

THE MAJOR DETERMINANTS OF NET RETURN
FROM HOG PRODUCTION IN MANITOBA

A Dissertation
Presented to
the Faculty of Graduate Studies
University of Manitoba

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
Sunday Abiodun Oyeneye
May 1972



ACKNOWLEDGEMENTS

The author would like to express his sincere appreciation to the following people who assisted in this study:

Mr. J. P. Hudson, major adviser, for his patient guidance, sympathy and inspiration in guiding the study.

Dr. W. J. Craddock, Mr. E. R. Poore, for their comments and constructive criticism at various stages in the preparation of the thesis.

Mr. G. W. Moore, employee of the Manitoba Agriculture Credit Corporation for his contribution to the research.

Mr. C. E. Shewfelt, A. Martin, J. Tulloch, C. Ross, F. Tung and S. Sun, fellow graduate students for their co-operation and helpful discussion.

The Secretarial Staff in the general office of the major department for their readiness to help whenever called upon.

The Staff of the Economics Branch of the Manitoba Department of Agriculture for their patience and attention to the many telephone calls or personal visits imposed upon them when the author was seeking information and farm records.

The hog producers who responded to the questionnaire sent them and most especially the three hog farmers in Stonewall on whose farms personal observations were made.

Mrs. A. Sutton who typed the thesis, for a job well done.

Finally my wife, Olu, for her encouragement throughout this study.

TABLE OF CONTENTS

	Page
LIST OF TABLES	vi
LIST OF APPENDIX TABLES	vii
LIST OF FIGURES	viii
ABSTRACT	ix
CHAPTER	
I. INTRODUCTION	1
OBJECTIVES	2
METHOD AND PROCEDURE	2
ORGANIZATION OF THE THESIS	4
II. HOG GRADING AND MARKETING INSTITUTIONS	6
A SHORT HISTORY OF HOG GRADING	6
CANADA AGRICULTURAL PRODUCTS STANDARDS ACT, 1958	7
THE NEW CANADIAN HOG VALUATION SYSTEM	9
How the New Valuation System Works	13
Determination of the A and B Equivalent	13
Payment Routine and Procedure	14
Differences Between the Old Grading System and the New Grading System	15
HOG MARKETING IN MANITOBA	17
III. THEORY AND METHOD	22
CHARACTERIZATION OF THE FARM-FIRM	22

CHAPTER	Page
CONCEPTUAL FRAME--WORK FOR MEASURING MANAGEMENT	
EFFICIENCY	27
Total Value of Output	29
Total Cost	29
Fixed Cost	29
Labour Cost	29
Feed Cost	30
Cash Expense	30
Management	30
IV. ANALYSIS AND RESULTS	32
Association Between Variables On Hog Farm Records	32
MODEL BUILDING	34
Determining the Form of the Equations	35
Regression Estimates	38
Value of Output and Cost Relationship	38
Net Return and Quality of Management Relationship	39
APPLYING THE ESTIMATES FROM THE REGRESSION ANALYSIS	41
Determining the Marginal Value Productivities . .	41
Estimating Net Return from Cost Factors and Management Factors	43
Determining Management Possibilities and Changes in Net Return	46
V. CONCLUSIONS	48
BIBLIOGRAPHY	53

CHAPTER	Page
APPENDIXES	55
A. TREATMENT OF THE DATA USED IN THE ANALYSIS	56
B. METHOD OF CALCULATING PAYMENTS	66
C. QUESTIONNAIRE	69
D. APPENDIX TABLES	71

LIST OF TABLES

Table	Page
1. Hog Carcass Grading Under the Canada Agricultural Products Standards Act	8
2. U. S. - Canada Trade in Pork (Excluding Canned Hams) . . .	11
3. New Hog Valuation System	12
4. Differences Between the Old Grading System and the New Valuation System	16
5. Average Regional Price Differences for Hogs for Periods Before and After the Establishment of the Teletype Auction in Winnipeg	20
6. Receipts of Hogs at Public Stockyard in Manitoba	21
7. Summary Data from 29 Records Used in This Analysis	33
8. Regression Estimates of Total Value of Output on Cost Factors	38
9. Regression Estimates of Net Return on Management Quality Variables	40
10. Estimates of Average Value Productivities and Marginal Value Productivities of the Cost Factors	42
11. Estimates of Average Value Productivities and Marginal Value Productivities of Management Quality Factors . . .	43
12. Average Net Return Per Sow and Cost Factors Stratified By Number of Pigs Weaned Per Sow	44
13. Average Net Return Per Sow and Management Quality Factors Stratified By Number of Pigs Weaned Per Sow	46
14. Effects of Ten Percent Increase on Management Quality of Pigs Weaned, Quality Rating of Hogs and Farm Size . . .	47

LIST OF APPENDIX TABLES

Table	Page
A1. Prices and Price Indexes of Hog Receipts for 1961, 1967, 1969 and 1970	57
A2. Farm Input Price Indexes for Western Canada Arranged in Four Cost Groups for the Years 1967, 1969 and 1970. Basis 1961 = 100	58
A3. Derivation of Index Weights from Average Values of Input Items in Four Cost Groups	60
A4. Composite Price Indexes Used in the Analysis, 1961 = 100 . .	63
D1. Manitoba Farm Cash Receipts	72
D2. Carcass Grade of Manitoba Hogs (1964-1970) (% of Canada Production)	73
D3. Feed Cost, Cash Expense and Fixed Cost Stratified by Quality Rating of Hogs	74
D4. Correlation Coefficients of the Variable Factors Related to Net Return Per Sow for the Hog Farms Summarized in Table 7	75
D5. Regression Estimates of Net Return on Management Quality Variables (Using Index for the Quality Rating)	76

LIST OF FIGURES

Figure	Page
1. A Model of the Farm-Firm in Operation	23
2. Diagram Showing Interrelationships Between Managerial Ability Management Decisions and Farm Productivity . . .	26
3. Diagram Showing Relationship Between Net Return to Management Total Value of Output and Total Cost	28
4. Scatter Diagram and Curve of Best Visual Fit for Feed Cost and Total Value of Output Per Sow	36
5. Scatter Diagram and Curve of Best Visual Fit for Number of Pigs Weaned and Net Return Per Sow	37

ABSTRACT

Hog production has become an important source of income to Manitoba farmers. An expansion in hog operations would add to this income source. Any information that assists in the process of expansion would be valuable to farmers and the economy of the Province. This study was directed to determine the important factors that influenced net return from hog production so as to guide the manner in which additional investment might be expended. The objectives were achieved by utilizing data from 29 Manitoba farms engaged in hog production. A regression model was constructed to study the relationship between value of production and various cost factors; another regression model was used to study the management factors that were associated with net returns. The costs which explained the greater part of the variation in the value of output were feed cost, cash expense, fixed cost and labour cost. The management factors which explained the greater part of the variation in net returns were number of pigs weaned, quality rating of hogs, years of formal education of the farmers and the number of sows per farm.

The analysis showed that the factors having the greatest influence on net returns from hog production were the number of pigs weaned, the quality rating of the hogs, feed cost and cash expense. The conclusions emphasize the importance of management decisions that relate to feeding, care at weaning time and a clean environment.

CHAPTER I

INTRODUCTION

Hog production has assumed an increasingly important position as a major source of farm income in Manitoba. It is shown in Appendix Table D1 that while farm cash receipts from crops, during the period 1966 to 1970, had steadily decreased; the share of income from hog production had steadily increased. Provincially, hog receipts, rose from 8.9 percent of total farm cash receipts in 1966 to 16.1 percent of total farm cash receipts in 1970. Among the Prairie provinces, Manitoba hog production increased from a total of 19.6 percent of total hog receipts in 1963 to 27.8 percent of total hog receipts in 1970. On the other hand, in the period 1964 to 1968, Manitoba produced fewer grade A hogs and more lower grades than the national average (see Appendix Table D2). It is also shown that in the period 1969 to 1970, fewer Manitoba hogs qualified in the grade A equivalent indexes of 102 to 112 than the Canadian average. These observations indicate that expanded hog production in Manitoba can be viewed in the light of the desirability to increase both quantity and quality. An expansion in Manitoba hog production will help to diversify Manitoba Agriculture resulting in a fuller use of labour and capital resources. It will improve the income and cash flow position of Manitoba hog farmers and provide a market outlet for surplus feed grains.

Farmers and government are interested in understanding the factors that influence the development of expanded and efficient hog production.

Any information that contributes to this understanding is desirable. Attention to this subject is the focus of this study; to appraise those factors which contribute to net income of hog producers.

OBJECTIVES

The prime purpose of the research reported in this thesis includes the following objectives.

1. To study the cost factors which contribute to value of output from hog production.
2. To study management quality factors which influence net returns to hog producers.
3. To establish the interrelationship between the variable factors and measure their effect on net returns.

METHOD AND PROCEDURE

Variability in management practices between farms was studied by first hand experience during a period of living and working on a commercial hog farm and subsequent visits to observe management practices on other farms. Attention was given to the importance attached to such management practices as hygiene (i.e. animal health), care of sows during the breeding, gestation and lactation period; care of litter and feeding practices from creep feeding of litters through the growing period and until the hogs were finished for market.

Discussions were held with officials of the Manitoba Agricultural Credit Corporation regarding the capital needs and credit policies that

might influence an expansion of hog operations on Manitoba farms. The old and new Canadian hog grading system was studied to appraise the relationship of hog grading to economic production of hogs.

Reports of the Royal Commission which was set up to study the conditions in the meat industry were read. Visits were made to the St. Boniface stockyard to observe how hog pricing was carried on. Officials of the Hog Commission demonstrated how to send and receive auction messages through the teletype system which they operate.

A questionnaire designed to collect information from the hog producers on the number of years in school, experience at hog production and sources of technical and market information was mailed to farmers. This information was required to supplement empirical data obtained from farm records.

Other information related to technical processes of production and credit availability was provided by farm journals, a list of which is contained in the bibliography.

Empirical data from audited records of farmers engaged in hog production were provided by the Manitoba Department of Agriculture for the years 1967, 1969 and 1970. A selection of 29 records was made from those available on the basis that the hog operation satisfied the following conditions:

1. The enterprise was a farrow to finish operation.
2. Production was not less than 70 hogs¹ per year.

¹The 1966 Census of Canada reported that only 14 percent of the farms in Manitoba had 63 pigs or more on their farms (i.e. 2,337 farms out of 16,048 farms).

3. The breeding program was designed to produce at least two litters per year.

4. The records were complete enough to provide adequate information on all the variables required for the study.

5. The hog enterprise was recorded separately from other enterprises on the farm.

The records were mainly from farms associated with the Hybrid Pig Program of Manitoba Pool Elevators which lend validity to the assumption that all farms have reasonably homogeneous herds in terms of genetic characteristics associated with feed conversion and rate of growth.

The cross section data provided from farm records can be subjected to the method of regression analysis, the method adopted in the study. The cross section data made it possible to study the variance in management which characterized the individual operators.

ORGANIZATION OF THE THESIS

The remaining chapters are organized in a manner intended to bring together all aspects of the research project. Chapter II considers hog grading and marketing institutions in Manitoba. It reviews the Agricultural Products Standards Act which established the grading system from August 1958 to December 1968 and the New Canadian Hog Valuation System of January 1969. The two systems were discussed and compared as far as they relate to producer and consumer interests. The chapter also reviews the development of the price setting mechanism in Manitoba from the appointment of a Royal Commission in 1961 and through the periods after the recommendations of

the Commission were implemented. Chapter III develops the concepts that were applied in the rest of the study. The relationship between managerial ability and decision making as they relate to farm productivity were discussed. Models were constructed to convey to the reader what was meant by management efficiency in the study. The chapter also contains definitions of the production factors used. Chapter IV deals with the analysis and results obtained. Two regression models were developed. The first was used to explain the influence of the input cost factors on total output. The second model measured the influence that management factors have on net returns. Regression estimates from the resulting equations were utilized to determine the marginal value productivities of the cost factors as well as the management factors. The accuracy of the coefficients was assessed by substituting data from farm records into the equations to determine an estimate of net returns. The estimated net returns were compared with the actual net returns. Chapter V relates the results of the analysis to the original objectives and contains the conclusions drawn from the results of the regression analysis.

CHAPTER II

HOG GRADING AND MARKETING INSTITUTIONS

The development of a grading system in Canada is closely associated with the growth of the Canadian market economy. Grades serve to facilitate trade by eliminating the need for personal inspection by the buyer. Consumers' purchasing decisions are often guided by economic reasoning such as favourable prices, quality grades and other economic considerations. An awareness of nutrition and health factors are also important in consumers' purchasing habits. The need for a grading system is especially important with meat products since quality of such products are identified by the consumers through the grades. In Canada, hogs are sold on a carcass grade-and-yield basis; the emphasis on producing meatier type hogs reflects the producers' response to the consumer demands for leaner meat.

A SHORT HISTORY OF HOG GRADING

Hog grading in Canada dates back to 1922 when live grading was started. Between 1922 and the present time, several changes of the grading system have taken place which reflect hog quality requirements within Canada and abroad. Historically, two stages in the development of the Canadian grading system compare closely and show definite developmental sequence in the realisation of both consumer and producer interests. These stages are the "Canada Agricultural Products Standards Act"¹ of 1958 which terminated

¹Ottawa Hog Carcass Grading Regulations, P.C. 1958-1202 (1958), made under the Canada Agricultural Products Standards Act, 1958.

on December 31, 1968 and the "New Canadian Hog Valuation System"² which started on January 1, 1969 and is currently the official standard for hog grading. In other parts of this study, the earlier Act may be referred to as the "old grading system" and the 1969 regulations as the "new grading system".

CANADA AGRICULTURAL PRODUCTS STANDARDS ACT, 1958

The Canada Agricultural Products Standards Act became law on August 28, 1958. The Act established eleven grades for hog carcasses designated as follows:

- | | |
|-------------------|------------------------|
| 1. Canada grade A | 7. Canada extra heavy |
| 2. Canada grade B | 8. Canada ridgling |
| 3. Canada grade C | 9. Canada stag |
| 4. Canada grade D | 10. Canada sow class 1 |
| 5. Canada light | 11. Canada sow class 2 |
| 6. Canada heavy | |

The weights and measurements for grades of hog carcasses established by Section III of the Act are presented in Table 1. From its beginning the grading system was not completely acceptable for its designed purpose. A critical appraisal of the adequacy of the grading system to predict yield and value of hog carcasses was reported by H. T. Fredeen and associates in 1964.³ A sample of 482 hog carcasses was studied to relate carcass yield to the

²New Hog Carcass Valuation System by Canadian Swine Council, Meat Packers Council of Canada and Canada Department of Agriculture (Ottawa: 1969).

³H. T. Fredeen et. al., "Prediction of Yield and Value of Hog Carcasses," Canadian Journal of Animal Science, 44:334-346, April, 1964.

Table 1. Hog Carcass Grading Under the Canada Agricultural Products Standards Act

	Carcass Weight (1)	Minimum Length (2)	Maximum Shoulder Fat (3)	Maximum Loin Fat (4)
1. Canada grade A	135 pounds or over but not over 150 pounds	29 - 29 1/2 inches	1 3/4 inches	1 1/4 inches
	Over 150 pounds but not over 170 pounds	29 1/2 - 30 inches	2 inches	1 1/2 inches
2. Canada grade B	125 pounds or over but not over 150 pounds	28 - 28 3/4 inches	1 3/4 - 2 1/4 inches	1 1/2 - 1 3/4 inches accord- ing to weight
	Over 150 pounds but not over 180 pounds	29 - 30 inches	2 1/4 - 2 1/2 inches according to weight	1 3/4 to 2 inches accord- ing to weight
3. Canada grade C	125 pounds or over but not over 180 pounds			
4. Canada grade D	All weights			
5. Canada light	90 pounds or over but less than 125 pounds			
6. Canada heavy	Over 180 pounds but not over 195 pounds			
7. Canada extra heavy	Over 195 pounds			
8. Canada ridgling	All weights			
9. Canada stag	All weights			

established grades. The study indicated that the measurement of total backfat was a more accurate indicator of carcass lean than was length or carcass weight; that the lean content of carcasses can be adequately predicted from the total of two specific backfat measurements. Among other things, the study revealed the following about the old grading system:

a) There were very few backfat categories which implied that backfat categories overlapped. The result was little or no difference between what was regarded as grade A or B insofar as backfat was concerned.

b) There was little correspondence between weight and yield, and the system of relating weight ranges to backfat requirements resulted in less rather than greater accuracy.

c) The phrase "according to weight" introduced ambiguity into carcass grading, leaving the grade assessment to the judgement of the grader.

d) Length of carcass was given prominence in the table, even though length had very little relation to yield; and did not add anything to the knowledge of yield once the backfat was known.

However, it must be stated that length of hog is an important component of type, and therefore of commercial importance. Undesirable deviations from type must be taken into account to arrive at the value of a hog. But, these deviations were rare in Canadian output, and the attempt to incorporate them into a grading system made more difficult and more inaccurate the process of valuing hogs.

THE NEW CANADIAN HOG VALUATION SYSTEM

The new Canadian hog valuation system was developed as a result of

findings cited and also the need for the Canadian hog producer to maintain a quality advantage over his United States counterpart. Pork movement between Canada and the United States was mainly in the form of wholesale cuts (hams, backs, bellies, butts, picnics, etc.). In 1968, Canada produced only 8.1 million hogs out of a total pool of 93.3 million hogs produced in Canada and the United States.⁴ It is shown in Table 2 that between 1965 and 1968 Canada exported 50 percent to 90 percent more commercial cuts of pork to the United States than what was imported from the United States. It is logical that an improvement in the quality of commercial cuts will strengthen the Canadian export position.

The new valuation system came into force January 1, 1969. Under the system, the Canada Department of Agriculture continues to measure and appraise carcass merit and supervise weighing. The main difference between the new rating system and the old is that the new emphasizes total backfat⁵ while the old emphasized length of carcass. Total backfat determines grading indexes and the grading indexes vary with changes in weight. Hogs, whose warm carcass weight is between 125 and 180 pounds are placed in one of 13 index categories. Other value-yield categories have been established for light carcasses (90 to 124 pounds); heavy carcasses (181 to 195 pounds); extra heavy carcasses (196 pounds and over) and for ridglings.

The table of differentials (see Table 3) is the key to the new valuation system. The index figures in the table are the result of

⁴R. K. Bennett, "Address to a meeting in Winnipeg On the Opportunities for Increasing Hog Production in Manitoba" (Ottawa: Livestock Division, Department of Agriculture, 1969).

⁵Total backfat is the sum of maximum depth of shoulder fat plus maximum depth of loin fat.

Table 2. U. S. - Canada Trade in Pork (Excluding Canned Hams)

Years	Imports from U. S. (lbs.)	Exports to U. S. (lbs.)	Ratio of Export to Import
1965	28,797,444	48,950,100	1.7
1966	28,556,457	41,808,500	1.5
1967	26,834,600	51,909,157	1.9
1968	36,395,100	53,419,244	1.5

Source: Dominion Bureau of Statistics, Trade of Canada, Volumes 2 and 3, Catalogues 65-202 and 65-203 Annual, Ottawa - Canada.

Table 3. New Hog Valuation System

Back Fat ^a	Predicted Yield ^b	Warm Carcass Weight Pounds									Ridgling	
		90 to 124	125 to 129	130 to 139	140 to 149	150 to 159	160 to 169	170 to 180	181 to 195	196 to and over		
Inches	Percent	----- Index -----										
- 1.9	69.7	87	105	109	110	112	112	112	91	85	67	
2.0 - 2.1	69.0	87	103	107	109	110	112	112	91	85	67	
2.2 - 2.3	68.2	87	102	105	107	109	110	110	91	85	67	
2.4 - 2.5	67.5	87	100	103	105	107	109	109	91	85	67	
2.6 - 2.7	66.7	87	98	102	103	105	107	107	91	85	67	
2.8 - 2.9	66.0	87	97	100	102	103	105	105	91	85	67	
3.0 - 3.1	65.2	87	95	98	100	102	103	103	91	85	67	
3.2 - 3.3	64.5	87	92	97	98	100	102	102	91	85	67	
3.4 - 3.5	63.8	87	88	95	97	98	100	100	91	85	67	
3.6 - 3.7	63.0	87	88	92	95	97	98	98	91	85	67	
3.8 - 3.9	62.3	87	88	88	92	95	97	97	91	85	67	
4.0 - 4.1	61.5	87	88	88	88	92	95	95	87	82	67	
4.2 - 4.3	60.8	87	88	88	88	88	92	92	87	82	67	
4.4 - +	60.1	87	88	88	88	88	88	88	87	82	67	

^aTotal back fat is the sum of maximum depth of shoulder fat plus maximum depth of loin fat. All measurements are taken to the nearest tenth of an inch.

^bPercentage of predicted yield associated with each back fat category.

exhaustive tests conducted on hog carcasses over the three years before December 1968. The percentage of predicted yield of lean associated with each backfat category for a range of warm carcass weights is shown in the second column.

How the New Valuation System Works

The valuation system allows the producers the opportunity to make higher returns for producing a quality product. It is thus a positive policy measure by which the free enterprise of the economy is adjusted to consumer needs by creating price incentives that encourage quality production from producers.

Determination of the A and B Equivalent

Prior to January 1, 1969, the average warm carcass weight of slaughter hogs (excluding sows and stags) was approximately 154 pounds. Tests carried out in developing the new grading system showed that the average total backfat of A and B grade carcasses was 3.2 inches. Reading across from the backfat measurement and down from the carcass weight in Table 3, it is shown that the index for an average hog carcass of 154 pounds with total backfat of 3.2 to 3.3 inches was set at 100. This grade is equivalent to the A and B grades under the old grading system.

As total backfat decreases the differential index increases and conversely, as backfat increases the index decreases. Each of the figures within the table is an index or a percentage change of the value per pound of carcass, which ranges up and down from 100.

In addition to fat and weight limitations expressed in Table 3, the following three sources of demerits are not desirable. These are type

demerit, quality demerit, and trimmable demerit.

a) Type demerits are those deficiencies or subnormalities found on the ham, shoulder and belly. These demerits are related to length and roughness and do not require trimming. A deficiency in any or all of these characteristics will result in a reduction of three percent on the differential index which applies to that particular carcass.

b) Quality demerits will include abnormal colour and texture of lean meat, (pale, watery, dark or abnormal fat that is soft and oily, etc.). Carcasses judged to have either one or both of these deficiencies will be reduced by ten percent.

c) Trimmable demerits are of such a nature that an officer of the Canada Department of Agriculture requires their removal on the killing floor. These abnormalities include deformities, pathological condition (disease, injury, etc.), late castration, excess mammary development, skin condition, pigmentation and adhesions. In these cases, the actual weight removed, if clearly of farm origin, will be deducted from the hot carcass weight. This adjusted weight will be used to determine the appropriate differential index.

The purpose of identification of demerits, as an essential part of the grading procedure, was to classify commodities into quality groups and to make possible an accurate determination of value to aid pricing accuracy.

Payment Routine and Procedure⁶

The payment statement to the farmer includes information on warm

⁶ See Appendix B for method of calculating payments.

carcass weight, total backfat, demerits and selling price. The steps taken to effect payment are as follows:

1. Select the appropriate index from Table 3. The selected index may need to be adjusted for type and quality demerits.
2. Multiply the market price per hundred pounds of carcass by the final index to arrive at the price for the category.
3. Multiply the product in step two by the warm carcass weight adjusted for trimmable demerits.

Differences Between the Old Grading System and the New Grading System

The new grading system assesses hog by index based on the concept of appraising carcass merit as predicted by backfat and weight. The old grading system assessed hogs in terms of grades based on length of carcass and weight. See Table 4.

The new grading system gives greater income to the producers who market hogs that yield a relatively higher proportion of lean. The new system recognizes quality above the A and B grades with index values from 105 to 112, (see Table 4). Under the old grading system, A and B grades received the highest prices and there was no quality rating above these grades.

The new grading system by its emphasis on carcass quality and by penalizing against demerits encouraged greater capital cost, medication costs, feed costs and other costs on hog farmers. This may not be a disadvantage to farmers who have chosen to stay in hog production as an occupation, but the farmers who produce hogs merely to fill the revenue gap from other sources may have an additional cost constraint. In Appendix Table D3, it is

Table 4. Differences Between the Old Grading System and the New Valuation System

Old (1958 - 1968)				New (1969 - Present)		
Established Grades	Warm Carcass Weight Range	Minimum Length	Total Backfat	Valuation	Warm Carcass Weight Range	Total Backfat
Grades	Pounds	Inches	Inches	Index	Pounds	Inches
No Equivalent	Nil	Nil	Nil	112-109	180-130	1.9-2.4
No Equivalent	Nil	Nil	Nil	107-105	180-125	2.5-2.8
A	170-135	30-29	3.00-3.25	103	180-125	2.9-3.0
B	180-125	30-28	3.25-4.50	102-100	180-125	3.1-3.5
C	180-125	No Restriction	No Restriction	98-95	180-125	3.6-4.1

shown that increased quality production of hogs necessitates additional feed expenses, fixed cost and cash expenses.

Judging from the content in the table of differential, it might be inferred that it is generally more remunerative to produce between the weight range of 150 lbs. to 180 lbs. carcass weight. However the concensus of opinion among the farmers visited was that indexes of 109 to 112 are rarely attained. They had observed that hogs with such a high index were generally poor growers that took a longer feeding period to reach market weight. The higher feed costs and longer period in the barn were not reflected in the price received.

HOG MARKETING IN MANITOBA

The marketing system plays an extremely important role in the economy of a country. Its functions are to determine consumer wants, allocate resources and move goods in the form and time desired from producer to consumer. It is therefore imperative that every means and opportunity be taken to increase the efficiency of the marketing system in performing its task. An enquiry into the meat industry was initiated by the appointment of a Provincial Royal Commission in 1961. At that time, Manitoba hog producers delivered most of their hogs either directly to packing plants in St. Boniface and Brandon, or to the public stockyards in St. Boniface or the Brandon Auction Market. It was estimated that less than ten percent of Manitoba hogs were marketed through the stockyard since the three largest national packers had such a large bargaining power as to divert the great portion of the hog output in Manitoba from the price setting public

market.⁷ The Commission felt that this condition was not conducive to competitive pricing. In order to correct the unsatisfactory marketing condition, the Royal Commission recommended that a Hog Marketing Commission should be established to operate a public teletype auction system of marketing on a voluntary basis coupled with a market information service.⁸

The Manitoba Hog Marketing Commission was established in 1964 and commenced operations in February 1965. The Commission is a group appointed by the legislature under the supervision of the Manitoba Marketing Board. The Manitoba Hog Marketing Commission is responsible for and has the authority to supervise and regulate the marketing of hogs produced in Manitoba. The Commission set up the following rules:

1. A producer cannot sell or consign his hogs directly to a buyer or processor unless the producer advises the Commission personally or by mail, in advance, of his intentions.

2. Every hog transported by a public service vehicle must be cleared through an office of the Commission before delivery to a processor. Further, a processor can only buy hogs through the Commission, or accept delivery of hogs, if the shipment is accompanied by a copy of the direct sale form. For each hog purchased in this manner, the processor deducts 30 cents from the purchase price and forwards this amount to the Hog Marketing Commission. The Hog Marketing Commission instituted a teletype auction system which, aided by the regulations, made it possible to achieve a more centrally determined price. The teletype auction system exposed all hogs

⁷Manitoba Department of Agriculture, Hog Marketing by Teletype, October, 1968, (Winnipeg: Queen's Printer, 1968), p. 7.

⁸Ibid., p. 9.

marketed through the Commission to all competitive buyers. The result was an increase in the price received for hogs. It is shown in Table 5 that, after the introduction of auction buying by teletype, and up to 1969, the price differential for hogs between Toronto and Winnipeg decreased. Within the same period, the price differentials for hogs between Winnipeg and Edmonton as well as between Toronto and Edmonton increased. It might be assumed that the degree of competition in the Winnipeg market had increased relative to other markets shown in the table. On the other hand, as shown in Table 5, the converse of the price condition stated above occurred in 1970 and early 1971. This situation might be partly explained by the fact that hog production in Manitoba, as shown in Table 6 increased sharply in 1970 while supply from other provinces was not significantly different in trend.

In conclusion, Chapter II has discussed the grading and the price setting systems in Manitoba. These systems relate to quality grades and selling prices which, though institutionally determined, affect the net return to the farmer. Grades are standards for quality and quality promotes acceptability of pigmeat to consumers. Efficient pricing ensures that the selling price is determined by competitive bidding. It must be noted that while gross receipt is the upper ceiling for net return, total cost determines its lower limit. The relationship between net return, total revenue and total cost will be discussed in the following chapter.

Table 5. Average Regional Price Differences for Hogs for Periods Before and After the Establishment of the Teletype Auction in Winnipeg

Markets	Period Before Teletype	Period After Teletype				
	Average 52 Weeks	1967	1968	1969	1970	1971
	----- Dollars -----					
Toronto - Winnipeg	2.45	2.15	1.70	0.25	3.00	3.57
		Change	Change	Change	Change	Change
		-0.30	-0.75	-2.20	+0.55	+1.12
Winnipeg - Edmonton	0.48	1.85	1.60	2.15	0.80	0.45
		Change	Change	Change	Change	Change
		+1.37	+1.12	+1.67	+0.32	-0.03
Toronto - Edmonton	2.93	4.00	3.30	2.40	3.80	4.02
		Change	Change	Change	Change	Change
		+1.07	+0.37	-0.53	+0.87	+1.09

Source:

Canada Department of Agriculture, Livestock Market Review Annual ,
Ottawa.

Table 6. Receipts of Hogs at Public Stockyard in Manitoba

Year	From Manitoba	From Saskatchewan	From Alberta
	----- Number of Hogs -----		
1964	582,066	165,236	770
1965	578,304	150,275	7,325
1966	593,270	114,334	1,210
1967	758,355	134,560	999
1968	745,989	135,692	9,162
1969	771,253	96,123	10,928
1970	1,065,105	147,341	642

Source:

Canada Department of Agriculture, Livestock Market Review Annual,
Ottawa.

CHAPTER III

THEORY AND METHOD

The purpose of this chapter is to establish a theoretical basis for the management efficiency analysis. In order to provide a frame of reference, the farm-firm is characterized as a socio-economic operating entity.¹ The operating procedure of the farm-firm is stated in the short-run context. The remainder of the theoretical discussion is devoted to the formulation of the concept of management efficiency on the hog farm.

CHARACTERIZATION OF THE FARM-FIRM

The farm-firm may be considered as a technical workshop in which commodities are produced. The entrepreneur has the primary task of deciding what quantity and by what means a particular commodity will be produced. The consequence of his decision is measured by the difference between revenue from the sale of output and the cost of inputs which may result in a profit or a loss.

The major purpose of this study is to explain why some firms are more efficient than others and identify the factors which individually or in aggregate, influence net return to management. The schematic representation of the farm-firm in Figure 1 provides a model for establishing the general theoretical nature and interaction of the efficiency factors. The model indicates that production processes are constrained by managerial ability,

¹Socio-economic operating entity refers to the farm as operating under economic and social forces.

Index
 - External Factors
 - Internal Factors
 = External and Internal Factor

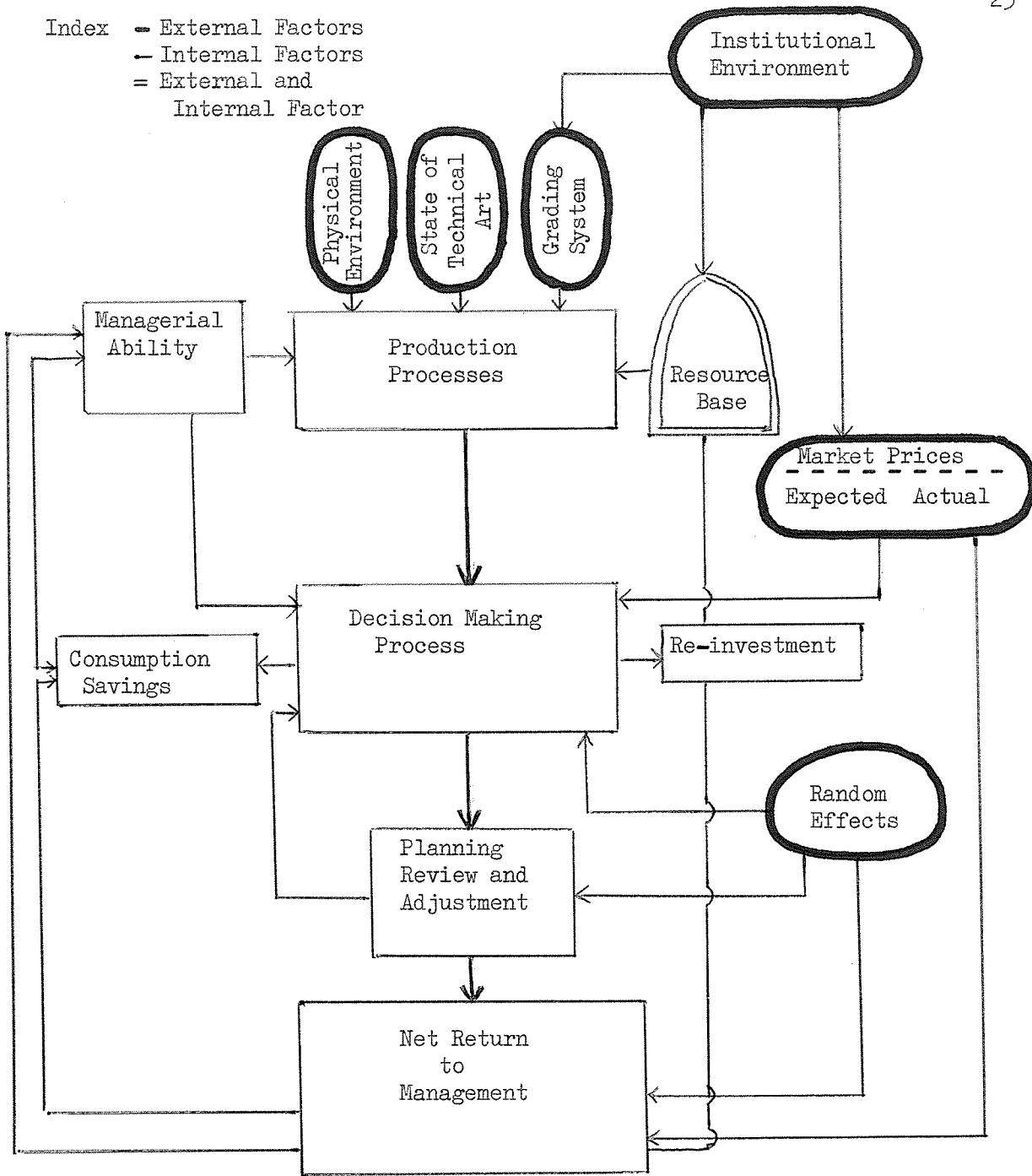


Figure 1

A Model of the Farm-Firm in Operation

physical environment, state of the technical arts, the grading system and the resource base of the farm. The choice of a production process is a function of managerial decision making and the result of the decision is net return. Net return to the manager may be spent on consumption goods, saved or reinvested in the farm.

The theory of the firm outlined in economic text books is simpler than can be expected within the farm-firm.² In the farm-firm, profit maximization is not an easy process since control and coordination of factors are not easily achieved. How much control the entrepreneur has over labour depends on his human relationship with the workers, his intelligence and experience. How well the physical factors are utilized depends on the ability of the manager to plan ahead and make appropriate decisions on the day to day functioning of the entire farm.

The operation of a farm-firm can be represented schematically as an interaction between external and internal forces.³ The external forces are those outside the control of the farmer, the farm can only at best adjust to them. Included are physical environment, state of the technical arts, institutional environment, market prices and random effects.⁴

Physical environment of the farm may denote the physical possibility frontier of farm production. This may include factors such as soil productivity, seed productivity, climate, water and air. Consideration of these factors must be taken before production decisions are made; therefore, the

²James M. Henderson and Richard E. Quandt, Microeconomic Theory (New York: McGraw-Hill Book Company, 1958), pp. 42-49.

³See Figure 1.

⁴Random effects refer to haphazard and unintended events.

physical environment may influence the farmer in his choice of production alternatives.

The state of the technical arts denote available technologies and the applied sciences. Institutional environment is represented by the industry, the market and the government. Institutional environment influences the farm through planning which may be either centralized or decentralized. Markets may be directed by compulsion or by incentive. It is assumed here that planning is decentralized, and that the dominant agent as regards profit motivation is the entrepreneur.

The internal factors in the operation of the farm are those factors which are within the control of the manager. Managerial ability denotes the power to reason and make appropriate decisions. Managers are equipped for this task by their innate ability, level of education and experience.

The link between farm productivity and managerial ability is accomplished by the various decisions which farmers make. Figure 2 has been constructed to illustrate this relationship. The competence of management relative to feeding practices influences profits and depends upon choosing from among several alternatives such as: whether to buy or grow feed, whether to have hogs on restricted feeding or full feed; and also the quality and cost of ration used in creep feeding, growing and finishing hogs.

Farm productivity can be enhanced by managers who can time the breeding program to obtain a maximum number of pigs during the productive life of a sow. Care in the selection of breeding stock from the most productive sows on the farm upgrades the sow herd and adds to profits.

The productivity of the farm can be increased if the manager

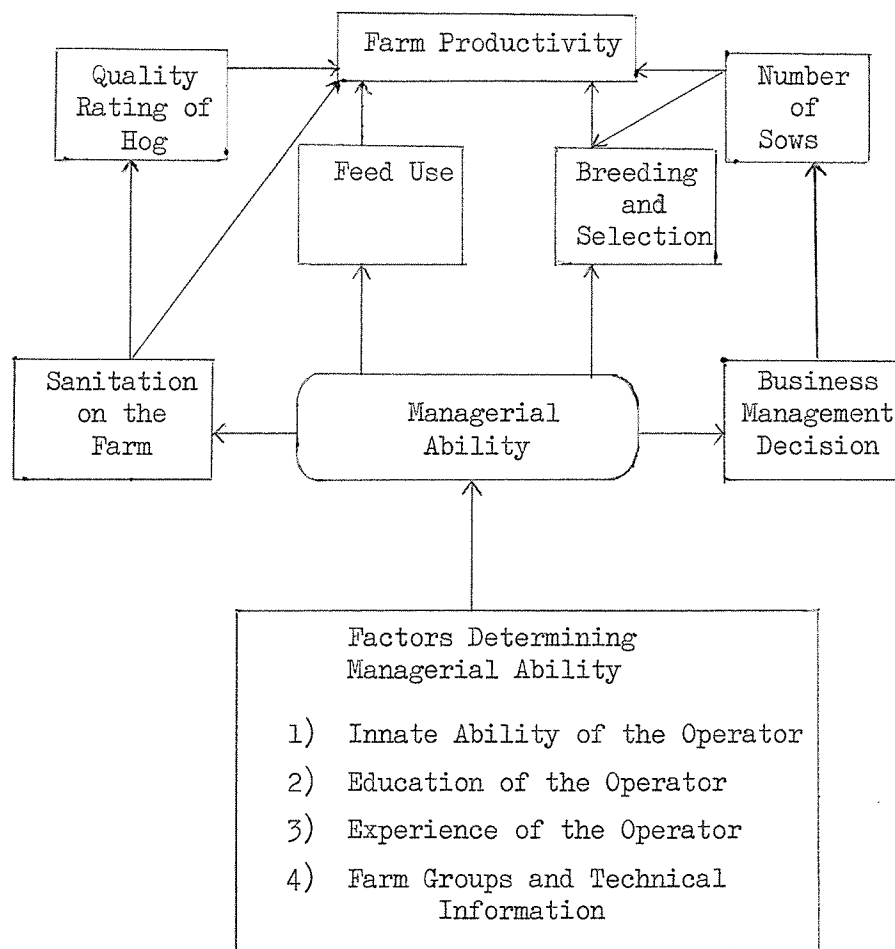


Figure 2

Diagram Showing Interrelationships Between Managerial Ability
Management Decisions and Farm Productivity

recognizes that there is a cycle in hog supply. This recognition enables the manager to adjust the output of his herd to meet the profit interest of his farm.

A sanitary environment is essential for a high level of productivity. To achieve adequate sanitation and hygiene involves critical management decisions respecting labour use, the direction of capital investment and operating costs on items that may contribute to a healthy herd and clean premises.

The sum of these multiple decisions must be focussed towards farm productivity. It is illustrated in Figure 2 that while separate decisions are required for such things as sanitation and feed use; together they influence quality of market hogs. Decisions related to rate of feeding have important effects on ease of farrowing, birth weights, live births and size of litter; all of which influence farm productivity. The number of sows on a farm enables the operator to make fuller use of his capital and labour resources.

CONCEPTUAL FRAME-WORK FOR MEASURING MANAGEMENT EFFICIENCY

Net return to management will be used as the measure of management efficiency in this thesis. Net return to management is the residual after all production costs are deducted from total value of output. It is sensitive to the decisions of management which affect the productivity of the hog enterprise. The diagram in Figure 3 was derived from the definition given above.

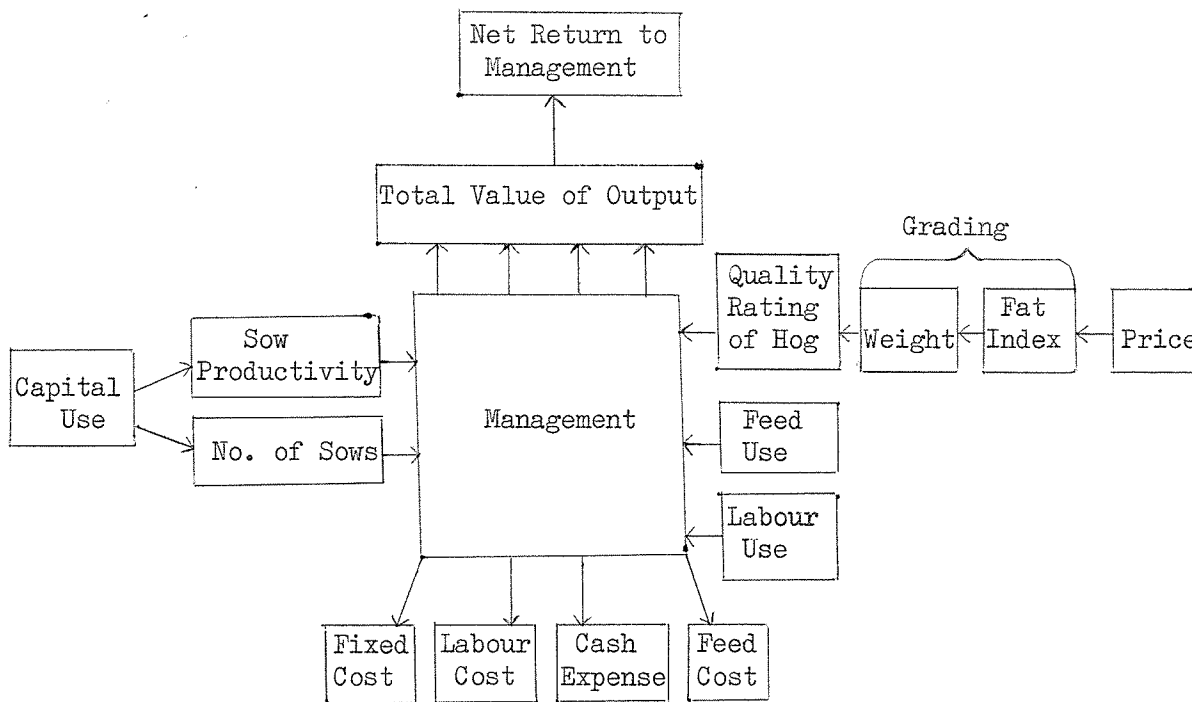


Figure 3

Diagram Showing Relationship Between Net Return to Management Total Value of Output and Total Cost

From the definition of net return to management and the illustration in Figure 3, a simple equation to measure management efficiency can be constructed:

$$\text{Net Return to Management} = \text{Total Value of Output} - \text{Total Cost.}$$

In the analysis, the variables in the equation are expressed in dollar terms as net return per sow. The farm data used were obtained over a period of three years. They were refined to a constant dollar basis by the construction and use of a series of price indexes appropriate for each of the variables considered.⁵ A description of each of the variables follows:

⁵See Appendix A for the price indexes.

Total Value of Output

Total value of output included total receipts from the enterprise plus a value for product consumed in the home and adjusted for the net change in hog inventory.

Total Cost

Total cost was the sum of the input factors priced at their market value. This procedure assumed that the marginal value productivity of the factors was equal to their market prices. The input factors considered were grouped into four categories, namely: fixed cost, labour cost, feed cost and cash expense.

Fixed Cost

Fixed cost consisted of depreciation on buildings and equipment, also an investment cost on buildings, equipment and breeding stock. The values used were those recorded by the operators. Depreciation on buildings and equipment represented the annual amount charged to the enterprise by the operator to replace the item at the end of its useful life. Investment cost was obtained by charging an interest rate to the total capital employed in the hog enterprise. The sum of these values is the fixed cost and it is related to the original stock as flow of services.

Labour Cost

A price of two dollars per hour was assessed for each hour of labour used in the hog enterprise. The hourly rate was based on the assumption that a man fully engaged in hog production would require a labour income of \$2.00 per hour to provide him with an annual wage adequate for his personal and family needs. The total number of hours of labour was provided in the farm records.

Feed Cost

Feed cost was the total cost of feed used in the enterprise and recorded by the operator. Feed cost included home grown grains priced at market value as well as the amount paid for commercial feeds and concentrates.

Cash Expense

Included was the enterprise share of such things as hydro, telephone, licenses and taxes. The direct cash costs of fuel, grease, veterinary services and medicine, repairs to hog buildings and equipment were also included.

Management

Management is the factor that coordinates all other factors of production such that total cost of production relative to total output results in a positive net return (see Figure 3). Management is able to carry out this task through appraisal and assessment, planning and action taken by the operator.

To summarize, this chapter contains a description of the actual situation of the farm-firm contrary to the simple case represented by only two factors of production commonly found in economic literature. The analysis that follows was structured on the concept that was developed in this chapter. At the same time some of the variables around which the concept was built were defined. Attention will be devoted in the next chapter to observation and analysis, from farm records, of the factors which explained the greater part of the variation in management efficiency. The management efficiency models will be formulated on the basis of logical and theoretical relationships

established in an earlier conceptual model. The models will be solved by regression analysis.

CHAPTER IV

ANALYSIS AND RESULTS

This chapter contains an analysis of the factors which influence total value of output and net returns to management. The results of the analysis are used to explain how the variation in net income was influenced by each of the selected factors.

The summary data from the 29 farm records used in the analysis were assembled in Table 7 in a descending order of net return per sow. A division of the farms into three equal groups showed that the upper group had an average net return of \$103 per sow, the middle an average net return of \$64 per sow and the lower group had an average net return of \$21 per sow. From the group averages it is noted that the factors, number of pigs weaned per sow and feed cost per sow also exhibit a descending trend with their higher values associated with the higher net returns per sow. The regression analysis that follows was made using the data from the 20 farms that provided information on all the factors including the number of years the operator spent at school.

Association Between Variables On Hog Farm Records

Correlation coefficients show degree of association between the variables of a model. Correlation coefficient can be positive or negative. A positive correlation coefficient implies that an increase in the independent variable is related to an increase in the dependent variable. A negative correlation coefficient implies that a decrease in the independent variable is related to an increase in the dependent variable, and vice versa. In the Appendix Table D4, the association existing between the dependent variable Z

Table 7. Summary Data from 29 Records Used in This Analysis

Farm Group	Net Return Per Sow	Total Value of Output Per Sow	No. of Pigs Weaned Per Sow	Quality Rating Per Sow	Feed Cost Per Sow	Cash Expense Per Sow	Fixed Cost Per Sow	Labour Cost Per Sow	No. of Sows Per Farm	Years of Operator at School
	\$	\$		\$	\$	\$	\$	\$		
Upper	131.44	627.38	17.73	35.39	303.36	40.92	57.69	93.97	13	9
Third	130.44	719.98	20.10	35.82	384.51	36.56	70.58	97.89	55	15
	111.62	579.10	16.08	36.01	280.60	54.00	36.40	96.48	10	9
	105.53	583.52	16.00	36.47	320.08	32.05	45.62	105.53	42	13
	100.66	628.70	17.00	36.98	322.49	41.40	68.95	95.20	20	10
	92.52	618.80	17.17	36.04	356.11	28.60	47.13	94.44	60	15
	90.10	599.20	17.00	35.25	313.48	40.00	62.12	93.50	25	15
	84.28	523.50	14.30	36.40	252.54	35.86	49.86	100.96	14	nil
	81.48	603.47	16.12	39.30	298.22	61.00	108.95	53.82	19	nil
Average	103.12	609.29	16.83	36.41	314.60	41.15	60.81	92.42	29	12
Middle	77.21	568.36	15.71	36.18	303.83	40.16	57.69	97.40	25	15
Third	73.61	560.04	15.00	37.34	284.65	42.26	68.00	92.52	23	14
	71.34	553.91	15.00	36.93	282.90	43.87	58.30	97.50	23	12
	69.37	672.55	18.37	36.61	346.64	50.40	105.10	101.04	20	15
	67.18	605.34	15.03	38.61	291.58	55.32	70.79	120.47	47	nil
	62.49	453.58	13.00	36.89	208.00	44.42	41.17	97.50	12	nil
	60.36	555.94	15.00	36.86	301.80	39.67	53.61	100.50	18	nil
	57.85	508.00	14.00	36.29	266.56	41.14	45.57	96.88	7	nil
	53.95	535.33	14.36	37.28	272.84	52.59	56.00	99.95	27	13
	51.58	552.48	14.30	38.63	288.57	42.04	72.33	97.60	46	9
Average	64.49	556.53	14.98	37.16	284.74	45.19	62.86	100.14	25	13
Lower	50.83	555.10	15.00	37.01	288.00	48.18	70.59	97.50	49	12
Third	48.64	448.09	13.83	32.40	227.64	39.55	35.45	96.81	11	9
	39.19	370.90	11.11	35.38	181.09	23.18	33.00	94.44	39	13
	29.34	552.38	14.83	36.64	269.16	60.48	88.00	105.40	29	nil
	17.86	515.21	14.58	35.34	274.83	40.29	93.15	89.08	48	12
	9.45	420.63	13.14	32.01	218.26	46.13	46.66	100.13	8	9
	4.15	385.10	13.17	36.24	231.13	27.67	23.37	98.78	30	12
	2.86	305.86	9.26	34.03	152.79	21.50	36.11	92.60	36	9
	2.12	331.80	9.73	38.10	185.89	23.33	40.13	96.33	30	nil
	2.45	302.39	11.00	37.49	172.39	29.61	27.44	70.50	18	nil
Average	20.64	418.75	12.57	35.46	220.12	35.99	49.39	94.16	30	11

and the nine other variables are recorded. It is noted, in the table that the number of pigs weaned and feed cost (K_1 and X_1) have a high positive association. This signifies a high degree of dependence, between K_1 and X_1 , which makes it difficult to determine the coefficient of either of the variables accurately. It was considered necessary to avoid this high dependence and at the same time take into account all the variables relevant to hog production by building two models.

MODEL BUILDING

Two models were constructed to express the functional relationships between the dependent variables and the independent variables.

Model 1. The first model was constructed to express the functional relationship between the value of output and the cost factors.

The relationship can be expressed as:

$$Y = f (X_1, X_2, X_3, X_4).$$

where:

Y = Total value of output,

X_1 = Total feed cost,

X_2 = Total cash expense,

X_3 = Total fixed cost,

X_4 = Total labour cost.

Model 2. The second model was constructed to express the functional relationship between net return to management and the quality of management.

The relationship was expressed as:

$$Z = f (K_1, K_2, K_3, K_4).$$

where:

$Z = Y - C,$

$C = \sum_{i=1}^4 X_i$ (i.e. the independent variables in Model 1),

- Z = Net return per sow (dollars),
- K_1 = Number of pigs weaned per sow,
- K_2 = A quality rating for hogs (dollars),
- K_3 = Number of sows per farm (measure of size of operation),
- K_4 = Number of years the operator spent at school.

Determining the Form of the Equations

The investigation of the relationship between the dependent variables and the independent variables started with an attempt to discover the approximate form of the relationship. Data were plotted on a scatter diagram and a free-hand curve of best visual fit was constructed. The shape of the curves shown in Figures 4 and 5 suggested a non-linear relationship between the dependent and independent variables. The Cobb-Douglas production function was used to express the relationship in both of the models used.

The equations which explained the greater portion of output and net returns were derived as follows:

$$1. Y = aX_1^{b_1} X_3^{b_3} X_2^{b_2} X_4^{b_4} E .$$

$$2. Z = cK_1^{d_1} K_2^{d_2} K_4^{d_4} K_3^{d_3} E .$$

Here "a" and "c" are the constants, the X and K values are the designated independent variables, while the b_i and d_i coefficients are the elasticities of the dependent variables as they are affected by the cost factors and management quality variables respectively. The error terms are E_i . The X_i and K_i are arranged in the equations in the order of their r^2 values. Variables with the highest r^2 values are at the left. The r_{ij} values are shown in Appendix Table D4.

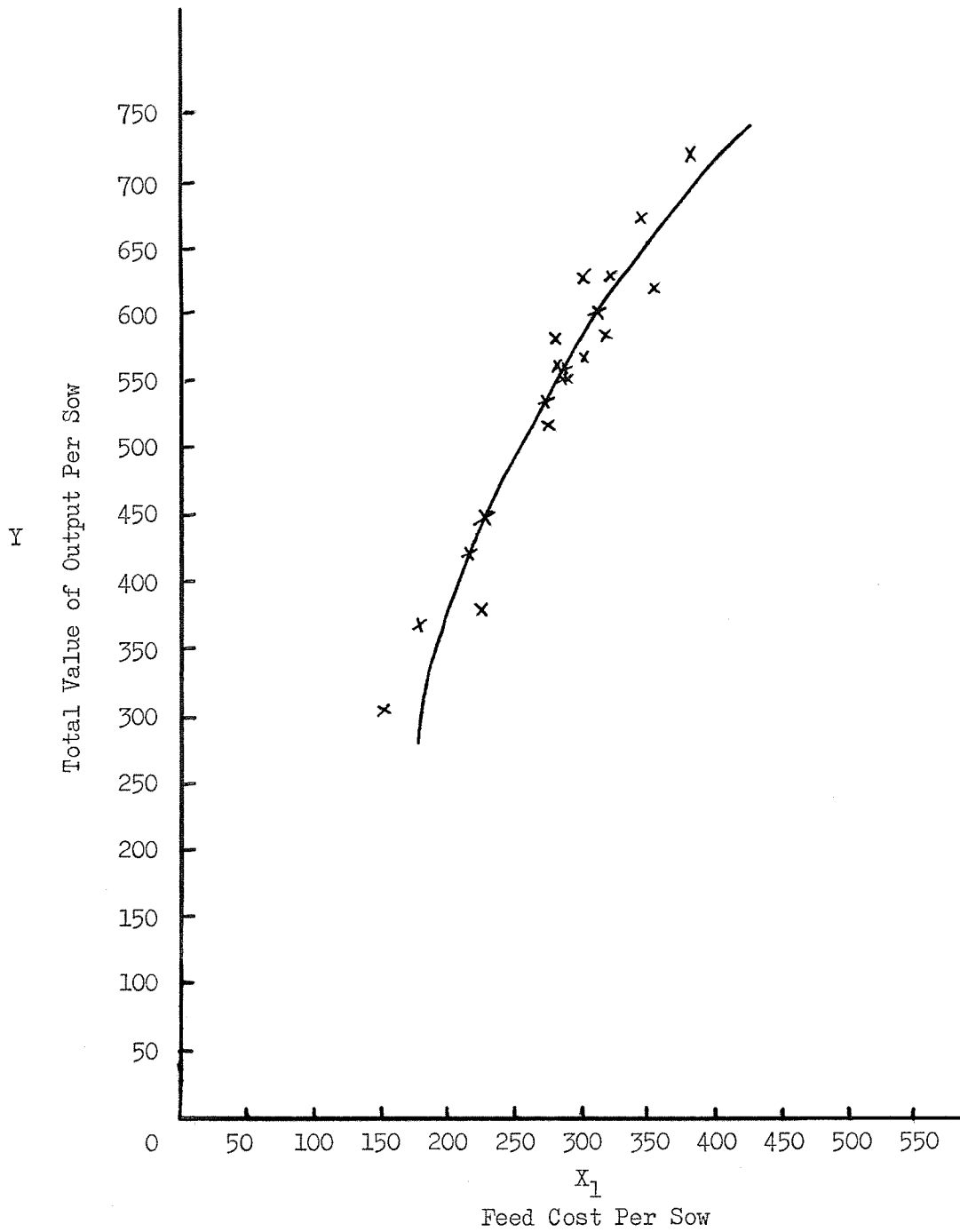


Figure 4

Scatter Diagram and Curve of Best Visual Fit for Feed Cost and Total Value of Output Per Sow.

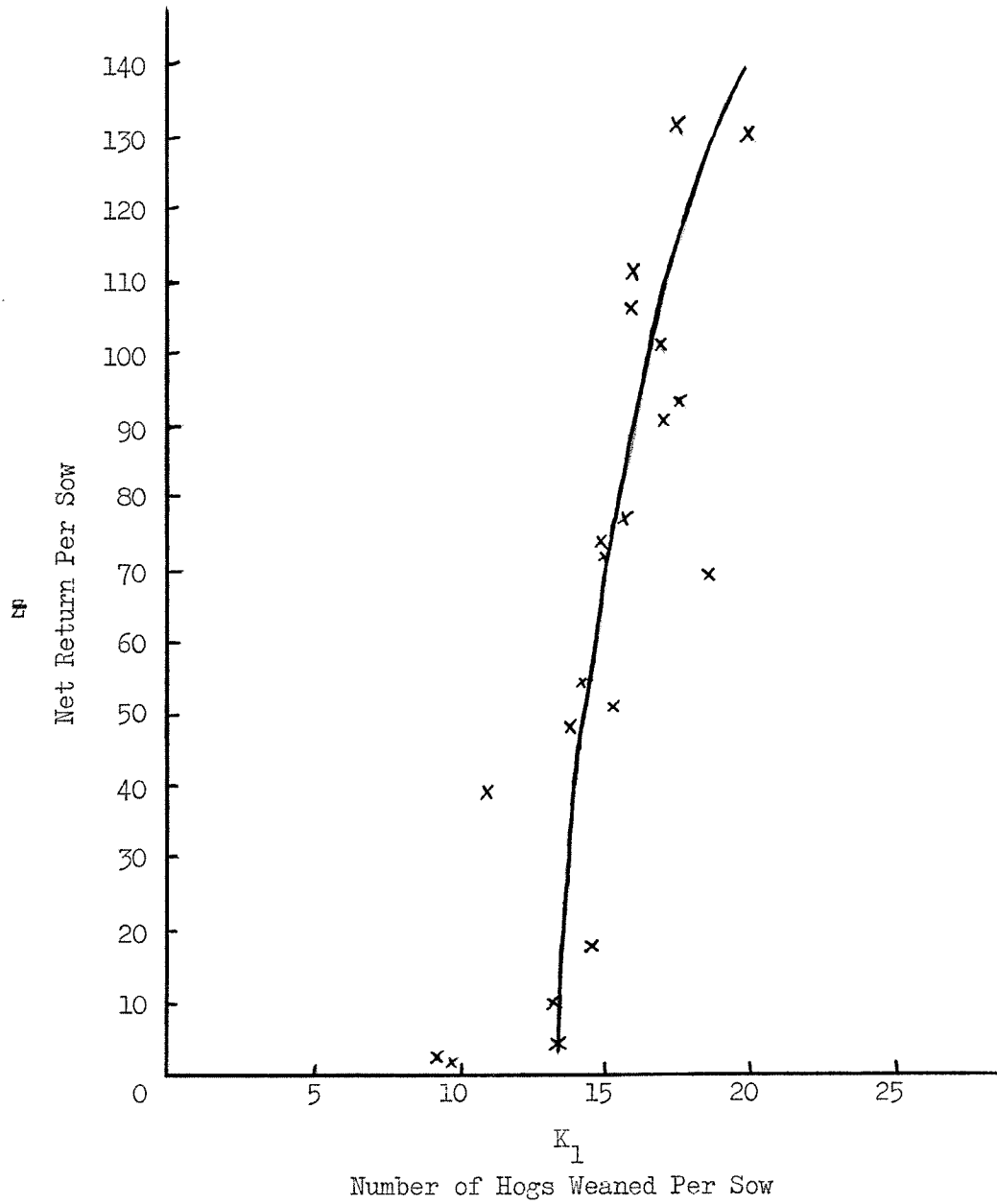


Figure 5

Scatter Diagram and Curve of Best Visual Fit for Number of Pigs Weaned and Net Return Per Sow.

Regression Estimates

The estimates that resulted from the regression of the dependent variables on the independent variables are discussed below.

Value of Output and Cost Relationship. Total value of output was regressed on the cost variables. The results contained in Table 8 show that the regression analysis gave an R^2 of 0.9639. That is, 96.4 percent of the variance in total value of output, Y, was explained by the variables in the model. The estimated regression coefficients of the cost variables are the elasticities of the product with respect to the variables. The elasticities show the percentage change in value of product associated with a one percent change in value of input. For example, the regression of the logarithm of value of output, Y, on the logarithm of the feed cost X_1 , was 0.8256 (see Table 8).

Table 8. Regression Estimates of Total Value of Output on Cost Factors

Variables	All Farms Regression Coefficients	Standard Error of Regression Coefficients
Constant (log a)	0.8098	
X_1	0.8256 ^{***}	0.0625
X_2	0.1148 [*]	0.0582
X_3	0.0432	0.0391
X_4	-0.1805	0.2571
R^2	0.9639 ^{***}	
S	0.0201	

Significance level *** 1%
* 10%

This indicates that on the average, an increase in the feed cost X_1 , by one percent of the original value of X_1 , holding other factors constant was associated with an increase in total value of output, Y, of 0.8256 percent. Similar interpretation can be made for the regression coefficients of the other

variables. The standard error of estimate, S , is 0.0201. This value indicates that assuming a normal distribution of farm population, two thirds of any estimates made using the regression coefficients would be correct within plus or minus 0.0201 percent.

The standard error of regression coefficients (Table 8) are used to test the significance of the individual coefficients. These can be tested by dividing the values of the standard errors into the values of the respective regression coefficients. The resulting values are used to make statistical statement about levels of significance. The term "significant" and "significance level" are often used in describing statistical tests. The significance level of a test is simply the probability P_1 of rejecting the hypothesis under test if it is true. Thus a low significance level corresponds to a wide acceptance region, and a high level to a narrow region, ceteris paribus. The difference between the observed value of a statistic and the tested value of the parameter is said to be significant if the statistic falls outside the acceptance region.¹

Net Return and Quality of Management Relationship. Net return was regressed on the selected management quality variables. The results of the analysis, contained in Table 9, show that the regression analysis gave an R^2 of 0.7858. That is, 78.58 percent of the variance in net return was explained by the selected management quality variables. The estimated regression coefficients are the elasticities of net return with respect to the management quality factors. For example, the regression of the logarithm of value of net return on the logarithm of number of pigs weaned is 3.1473. This indicates that on the average, an increase in the number of pigs weaned K_1 , by one percent of

¹C. F. Christ, Econometric Models and Methods, New York: John Wiley and Sons, Inc., 1968, p. 283.

the original value of K_1 , holding other factors constant was associated with an increase in net return, Z , of 3.1473 percent. Similarly, an increase of one percent in the number of sows, K_3 , holding other factors constant was associated with a decrease of 0.3485 percent in net return, Z . This means that a positive change in K_3 was associated with a corresponding negative change in net returns. Only the variables K_1 (number of pigs weaned) and K_2 (quality rating of hogs) were significant at the one percent level. Negative regression coefficients may occur but they are not significant.²

Table 9. Regression Estimates of Net Return on Management Quality Variables

Variables	All Farms Regression Coefficients ^a	Standard Error of Regression Coefficients
Constant (log c)	-14.6713	
K_1	3.1473***	1.0086
K_2	8.1325***	2.4234
K_3	-0.3485	0.2884
K_4	0.5137	0.8563
R^2	0.7858***	
S	0.2491	

Significance level *** 1%

^aSee Appendix Table D5 for the regression estimates when K_2 was in index form.

The standard error of estimate S is 0.2491. The importance attached to the standard error of estimate as well as the standard errors of the regression coefficient were described relative to Table 8, and therefore are not repeated here.

²Cecil, B. Haver "Economic Interpretation of Estimates" Resource Productivity, Returns to Scale and Farm Size, ed. E. O. Heady (Ames, Iowa: The Iowa State College Press).

There were decreasing returns to scale in hog production, since the sum of the regression coefficients was less than one, which means that with an increase in size of operation, output increased by a smaller percentage than the increase in input. The marginal product was less than the average product and the variable costs increased. Each of the partial elasticities of the factor inputs was less than unity, which means that with each marginal increase in factor use the total output increased at a diminishing rate.

APPLYING THE ESTIMATES FROM THE REGRESSION ANALYSIS

In this section, the marginal value productivities of all the variable factors shown in Tables 8 and 9 were presented. Secondly, the regression estimates in Table 8 and Table 9 were used to explain net returns to the 29 farms stratified into three groups according to the number of pigs weaned per sow. The main purpose here was to observe how close the actual average net return and the estimated average net return from the cost factors as well as management quality factors would be.

Determining the Marginal Value Productivities

The formula shown below was used to determine the marginal value productivities of the variable factors.

$$MVP_i = e_i (AVP_i).$$

where:

MVP_i = Marginal value productivity of the i^{th} factor ($e_i \cdot \bar{Y}/\bar{X}$),

e_i = Elasticity (i.e. regression coefficient in the analysis),

AVP_i = Average value productivity obtained by dividing value of output produced by cost of input that produced the output.

The marginal productivity of a particular resource, with input of the other resources held constant at the mean of the quantities used, indicates how much the use of one additional unit of that input will change total output. Marginal value productivity is marginal productivity measured in value terms. Data in the fifth column of Table 10 were used to illustrate the marginal productivities of the cost factors used in the analysis.

Table 10. Estimates of Average Value Productivities and Marginal Value Productivities of the Cost Factors

Variables	Average Value of Factors for All Farms	Partial Elasticities	Average Value $\frac{\bar{Y}}{\bar{X}}$ Productivities	Marginal Value Productivities $e_i \left(\frac{\bar{Y}}{\bar{X}_i} \right)$
X_1	\$275	0.8256	1.9212	1.6438
X_2	\$ 38	0.1148	13.7591	1.5796
X_3	\$ 53	0.0432	9.9175	0.4282
X_4	\$ 95	-0.1805	5.5458	-1.0011
Y	\$529			

It is shown that when the input resources are at the average values of the farms used in the analysis, an additional dollar spent on feed will increase value of output by \$1.64. An additional dollar spent on cash expense will increase output by \$1.58. An additional dollar spent on capital and equipment will increase output by \$0.43.

The data in the fifth column of Table 11 were used to show the marginal value productivities of the management quality variables.

Table 11. Estimates of Average Value Productivities and Marginal Value Productivities of Management Quality Factors

Variables	Average Value of Factors for All Farms	Partial Elasticities	Average Value Productivities $\frac{\bar{Z}}{\bar{K}_i}$	Marginal Value Productivities $e_i (\frac{\bar{Z}}{\bar{K}_i})$
K_1	15 (hogs)	3.1473	3.1235	9.8306
K_2	35 (dollars)	8.1325	1.3264	10.7870
K_3	26 (sows)	-0.3485	1.7776	-0.6195
K_4	12 (years)	0.5137	3.9813	2.0452
Z	47 (dollars)			

It is shown that, net return was increased by \$9.83 per sow for each additional pig weaned over 15 pigs; that net return increased by \$10.79 per sow, for each increase of one dollar in quality rating of hog carcass, with the market base price for 100 index hog constant at \$37.28. That net return increased by \$2.05 per sow for each additional year over 12 years of formal education. However, that net return decreased by \$0.62 per sow for additional sow increase in the herd over 26 sows.

Estimating Net Return From Cost Factors and Management Factors

Data from the 29 records summarized in Table 7, were stratified into three groups according to the number of pigs weaned per sow. The average values for the various cost factors, management factors, and net returns were calculated for each of the three groups. The results in Table 12 show the average values obtained relative to the cost factors. The average costs for each group were substituted into equation 3 (below) using the regression

estimates from Table 8 to test the reliability of the estimates alongside the actual net return per sow.

$$3. \log \hat{Y} = 0.8098 + 0.8256 \log X_1 + 0.1148 \log X_2 + 0.0432 \log X_3 - 0.1805 \log X_4 .$$

where:

\hat{Y} = Estimated total value of output,

X_1 = Feed cost,

X_2 = Cash expense,

X_3 = Fixed cost,

X_4 = Labour cost,

$$\text{Average net return} = Y - \sum_{i=1}^4 X_i .$$

Table 12. Average Net Return Per Sow and Cost Factors Stratified by Number of Pigs Weaned Per Sow

	Number of Pigs Weaned Per Sow		
	I Below 14.18	II 14.18 - 15.24	III Above 15.24
Number of farms	9	10	10
Average number of pigs weaned	12.03	14.74	17.13
Average feed cost \$	204.86	280.52	322.73
Average cash expense \$	32.95	46.06	42.51
Average fixed cost \$	36.54	68.03	65.23
Average labour cost \$	96.77	100.15	90.60
Average net return per sow (actual) \$	25.45	56.03	99.04
Net return per sow (estimated) \$	28.58	54.64	100.23
Difference between actual and estimated net return \$	-2.13	1.39	-1.19
Percentage difference %	-8.36	2.48	-1.2

The regression estimates of net return per sow approximated the actual net

returns for each group. Group I had a difference of \$2.13 between actual and estimated net returns per sow whereas in Group III the difference was \$1.19.

The results shown in Table 13 are the average values obtained relative to the management factors, for the same farms used in the groupings in Table 12. The average values for each group were substituted into equation 4 (below) using the regression estimates from Table 9 to test the reliability of the estimates alongside the actual net return per sow.

$$4. \log \hat{Z} = -14.6713 + 3.1473 \log K_1 + 8.1325 \log K_2 - 0.3485 \log K_3 \\ + 0.5173 \log K_4 .$$

where:

- \hat{Z} = Estimated net return per sow (dollars),
- K_1 = Number of pigs weaned per sow,
- K_2 = Quality rating of hogs (dollars),
- K_3 = Number of sows per farm,
- K_4 = Years of the operator in school.

Table 13. Average Net Return Per Sow and Management Quality Factors
Stratified by Number of Pigs Weaned Per Sow

	Number of Pigs Weaned Per Sow		
	I Below 14.18	II 14.18 - 15.24	III Above 15.24
Number of farms	9	10	10
Average number of pigs weaned	12.03	14.74	17.13
Average number of sows	21.22	32.40	28.90
Years of education	10.40	10.29	12.89
Average quality rating (\$)	35.44	37.10	36.70
Average net return per sow (actual) \$	25.44	56.03	99.04
Net return per sow (estimated) \$	24.56	57.98	99.49
Difference between actual and estimated net return per sow \$	0.89	-1.95	-0.45
Percentage difference %	3.50	-3.48	-0.46

The regression estimates of net returns per sow approximated the actual net returns for each group. Group II had a difference of \$1.95 between actual and estimated net returns per sow whereas in Group III the difference was \$0.45.

The results obtained by employing the method of analysis and observation described for Tables 12 and 13 support the assumption that both the management factors and the cost factors contribute to the total value of output and have significant influence on net returns per sow.

Determining Management Possibilities and Changes in Net Return

As a further step in the analysis, an estimate was made of the effect, on net returns, of a ten percent increase in the quality variables. It was assumed that the farmer could possibly increase his management qualities with respect to pig weaning, grading, and size of herd by ten percent. An illustration of the impact of such changes on net returns was assessed using

the management quality data from the ten most productive farms in Group III as shown in Table 13. These possibilities are outlined under cases 1 to 3 below.

Case 1. If the number of pigs weaned per sow were increased by ten percent, holding all other management quality factors constant at their average level (i.e. increase pigs weaned from 17.13 to 18.84 pigs per sow), average net return would increase from \$99.49 to \$134.40 per sow.

Case 2. If the quality of hogs were increased by ten percent, market base price for 100 index remaining unchanged at \$37.28 (i.e. increase quality rating from \$36.70 to \$40.37 per hog), average net return for the group of farms would increase from \$99.49 to \$216 per sow.

Case 3. If the number of sows on the farm were increased by ten percent, other management quality variables remaining constant at their average, net return would decline from \$99.49 to \$96.25 per sow. These changes are expressed in percentages in Table 14.

Table 14. Effects of Ten Percent Increase on Management Quality of Pigs Weaned, Quality Rating of Hogs and Farm Size

	Net Return Before Increase \$	Net Return After Increase \$	Change in Net Return \$	Percent Change %
Case 1. Increase Pigs weaned by ten percent	99.49	134.4	34.91	35.09
Case 2. Increase hog quality rating by ten percent	99.49	216.00	116.51	117.11
Case 3. Increase number of sows by ten percent	99.49	96.25	-3.24	-3.26

The discussion in Chapter V will relate the analysis carried out in this chapter to the objectives set at the beginning of this thesis and conclusions will be drawn as to the factors which have the most important influence on net return to management.

CHAPTER V

CONCLUSIONS

An analysis of the variable factors which influence value of production from hog operations was made using data from farm records. The data were assembled and analyzed in a manner designed to achieve the purpose set out in the objectives for the study, namely:

1. To study the cost factors which contribute to value of output from hog production.
2. To study management quality factors which influence net returns to hog producers.
3. To establish the interrelationship between the variable factors and to measure their effect on net returns.

The cost factors used were feed cost, cash expense, fixed cost and labour cost. A Cobb-Douglas production function was used to analyze the effect of the costs on total value of output. The analysis revealed that 96 percent of the variance in total value of output was accounted for by all the costs taken into consideration. Output was inelastic to the various costs involved (i.e. elasticities were less than unity). For instance, the elasticity of output on feed cost was 0.83 which means that an increase of one percent in feed cost increased the value of output by 0.83 percent. The elasticity of output on cash expense was 0.11 (i.e. a one percent increase in cash expense increased output by 0.11 percent). An analysis of the marginal productivities of these cost factors showed that the largest contributor to output was feed and then cash expense. Fixed cost and labour cost had low

marginal productivities. The marginal productivity of fixed cost was 0.43. This implies that a one dollar increase in fixed cost added \$0.43 to output. The marginal productivity of labour was -1.00. This implies that a one dollar decrease in labour cost increased output by \$1.00. The low marginal productivity of capital and labour suggests that capital was underemployed while labour was overutilized. In most cases, farmers could increase output from their present plant without adding more capital; that is the fixed cost could be spread over more sows thus reducing the fixed cost per sow. Labour also could handle more sows from the hours of labour associated with the existing plant and thus reduce labour costs per sow.

The management quality factors used were numbers of pigs weaned, quality rating of hogs, number of years the operator spent at school and the number of sows per farm. A Cobb-Douglas production function was used to analyze the effect of the quality factors on net returns to management. The analysis revealed that 78 percent of the variance in net returns to management was accounted for by all the selected management quality variables taken into consideration. Net returns were highly elastic with respect to the quality factors in the study (i.e. elasticities greater than unity). For instance, the elasticity of net returns on number of pigs weaned was 3.15; that is a one percent increase in the number of pigs weaned increased net returns by 3.15 percent. The elasticity of net returns on the quality rating was 8.13; a one percent increase in quality rating increased net returns by 8.13 percent. However, net return was inelastic relative to the education level of the farmer as well as the number of sows per farm. An analysis of the marginal value productivities of the management quality factors revealed

that \$9.83 per sow was added to net returns for each pig weaned above the average of 15 pigs per sow, that \$10.79 net return per sow was obtained for each dollar increase in quality rating of hog carcass when the market base price for 100 index hog was unchanged. The results showed that the management factors that increased net returns per sow were number of pigs weaned, quality rating of each hog and the level of education of the farmer. The number of pigs weaned per sow and the quality rating factor were significant at the one percent level.

There is an interrelationship between input factors as they jointly contribute to total value of output. This interrelationship varies from factor to factor and between factors. Similarly, the variables related to quality of management are interrelated in their joint contribution to net returns. There also exists an interrelationship between the cost factors, the quality of management factors and their contribution to output. Managerial decision making is the instrument which determines the coordination that exists between the cost factors and the management quality factors so that total value of output is an aggregate of the productive capacity of both the cost factors and the management quality factors. Wise decisions made by managers reduce the cost of producing a given output. Excellence in management involves weaning more pigs per sow, producing more volume with the given capital and labour; and also producing high grade hogs. Data in Table 12 were substituted in the estimated production function of total output to determine an estimate of net return from the estimated total output. A residual value (net return) was obtained when production costs were deducted from total output. The data in Table 13 were substituted in the estimated net return equation

to determine an estimate of net return attributable to the management quality variables. The value of the residual (net return) in Table 12 approximates the value of net return in Table 13 considering each group of farms. The fact that the two values are close strengthens the assumption that net return from production can be attributed to quality of management. The value of net return varies from farm to farm and between groups of farms with similar productivity. The reward for superior management were high net returns.

The analysis reveals certain facts that have important implications for farmers engaged in hog production. Observations made from the analysis reveal:

1. That the marginal returns from feed costs and other cash expenses are greater than the marginal returns from fixed costs and labour costs.
2. That the marginal returns for the capital input are greater than for the labour input which suggests that substituting capital for labour wherever practical could improve net returns.
3. That management returns can be enlarged by improving the practices which add to the number of pigs weaned per sow and the quality rating of hogs rather than merely expanding the sow herd.

In summary, it can be noted that a real possibility exists for hog producers to expand production with the labour and capital resources that they currently employ. Any decision made to enlarge the size of the enterprise by adding capital and labour should be conditioned by a demonstrated ability to employ the managerial skills and those input factors that are associated with profitable production.

BIBLIOGRAPHY

BIBLIOGRAPHY

- Bennett, R. K. "Address to a Meeting in Winnipeg ... On the Opportunities for Increasing Hog Production in Manitoba", (Ottawa: Livestock Division, Department of Agriculture, 1969) (mimeo) "Summary of Remark".
- Canada: New Hog Carcass Valuation System (by Canadian Swine Council, Meat Packers Council of Canada and Canada Department of Agriculture) Ottawa, 1969.
- Carroll, W. E., et. al. Swine Production. 3d Ed. New York: McGraw-Hill Book Co., 1962.
- Christ, C. F. Econometric Models and Methods. New York: John Wiley and Sons, 1968.
- Department of Agriculture. Livestock Market Review Annual. Ottawa - Canada.
- Dominion Bureau of Statistics. Trade of Canada. Vol. 2 and 3, Catalogues 65-202 and 65-203 Annual, Ottawa - Canada.
- Faculty of Agriculture and Home Economics. Principles and Practices of Commercial Farming. 2nd Ed. Winnipeg: University of Manitoba, 1968.
- Fellows, Irving, F. "Typical Problems in Budgeting". Budgeting - Tool of Research and Extension in Agricultural Economics. Storrs, Connecticut: Storrs Agricultural.
- Fredeen, H. T., et. al. "Prediction of Yield and Value of Hog Carcasses", Canadian Journal of Animal Science. Vol. 44 (1964), pp. 334-346.
- Goldberger, Arthur S. Econometric Theory. New York: John Wiley and Sons, 1964.
- Haver, Cecil, B. "Economic Interpretation of Estimates" Resource Productivity, Returns to Scale and Farm Size. Ed. E. O. Heady, Ames, Iowa: The Iowa State College Press.
- Heady, Earl O. "Choice Between Products and Resources Uses", Economics of Agricultural Production and Resource Use. Englewood Cliffs, N. J.: Prentice-Hall, 1952.
- Henderson, James H. and Quandt, Richard E. Microeconomic Theory. New York: McGraw-Hill Book Company, 1958.

- Johnston, J. Econometric Methods. New York: McGraw-Hill Book Co., 1963.
- Lawley, D. N. and A. E. Maxwell. Factor Analysis as Statistical Method. London: Butterworths, 1961.
- Manitoba Department of Agriculture. Hog Marketing by Teletype, October, 1968. Winnipeg: Queen's Printer.
- Manitoba Department of Agriculture. Sources of Credit for Manitoba Farmers, February 1971. Winnipeg: Queen's Printer.
- Ottawa: Hog Carcass Grading Regulations, P. C. 1958-1202 (1958) Canada made under the Canada Agricultural Products Standards Act, 1958.
- Statistics Canada. Prices and Price Indexes. Catalogue 62-002 Monthly, September 1971. 1961 = 100.
- Stedry, A. C. "Market Versus Behavioural Theories of the Farm and Basic Managerial Research", Production Economics in Agricultural Research. March 1966. Proceedings of Conference held at University of Illinois, 1966.

APPENDIX A

TREATMENT OF THE DATA USED IN THE ANALYSIS

Since the index numbers of farm prices of agricultural products and farm input prices carry different weights depending upon the products that are built into them, it became essential for the study to extract relevant facts from the catalogue of prices and price indexes published by Statistics Canada. The appropriate price indexes that will be used in the analysis are calculated from these extracts.

Index Formula and Index Calculation

The farm price indexes are calculated using a base weighted or Laspeyres index formula, i.e.,

$$I_t = \frac{\sum W_o (P_t/P_o \times 100)}{\sum W_o}, \text{ where:}$$

I_t = Price index in time t ,

W_o = Base-year index weights for each item (see Table A2),

$\frac{P_t}{P_o} \times 100$ = Price for each item in time period ' t ' as a percentage of price in period ' o ',

Σ = Summation over items.

The above formula can be used to produce a price index for any two or more item and/or group price indexes according to any desired combination. The same methodology may also be employed to combine selected price index components using weights, either actual dollar values or percentages. The use of item weights, W_o , in the calculation ensures that each item price change, $\frac{P_t}{P_o} \times 100$, contributes to the overall price change in accordance with the importance of that item in the base-year basket of commodities and services.

However, in the recombination of item or group price indexes, weights and price indexes of components are related to the same time period.

Calculation of Price Index for Gross Return

Employing the Laspeyres formula, annual averages of hog prices, quoted at Winnipeg, were used to calculate price indexes for gross return. The indexes constructed are price relatives.

$$I_t = \frac{\sum_{i=1}^{k=1} W_o \left(\frac{P_t}{P_o} \times 100 \right)}{\sum_{i=1}^{k=1} W_o},$$

$$= \frac{P_t}{P_o} \times 100.$$

Table A1. Prices and Price Indexes of Hog Receipts for 1961, 1967, 1969 and 1970

Years	Price	Price Index
	Dollars	Percent
1961	24.85	100.0
1967	28.55	114.9
1969	35.45	142.7
1970	29.20	117.5

Price Indexes for Farm Inputs

The price indexes shown in Table A2 relate to the prices of farm inputs employed for farm services in Western Canada for the years shown. The sources of the price indexes are contained in the footnote to the table.

Table A2. Farm Input Price Indexes for Western Canada Arranged in Four Cost Groups for the Years 1967, 1969 and 1970.
Basis 1961 = 100

Costs	Inputs	Price Indexes ^(a)			
		1961	1967	1969	1970
			- Percent -		
Fixed cost	Building replacement ⁽¹⁾	100.0	123.0	143.0	142.4
	Machinery and motor vehicle replacement ⁽²⁾	100.0	119.0	125.8	129.0
	Mortgage credit ⁽³⁾	100.0	150.3	186.3	202.8
Cash expense	Building repairs ⁽³⁾	100.0	123.4	139.0	139.1
	Repairs, tires and batteries ⁽⁴⁾	100.0	119.3	127.1	131.4
	Veterinary and medicine ⁽⁵⁾	100.0	100.0	97.4	98.2
	Other cash expenses (i.e. custom work, hydro, small tools and supplies) ⁽⁶⁾	100.0	108.5	114.0	116.2
Feed cost	Grain feed ⁽⁷⁾	100.0	109.4	99.1	89.8
	Prepared feed ⁽⁷⁾	100.0	112.6	109.5	107.6
Labour cost	Hired farm labour ⁽⁸⁾	100.0	140.2	155.7	159.4

(a) Source: Statistics Canada, Prices and Price Indexes, Catalogue 62-002 Monthly, September 1971.

(1) Ibid., p. xx.

(2) Ibid., p. xxii.

(3) Ibid., p. xxi.

(4) Ibid., p. xxvi.

(5) See pharmaceuticals, *ibid.*, p. 57. See also Prices and Price Indexes, December 1969, p. 50.

(6) *Ibid.*, p. xxix, custom work, p. xxxi, hydro, p. xxxi, small tools and supplies.

(7) *Ibid.*, p. xxx.

(8) *Ibid.*, p. xxvii.

Index Weights

Index weights were used to combine individual price indexes of the various input factors used in each of the cost groups for which the composite indexes were constructed. Each composite index then, was weighted by the relative importance of the input factors used in hog production. The formula, below, was used to compute the index weights compiled in column four of Table A3.

$$W_i = \frac{C_i}{\sum_{i=1}^n C_i} .$$

where:

W_i = Index weight of the expense on the i^{th} input factor,

C_i = Expense for i^{th} input factor,

$\sum_{i=1}^n C_i$ = Total expense for all input factors.

In Table A3, the C_i values are listed in the third column while the W_i values are listed in the fourth column.

Calculation of Composite Price Indexes

The variables that were used in the calculations that follow were extracted from the data in Tables A2 and A3. Price indexes were obtained from Table A2 and index weights from Table A3. The calculated indexes were used to deflate costs for the years 1967, 1969 and 1970.

Composite Index for Fixed Cost. The composite index for fixed cost was constructed from the combination of the building replacement, machinery and motor vehicle replacement, and mortgage indexes.

Table A3. Derivation of Index Weights from Average Values of Input Items in Four Cost Groups

Costs	Inputs	Average Value of Input (\$)	Weight Factors (%)
Fixed cost	Building replacement	540.76	0.041
	Machinery and motor vehicle replacement	329.75	0.025
	Mortgage credit	725.42	0.055
Cash expense	Building repairs	225.99	0.017
	Machinery repairs	292.44	0.022
	Veterinary and medicine	172.77	0.013
	Other cash expenses	438.65	0.033
Feed cost	Grain feed	3,772.13	0.285
	Prepared feed	2,845.29	0.215
	Supplements	1,257.66	0.095
Labour cost	Labour hours	2,652.31	0.199
Total cost	All inputs	13,253.51	1.000

Construction of Composite Index for Fixed Cost

$$\begin{aligned}
 I_{1967} &= \frac{(123.0 \times 0.041)}{0.041} + \frac{(119.0 \times 0.025)}{0.025} + \frac{(150.3 \times 0.055)}{0.055} \\
 &= \frac{5.043 + 2.975 + 8.267}{0.121} = \frac{16.285}{0.121} \\
 &= 134.587
 \end{aligned}$$

$$\begin{aligned}
 I_{1969} &= \frac{(143.0 \times 0.041)}{0.041} + \frac{(125.8 \times 0.025)}{0.025} + \frac{(186.3 \times 0.055)}{0.055} \\
 &= \frac{5.863 + 3.145 + 10.247}{0.121} = \frac{19.255}{0.121} \\
 &= 159.132
 \end{aligned}$$

$$\begin{aligned}
 I_{1970} &= \frac{(142.4 \times 0.041)}{0.041} + \frac{(129.0 \times 0.025)}{0.025} + \frac{(202.8 \times 0.055)}{0.055} \\
 &= \frac{5.838 + 3.225 + 11.154}{0.121} = \frac{20.217}{0.121} \\
 &= 167.083
 \end{aligned}$$

Composite Index for Feed Cost. The composite index for feed cost was constructed from a combination of grain feed and prepared feed indexes.

Construction of Composite Index for Feed Cost

$$\begin{aligned}
 I_{1967} &= \frac{(109.4 \times 0.285)}{0.285} + \frac{(112.6 \times 0.215)}{0.215} \\
 &= \frac{31.179 + 24.209}{0.5} = \frac{55.388}{0.5} \\
 &= 110.776
 \end{aligned}$$

$$\begin{aligned}
 I_{1969} &= \frac{(99.1 \times 0.285)}{0.285} + \frac{(109.5 \times 0.215)}{0.215} \\
 &= \frac{28.244 + 23.543}{0.5} = \frac{51.787}{0.5} \\
 &= 103.574
 \end{aligned}$$

$$\begin{aligned}
 I_{1970} &= \frac{(89.8 \times 0.285)}{0.285} + \frac{(107.6 \times 0.215)}{0.215} \\
 &= \frac{25.593 + 23.134}{0.5} = \frac{48.727}{0.5} \\
 &= 97.454
 \end{aligned}$$

Composite Index for Cash Expense. The composite index for cash expense was constructed from a combination of building repairs, machine repairs, tires and batteries, veterinary and medicine; and the item other cash expenses (calculated from the indexes for such items as custom work, small tools and supplies, and hydro). First, representative indexes were calculated using

equal weighting for the items that make up other cash expenses. Second, the indexes were combined to construct the composite index for cash expenses.

1. Construction of Composite Index for Other Cash Expenses

$$\begin{aligned}
 I_{1967} &= \frac{(123.1 \times 0.33) + (106.0 \times 0.33) + (96.3 \times 0.33)}{0.33 + 0.33 + 0.33} \\
 &= \frac{40.623 + 34.980 + 31.779}{0.99} \\
 &= \frac{107.382}{0.99} \\
 &= 108.467
 \end{aligned}$$

$$\begin{aligned}
 I_{1969} &= \frac{(132.6 \times 0.33) + (109.4 \times 0.33) + (99.9 \times 0.33)}{0.33 + 0.33 + 0.33} \\
 &= \frac{43.758 + 36.102 + 32.967}{0.99} \\
 &= \frac{112.827}{0.99} \\
 &= 113.967
 \end{aligned}$$

$$\begin{aligned}
 I_{1970} &= \frac{(135.6 \times 0.33) + (112.0 \times 0.33) + (100.9 \times 0.33)}{0.33 + 0.33 + 0.33} \\
 &= \frac{44.748 + 36.960 + 33.297}{0.99} \\
 &= \frac{115.005}{0.99} \\
 &= 116.167
 \end{aligned}$$

2. Construction of Composite Indexes for Cash Expenses

$$\begin{aligned}
 I_{1967} &= \frac{(123.4 \times 0.017) + (119.3 \times 0.022) + (100.0 \times 0.013) + (108.5 \times 0.033)}{0.017 + 0.022 + 0.013 + 0.033} \\
 &= \frac{2.098 + 2.625 + 1.3 + 3.581}{0.085} \\
 &= \frac{9.604}{0.085} \\
 &= 112.988
 \end{aligned}$$

$$\begin{aligned}
 I_{1969} &= \frac{(139.0 \times 0.017) + ((127.1 \times 0.022) + (97.4 \times 0.013) + (114.0 \times 0.033))}{0.017 + 0.022 + 0.013 + 0.033} \\
 &= \frac{2.363 + 2.796 + 1.266 + 3.762}{0.085} \\
 &= \frac{10.187}{0.085} \\
 &= 119.847
 \end{aligned}$$

$$\begin{aligned}
 I_{1970} &= \frac{(139.1 \times 0.017) + (131.4 \times 0.022) + (98.2 \times 0.013) + (116.2 \times 0.033)}{0.017 + 0.022 + 0.013 + 0.033} \\
 &= \frac{2.365 + 2.891 + 1.277 + 3.835}{0.085} \\
 &= \frac{10.368}{0.085} \\
 &= 121.976
 \end{aligned}$$

How the Price Indexes Were Used

The price indexes in Table A4 were the indexes used in the analysis.

The base period for all indexes was 1961 = 100.

Price indexes were used to normalize the dollar values of gross returns and farm costs. Price indexes made it possible to

Table A4. Composite Price Indexes Used in the Analysis, 1961 = 100

Years	1961	1967	1969	1970
	- Percent -			
Fixed cost	100.0	134.6	159.1	167.1
Cash expense	100.0	113.0	119.8	122.0
Feed cost	100.0	110.8	103.6	97.5
Labour cost	100.0	140.2	155.7	159.7

bring gross return for different years to constant dollar values, it also enabled one to measure non-price changes in real inputs by deflating values with the price indexes. The following example illustrates how the indexes were used:

If farmer A incurred a fixed cost of P_A per sow in 1967 and farmer B incurred a fixed cost of P_B per sow in 1969; P_A and P_B were reduced to constant dollar values using the indexes in Table A4 as follows:

$$P_A \times \frac{100}{134.6} \quad \text{and} \quad P_B \times \frac{100}{156.1} .$$

APPENDIX B

METHOD OF CALCULATING PAYMENTS

The calculations that follow illustrate the process by which payments to hog producers are made for the various categories of hog carcass.

Carcass without demerits

Bid Price = \$30.00 per cwt.

Computation for a 150 lbs. carcass with 2.5" backfat is:

- (a) Index = 107
 (b) 30 x 107 = \$32.10
 (c) \$32.10 x 150 = \$48.15

Carcass with demerit

Type demerit Warm dressed weight = 154 lbs.
 Total backfat = 2.2" to 2.3"
 Basic index = 109
 Type demerit (roughness) = -3 points
 Adjusted index = 106
 Calculation = 106 x bid price x 154.

Quality demerit Warm dressed weight = 154 lbs.
 Total backfat = 2.2" to 2.3"
 Basic index = 109
 Quality demerit = (soft, oily carcass)
 = 10 points

Adjusted index	= 99
Calculation	= 99 x bid price x 154
<u>Trimnable demerit</u> Warm dressed weight	= 154 lbs.
Total backfat	= 2.2" to 3.3"
Basic index	= 109
Trimnable demerit	= 6 lbs.
Settlement weight	= 154 - 6 = 148 lbs.
Calculation	= 109 x bid price x 148.

APPENDIX C

QUESTIONNAIRE

This questionnaire was designed to collect additional information on the level of education and experience that the farmers had. The questionnaire also asked farmers to disclose their sources of technical and marketing information. Twenty-six copies of the questionnaire were mailed to farmers. There were only twenty returns of which, only the variable, education was satisfactorily answered.

Contents of the Questionnaire:

Please check the appropriate line or fill out the blanks for additional comments and return the completed form in the enclosed envelope.

1. Level of education completed

- (a) Elementary (Grades 1 through 6)
- (b) Junior High (Grades 7 through 9)
- (c) Secondary (Grades 10 through 12)
- (d) Diploma Course, Faculty of Agriculture,
University of Manitoba
- (e) University (Number of years completed)
or University degree
- (f) Other (i.e. Farm Business Group - Sponsored
by M.D.A., etc.)

2. The period swine enterprise was started

- (a) 1940 - 1950
- (b) 1950 - 1960
- (c) 1960 - 1965
- (d) 1966 - 1970
- (e) If prior to or after the above dates please give the year

3. Indicate the source of information obtained in relation to your swine enterprise by checking the appropriate line and by any additional comments you wish to make.

(a) Source of market information is obtained from:

- (1) Radio - T.V.
- (2) Daily newspapers
- (3) Manitoba Hog Marketing Commission
- (4) Manitoba Department of Agriculture
- (5) Packer Representative
- (6) Neighbors and other producers
- (7) Others, please name sources

(b) Source of technical (production) information is obtained from:

- (1) Manitoba Hog Marketing Commission
- (2) Manitoba Department of Agriculture, Extension Service
- (3) Agribusiness Extension Services
- (4) Hog Manual, Manitoba Department of Agriculture
- (5) Country Guide
- (6) Manitoba Pool Elevators
- (7) By discussing with others
- (8) Others, please name sources

4. Please fill in the following where applicable. I belong to the following organisation where matters are discussed pertaining to problems and progress of the swine industry.

- (a)
- (b)
- (c)
- (d)

APPENDIX D

Table D1. Manitoba Farm Cash Receipts

Year	Total Farm Cash Receipts	Farm Cash Receipts Crops ----- dollars	Farm Cash Receipts Livestock	Farm Cash Receipts Hogs	Hog Receipts as Percentage of Total Farm Cash Receipts	Hog Receipts as Percentage of Total Hog Receipts for the Prairies
1961	246,092	112,924	129,446	23,016	9.3	18.9
1962	263,515	134,358	117,028	20,305	7.7	17.3
1963	269,929	143,648	123,932	18,925	7.0	19.6
1964	299,795	170,081	127,138	23,291	7.7	21.3
1965	340,852	183,404	154,828	28,046	8.2	21.4
1966	376,387	201,158	170,170	33,820	8.9	23.9
1967	372,933	192,566	173,321	35,988	9.6	25.4
1968	364,816	187,122	171,420	35,484	9.7	24.6
1969	351,941	169,662	176,715	43,376	12.3	26.3
1970	341,954	130,244	201,781	55,351	16.1	27.8

Source:

Dominion Bureau of Statistics, Catalogue No. 21-001 Quarterly, Ottawa - Canada.

Table D2. Carcass Grade of Manitoba Hogs (1964-1970)
 (% of Canada Production)

Year	Grade A		Grade B		Grade C		Others		Sows	
	Can.	Man.	Can.	Man.	Can.	Man.	Can.	Man.	Can.	Man.
1964	39.0	37.7	45.7	45.5	7.7	7.8	3.9	4.5	3.7	4.5
1965	41.1	38.0	44.8	45.7	6.9	7.8	4.1	4.7	3.1	3.8
1966	42.0	35.5	43.9	46.5	6.4	9.0	4.8	5.1	2.9	3.9
1967	42.2	37.3	43.5	46.0	6.4	7.4	4.6	5.2	3.3	4.1
1968	43.0	35.7	43.1	46.6	6.4	8.9	4.4	5.3	3.1	3.5
1964-68 Average	41.46	36.84	44.20	46.06	6.76	8.18	4.36	4.96	3.22	3.96
Index Grades										
	112		110 109		107 105		103 102		Sows	
	Can.	Man.	Can.	Man.	Can.	Man.	Can.	Man.	Can.	Man.
1969	0.1	0.1	1.8	1.2	11.3	9.3	30.6	28.5	2.8	3.7
1970	0.1	0.0	1.7	1.1	11.4	8.8	29.9	26.9	3.3	4.3

Table D3. Feed Cost, Cash Expense and Fixed Cost Stratified by Quality Rating of Hogs

	Quality Rating of Hogs (dollars)		
	I Below 35.97	II 35.97 to 36.71	III Above 36.71
Number of farms	8	9	12
Average quality rating \$	34.45	36.32	37.62
Change in average quality \$	II-I 1.87		III-I 3.17
Average feed cost per hog \$	17.61	18.81	18.75
Change in feed cost per hog \$	II-I 1.20		III-I 1.14
Average cash expense \$	2.47	2.65	3.07
Change in cash expense	II-I 0.18		III-I 0.60
Average fixed cost \$	3.72	3.57	4.32
Change in fixed cost \$	II-I -0.17		III-I 0.60

Table D4. Correlation Coefficients of the Variable Factors Related to Net Return Per Sow for the Hog Farms Summarized in Table 7

	Z	K ₁	K ₂	K ₃	K ₄	Y	X ₁	X ₂	X ₃	X ₄
Z	1.00									
K ₁	0.82	1.00								
K ₂	0.55	0.49	1.00							
K ₃	-0.02	0.06	0.22	1.00						
K ₄	0.25	0.44	0.24	0.42	1.00					
Y	0.84	0.97	0.70	0.12	0.43	1.00				
X ₁	0.77	0.96	0.61	0.26	0.54	0.97	1.00			
X ₂	0.25	0.42	0.50	-0.45	-0.09	0.49	0.36	1.00		
X ₃	0.18	0.52	0.61	0.18	0.30	0.61	0.56	0.48	1.00	
X ₄	-0.18	0.06	-0.11	-0.30	0.06	0.02	-0.01	0.42	0.06	1.00

Table D5. Regression Estimates of Net Return on Management Quality Variables
(Using Index for the Quality Rating)

Variables	Twenty Farms Regression Coefficients	Standard Error of Regression Coefficients
Constant (log a)	-13.9925	
K ₁	2.9004**	1.0597
K ₂	6.6434**	2.5456
K ₃	-0.7217**	0.3034
K ₄	0.5019	0.8998
R ²	0.7369***	
S	0.2617	

Significance level *** 1%

** 5%