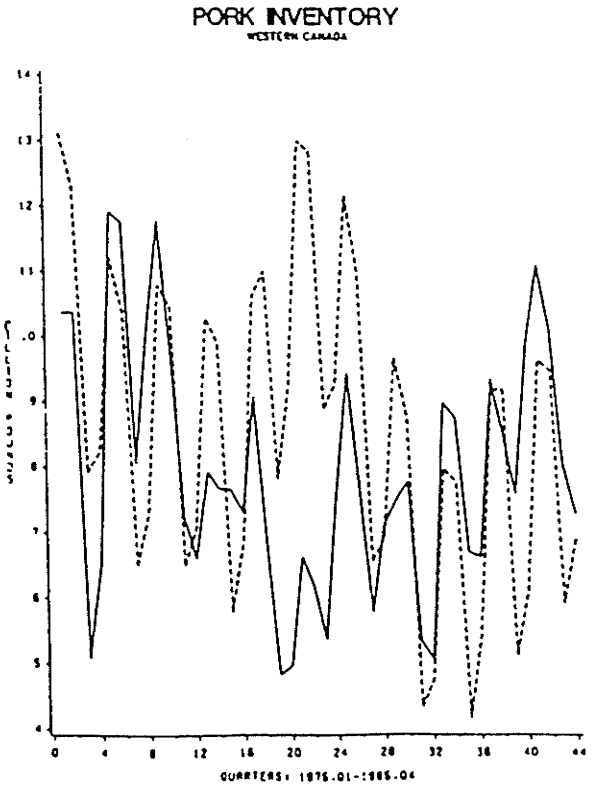
Actual vs. Simulated Values for Major Endogenous Variables

———: Actual Values - - - - -: Simulated Values









the models are quite successful in simulating turning points, i.e. none of the models appear to generate divergent values of the endogenous variables over the historical period.

Another way of testing whether a given model is capable of replicating the historical values satisfactorily involves regressing the actual values of the endogenous variables on their simulated counterparts. Consider the simple regression:

(3.30) Actual = a + b simulated

where,

Actual	=	historical values of the endogenous variables
Simulated	=	simulated values of the endogenous variables
a,b	=	parameters to be estimated.

A perfect forecast is one where the simulated values exactly match the actual values. In such a case it is expected that the parameters a = 0 and b = 1. Additionally, for a perfect forecast, the R^2 is expected to be equal to 1. Hence, the present test involves:

(1) testing the joint hypothesis that a = 0 and b = 1

This can be done through a joint F-test with two restrictions on the regression equation (3.30). The intercept is first suppressed thereby forcing it to take the value of zero and the parameter b is restricted to take the value of 1.

(2) test individually that a = 0 and b = 1 using the t-test

Table 3.2 gives the summary statistics for the above tests for the twenty-one endogenous variables that are estimated behaviourally in the hog-pork model. The t-test shows that in 58 percent of the cases, a = 0 and in 71 percent of the cases

Table 3.2

Summary Statistics from Regressions of Actual on Simulated Values of the Endogenous Variables of the Hog-Pork Model: 1975.1-1985.4

Equations (a)	Computed t-values (b) a = o	b = 1	R^2	F-Values
1. Hog Carcass Weight (west)	-0.15	0.14	0.81	2.51
2. Hog Carcass Weight (east)	-0.27	0.17	0.93	33.75
3. Exports of Hogs from west	-0.54	0.15	0.85	1.27
4. Demand for Pork Inventory (west)	3.68	5.50	0.59	20.74
5. Demand for Pork Inventory (east)	0.14	0.30	0.75	6.22
6. Net Pork Trade with US (west)	0.67	0.10	0.95	0.86
7. Net Pork Trade with US (east)	2.93	1.99	0.96	20.00
8. Per Capita Disappearance of Pork	0.50	0.37	0.93	1.50
9. Price of Index 100 hogs (Alberta)	2.95	3.20	0.90	5.29
10. Price of Index 100 hogs (Sask.)	2.77	3.39	0.91	10.76
11. Price of Index 100 hogs (Manitoba)	2.82	3.29	0.91	6.69
12. Canada-US Price Linkage (PHG21)	3.12	3.63	0.91	9.03
13. Retail Price of Pork	-0.30	-0.05	0.99	6.16
14. Hog Marketing (British Columbia)	-0.06	0.58	0.98	12.35
15. Hog Marketing (Alberta)	2.38	2.81	0.96	0.73
16. Hog Marketing (Saskatchewan)	4.29	4.97	0.88	1.79
17. Hog Marketing (Manitoba)	-3.00	1.90	0.92	53.69
18. Hog Marketing (Ontario)	0.48	0.71	0.97	36.94
19. Hog Marketing (Quebec)	0.40	0.74	0.97	37.38
20. Hog Marketing (Atlantic Region)	0.04	0.00	0.98	4.17
21. Wholesale Price of Pork	1.19	1.53	0.93	4.73

(a) All the above equations were corrected for first order autocorrelations.

(b) For 41 degrees of freedom, the critical t-value at the 5 percent level of significance is approximately 2.02.

b = 1. It should be noted that in the regression of the price variables (PHG12, PHG13, PHG14 and PHG21) all performed rather poorly. Excluding these variables from the above sample, almost 76 percent of the intercept parameter a = 0 and as much as 90 percent of the parameters b = 1. The poor performance of the price variables based on the above test can be explained by the fact that prices do tend to fluctuate more than the other variables, from quarter to quarter and a simple linear model described by equation 3.30 performs rather poorly in capturing these fluctuations. However, based on other tests (see charte of actual vs. simulated values, Figure 3.2), the price equations seem to replicate the historical values of the endogenous variables satisfactorily.

As far as the R^2 test is concerned, in only five cases, the R^2 is below 0.90. The overall performance of the model, based on this criterion is considered to be satisfactory.

3.6. Summary

The major objective of this chapter was to develop an econometric model that can be used for the estimation of the effects of CVD's on the Canadian hog-pork sector under the national tripartite hog program. This was accomplished by specifying a set of equations explaining the dynamics of the hog-pork sector. These include the specification of equations for the domestic disappearance, supply, inventory, net exports and prices. However, since government stabilization programs form an integral part of the hog-pork system in Canada, a set of accounting identities which take explicit account of these programs were also included into the model. In addition, the US CVD's on Canadian hog and pork exports are also accounted for in the model. This was accomplished by specifying a price linkage equation explaining hog prices in Canada as a function of US hog

prices and any other factors that relate the two prices, examples include the transportation costs and the CVD's.

Having specified and estimated the behavioural equations of the econometric model, the next task involved verifying how well the different models perform in replicating historical data. This exercise is especially important for this study because the different models are used primarily for forecasting and policy analysis. Validation of the hog-pork models showed that the individual behavioural equations performed reasonably well in tracking the historical values of the respective endogenous variables. In addition, the ability of the model, as a whole, to replicate the historical values of the endogenous variables also appears to be satisfactory.

CHAPTER IV

MODEL SIMULATION AND POLICY ANALYSIS

4.1. Introduction

In this chapter, a series of simulations are performed using the estimated hog-pork model to evaluate the impacts of different CVD policies on the Canadian hog-pork sectors over the period 1986-1991. A number of experiments are performed under different assumptions about the major policy variable, the CVD's, on hogs as well as on pork. These experiments are described one at a time followed by a summary of the impacts on a selected number of endogenous variables.

The next section describes the base scenario followed by five major experiments contained in sections (3) to (6). Section seven looks at consumer welfare while the summary to this chapter is contained in the last section.

4.2. The Base Scenario

Before proceeding with the various experiments involved in assessing the impacts of CVD's on the Canadian hog-pork sector, it is instructive first to define the baseline scenario. The baseline scenario serves as the benchmark against which all subsequent experiments are compared. In this study, the baseline scenario assumes the following situation to prevail in the Canadian hog-pork sector over the forecast period, 1986.1 - 1991.1:

a. the current CVD's on live hog exports to the US are maintained; and

b. all provinces are assumed to join the national tripartite program for hogs as from the first quarter of 1986.

The implementation of the national tripartite program in Canada requires that all provinces abolish their provincial stabilization programs and join the national program. Some provinces have already done so while others have adopted a gradual phasing out of their provincial programs over a number of years and some are still at the negotiating stage. For all practical reasons, in this study all the provinces are assumed to join the national tripartite program for hogs during the first quarter of 1986. Therefore, over the forecast period, only the national tripartite program prevails. Within the context of this model, this is accomplished by setting all endogenous and exogenous variables relating to provincial stabilization programs equal to zero from the first quarter of 1986.

It should be noted that although provincial programs disappear at the beginning of 1986, the production of both live hogs and pork in 1986 are still affected by provincial stabilization payments in 1985. This is explained by the fact that payments in 1985 influence the producer's decision making process and since it usually takes about four quarters for hogs to be ready for slaughter, there is a lagged impact.

One exception, however, is the province of Quebec which operates its provincial hog stabilization programs on a fiscal year basis. As such, all provincial stabilization programs, including the piglet stabilization program, are replaced by the national tripartite program as from the second quarter of 1986. Therefore, the production of live hogs and pork in Quebec is influenced by payments from these programs until the first quarter of 1987. All endogenous and exogenous variables relating to provincial stabilization programs in Quebec are set equal to zero as from the second quarter of 1986. As in the case of all the other provinces, the Quebec government absorbs any deficit of the provincial programs up to the first quarter of 1986.

Premiums paid by participating producers into the national tripartite program are started as from the third quarter of 1986. The amount of the premiums are determined on the basis of the expected surplus or deficit of the program. Furthermore, (a) the guaranteed margin under this program is also assumed to decline gradually by one percentage point each year; from 95 percent in 1986 to 90 percent in 1991; and, (b) it is assumed that 90 percent of all hog producers in each province participates in the national tripartite program for hogs. Both (a) and (b) are consistent with the provisions of the National Tripartite Stabilization Program for hogs.

Taking the above assumptions into account, the baseline scenario is simulated 21 quarters into the future, starting from the first quarter of 1986. The forecasts produced in this study are conditional forecasts in the sense that the forecast of the dependent variable is conditional upon the predicted values of the independent variable. In a conditional forecast, values of the explanatory variables are not known with certainty and guesses of them must be used to produce the forecast of the dependent variable (Pindyck and Rubinfeld, 1981). In this study, the values assigned to the exogenous variables for the period 1986.1 to 1991.1 are from the short and medium term forecasts of Wharton Econometrics, Agriculture Canada and the Conference Board of Canada.

The results of the baseline scenario for a selected number of endogenous variables are summarized in Table 4.1. It should be noted that the objective was to make the baseline scenario reflect the conditions existing in the Canadian hog-pork sector as close as possible and it should not, in anyway, be regarded as a forecast. Hence, the results in Table 4.1 should be interpreted with caution giving full consideration to the assumptions underlying the study.

Table 4.1

Baseline Scenario: Predicted Values for Selected Endogenous Variables
(Average Quarterly Estimates: 1986.1-1991.1)

Endogenous Variables	1986	1987	1988	1989	1990	1991*
Price of Index 100 Hogs ($/cwt)						
Alberta	76.84	75.68	62.06	66.87	73.46	70.90
Saskatchewan	76.74	75.06	61.52	66.21	72.75	69.83
Manitoba	77.36	75.45	62.08	66.69	73.16	70.06
Ontario	79.74	78.08	64.87	69.45	75.87	72.29
Canada	79.28	77.49	64.18	68.80	75.26	71.94
Net Exports of Pork (Mil. lb)						
West to East	9.55	10.7	12.18	8.89	7.5	4.5
West to US	30.7	28.9	32.08	32.5	31.2	34.7
East to US	62.3	67.9	71.07	71.10	70.11	76.5
Export of Slaughter Hogs (000 Head)						
West	64.05	61.6	98.4	84.34	73.75	101.0
East	53.3	49.3	121.0	62.1	54.3	98.7
Hogs Slaughtered (000 Head)						
West	1094.3	1118.7	1193.5	1180.3	1125.9	1173.4
East	2327.4	2402.4	2474.8	2476.5	2370.2	2452.1
Pork Production (Mil. lb)						
West	151.7	155.2	165.4	163.1	155.4	162.5
East	329.3	345.2	359.5	363.0	350.7	367.8
Hog Marketing (000 Head)						
West	1158.6	1180.3	1292.0	1264.7	1199.6	1274.5
East	2380.8	2451.9	2596.2	2538.6	2424.5	2550.8
Wholesale Price of Pork ($/cwt)						
Canada	129.2	125.9	110.6	116.6	125.0	119.9
Disappearance of Pork (Mil. lb)						
Canada	366.6	377.9	396.6	399.9	382.4	391.2

* Only first quarter of 1991

The information in Table 4.1 shows the values of a selected number of variables likely to be observed had the entire hog industry adhered to the tripartite program in the presence of the US CVD's on hogs. Briefly, the price of index 100 hogs in all regions would fall over the 1986-1990 period. However, prices would bottom-out in 1988 and improve slightly up to 1990 in all regions.

The number of hogs slaughtered in eastern and western Canada would increase slightly by 43 and 32 thousand head respectively over the 1986-1990 period. This shows clearly that with the national tripartite program, no major change in the number of hogs slaughtered is expected. Similarly, the exports of live hogs to the US would increase only marginally in both regions.

However, it appears that the increase in domestic slaughter and the existence of the CVD's result in a slight increase in the exports of pork to the US. For eastern Canada the volume of pork exports to the US increases by about 10 percent over the 5-year period. For western Canada these increases are less substantial and almost negligible, although positive.

Regarding hog marketings, both eastern and western Canada would experience a slight increase, of about 40 thousand head over the 1986-1991 period. In terms of proportion however, the increases are more significant for western Canada than for eastern Canada.

Having established the baseline scenario, a number of experiments are then performed with different assumptions about the CVD and the results from each experiment are compared to the baseline scenario. In other words, an attempt is made to evaluate the impacts of different CVD levels on the endogenous variables

over the period 1987-1991.[33] In the first instance, three experiments are carried. These are referred to:

1. Scenario 1: Free Trade (complete removal of CVD's)
2. Scenario 2: Extension of CVD's on pork concurrently with CVD's on live hogs; and
3. Scenario 3: Reduced CVD's.

Each of these scenarios and the results from them are discussed in the sections to follow.

4.3. Scenario 1: Free Trade

This scenario assesses the impacts of the removal of the US CVD's on Canadian live hog exports to the US. In other words, it is assumed that Canadian live hogs are allowed to enter the US freely. Within the context of the present model, the values of the CVD's on live hogs are set equal to zero wherever they appear in the model for the period 1986-1990. The models are then simulated under the new assumption and the results compared to the baseline scenario. In effect, the comparison of the free trade scenario to the base scenario gives the impacts of the current CVD on live hogs. The results are summarized in Table 4.2 and Figures 4.1 to 4.5 inclusive.

As expected and following the conceptual model in Section 2.3, the removal of the current CVD's on live hog exports results in higher levels of trade in live hogs but less in pork (see Section 2.3). Live hog exports from western Canada increases

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[33] For each scenario, the results are reported for the period 1987-1991 for comparison with the base scenario although model simulations start from the first quarter of 1986. Due to the fact that hog production in some provinces are still affected in 1986 by government programs in the previous year, the simulated values for the four quarters of 1986 are excluded here as 1986 represents a transition year.

Table 4.2

Impacts of the Removal of CVD's on Selected Endogenous Variables Average Quarterly Estimates 1987 to 1991

Endogenous Variables (Unit) and Region	Base Scenario	Scenario 1 Free Trade	Difference	Percent Change (%)
Hog Marketings (000 Head)				
Western Canada	1242.2	1260.5	+18.3	1.47
Eastern Canada	2512.4	2539.0	+26.7	1.06
Canada	3754.6	3799.5	+44.9	1.19
Hog Slaughtered (000 Head)				
Western Canada	1158.3	1148.7	-9.6	-0.8
Eastern Canada	2435.2	2315.2	-120.0	-4.9
Canada	3593.5	3463.9	-129.6	-3.6
Live Hog Exports (000 Head)				
Western Canada	83.8	111.8	+28.0	+33.4
Eastern Canada	77.0	223.8	+146.8	+190.6
Canada	160.8	335.6	+174.8	+108.7
Pork Production (Mil. lb.)				
Western Canada	159.9	159.2	-0.7	-0.45
Eastern Canada	355.4	338.9	-16.4	-4.62
Canada	515.3	498.1	-17.1	-3.3
Net Pork Exports to US (Mil. lb.)				
Western Canada	31.3	22.7	-8.5	-27.5
Eastern Canada	70.0	63.4	-6.6	-9.4
Canada	101.3	86.1	-15.2	-15.0
Price of Hogs ($/cwt)				
Alberta	69.6	70.7	+1.15	+1.7
Saskatchewan	68.9	70.6	+1.68	+2.4
Manitoba	69.4	71.3	+1.82	+2.6
Ontario	72.1	73.9	+1.80	+2.5
Canada	71.5	73.2	+1.67	+2.3

For consistency between the different regions, the results are reported for the period 1987.1 - 1991.1.

by 33 percent compared to the base scenario while exports from eastern Canada to the US more than double. Overall live hog exports from Canada are expected to increase by about 109 percent between 1987 and 1991 should the CVD be removed under the assumption that the tripartite program is in place.

Regarding other impacts of the removal of the CVD's on live hogs, it is interesting to note that the average quarterly price of index 100 hogs improve in all regions, with an average increase of about 2.3 percent for the country. In monetary terms, the price of index 100 hogs are expected to increase by about $1.67/cwt[34] over the 1987-1991 period.

Since under this scenario live hogs can enter the US freely, there is an incentive to ship more live hogs to the US as opposed to shipping dressed meat. The number of hogs slaughtered in Canada drops slightly by 3.6 percent. As a result, pork production in Canada is expected to decline. It is interesting to note that the decline in pork production is much more important in eastern Canada (4.6 percent) and almost insignificant for western Canada (0.45 percent). Consequently, the volume of pork exports to the US falls in all regions; with an average decline of about 15 percent for the country. Again this finding consistent with the conceptual model in Section 2.

4.4. Scenario 2: Extension of CVD's on Pork Concurrently with CVD's on Live Hogs

In this scenario it is assumed that the US decides to impose CVD's equal to $C5.50[35] on pork imports from Canada concurrently with the existing CVD's on

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[34] It should be noted that the impact in the first year is larger. This is due to the biological lag of marketing which prevents hog marketing from adjusting substantially to price signals. Hence, short term impact > medium term impact > long term impact.

[35] Note that a CVD of $4.39/cwt live weight translates into a CVD of $5.50/cwt dressed weight.

live hogs. The likelihood of this event to happen stems from the controversies and ambiguities that still prevail within the US International Trade Commission regarding the question of upstream subsidies and subsidies on like products. Accordingly, subsidies on live hogs in Canada can constitute subsidies on pork which is a related product and therefore could be countervailable. In fact the USITC did impose CVD's of $5.50 on pork from Canada for a short period of time (temporarily) until they were revoked. However, with the recent rise in protectionist sentiments in the US, a revival of the CVD's on Canadian pork can be anticipated. The results of this experiment are summarized in Table 4.3 and Figures 4.1 to 4.5 inclusive.

The imposition of CVD's on pork concurrently with CVD's on live hogs is expected to have some adverse economic implications for the Canadian live hog-pork sector. However, since both live hogs and pork are now faced with CVD's, it appears that the imposition of CVD's on pork results in greater amounts of live hogs to be shipped to the US. In fact, the results show that live hog exports increase by about 40 percent for the whole country, compared to the base scenario. One interesting point is that most of this increase come from eastern Canada (62 percent) and western Canada's exports increase by 18 percent. This is because pork production in eastern Canada represents two-thirds of the national production and consequently anything that affects pork trade is likely to have a much bigger impact on eastern live hog exports than on western live hog exports. In addition, western Canada can redirect its pork exports to eastern Canada instead of the US. The results show that compared to the base scenario, the concurrent existence of CVD's on pork result in western Canada increasing its shipment of pork to eastern Canada by 45 percent.

Compared to the base scenario, the imposition of CVD's on pork results in the exports of pork to decline. The effects are more severe in western Canada where

Table 4.3

Impacts of Imposing CVD's on Pork Concurrently with CVD's on Hogs: Scenario 2 - Rise in Protectionism Average Quarterly Estimates: 1987-1991[a]

Endogenous Variables Region (unit)	Base Scenario	Scenario 2 CVD on Pork	Difference	Percent (%)
Hog Marketings (000 Head)				
Western Canada	1242.2	1221.3	-20.9	-1.7
Eastern Canada	2512.4	2486.5	-25.9	-1.0
Canada	3754.6	3707.8	-46.8	-1.2
Hog Slaughtered (000 Head)				
Western Canada	1158.3	1122.0	-36.3	-3.1
Eastern Canada	2435.2	2361.6	-73.6	-3.0
Canada	3593.5	3483.6	-109.9	-3.0
Live Hog Exports (000 Head)				
Western Canada	83.8	99.3	+15.5	18.4
Eastern Canada	77.0	124.9	+47.9	+62.2
Canada	160.8	224.2	+63.2	+39.3
Pork Production (Mil. lb.)				
Western Canada	159.9	155.0	-4.9	-3.0
Eastern Canada	355.4	344.7	-10.7	-3.0
Canada	515.3	499.7	-15.6	-3.0
Net Pork Exports to US (Mil. lb.)				
Western Canada	31.3	21.7	-9.6	-30.6
Eastern Canada	70.0	62.6	-7.4	-10.6
Canada	101.3	84.3	-17.0	-16.8
Price of Hogs ($/cwt)				
Alberta	69.6	67.8	-1.8	-2.6
Saskatchewan	68.9	67.4	-1.5	-2.2
Manitoba	69.4	67.9	-1.5	-2.2
Ontario	72.1	70.6	-1.5	-2.0
Canada	71.5	69.9	-1.6	-2.2
Net Exports of Pork West-East (Mil. lb.)	9.51	13.83	+4.3	+45.5

[a] For consistency, results are reported for the period 1987.1-1991.1.
Scenario 2: CVD's on both live hogs and pork.

exports fall by 30 percent over the base period. In eastern Canada, exports falls by 10 percent only. In terms of volume, the average quarterly exports of pork falls by 17 million pounds compared to the base scenario over the 1987-1991 period.

Overall, hog marketings in Canada decline by 1.2 percent over the base scenario. Similarly the number of hogs slaughtered decline by about 109 thousand head, representing about 3 percent of the average quarterly hog slaughter of the base scenario. With lower hog marketings and slaughter, the result is a decline in the amount of pork produced. In both eastern and western Canada, pork production declines by about 3 percent over the base scenario.

The imposition of the CVD on pork also has a depressing effect on the prices of index 100 hogs. The greatest price impact occurs in Alberta where a decline of about $1.80/cwt[36] is experienced. However, the average price decline for the whole country is about 2.2 percent of the base price, or about $1.60/cwt.

A comparison of the free trade scenario to scenario 2 where equivalent CVD's are imposed on pork concurrently with CVD's on live hogs gives the total effects on the hog-pork sector that can be attributed to CVD's. Under the free trade scenario there are no CVD's at all. Under the second scenario, there are CVD's of equal amount on both live hogs and pork. The data in Table 4.4 summarizes some of the results.

Hog Marketings in Canada decline by about 92 thousand head with about 52 thousand less hogs marketed in eastern Canada. Live hog exports to the US from Canada decline by about 111 thousand head. However, the decline from eastern Canada is about 99 thousand head. Since the number of hogs slaughtered increases slightly in the whole country, pork production also increases. However, these increases occur only in eastern Canada and offset the slight decline in both hog

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[36] Refer to Footnote 32.

Table 4.4

Free Trade Versus Protectionism in the
Canadian Hog-Pork Sector
Average Quarterly Estimates: 1987-1991

	Scenario 1 Free Trade	Scenario 2 Protectionism	Difference
Hog Marketings (000 Head)			
Western Canada	1260.5	1221.3	-39.2
Eastern Canada	2539.0	2486.5	-52.5
Canada	3799.5	3707.8	-91.7
Hog Slaughtered (000 Head)			
Western Canada	1148.7	1122.0	-26.7
Eastern Canada	2315.2	2361.6	+46.4
Canada	3463.9	3483.6	+19.7
Live Hog Exports (000 Head)			
Western Canada	111.8	99.3	-12.5
Eastern Canada	223.8	124.9	-98.9
Canada	335.6	224.2	-111.4
Pork Production (Mil. lb.)			
Western Canada	159.2	155.0	-4.2
Eastern Canada	338.9	344.7	+5.8
Canada	498.1	499.7	+1.6
Net Pork Exports to US (Mil. lb.)			
Western Canada - Eastern Canada	17.96	13.83	-4.2
West - US	22.7	21.7	-2.0
East - US	63.4	62.6	-0.8
Canada - US	86.1	84.3	-1.8
Price of Index 100 Hogs ($/cwt)			
Alberta	70.7	67.8	-2.9
Saskatchewan	70.6	67.4	-3.2
Manitoba	71.3	67.9	-3.4
Ontario	73.9	70.6	-3.3
Canada	73.2	69.9	-3.3

Scenario 2: CVD's on both live hogs and pork.

slaughter and pork production in western Canada. The net exports of pork falls in all regions with an average of 1.8 million pounds less pork being exported to the US as a result of CVD's on pork and live hogs. The increase in the domestic consumption due to lower prices explain why pork production increases while exports of pork decrease.

The price of index 100 hogs fall in all regions. The joint impacts of the CVD on live hogs and pork result in the price of index 100 hogs to decline by an average of $3.30/cwt.[37] The lowest price impact is felt in Alberta where the difference between the free trade price and the protectionist price is only $2.90/cwt over the 1987-1991 period.

4.5. Scenario 3: Revised CVD's

Under this experiment, it is assumed that the United States and Canada come to a consensus through trade negotiations to reduce the CVD's to a mutually agreed level. This is a very likely event for different reasons. First, the implementation of the tripartite program itself necessitates a re-examination of the levels of the present CVD's. It should be recalled that the CVD's on live hogs were assessed during the fiscal year, 1984. At that time, the national tripartite program was not in existence. In addition, between 1984 and 1987, the economic situation in the hog sector has changed as a result of not only new policies that are specifically designed for that sector, but also due to global economic changes. Furthermore, it is a well known fact that the tripartite program is designed to be less generous than the previous provincial government programs. Hence, there are

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[37] It should be noted that in the short run (the immediate effects) before Canadian production adjust to lower prices, the impact of the CVD on Canadian prices is much larger.

sufficient reasons to believe that the amount of subsidies available to hog producers over the 1987-1991 period are very likely to be lower than what they were in 1984.

Two experiments are carried in this section. Both assume a 25 percent reduction in the current CVD's as from 1988. In Scenario 3.1 the CVD on live hogs is reduced by 25 percent and the results are compared to the base scenario where the full CVD's exist. In Scenario 3.2, it is assumed that the CVD's on both live hogs and pork are reduced by 25 percent starting in 1988. The results of this experiment are compared to Scenario 2 where the full CVD's exist on both live hogs and pork. The comparison of these two experiments essentially shows the effects of reducing the CVD's by 25 percent on some economic indicators of the hog sector.

The results for Scenario 3.1 are summarized in Table 4.5. Overall, it is estimated that by reducing the current CVD's by 25 percent, no major changes occur in the hog-pork sector. The most striking impacts are that live hog exports increase by 32 percent in eastern Canada and by 7 percent in western Canada. Reducing the CVD's on live hogs makes it relatively more attractive to export live hogs than pork. Pork exports to the US decline by about 1.9 percent from eastern Canada and by about 4 percent from western Canada. A marginal increase is also noted in the Index 100 hog prices, which improves by about 0.7 percent over the base scenario. Overall, it can be concluded that by reducing the CVD's by 25 percent, no major shocks are felt in the hog pork sector compared to the other scenarios (see Figure 4.1 - 4.5).

The results for Scenario 3.2 are summarized in Table 4.6. Again no major changes are visible following a reduction of the CVD's on both live hogs and pork by 25 percent. The most apparent changes are those that occur with live hog exports and the price of Index 100 hogs. As a result of lower CVD's, eastern Canada's exports of live hogs to the US increases by about 10.5 percent over the

Table 4.5

Impacts of a 25 Percent Reduction in CVD's on Live Hogs
Average Quarterly Estimates: 1988-1991
Scenario 3.1 Versus Base Scenario

	Eastern Canada	Western Canada	Canada
		(percent)	
Hog Marketings	+0.08	+0.11	+0.09
Hog Slaughtered	-0.75	-0.33	-0.62
Live Hog Exports	+31.7	+6.7	+16.7
Pork Exports to US	-1.93	-3.96	-2.56
Cash Receipts for Hogs	+0.52	0.53	+0.53
West - East Pork Trade	-	-	+14
Price of Index 100 Hogs	-	-	+0.70

Table 4.6

Effects of a 25 Percent Reduction in CVD's on Both Live Hogs and Pork
Average Quarterly Estimates: 1988-1991
Scenario 3.2 Versus Scenario 2

	Eastern Canada	Western Canada	Canada
		(percent)	
Hog Marketings	0.12	+0.2	+0.15
Hog Slaughtered	-0.4	-0.09	-0.24
Live Hog Exports	+10.5	+1.43	+6.15
Pork Exports to US	-0.15	-0.40	-0.22
Cash Receipts for Hogs	1.0	1.1	1.03
West - East Pork Trade	-	-	+4.32
Price of Index 100 Hogs	-	-	+1.28

export levels in Scenario 2. Exports of live hogs from western Canada also increases, but by a lesser proportion; by approximating 1.4 percent. Over the 1988-1991, period the average quarterly price of Index 100 hogs increases by about 1.3 percent compared to the experiment where full CVD's exist. A casual look at Figure 4.1 - 4.5 shows that a 25 percent reduction of CVD's on both live hogs and pork does not constitute a major shock on the hog-pork industry in that no significant impacts are felt compared to the case where the full CVD's are in effect.

In summary, the results of the two preceding experiments show clearly that besides the levels of live hog exports, no major changes occur in the hog-pork sector following a 25 percent reduction in CVD's. This is interesting in that despite some improvement, the welfare of hog farmers do not improve in the same proportion as the decline in CVD's. This might be due to the fact that prices do not respond equally to changes in the levels of CVD's One reason for this, and as pointed out in section 2.5, might be that the supply elasticities or the relevant excess supply functions are understated. Hence, it should be instructive to investigate how responsive the hog-pork sector is to changes in CVD levels under different elasticity assumptions. This will be the object of the next section.

Figure 4.1

Simulated Hog Slaughter: 1987.Q4-1991.Q1

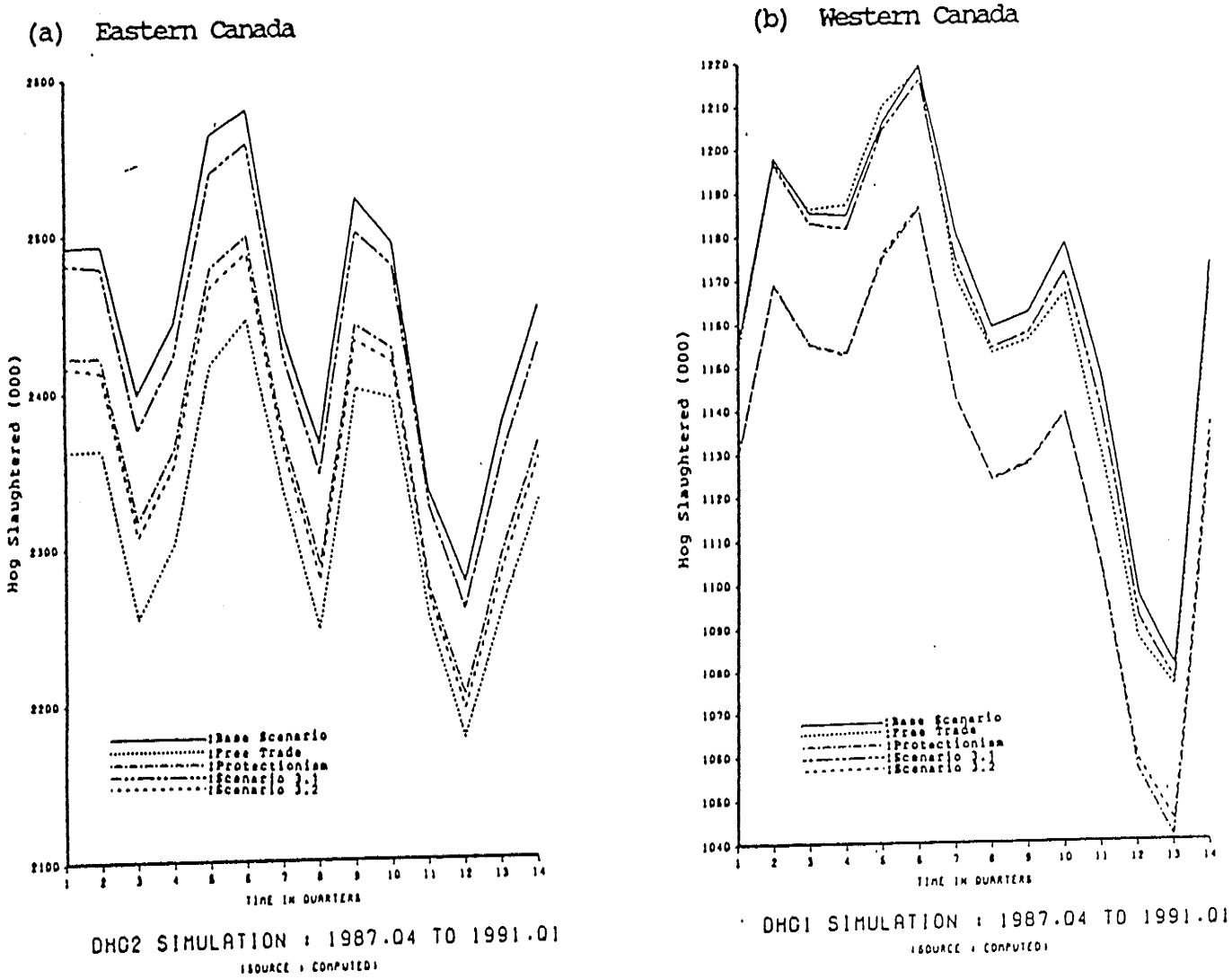
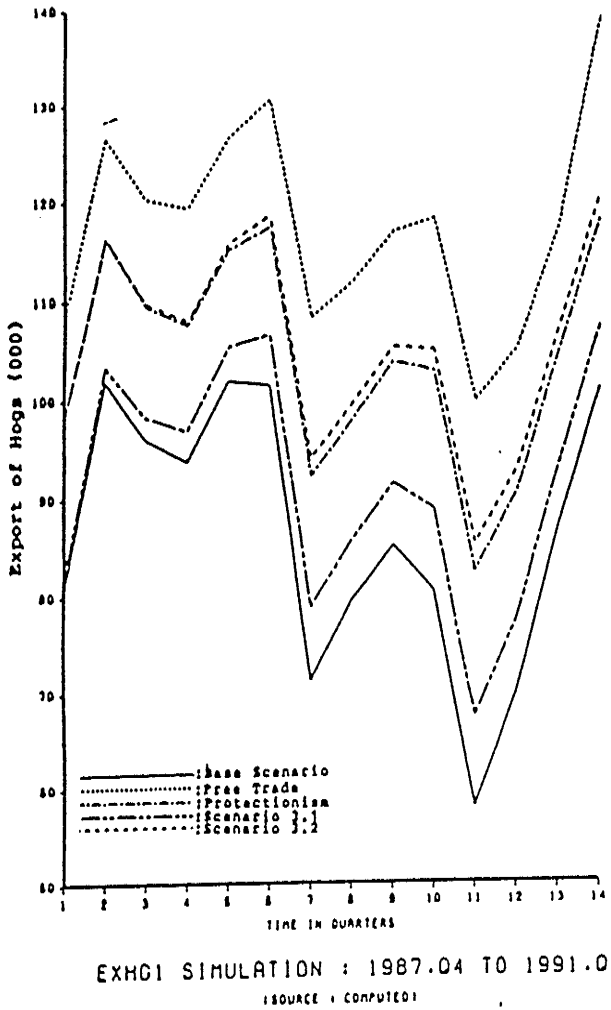


Figure 4.2

Simulated Live Hog Exports: 1987Q4 - 1991.Q1

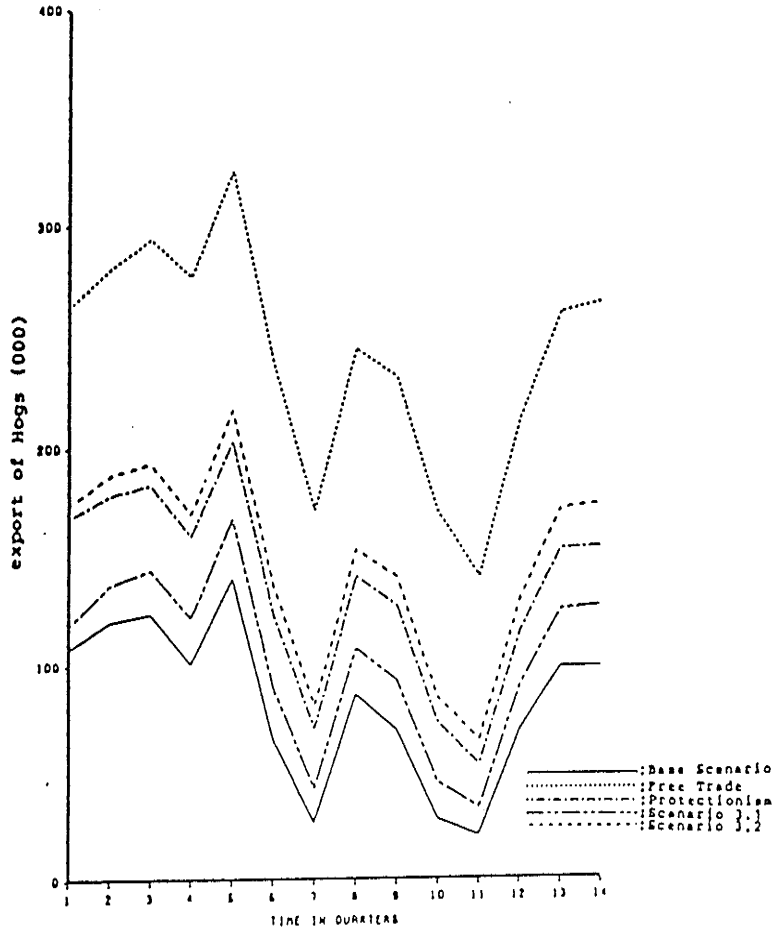
(a) Western Canada



EXHG1 SIMULATION : 1987.04 TO 1991.01

(SOURCE : COMPUTED)

(b) Eastern Canada



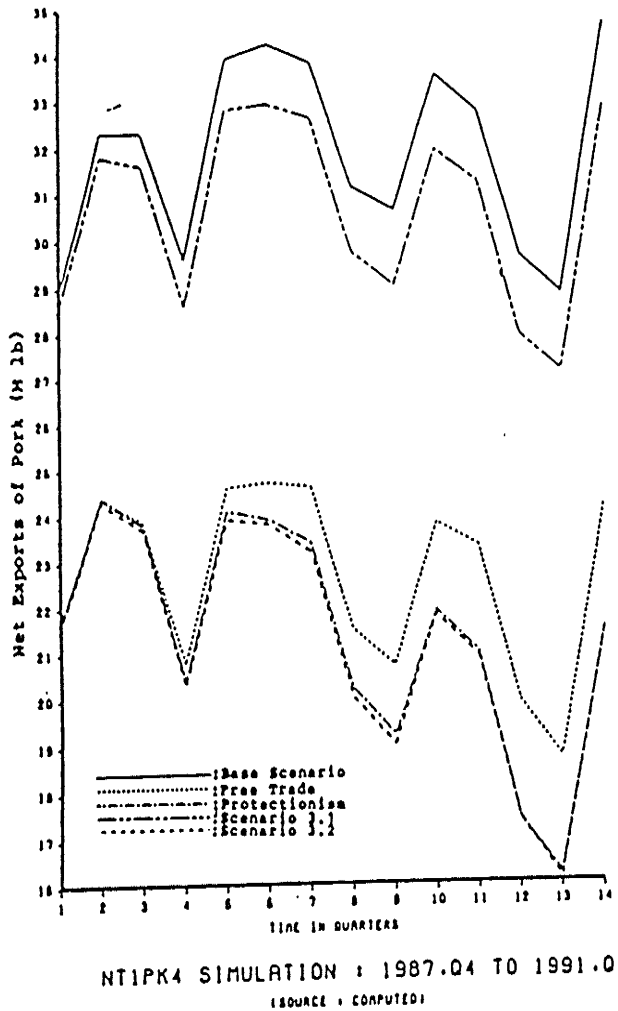
EXHG2 SIMULATION : 1987.04 TO 1991.01

(SOURCE : COMPUTED)

Figure 4.3

Simulated Net Pork Exports to US: 1987.Q4-1991.Q1

(a) Western Canada



(b) Eastern Canada

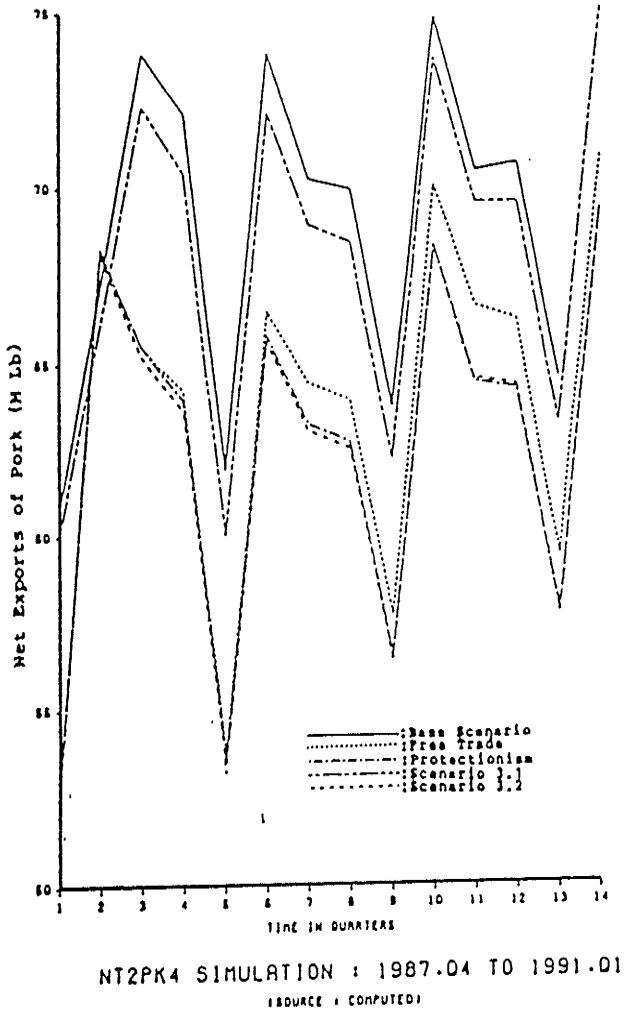
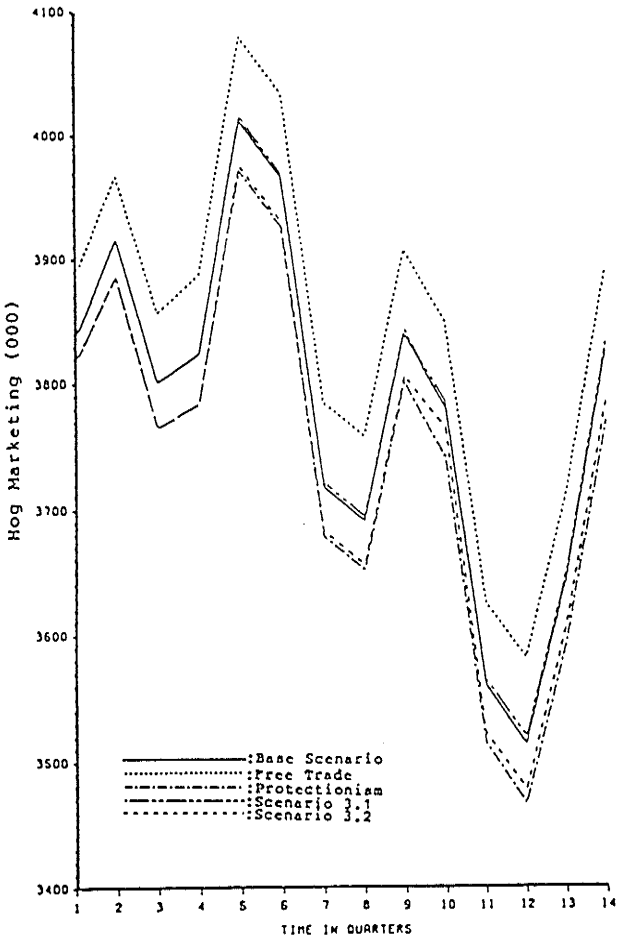


Figure 4.4

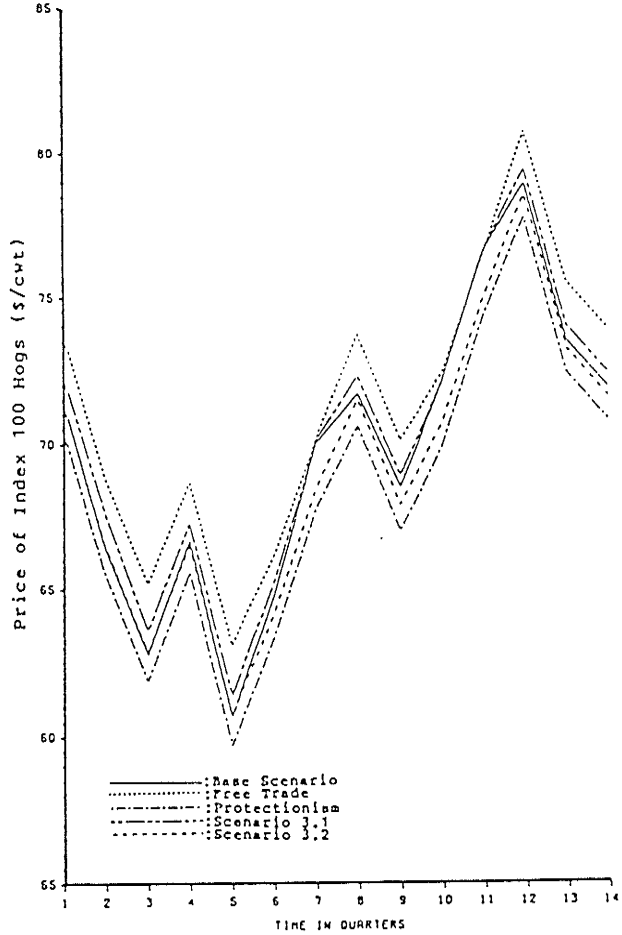
Simulated Net Marketing



SHG3 SIMULATION : 1987.04 TO 1991.01

(SOURCE : COMPUTED)

Simulated Price of Index 100 Hogs



PHG3 SIMULATION : 1987.04 TO 1991.01

(SOURCE : COMPUTED)

4.6. Sensitivity Analysis

In this section a number of experiments are executed to analyze how sensitive the hog-pork sector is to CVD's under different assumptions about the demand and supply elasticities. From the theoretical section (section 2.4, Chapter II), it was established that the more inelastic the excess supply curve, the greater is the impact of the CVD on the domestic price of the exportable in the exporting region. A more inelastic excess supply function implies more inelastic domestic demand and supply functions. Therefore it can be postulated that the more inelastic the domestic supply and demand functions, the greater will be the impact of a given CVD on the exporter's price.

In the experiments to follow, the original elasticities that were used for the previous exercises (Scenarios (1)-(3)) are modified by 20 percent. The new set of elasticities together with the original ones are summarized in Table 4.7. The long-run elasticities for the supply functions are calculated as:

$$LRE = SRE/(1-b)$$

where,

LRE = long-run elasticity

SRE = short-run elasticity

b = coefficient of the lagged dependent variable.

The new elasticities in column (1) and (3) of Table 4.7 are simply the original elasticities downgraded and upgraded respectively by 20 percent. Caution was taken to ensure that the value of the dependent variable at the means are the same for each elasticity measure. This was achieved by changing both the intercept and the slope of the respective functions. The idea behind the above explanation is presented in Figure 4.5 below.

Table 4.7

Price Elasticity of Demand and Supply

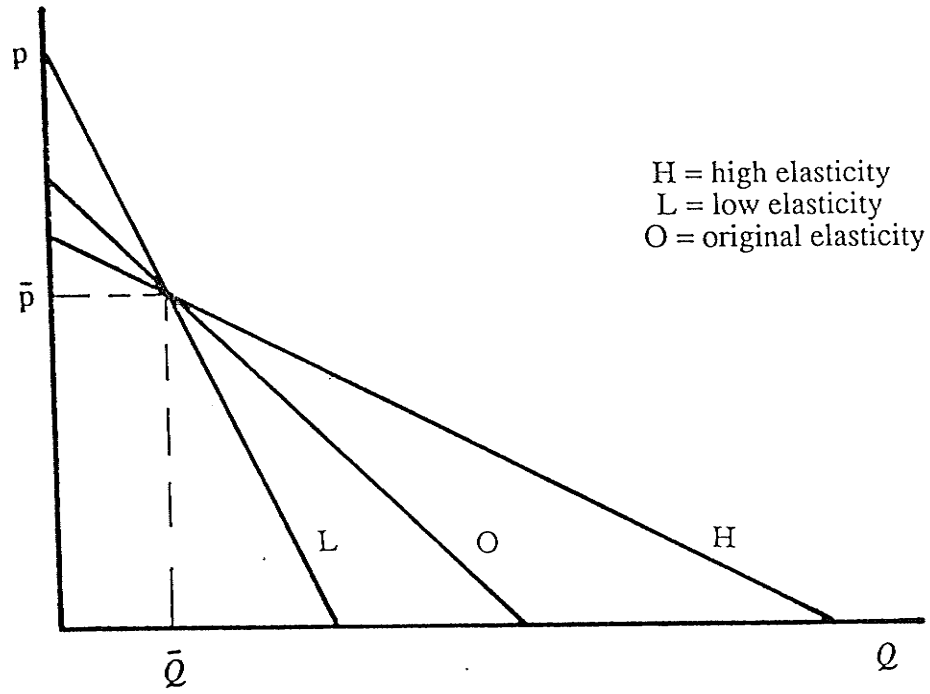
	Low Elasticity	Original Elasticity	High Elasticity
Demand, Canada (Pork)	-0.56	-0.70	-0.84
Supply (Hogs)			
British Columbia*	5.51	6.89	8.27
Alberta	0.178	0.222	0.266
Saskatchewan	0.11	0.14	0.168
Manitoba	1.02	1.28	1.54
Ontario	0.63	0.786	0.94
Quebec	0.95	1.19	1.43
Atlantic Provinces*	6.99	8.74	10.49

* The elasticity measures for the province of British Columbia and for the Atlantic region appear to be exceptionally large compared to those of the other provinces. Different models were tried for these two regions and most yielded elasticities which were not noticeably different from the ones presented here. To the extent that both British Columbia and the Atlantic provinces represent only minor participants in the Canadian hog sector (each accounting for about 2 and 4 percent respectively, of total Canadian hog production), the magnitudes of these elasticities do not bear any major influence on the overall model.

Source: Estimated.

Figure 4.5

Illustration of High, Low and Original Elasticities



The next step is to use the elasticities derived above to estimate the impacts of CVD's on the Canadian hog-pork sector. The focus of the discussion will be primarily on the price impact although some other results are also reported. The base scenario in this set of experiment is the free trade scenario of section 4.3. Recall that this scenario assumes the original elasticity of demand and supply and a complete removal of all CVD's.

4.6.1. Scenario 4: Low Demand, Low Supply Elasticities (LDLS)

The first experiment (Scenario 4) involves simulating the model over the 1987-1991 period under the assumption of reduced elasticities and imposing CVD's on both live hogs and pork. The elasticities used in this experiment are the low elasticities in Table 4.7. The comparison of the results from this experiment to

those of the base scenario gives the combined effect of CVD's under the assumption of lower elasticities. Some of the most important impacts are summarized in Table 4.8.

4.6.2. Scenario 5: High Demand, High Supply Elasticities (HDHS)

The second experiment involves repeating the above experiment but this time assuming high demand and supply elasticities. These elasticities are shown in column 3 of Table 4.7. The high elasticities are 20 percent higher than the original elasticities. The results from this scenario (labeled HDHS) are summarized in Table 4.8. A comparison of these results to the free trade scenario gives the combined effects of CVD's on both live hogs and pork on the Canadian hog-pork sector under the assumptions of high demand and high supply elasticities.

The results in Table 4.8 are interesting in that they lead to several conclusions. First, given the fact that the Canadian hog/pork sector is a small but integral part of a bigger north American market, changes in the domestic demand and supply elasticities do not influence the effects that CVD's have on domestic prices.

Under the base scenario the Canadian price of Index 100 hogs is $73.2/cwt. Under the "low elasticity" assumption prices fall to $69.75 - a decline of $3.45/cwt. However, under the "high elasticity" assumption prices decline by only $3.10/cwt to $70.10/cwt. It is interesting to note that between the "high elasticity" and "low elasticity" scenarios, there is a 50 percent variation in the elasticities. However, the difference between the impacts on the price is only about 12 percent (between $3.10 and $3.45). This finding is interesting in that domestic demand and supply elasticities have only marginal impacts on the price of hogs. This finding is also consistent with the small country case presented in section 2.1. To repeat, this

Table 4.8

Sensitivity Analysis with Low and High Elasticities
Average Quarterly Estimates: 1987-1991

	Scenario 1 Free Trade[a]	Scenario 4 LDLS[b]	Scenario 5 HDHS[c]
Hog Marketings (000 Head)			
Western Canada	1260.5	1228.2	1214.9
Eastern Canada	2539.0	2497.3	2480.0
Canada	3799.5	3725.5	3694.9
Live Hog Exports (000 Head)			
Western Canada	118.8	101.3	97.7
Eastern Canada	223.8	135.0	117.7
Canada	342.6	236.3	215.4
Pork Production (Mil. lb.)			
Western Canada	159.3	155.7	154.0
Eastern Canada	338.9	344.7	344.7
Canada	498.2	500.4	498.7
Net Pork Exports to US (Mil. lb.)			
Western Canada	22.7	22.4	21.0
Eastern Canada	63.4	63.2	62.2
Canada	86.1	85.6	83.2
Price of Index 100 Hogs ($/cwt)			
Alberta	70.75	67.56	67.9
Saskatchewan	70.58	67.16	67.5
Manitoba	71.21	67.64	68.9
Ontario	73.90	70.44	70.8
Canada	73.20	69.75	70.1

a Free trade scenario: assumes original elasticities and no CVD's.

b LDLS Scenario 4: assumes low demand and low supply elasticities plus CVD's on both live hogs and pork.

c HDHS Scenario 5: assumes high demand and high supply elasticities plus CVD's on both live hogs and pork.

might be so because the relatively small Canadian hog sector is closely tied to the larger US hog sector.

The second interesting finding of the above experiment relates to the general effects rather than to the magnitudes of the effects. The results support the theoretical hypothesis of section 2.4 (Chapter II) where it was postulated that the more inelastic the demand and supply functions, the greater is the impact of the CVD on the domestic price. This is exactly what the model shows. Under the more inelastic supply and demand function assumptions, the Canadian price of Index 100 hogs falls by $3.45/cwt compared to only $3.10/cwt in the case of the less inelastic demand and supply assumptions.

4.7. Consumer Welfare Analysis

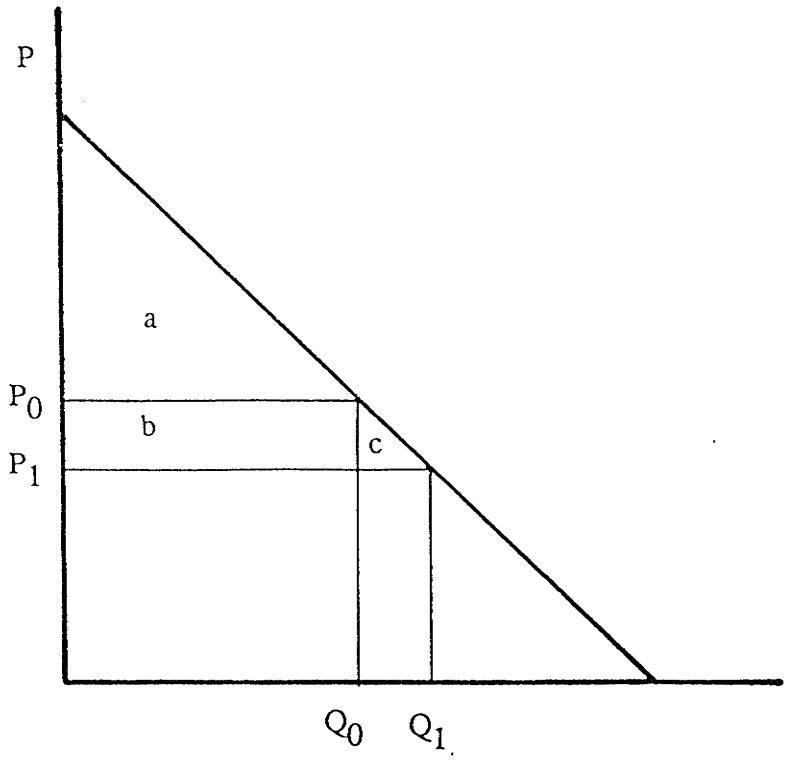
So far the discussion on the impacts of CVD's has been limited to the industry. The effects on prices, exports, slaughter, marketing and so forth were analyzed in the previous section. However, any shock in an economic system that results in changes in prices has welfare implications for the consumers. This section analyses some of the implications on Canadian consumers resulting from CVD's.

It has already been shown that the imposition of CVD's on hogs results in Canadian hog prices to decline. A fall in the price of hogs in Canada is expected to benefit Canadian consumers, ceteris paribus. The increase in the welfare of Canadian consumers can be measured by using the "consumer surplus" concept.

First developed by Dupuit (1844), consumer surplus has been widely applied in welfare economics as a means of measuring consumer gain or loss resulting from changes in the price level (Just et al., 1982:84-85). Dupuit defined consumer surplus as "the maximum price the consumer is willing to pay for the last unit consumed".

Figure 4.6

Consumer Surplus



More recently, Willig[38] (1976) and Just et al. (1982) have demonstrated that consumer surplus can be used as an approximation to measure the welfare changes resulting from price changes.[39]

Generally, consumer surplus is defined as the area under the demand curve and above the price line. From Figure 4.6 the consumer surplus at price P_0 is then given by area "a". Similarly the consumer surplus at price P_1 is given by area "a+b+c". A price decrease from P_0 to P_1 therefore results in a change in consumer

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[38] Willig, R.D. "Consumer's Surplus Without Apology," American Economic Review 66(4:September 1976):589-597.

[39] For a rigorous discussion of the issues relating to the use of consumer surplus as a measure of welfare change, see Just et al (1982) and Willig (1976).

surplus that can be approximated by areas "b+c". This represents the net gain (in monetary terms) to consumers as a result of the decline in the price level.

In order to calculate the areas b+c, one needs to know with certainty the values of P_1 and P_0, Q_1 and Q_0 and the slope of the demand curve. However, the choice of the appropriate elasticity measure for the demand poses some problems in calculating the areas under the curve since between Q_0 and Q_1, for instance, a range of elasticities exists. Just et al. (1982) have demonstrated that this problem can be bypassed by using the average of the elasticities at Q_0 and Q_1 respectively.

Within the context of the present study, the estimated demand function for pork in Canada is used to calculate the changes in consumer surplus resulting from price changes for each scenario. The results are summarized in Table 4.9.

As shown earlier, the imposition of CVD result in the domestic price of pork to decline in Canada and represents a benefit to consumers. Column 2 in Table 4.9 shows the benefits to Canadian consumers as a result of the CVD on live hogs by comparing the base scenario to the free trade scenario. On average between 1988 and 1991, consumers in Canada gain $7.5 million every quarter as a result of the CVD. The highest quarterly gain occurs in 1988 where the change in consumer surplus is $9.8 million.

A reduction of CVD's by 25 percent means that prices in Canada for the exportable are likely to increase. A comparison of the base scenario to scenario 3.1 which assumes a 25 percent reduction in CVD's in live hogs shows that between 1988 and 1991, consumers lose an average of $2.1 million every quarter. In other words, by reducing the CVD's by 25 percent on live hogs, cost Canadian consumers lose an average of $8.4 million annually between 1988 and 1991.

A comparison of scenario 3.1 to the free trade scenario shows the effects of a reduced CVD against a "no CVD" situation. In other words, if we move from a

Table 4.9

Change in Consumer Surplus for Pork Consumers
Average Quarterly Estimates: 1987-1991

Year	Base Versus Free Trade	Base Versus Scenario 3.1	Free Trade Versus Scenario 3.1	Base Versus Scenario 2
		(Million Dollars)		
1987(a)	+9.2	N.A.	N.A.	+7.4
1988	+9.8	-3.1	-6.7	+3.8
1989	+6.1	-1.7	-4.4	+6.2
1990	+4.7	-1.2	-3.5	+6.8
1991(1)	+9.4	-2.4	-7.0	+4.2
Average(b)	+7.5	-2.1	-5.4	+5.2

[a] Fourth quarter of 1987 only.

[b] 1988 to 1991 average.

Note: Base Scenario: CVD on live hogs only
Free Trade: CVD on live hogs eliminated
Scenario 2: CVD on pork concurrently with CVD on live hogs
Scenario 3.1: Low CVD on live hogs (reduced by 25%)

situation where there are CVD's of $3.30/cwt to a situation of free trade, Canadian consumers lose a quarterly average of $5.4 million over the 1988-1991 period.

Finally, comparing the base scenario to scenario 2 gives the effect that the additional CVD on live hogs would have on consumers. Here, consumers gain a quarterly average of $5.2 million for the 1988-1991 period.

4.8. Impacts on Producers

The impacts of different levels of countervailing duties on Canadian hog producers can be assessed in a more straight forward fashion. This section analyzes the changes in total farm cash receipts from hogs for Canadian hog producers over the 1987-1991 period for the different scenarios considered.

Total farm cash receipts from hogs are composed of two components. These are: (1) farm cash receipts from the market; (2) farm cash receipts from hog stabilization programs. Farm cash receipts from the market is derived as follows:

(4.1) $CRMHG_i = PHG_i * (CWHG_i/80.5) * SHG_i$

where: $CRMHG_i$ = cash receipt from the market for hogs (mil.$)

PHG_i = price of index 100 hogs ($/cwt)

$CWHG_i$ =average hog carcass weight (lb) divided by the yield factor.

SHG_i = number of hogs marketed (000)

Equation 4.1 simply gives the revenue from hog marketing for each region based on the index 100 hog prices, the average carcass weight and a yield factor to convert dressed weight to live weight and the number of live hogs marketed in each region.

Farm cash receipts from hog stabilization is somewhat more complicated to

derive given that different provinces have different stabilization programs. Generally, farm cash receipts from hog stabilization is defined as:

(4.2) $CRSHG_i = (PPAHG_i - PLYHG3) * 0.9 * CWHG_i/80.5 * SHG_i$

where: $CRSHG_i$ = farm cash receipts from hog stabilization programs (mil.$).

$PPAHG_i$ = stabilization payment from national tripartite stabilization programs ($/cwt)

PLYHG3 = producer levy to the tripartite stabilization program ($/cwt)

$CWHG_i$ and SHG_i are as defined before.

For the period under consideration (1987.4-1991.1) it is assumed that the national tripartite program is the only stabilization program in operation. Under the national tripartite program, only 90 percent of hogs produced are eligible for support. Farm cash receipts are also calculated net of the producer's contribution into this program.

Having estimated equations (4.1) and 4.2), the total farm cash receipts from hogs for both western and eastern Canada can be defined as:

(4.3) $CRHG_i = CRMHG_i + CRSHG_i$

Equation (4.3) simply postulates that the total farm cash receipts from hogs is the sum of cash receipts for hogs from the market and the net receipts from the national tripartite stabilization program.

The information in Table 4.10 summarizes the changes in total farm cash receipts from hogs under the three most important scenarios (Free Trade, Scenario

TABLE 4.10

QUARTERLY CHANGES IN TOTAL FARM CASH RECEIPTS FROM HOGS
1987.4 - 1991.1

Experiment	East	West	National
	- - - - - - -million $ - - - - - - -		
Base Scenario VS. Free Trade	12.65	5.55	18.20
Base Scenario VS. Scenario 3.1	1.80	0.79	2.59
Free Trade VS. Scenario 3.1	10.80	4.76	15.56
Base Scenario VS. Scenario 2	8.50	5.25	13.75
Free Trade VS. Scenario 2	10.30	6.04	16.34

NOTE:Base Scenario: includes CVD's on live hogs only
Free Trade Scenario: CVD's are eliminated
Scenario 2: CVD's on pork and live hogs at the same time
Scenario 3.1: assumes reduced CVD's on live hogs ($3.30/cwt)

Source: computed.

2 and Scenario 3.1. Elimination of the CVD's on live hogs (Base scenario vs. Free trade) result in a quarterly increase of roughly $18.2 million in farm cash receipts from hogs. Of this amount, the benefits of removing the CVD's to eastern Canada are approximately $12.65 million. Another interpretation of this result is that CVD's on live hogs cost Canadian farmers approximately $18.2 million every quarter between the fourth quarter of 1987 to the first quarter of 1991.

When the CVD's on live hogs are reduced by 25 percent, however, no significant change is noticed in the level of farm cash receipts. A comparison of the bse scenario to scenario 3.1 shows that Canadian hog farmers gain only about $2.59 million every quarter following a reduction of 25 percent in the level of CVD's.

The imposition of CVD's on pork exports concurrently with CVD's on live hogs result in total farm cash receipts to decline by about $13.75 million every quarter over the 1987-1991 period. A comparison of the base scenario to Scenario 2 also gives the loss of farm cash receipts as a result of the CVD's on pork (since the base scenario already assumes CVD's on live hogs).

Hence, a comparison of the magnitudes of the changes in cash receipts from hogs shows that the largest losses in cash receipts from hogs occur when live hog exports are hit by CVD's. The losses for each region also seems to be proportional to each region's share of total hog production.

4.9. Impacts on the Pork Processing Sector

The pork processing industry forms an integral part of the hog-pork sector. Live hogs represent the major input in the pork processing industry and any disturbance in the hog-pork sector automatically has economic repercussions on this industry. It should therefore be interesting to assess the economic impacts of

CVD's (on hogs) on the pork processing sector. Analyses of the cash receipts of the pork primary cuts industry under the various scenarios are used for this purpose.

The cash receipts of the pork primary cuts industry for each region is defined as:

(4.4) $CRPK_i = WPPK_i * [CWHG_i * DHG_i]$

where: $CRPK_i$ = cash receipts of the pork primary cuts industry ($mil.)

$WPPK_i$ = wholesale price of pork

$CWHG_i$ = average hog carcass weight

DHG_i = hogs slaughtered

The information in Table 4.11 shows the average quarterly changes in cash receipts of the pork primary cuts industry over the 1987.4-1991.1 period under different scenarios. A comparison of the base scenario to the free trade scenario gives the difference in cash receipts that can be attributed to the CVD's on live hogs. The estimates show that the primary cuts industry actually benefited from the CVD's on live hogs; by a quarterly average of $11.35 million. However, the results also show that western Canada actually loses $1.54 million on average and that the net gain in eastern Canada offsets those losses. The net benefits accruing to the pork processing industry can be explained by the fact that the imposition of tariffs on live hogs mean: (1) cheaper live hogs (inputs) for the industry and (2) greater export potentials for pork since there is no tariff on its exports.

Only a slight gain is registered, compared to the base scenario, when the tariff on live hogs is reduced by 25 percent. The processing industry only gains about $0.73 million, on a quarterly average basis.

TABLE 4.11

QUARTERLY CHANGES IN CASH RECEIPTS OF THE PORK PRIMARY CUTS INDUSTRY: 1987.4 - 1991.1

Experiment	East	West	National
	- - - - - - -million $ - - - - - - -		
Base Scenario VS. Free Trade	12.89	-1.54	11.35
Base Scenario VS. Scenario 3.1	0.99	-0.26	0.73
Scenario 3.1 VS. Free Trade	11.90	-1.28	10.62
Scenario 2 VS. Base Scenario	-18.79	-8.98	-27.77
Free Trade VS. Scenario 2	5.90	10.52	16.42

NOTE:Base Scenario: includes CVD's on live hogs only
Free Trade Scenario: CVD's are eliminated
Scenario 2: CVD's on pork and on live hogs
Scenario 3.1: assumes reduced CVD's on live hogs ($3.30/cwt)

Source: computed.

By contrast, the largest losses to the pork processing industry occur when there are tariffs on both live hogs and pork concurrently compared to the scenario where there are tariffs on live hogs only. By extending the tariffs to pork exports, the pork processing industry loses a quarterly average of $27.7 million dollars. Consistent with earlier observations, the major losses occur in eastern Canada where most pork processing takes place.

4.10. Summary

The economic impacts of countervailing duties on the Canadian hog-pork sector was analyzed in this chapter. A series of simulations were conducted whereby:

(a) the current CVD's on live hogs were removed

(b) the current CVD's on live hogs were lowered to $3.30/cwt

(c) in addition to live hogs, CVD's of equal amounts were imposed on pork

(d) sensitivity analysis were performed on the relevant elasticities.

The results from these experiments generally showed that the US CVD's on Canadian live hog have had important negative economic impacts on the Canadian live hog and pork sector. The imposition of CVD's on pork concurrently with CVD's on live hogs tend to magnify these effect. Furthermore, the removal of CVD result in important gains to producers at the expense of losses to pork consumers as a result of higher prices.

The results from the sensitivity analysis confirmed the assumption that Canada is only a small live hog and pork exporter. It appears that the excess supply elasticities are less important than the US excess demand elasticities in determining trade flows and price impacts.

Finally, it should be borne in mind that the complexity of the hog-pork sector has required several simplifying assumptions in order to facilitate both the modelling process and the estimation of the econometric models. Therefore full considerations should be given to these assumptions in interpreting the results presented in this chapter.

CHAPTER V

SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.1. Introduction

This study reports the results of a simulation model designed to assess the impacts of US countervailing duty (CVD) measures on the Canadian hog-pork sector for the period 1986-1991. The simulations performed are based on parameter estimates from econometric models explaining the dynamics of Canadian hog-pork complex over the 1975-1985 period.

The general findings show that the US CVD's on Canadian hog and/or pork have, potentially substantial effects on the domestic hog-pork sector. The application of the CVD's on both live hogs and pork at the same time has the greatest impact. In addition, sensitivity tests on the CVD's variable also show that a reduction of the current CVD's by 25 percent does not result in significant improvements for the domestic industry.

In order to fulfill the specific objectives of this study, the first step involves establishing a baseline scenario which serves as a benchmark against which all subsequent experiments (scenarios) are compared. The baseline scenario assumes that all provinces in Canada participate in the National Tripartite Program for hogs and that the current US CVD's on live hogs continues to exist over the 1986-1991 period. The base scenario describes more or less the prevailing situation in the industry, except that not all provinces have, as yet, joined the national tripartite program for hogs. Nonetheless, for all practical reasons, it is assumed that over the 1986-1991 period, all provinces implement this program.

The first experiment (Scenario 1) involves simulating the model while eliminating the US CVD's on live hogs. The US CVD's represents the major policy variable in this study. In other words, Scenario 1 assumes that live hogs and pork from Canada are allowed to enter the US freely. Viewed differently, this scenario gives the effect that the US CVD's on live hogs is likely to have on the Canadian hog-pork sector over the 1986-1991 period with free trade in both live hogs and pork.

The general results show that hog marketing in Canada is expected to increase by about 1.35 percent following the elimination of the CVD's on live hogs. Similarly, the price of index 100 hogs in Canada also increases by about 2.3 percent or $1.57/cwt. On a regional basis prices go up by $1.15/cwt in Alberta to a high of $1.80/cwt in Manitoba. Increased hog marketing coupled with higher prices lead to an increase in farm cash receipts of about 3.8 percent for the whole country. In dollar terms, the removal of the current US CVD's on Canadian live hogs entering the US is likely to result in an annual gain of about $73 million per year to hog producers in Canada. By contrast, Canadian consumers lose from the removal of the current CVD's as a result of higher price of hogs. These losses are approximated by the change in consumer surplus and are estimated to be around $30 million annually over the 1987-1991 period. The net impact of the removal of the current CVD's on live hogs appears to be about $42.8 million annually (Table 5.1).

Regarding other impacts, a slight decrease in the number of hogs slaughtered domestically is noted. About 3.6 percent less hogs are slaughtered with free trade in hogs and pork. As a result, there is also a slight decrease in the net exports of pork to the US; about 27 percent and 9 percent less pork are exported from western and eastern Canada respectively. The total decrease in the volume of pork

exports to the US from Canada following the removal of the CVD is approximately 15 percent.

The drop in the level of pork exports following the removal of the CVD's leads to the tentative conclusion that the hog processing industry (the slaughtering and meat packing industries) might have gained some benefits from the US CVD's. It appears that the absence of any trade restriction in the pork sector results in more hogs to be processed domestically and exported in the form of pork and pork products.

It should also be pointed out that the imposition of the US CVD's caused hog prices in Canada to drop by $1.67/cwt on average over the 1986-1991 period. However, the short-run impacts (immediately following the imposition of the CVD's) are much more substantial. Again, over the longer period, the conversion of live hogs into pork and an increase in the exports of pork following the imposition of the CVD's help dampen the impacts of the CVD's on the domestic price of hogs.

As far as live hog exports are concerned, it is interesting to note that the removal of the current CVD's on live hogs is likely to result in Canada's exports of live hogs to the US to increase by an average of 175 thousand head a quarter over the 1986-1991 period compared to the base run. Exports from western Canada would increase by about 33 percent over the base period while exports from eastern Canada would go up by about 190 percent.

A second scenario assumes that the US CVD's on live hogs is extended to pork, i.e. it is assumed that as from the beginning of 1986, the US decides to impose CVD's of equal amount on Canadian pork entering that country. Compared to the base scenario, the results give the effects that CVD's of $5.50/cwt (dressed weight) on pork would have on the industry.

Generally, the results show that hog marketings fall by about 3.8 percent for the whole country. The price of Index 100 hogs also falls: by about 2.2 percent and representing on average $1.60/cwt compared to the base price. Together, these result in lower cash receipts for hog producers amounting to about $56.8 million annually. Consumers in Canada, however, benefit directly from the extension of CVD's to pork since this action causes the price of hogs in Canada to fall. The gains to consumers are estimated to be about $21 million annually. The net impact, therefore is an annual loss of about $25.8 million (Table 5.1).

Interestingly, the imposition of CVD's on pork exports concurrently with CVD's on live hogs lead to an increase in the exports of live hogs to the US compared to the base scenario (Table 4.3). This can be explained by the fact that following the tariff on pork, Canadian packers become less competitive in more distant markets because of the extra cost. Consequently, hog slaughter and pork production decline. This situation leaves more live hogs on the market for exports than under the base scenario where no restrictions on pork exports existed. In other words, the demand for slaughter hogs in Canada falls and the excess supply of live hogs are instead exported live to the US. On average, an extra 70 thousand heads are exported every quarter as a result of the US extending the CVD's on pork.

By comparing Scenario 2 to the free trade scenario instead of the base scenario, one can derive the combined effects of CVD's on both live hogs and pork on the whole industry. The welfare effects are summarized in Table 5.1. Producers under this situation lose about $129 million while consumers gain about $52 million. The net loss for Canada resulting from CVD's on both live hogs and pork is about $77 million compared to the free trade situation.

An important conclusion can therefore be drawn from these two effects. The results indicate that the US CVD's are more effective on live hogs than on pork in

TABLE 5.1

NET ANNUAL WELFARE EFFECTS OF US COUNTERVAILING DUTIES ON THE CANADIAN HOG-PORK ECONOMY: 1987.4 - 1991.1

	Scenarios	..Benefits(+) and Costs (-).. Consumers	Producers	Net Effects
		- - - - - - - - - - million $ - - - - - - - -		
(1)	CVD's on live hogs	(+) 30.0	(-) 72.8	(-) 42.8
(2)	Reduced CVD's on live hogs	(+) 21.6	(-) 62.2	(-) 40.6
(3)	CVD's on live hogs and pork	(+) 52.0	(-) 129.0	(-) 77.0
(4)	CVD's on pork only	(+) 21.0	(-) 56.8	(-) 25.8

Note: (1) Base Scenario VS. Free Trade (Full CVD's on live hogs).
(2) Free Trade VS. Scenario 3.1 (Reduced CVD's on live hogs).
(3) Free Trade VS. Scenario 2 (Full CVD's in effect).
(4) Base Scenario VS. Scenario 2

Source: Computed.

the sense that live hog prices decline by a larger magnitude following CVD's on live hogs compared to CVD's on pork. The combined effects of CVD's on both live hogs and pork on the Canadian hog prices is a reduction of as much as $3.30/cwt (Table 4.4). However, to the extent that live hogs can be transformed into pork, as soon as the CVD's on one of the products is lifted, there is an automatic shift from one trade to the other thereby dampening the overall effects of CVD's on Canadian hog prices.

Another important finding relates to the root of the problem itself. CVD's were brought in the first place to control increased imports of live hogs into the US. However, the CVD's on pork appear to result in an average increase of about 70 thousand head of live hogs to be exported to the US every quarter (Table 4.3). Clearly, the imposition of the CVD's on pork concurrently with CVD's on live hogs did not help solve the original problem of limiting imports of live hogs into the US and therefore it was more beneficial to drop the CVD's on pork altogether.

A third set of experiments are performed whereby it is assumed that the CVD's are revised downwards by 25 percent as follows:

(A). In the first case the CVD's on live hogs is reduced to $3.30/cwt as from the fourth quarter of 1987. The results are compared to the base scenario where the full CVD's exists. The results indicate that under such a situation no major changes occur within the industry. A 25 percent reduction in CVD's result in the price of live hogs to increase by only 0.70 percent over the base price. Hog marketing increases only marginally (0.09 percent) and farm cash receipts go up by only 0.53 percent. However, live hog exports increases by about 31 percent in eastern Canada and by about 7 percent in western Canada with an average increase of about 16.7 percent for the whole country. Pork

exports to the US, however declines by about 2.6 percent over the base export level.

(B). The second case considered is one where CVD's on both live hogs and on pork are reduced by 25 percent (i.e., $3.30/cwt on live hogs and $4.10/cwt on pork). The results here are compared to Scenario 2 which assumes that the full CVD's exists on both pork and live hogs. Under this scenario, the exports of live hogs to the US increase by about 10.5 percent and 1.43 percent from eastern and western Canada respectively compared to the base levels. For the whole country, live hog exports improve by about 6.15 percent as a result of the reduction of CVD's by 25 percent. The price of Index 100 hogs improves by about 1.3 percent over the base price. As a result, farm cash receipts increase marginally by 1 percent.

The apparent unresponsiveness of Canadian hog prices to CVD's when imposed on live hogs only suggests that the excess supply curve for Canadian hog exports are more elastic (less inelastic). In order to verify this possibility, some sensitivity tests were performed whereby the domestic demand and supply elasticities were altered by 25 percent in a number of experiments. As before, the results from these experiments show that the effects of the CVD's on Canadian hog prices seem to be rather modest when applied on either product alone. However, when both products are faced with CVD's, the effects on Canadian hog prices are more important.

The general results also suggest that these elasticities are not as crucial in determining the magnitude of the impacts of CVD's on the Canadian hog-pork sector. The findings from the set of sensitivity analyses confirmed that Canada represents a relatively small exporter of live hogs and pork and that domestic

demand and supply conditions are not the major factors that affect prices. These findings are also consistent with the theoretical model developed for the small exporter case and suggest that the shape of the importer's excess demand function to be more important.

What implications does this have for the Canadian hog-pork sector? One guess would be that the removal of the CVD's would not affect Canadian hog prices by the same magnitude as that of the CVD's. By the same analogy, any increase in CVD's would not likely affect hog prices in Canada by the same magnitude as the increase in the CVD's.

In addition, the magnitude of the impacts of CVD's on domestic prices also seems to depend on where market equilibrium is achieved, i.e. whether the excess supply curve intersects the excess demand curve over the elastic or the inelastic range (Figure 2.2.a). If the excess supply curve intersects the excess demand curve over the elastic range, the magnitude of the impacts of CVD's are likely to be greater than the case where international market equilibrium is achieved in the inelastic portion of the excess demand curve. Recall that over the forecast period, the volume of live hog exports are much lower than during the 1984-85 period and this partially explain why the price effects in 1984-85 are much larger than the price effects over the 1986-91 period. Hence, during periods when exports volume are higher, the price effects are expected to be higher than during periods of low exports volume.

More importantly however, it appears that the major effect on Canadian hog prices come from the US industry and not from supply and demand conditions in Canada. To the extent that the Canadian hog-pork sector represents only a small component of the larger North American hog-pork complex, the domestic demand and supply conditions do not have any major influence on hog prices in Canada.

This relates back to the point made above about the more elastic nature of the supply curve. Being a small participant in a big market makes Canada almost a price taker with a more elastic supply curve.

5.2. Limitations of the Study

Any empirical model has certain limitations. Most of the time these limitations are related to the nature of the model used and the underlying assumptions. For this reason, full consideration should be given to both the structure of the model and its assumptions when interpreting the findings of any study.

The main objective of this study was to estimate the impacts of US CVD's on the Canadian hog-pork sectors up to 1991. In order to achieve this objective, an econometric simulation model was used. Since the major objective was for policy analysis and forecasting rather than the estimation of elasticity measures, the main concern was to build models that are capable of reproducing the historical values of the endogenous variables as closely as possible. Hence, much discretion was used in the specification of the structural form of the different relationships explaining the dynamics of the Canadian hog-pork sector. On this aspect, Pindyck and Rubinfeld (1981) note that:

> "In examining the equations of a model, one typically finds that some of the equations fit the data very well while others do not. Thus a judgement must be made regarding the overall statistical fit ... and the builder makes this judgement as the model is constructed ... In practice it may be necessary to use specifications for some equations in the model that are less desirable from a statistical point of view but that improve the ability of the model to simulate well ... The model builder is thus forced to make some compromises." (P.361-362).

To the extent that the present model was a multi-equation model, the performance of the overall simulation was more important than the statistical fit of specific equations in the model.

An important limitation of the present model is that it ignores the dynamics of hog-pork production in the United States and as such no effects are transmitted to the Canadian market from the US market. The only way that the model links the Canadian-US pork sector is through a price transmission equation (Equation 3.22). Hog prices in Canada are linked to hog prices in the US, but to the extent that US hog prices are determined exogenously, the transmission of any price effects through the price linkage equation becomes very weak. However, for the type of simulations considered in this study, the basic question is whether the change in the exports of live hogs and pork from Canada from the base run big enough to influence the US price of hogs significantly? The answer is probably no and consequently the analysis should not be affected by the exogenous treatment of the US price of hogs. However, empirical verification of this is desireable.

Modeling the Canadian hog-pork sector in isolation of the US hog pork sector does have other drawbacks for the present study. The demand and supply conditions in the US essentially determine hog prices in North America and therefore, to certain extent, determine Canadian production and supply. However, changes in US policies that affect US hog prices do not necessarily affect Canadian production and supply of hogs and pork in the same proportion because Canada also has important third markets for her pork. Japan is one such market and has grown in importance over the years. Unfortunately, exports of pork to countries other than the US also had to be treated exogenously in this model and this represents another limitation. The model is not designed to capture the effects of diverting exports to third countries as a result of CVD's in the US. Export to third countries would in fact dampen the effect of the CVD's on the Canadian hog-pork sector in the sense that if the surplus product (as a result of the CVD's) can be exported to other countries, hog prices in Canada will not likely decline by the full

amount of the CVD's. However, in recent years, Canada's share of the Japanese market has declined considerably and because now Japan only represents a small selective market for Canadian pork, the overall conclusions of this study are not affected by the ommission of the Japanese market from this model.

The inability of the present model to account for exports to the rest of the world should nonetheless be taken into consideration in interpreting the results. Treating exports to the rest of the world endogenously will likely result in a more accurate estimate of the price effect. Consequently, the impacts on Canadian hog producers will likely be different from the present analysis since it is expected that exports to the rest of world should help prevent hog prices from declining by the same magnitudes as in the present study.

Another limitation of the present model relates to the assumptions that were made in the estimation of both demand for pork and supply (marketing) of live hogs. The theoretical models explain individual consumer and firm behaviour. In this study, however, aggregate market data were used to estimate both demand and supply functions. The implicit assumptions here are that all consumers and firms behave in a similar fashion. This assumption need not necessarily be true, although it does simpify the estimations procedures.

5.3. Policy Implications and Concluding Remarks

Although the foregoing experiments have helped shed light on the effectiveness of CVD's as policy instruments to curb imports and on the costs to the exporter faced with the CVD's, many questions are left unanswered regarding US CVD laws and the implications for the Canadian hog-pork sectors. One such question relates to the very existence of subsidies in the Canadian hog-pork sector. How much subsidy does the national tripartite program constitute? Does the national tripartite program constitute a production subsidy or and export subsidy? Canadians claim

that the national tripartite program applies to hogs that are for domestic use only. US officials at the International Trade Commission claim otherwise. In view of these ambiguities, further research in this area is warranted.

The general rule (in US trade legislation) providing for duties on imports is contained in Section 701 (a) of the Tariff Act 1930 (as amended). Accordingly if a country signatory to the Subsidies Code, is found to provide directly or indirectly a subsidy with respect to the manufacture, production or exportation of a class of merchandise imported or sold for importation in the US and it is determined that the industry in the US is materially injured or is threatened with material injury by reason of imports of that merchandise, then, there shall be imposed upon such merchandise a countervailing duty, in addition to any other duty imposed, equal to the net amount of the subsidy (McGovern, 1986, p. 348).

Several problems are related to the above rule; the loose definition of what constitute subsidies being the most important one. Authorities and parties involved in trade disputes have often relied on the Subsidies Code which became effective in January 1980 for some guidance. This code contains an illustrative list of export subsidies which can be considered "countervailable". Although this list does provide some guidance upon the existing GATT provisions on subsidies and countervailing duties, it is not exhaustive and is often discarded by the much stricter standards of US CVD legislation. Hopefully, the Uruguay Round of Multilateral Negotiations of the GATT might make this list more definitive-especially as far as agricultural products are concerned.

Another point which is worth noting relates to the attribution of injury to subsidize imports. First, the broad definition of material injury itself poses some problems. Under US CVD law, material injury is defined as "harm which is not inconsequential, immaterial or unimportant" (Lande and VanGrasstek, 1986). This

definition raises some questions as to what exactly constitutes injury to the US industry. In addition, how much "causality" between countervailable subsidies and injury is necessary before CVD actions are triggered against imports also has to be established. It appears that under US CVD laws there are no definite rules to follow in order to establish causality between imports and injury to the US industry and decisions for CVD actions are still largely arbitrary in this respect.

Furthermore and as pointed out by Martin and Goddard (1987), analysts should agree over the conceptual issue that in assessing injury, the increase in imports as a result of government subsidies should be considered and not the total volume of imports. It appears that in most analysis and certainly in the Canadian hog-pork case, total imports have been used to assess injury to the US hog industry. Hence, this represents another area where further research is needed.

Another unresolved issue pertaining to CVD's on Canadian live hogs relates to the question of "upstream subsidies". One major contribution of the US Trade and Tariff Act, 1984 (TTA) was its treatment of upstream subsidies found in Section 613. Upstream subsidies are not dealt with in either the GATT or the Tariff Act, 1930. The 1984 Act adds upstream subsidies explicitly to the list of prohibited subsidies against which the US can charge a CVD.

The TTA (1984) provides that subsidies given on input products which bestowe a competitive benefit on the imported merchandise and have a significant effect on its production cost constitute "upstream subsidies and are countervailable to the extent of that benefit". To the extent that live hogs represent a major input into the pork processing sector, the exports of fresh, frozen and chilled pork to the US still run the risks of being countervailable. The analysis in this study has shown that should the US authorities decide to extend CVD's to fresh, frozen and chilled pork, the economic impacts on the Canadian hog-pork sector can be very important.

However, the provisions of the 1984 Act governing upstream subsidies remain very unclear and precedents suggests that much discretion is used by of the International Trade Comission in determining whether a certain import is benefiting from upstream subsidies. Whether live hogs represent imputs into the pork sector is an ongoing debate. Recently there have been attempts by US packers to initiate CVD actions against the imports of pork from Canada. This shows that the Canadian pork sector is still vulnerable to US CVD legislation.

Given the current situation in the hog-pork sector and the complexity of US CVD legislation, several policy alternative exist which can potentially minimize the losses to the hog industry as a result of the US CVD's.

(i) One option would be to cut production down to a level which is mutually acceptable to both Canada and the US. This level of production would likely generate an amount of exports that would not constitute "a more than equitable share" of the export market under US CVD law. However, cutting down the Canadian hog production would be meaningful if and only if injury to the US hog industry is linked specifically to imports from Canada. In the absence of any rigorous analysis to establish firm causality betweem imports of live hogs from Canada and economic injury to the US industry, the unilateral reduction of production in Canada would not necessarily remedy the economic state of the US hog sector.

(ii) The second option would be to restrict the subsidies to the units produced for domestic use only. This is exactly what the NTSP attempts to achieve and to some extent solves the problem of subsidies and countervailing duties. By having the producer to contribute directly into the financial affairs of the NTSP

along with the federal and the provincial governments, the NTSP in a sense stabilizes only that portion of hog production destined for domestic use. However, US authorities view the NTSP differently. It should be recalled that US authorities determined the amount of subsidies available to Canadian hog producers by aggregating the total payments under federal and provincial stabilization programs and divided that amount by the total number of hogs produced in Canada over the fiscal year 1983-84. If this practice prevails, it is doubtful whether the NTSP will be effective at all in sparing Canadian exports in general, from US CVD's.

(iii) A third alternative would be to restrain exports from Canada voluntarily. Voluntary export restraints have been used successfully by many countries but as everything else there are costs associated with such a measure. The imposition of export quotas or the imposition of an export tax are the two options available under voluntary export restraints. The one advantage, at least, with the imposition of an export tax to control the flow of hog to the US would probably be that export tax revenues can be used to compensate hog farmers for income loses. However, an additional problem with administering export taxes relates to the redistribution aspect of the revenues generated by the taxes. However, both export taxes and export quotas are unattractive from an efficiency standpoint; they both discriminate against efficient producers. Under Section 611 of the TTA (1984), however, the USITC may not revoke a CVD order or terminate a suspended investigation solely on the basis of any export taxes, duties, or charges that are levied on products exported to the US in order to offset the effect of subsidies (Lande and VanGrasstek, 1986:136). Export taxes can be used as a basis for the suspension of investigations but not as the basis for a negative determination or for the termination of an investigation.

(iv) Finally, the Canadian hog-pork sector can diversify its export market such that exports to the US are kept at reasonable levels. However, there are limitations to the extent to which more distant markets can be established given the perishable nature of the product being considered. To the extent that Canada has been very successful in the past in penetrating the Japanese market and in capturing and maitaining an important share of that market, overseas market development should be pursued more rigorously. Among the potential markets for Canadian pork products are the "pacific rim" countries.

As a concluding remark, it is interesting to note that the current CVD's on Canadian live hog have favoured the pork processing industry. On the one hand, the CVD's have resulted in depressed domestic hog prices, thereby making it possible for the processing industry to buy its major input (live hogs) at prices lower than those that would prevail in the absence of CVD's. Additionally, CVD's also caused hog and pork prices in the US to increase. Therefore, CVD's on live hogs have resulted in increased opportunities for Canadian live hogs and pork in the US. As a natural response to more favourable economic conditions in the US pork market, the volume of processed pork exports to the US has soared over the recent past. As pointed out earlier, the danger that the US extends CVD's to processed pork remains and Canadian exporters should be very prudent not to create a situation which will trigger CVD actions against pork exports. The present analysis has shown clearly that the extension of CVD's to pork can have important economic impacts on the Canadian hog-pork sectors. However, one recomforting recent development is that under the Canada-US Free Trade Agreement, the two countries have agreed to establish a binational panel for the settlment of trade disputes.

Hopefully this mechanism will result in fairer applications of US CVD legislations and will enable parties in trade disputes to spare the high financial costs involved in settling trade disputes under the current system.

Finally, an interesting area for further research is related to the processing industry. In Canada the slaughter and meat processing industry is essentially oligopolistic in nature; a small number of packers controlling hog slaughter and processing. The imposition of CVD's on live hogs implicitly provides protection to the processing industry since live hogs represent the major input (raw material) into pork production. It should therefore be interesting to investigate the effective protection afforded to the Canadian hog processing industry by the current US CVD's on live hogs.

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APPENDIX A

Government Programs Included in CVD Investigation

The following government programs were found to constitute subsidies to Canadian hog producers during the fiscal year April 1, 1984 to March 31, 1984. The US Department of Commerce took these programs into account in its determination of the amount of the CVD to be imposed on live hogs.

1. Federal Programs
    a. Hog Stabilization Payments Provided under the Agricultural Stabilization Act; and
    b. Record of Performance Program.
2. Provincial Programs
    a. Stabilization Programs
        i. Prince Edward Island Price Stabilization Program;
        ii. Newfoundland Hog Price Support Program;
        iii. Nova Scotia Pork Price Stabilization Program;
        iv. British Columbia Swine Producers' Farm Income Plan;
        v. Saskatchewan Hog Assured Returns Program;
        vi. Manitoba Hog Income Stabilization Plan;
        vii. New Brunswick Hog Price Stabilization Plan; and
        viii. Quebec Farm Income Stabilization Insurance.
    b. Other Programs
        i. Prince Edward Island Hog Marketing and Transportation Subsidies;
        ii. Prince Edward Island Interest Payments on Assembly Yard Loan;

iii. Nova Scotia Swine Herd Health Policy;

iv. Nova Scotia Transportation Assistance Program;

v. Saskatchewan Financial Assistance for Livestock and Irrigation;

vi. Ontario Farm Tax Reduction Program;

vii. Ontario (Northern) Livestock Programs;

viii. Quebec Meat Sector Rationalization Program;

ix. Quebec Special Credits for Hay Producers;

x. New Brunswick Swine Assistance Program;

xi. New Brunswick Loan Guarantees and Grants under the Livestock Incentives Program; and

xii. New Brunswick Hog Marketing Program.

From the above list, USDC computed the total subsidies to be c$4.39/cwt (live weight) and c$5.52/cwt (dressed weight). This list is in accordance with the information provided in Live Swine and Pork from Canada, USITC Publication 1733, July 1985.

It should be noted that the amount of the CVD's were calculated for the fiscal year 1983-84. Canadian farmers claim that government transfers to hog producers have been substantially less than what they were in 1983-84. At the time of writing (June 1988) the CVD's on live hogs have been tentatively reduced to $2.20/cwt pending a final ruling by USDC.

In addition, it is worth pointing out that the rapid increases in the volume of live hog exports to the US in the early 1980's could have been as a result of a number of factors. These include speculation in the hog industry about the implementation of supply management, a weak Canadian dollar relative to the US dollar, and generally more favourable hog prices in the US at a time when the US

hog cycle just bottomed out. As a natural response to the favourable economic situation, it is not surprising that the volume of exports of both live hogs and pork to the US increased substantially over a relatively short period of time, unfortunately, the CVD investigation by USITC did not fully consider them factors.

APPENDIX B

Summary of the Hog-Pork Model

Hog Marketing (Western Canada)

1. SHG14 = f(PHG14(-4) + NPHOG14, FIGR3(-2), LDV, JSi)
2. SHG13 = f(PHG13(-4) + NPHOG13, FIGR3(-2), LDV, JSi)
3. SHG12 = f(PHG12(-4) + NPHOG12, FIGR3(-2), UR12(-2), JSi)
4. SHG11 = f(PHG11(-4) + NPHOG11, PIMQ21(-6), LDV, JSi)
5. SHG1 = SHG11 + SHG12 + SHG13 + SHG14 (west)

Hog Marketing (Eastern Canada)

6. SHG21 = f(PHG21(-4)+NPHOG21,TCCHG21(-4),XMSQ21(-6),JSi)
7. SHG22 = f(PHG22(-4)+NPHOG22,TCCHG22(-4),XMSQ22(-6),JSi)
8. SHG27 = f(PHG27(-4) + NPHOG27, XMSQ27(-4), LDV, JSi)
9. SHG2 = SHG21 + SHG22 + SHG27 (East)

Hog Marketing in Canada

10. SHG3 = SHG1 + SHG2

Exports of Live Hogs (West, East)

11. EXHG1 = f(PHG12 + CVD, PHG4*ER, LDV, JSi)
12. EXHG2 = (Solved Residually)
13. EXHG3 = EXHG1 + EXHG2

Domestic Hog Slaughter

14. DHG1 = SHG1 - EXHG1 (west)
15. DHG2 = SHG2 - EXHG2 (east)
16. DHG3 = DHG1 + DHG2 (Canada)

Hog Carcass Weight

17. CWHG1 = f(PHG12(-1), OPBA1(-1), LDV, JSi) (west)
18. CWHG2 = f(PHG21(-1), FPCO2(-1), LDV, JSi) (east)
19. CWHG3 = CWHG1*(DHG1/DHG3)+CWHG2*(DHG2/DHG3)(Canada)

Supply of Pork

20. QPK1 = CWHG1*DHG1/1000 (west)
21. QPK2 = CWHG2*DHG2/1000 (east)
22. QPK3 = QPK1 + QPK2 (Canada)

Domestic Disappearance

23. PCDPK3 = f(RPPK3, RPLBF3, PCDY3, JSi) (Canada)
24. DPK1 = PCDPK3*POP1 (West)
25. DPK2 = PCDPK3*POP2 (East)
26. DPK3 = DPK1 + DPK2 (Canada)

Demand for Inventory

27. IPK1 = f(QPK1, RPEN3, LDV, JSi) (west)
28. IPK2 = f(QPK2, RPEN3, LDV, JSi) (east)
29. IPK3 = IPK1 + IPK2 (Canada)

Pork Export

30. NT1PK4 = f(WPPKSF*ER, (WPPK2+CVD), LDV, JSi) (west)
31. NT2PK4 = f(WPPKSY*ER, (WPPK2 + CVD), LDV, JSi) (east)
32. NT3PK4 = NT1PK4 + NT2PK4

Market Clearing Identities

33. DPK1 = QPK1 + IPK1(-1) - IPK1 - NT1PK2 - NT1PK4 - NT1PK9 (west)
34. DPK2 = QPK2 + IPK2(-1) - IPK2 - NT1PK2 - NT2PK4 - NT2PK9 (east)

Retail Price of Pork

35. RPPK3 = f(WPPK2, WAPK3, JSi)

Wholesale Price of Pork

36. WPPK2 = f(PHG21, WAPK3, JSi)

Eastern-Western Canada Hog Price Transmission

37. PHG12 = f(PHG21, NT1PK2, RPGAS, JSi)
38. PHG14 = f(PHG21, JSi)
39. PHG13 = f(PHG14,PHG12, JSi)

USA-Eastern Canada Hog Price Transmission

40. PHG21 = f(PHG4*ER-CVD, log(EXHG2), NT2PK4, JSi)

National Weighted Hog Price, Canada

41. PHG3 = [PHG21*(SHG2/SHG3)+PHG12*(SHG11+SHG12/SHG3)+ PHG13*(SHG13/SHG3) + PHG14*(SHG14/SHG3)]

Government Stabilization Programs

Atlantic Provinces

42. PSPHG23 = [(0.7*TFCHG27) + (0.2*PHG21(-1)/28.5*12.5) + (0.1*TOCHG27) + 0.965*PSPHG23(-1)]
43. PMPHG23 = PMP23*PHG21
44. PPAHG23 = IfPSPHG23>PMPHG23;thenPSPHG23-PMPHG23;else0
45. PPAHG27 = If PPAHG23 < 0; then 0; else PPAHG23

Quebec

46. PMPHG22 = PMPHG22(-4)*(SUM(I=-3 to 0:PHG21)/SUM (I=-7 to-4:PHG21))
47. PPASHG22 = IfPMPHG22<PSPSHG22thenPSPSHG22-PMPHG22;else 0
48. PPIG22 = JS1*((-1)*8.78 + 0.61*SUM(I=-3 to 0:PHG21))/4
49. PPASOW22 = If17*PPIG22<PSPWHG22thenPSPWHG22-17*PPIG22; else 0
50. PPAWHG22 = (PPASOW22*NSSOW22)/SUM(I=-3 to 0:SHG22/1.71)
51. PLYWHG22 = (PLYSOW22 * NSSOW22)/SUM(I=-3 to 0:SHG22/1.71)

Manitoba

52. PSPHG14	=	TCCHG14 + 27; if year < 1986(1) then 1; else 0
53. PLYHG14	=	0.04*PHG14
54. PPAHG14	=	If PHG14 < PSPHG14 then PSPHG14 - PHG14; else 0

Saskatchewan

55. PSPHG13	=	TCCHG13 + 0.88 * (PSPHG13(-1) - TCCHG13(-1)
56. PLYHG13	=	(If year > 1986.2 then 0.016; else 0.04)*PHG13
57. PPAHG13	=	If PHG13 < PSPHG13 then PSPHG13 - PHG13; else 0

British Columbia

58. PMPHG11	=	PHG12 + 0.69*(PMPHG11(-1)-PHG12(-1))
59. PSPHG11	=	TCCHG11 + 0.785 * (PSPHG11(-1) - TCCHG11(-1)
60. PPAHG11	=	If PMPHG11 < PSPHG11 then PSPHG11 - PMPHG11 else 0
61. PLYHG11	=	If PPAHG11 < 0.0001 then 3; else (if PPAHG11 > 0 and PPAHG11 < 3 then PPAHG11; else if PPAHG11 > 3 and PPAHG11 < 14 then (PPAHG11/S) + 0.08; else if PPAHG11 > 14 and PPAHG11 < 20 then 7.8; else if PPAHG11 > 20 then 7 + (PPAHG11 - 20)/4 + 0.8; else 0

National Tripartite Hog Price Stabilization Scheme

62. PSPHG3	=	(TCCHG3+CRMHG*(PHG3(-4)+PHG3(-8)+PHG3(-12)+ PHG3(-16) + PHG3(-20) - TCCHG3(-4) - TCCHG3(-8)- TCCHG3(-11)-TCCHG3(-16) -TCCHG3(-20)/5
63. PPAHG3	=	If PSPHG3 > PHG3 then PSPHG3-PHG3; else 0
64. TCCHG3	=	TCCHG11 * SHG11/SHG3 + TCCHG12 * SHG12/SHG3 + TCCHG13 * SHG13/SHG3 + TCCHG14 * SHG14/SHG3 + TCCHG21 * SHG21/SHG3 + TCCHG22 * SHG22/SHG3 + TCCHG27 * SHG27/SHG3

VARIABLE DEFINITIONS

Endogenous Variables

1. CWHG1	=	Average Hog Carcass Weight, Western Canada (LB)
2. CWHG2	=	Average Hog Carcass Weight, Eastern Canada (LB)
3. CWHG3	=	Average Hog Carcass Weight, Canada (LB)
4. DHG1	=	Hogs Slaughtered, Western Canada (000)
5. DHG2	=	Hogs Slaughtered, Eastern Canada (000)
6. DHG3	=	Hogs Slaughtered, Canada (000)
7. DPK1	=	Disappearance of Pork, Western Canada (Mil. lb)
8. DPK2	=	Disappearance of Pork, Eastern Canada (Mil. lb)
9. DPK3	=	Disappearance of Pork, Canada (Mil. lb)
10. EXHG1	=	Export of Slaughter Hogs, Western Canada (000)
11. EXHG2	=	Export of Slaughter Hogs, Eastern Canada (000)
12. EXHG3	=	Export of Slaughter Hogs, Canada (000)
13. IPK1	=	Closing Stock of Pork, Western Canada (Mil. lb)
14. IPK2	=	Closing Stock of Pork, Eastern Canada (Mil. lb)
15. IPK3	=	Closing Stock of Pork, Canada (Mil. lb)
16. NPHOG	=	The Net Price Received by Hog Producers Defined as: (Payment - Premium)* number stabilized/total production for the Respective Provinces ($/cwt)
17. NT1PK2	=	Net Exports of Pork from Western Canada to Eastern Canada (Mil. lb)
18. NT1PK4	=	Net Exports of Pork from Western Canada to United States (Mil. lb)
19. NT2PK4	=	Net Exports of Pork from Eastern Canada to United States (Mil. lb)
20. NT3PK4	=	Net Exports of Pork from Canada to United States (Mil. lb)
21. PCDPK3	=	Per Capita Disappearance of Pork in Canada (lb)
22. PHG12	=	Price of Index 100 Hogs, Alberta ($/cwt)
23. PHG13	=	Price of Index 100 Hogs, Saskatchewan ($/cwt)
24. PHG14	=	Price of Index 100 Hogs, Manitoba ($/cwt)
25. PHG21	=	Price of Index 100 Hogs, Ontario ($/cwt)
26. PHG3	=	National Weighted Price of Index 100 Hogs ($/cwt)
27. PLYGH11	=	Producer Levy to the British Columbia Slaughter Hogs Stabilization Program ($/cwt)
28. PLYHG13	=	Producer Levy to the Saskatchewan Slaughter Hogs Stabilization Program ($/cwt)
29. PLYHG14	=	Producer Levy to the Manitoba Slaughter Hogs Stabilization Program ($/cwt)
30. PLYWHG22	=	Producer Levy to the Quebec Weaner Hogs Stabilization Program ($/cwt of Slaughter Hogs)
31. PMPHG11	=	British Columbia Stabilization Program Market Price for Slaughter Hogs ($/cwt)
32. PMPHG22	=	Quebec Stabilization Program Market Price for Slaughter Hogs ($/cwt)
33. PMPHG23	=	New Brunswick Stabilization Program Market Price for Slaughter Hogs ($/cwt)
34. PPAHG11	=	Payments from the British Columbia Slaughter Hogs Stabilization Program ($/cwt)

35. PPAHG13 = Payments from the Saskatchewan Slaughter Hogs Stabilization Program ($/cwt)
36. PPAHG14 = Payments from the Manitoba Slaughter Hogs Stabilization Program ($/cwt)
37. PPAHG23 = Payments from the New Brunswick Slaughter Hogs Stabilization Program ($/cwt)
38. PPAHG27 = Weighted Payments from all Atlantic Provinces Slaughter Hogs Stabilization Program ($/cwt)
39. PPAHG3 = Tripartite Stabilization Payments for Hogs ($/cwt)
40. PPASHG22 = Payments from the Quebec Slaughter Hogs Stabilization Program ($/cwt)
41. PPASOW22 = Payments from the Quebec Weaner Hogs Stabilization Program ($/sow)
42. PPAWHG22 = Payments from the Quebec Weaner Hogs Stabilization Program ($/cwt of Slaughter Hogs)
43. PPIG22 = Price of Piglets in Quebec ($)
44. PSPHG11 = British Columbia Stabilization Program Support Price for Slaughter Hogs ($/cwt)
45. PSPHG13 = Saskatchewan Stabilization Program Support Price for Slaughter Hogs ($/cwt)
46. PSPHG14 = Manitoba Stabilization Program Support Price for Slaughter Hogs ($/cwt)
47. PSPHG23 = New Brunswick Stabilization Program Support Price for Slaughter Hogs ($/cwt)
48. PSPHG3 = Tripartite Support Price for Hogs ($/cwt)
49. QPK1 = Production of Pork, Western Canada (Mil. lb)
50. QPK2 = Production of Pork, Eastern Canada (Mil. lb)
51. QPK3 = Production of Pork, Canada (Mil. lb)
52. RPPK3 = Retail Price of Pork, Canada (1981=100)
53. SHG1 = Marketings of Hogs, Western Canada (000)
54. SHG11 = Marketings of Hogs, British Columbia (000)
55. SHG12 = Marketings of Hogs, Alberta (000)
56. SHG13 = Marketings of Hogs, Saskatchewan (000)
57. SHG14 = Marketings of Hogs, Manitoba (000)
58. SHG2 = Marketings of Hogs, Eastern Canada (000)
59. SHG21 = Marketings of Hogs, Ontario (000)
60. SHG22 = Marketings of Hogs, Quebec (000)
61. SHG27 = Marketings of Hogs, Atlantic Provinces (000)
62. SHG3 = Marketings of Hogs, Canada (000)
63. TCCHG3 = Tripartite National Cash Cost of Production for Hogs ($/cwt)
64. WPPK2 = Wholesale Price of Pork Primary Cuts ($/cwt)

Exogenous

65. ASAPAHG3 = ASA Stabilization Payments for Hogs ($/cwt)
66. ASAPA27 = Percentage of Hogs Marketed Eligible to ASA Payments in the Atlantic Provinces
67. CPI3 = Consumer Price Index all Items, Canada (1981=100)
68. D19783 = Dummy for Packer Lock-Out in the Third Quarter of 1978 in Manitoba
69. D19843 = Dummy for Labour Dispute in the Packing Industry in the Third Quarter of 1984

70. ER	=	Canada - USA Exchange Rate ($Canada/$US)
71. FIGR3	=	Farm Closing Inventory of Wheat, Barley and Oat in Canada (Mil Tonnes)
72. FPCO2	=	Price of Corn in Chatham (on track) ($/tonne)
73. JS1	=	Seasonal Dummy (1 in the first quarter, 0 elsewhere)
74. JS2	=	Seasonal Dummy (1 in the second quarter, 0 elsewhere)
75. JS3	=	Seasonal Dummy (1 in the third quarter, 0 elsewhere)
76. LDV	=	Lag Dependent Variable
77. NSSOW22	=	Number of Sows Eligible to a Stabilization Payment in Quebec (000)
78. NT1PK9	=	Net Exports of Pork, Western Canada to Other Countries (Mil. lb)
79. NT2PK9	=	Net Exports of Pork, Eastern Canada to Other Countries (Mil. lb)
80. OPBA1	=	Off-Board Price of Barley, Prairies ($/T)
81. PCDY3	=	Per Capita Disposable Income in Canada ($)
82. PCTHG11	=	Percentage of hogs marketed eligible for payments from the British Columbia Stabilization Progams
83. PCTHG12	=	Percentage of hogs marketed eligible for payments from the Alberta Stabilization Progams
84. PCTHG13	=	Percentage of hogs marketed eligible for payments from the Saskatchewan Stabilization Progams
85. PCTHG14	=	Percentage of hogs marketed eligible for payments from the Manitoba Stabilization Progams
86. PCTHG22	=	Percentage of hogs marketed eligible for payments from the Quebec Stabilization Progams
87. PCTHG27	=	Percentage of hogs marketed eligible for payments from the Atlantic Provinces Stabilization Progams
88. PHG4	=	Price of Barrows and Gilts, 7 Markets USA ($/cwt)
89. PIMQ21	=	Price of Industrial Milk Quotas in Ontario ($/hl Per Day)
90. PLYHG12	=	Producer Levy to the Alberta Slaughter Hogs Stabilization Program ($/cwt)
91. PLYHG27	=	Producer Levy to the Atlantic Provinces Slaughter Hogs Stabilization Program ($/cwt)
92. PLYSHG22	=	Producer Levy to the Quebec Weaner Hogs Stabilization Program ($/cwt)
93. PLYSOW22	=	Producer Levy to the Quebec Weaner Hogs Stabilization Program ($/sow)
94. POPN1	=	Population in Western Canada (Mil.)
95. POPN2	=	Population in Eastern Canada (Mil.)
96. PPAHG12	=	Payments from the Alberta Slaughter Hogs Stabilization Program
97. PPAWHG21	=	Payments (Net of Levy) from the Ontario Weaner ($/cwt) Hogs Stabilization Program ($/cwt of Slaughter Hogs)
98. PSPSHG22	=	Quebec Stabilization Program Support Price for Slaughter Hogs ($/cwt)
99. PSPWHG22	=	Quebec Stabilization Program Support Price for Weaner Hogs ($/sow)
100. RPEN3	=	Retail Price of Energy in Canada (1981=100)
101. RPGAS3	=	Retail Price of Gasoline in Canada (1981=100)
102. RPLBF3	=	Retail Price of Low Quality Beef in Canada (1981=100)

103. TAR4HG3 = USA Tariff on Imports of Hogs from Canada ($Canada/cwt)
104. TAR4PK3 = USA Tariff on Imports of Pork from Canada ($Canada/cwt)
105. TCCHG11 = Cash Cost of Producing Hogs in British Columbia According to the Tripartite Stabilization Cost of Production Model ($/cwt)
106. TCCHG12 = Cash Cost of Producing Hogs in Alberta According to the Tripartite Stabilization Cost of Production Model ($/cwt)
107. TCCHG13 = Cash Cost of Producing Hogs in Saskatchewan According to the Tripartite Stabilization Cost of Production Model ($/cwt)
108. TCCHG14 = Cash Cost of Producing Hogs in Manitoba According to the Tripartite Stabilization Cost of Production Model ($/cwt)
109. TCCHG21 = Cash Cost of Producing Hogs in Ontario According to the Tripartite Stabilization Cost of Production Model ($/cwt)
110. TCCHG22 = Cash Cost of Producing Hogs in Quebec According to the Tripartite Stabilization Cost of Production Model ($/cwt)
111. TCCHG27 = Cash Cost of Producing Hogs in Atlantic Provinces According to the Tripartite Stabilization Cost of Production Model ($/cwt)
112. TFCHG27 = Feed Cost of Producing Hogs in the Atlantic Provinces According to the Tripartite Stabilization Cost of Production Model ($/cwt)
113. TOCHG27 = Non-Feed Cost of Producing Hogs in the Atlantic Provinces According to the Tripartite Stabilization Cost of Production Model ($/cwt)
114. UR12 = Unemployment Rate in Alberta (%)
115. WAPK3 = Average Weekly Earnings in the Packing and Slaughtering Industry in Canada ($)
116. WPPKNY = Wholesale Price of Pork Primary Cost in New York ($/cwt)
117. WPPKSF = Wholesale Price of Pork Primary Cuts in San Francisco ($/cwt)
118. XMSQ21 = Industrial Milk Quota in Ontario (Mil. hl)
119. XMSQ22 = Industrial Milk Quota in Quebec (Mil. hl)
120. XMSQ27 = Industrial Milk Quota in Atlantic Provinces (Mil. hl)
121. YEARQ = Year Plus Quarter Dummy Variable

APPENDIX C

Validation Statistics for Endogenous Variables

Variable	Achial Mean	Model's Mean	RMSE	RMSPE
CWHG1	136.0	136.2	1.35	1.00
CWHG2	136.4	137.9	1.94	1.44
CWHG3	136.3	137.4	1.61	1.20
DHG1	839.2	871.2	68.12	9.65
DHG2	1958.9	1834.1	157.1	7.40
DHG3	2798.1	2705.4	156.1	5.22
DPK1	98.0	97.2	3.10	3.33
DPK2	245.5	243.5	7.86	3.33
DPK3	343.5	340.8	10.96	3.33
EXHG1	52.98	57.68	28.87	177.3
EXHG2	39.90	53.51	48.35	294.4
EXHG3	92.88	111.2	58.8	152.4
IPK1	7.95	8.59	2.44	36.79
IPK2	16.87	15.74	2.41	14.45
IPK3	24.81	24.3	3.51	15.27
NT1PK2	10.7	17.5	9.43	148.3
NT1PK4	0.79	-0.82	10.60	2286.2
NT2PK4	19.6	13.9	9.09	379.5
NT3PK4	20.4	13.1	16.97	63.3
PCDPK3	14.2	14.1	0.46	3.33
PHG12	66.2	66.9	3.88	6.40
PHG13	65.7	67.4	4.0	6.46
PHG14	65.7	66.8	3.86	6.30
PHG21	68.4	69.6	3.69	5.57
PHG3	67.6	68.7	3.64	5.61
QPK1	114.3	118.7	9.61	10.81
QPK2	268.5	254.0	19.04	6.47
QPK3	382.8	372.8	19.66	4.97
RPPK3	96.4	97.4	2.11	2.36
SHG1	892.1	928.9	76.0	10.19
SHG11	55.8	51.0	11.54	22.0
SHG12	377.4	383.5	34.6	10.0
SHG13	161.1	157.8	18.7	11.9
SHG14	297.6	336.4	45.6	18.3
SHG2	1998.8	1887.6	136.1	6.60
SHG21	928.9	882.6	59.9	6.27
SHG22	957.6	893.2	81.5	8.16
SHG27	112.2	111.7	8.8	8.3
SHG3	2891.0	2816.6	137.6	4.6
WPPK2	107.4	109.3	4.6	4.4