

THE UNIVERSITY OF MANITOBA

A SIMPLIFIED RECURSIVE STUDY OF  
THE SUPPLY OF HOGS AND  
THE DEMAND FOR PORK IN CANADA

by

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## ABSTRACT

This is a study on the supply of hogs and demand for pork in various regions of Canada. The analysis is made on the data obtained from Statistics Canada for the period between 1951 and 1973.

The objective of the study is to examine and evaluate some of the factors influencing the production of hogs and demand for pork, as well as to forecast some of the future trends of the hog industry in Canada beyond the year 1973.

An econometric model is constructed for evaluating the factors that influence hog supply and demand for pork, and by assuming equilibrium conditions between supply of hogs and demand for pork, equilibrium prices are recursively predicted. Total supply of hogs, and per capita consumption of pork are the dependent variables in the regression equations. Lagged price of hogs (index 100), lagged stocks and production of feed grains, lagged number of hogs on farms, retail price of pork, retail price of beef, personal disposable income, and the dependent variables lagged one period are the independent variables. The supply and demand functions are fitted using the OLS regression technique. The parameters or regression coefficients indicate the magnitude of the influence that the specific factors have on the supply of hogs and demand for pork.

Results of the analysis of the data indicate that supply of hogs in all major regions of Canada is considerably influenced by lagged price of hogs, availability of feed grains and number of all kinds of hogs on farms. The dependent variable lagged one period and included in the set of explanatory variables is not a significant factor in all regions. In

the Maritime provinces feed grain importation is the key factor, whereas in Ontario local feed production is predominant. On the prairies stocks of all feed grains prove the main factor for the feed variable. Using annual data the models specified in this study have problems in picking up the adjustment lag both in the Maritime provinces and the Central region.

Results from the demand equation indicate retail price of pork and retail price of beef as the major influences on pork consumption. Personal disposable income has no discernible influence on consumption in this model. The adjustment coefficient in the demand function is close to one, an indication that quantity demanded in the previous period has no effect on current demand, and in the majority of cases consumers' expectations are actually realized during the same period of time.

On a predictive note, there is no evidence that per capita consumption of pork will increase dramatically in the next few years. Any increase in aggregate demand for pork is likely to be mainly the result of increased population. Barring any major catastrophe in the foreseeable future, Canadian hog producers will continue to produce hogs beyond the domestic requirements of pork in this country. Given this situation, Canada should develop policies that would promote increased exports of pork both to traditional buyers as well as trying to open up new markets in other parts of the world.

## Chapter 1

### INTRODUCTION

Canadian agriculture consists mainly of two important sectors: the crop sector and the livestock sector. Of the major livestock enterprises, hog production ranks third after beef and dairy production as a contributor to farm cash earnings.

The consumption of red meat particularly beef has been on the increase for the last twenty-five years. Though not as dramatically as beef, pork consumption has tended to show increases whenever the price for pork is cheaper relative to the prices of other red meats. Pork, however, ranks second to beef on a per capita consumption basis for all red meats.

The hog industry is therefore important from both the food industry viewpoint as well as the national economy. The hog industry has assumed even greater importance in recent years as high quality pork products have become major export items particularly to the U.S.A. and Japan. This latter development has been the result of the high efficiency technology that the Canadian hog producers have achieved in the past few years. This efficiency in production puts a Canadian hog producer in a position of comparative advantage.

#### The Problem

Despite its economic and nutritional value, the hog industry is notorious for price and output fluctuations. This variability in hog production stems mainly from two factors viz;

- 1) the economic factors,
- 2) the biological nature of the hog industry.

The effects of these fluctuations on the farming community, marketing firms, processors, packers and consumers need not be over-emphasized. This instability in supply of hogs creates uncertainty and inefficiency throughout the food chain. The effects on efficiency are perhaps most obvious during periods of reduced supplies when available resources and capacity are not fully utilized by farmers or processors. The instability in supply and the consequent changes in the retail price of pork tend to alter the consumer's consumption pattern and hence the stability of his level of welfare.

#### Objectives of the Study

The problem of instability in supply of hogs and the consequent instability in prices for pork necessitates inquiring into the factors that are responsible for these fluctuations. According to Nerlove<sup>1</sup> et al, in general, supply analysis has three major objectives outlined below, that is to improve:

- 1) "the understanding of the mechanisms of supply response",
- 2) "the ability to forecast supply changes",
- 3) "the competence to prescribe solutions to problems related to agricultural supply".

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<sup>1</sup>Nerlove, M. and Bachman, K. L., "The Analysis of Changes in Agricultural Supply: Problems and Approaches," Journal of Farm Economics, Vol. XLII, No. 3 (August, 1960), p. 532.

This study attempts firstly to theoretically formulate and statistically estimate an econometric model that will explain variations in total output (production) of hogs. This necessitates the identification of the economic and other factors that determine the production of hogs. The supply analysis in this study is to be done at a regional level so as to capture the influence of the basic geographical differences of the different areas. Secondly, the study aims at the formulation of somewhat a similar model for the estimation of a demand function for Canada as a whole. The third objective is to test the models used in 1) and 2) for forecasting purposes. By assuming equilibrium conditions between supply for hogs and demand for pork, a price equation is derived. Part of the objective of this study is to predict those prices that would clear the market if supply and demand were to be equal. The study also makes an attempt to intuitively project the future requirements of pork and the necessary level of production to meet this demand.

#### Usefulness of the Study

The understanding of the mechanisms of supply response in the hog industry is a key guide to the formulation of realistic and sensible policies affecting the hog industry. Some of the serious repercussions of the instability in hog supply and hog prices may be reduced when the motivating forces behind these fluctuations are identified, quantified, statistically and econometrically analysed in order to obtain numerical estimates of the coefficients of the economic relationships. Obtaining numerical estimates of the economic relationship serves three main purposes, namely;

- 1) testing the hypotheses suggested by economic theory,
- 2) forecasting future levels of the economic variables,
- 3) developing policies to meet the objectives of producers, consumers and other related interested parties.

The knowledge of the numerical value of the coefficients from the supply and demand functions are important for the decision of farms as well as for the formulation of economic policy of the government. It now helps to compare the effects of alternative policy decisions. In short, the numerical estimates of the economic relationships provide some insight as to the economic nature of the industry under analysis. This new insight is a pre-requisite to proper policy-making decisions and future forecasting of economic magnitudes of the variables.

## Chapter 2

### THE CANADIAN HOG INDUSTRY

This chapter provides the background for the theoretical analysis undertaken in Chapter 3. It describes the hog industry in terms of location, production, processing (slaughter pattern), domestic consumption and exports (trade). Implicit in the description are the trend and developmental aspects of the industry between 1951 and 1973. There has been no effort to describe the evolvement and current hog marketing institutions. Suffice to say all the provinces have some form of producers' marketing boards and the teletype system is operational throughout all provinces of Canada.<sup>1</sup>

#### Geographical Location

Hogs are produced in nearly every province, but Ontario in Central Canada and Alberta in Western Canada are by far the two largest producers traditionally. Table 1 indicates average annual net marketing of hogs for selected periods namely the averages for 1951-55, 1956-60, 1961-65 and for the years 1966 up to 1972 are shown. The table also shows the relative

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<sup>1</sup> Further information on hog marketing institutions and the teletype system can be found in

- 1) Wen-Fong-Lu, "Effect on Regional Price Levels of Selling Hogs by Teletype": (unpublished Master's Thesis, University of Manitoba, 1968).
- 2) Lowe, J. C. "An Economic Analysis of the Teletype Hog Marketing System in Manitoba Canada" (unpublished Master's Thesis, University of Wisconsin, 1968).
- 3) Lowe, J. C. Hog Marketing by Teletype, Manitoba Department of Agriculture. Publication No. 471, Winnipeg, 1968.

Table 1

Estimated Average Annual Net Marketing of Hogs for Selected Periods 1951-65 and Years 1966-72

Year	B.C.	Alberta	Sask.	Manitoba	Ontario	Quebec	Maritimes	Canada
Number ('1000')								
1951-55 Av.	37.6	1,380.0	453.2	367.2	2,050.9	1,063.7	165.7	5,518.3
1956-60 Av.	37.9	1,769.2	665.7	468.8	2,384.5	1,159.0	145.1	6,630.2
1961-65 Av.	31.2	1,574.4	496.3	516.8	2,560.7	1,419.4	186.4	6,785.2
1966	33.2	1,350.7	466.4	593.7	2,589.5	1,592.6	233.9	6,860.0
1967	48.4	1,562.9	598.0	758.5	2,929.7	2,003.6	285.3	8,186.4
1968	59.7	1,697.0	601.0	746.4	2,830.7	1,895.9	314.5	8,145.2
1969	52.7	1,415.5	553.6	771.6	2,652.2	1,717.9	318.0	7,481.5
1970	65.2	1,620.0	868.3	1,067.2	2,933.1	1,742.6	351.9	8,648.3
1971	83.1	2,015.4	1,249.9	1,331.2	3,141.1	1,927.5	365.3	10,113.5
1972	57.4	1,878.5	1,094.3	1,197.3	2,927.8	1,881.2	320.6	9,357.1
Percentage of Canadian Total								
1951-55 Av.	0.7	25.0	8.2	6.7	37.3	19.3	3.0	100.0
1956-60 Av.	0.6	26.7	10.0	7.1	36.0	17.5	2.2	100.0
1961-65 Av.	0.5	23.2	7.3	7.6	37.7	20.9	2.8	100.0
1966	0.5	19.7	6.8	8.7	37.7	23.2	3.4	100.0
1967	0.6	19.1	7.3	9.3	35.8	24.4	3.5	100.0
1968	0.7	20.8	7.4	9.2	34.7	23.3	3.9	100.0
1969	0.7	18.9	7.4	10.3	35.4	23.0	4.3	100.0
1970	0.8	18.8	10.0	12.3	33.9	20.2	4.0	100.0
1971	0.8	19.9	12.4	13.2	31.0	19.1	3.6	100.0
1972	0.6	20.1	11.7	12.8	31.3	20.1	3.4	100.0

Net = Total marketings less inward movementSource: Calculated from Livestock Market Review, Catalogue No. 23-203 C.D.A.



fluctuations in the number of hogs marketed by each province. Ontario marketings for example, in terms of shares of the Canadian total, fluctuated from a low of 31 percent in 1971 to a high of 37.7 percent in 1966. Alberta held a share of 19.9 percent and 19.7 percent in those respective years. Alberta's share of the Canadian total started declining during the period 1961-1965 at a time when Manitoba's share was increasing substantially. During the period of decline in Alberta, Quebec was usually second to Ontario in production. British Columbia, the Maritime Provinces and Saskatchewan are the smallest producers claiming .6 percent, 3.0 percent and 11 percent of the national production figure respectively.

Table 2 gives a more recent picture of the Canadian hog industry. It shows the provincial origin of hog carcasses graded between 1970 and 1974. During this period Ontario farmers produced 57.8 percent of Eastern Canada's total supply and about 32 percent of national output. The negative percent changes in hog marketings indicate a steady decline in production in some provinces such as Prince Edward Island. This is also true of Alberta for the period of 1970 to 1973, whereas production declined in Saskatchewan and Manitoba by -4.1 percent and -2.7 percent respectively. Overall the industry experienced rapid growth during the 60's in Manitoba. British Columbia recorded the highest percentage increases of 39.8 percent during the period 1973 to 1974, followed by Quebec with 19.2 percent increases and Newfoundland with 15.1 percent increases. During this period Western Canada's production declined by 3.6 percent, and their share of national supply 42 percent. Historically, the production of hogs in Western Canada has been less than in Eastern Canada. For instance in the period 1951-1973 the marketing of hogs from Eastern Canada represented between 55 percent and 60 percent of the total Canadian marketings.

Table 2

## Canada: Origin of Hog Carcasses Graded in 1974

Provinces	Three years average 1970-71 and 1972	1973	% change 1970-72 to 1973	1974	% change 1973-74
Newfoundland	17.4	18.6	+ 6.9	21.4	+15.1
P.E.I.	150.4	133.7	-11.1	118.3	-11.5
N.S.	112.0	106.5	- 4.9	108.0	+ 1.4
N.B.	66.1	61.2	- 7.4	61.4	+ 0.3
Quebec	1,850.4	1,910.9	+ 3.3	2,278.4	+19.2
Ontario	3,007.7	2,748.4	- 8.4	2,768.0	+ 0.7
EAST	5,197.0	4,975.3	- 4.2	5,355.5	+ 7.6
% Can.	(55)	(55)		58	
Manitoba	1,198.5	1,221.2	+ 1.9	1,188.3	- 2.7
Sask.	1,070.8	1,072.8	+ 0.2	1,028.6	- 4.1
Alberta	1,838.0	1,717.6	- 6.6	1,626.8	- 5.3
B.C.	68.6	50.3	-26.7	70.3	+39.8
WEST	4,175.9	4,061.9	- 2.7	3,914.0	- 3.6
% Can.	(45)	45		(42)	

Source: Markets Information Section, Agriculture Canada and Livestock Market Review, Cat. No. 23-203, Statistics Canada, 1974.

Figure 1 shows the fluctuations in total production of hogs for the Central region (Quebec and Ontario) and for Western Canada, and in prices for hogs at Toronto and Winnipeg. As the graphs clearly show that in times of peak production of hogs prices plummet to their lowest levels which in a way confirms our theoretical beliefs that current supply determines current price but current price determines future output.

Naturally the hog industry has shown some substantial growth despite recurring cyclical movements. Of real importance is the annual growth rate compounded that has taken place in Canada's hog output. Between 1963 and 1974 the annual increase in Canada's hog marketings averaged 3.4 percent. The largest annual growth rate during this period took place in Manitoba with 10.1 percent increase, while the smallest growth rate occurred in Ontario with 0.5 percent.

Several factors have assisted the growth of the hog industry and in making hog production both environmentally and economically a viable proposition in Canada. Notable amongst these factors are the technological know-how and management capability of Canadian hog-producers. Technological advances have occurred in better nutrition, housing facilities, feeding equipment, sanitation and improved breeds. All these factors combined have resulted in the production of well-bred and generally healthy animals that have made Canada's pork products some of the best qualities in the world.

Another crucial factor sustaining the hog-industry is the availability of relatively cheap feed grains within easy reach. Outside of investment in fixed capital, feed supply is probably the single most important factor that Canada is naturally endowed with and has contributed enormously to the establishment of a firm hog industry. All major areas

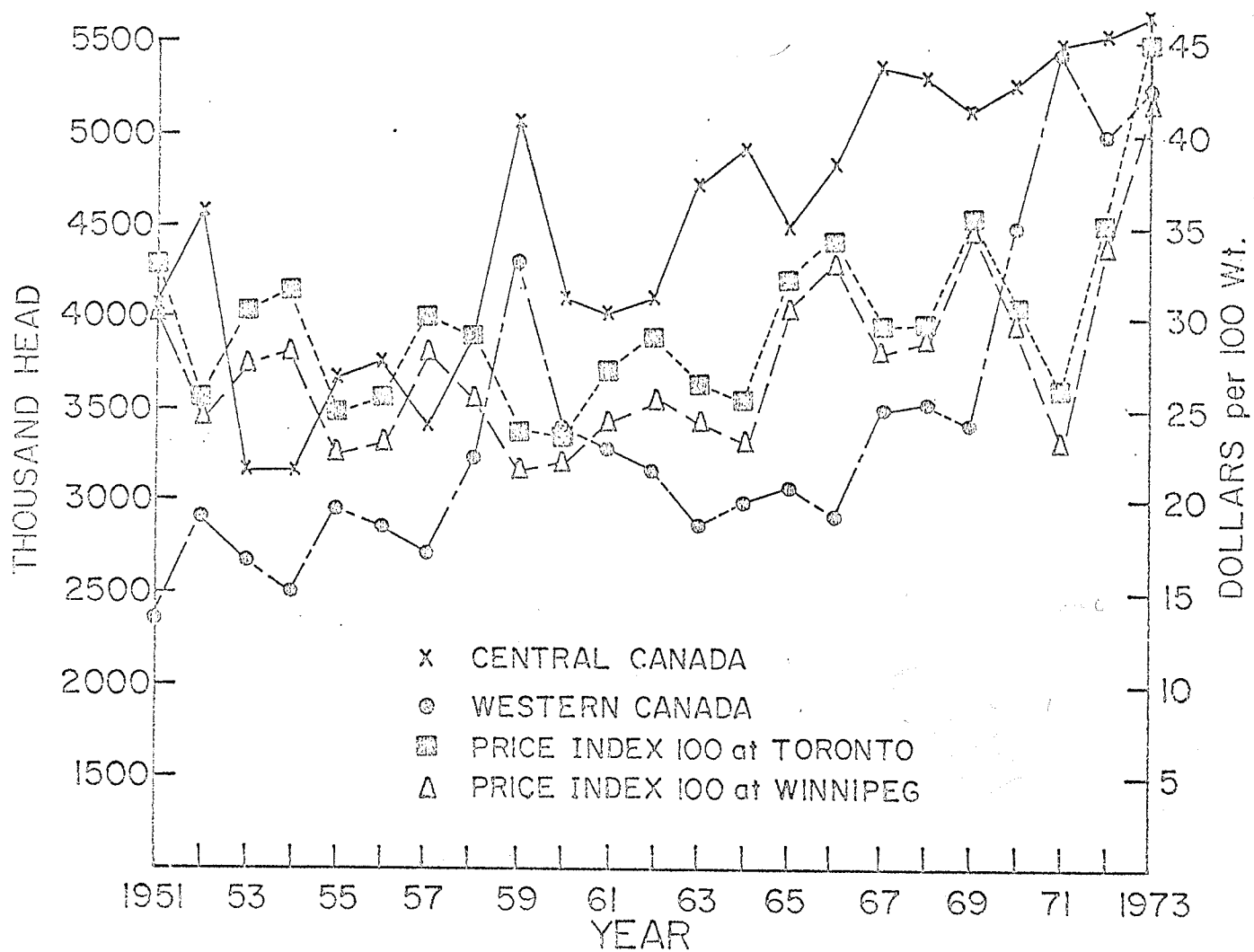


Figure 1. Fluctuations in total hog output in Central and Western Canada and in prices for hogs at Toronto and Winnipeg.

of Canada produce some form of feed grain, however the two major producing areas are the South West Central region and the Prairie provinces. The geographical proximity to the U.S.A., a major producer of feed grains herself, is of some importance to the hog industry here as well.

The hog industry in the Maritimes, British Columbia and Quebec is heavily dependent on imports of Prairie feed grains. In a typical year, feed grain supplies in these regions are made up of five million tons produced within the region, three million tons of Western feed grains and about 0.7 million tons of imported U.S. feed corn.<sup>2</sup> These feed grain supplies are supplemented with protein and other nutrients used in the rations for livestock. Ontario is virtually self-sufficient in feed grains.

#### Production and Slaughter Pattern

In the late forties through the fifties, and early sixties, hog slaughtering was concentrated in the fall and early winter months (October to January) in Canada. This mainly reflected the highly seasonal production and slaughter pattern of the West. Because of the severe winters in the West, breeding was done such that sows farrowed in early spring allowing relatively easy management in the warmer months of spring and summer, and marketing in the fall. Eastern Canada also slaughtered more hogs in the fall of the year, however a large proportion of its sows also produced a fall litter for spring slaughter. Petrie<sup>3</sup> has observed that by 1972, hog

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<sup>2</sup> Food Prices Review Board: Feed Grain Policy in Canada, 1975, p. 26.

<sup>3</sup> Petrie, T. M., Seasonal, Cyclical and Trend Variations in the Hog Industry, Economics Branch, Agriculture Canada; Publication No. 74/20. November 1974.

production and slaughter had become much more uniform by season and although still heavier in the spring and the fall than in the other two seasons of the year, its amplitude had declined considerably from 90 percent to 21 percent in Western Canada, from 47 percent to 17 percent in Eastern Canada, and from 62 percent to 14 percent in Canada. The same author contends that slaughtering has increased in the "off season", the winter and summer months relative to the spring and fall over the past 25 years in Canada. The late forties and fifties' pattern of production and slaughter for Western Canada reflected the fact that most farmers bred their sows to farrow only once a year, because many lacked adequate facilities for winter production. By the early sixties the proportion of sows producing two litters per year had increased sharply. This points to the fact that there was a general improvement in production facilities to allow for winter farrowing and feeding. In the East it has always been possible to produce two litters a year because of the relatively mild winter in many of the major producing areas.

The slaughtering of livestock in general in Canada displays seasonal variations which reflect the influence of weather on production. Most of the country's pigs are born in the spring to avoid harsh winters. This naturally results in the build-up of pork at fairly predictable times. As noted earlier, this pattern is slowly changing with improved technology in pig housing and overall management. Hog production was weather oriented 25 years ago, particularly in Western Canada. With today's improved technology, obtaining two litters per sow per year results in a more uniform slaughter by season for hogs.

The hog industry is generally characterized by fairly strong fluctuations in the following variables:

- 1) prices received by farmers
- 2) as a result of unstable prices -  
unstable incomes
- 3) supply of hogs for market slaughter.

The variation in these factors can be observed from season to season in any given year. This we call seasonal variation and is naturally attributed to climatic seasons. This kind of variation has been described in the preceding section.

The second type of variation that occurs is of a cyclical nature. According to Chin et al<sup>4</sup> the cycle may be described in terms of prices or marketings. The main characteristics of a cycle are its length and magnitude of fluctuations. Hog cycles like any other commodity cycles are not always clearly defined. In Canada cycles are most distinct in Alberta and Ontario. It is estimated that hog cycles average about three years in length and the periods of cyclical expansion and contraction average 21 and 14 months respectively.<sup>5</sup> These cycles are identified on the basis of their peaks and troughs which are periodically recorded during a prolonged cyclical movement.

#### Economic Importance

The hog industry constitutes an important segment of Canadian agriculture. It is estimated that out of a farm population of 366,128 about 122,481 farm operators, or 33.5 percent of the total farm population,

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<sup>4</sup>S. B. Chin et al, National and Regional Hog Supply Functions, Economics Branch Publication #74/15, September 1974, Agriculture Canada.

<sup>5</sup>Ibid., p. 21.