STRUCTURE AND PRICE FORMATION IN THE STORE CATTLE INDUSTRY

A thesis
presented in partial fulfilment
of the requirements for the degree
of
Master of Agricultural Science
in
Agricultural Economics and Marketing
at
Massey University

Ian David Walker
1974

ABSTRACT

Substantial increases in overseas beef prices in recent years have made the farming of beef cattle increasingly important to the New Zealand economy. This study describes the place of the store cattle sector within the cattle industry and investigates price formation in the store cattle market.

The specific aims of the study were :

1. To identify and describe the various channels and institutions involved in store cattle marketing.
2. To investigate the process of price formation for store cattle on an annual basis.
3. To study the relationship of the prices of various classes of store cattle to each other and to the meat exporters' beef schedule.
4. To investigate the inter-regional price differences for classes of store cattle in relation to the transport cost differentials between regions.

Over the period 1965 - 1971 there was a 41% increase in total cattle (beef) numbers in the North Island. Also there was an increase in the proportion of younger steers in the herd at the expense of breeding cows and older steers. Over the same period the number of dairy calves bred and retained for beef purposes increased from approximately 180,000 to 460,000. The rearing of calves from the dairy herd suitable for beef production has made possible a far greater expansion of beef production than would have been possible from the traditional beef herd alone.

The structural changes in the traditional beef herd may be disguised by the presence of dairy beef animals suitable for beef purposes that are classified as beef cattle in the agricultural production statistics.

Present data limitations made it impossible to investigate the spatial nature of the North Island store cattle industry in the spatial equilibrium framework used by Judge and Wallace. However a statistical model was formulated to analyse store market prices for different classes of stock within a regional framework on a per head and per lb liveweight basis.

The factors influencing the price of store cattle included in the analysis were beef schedule price (OxGAQ), seasonal conditions, class of store cattle, and region of origin.

Although the model did indicate regional differences, no systematic or identifiable regional pattern of store cattle prices was apparent for individual classes of stock. However the results obtained for the per lb liveweight model were consistent with the conclusions of recent theoretical beef investment models, namely :

1. The store value of an animal on a per lb basis is greater than its slaughter value at any age prior to slaughter, and equal to it at slaughter. The per lb store value of a steer is larger for younger classes of steers and declines with age.
2. Changes in seasonal conditions have a greater impact on the price of younger classes of store cattle.
3. The beef schedule price coefficients for individual classes of steers on a per lb basis indicate that a unit change in the beef schedule price has a greater effect on the store cattle prices of younger classes of cattle. This is in direct contrast with the beef schedule price coefficients for the per head model where, as the age of the store animal increases changes in the beef schedule are reflected in greater increases in store prices.
4. The elasticity of store cattle prices with respect to the beef schedule price, is greater than unity for all cattle in the herd below the optimum slaughter age and declines monotonically towards unity as the animal approaches this slaughter age. The elasticities suggest that the optimum slaughter age for store cattle in the North Island is approximately 2½ years.

The investigation of the regional differences of store cattle prices for selected pairs of regions indicated that regional price differences in excess of the transport costs between pairs of regions exist. This suggests that it would be profitable for traders to transfer additional store cattle from the surplus store cattle breeding regions to the growing and finishing regions.

ACKNOWLEDGEMENTS

I am indebted to the people who helped me in this study.

I wish to thank my Supervisor, Dr. W.R. Schroder, for his advice and continued encouragement throughout this study and Dr. R.W.M. Johnson for his assistance and encouragement since I have been in Wellington. Also I wish to thank P. Bushnell and Dr. J.K. Revfiem for their assistance.

I am also indebted to the Department of Lands and Survey and the Meat and Wool Boards' Economic Service for making available unpublished data.

I gratefully acknowledge the financial assistance of the Ministry of Agriculture and Fisheries and for the time I was given to complete this study.

Special thanks are also due to Mrs Jenny Cronin who has typed this script with the utmost patience.

Finally, I wish to thank my wife, Jane, for her encouragement and understanding throughout this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

142

CHAPTER ONE

INTRODUCTION

Beef cattle have long been important in New Zealand's livestock based economy. Initially beef cattle were used, especially before the introduction of aerial top-dressing, to break in large areas of hill country and to maintain them for sheep farming. On farms where roughage control is important and on some hill country runs where cattle graze the swampy valleys, sheep and cattle grazing are still often complementary. However, over recent years substantial increases in overseas beef prices have resulted in cattle becoming recognised as meat producers in their own right.

These substantial increases in overseas beef prices as reflected in the beef schedule to New Zealand beef producers (see Table 1.7.3) have made the farming of beef increasingly important to the New Zealand economy, and the cattle industry is now an important area for research.

In particular this study describes the place of the store cattle sector within the cattle industry and investigates the process of price formation within this sector. The study is confined to the cattle industry in the North Island.

1.1 STRATIFICATION OF THE BEEF CATTLE INDUSTRY

Beef cattle are distributed fairly evenly over the occupied areas of the North Island apart from the predominantly non-sheep farming areas of Taranaki and parts of South Auckland. The proportion of total cattle to total sheep is higher on hill country and the proportion of breeding cows to total cattle is higher on the rougher, less fertile country.

In fact a pattern of stratification similar to that for sheep farming exists. The fattening/finishing process is usually restricted to the more fertile and improved pastures whereas the breeding of store animals is relatively more flexible with respect to pasture type. Free market economic forces work to reserve the better areas for fattening and entice the breeder onto the poorer country where he has a comparative advantage. With the exception of many farms which have areas of both classes of land

and on which both breeding and fattening may take place the majority of farms fall into the category of being either store or fattening units, with the regular transfer of store cattle occurring from the former to the latter. In areas where farms are predominantly of one class or the other this shifting of store cattle may occur over long distances. The best known example of this is the annual draft of store cattle from the East Cape region to the South Auckland fattening areas. (Predominantly 'store' producing beef cattle areas tend to be also predominantly 'store' with respect to the type of sheep run).

The beef cattle industry therefore is a two tiered structure with the movement of store cattle occurring from the breeding or store producing farms in response to a derived demand from the fattening/finishing farms. This movement of store cattle implies regional movements of cattle - 'inter-regional flows' - with the supply of store cattle of an area determined by the history of production of that area.

Buyers, from regions where production of store cattle does not satisfy local demand for finishing purposes, purchase store cattle from surrounding regions where excess supply exists above their requirements. In any year the supply is predetermined by production decisions in the previous year, or years, while the demand for store cattle shifts according to farmers' expectations of the future level of the beef schedule and the amount of feed available in any area. The aggregate demand curve for an area is the sum of the demand curves for that area and all other areas where cattle may be shipped.

The term "fattening" as used here is traditional but perhaps rather unfortunate in the light of the present discrimination against excess fat by the market as evidenced in the beef schedule. It should, therefore, be interpreted as synonymous with the growing and finishing to the desired size of non-breeding animals for slaughter. The store producing or breeding function on the other hand is essentially the biological production of such animals to be finished.

1.2 THE AIMS OF THIS STUDY

The specific aims of this study are as follows :

1. To identify and describe the various channels and institutions involved in store cattle marketing.
2. To investigate the process of price formation for store cattle on an annual basis.
3. To study the relationship of the prices of various classes of store cattle to each other and to the meat exporters' beef schedule.
4. To investigate the inter-regional price differences for classes of store cattle compared with the transport cost differentials between regions.

1.3 CHAPTER OUTLINE

The remainder of Chapter 1 is a brief resume of the importance of beef to the New Zealand economy, a statistical review of the New Zealand beef industry as it exists at present, and a summary of the recent changes of significance that have occurred within the New Zealand beef industry.

Chapter 2 describes the North Island cattle industry, the store cattle sector, and the institutions and channels involved in the marketing of store and finished cattle.

Chapter 3 discusses the factors affecting the supply of, and demand for store cattle, and the theoretical framework for inter-regional models. A spatial model is formulated to measure significant differences in observed store cattle prices in the North Island store cattle market and the data used outlined.

Chapter 4 discusses the results for the model formulated on a per head basis.

Chapter 5 investigates the store cattle market on a cents/lb unit liveweight basis to isolate (if possible) the problem of the varying description of classes of store cattle that may occur between regions.

Chapter 6 investigates the spatial distribution of store cattle

prices in relation to the transport cost differentials between selected pairs of regions.

Chapter 7 presents the summary and conclusions of the study.

1.4 IMPORTANCE OF BEEF TO THE NEW ZEALAND ECONOMY

Overseas trade in primary products is an important feature of the New Zealand economy - in fact New Zealand has always been heavily dependent on overseas trade for its development and progress. Approximately one quarter of this country's gross national product is exported and a similar proportion of gross domestic expenditure is in payment for imports.

In recent years pastoral products processed to various degrees have contributed the major proportion of export receipts [3]. This proportion has been slowly declining, but such products still account for roughly 90% of total visible exports. Meat exports earned a record $613.6 million in the year ended 30 September 1973, an increase of $158.7 million or 34.9% on the 1971-72 season's record. [11]

Together meat and meat by-products returned $742.8 million, or 40.7% of New Zealand's total export receipts of $1,823.2 million. [11] The dramatic rise in New Zealand's meat export earnings is attributable largely to the increasing world demand for meat and to lower domestic production in some major markets caused by a shortage of grains and other animal feed stuffs. Meat shipments to all destinations for the season totalled 652 459 tons which was a drop of more than 15,000 tons, or 2.2% on those for the 1971-72 season. [6]

Despite the decline in shipments, estimated receipts for each type of meat were up on the previous season's figures. Beef and veal remain the principal earners of New Zealand's meat export income. Beef and veal accounted for an estimated $266 million, or 35.8% of the total export earnings for meat and meat by-products, with lamb and mutton accounting for 33.3% and 8.1% respectively. [11]

The relative importance of beef and veal exports, in quantity rather than value terms, remained rather static in the early 1960's

but since 1967 the volume of beef and veal exports have risen in response to higher overseas beef prices.

In the long run, different types of pastoral production may be substituted one for another. At some time in the future, much more of New Zealand's pasture land could be devoted to beef production if changes in relative market prices for the various alternative final products were to warrant such a change in output proportions.

1.5 ECONOMIC IMPORTANCE OF BEEF CATTLE TO THE INDIVIDUAL FARMER

The economic importance of beef cattle to a sample of sheep farmers surveyed by the New Zealand Meat and Wool Boards' Economic Service for the years ended 30 June 1961, 1966 and 1972 are shown below in Table 1.5.

TABLE 1.5 CATTLE INCOME AS A PERCENTAGE OF GROSS FARM INCOME ON NEW ZEALAND SHEEP FARMS (AVERAGE FOR EACH FARM CATEGORY)

	1961	1966	1972
	Year Ended June 30		
Farm Class			
High country (S. Is.)	7.6	4.9	20.0
Hill country (S. Is.)	9.2	12.6	26.0
Fattening/breeding (S. Is.)	4.7	7.0	10.6
Intensive fattening (S. Is.)	3.1	5.0	8.3
Mixed fattening (S. Is.)	3.8	2.7	0.3
Hard hill country (N. Is.)	29.4	28.5	38.7
Hill country (N. Is.)	19.6	21.4	32.1
Fattening country (N. Is.)	18.0	16.5	26.3

Source: New Zealand Meat and Wool Boards' Economic Service Bulletins and Sheep Farm Survey 1971/72 [8]

This Table highlights the increasing importance of cattle on all the major farm types and in particular the more important role of cattle on North Island sheep farms, though their use in the South Island is increasing.

1.6 CURRENT PRODUCTION, CONSUMPTION AND EXPORTS

In January 31 1973 there were some 9.09 million cattle in New

Zealand. Approximately 37% (3.36 million) of these were classified as dairy animals and 63% (5.73 million) as 'beef' animals. [5] (The word 'beef' is placed in inverted commas here because of an inconsistency which occurs between common usage of the word and the usage in the national statistics. Note that the product beef, is derived not only from 'beef' animals but also from 'dairy' animals, in both usages.)

The proportion of breeding stock to dry stock in the two national categories is quite different; at January 1973 there were 65% (2.19 million) dairy cows in milk as opposed to only 35% (2.00 million) beef cows used for breeding. Approximately half of New Zealand's current annual calf crop comes from dairy cows. Of these dairy-cows, about 60% are now Jersey and over 80% of the remainder predominantly Friesian. The increasing importance of calves of dairy origin suitable for beef production will be discussed in Chapter 2.

Each year about one third of the total cattle population is slaughtered. In the 1972/73 season, for the year ended 30 September 1973, total slaughterings amounted to 3.10 million head [10] comprised as follows :

Calves (under 60lb)	0.97 million
Vealers (61 - 350lb)	0.09
Heifers	0.22
Steers	0.74
Cows	0.82
Bulls	0.26
	3.10 million

There is no known data available to show the break up of each of these age/sex classes slaughtered into the main dairy and beef breeds. Nevertheless indications are :

(i) Virtually all the bobby calves are from the dairy herd.

(ii) The cow slaughterings of dairy and beef herd origin are roughly in the same proportion as their respective breeding cow populations.

(iii) The majority of the steers and heifers will be 'beef' breed animals.

Calder [15] estimated that the dairy herds contribution to export beef and veal production for the years ended 30 September 1969, 1970 and 1971 was 40%, 43% and 45% respectively.

Total slaughterings yielded for the year ended 30 September 1973, an estimated total weight of carcase (bone-in) beef of 420 thousand tons, and 22 thousand tons of veal (Ministry of Agriculture and Fisheries estimate).

New Zealand's domestic consumption of beef took 121,000 tons (27%) of this total bone-in beef production, leaving 321,000 tons for further processing and export in the year ended 30 September 1973 (Ministry of Agriculture and Fisheries estimate)

No data is available, but it is apparent that consumption in New Zealand is mainly of the better quality beef derived from prime steer, prime heifer and heavy vealer animals.

Table 1.6 gives an indication of the various types of beef exported in 1972/73 season (i.e. September year) on a bone-out or shipping weight basis.

TABLE 1.6 NEW ZEALAND'S BEEF AND VEAL EXPORTS (SHIPPING WEIGHT) BY MAIN CATEGORIES FOR THE YEAR ENDED 30 SEPTEMBER 1973

Chilled Beef Quarters and Cuts	1,327	
Frozen Beef Quarters	4,426	
Frozen Beef Cuts	29,642	
Frozen Beef and Vealer Manufacturing	156,458	
Vealer Quarters and Cuts	541	
Bobby Veal	6,592	
TOTAL BEEF EXPORTED	198,986	tons

Source: New Zealand Meat Producers' Board Annual Report

Therefore, in the 1972/73 season 79% of our exports of beef were boned-out frozen manufacturing beef and veal suggesting that the majority of prime beef is consumed within New Zealand.

1.7 RECENT CHANGES OF SIGNIFICANCE

1.7.1 Cattle Numbers

Table 1.7.1 indicates that over the thirteen years from 1960 to 1973, dairy cattle numbers increased by 12.8%, beef cattle numbers by 89.9% and total cattle by 51.7% [5]

TABLE 1.7.1 RECENT INCREASES IN THE NATIONAL BEEF AND DAIRY HERDS

	000 head as at January 31			
	1960	1965	1970	1973
Dairy Cows in Milk	1887	2032	2321	2190
Total Dairy Cattle	2973	3174	3729	3355
Dairy Cows as a % total dairy cattle	63.5	64.0	62.0	65.3
Beef Cows and Heifers over 2 yrs used for breeding	1144	1320	1519	1996[1]
Total Beef Cattle	3019	3628	5048	5733
Beef Cows as a % total beef cattle	38.0	36.4	30.0	34.8
Total Cattle	5992	6801	8777	9088

1. Includes cows and heifers of all ages used for breeding

Source: Department of Statistics

Over the same period total sheep numbers increased from 47.1 million in 1960 to 60.9 million in 1972, an increase of 29%.

1.7.2 Slaughterings and Meat Production

Over the same period annual slaughterings of 'beef' and dairy animals and therefore total beef production show year to year fluctuations. Short run fluctuations aside, there has been a long run increase in annual cattle slaughterings, while calf slaughtering has shown a decline over recent years.

TABLE 1.7.2 ANNUAL CATTLE AND CALF SLAUGHTERINGS

Year ended 30 September	Cattle Slaughter (000 head)	Calf Slaughter (000 head)
1960	956	1,234
1965	1,138	1,231
1970	1,836	1,311
1971	1,828	1,077
1972	1,784	1,061
1973	2,044	1,063

Source: Ministry of Agriculture and Fisheries Slaughtering Statistics.

Therefore, over the past 13 years adult cattle slaughter has increased by 114% and calf slaughter has declined 14%.

Figure 1.7.1 shows graphically the changes in total beef cattle and beef breeding cow numbers since 1960. When Figure 1.7.1 is compared with Figure 1.7.2, it will be noticed that increases in beef production tend to follow increases in breeding stock. Also it is to be expected that when the national beef herd in general, or the breeding herd in particular, are being built up faster than normal by the retention of a greater proportion of young females as replacements, increases in beef production will be lower than normal.

The percentage of total beef and veal production consumed domestically declined from 44% in 1960 to 27% in 1973 (on a September year basis). However, the absolute consumption of beef and veal in New Zealand rose steadily until about 1967, but since then has declined suggesting that the consumption of beef shows some response to price and the general economic climate.

Residual beef and veal production (bone-in) left available for export is also shown graphically in Figure 1.7.2. Again short run fluctuations aside it appears that beef exports rose gradually till about 1967, but since then have increased dramatically.

Figure 1.7.1. Annual Beef Cattle Numbers 1960-1973
(At January 31)

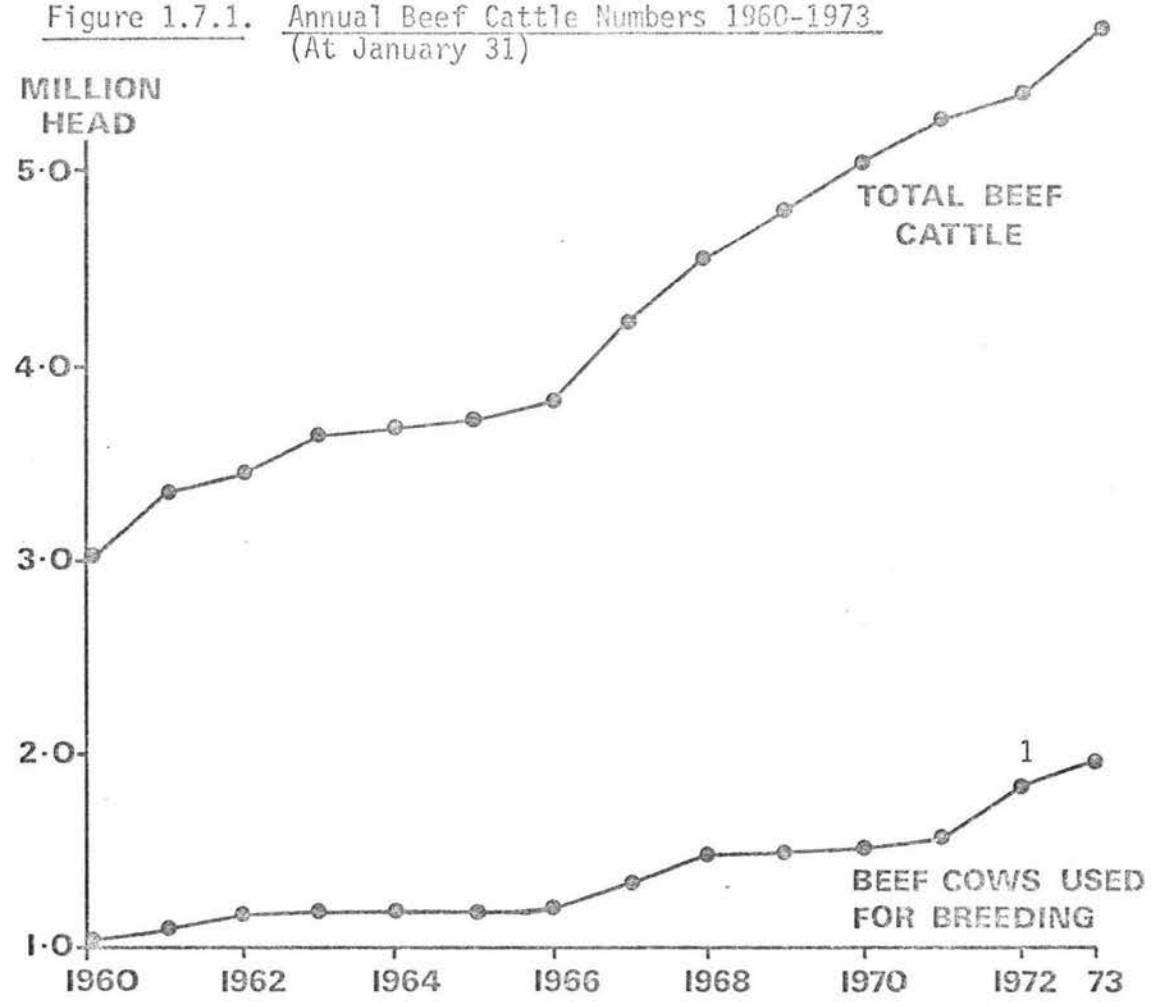
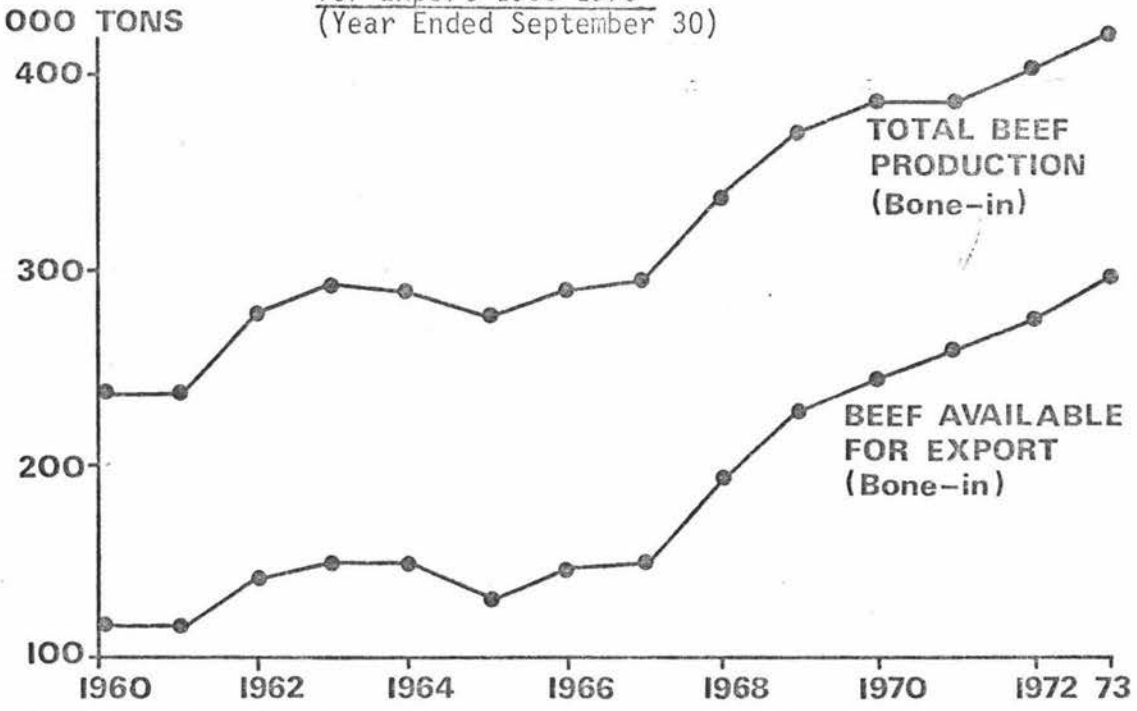


Figure 1.7.2. Annual Beef Production and Beef Available for Export 1960-1973
(Year Ended September 30)



Source: *Department of Statistics - New Zealand Year Books*

1 Prior to 31 January 1972 heifers under 2 years old which were used for breeding were not included.

1.7.3 Export Beef Schedule Prices to Producers

General beef prices have shown a marked rise since World War II. Economic trends favoured the expansion of beef production in the 1960's and moderated growth in dairy and sheep production. Prices to producers for beef increased at a faster rate than for other livestock products reflecting the rise in world demand for beef. While meat prices showed sizeable increases there were only slight increases in dairy prices and a decline in wool prices. Taking opening beef export schedule prices as indicators of seasonal levels, the price (undeflated) for top grade steer carcase beef rose from 4.5 cents per pound in 1946 to 29.0 cents per pound in 1972. In particular Table 1.7.3 indicates the movement of selected North Island opening beef export schedule prices over the period 1960 to 1972. The top grade steer schedule rose 207 percent over this period from 14.0 cents per pound in 1960 to 29.0 cents per pound in 1972. Opening boner cow and boner bull prices have shown an even greater rise over the same period. Boner cow and boner bull schedules rose by 230 percent over the same period. The large increase in boner cow and boner bull schedules occurred due to the development of the United States market for New Zealand manufacturing grade beef and its continued growth since the late 1950's.

TABLE 1.7.3

SELECTED NORTH ISLAND BEEF EXPORT SCHEDULE PRICES

(CENTS/LB CARCASE WEIGHT)

OPENING SCHEDULE FOR THE SEASON BEGINNING OCTOBER 1	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1. PRIME STEER, GAQ (TOP WEIGHT GRADE)	14.0	11.5	13.5	12.5	15.0	15.0	15.5	14.0	18.0	21.5	22.5	25.0	29.0
2. BONER COW (TOP WEIGHT GRADE)	11.0	10.0	10.0	10.5	10.5	11.3	14.0	12.5	17.0	19.5	20.0	21.0	25.5
3. BONER BULL (TOP WEIGHT GRADE)	12.8	12.0	13.0	13.3	13.5	14.0	17.3	17.3	22.0	24.5	24.0	26.0	30.0

SOURCE : NEW ZEALAND MEAT PRODUCERS' BOARD ANNUAL REPORTS

CHAPTER TWO

THE NORTH ISLAND CATTLE INDUSTRY

INTRODUCTION

This Chapter outlines the distribution of cattle in the North Island and describes the movement of store cattle from store producing or breeding enterprises to finishing enterprises.

The channels and institutions involved in the sale of classes of store cattle and finished cattle are discussed as well as the position and role of dairy beef in the North Island cattle industry. Finally, a flow chart portraying the overall movement of store and finished cattle from the traditional beef herd and the dairy herd is outlined and discussed.

For the purpose of this description and the model set out in later Chapters, the analysis is restricted to the North Island with the assumption that there is no significant movement of beef cattle between the North Island and South Island.

2.1 TOTAL CATTLE DISTRIBUTION AND CLASSIFICATION OF NORTH ISLAND SHEEP FARMS

In January 1973, 92.4% of New Zealand's beef cattle, and 83.0% of total cattle (beef and dairy) were in the North Island. [5]

The dairy animals are concentrated mainly in the two principal dairying areas of South Auckland and Taranaki (60.1%) and in smaller dairying pockets throughout the North Island and South Island. A large part of New Zealand's total beef production is derived from dairy farms as a by-product of dairy production in the form of surplus bobby calves and culled breeding animals. However, calves suitable for beef production derived from the dairy herd are now an important part of the beef industry and will be discussed later in Section 2.4.

Beef cattle are distributed fairly evenly over the occupied areas of the North Island, apart from the predominantly non-sheep farming areas of Taranaki and parts of South Auckland. Table 2.1.1 indicates the distribution of total beef cattle

and beef breeding cows in the North Island. It will be noticed that the ratios of breeding cows to total cattle, and total sheep to total cattle, vary between areas. This variation is even more pronounced when individual counties are concerned. For instance the breeding cows/total cattle ratio reaches 40% in Waiapu County (East Coast) and is as low as 18% in Piako County (South Auckland). In Waiapu County the total sheep/total cattle ratio is 6:1 while in Oroua County (Wellington) it is 22:1. These are extremes of variations, but in general, it is apparent that the proportion of total cattle to total sheep is higher on hill country and on wetter country, and that the proportion of breeding cows to total cattle is higher on the rougher, less fertile country.

TABLE 2.1.1 DISTRIBUTION OF BEEF CATTLE IN NEW ZEALAND AND BEEF BREEDING COW/TOTAL CATTLE AND TOTAL SHEEP/TOTAL BEEF CATTLE RATIOS BY STATISTICAL AREAS (JANUARY 31, 1973)

	% of Total N.Z. Beef Cattle	Breeding Cows[I] as % Total Beef Cattle	Total Sheep[II] per Cattle Beast
Northland	9.9	33.5	2.9
Central Auckland	4.2	25.3	4.2
Sth. Auckland & Bay of Plenty	22.7	27.7	6.7
East Coast	8.0	43.3	5.4
Hawkes Bay	12.6	37.4	9.9
Taranaki	3.6	23.9	7.8
Wellington	16.3	35.6	10.1
North Island	77.6	33.0	7.2
South Island	22.4	41.0	22.3
New Zealand	100.0	34.8	10.6

I Includes cows and heifers of all ages used for breeding.

II 30 June, 1972.

Source: Department of Statistics

In fact a pattern of farming for cattle similar to that of sheep farming has developed. The North Island can be classified into three main land types which are closely associated with the type of sheep and cattle enterprise pursued. These divisions correspond to the following Meat and Wool Boards Economic Service classifications for North Island sheep farms, namely: fattening country, medium hill country and hard hill country.

(1) Fattening Country

High producing grassland farms carrying over 4 sheep to the acre plus cattle. Replacement ewes are often bought-in and mostly dry cattle are carried.

(2) Hill Country

Easier hill country and smaller holdings than hard hill country. Mainly Romney sheep and carrying about three sheep per acre plus cattle. Approximately one cattle beast to 10-12 sheep is carried. A high proportion of the stock sold (sheep and cattle) are in forward store or finished condition.

(3) Hard Hill Country

Mainly Romney sheep and carrying approximately two sheep per acre plus cattle (approximately one cattle beast to 8-9 sheep). Cattle provide over a third of the revenue from the sale of store animals and cull breeding stock, the balance being derived from the sale of store sheep and lambs, plus wool income.

The estimated size of these categories for 1971/72 is illustrated in Table 2.1.2.

These three broad categories of sheep/beef farms found in the North Island are considered representative of the industry. On hard hill country in the North Island a beef breeding herd is dictated by the natural conditions. Market forces work to reserve the better areas for finishing cattle and, therefore entice the breeder on to the poorer country where he has a comparative advantage. But on medium hill country, breeding

and finishing may take place with those animals surplus to the finishing enterprise being sold as store animals for finishing on "fattening" farms. With the exception of many farms which fall into this category, or which have areas of both classes of land, and on which both breeding and finishing take place, the majority of sheep farms fall into the category of being either store or finishing units with the regular transfer of store stock occurring from the former to the latter.

TABLE 2.1.2 CLASSIFICATION OF SHEEP FARMS IN THE NORTH ISLAND BY FARM TYPES FOR 1971/72

	Hard Hill Country	Medium Hill Country	Fattening Country
Effective Area (M. acres)	4.0	4.2	2.6
No. Farms	1800	5000	5675
No. Sheep (millions)	6.6	13.2	10.5
No. Cattle (thousands)	763	1280	1032
No. Cows per farm	199	100	33

Source: Meat and Wool Boards Economic Service
Sheep Farm Survey 1971/72 and Supplement.

The breeding and farming of beef cattle in New Zealand has been based largely on the use of British breeds. The Beef Shorthorn was first introduced in 1849, followed by the Aberdeen Angus in 1863, and the Hereford in 1869. Polled Herefords were first imported from the United States in 1929. These three breeds and their crosses still constitute the bulk of the cattle in New Zealand beef herds.

However, within the last decade substantial interest has been shown in numerous new breeds of beef cattle throughout the world. Particular attention has been paid to European breeds which, once obscure, are now in the forefront of revolutionising the beef industry through programmes of crossbreeding with the traditional beef breeds mentioned above, as well as with other

breeds of cattle. The exotic breeds of interest in New Zealand include the Charolais, Simmental, Blond d'Aquitaine, Limousin and Santa Gertrudis.

Strictly speaking there are three tiers in the stratification of the beef industry, the uppermost being comprised of the stud cattle herds. Within each breed there is a pyramidal structure of the registered herds. A small number of nucleus herds breed most of the stud bulls, which are sold to a larger intermediate stratum of herds, breeding mainly herd bulls and some stud bulls, and a larger base of herds breeding mainly commercial herd bulls and an occasional stud bull. However, the pyramidal structure is not clearly defined and even the nucleus herds breed considerable numbers of commercial herd bulls.

However, for the purposes of this study the beef industry is a two tiered structure with the transfer of store cattle occurring from store producing enterprises to growing and finishing enterprises.

The place of beef cattle on sheep farms in New Zealand and in particular on North Island hill country sheep farms has been periodically documented in the past. See for instance Graham [25], Bevin[14], Ward[51]. It is noticeable in the literature that only in very recent years when beef prices have risen considerably relative to sheep product prices that a case has been made for cattle being as profitable as, or more profitable than sheep. See for example, Parker [41], Clarke [18], McClatchy [39], Lowe[35]. Prior to this, reasons advocated for running beef cattle were based mainly on the believed necessity for having a certain proportion of beef cattle in the grazing complement because of their beneficial effects in the development and maintenance of good pasture. This belief is still generally held. Cattle have been described as "implements of development" on country too steep or otherwise unsuited for mechanical cultivation. It is claimed for cattle that they crush certain weeds and eat others on which sheep have little or no effect; that they spread grass and clover seeds via their faeces more effectively than sheep; that by the nature of their grazing habit they control surplus seasonal growth in pasture, keeping it short in a form suitable

for sheep utilisation; and even, by some, that cattle have some as yet incompletely-explained beneficial effect on sheep health. In addition, the low unit labour requirement of the cattle enterprise allows cattle to be carried to absorb grazing potential when labour supply is a limiting factor as far as sheep are concerned.

The above statements suggest that a degree of economic supplementarity exists in the utilisation of both pasture and labour resources between sheep and cattle enterprises which may even extend to some economic complementarity as far as the pasture resource is concerned on some types of country. However there is no evidence to suggest that the growing of beef per se needs to be regarded as necessarily combined with sheep production. A few all beef farms now exist, and the possibility of beef - dairy or beef - cropping combinations without sheep appear to be practicable in many areas if future prices continue to favour enterprise combinations other than the traditional patterns of beef production. Thus the relationship of sheep and cattle may be competitive, with the scarce resources, land, labour and capital being allocated to that enterprise which the farmer considers most profitable under his farming conditions. McLatchy [39]

2.2 CHANGES IN THE DISTRIBUTION OF BEEF CATTLE IN STATISTICAL AREAS IN THE NORTH ISLAND

This section documents with the statistics available from the Department of Statistics, Annual Agricultural Statistics publications [2], the distribution and the major structural changes that have occurred in the North Island cattle industry over recent years. Also the conclusions drawn from this section are used to classify regions for later analysis as either surplus store cattle producing or predominantly growing and finishing.

Section 1.7.1 in Chapter 1 gave a brief resume of the growth in cattle numbers for the whole of New Zealand between 1960 and 1973. This however did not identify where in New Zealand the major changes in cattle numbers occurred. Similarly in this Chapter, Section 2.1 and Table 2.1.1 show only the most recent

distribution of cattle throughout the North Island of New Zealand. This section outlines the changes in distribution of cattle in statistical areas in the North Island from 1960 to 1971. Limitations in the classification of beef cattle in the national beef statistics limit the time period of the analysis of changes in the major classes of steers held for growing and finishing to the years 1965 to 1971. Prior to 1965 steers and bulls of all ages were aggregated together and classified as "steers and bulls of all ages". 1971 is the last year that all classes of beef cattle statistics are available on a regional basis at January 31.

Figure 2.2.1 sets out the regional (statistical area) classifications used in the New Zealand Agricultural Statistics. The counties listed are those related to the sale centres (and their surrounding regions) used in the spatial model outlined and estimated later in this study. The sale centres are those centres in the North Island for which price series of store cattle were available from the Department of Lands and Survey.

Table 2.2.1 sets out the statistical area and counties related to the Lands and Survey sale centres and the description of the regions used in the later chapters.

TABLE 2.2.1 SALE CENTRES AND REGIONS RELATED TO STATISTICAL AREAS

Statistical Area or County	Sale Centre	Region
Northland	Whangarei	North Auckland
Otorohanga & Waitomo	Te Kuiti	Te Kuiti
Rotorua	Rotorua	Rotorua
East Coast	Gisborne	East Coast
Hawke's Bay & Waipawa	Hastings	Hawke's Bay
Taranaki	New Plymouth	Taranaki
Oroua, Manawatu & Kairanga	Palmerston North	Manawatu
Masterton & Wairarapa South	Masterton	Wairarapa

Table 2.2.2 indicates the relative changes in the distribution of total beef cattle in each area from 1960 to 1971.

FIGURE 2.2.1 REGIONAL CLASSIFICATION OF NORTH ISLAND AS USED IN NEW ZEALAND AGRICULTURAL PRODUCTION STATISTICS

COUNTIES:

1. WHANGAREI
2. OTOROHANGA and WAITOMO
3. ROTORUA
4. HAWKE'S BAY and WAIPAWA
5. OROUA, MANAWATU and KAIRANGA
6. MASTERTON and WAIRARAPA SOUTH

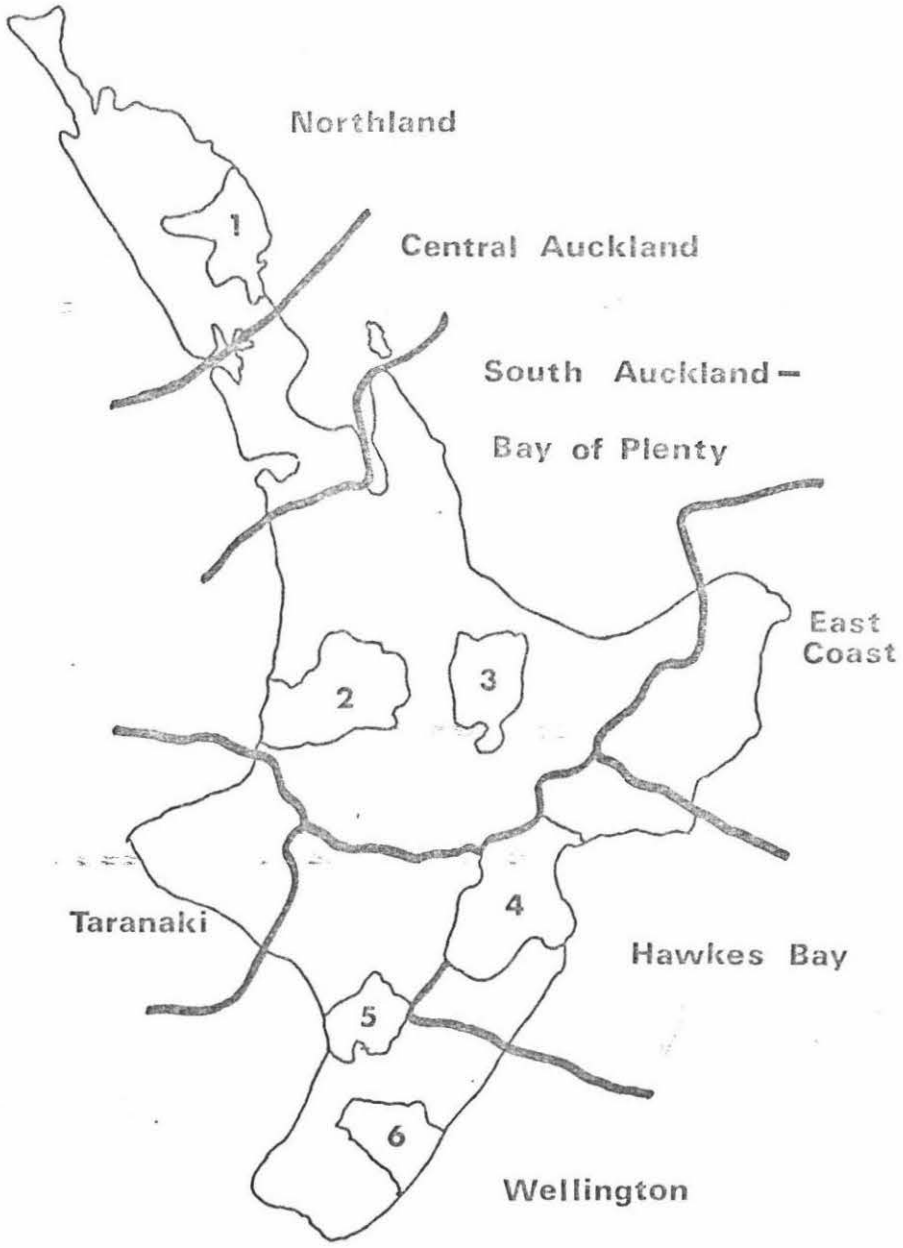


TABLE 2.2.2.

DISTRIBUTION OF TOTAL BEEF CATTLE IN THE NORTH ISLAND

(% TOTAL BEEF CATTLE/TOTAL BEEF CATTLE N.I. FOR EACH REGION)

STATISTICAL AREA OR COUNTY	1960	1965	1966	1967	1968	1969	1970	1971
WHANGAREI	2.2	2.3	2.6	2.8	2.9	2.8	2.8	3.1
NORTHLAND	8.9	9.3	10.1	11.0	11.6	11.4	11.6	12.6
CENTRAL AUCKLAND	3.9	3.6	3.9	4.2	4.4	4.7	4.9	5.2
OTOROHANGA AND WAITOMO	6.0	6.3	6.3	6.2	6.1	6.1	5.9	5.7
ROTORUA	2.4	2.6	2.6	2.7	2.8	2.7	2.4	2.3
SOUTH AUCKLAND - BAY OF PLENTY	26.8	28.7	29.0	28.9	28.7	28.9	29.1	28.5
EAST COAST	13.2	12.4	12.0	11.5	11.1	11.2	11.2	11.0
HAWKES BAY AND WAIPAWA	7.9	7.8	7.9	7.9	8.0	7.8	8.0	7.9
HAWKES BAY	18.6	17.8	17.4	17.5	17.7	17.2	17.4	17.3
TARANAKI	3.0	4.3	4.3	4.2	4.0	4.1	4.3	4.4
OROUA, MANAWATU AND KAIRANGA	1.9	2.1	1.8	1.9	1.9	1.9	1.9	2.1
MASTERTON AND WAIRARAPA SOUTH	3.5	3.2	3.5	3.5	3.7	3.8	3.6	3.3
WELLINGTON	25.5	23.9	23.2	22.7	22.5	22.4	21.5	20.9
NORTH ISLAND (TOTAL)	2,553,412	2,956,440	3.153,239	3,477,929	3,727,009	3,897,106	4,034,897	4,167,894
NEW ZEALAND (TOTAL)	3,019,162	3,627,576	3,856,099	4,241,152	4,549,143	4,811,791	5,048,048	5,279,529
NORTH ISLAND/TOTAL NEW ZEALAND	84.6	81.5	81.8	82.0	81.9	81.0	79.9	78.9

SOURCE : DEPARTMENT OF STATISTICS, AGRICULTURAL STATISTICS

Firstly the rate of growth in total cattle numbers has been greater in the South Island than in the North Island. In 1960, 84.6% of total beef cattle were in the North Island but in 1971 there were only 78.9%. This increasing importance of beef cattle in the South Island was also outlined in Table 1.5 which showed a marked increase in the gross income in the South Island hill country areas from cattle between 1961 and 1972.

Within the North Island over half the total beef cattle in 1960 were in the South Auckland - Bay of Plenty and Wellington areas, 26.8% and 25.5% respectively. Although, in 1971 nearly half were still in these two areas, 28.5% were now in the South Auckland - Bay of Plenty area compared with only 20.9% in Wellington. Relative numbers also grew steadily in Northland over this period, while more moderate increases occurred in Central Auckland and Taranaki. The rate of expansion in total beef cattle numbers appears to have been greater in these areas than in Hawke's Bay, the East Coast, and Wellington whose relative share of total beef cattle declined over this period.

Table 2.2.3 shows the distribution of beef cows used for breeding as a percentage of total beef cattle for each region from 1960 to 1971.

For all areas except Wellington there has been a decline in the proportion of beef breeding cows in the beef herd between 1960 and 1971. In Wellington there was an increase in the proportion of breeding cows to 30.6% in 1968 but then the proportion declined to 29.6% by 1971. Similarly in the Masterton and Wairarapa South counties the proportion of breeding cows was 38.3% in 1960, 39.4% in 1966, and 38.4% in 1971. The proportion of breeding cows in the Hawke's Bay and East Coast areas remained fairly constant with only a slight decline occurring over the period.

Surplus store producing regions are defined as those areas having a higher ratio of breeding cows to total beef cattle than regions which are predominantly growing and finishing.

The proportion of breeding cows to total cattle has shown a sharp

TABLE 2.2.3

DISTRIBUTION OF BEEF COWS USED FOR BREEDING/TOTAL BEEF CATTLE

(% FOR EACH REGION)

STATISTICAL AREA OR COUNTY	1960	1965	1966	1967	1968	1969	1970	1971
WHANGAREI	32.0	31.2	31.0	30.9	30.9	30.0	27.1	24.6
NORTHLAND	34.3	33.2	32.8	31.9	31.8	31.0	29.2	27.9
CENTRAL AUCKLAND	29.4	27.2	27.1	25.7	26.3	24.0	23.2	20.8
OTOROHANGA AND WAITOMO	36.0	33.6	34.7	35.0	34.4	33.1	31.9	31.0
ROTORUA	35.1	29.0	30.6	30.7	32.9	31.0	28.9	30.0
SOUTH AUCKLAND - BAY OF PLENTY	32.2	29.4	30.1	30.0	30.9	29.1	27.5	26.1
EAST COAST	37.8	35.6	36.8	37.2	36.9	36.8	36.5	36.6
HAWKES BAY AND WAIPAWA	31.4	30.6	30.9	31.0	31.1	30.5	30.0	29.2
HAWKES BAY	32.6	31.8	32.8	33.2	33.1	32.2	32.0	31.6
TARANAKI	31.7	26.9	27.7	27.8	27.6	25.4	22.3	20.5
OROUA, MANAWATU AND KAIRANGA	19.6	18.0	19.0	19.7	19.5	18.6	18.5	17.5
MASTERTON AND WAIRARAPA SOUTH	38.3	37.5	39.4	38.5	37.8	37.5	37.8	38.4
WELLINGTON	28.7	28.4	29.4	29.9	30.6	29.6	29.6	29.6
NORTH ISLAND	32.2	30.5	31.3	31.3	31.7	30.5	29.5	28.6
NEW ZEALAND	32.1	30.9	31.5	31.5	31.8	30.9	30.1	29.5

SOURCE : DEPARTMENT OF STATISTICS, AGRICULTURAL STATISTICS

decline between 1960 and 1971 in Northland, Central Auckland, South Auckland - Bay of Plenty, and Taranaki; predominantly growing and finishing areas. This trend would be expected with the advent of more intensive growing and finishing of younger stock for slaughter. This has resulted in the build up of younger cattle and altered the composition of the beef herd. Table 2.2.5 shows that there has been a build up in the proportion of steers and bulls one and under two years over this period. This build up has been at the expense of the proportion of beef breeding cows in the beef herd (as well as steers two years old and over).

The predominantly store producing area of the East Coast has the highest proportion of beef cows for a statistical area, however the Wairarapa region (Masterton and Wairarapa South counties) has an even higher proportion of breeding cows which implies that this region may also be a surplus store cattle producing region. Similarly the Te Kuiti sale centre and region (Otorohanga and Waitomo counties) also has a high proportion of breeding cows. Table 2.2.3 shows that the proportion of beef cows in this region has declined more than would be expected for a surplus store producing region.

Store cattle in the above context refers mainly to weaner steers (castrated males) which are sold in weaner fairs in April, May and June. Tables 2.3.2.1. and 2.3.2.2 indicate that weaner steers were the major class of store cattle traded in Hawke's Bay in the years 1968 and 1969, and April, May, and June were the months in which these sales occurred.

Although the Hawke's Bay statistical area has a fairly high proportion of breeding cows to total cattle, the Hawke's Bay and Waipawa counties (sale centre Hastings) purchase store cattle from other regions. In fact the area is predominantly store growing and finishing with a large number of store cattle being purchased from other counties within Hawke's Bay such as the neighbouring county of Waipukurau. A large number of weaner steers are also purchased from the East Coast by this region.

The Rotorua region, although it appears to have a relatively high proportion of beef cows compared with Northland and Taranaki

statistical areas and the Manawatu region (Oroua, Manawatu and Kairanga counties) purchases a large number of store cattle from other areas such as the East Coast. The explanation for this is that a large proportion of the beef cattle in the Rotorua county and surrounding counties are on Department of Lands and Survey farm blocks, and although these cattle contribute to the county cattle numbers they do not enter the store cattle market. Movement of store cattle occurs between Lands and Survey farms en masse and not via the store cattle market. Thus, Rotorua, a region that appears to be relatively self sufficient in store cattle actually purchases a large number of store cattle from surrounding areas because a large number of the cattle bred in the region do not enter the market in the normal way, but are simply transferred between Lands and Survey farm blocks.

Table 2.2.4, distribution of steers two years and over as a proportion of total beef cattle, shows that over the period 1965 to 1971 there has been a decline in the proportion of steers in this class for all areas in the North Island. The increases in the prime beef schedule price over the last few years (see Table 1.7.3) has resulted in a more intensive form of beef production, with animals being finished at a much younger age at around 18-20 months before their second winter.

Lowe [35] notes that there is a trend to replace 2 year old cattle with one year old cattle and a trend toward the sale of animals at a younger age as the beef price increases. Lowe concludes from his case farm results that the most profitable beef policy in general was the purchase of weaners to be grown as fast as possible and sold before their second winter. Only at slow growth-rates and low beef prices should animals be kept for a second winter. Similarly, the purchase of store 18 month cattle to be sold the following spring and summer does not compete with fast-growing young cattle at reasonable beef prices.

Yver [53] and Jarvis [28] reached similar conclusions about the cattle portfolio held by Argentinian farmers as the beef price increases.

The trend to farming beef cattle intensively and finishing them at a younger age is indicated in Table 2.2.5. The major build

TABLE 2.2.4

DISTRIBUTION OF STEERS, TWO YEARS AND OVER/TOTAL BEEF CATTLE

(% FOR EACH REGION)

STATISTICAL AREA OR COUNTY	1965	1966	1967	1968	1969	1970	1971
WHANGAREI	11.6	10.9	8.4	10.3	9.5	9.2	8.9
NORTHLAND	11.3	10.7	9.0	9.7	9.7	8.7	8.1
CENTRAL AUCKLAND	14.9	12.9	11.7	11.2	12.2	11.0	10.9
OTOROHANGA AND WAITOMO	8.3	8.4	7.9	8.0	8.2	8.2	8.3
ROTORUA	17.2	17.4	13.6	15.1	11.7	12.9	9.2
SOUTH AUCKLAND - BAY OF PLENTY	13.9	14.2	12.2	11.7	11.5	11.7	11.0
EAST COAST	7.6	7.1	6.5	6.1	5.7	5.9	5.7
HAWKES BAY AND WAIPAWA	14.4	11.6	14.1	13.1	12.4	12.7	12.2
HAWKES BAY	12.6	12.3	11.7	10.8	10.7	10.4	10.1
TARANAKI	13.6	13.1	13.1	14.2	14.1	12.3	12.0
OROUA, MANAWATU AND KAIRANGA	28.8	30.8	25.8	23.9	23.2	21.4	19.8
MASTERTON AND WAIRARAPA SOUTH	6.3	5.7	5.3	4.6	4.5	4.6	4.0
WELLINGTON	20.0	20.4	18.9	16.8	16.6	16.2	15.4
NORTH ISLAND	14.1	14.0	12.6	11.9	11.8	11.4	10.9
NEW ZEALAND	13.2	13.1	11.8	11.1	10.8	10.4	9.9

SOURCE : DEPARTMENT OF STATISTICS, AGRICULTURAL STATISTICS

TABLE 2.2.5

DISTRIBUTION OF STEERS AND BEEF BULLS, ONE AND UNDER TWO YEARS/TOTAL BEEF CATTLE
(% FOR EACH REGION)

STATISTICAL AREA OR COUNTY	1965	1966	1967	1968	1969	1970	1971
WHANGAREI	13.1	11.0	12.3	13.0	13.8	15.7	15.6
NORTHLAND	11.3	10.0	11.3	12.0	12.3	13.0	13.7
CENTRAL AUCKLAND	14.5	14.9	16.1	18.5	18.6	18.6	20.1
OTOROHANGA AND WAITOMO	11.5	11.1	10.3	11.4	11.6	12.0	12.0
ROTORUA	11.0	10.7	11.2	14.2	12.2	12.6	11.1
SOUTH AUCKLAND - BAY OF PLENTY	12.5	11.6	11.8	13.7	13.0	13.6	13.8
EAST COAST	9.6	9.7	10.0	9.8	9.8	10.1	10.4
HAWKES BAY AND WAIPAWA	10.4	10.8	11.8	12.9	12.7	12.9	14.3
HAWKES BAY	9.9	10.2	13.4	11.5	11.5	12.1	12.9
TARANAKI	11.8	12.2	12.2	13.2	13.3	14.8	15.8
OROUA, MANAWATU AND KAIRANGA	14.4	14.2	15.0	18.8	18.8	19.5	19.5
MASTERTON AND WAIRARAPA SOUTH	8.7	8.3	7.6	9.6	8.9	9.2	8.9
WELLINGTON	12.0	11.3	11.1	12.2	12.4	12.2	12.8
NORTH ISLAND	11.5	11.0	11.4	12.5	12.5	12.9	13.4
NEW ZEALAND	12.0	11.5	11.7	12.8	12.7	13.1	13.6

SOURCE : DEPARTMENT OF STATISTICS, AGRICULTURAL STATISTICS

up of young cattle is in those areas that are predominantly growing and finishing. For instance in South Auckland - Bay of Plenty, Hawke's Bay (Hawke's Bay and Waipawa counties) and the Manawatu (Oroua, Manawatu and Kairanga counties) there has been an increase in the proportion of steers and beef bulls one and under two years to total beef cattle over this period (Table 2.2.5) and a decline in steers two years old and over (Table 2.2.4).

The increase in steers and beef bulls in areas that contain a large number of dairy cattle may be due, in part, to an increase in the number of dairy bred steers and bulls in this age group retained for beef purposes. In the Occupiers Schedule (questionnaire) for Agricultural Statistics Part 12 relating to dairy cattle, there is a note indicating that, "dairy-type heifers and bulls intended for beef to be entered in Part 13" which is the beef cattle section of the questionnaire. This means that dairy bred calves suitable for beef purposes that are retained, are classified in the beef cattle statistics even though they may still be on dairy farms.

Many of the areas that are suitable for growing and finishing beef animals also contain a large proportion of the dairy cattle. For instance, at January 1970 Northland contained 13.3% of the total dairy cattle, South Auckland - Bay of Plenty, 47.9%; Taranaki 17.2%; whereas, for example, the predominantly store producing areas of the East Coast and Hawke's Bay contained less than 1% and 2.1% respectively. (i.e. Hawke's Bay statistical area).

Therefore, in statistical areas that contain a large number of dairy cattle the structural changes that have occurred in the beef herd such as a reduction in the proportion of beef breeding cows and steers two years and older, and an increase in steers and beef bulls 1-2 years in the total beef herd, may in a large part be due to the build up of dairy beef on dairy farms (and sheep farms) in these areas and their inclusion in the beef cattle statistics. Thus the structural changes in the beef herd may not be as pronounced in these areas as the national beef cattle statistics indicate.

On the other hand, in those areas that are predominantly store

producing and net suppliers of store cattle, the proportion of 1-2 year steers and bulls over the period is relatively constant, i.e. for Otorohanga and Waitomo, the East Coast, and Masterton and Wairarapa South. We would expect these predominantly store producing areas to grow and finish only a limited number of beef cattle compared with the other regions. But these areas also have very few dairy cattle [2] so that the opportunity for increases in this statistical category compared with areas such as South Auckland - Bay of Plenty, Taranaki, Northland or the Oroua, Manawatu and Kairanga counties by this means is limited. The importance and role of dairy beef is discussed later in this Chapter in Section 2.4.

Therefore, when interpreting the changes that have occurred in the composition of the beef herd, it is important to note that the inclusion of dairy beef animals in the Northland, (Central Auckland), South Auckland - Bay of Plenty and Taranaki areas has exaggerated the structural changes.

However, even in those areas where there are very few dairy cattle, a structural change in the beef herd has occurred. Namely, there has been a decline in the proportion of beef cows used for breeding and steers two years old and over, and an increase in the proportion of steers 1-2 years in the beef herd.

For the analysis in the following Chapters it is necessary to identify the regions in Table 2.2.1 (represented by statistical areas/counties) as either predominantly store producing and therefore surplus in their requirements of weaner steers for growing and finishing, or as deficit, in which case they purchase weaner steers from surrounding regions to satisfy the demand for growing and finishing of store cattle that exists above their own productive capacity.

The surplus or deficit status of a region refers to the net situation after all transfers of store cattle have occurred. Because of the heterogeneity of the farm types in each region there is likely to be flows of store cattle into and out of each region. Surplus and deficit imply the net result after all store stock transfers have taken place.

With reference to the Agricultural Statistics the following flow

diagram, Figure 2.2.2, outlines the classification of steers (and bulls) from birth to slaughter at January 31 each year.

FIGURE 2.2.2 FLOW OF BEEF CATTLE (STEERS) FROM BIRTH TO SLAUGHTER FOR AN OPTIMUM GROWING AND FINISHING POLICY

Activities in Beef Cattle Life Cycle	Classification in the Beef Cattle Statistics at 31 January	Year (31 January)
Bulls put out with cows in the Autumn for Spring Calving		
Cows In-Calf	"Beef Cows Used for Breeding"	t
Calves born in September-October (50/50 Male/Female calves)		
Male Calves - Steers and Bulls (4-5 months old)	"Beef Bull and Steer Calves under One Year"	t+1
Weaner Fairs April May and June. Transfer of weaners to growing and finishing farms (in other regions) (7-10 months old)		
Steers on growing and finishing farms (16-17 months old)	"Steers and Beef Bulls One and under Two Years"	t+2
Steers finished for slaughter as prime beef before Winter (18-24 months old)		
Older Steers being finished or retained for purposes other than prime beef production (2 years old and over)	"Steers Two Years old and over"	t+3

If the major flows of store cattle from store producing to growing and finishing farms occurs when store cattle are 7-10 months old weaner steers (see Tables 2.3.2.1 and 2.3.2.2) then by January t+2

as outlined in Figure 2.2.2, the major transfer of store cattle will have occurred. In aggregate, for the North Island, the breeding cows in year t, "Beef Cows Used for Breeding" are the main biological constraint on the number of "Steers and Beef Bulls one and under two years" in the North Island in the beef cattle statistics in year t+2.

Assuming a calving percentage of approximately 84%, a mortality rate to year t+2 of 5% [39], and a ratio of male to female calves of 50%, then at January year t+2 there is a survival rate of approximately 40% for Steers and Beef Bulls one and under two years in the North Island (and New Zealand). (Autumn calving will not affect these assumptions because the Autumn calves will still fall into the same statistical categories as Spring calves.) Also it is assumed that steers (and bulls) will not be finished for slaughter before 16-17 months of age at January year t+2.

If the inter-regional movement of store cattle occurs, then those regions that produce a surplus of weaner steers above their own requirements should have a ratio of less than 40% when steers and bulls 1 - 2 years (at year t+2) are expressed as a proportion of the beef cows used for breeding two years before (at year t). Similarly those regions that have purchased weaner steers should have a ratio greater than 40%.

The distribution of "Steers and Beef Bulls, one and under two years" at year t+2 as a proportion of the "Beef Cows Used for Breeding" in year t are set out in Table 2.2.6, where t = 1963 to 1969.

In Table 2.2.6 the hypothesised survival rate of 40% is realistic for New Zealand and the North Island for January 1965, 1966 and 1967, (i.e. year t+2) but in later years the survival rate implies an unrealistically high calving percentage in year t.

The main reason for the distortion of the survival rates for the North Island and New Zealand in the later years is the appearance of an increasing number of dairy beef retained which are classified as beef cattle.

Table 2.4.1 sets out a reconciliation of the number of calves available for dairy beef in New Zealand. If we adjust the total

TABLE 2.2.6

DISTRIBUTION OF STEERS AND BEEF BULLS, 1-2 YEARS IN YEAR †+2/BEEF COWS USED FOR BREEDING IN YEAR †

(% FOR EACH REGION)

STATISTICAL AREA OR COUNTRY	YEAR † 1963	1964	1965	1966	1967	1968	1969
WHANGAREI	40.7	42.4	55.8	54.3	51.0	54.0	61.7
NORTHLAND	33.2	33.9	48.0	49.4	44.9	44.4	51.8
CENTRAL AUCKLAND	51.3	60.9	82.1	91.1	90.6	85.4	98.8
OTOROHANGA AND WAITOMO	33.9	35.5	35.4	37.1	36.5	36.9	36.4
ROTORUA	36.2	39.0	46.8	58.1	44.5	36.8	32.6
SOUTH AUCKLAND - BAY OF PLENTY	42.1	42.7	47.4	53.4	48.7	48.4	49.8
EAST COAST	25.6	26.7	30.3	29.2	28.9	29.8	27.7
HAWKES BAY AND WAIPAWA	31.5	34.6	45.8	50.4	45.5	44.4	50.7
HAWKES BAY	29.8	31.1	48.7	41.8	38.2	39.1	43.0
TARANAKI	43.2	48.1	51.8	52.6	52.6	62.6	72.3
OROUA, MANAWATU AND KAIRANGA	81.1	79.1	92.2	120.1	108.9	106.8	112.9
MASTERTON AND WAIRARAPA SOUTH	21.8	24.0	26.0	28.4	27.9	25.5	22.3
WELLINGTON	43.5	40.6	43.7	47.5	45.9	41.1	43.0
NORTH ISLAND	37.0	37.5	43.8	47.4	44.6	44.1	47.2
NEW ZEALAND	38.9	40.0	44.3	48.1	45.8	45.7	48.4

SOURCE : DEPARTMENT OF STATISTICS, AGRICULTURAL STATISTICS

"Beef heifer, steer and bull calves under one year" in the national beef cattle statistics for the estimated number of dairy beef retained as outlined in Table 2.4.1, then the ratio (survival rate) for the adjusted beef calf population (for January year t+1) and "Beef Cows used for breeding" (at January year t) in Table 2.2.7 is far more realistic, especially if it is compared with the Meat and Wool Boards' Economic Service Estimate for calving percentage in year t.

TABLE 2.2.7 SURVIVAL RATE FOR BEEF CALVES (ADJUSTED FOR DAIRY CALVES RETAINED FOR BEEF PRODUCTION)

January 31 Year t	Survival rate 'Beef' Calves year t+1 / Breeding Cows year t	Survival rate Male Calves (if 50/50 male/female)	Meat and Wool[1] Board Economic Service Estimate Calving % year t
1964	72.3	36.2	78.3
1965	72.2	36.1	83.6
1966	73.4	36.7	84.9
1967	76.6	38.3	83.9
1968	74.3	37.2	78.4
1969	80.8	40.4	82.4
1970	78.3	39.2	82.1

Source: 1 1970 - 1970/71 Sheep Farm Survey
Prior to 1970 unpublished data from New Zealand Meat and Wool Boards' Economic Service Farm Survey Stock Reconciliations.

The reason for the low survival rate of beef calves (compared with the calving percentage) may be due to the fact that the estimated number of calves available for dairy beef in Table 2.4.1 is too high. However, this figure is qualified in Table 2.4.1. It only indicates the order of magnitude of calves sold or retained for beef purposes and not the actual numbers. Table 2.2.7 indicates that it is mainly the presence of dairy beef animals in the national beef statistics that distorts the expected biological ratios for the beef cattle herd and leads to the high survival rates for steers and bulls 1-2 years shown in Table 2.2.6.

However, because there are very few dairy cows in the predominantly

store producing areas, it is possible to identify from Table 2.2.6 those regions from which a net outflow of weaner steers may have occurred over the period 1965-1971.

For the East Coast area and the Masterton and Wairarapa South counties the ratios suggest a net outflow of weaner steers for the period. Similarly, compared with the other regions, Otorohanga and Waitomo counties are also ranked as a net surplus store producing region.

For Rotorua county the ratios in many years would suggest the county was a net surplus store producing region but we know that a large proportion of the weaner steers in the region do not enter the store cattle market and are simply transferred to other Lands and Survey farm blocks in the region or in other regions. Rotorua, to satisfy growing and finishing requirements, purchases store cattle from surrounding regions and is therefore a deficit region.

Northland is also defined as an area deficit in weaner steers, but the area is likely to be self-sufficient and the high survival ratios in Table 2.2.6 which imply a net inflow of store cattle may be due to the presence of dairy beef cattle rather than an inflow of weaner steers.

The ratios for Hawke's Bay statistical area suggests that the area is predominantly store producing. However the ratios for the counties of Hawke's Bay and Waipawa have, over the period, increased so that these counties are defined as being a deficit store producing region requiring an inflow of calves. (Only 0.5% of the dairy cattle in the North Island are in these two counties. Thus dairy calves retained for beef purposes will not affect the ratios to any significant extent). These two counties, apart from purchasing store cattle from the East Coast, have adequate supplies of store cattle in the surrounding counties of Wairoa and Waipukurau, and the Central Hawke's Bay.

Taranaki is a predominantly dairy farming area with steep hill country farms. A supply of good weaner steers is unlikely from these hill country farms, so that the area would most likely be deficit in its store cattle requirements.

The Oroua, Manawatu and Kairanga counties are very dependent on store cattle from surrounding regions for growing and finishing purposes. Farmers within this region have the option of purchasing weaner steers from surrounding counties, the Wairarapa, Southern Hawke's Bay and the East Coast. The very high ratios from 1965-1971 in Table 2.2.6 indicate that this is a deficit area, however, dairy beef would almost certainly be present as well.

Table 2.2.8 summarises the results outlined above, and for the inter-regional model formulated in Chapter 3 and the interpretation of the regional coefficients in Chapters 4 and 5 regions are defined as being either "surplus" (i.e. predominantly store producing with a net outflow of store cattle) or "deficit" (which implies that the region is a net purchaser of store cattle from surrounding regions in order to satisfy their own growing and finishing requirements).

The demand for store cattle in any one year in the growing and finishing regions, in particular, will be influenced by the seasonal conditions. Good seasonal conditions will shift the aggregate demand curve in the surrounding store producing region(s) to the right.

TABLE 2.2.8 STATUS OF REGIONS WITH RESPECT TO THEIR NET REQUIREMENTS FOR STORE CATTLE (WEANER STEERS)

Statistical Area or County	Name of Region	Status Surplus/ Deficit
Northland	North Auckland	Deficit
Otorohanga and Waitomo	Te Kuiti	Surplus
Rotorua	Rotorua	Deficit
East Coast	East Coast	Surplus
Hawke's Bay and Waipawa	Hawke's Bay	Deficit
Taranaki	Taranaki	Deficit
Oroua, Manawatu and Kairanga	Manawatu	Deficit
Masterton and Wairarapa South	Wairarapa	Surplus

In summary this Section outlines the structural changes that have

occurred in the North Island beef industry between 1965 and 1971. In particular, there has been a build up in the proportion of younger steers in the beef herd at the expense of breeding cows and older steers. However it is important to note that these structural changes may be distorted by the presence of dairy beef animals suitable for beef purposes in areas with a large number of dairy cattle.

2.3 INSTITUTIONS AND CHANNELS INVOLVED IN THE MARKETING OF CATTLE

2.3.1 Store Producing Hill Country Farms

The hill country and hard hill country farms typically undertake the breeding or store producing function in response to a derived demand for store animals from the finishing farms. Table 2.1.2 indicates that these two farm classes (hill and hard hill country) account for 73% of the beef/sheep farms in the North Island by area, 66% of the total beef cattle and 90% of the beef breeding cows.

Store country, by definition, dictates a breeding policy; the scope for growing and finishing young beef in the hill country is limited. Poorer country cannot compete strongly with the better class land in this respect. Stock performance will be lower and costs higher.

As a check to the Meat and Wool Boards' Economic Service breakdown and classification of farm types and cattle distribution in the North Island reference to the national beef cattle distribution statistics (by counties) in Section 2.2 bear out the above conclusion.

The almost completely hill country areas of the North Island, the Western Uplands and the East Cape comprised 22% of the total cattle in the North Island. A further 52% were in the largely hill country areas of the Rangitikei, Wairarapa, Hawke's Bay and Northland. Bearing in mind that many other statistical areas contain considerable areas of hill country, e.g. the Waikato, the Central Plateau and the Manawatu, it is apparent that North Island hill country carries the bulk of the North Island's (and New Zealand's) total beef cattle, and certainly most of her store producing beef breeding cattle.

However, the store producing and finishing role can now no longer be easily segregated. The past few years have seen the continuing improvement of hill country pasture. This has been because of improving management, and programmes of top dressing, oversowing, subdivision and increased stocking rates, leading not only to better quality of pasture but also to a greater quantity of feed particularly in the winter.

These factors, taken together, have meant that overall there has been less need for cattle in their traditional role of pasture conditioners and controllers on hill country.

While this improvement in hill country has reduced the need for mature beef cattle, it has in many instances, made it more feasible to consider the farming (finishing for slaughter) of young beef cattle. Better quality pasture, coupled with improved subdivision and stock management (particularly in the field of parasite control) has meant that on many hill country properties growth rates of young cattle can now be sustained at a level that a few years ago would have been impossible. In particular, young stock can be wintered more easily in better conditions and frequently at less cost.

On most fully developed hill country farms the potential for improvement of sheep performance is small and is likely to be confined mainly to genetic improvement through selection and culling. This is because generally sheep, in the past have had preferential treatment as far as management and husbandry practices are concerned. Their performance, therefore, would be expected to be approaching full potential.

On the other hand, there has been considerable scope for increasing beef cattle performance by allowing them more farm resources - particularly feed and management. Beef cattle profits can be improved markedly when cattle are farmed as an enterprise in their own right, rather than running them for the benefit of sheep. Lowe [35] Hocking [27]

This shift on the hill country of the cattle enterprise to a competitive one with sheep has led not only to the build up in herds and a greater production of calves, but also with the improved productivity of hill country, to the finishing of calves for slaughter, previously the domain of the fattening farms. Thus the supply of store cattle from hill country can be considered, in many cases, as the supply of store animals surplus to their own requirements.

The improvement of hill country farms and the gradual disappearance of hard hill country, as envisaged in the past, from the Meat and Wool Boards' Economic Service Sheep Farm Survey could eventually lead to the introduction of a single North Island hill country classification. For instance in 1956/57 there was an estimated 2,226 hard hill country farms in the North Island while Table 2.1.2 indicates that in 1971/72 there was only an estimated 1,800. Taylor [46]

2.3.2 Sale of Store Cattle

The sale of store cattle takes place in practically every month of the year, but there are well defined months when the major movement or transfer of store cattle from the store producing farms to finishing farms occurs. The transfer is facilitated chiefly by the auction system, and to a lesser extent by private treaty with or without the assistance of a stock and station agent.

In fact marked seasonal patterns of production, stock supplies and demand for store cattle exist, with apparently unpredictable short term fluctuations due to the seasonal feed conditions that exist on both the store producing hill country farms and the growing and finishing farms.

In March, April and May store cattle breeders on hill country farms are weaning calves, sorting up cattle and disposing of any surplus cattle not required to winter. The weaned calves and other surplus cattle are purchased by finishing farms to replace cattle finished and sold during the late summer and autumn months, or (to a diminishing degree) by other store cattle farmers who are

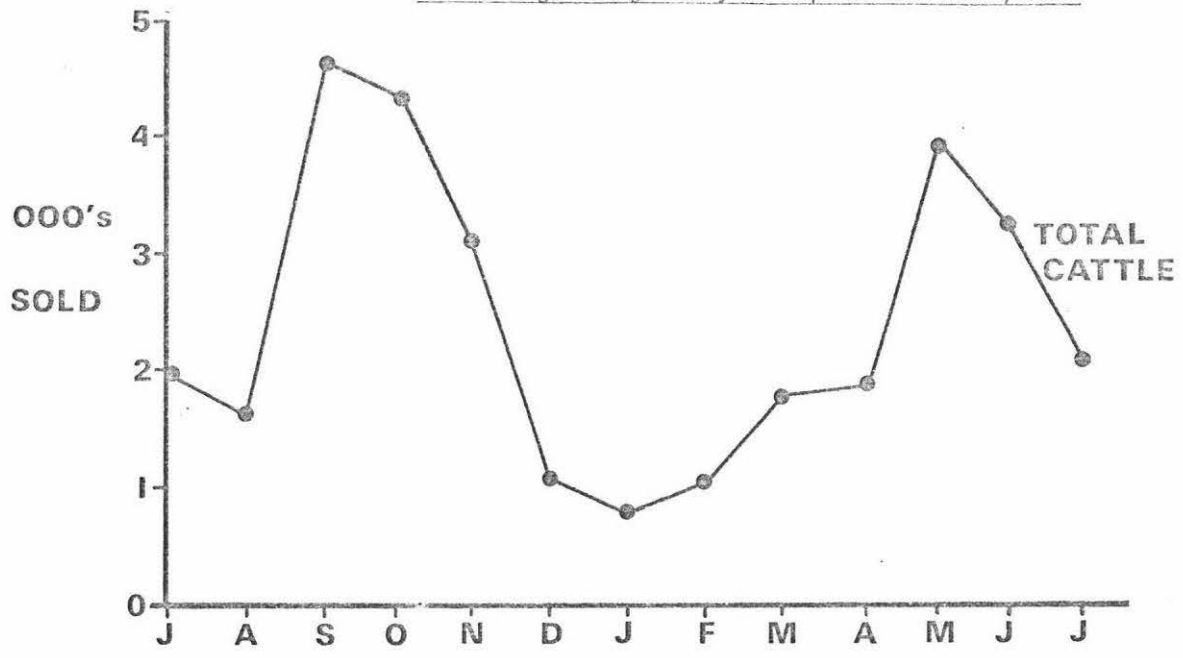
replacing older cattle with younger ones. All classes of cattle pass through the market at this time of the year but weaners (more particularly steers) make up the bulk of the cattle sold.

In the spring, with the problems of the winter behind and the onset of the flush of pasture growth, a strong demand for store cattle may develop and the number of transactions reach another peak which in effect constitutes the second main selling season of the year. The strong demand for store cattle in the spring can be capitalised on by the hill country farmer, especially by the rougher hill country farmer where a number of cattle are used during the winter period to clean up pastures and reversionary growth. Having done this by August or September, surplus cattle can be disposed of making room for the spring drop of calves and lambs. Thus there are substantial numbers of store steers and heifers together with bullocks offered for sale during the September and October period. Later in October and November considerable numbers of female cattle (mainly cull two year heifers and dry cows) come on the market since this is the time when farmers are culling heifers, marking calves, and generally adjusting their herds prior to putting bulls out.

Watson [52] documents the sale of cattle at Feilding sale yards for 1961/62 and 1962/63 (June years). Figure 2.3.2.1 illustrates the fact that two pronounced selling periods are apparent. In the spring market of September and October sales of store and finished cattle totalled 9,100 as against 7,200 in the Autumn market with May and June as the peak. Sales of cattle reach their low point in December and January when less than 1,000 changed hands each month.

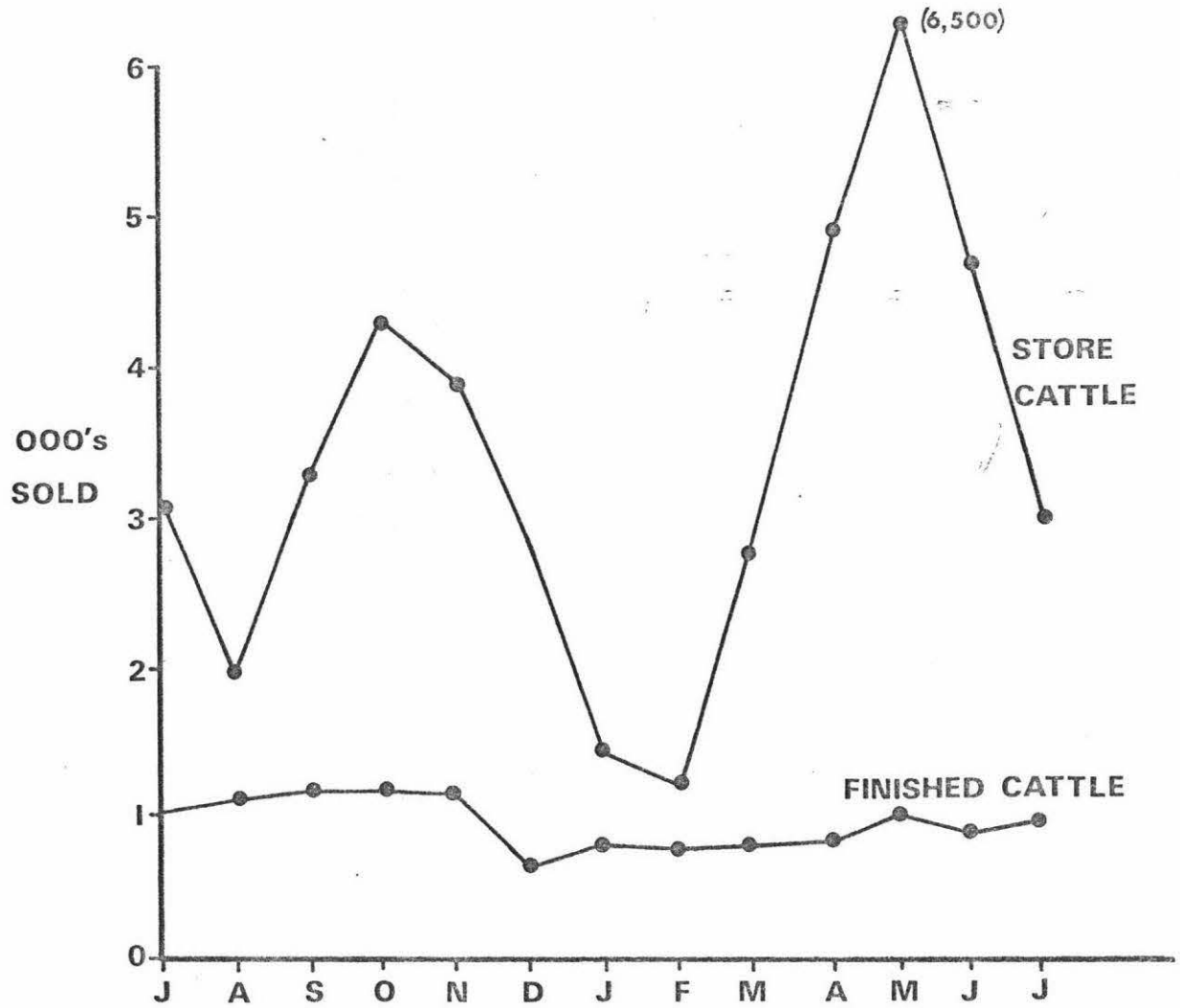
Also data collected from Stortford Lodge Saleyards' Association, Hastings for the years 1955 to 1971 for sales of store and finished cattle (separately in Figure 2.3.2.2) indicates again two pronounced peaks with the largest being in May when 6,500 store cattle and 1,000 finished cattle were sold at auction, while in October 4,800 store cattle and 1,300 finished cattle were sold.

Figure 2.3.2.1. Average Monthly Sales of All Cattle at Feilding Saleyards, 1961/62 and 1962/63.



Source: Watson

Figure 2.3.2.2. Average Monthly Sales of Cattle at Stortford Lodge Saleyards, Hastings, 1955/56 to 1970/71



Source: Stortford Lodge Saleyards Association, Hastings

For either sale, Feilding or Stortford Lodge, it has not been possible to ascertain a breakdown into classes the store cattle sold in any month.

However, by aggregating sales data obtained from the Meat and Wool Boards' Economic Service Farm Survey returns for the years ended June 30 1968 and 1969 it is possible to get an indication of the classes of store cattle sold by Hawke's Bay farmers in the Meat and Wool Boards' Farm Survey over this period.

The average farm sales of store stock for Hawke's Bay farmers in the Survey for the two years ended June 30 1968 and 1969 indicate that the two seasonal peaks referred to at Stortford Lodge and Feilding exist for sales from these farms.

Table 2.3.2.1 shows that the majority of weaner steers and heifers, as well as 88% of the breeding cows, are sold in April, May and June. However, the sale of older steers is more evenly distributed throughout the year, but 42% of the 1½ year steers and 28% of the 2½ year steers are still sold in the April-May-June period.

The other pronounced seasonal peak of September - October accounted for 11% of the sale of yearling steers, 34% of the 2 year steers and 51% of the sales of steers 3 years old and over. Consistent with Watson's observations at Feilding, 29% of the yearling heifers were sold in September-October and 49% of the 2 year heifers. Over the 4 months September-December 59% and 78% respectively of these classes of cattle were sold. At this time farmers are culling heifers and adjusting their herds before putting out the bulls.

Table 2.3.2.2 indicates the proportion of each class sold as a percentage of the total monthly sales. Weaner steers make up the majority of the sales over April, May and June, while in September and October the proportion of yearling and two year steers sold is fairly even.

It was not possible to estimate the numbers of store cattle transferred from one region to another. The heterogeneity

TABLE 2.3.2.1

PERCENTAGE OF EACH CLASS OF STOCK SOLD EACH MONTH FOR MEAT AND WOOL BOARD SURVEY FARMS IN HAWKE'S BAY
(AVERAGE OF SALES FOR THE YEARS ENDED JUNE 30 1968 AND 1969)

SALES	JULY	AUGUST	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	TOTAL
SALES	74	158	272	280	139	285	237	71	125	722	1 414	587	4 364
MONTHLY SALES % TOTAL SALES	1.7	3.6	6.3	6.4	3.2	6.5	5.4	1.6	2.9	16.5	32.5	13.4	100
% SALES OF EACH CLASS BY MONTH													
CALVES (MALE AND FEMALE)		78	22										100
WEANER STEERS									3	28	55	14	100
STEERS 1-1½ YEARS	7	4	10	1	4	15	18			16	19	7	100
STEERS 2-2½ YEARS		2	15	19	3	13	7	6	7		9	19	100
STEERS 3 YEARS AND OVER				51					49				100
WEANER HEIFERS										28	63	9	100
HEIFERS 1-1½ YEARS		3	10	19	3	27	8	4	2	5	6	13	100
HEIFERS 2-2½ YEARS		7	23	26	27	2		6		4		5	100
BREEDING COWS	1	4	2		1		4			40	48		100

SOURCE: MEAT AND WOOL BOARD ECONOMIC SERVICE UNPUBLISHED FARM SURVEY DATA

TABLE 2.3.2.2

MONTHLY SALES OF STORE STOCK BY CLASS FOR MEAT AND WOOL BOARD SURVEY FARMS IN HAWKE'S BAY
(AVERAGE OF SALES FOR THE YEARS ENDED JUNE 30 1968 AND 1969)

SALES	JULY	AUGUST	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	TOTA
MONTHLY SALES	74	158	272	280	139	285	237	71	125	722	1 414	587	4364
MONTHLY SALES % TOTAL	1.7	3.6	6.3	6.4	3.2	6.5	5.4	1.6	2.9	16.5	32.5	13.4	100.0

% MONTHLY TOTAL													EACH CLAS AS % OF TOTAL SA FOR THE YEAR
CALVES (MALE AND FEMALE)		37	6										1.9
WEANER STEERS								4	38	65	65	43	39.9
STEERS 1-1½ YEARS	95	32	40	17	30	56	80	7	3	25	14	5	22.4
STEERS 2-2½ YEARS		6	19	23	8	15	10	29	19		2	11	7.9
STEERS OVER 3 YEARS				16					35				2.3
WEANER HEIFERS										7	8	3	4.4
HEIFERS 1-1½ YEARS		6	11	20	8	27	10	17	5	2	1	6	6.7
HEIFERS 2-2½ YEARS		11	22	24	52	2		23		1		2	6.1
BREEDING COWS	5	8	2		2			20			10	30	8.4
	100	100	100	100	100	100	100	100	100	100	100	100	100

SOURCE: MEAT AND WOOL BOARD ECONOMIC SERVICE UNPUBLISHED FARM SURVEY DATA

of land types in most regions means that a large proportion of the movement of store cattle from surplus store producing to growing and finishing farms takes place within statistical areas and in many cases within counties.

In theory a comparison of 1-2 year old steers and beef bulls with mature cows in each statistical region should indicate whether that area is a breeding or finishing region.

The presence of dairy beef animals in the regional beef cattle statistics means that a stock reconciliation model does not give a reliable indication of the quantity of store cattle transferred from store producing to store finishing areas. At present the information on dairy bred animals retained for beef purposes is not separately enumerated in the Agricultural Production Statistics. Also the actual statistics in each region do not give any indication of the source or destination of the numbers of store cattle transferred.

Information available from the New Zealand Stock and Station Agents' Association [45] outlines the number of stock handled on a commission basis at auction and privately, and those handled on a "headage" basis (per head commission charge) on a regional basis. However store and prime stock are aggregated together. There is no information available from this source on the numbers of store cattle transferred from one region to another.

2.3.3 Method of Sale of Store Cattle

2.3.3.1 Sale of Store Cattle by the Auction System

The auction system is the major institution facilitating the transfer of traditional breeds of store cattle from the store producing to the growing and finishing enterprise.

Since the mid-1960's about 90% of store cattle have been sold through saleyards at auction, McCaw [38] Prior to that time paddock sales were popular but rising market prices made sale by auction far more popular.

Livestock auctions are market places of business where livestock are assembled and sold by means of public bidding. Animals are driven from holding pens into a sales ring where they can be viewed simultaneously by all buyers. The sale is conducted by the Auctioneer who is mainly responsible for obtaining the highest possible bid for the stock.

Livestock auction market facilities are owned by local sale-yard companies in which stock and station firms generally hold shares.

The movement of store cattle through an auction market requires facilities for receiving, selling and loading out animals. Buyers are able to observe the lots presented for sale in the pens prior to the auction and consider what they will bid when the line is offered for auction. Competition between an assembly of prospective buyers is a prime factor in auctions.

A seller can attend the auction and ensure to some extent that his cattle are sold to best advantage. Should the offered price not reach what is, in the seller's view his reserve, he has the option of taking them home, but this involves further transport costs home, and then transport to the next sale. Auctions present an opportunity to study the preferences of buyers as indicated by the prices offered for different lots.

On the other hand, the seller has to pay, in addition to cartage charges, the stock agent's commission. This amount varies, but an average charge is 5% of the sale price. Auctions represent a high risk, high opportunity method of selling. A poorly attended sale may mean low prices. A frequently unappreciated cost of beef producers selling, or buying, by auction is the cost involved in the time spent in attending the sale.

A farmer with a close, convenient sale centre is more able to buy in small lots and is more likely to get the right beast at the right price than the farmer forced to travel long distances.

2.3.3.2 Other Methods of Sale of Store Stock

The other two methods of sale of store stock are sale on farm and forward contract selling of store cattle. Both methods, although of little importance now, may receive increasing interest as farmers move into more intensive feedlot finishing of cattle, in which case they will wish to ensure a continuous supply at a price acceptable to both buyer and seller. In fact cattle may be purchased on a liveweight rather than on a per head basis.

2.3.4 The Growing and Finishing of Store Cattle

Just as no clear cut separation may now exist between the breeding and finishing enterprises on hill country farms, there is also no distinct geographical separation of hill country areas and finishing country in the North Island. Both classes of country exist side by side in most statistical areas and even in counties, e.g. Waipawa and the Manawatu.

Intensive beef farming on finishing country is characterised by the purchase of a 6 to 8 month old traditional beef weaned calf, feeding well and slaughtering it at 16 to 20 months of age before the second winter. This is technically the most efficient method of producing beef as it utilises the faster growth rates and higher feed conversion efficiency of the younger animal. Lowe [35]

The profitability of a store beast will depend on the price paid per lb live weight and its growth potential under the farming conditions to which it will be subjected. It follows then that these are the two factors which a farmer must assess in purchasing cattle, and the accuracy of this assessment and the application of it will determine the profitability of the buying price.

The assessment of growth potential is one of the facets of the stockman's art and the farmers innate ability to "pick" stock is, and always will be, one of the major factors determining the profits to be made from growing and finishing cattle. However, even the most experienced

stockmen have difficulty in accurately assessing an animal's liveweight. In fact Everitt [22] has shown that a wide disparity of estimates between judges of the carcase weight of live animals of different breeds can occur. (See Figure 2.3.4) A similar disparity could quite easily exist when farmers try to estimate the live weight of a store animal. Therefore, Everitt [22] believes that the weighing of store cattle for sale would be of invaluable assistance and should be actively encouraged.

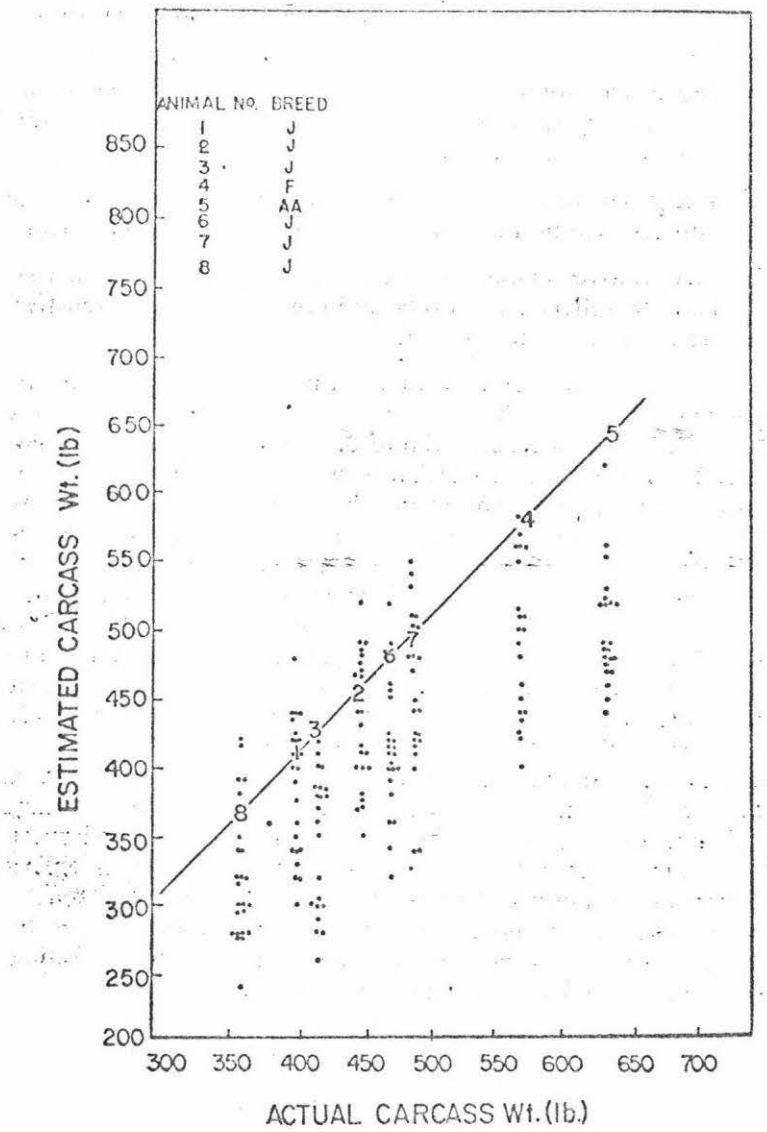
The weighing of store cattle is a common occurrence in the United States in terminal markets and smaller auction markets [29]. In New Zealand interest in purchasing traditional store cattle on a liveweight basis has only occurred in the last couple of years. However, weight recorded beef weaner sales in 1971 at Omarama, Otago [19] indicated that farmers' assessment of the weight of weaners were accurate and that the variation in price paid on a per pound basis was the same for those lines for which the weight was displayed as for those lines where the buyer was required to make his own assessment.

It appears then that buyers at these sales have been able to rank animals on a liveweight basis and pay a price accordingly. Therefore the development of weight recorded beef weaner sales may not be of the priority previously thought to improve beef marketing and production. It is far more important that beef finishers use scales and liveweight information for decision making once they have purchased store cattle for growing and finishing. These farmers will eventually request liveweights when purchasing as part of their planned production programme, rather than as a buying guide which is thought to be the reason for weight recorded sales at present. This is the direction from where the pressure required to increase the number of weight recorded beef weaner sales is likely to come from.

Work done by Baker [12] on liveweight sales of dairy weaners indicated that liveweight assisted buyers in assessing the value of animals and in turn gave a better return to sellers. Also the South Auckland Beef

FIGURE 2.3.4 ESTIMATES OF CARCASS WEIGHT

The relationship between estimates of carcass weight of eight live animals of different breeds and the actual chilled carcass weights as judged independently by 23 people experienced in handling livestock are set out below. Correct estimates for each animal would fall on the diagonal line. A marked tendency to under-estimate carcass weight, especially of heavier animals, together with a wide disparity of estimates between judges, is clearly shown.



Source: N.Z. Beef Processing and Marketing Production.

Development Committee [44] have printed a ready reckoner as a guide to farmers on the value to pay on a per lb liveweight basis for a particular live animal.

2.3.5 Sale of Finished Cattle

2.3.5.1 Seasonality of Finished Cattle Values and the Relationship Between Export and Local Market Prices.

Often the sale of finished cattle coincides with the purchase of store cattle. The majority of store cattle are purchased by finishing farms in April, May and June and to a lesser extent in September and October. The optimum finishing policy, as outlined in Section 2.3.4, is to purchase good weaner steer calves and finish them before the second winter when younger cattle can again be purchased.

There is a well defined seasonal pattern of finished cattle prices, but this may vary from year to year due to short run changes in the many factors influencing supply and demand. Figure 2.3.5.1 illustrates the movement of the average Auckland wholesale price and the export beef schedule price paid to producers for GAQ ox less than 680 lb over the period 1967 to 1973.

Cattle are relatively easy to finish over the late summer, autumn and early winter and many farmers are forced to sell before the winter due to the falling off in feed supplies and the wet soil conditions on the heavier land. As a consequence, finished cattle become more difficult and more costly to produce. Thus, although the supply declines the local market trade demand remains about the same, and values rise till they reach a peak which is usually in October. From October there is a progressive but not severe drop in values through to January. This is illustrated by the seasonal movement of the Auckland wholesale price for GAQ ox less than 680 lb.

Figure 1.7.2 indicated that New Zealand exports the bulk of its beef production. Thus the influence of world demand expressed through the meat-exporters' schedule has a direct bearing on the level of domestic meat prices at the wholesale

Figure 2.3.5.1 Comparison of Average Local Wholesale[1] and Export Schedule Price[2] for Ox (GAO Ox <680 lb, Auckland)

Source: 1) Department of Trade and Industry Unpublished Data
2) New Zealand Meat Producers' Board Annual Reports

and retail stages. With the possible exception of the winter early spring months, July to October, the schedule acts as a floor price to producers and also sets the base price for the domestic market.

However, buyers of local market meat in order to ensure adequate and continuous supplies need to offer the same or a higher price than the export schedule to producers. Indeed some premium over export rates may be expected even during times of adequate stock supplies to ensure supplies at later stages in the season when stock is more scarce. Also local buyers, who wish to purchase a few cattle from a given line of stock may have to pay a premium, whereas the exporter's agent is usually prepared to purchase a larger proportion of the total number of stock offered. This premium is accentuated during the off season when farmers have to be recompensed for the extra cost of winter feeding and need some incentive to carry stock during the period of restricted grazing and adverse climatic conditions. Figure 2.3.5.1 illustrates this point clearly. Around June the local wholesale price tends to climb above export schedule prices and reaches a peak around October-November. The wholesale prices may lag behind the exporter's schedule while wholesale stocks purchased at the old price are used up.

Table 2.3.5.1 shows the average number of finished cattle sales for farms in the Meat and Wool Boards' Economic Service Farm Survey in the Hawke's Bay area for the two years ended June 30 1968 and 1969.

Sales of finished cattle are at a peak around May and June as cattle are sold off before the winter, otherwise sales of finished cattle occur each month with a decline in numbers sold in August, September and October, when most finished cattle sold will be for the local market. Export killing is very low over this period.

2.3.5.2 Method of Sale of Finished Cattle

The producer has several alternative methods of selling finished cattle, he may :-

TABLE 2.3.5.1

MONTHLY FAT STOCK SALES FOR MEAT AND WOOL BOARD SURVEY FARMS IN HAWKES BAY
(AVERAGE OF SALES FOR THE YEARS ENDED JUNE 30 1968 AND 1969)

SALES	JULY	AUGUST	SEPT	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	TOTAL
COWS	110	10	22	15	75	151	24	22	35	39	248	379	1 130
%	10	1	2	1	7	13	2	2	3	3	22	34	
HEIFERS 2-2½ YEARS	17	22	60	20	73	24	11	22	29	20	52	64	414
%	4	5	14	5	18	6	3	5	7	5	13	15	
HEIFERS 1-1½ YEARS	25	64	3	0	1	6	11	25	0	3	20	56	214
%	12	30	1	0	0	3	5	12	0	1	9	26	
STEERS 1-1½ YEARS	5	11	1	3	4	13	11	5	22	73	66	150	364
%	1	3	0	1	1	4	3	1	6	20	18	41	
STEERS 2-2½ YEARS	20	11	14	8	4	25	45	154	158	59	199	168	865
%	2	1	2	1	0	3	5	18	18	7	23	19	
STEERS 3 YEARS AND OVER	118	33	15	20	48	15	29	7	58	2	46	38	429
%	28	8	3	5	11	3	7	2	14	0	11	9	
TOTAL	295	151	115	66	205	234	131	235	302	196	631	855	3 416
%	9	4	3	2	6	7	4	7	9	6	18	25	100

SOURCE: MEAT AND WOOL BOARDS ECONOMIC SERVICE UNPUBLISHED FARM SURVEY DATA

(i) sell on schedule to an export slaughter house;
(ii) sell on 'owner-account';
(iii) sell through a producer co-operative;
(iv) sell at saleyards to buyers for the internal or external trade;
(v) sell by private treaty on the farm to a butcher, butcher's buyer, or export buyer;

The quantitative importance of the alternative sale methods is difficult to assess due to lack of statistics.

(i) Sale on Schedule

Selling on schedule is however almost certainly the major method of sale [38]. In addition, export meat operators supply substantial quantities of meat for the local market.

The Meat Export Schedule indicates the minimum price which meat exporters will pay for all grades of export meat to be purchased in the following week. The prices relate to the weight of the carcase and an allowance for the hide. The schedule is fixed weekly, following consultation between the major exporters and reflects the exporters' assessment of:

(a) Costs and commission to the point of sale,
(b) Current realisations, and
(c) Future movements, in market prices.

Exporters may from time to time privately offer payment at rates in excess of schedule prices; when certain classes of beef cattle are in demand, due to shortage of supply; when there is a need to compete with local market buyers (particularly over the winter period).

Payment is made according to the "hot weight" of the animal. Traditionally, the proceeds from sale of internal organs have been used to offset, in part, the costs of killing and processing. Producers receive their payments shortly after slaughter.

Because the majority of New Zealand finished cattle are sold on schedule, the schedule price will have a strong influence

on the level of prices ruling in other finished cattle market institutions and also on the prices paid for store cattle. This is discussed later in Chapter 3. No meat producer will sell stock by another method if he can obtain a higher price by selling on schedule. In choosing between alternative sales methods the producer must however assess the value of meat on the animal. This is because he is choosing between liveweight and deadweight sale methods. Personal judgement will therefore blurr the certainty of choice.

Sale by schedule has the advantage that it eliminates guesswork necessarily involved in the estimation of carcase weight and grade of live animals. Everitt [22]

However, selling by schedule also has disadvantages such as under conditions of heavy supply. The schedule price may be unrealistic bearing little relationship to actual realisations. Conditions of temporary over supply tend to eliminate competition at the point of stock procurement.

Sale on owner's account or through a Producer Marketing Co-operative are two institutional systems through which the farmer can dispose of his stock if he feels that the schedule is unrealistic and bears little relationship to actual realisations.

(ii) "Owner-Account" Selling

Sale of finished cattle by the Owner-Account method of marketing places the producer in a similar position to an exporter operating without his own processing plant. Owner-Account selling gives producers the right (by law) to have their stock killed, processed and marketed on their own account and the meat sold through brokers or agents operating in New Zealand or overseas. Hides and other by-products are sold on the producer's behalf. The producer receives the full value of his animal at the time of sale of the meat which may be 3-4 months after it is processed. In recent years these proceeds have tended to exceed the values obtained by selling on schedule, but at the same time, any fall in overseas prices that does occur is

likewise borne by the producer instead of the meat trader who is paid a commission to cover the costs of marketing.

(iii) Producer Marketing Co-operatives

These were established by producers in an effort to gain a higher net return for their stock than that obtained by selling to the existing meat exporters. Farmers place their stock in the hands of the co-operative for disposal. At the time of slaughter, the farmer receives 85-90% of the current schedule price for the stock, with the balance being paid at the end of the trading year, depending on the profits obtained.

The farmers co-operative organisations include :-

(a) Processing co-operatives, e.g. Auckland Farmers' Freezing Co-operative Ltd. (AFFCO) and Alliance Freezing Co. (Southland) Ltd. In 1960, the Co-operative Freezing Companies Act was passed to provide for the registration of freezing companies as co-operatives. (AFFCO) is not a true co-operative in that not all farmers supplying stock are shareholders.

(b) Meat export co-operatives, e.g. Producers' Meats (N.I.) Ltd. (Auckland) and the Primary Producers' Co-operative Society Ltd. (PPCS) (Dunedin). These companies do not own meat works but use existing facilities to kill stock. The first of these co-operatives, PPCS, was set up in 1948, and Producers' Meats (N.I.) Ltd. four years later.

(c) Combined processing and exporting co-operatives, e.g. the Co-operative Pig Marketing Association (P.M.A.) (Auckland). This organisation was formed in 1927 to handle pig processing and marketing, bobby calf pools and cattle processing. In recent years the decline in pig and bobby calf slaughterings has resulted in reduced levels of turnover.

Both these forms of sale, Owner-Account selling and sales through producer co-operatives provide producers with an

alternative channel for sale for the export market, to the forced sale to the large meat operators' companies, thus reducing the possibilities of monopsonistic exploitation of the finished stock producer.

The other forms of sale open to producers are all on a liveweight basis. Problems immediately arise in estimating the carcase weight of the live animal.

(iv) Sale of Finished Stock Through Saleyards at Auction. Saleyards hold regular auctions of finished stock in association with all classes of store stock. Individual butchers, group buyers, butcher Co-operative Association buyers, buyers for firms wholesaling meat within New Zealand, and buyers for exporters, all attend these sales. Only about 5% of all finished cattle are sold through saleyards, and there are only three saleyards that have any substantial number of finished cattle [38]. They are Westfield, Frankton and Stortford Lodge, but even then the numbers are relatively small as indicated for Stortford Lodge in Figure 2.3.2.2. Finished stock coming onto the market at Stortford Lodge, Hastings indicates a fairly constant supply of finished cattle being offered for sale.

Figure 2.3.2.2 indicates that there is a rise in numbers from August to November. Sale at auction may be a more important outlet for finished cattle at this time of the year when killing for export declines. Also bidding between local buyers is expected to be competitive, realising a higher price than may be expected selling on the hoof on farm.

(v) On Farm Sale of Finished Cattle

With sale by private treaty on farms the farmer negotiates the sale on the hoof on a per head basis with the buyer's agent. This method tends to be used at times of short supply and consequently keen competition. Individual butchers, or a buyer for a group of butchers will often buy privately from producers, but export buyers in times of scarcity or to fill a particular order may also buy on the hoof on farms.

Higher prices are received by the seller, although this is more a function of the market conditions prevailing than the method of marketing itself. The method is subject to the variability inherent in estimating carcase weight. Another disadvantage with sale on the hoof and at auction is that no record of carcase weights or grades is received; an important requirement in assessing a continuing production programme.

A large part of the local market meat requirements are met by sale at auction and on the farm.

2.4 BEEF FROM THE DAIRY HERD

2.4.1 The Bobby Calf Industry

Each year almost one million bobby calves are slaughtered as a by-product of the dairy industry. [10] While overseas revenue is obtained from the sale of bobby veal, vells, calf rennet and calf skins [4], it has frequently been suggested that from the national viewpoint, it would be more profitable to rear at least a proportion of these bobby calves to mature slaughter weights.

Table 2.4.1 indicates that the annual number of bobby calves killed increased up to the year ended May 1970 when the number slaughtered was 1,266,000 head. The number slaughtered in the North Island steadily increased till 1970 while in the South Island the number killed declined from 98,000 in 1950 to only 40,000 in 1970. Since 1970 the annual bobby calf kill has declined approximately 10% each year; the bobby calf kill for the year ended May 1973 was only 983,300 head. [10]

The bobby calf pool system of marketing and administration is unique among the various methods of marketing livestock in New Zealand [13] Prior to the formation of bobby calf pools in 1937, bobby calf prices based on schedule rates ranged from 25 cents to 65 cents per head. Farmers began to realise that meat operators were making excessive profits from this product, and, in an endeavour to retrieve some of this margin for themselves, began to form groups to be able to offer a substantial number of calves for sale and thus increase their bargaining power through co-operation. Success was immediate and in the first year of operation the first pool formed in the Piako area returned nearly $1.00 per head to the suppliers.

2.4.2 Beef From Cull Dairy Cows and Bulls

As indicated in Chapter 1, by Calder, a large proportion of manufacturing beef exported comes from the dairy herd.

2.4.3 Prime Beef Production from the Dairy Herd

In 1969 the Government introduced the Dairy Industry Diversification Scheme to encourage beef production from

TABLE 2.4.1

RECONCILIATION OF DAIRY CATTLE NUMBERS AND CALVES AVAILABLE FOR DAIRY BEEF

(000)

MAY YEARS	1964/65	1965/66	1966/67	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73
NUMBER OF COWS IN MILK [1]	2 032	2 088	2 131	2 232	2 304	2 321	2 239	2 218	2 190
CALVES BORN AT 90% CALVING [2]	1 829.0	1 879.2	1 917.9	2 008.8	2 073.6	2 088.9	2 015.1	1 996.2	1 971.0
CALVES RETAINED FOR REPLACEMENTS PER 100 COWS IN MILK [3]	30	30	30	30	30	27	25	26	26
NUMBER CALVES RETAINED	548.7	626.4	639.3	669.6	691.2	626.7	559.8	576.7	569.4
NUMBER BOBBIES KILLED [4]	1 212.4	1 074.2	1 015.3	1 147.0	1 135.0	1 266.0	1 125.0	957.8	983.3
TOTAL CALVES RETAINED OR KILLED	1 761.1	1 700.6	1 654.6	1 816.6	1 826.2	1 892.7	1 684.8	1 534.2	1 552.7
NUMBER AVAILABLE FOR DAIRY BEEF [5]	67.9	178.6	263.3	192.2	247.4	196.2	331.3	462.0	418.3

SOURCES AND NOTES :

1. DEPARTMENT OF STATISTICS, AGRICULTURAL PRODUCTION STATISTICS AT JANURARY 31
2. 90% OF COWS IN MILK ASSUMES A 10% WASTAGE OF THOSE BORN
3. DAIRY FARM PRODUCTION REPORTS; COW CENSUS DATA
4. M.A.F. MAY YEAR. SLAUGHTERING STATISTICS - MEAT EXPORT WORKS AND ABATTOIRS
5. NUMBERS AVAILABLE FOR BEEF IS A RESIDUAL OF CALVES BORN MINUS THOSE RETAINED FOR REPLACEMENT AND THOSE KILLED. THIS FIGURE ONLY INDICATES THE ORDER OF MAGNITUDE OF THOSE CLAVES SOLD OR RETAINED FOR BEEF PURPOSES.

the dairy herd. A subsidy of $10 per head was paid for registered calves carried on a dairy farm through the following winter to September 1. To qualify a farmer had to have produced 6,000 lb. of butterfat the previous season.

This scheme was aimed at the replacement of dairy animals with beef animals in an effort to decrease total dairy production. The major reasons were the world over supply of milkfat products and Britain's pending entry into the European Economic Community.

With an improvement in demand for milkfat products New Zealand was unable to fulfill all its orders, so the Dairy Diversification Scheme was suspended before the beginning of the 1971/72 season (i.e. before May 1971).

However, several changes have occurred to the composition of the dairy herd since 1963 and over the period this scheme was operating :

(i) The most obvious effect was the decrease in the number of bobby calves killed as outlined in Table 2.4.1 from 1969 to 1971. Bobby veal production at export works decreased by 2,200 tons (shipping weight) over the two meat seasons to the year ended September 30, 1971. [6]

(ii) The proportion of Jersey inseminations continued to fall while Friesian inseminations rose as outlined in Table 2.4.3 and the proportion of the dairy herd that was predominantly of the Jersey breed fell from 81.0% in 1963 to 58.0% in 1972. During the same period the proportion of cows of predominantly Friesian origin increased from 11% to 34% [1]. The trend towards the Friesian breed is reflected in the increased usage of semen from Friesian sires (see Table 2.4.3) by farmers using the N.Z. Dairy Board artificial breeding services.

(iii) Also Table 2.4.3 indicates that the proportion

TABLE 2.4.3 TRENDS (%) IN INSEMINATIONS OF DAIRY COWS BY BREED OF BULL

(ROOM TEMPERATURE SEMEN)

Year	Friesian	Jersey	Other Dairy	Beef Bulls	Proportion of Total Dairy Cows Inseminated
1963	18.1	76.8	3.4	1.7	29
1965	20.6	74.8	2.2	2.4	37
1967	30.0	66.4	1.6	2.0	44
1968	38.1	58.0	1.4	2.5	45
1969	42.4	52.2	1.2	4.2	43
1970	52.4	40.9	1.2	5.5	43
1971	55.4	38.3	1.2	5.1	43
1972	53.1	38.3	1.3	7.3	47

Source: Dairy Board Farm Production Report No. 49.

of dairy cows inseminated with beef-type semen more than doubled over this period. In 1968 they accounted for only 2.5% of the total dairy cow inseminations and in 1970 they were 5.5%. And in 1972, 15.2% of the dairy cow inseminations were with beef type semen. Table 2.4.3 also outlines the proportion of dairy cows inseminated and shows that the proportion increased from 29% in 1963 to 47% in 1972.

(iv) Table 2.4.1 shows that the estimated number of calves bred and retained or sold for dairy beef purposes doubled, rising from around 200,000 in 1967/68 to 460,000 by 1970/71.

(v) Also over this period increases in the export beef schedule (see Table 1.7.3) has meant that the relative profitability of rearing calves for beef has been increasing with rising beef prices. Relative prices between beef and dairy have moved in favour of beef since 1968 and there has also been a considerable improvement in beef farming technology. These two factors taken together have led to an increase in the relative profitability of beef compared with dairying. The relative price movements are shown in Figure 2.4.3. However, Figure 2.4.3 indicates that over more recent years the price of milkfat has improved considerably and this has held the number of calves retained for beef purposes at approximately 400,000 per annum (see Table 2.4.1.)

The rearing of calves from the dairy herd suitable for beef production has made possible a far greater expansion of the beef industry than would have been possible from the resources of the traditional beef herd.

The rearing of calves suitable for beef production may be considered under three different rearing regimes :

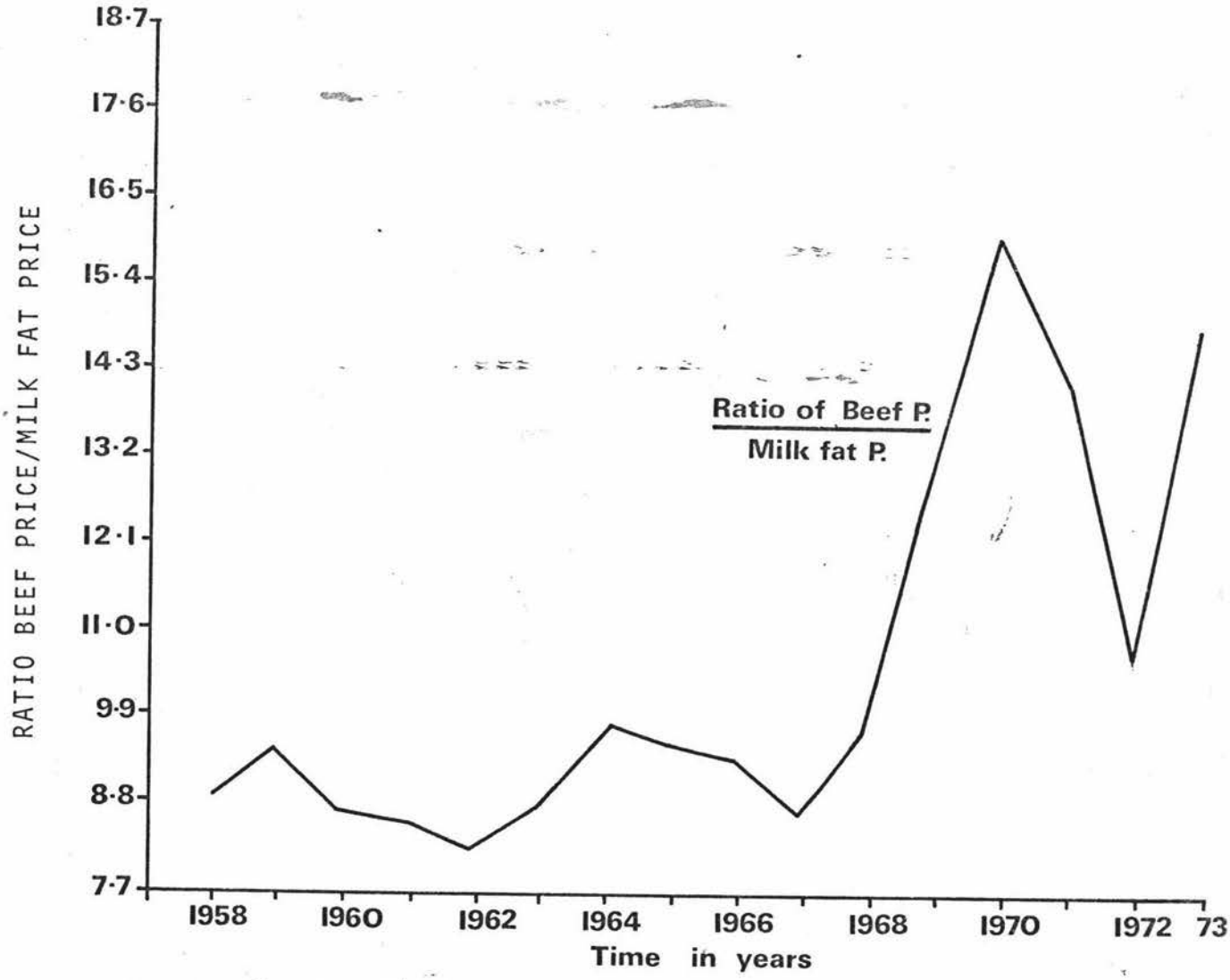
(i) Rearing on the dairy farm for sale as weaners at a dairy weaner sale, or for sale by contract,

for growing and finishing on a traditional fattening farm or taken through to slaughter on the dairy farm of origin.

(ii) Transfer of calves from the dairy farm to the store beef farm to be multi-suckled.

(iii) Transfer of calves to specialist calf rearing units to be sold as weaners, mainly on a contract basis, to traditional "fattening" farms for growing and finishing.

FIGURE 2.4.3 RATIO OF THE AVERAGE BEEF SCHEDULE (OxGAQ <680 lb)[1] CENTS/LB AND THE AVERAGE PRICE OF MILK FAT[2] CENTS/LB



Source: 1) N.Z. Meat Producers' Board Annual Reports
2) Dairy Board Farm Production Reports

2.4.4 Dairy Beef Auctions

Before there was an orderly marketing system for this new class of livestock dairy farmers forced to sell weaners as the season progressed did so at auctions at which few, if any, interested buyers were present. Discouraging financial returns resulted. The first organised sale of weaner calves from dairy farms took place at the Frankton saleyards in late 1967 as a collaborative venture between the Waikato Stock and Station Agents' Association and the South Auckland Beef Development Committee [12]. The sale demonstrated an intense interest in this form of beef production and revealed the technical and educational advantages of placing such auctions on a liveweight basis [22]. Further specialised sales held in the spring of 1968 [49], allowed the transfer of about 6,500 weaners between breeders, rearers and graziers, and about 7,500 in 1969.

Thus, by 1970 from a modest beginning in 1967, when only one sale was held at Frankton and 630 dairy weaners were sold, some 12,000 animals, worth over half a million dollars, changed hands through dairy beef weaner sales. Dairy beef weaner sales held in the Northland and South Auckland regions are now firmly established on the stock sale calendar. In 1970 sales were held at Frankton (Hamilton), Pukekohe (Auckland), Ngongataha (Rotorua) and Kauri (Whangarei). These specialist dairy beef weaner sales occur in November and December. Animals offered for sale are generally 3 to 4 months old and weigh on average between 240 to 300 pounds liveweight.

In 1971 a further 15,500 dairy beef weaners were sold through special dairy beef weaner sales with Frankton holding four sales which accounted for 56% of all animals sold, Pukekohe three sales (20%), Ngongataha one sale (13%) and Kauri one sale (11%). Callow [16]

Older classes of dairy beef cattle are generally sold through the traditional auction system. However in 1970 the first dairy beef yearling sale was held in Pukekohe and repeated in 1971. There was a yarding of 782 yearlings

in 1970 and 844 in 1971. All animals offered for sale were sold. Callow [17]

2.4.5 Growing and Finishing of Dairy Beef Calves

The estimated number of dairy calves retained for beef production rose from around 200,000 in 1967/68 to 460,000 in 1970/71, and in 1971/72 400,000 (see Table 2.4.1) were reared rather than slaughtered as bobbies despite the recent improvement in the dairy payout.

The majority of these calves are retained on dairy farms but an increasing number are being transferred to sheep farms either by sale through dairy weaner auctions, by contractual arrangements between individual dairy and sheep farmers, or by contractual arrangements with specialist calf rearers. As was noted in Section 2.2 these dairy breed animals retained for beef purposes are classified as beef cattle in the national statistics.

These calves will be grown and finished on dairy or sheep farms and slaughtered at 18-24 months of age before the second winter. (i.e. In an optimum finishing policy).

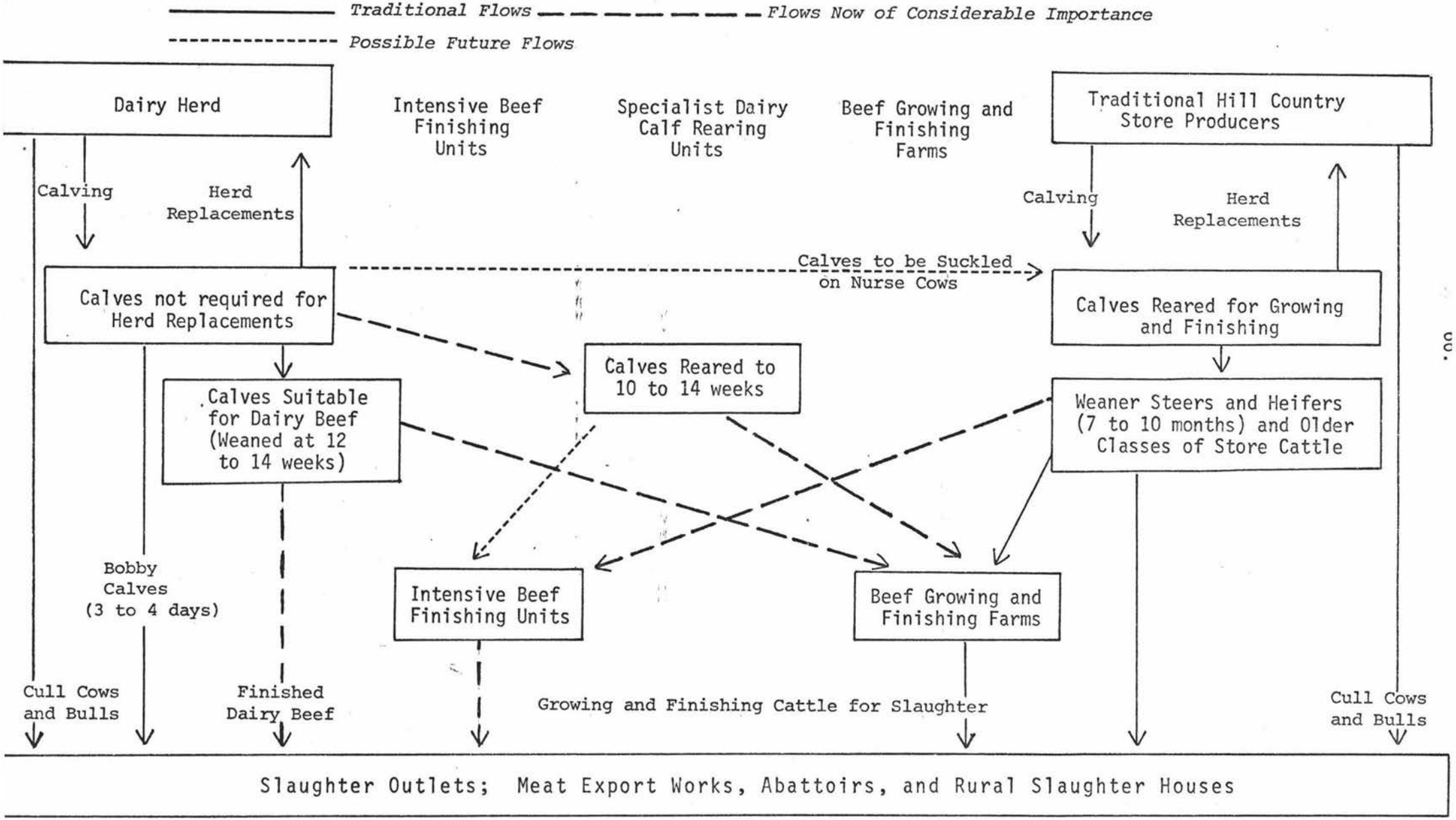
2.5 TRANSFER OF CATTLE BETWEEN SECTORS OF THE CATTLE INDUSTRY IN THE NORTH ISLAND

Figure 2.5 is a flow chart indicating the overall movement of store cattle and finished cattle to the point of slaughter in the North Island. As long as one does not attempt to classify all farms strictly according to the enterprises shown in the diagram, but allows that more than one enterprise may, and frequently does occur on a single farm (for instance the finishing of cattle for slaughter on hill country farms), then the flow diagram remains realistic in its representation of the actual situation.

The solid lines represent what were once considered the traditional flows of various classes of beef animals between the corresponding beef producing enterprises and final slaughter. The dashed lines represent the more recent innovations which have increased in their significance (i.e. magnitude) over the recent years.

Johnson [30] assessed the likely future trends in beef production,

Figure 2.5 Diagrammatic Representation of the Movement of Cattle in the North Island Cattle Industry to Slaughter



and considered that expansion in the beef industry would be at the maximum biological rate. Because the required supply of animals necessary to satisfy the increased demand for calves for growing and finishing enterprises could not be readily satisfied from the traditional breeding herd, the expansion, and continued expansion, therefore, of beef production in New Zealand is in fact largely determined by the extent to which the pool of surplus dairy stock is further mobilised. Owing to marked changes in dairy industry breeding practices, (see Table 2.4.3) with increased use of Friesian bulls and beef bulls, the number of surplus Friesian cross Jersey, Friesian calves and beef cross calves suitable for beef production have increased substantially. The dashed lines indicate recent flows which now have an important place in the total pattern of beef production in the North Island. The dotted lines on the other hand indicate flows which may assume importance in the future.

The solid lines trace the traditional flows of store cattle from traditional store producing farms to beef growing and finishing enterprises and the consequent flow of prime beef breed animals for slaughter in abattoirs and export works. A certain level of boner beef production, being aged breeding stock, will always be associated with prime beef production and with dairy production. Also dairy calves surplus to replacement requirements (and not suitable for beef production) are slaughtered as bobby calves at 2-3 days of age. The main bobby calf kill occurs from early July to late October.

The dashed lines represent flows which now have an important place in the total pattern of beef production in the North Island. This is the rearing of the calves from the dairy herd suitable for beef production to weaning age either on the dairy farm or on specialist calf rearing units. The weaned calves are either retained for growing and finishing on the dairy farm or passed over (which must occur with specialist calf rearing units) to growing and finishing enterprises. Two alternative dispositions of these surplus dairy calves which may become important in future years is traced in dotted lines. This is the transfer of surplus calves from the dairy farm to the store beef farm there to be multi-suckled on beef cows. This practice would probably be restricted to those farmers whose beef herd is of a high milk producing breed,

e.g. Friesian, a category of farmer virtually non-existent at present. A second alternative disposition is the transfer of dairy beef animals from specialist calf rearing units to intensive beef feed lot enterprises. Dairy calves suitable for such intensive beef feed lot operations would include Friesian cross Hereford, Simmental and Charolais calves. With the increased use of semen from beef and exotic beef breed bulls this may become a real possibility in the future.

The other recent change (dashed line) that now has an important place in the total pattern of beef production is the growing and finishing of traditional weaner steers on intensive beef feed lot operations.

The remainder of this study is concerned with price formation in the traditional store cattle market and the factors influencing the price of traditional store cattle. With reference to Figure 2.5 the area under study in later Chapters is primarily the transfer of store cattle from the traditional store producing enterprise to the beef growing and finishing enterprise or to an intensive beef feed lot operation. Store cattle are mainly from this traditional source.

Dairy beef weaner sales and price formation in this market are not considered. However, it is widely recognised that the level of the meat exporters' schedule price to producers is the most important determinant of stock prices in this market as in the traditional store cattle market.

As well as the store market facilitating transfer of store stock from breeding to growing and finishing units, it also facilitates the movement of classes of store cattle such as breeding cows, from one breeding unit to another.

Chapter 3 outlines the theoretical model which is the basis for inter-regional flows and price formation among spatially separated markets and outlines the model formulated to measure significant differences in observed store cattle prices.

CHAPTER THREE

THEORETICAL FRAMEWORK, SPECIFICATION OF STATISTICAL MODELS AND SOURCES OF DATA

INTRODUCTION

This Chapter describes the factors affecting the supply of, and demand for store cattle and discusses the concept of eqilibrium in spatially separated markets. The theoretical framework and development of an operational model for spatial price equilibrium analysis and its application to the North Island cattle industry is discussed. Finally a statistical model used to investigate the effect of the beef schedule price, class of store stock, region and seasonal conditions on store cattle prices and the data used in this model are outlined.

3.1 FACTORS AFFECTING SUPPLY OF, AND DEMAND FOR STORE CATTLE

The fundamental difference between agricultural marketing of New Zealand's products and those of producers in our major markets is that the price received by New Zealand producers is determined on world markets.

Over the last 10 years New Zealand has supplied less than 5% of total world beef exports [24]. Further, it is assumed that beef is a reasonably homogeneous product throughout the world. Hence, the export demand for New Zealand beef is postulated to be perfectly elastic. This implies that the world price of beef is exogenous to the system and that exports are determined, simply as the difference between total domestic supply and the demand at domestic prices. Figure 2.3.5 shows that the level of local wholesale prices for beef in Auckland is closely related to the export schedule price, and only in the winter early-spring period when there is low export killing is the price of beef on the domestic market determined by local supply and demand factors.

The demand for store cattle in New Zealand is essentially the derived demand for the intermediate product determined by the expected profitability of growing and finishing store cattle for prime beef. Thus in general the demand for store cattle is

governed by expected profitability and is highly elastic. The demand curve shifts according to the level of the beef schedule and traces out a pattern of prices. The export beef schedule acts as a demand curve shifter for the aggregate store cattle demand function.

Although the expected price of the processed beef product is a major determinant of the equilibrium market price for store cattle, other factors are important. These are :

(1) Current beef schedule prices both insofar as they affect the farmer's expectations of likely future price levels and long run prospects, and as they determine his expectations of revenue to be derived over the expected lifetime of the animals now held.

(2) Similarly, the expected prices for alternative products such as wool, lamb, mutton and milk products.

(3) The availability of feed on the farms of both vendors and purchasers.

(4) The availability of capital for long term investment in livestock, and the aversion of the farmer to debt. The importance of these factors arises from beef cattle representing generally a larger capital investment per stock unit than sheep, and hence a substitution of cattle for sheep requires a greater overall investment of capital in livestock. In addition there will usually be further capital costs for fence and yard modifications and water supply provision involved in a major increase in cattle numbers.

(5) The availability of seasonal credit, i.e. the ease with which farmers can finance their purchases of store cattle. The availability of seasonal credit or overdraft facilities is of course very important where a farmer's own liquidity position is poor. Cattle usually require a higher level of working capital per stock unit than sheep, as revenue only comes at one time of the year, while costs, especially the overheads which are a high proportion of total costs, are well spread.

(6) The current level of farm income. This effect is

amplified by the present system of progressive income tax, so that in a high profit year farmers are prepared to pay considerably more for cattle.

(7) The supply of store cattle is limited by the biological constraints placed on the rate of expansion of the beef herd, and is predetermined in any one year by husbandry decisions made in the previous year(s). That is, the supply is fixed and inelastic over an annual period, and is determined by the number of livestock in various categories in previous years - biological constraint.

Over the long term, although the supply is predetermined and remains inelastic it shifts over time. The supply curve will shift over time due to changes in technology. The supply is predetermined in any year and independent of price and is based on the past expectations of breeders. But in the short term - less than a year, supply is not predetermined because store cattle can be withheld from the market. For any month, supply is in fact very elastic as farmers can withhold stock. Thus supply is inelastic or elastic with respect to current beef prices depending on the length of the time period under consideration.

The supply of store cattle at a particular auction is independent of the price at that auction. But if the time period is a month, the average price for store cattle for the month is the aggregate of all sales in the month. The prices at a sale early in the month may influence the supply of store cattle for later sales in the month.

Therefore, whether in the short term the supply can be considered independent of current beef prices depends on the time period taken.

Although the supply of store stock may be predetermined and inelastic for any year the degree to which surplus dairy calves suitable for beef production can be mobilised means that the supply is not completely inelastic. But the supply of weaned calves suitable for dairy beef production is also fixed on an annual basis by dairy farmers' decisions about how many calves to

retain the previous year.

The supply of competing inputs will probably not be very elastic in the short term when considering other classes of cattle or other types of livestock.

(8) The supply of fixed labour or in the longer term where labour supply is not considered fixed, the price of labour. The reason for the importance of labour lies in beef cattle requiring less labour per acre than ewes and (to a lesser extent) wethers.

(9) Long term geographic factors that affect the supply of and demand for store cattle in a region. McLatchy [39]

(i) The stage of development and topography of the farm. Reference has already been made in Chapter 2 to the value of cattle as implements of development, especially for scrub and fern country. Their necessity for this purpose, which is strongly questioned by some, apparently lessens as development proceeds, and is confined to steeper country where tractors cannot be used. It should be noted, however, that while not necessary, it may still often be preferable to use cattle for crushing and 'opening up' purposes on flatter country. Furthermore the question as to whether or not cattle are technically necessary for development on some steep country is not really relevant. What is relevant in this context, is whether producers think they are necessary or desirable, and this point has not been seriously disputed.

(ii) The length of the winter period, as measured by the negligible or no-growth period. The winter feeding of cattle is rather more critical than that of sheep, and supplementary feeding is usually required for cattle first as the winter becomes more severe. On the grounds that higher wintering costs will reduce the relative profitability of cattle the longer and

more severe the winter, it is hypothesised that fewer cattle will be carried under such conditions.

(iii) The extent of summer rainfall. Cattle are more susceptible to drought than sheep, and a lower summer rainfall will in general mean less surplus mid-summer pasture growth than would otherwise be the case, although sharp short-term flushes will still occur with infrequent but heavy rains which typically occur in areas of low rainfall. In general the risks of running cattle are higher, and they will not be popular above a certain minimum essential level, in such areas (e.g. parts of Hawke's Bay).

(iv) The soil type. Some soil types which drain poorly become permanently very wet in the winter and pugging by cattle, especially heavier older cattle, can severely curtail subsequent pasture production. On such soils the net value of cattle tends to decrease as numbers carried increase.

(v) Local conditions particularly predisposing to some particular cattle or sheep disease, which in either case would favour the carrying of the other animal. For instance, the problem of grass staggers is a deterrent to the carrying of more cattle in some areas.

The geographical factors listed above tend to determine the long term supply and demand for store cattle in an area, whereas the expected schedule price for prime beef, expected alternative product prices, the availability of feed, and seasonal liquidity tend to be the short term determinants of the level of supply and demand in an area.

3.2 SPATIAL DISTRIBUTION OF THE STORE CATTLE MARKET

In Chapter 2 the store cattle market was described as a two tiered structure with the transfer of store cattle occurring from

predominantly store producing enterprises to growing and finishing enterprises (in different regions). This adds a spatial element to the store cattle market.

We therefore have a set of supply and demand curves for each region. The position of these curves depends in the long term on the comparative advantage each region has with regard to producing versus the growing and finishing of store cattle.

The supply of store cattle of a region is determined by the history of production of a region even in the short term. The supply curve is predetermined and inelastic on an annual basis.

In the short term the aggregate North Island demand for store cattle is determined by the expected profitability of finishing cattle based on the price of the export beef schedule. However within individual regions the demand curve may move according to the seasonal conditions of the region.

For instance, poor seasonal conditions in a predominantly store producing area may depress the price of store cattle by shifting the supply curve to the right. However, the actual impact of the poor seasonal conditions on the demand curve for this region will depend on the impact of the aggregate demand curve for the region which is made up of its own demand for store cattle and the demand from all the surrounding regions where store cattle may be transferred. If the surrounding regions are experiencing better seasonal conditions, then the aggregate demand curve for a store producing region experiencing poor seasonal conditions may also move towards the right and have a balancing effect.

3.3 EQUILIBRIUM AMONG SPATIALLY SEPARATED MARKETS

The general problem of equilibrium among spatially separated markets has been stated in one of its simplest forms by Enke [21].

"There are three (or more) regions trading a homogeneous good. Each region constitutes a single and distinct market. Each

possible pair of regions are separated but not isolated by a transportation cost per physical unit which is independent of volume. There are no legal restrictions to limit the actions of the profit-seeking traders in each region. For each region, the functions which relate local production and local use to local price are known and, consequently, the magnitude of the difference which will be exported or imported at each local price is also known. Given these trade functions and transportation costs we wish to determine :

(1) The net price in each region.
(2) The quantity of exports or imports for each region.
(3) Which regions import, export, or do nothing.
(4) The aggregate trade in each commodity.
(5) The volume and direction of trade between each possible pair of regions."

Given the general problem, Judge and Wallace [32] developed a spatial price equilibrium model for the beef sector of the United States economy. Their particular model followed that of Enke's except that the regional supply of beef, population and income were considered as predetermined variables, i.e. the optimum regional level and location of beef production is not considered and is taken as given for any point in time. Therefore, given the regional demand relationships and transport costs along with the existing values of the predetermined variables, Judge and Wallace's problem became one of ascertaining :

(1) A set of spatial equilibrium prices for beef and the quantities consumed in each region.
(2) The quantity of beef exported and imported from each region under the equilibrium conditions.
(3) The aggregate net trade and the corresponding total transport cost, and
(4) The volume and direction of trade between each possible pair of regions that will maximise net returns to each source and permit the geographical distribution of beef at a minimum transport cost.

In developing their spatial model, Judge and Wallace made the following restrictive and expository assumptions to simplify the model.

Perfect competition assumptions dictate the requirements for the regional pattern of prices and flows of the commodity. Therefore, each firm is assumed to have the objective of maximising profits and thus will make shipment decisions which yield the greatest per unit net return. The supply source and market for each geographical (defined) area is assumed to be represented by a fixed point. It is assumed that regional demands can be represented by known linear demand functions, and regional supplies are taken as predetermined for the given time period. All areas are connected by transport costs that are independent of the direction and volume of trade, and flows of beef among regions are assumed unhampered by governmental or other interference. It is assumed that consumers are indifferent as to sources of supply and that the product is homogeneous. The observed value of factors affecting regional consumption over and above the price of the commodity are taken as predetermined or given. Imports and exports of beef outside the United States are negligible and it is assumed for any time period, t, that total production and total consumption of beef are equal.

Obviously, both production and consumption of beef can take place in all regions and beef consumed out of local production does not require transporting since each region is represented by a point. Another obvious assumption, although required explicitly in a mathematical sense, is that there can be no negative shipments. It may also be observed that as a result of the profit maximising postulate there can be no cross-hauling of the product, deficit regions cannot export, and surplus regions can only export to deficit regions.

Judge and Wallace's model can be used to describe the spatial separation and inter-regional flow of cattle in the North Island.

The cattle industry of the North Island, New Zealand, consists of a two tiered structure with breeding on store producing hill country farms, in general, spatially separated from growing and finishing farms. Store cattle may be purchased by one of the methods outlined in Chapter 2 and transported by road or rail to growing and finishing farms in other regions (or the same region).

Classes of store cattle are assumed to be homogeneous with no variation in description within regions or between regions. All the assumptions implicit in Judge and Wallace's model are the same for the spatial equilibrium model postulated here for the North Island store cattle industry. Also there is no movement of store cattle from or to the South Island.

3.4 THE FORMAL MODEL

Given the postulates and the objectives, the problem can be divided for simplicity into three parts.

(1) A general solution for determining equilibrium store stock prices, the demand in each region, and also which regions are surplus or deficit regions in terms of their historical patterns of production of store stock.

(2) Deriving minimum cost flows of store stock among regions, and

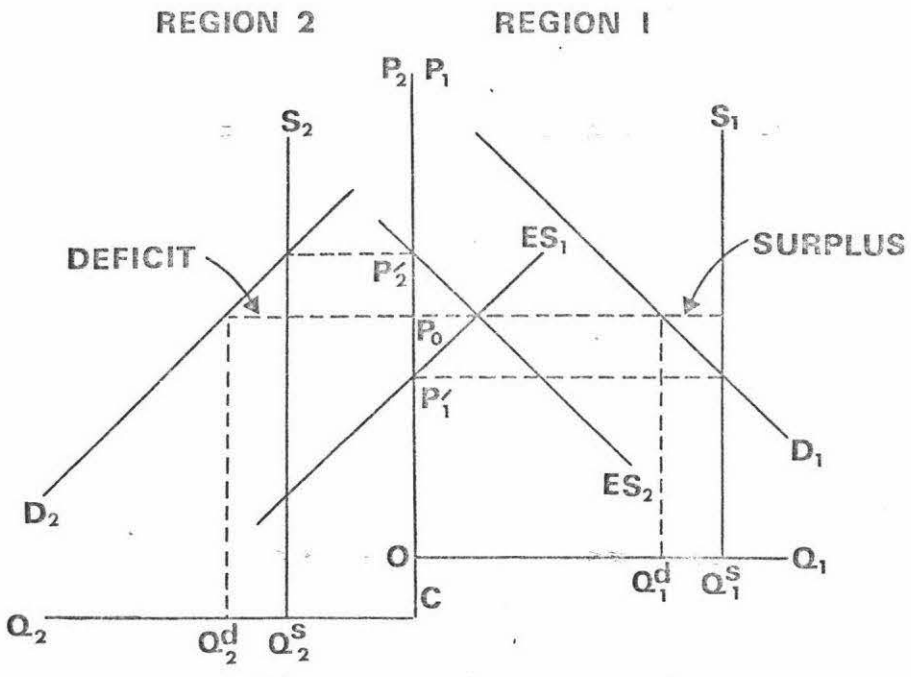
(3) Estimating objective regional price differentials and determining the final spatial price equilibrium solution that minimises the total transport costs.

Although the problem is divided into three parts for purposes of simplification, the determination of all unknowns is, of course, a mutually dependent process.

3.4.1 Determination of Regional Prices, Demand for Store Cattle by Growing and Finishing Units, and Determination of Regions Surplus and Deficit in Store Cattle.

The two-regional competitive case is presented since it can be easily diagrammed and provides the basis for the solution for the general case.

FIGURE 3.4.1 DETERMINATION OF EQUILIBRIUM PRICES, DEMAND, AND SURPLUS AND DEFICIT QUANTITIES FOR THE TWO-REGION CASE.



Source: Judge and Wallace

S_1 and S_2 represent the linear supply schedules for regions 1 and 2 respectively, and D_1 and D_2 are the corresponding linear demand schedules for store cattle for each region. Assuming no store cattle will be shipped, the equilibrium price would be at P'_1 and Q^S_1 would be the quantity of store cattle produced and finished in Region 1 while the price and quantity finished in Region 2 would be P'_2 and Q_2^S.

Now assuming that shipments between regions can occur at a unit transport cost of C, a joint equilibrium price would be established at price Po for Region 1 (determined by the intersection of ES_1 and ES_2, the excess supply curves for the two regions). The joint equilibrium price for Region 2 would be Po + C, Region 1 would finish the amount of store cattle Q^d_1 and would produce Q^S_1. Region 2 would finish Q^d_2 and would produce Q^S_2.

Thus, knowing the demand and supply schedules for Regions 1 and 2, the supplies for both regions, and the transport cost between the two regions, permits the determination of :

(1) the joint equilibrium prices and demand for store cattle for both regions,

(2) which region is a surplus or deficit store producing region with respect to demand in that region for store cattle for growing and finishing, and

(3) the number of store cattle that will be transported to satisfy the equilibrium condition.

Total transport costs may then be estimated by multiplying C times either $Q_2^d - Q^S_2$ or $Q_1^s - Q_1^d$.

Since C is known, solving the algebraic analogue of the geometric model for P_o, $P_o + C$ can be calculated and the supply and demand equations used to calculate regional demand for store cattle and supplies of store cattle.

Judge and Wallace generalised this two region case to N regions. For the two region case it should be noted that if the price differential $P_2^I - P_1^I$, is less than the cost of shipping between regions, there would be no movement of store cattle between the two regions. Also, if the store cattle price differential were equal to the unit transport cost between the two regions, either region would be indifferent to shipping store cattle.

3.4.2 Determining Minimum Cost Flows of Store Cattle and Equilibrium Prices Between Regions.

The problem of determining minimum cost flows of store

cattle between regions can be treated as a linear programming problem.

Regions are initially partitioned as being either surplus or deficit in their requirements of store cattle.

For any given period, regional supplies of store cattle, the number of farmers growing and finishing cattle in each region, the individual farmer's requirements of store cattle and hence the aggregate demand for store cattle within each region must be known. In Chapter 2 (Section 2.2) regions were ranked as being either surplus or deficit depending on the composition of the beef herd for the area. In particular by the number of breeding cows and 1-2 year steers and bulls in the national beef cattle statistics. The status of each region (surplus or deficit) was specified in Table 2.2.8.

Given information relative to the classification of each region, an approximate set of price differentials can be generated. (Regional price differentials are the price differences between store cattle prices in particular classes in different districts before any transfer of store cattle has occurred. They are not the regional equilibrium prices.) An approximate set of price differentials can be generated by employing the following rules :

(1) If one region ships to another, the prices must differ by the known unit transport cost for store cattle, and

(2) If two surplus regions ship to the same deficit region, the difference between prices in the surplus regions will be equal to the difference between their unit transport costs to the deficit region. Thus, the system involves a structure of regional prices bound together by specific transport costs. The approximate regional price differentials may then be used to

determine the equilibrium regional prices. These regional equilibrium prices are used to solve the transportation problem and ascertain the optimum geographical flows of store cattle.

However, the solution of the linear programming problem implicitly places values on the various inputs and outputs involved. Therefore, with the aid of the duality theorem of linear programming a unique set of price differentials may be derived which corresponds to the equilibrium set of flows. These may be used to check the approximate regional price differentials of the initial formulation. The equilibrium prices and flows of store cattle thus obtained are those that will maximise net returns to each source.

Thus the linear programming transportation model may be used to determine the optimum distribution system. The resulting minimum cost set of flows is the one that would be determined under conditions of perfect competition. This conclusion follows since the equilibrium prices are tied together by a specific set of transport costs and the relevant transport costs, used in obtaining the optimum set of flows, are less than for every possible alternative delivery which is not made. The solution obtained will be unique except for the case where two or more sources find two markets equally profitable. In this case, of course, more than one optimum shipment plan exists.

3.5 FORMULATION OF AN OPERATIONAL SPATIAL PRICE EQUILIBRIUM MODEL OF THE NORTH ISLAND STORE CATTLE INDUSTRY.

In order to convert the conceptual framework into an operational model, real world counterparts must be defined and the data used to reflect the variables must be specified. In converting the formal model to a reflection of the real world situation the area under study is divided into meaningful geographical units or regions, see Figure 2.2.2 and Table 2.2.1. Then for each region, the model specifies a need for the following data :

(1) Factors affecting the demand for store cattle and consequently the regional demand relationships for

store cattle,

(2) Observed values of the predetermined variable - regional supply of store cattle, and

(3) A matrix of transportation rates between all possible pairs of regions.

Present data limitations make it impossible to investigate the spatial nature of the North Island store cattle industry in the linear programming framework used by Judge and Wallace and others. The data necessary to estimate supply and demand relationships for store cattle within each region are not available.

Supply of store cattle in aggregate for the North Island can be estimated through a stock reconciliation model. However, at the regional level, supplies of different classes of store cattle are not known. Estimates of calving percentage for individual regions are not known and the presence of dairy beef animals makes it difficult to estimate how many steers and heifers in the national beef statistics are from the beef herd. For older classes of store cattle, because regional slaughtering statistics are not available by counties it is not possible to estimate how many in each region were born there, and how many were purchased in other regions and transferred at a later date. Therefore it is not possible to ascertain the supply of store cattle of a region for cattle older than calves as we do not have regional slaughtering statistics.

Similarly changes in the quantity of store cattle demanded by any district are also difficult to estimate. Slaughter statistics of cattle do not necessarily supply information on cattle reared in that locality in the past because cattle are drawn for slaughter from several regions. Also slaughterings are not broken down into age groups, but are simply classified as"steers and heifers".

Inter-regional flows of store cattle, essential for comparison with the optimum flows generated by the model are not available. All we know is that inter-regional movements of store cattle occur, but these flows have never been quantified. However, it can be assumed from economic theory that the regional equilibrium price in a region occurs at a point where demand in that region is satisfied, i.e. the quantity demanded and supplied are in equilibrium

at the equilibrium price.

Therefore, though a structural model, incorporating estimated quantities supplied and demanded in each region cannot be formulated it is still possible to achieve the objectives of this study by analysing market prices for different classes of store stock within a regional framework. In theory, equilibrium prices will be such that price correcting flows of store cattle will take place between regions. If observed market prices in different markets for store cattle vary by more than the observed transport costs between markets then spatial equilibrium is not reached in the North Island store cattle market or other factors may be causing such differences.

Section 3.6 sets out a model to measure significant differences in observed store cattle prices in the North Island store cattle market.

In summary the inter-regional model estimated by Judge and Wallace provides equilibrium prices and flows that can be compared with the actual prices and flows. In the statistical model postulated in Section 3.6 we do not have flows but we can (conceptually) compare prices of store cattle in different regions.

3.6 THE STATISTICAL MODEL

Of the factors influencing the price of store cattle we have included in this analysis, beef schedule price, seasonal conditions, class of store cattle and region of origin.

In Chapters 4 and 5 a statistical model is used to investigate the effect of beef schedule price, seasonal conditions, class of store cattle, and region on store cattle price.

The model is similar to that used by Matheson and Philpott [36] to estimate the regional pattern of demand for meat in the United Kingdom in 1967.

3.6.1 Specification of the Model

It is postulated that movements in store cattle prices in the North Island of New Zealand can be explained by the following functional relationship. The model is estimated

on an annual basis, with a separate model for autumn and spring, the two periods when the main store stock sales occur.

$$P_{krt} = f(C_k, R_r, W_{frt}, S_t)$$

Where:

P_{krt} = the store stock price in dollars per head for the k^{th} class of stock, in the r^{th} region, for the year t.

C_k is a class dummy variable
= 1 for class k; = 0 elsewhere.

R_r is a regional dummy variable
= 1 for region r; = 0 elsewhere.

W_{frt} is a seasonal dummy variable and takes the following values;
f = 0 for poor seasonal conditions
f = 1 for average seasonal conditions
f = 2 for good seasonal conditions

S_t = beef schedule price, OxGAQ, for the top weight grade, in the year t.

and k = 1.... 8 in Autumn and 1 .... 9 in Spring
r = 1.... 8 in Autumn and Spring
t = 1....16

Such a model will thus explain changes in all store stock prices in the period concerned (1957-1972) according to changes in the beef schedule for finished cattle with systematic measurement of the differences in store stock prices due to class of stock, region of origin, quality of stock, and availability of feed.

In particular it should be possible to estimate the regional component of all store stock prices at a given time of year and to test whether such differences conform to expectations laid down by spatial equilibrium analysis.

3.7 STORE CATTLE PRICES AND OTHER DATA

To explore the regional nature of the store cattle market it is necessary to have price series from several sale centres or "regions". The Department of Lands and Survey maintains a suitable series of average stock prices ruling in various centres. Returns cover the two main sale periods for store cattle discussed in Chapter 2, namely :

(a) Autumn (April - May)
(b) Spring (August - September - October)

The cattle prices are assembled by regional officers from any recognised authorities in the district willing to co-operate, such as, stock firms, auctioneers, other Government Departments and persons specialising in livestock values.

The value recorded for each class of livestock is a fair value of the average line for the period above in Autumn or Spring and not an arithmetic average of values over a number of lines of livestock in a particular class.

The price is representative of the bulk of the livestock sold. A single figure is fixed for each class and not a range of prices, and the figure is the gross sale price before costs such as commission are deducted. In general though the prices are representative prices from the main sale centre for each class of stock.

3.7.1 Regional Demarcation

Stock prices are collected by Lands and Survey Officers from eight sale centres in the North Island and returns forwarded to the Department of Lands and Survey in Wellington twice a year. For the purpose of this study, this data has specified the regional distribution of prices available for this analysis.

	Sale Centre	Region
(1)	Whangarei	North Auckland
(2)	Te Kuiti	Te Kuiti
(3)	Rotorua	Rotorua
(4)	New Plymouth	Taranaki

	Sale Centre	Region
(5)	Gisborne	East Coast
(6)	Hastings	Hawke's Bay
(7)	Palmerston North	Manawatu
(8)	Masterton	Wairarapa

The store stock prices collected at each of these sale centres are assumed to be representative of prices for classes of livestock in that region in either Autumn or Spring over the period concerned.

In terms of the statistical areas used by the Department of Statistics in Figure 2.2.2, the sale centres in each region generally coincide with the Department of Statistics statistical areas. In fact, except for the central Auckland area, which has less dairy cattle (apart from the East Coast) and beef cattle than any other statistical area, the sale centres above are reasonably distributed over the whole of the North Island as indicated In Figure 3.7.1.

In Table 2.2.8 the regions specified are defined as being either surplus or deficit in their requirements for store cattle.

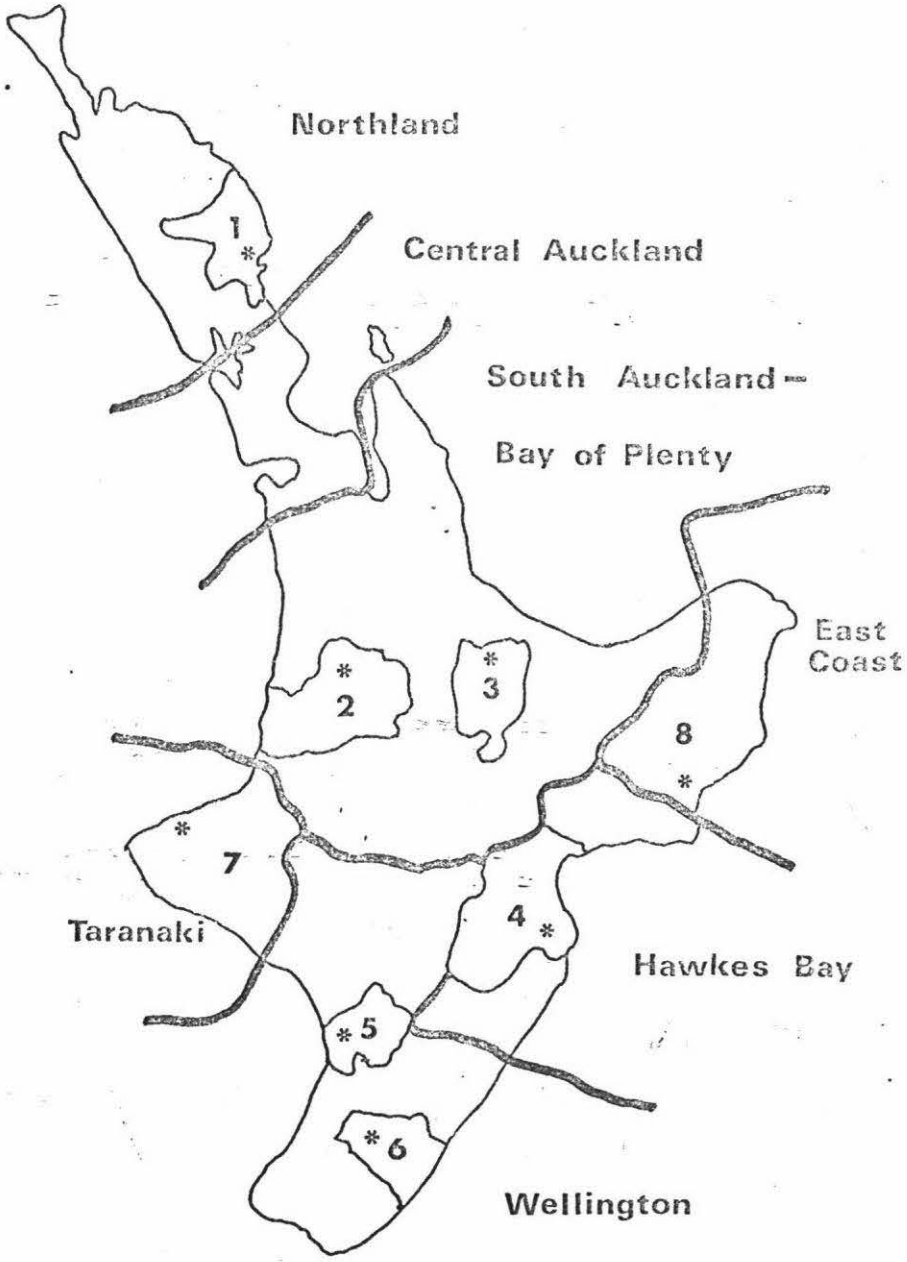
3.7.2 Classes of Stock

Store stock prices received by the Lands and Survey Department each Autumn and Spring contain several classes of store cattle.

In Autumn the classes of cattle used for this analysis were :

(1) Good Weaner Heifers
(2) Breeding Cows
(3) Cull Cows
(4) Good Weaner Steers
(5) Medium Weaner Steers
(6) 18-month Steers
(7) 2½-year Steers
(8) Store Bullocks

FIGURE 3.7.1 SALE CENTRES AND REGIONS IN THE NORTH ISLAND USED IN THE SPATIAL ANALYSIS OF STORE CATTLE PRICES.



COUNTIES:

1. WHANGAREI
2. OTOROHANGA and WAITOMO
3. ROTORUA
4. HAWKE'S BAY and WAIPAWA
5. OROUA, MANAWATU and KAIRANGA
6. MASTERTON and WAIRARAPA SOUTH

SALE CENTRES

1. WHANGAREI
2. TE KUITI
3. ROTORUA
4. HASTINGS
5. PALMERSTON NORTH
6. MASTERTON
7. NEW PLYMOUTH
8. GISBORNE

(Position of sale centre denoted by asterisk)

Weaner heifers and weaner steers are 6-8 months old weaned calves from traditional beef herds. Store bullocks, on the other hand, are cattle in store condition over three years old. Similarly 18 month and 2½ year steers are steers in store condition. There are no classes of cattle in a forward store or finished condition.

In Spring, classes of cattle are approximately six months older. Their classification will vary from those in Autumn, and prices for a similar class six months older will be correspondingly higher, other things being equal.

In Spring the classes of store cattle used in the analysis were :

(1) Good Yearling Heifers
(2) Good 2-year Dry Heifers
(3) Breeding Cows In-Calf
(4) Breeding Cows Empty
(5) Good Yearling Steers
(6) Medium Yearling Steers
(7) 2-year Steers
(8) 3-year Steers
(9) Store Bullocks

Store stock prices used in the analysis are set out in Appendix III.

3.7.3 Seasonal Conditions

Seasonal feed conditions affect the price paid for store cattle. Appendix II sets out the seasonal weather conditions for each region, each year in Autumn and Spring.

The seasonal index reflects the seasonal weather conditions and feed availability in each region within one of the following three classifications for the Autumn period over the two months, April and May, and for the Spring period, over the three months, August, September and October.

The three seasonal classifications are :

(1) Poor
(2) Average
(3) Good

Poor conditions were said to exist when the seasonal growth was below normal and in particular when drought conditions prevailed.

Average conditions represent normal seasonal growth patterns whereas good conditions typify seasons where growth is excellent and prospects are for this to continue.

Three sources of information were used to classify the weather and seasonal growth conditions in each region.

(1) Meat and Wool Board's Economic Service, Annual Review of the Sheep Industry - Seasonal conditions and District Reports [7].
(2) The New Zealand Year Book - Annual Review of New Zealand's Climatic Conditions [3].
(3) The Annual Report of the Ministry of Agriculture and Fisheries - Weather and Pasture Report [9].

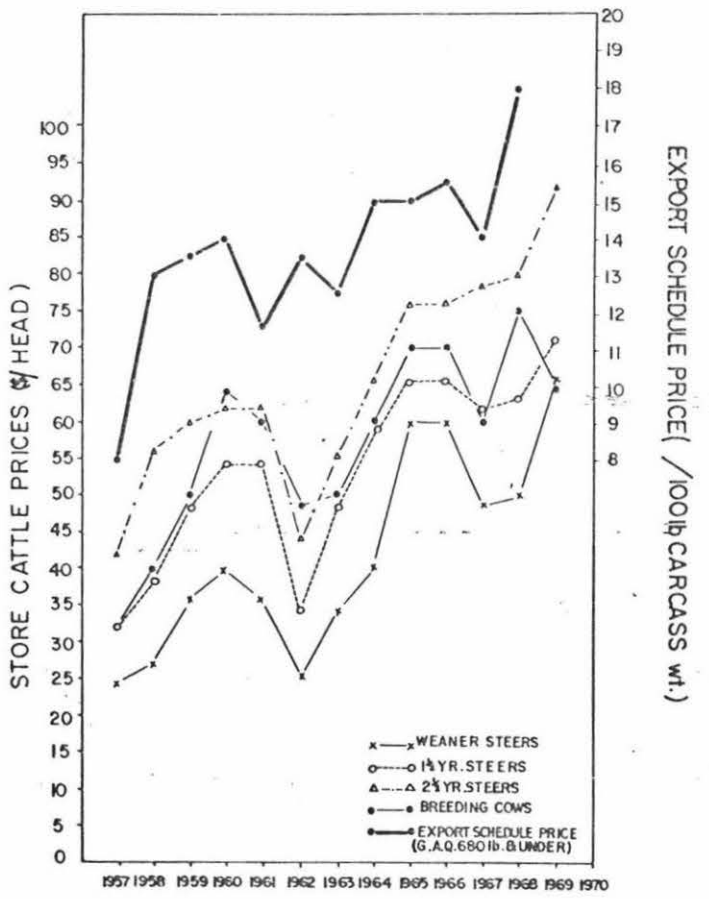
3.7.4 Export Beef Schedule Prices to Producers

The South Auckland Beef Development Committee [44] assembled information on beef schedule prices and replacement costs for the years 1957-1969 and this information is presented in Figure 3.7.4. The comment is made in this publication that "store cattle prices fluctuate from year to year but are closely associated with the beef carcass export schedule prices".

A farmer's expectations about future profitability are based on the current schedule prices. Therefore, by using the current schedule price as a determinant of current store prices we are postulating a naive expectation model.

This assumption is supported by several studies in the United States. For instance, Trierweiler and Hassler [48] found that prices paid for store cattle are not based on expected future slaughter price, but rather on the existing slaughter price at the time of the store cattle purchase.

FIGURE 3.7.4 RELATIONSHIP BETWEEN STORE CATTLE PRICES AND THE EXPORT BEEF SCHEDULE Ox GAQ ($/100 lb)



Source: South Auckland Beef Development Committee

The export beef schedule price for Autumn is the average of the mid-month schedule prices for April and May, and in the Spring the average of the mid-month schedule prices for September, October and November. The beef schedule values used, top weight grade OxGAQ, are in Appendix I.

3.7.5 Use of Dummy Variables

Zero-one or dummy variables are used in regression analysis when time series data can be divided into distinct classes. Tomek [47] argues that a condition that must be satisfied before dummy variables can appropriately be used in regression analysis is that the original observations can be logically divided into mutually exclusive classes.

Unless dummy variables are applied with care, their introduction into the regression equation can result in an indeterminate solution for the regression coefficients. There are several alternative approaches to this problem. Each involves some restriction on the regression coefficients (B_j's) associated with the zero-one variables. In each case, the consequence of the restriction is to remove the perfect intercorrelation among the variables.

The most common procedure (restriction) is to set one of the B_j equal to zero. When interpreting the results, the constant B_o, represents the intercept for the class omitted. The other B_j associated with zero-one variables indicate the deviations of the class intercepts from this base. That is, the class effect of the particular B_j set equal to zero appears in the constant term.

Use of Dummy Variables for the Autumn Model

1. Class Dummy Variables
   Store cattle are separated into eight mutually exclusive classes. The base class omitted is good weaner heifers.
2. Regional Dummy Variables
   The North Island is divided into eight sale centres. The base region is North Auckland with sale centre Whangarei.

3. Seasonal Dummy Variables

Although seasonal conditions could be quantified and related to beef cattle numbers using rainfall or soil moisture data as an index ([37]), it was considered that this degree of accuracy was unnecessary, and that a "quality" index would be sufficient to encompass the overall effect of the seasonal feed conditions on store cattle prices. Therefore for each region ($r = 1.... 8$), for each year ($t = 1.... 16$), seasonal feed conditions were ranked either poor, average or good. For W_{frt} specified before, W_f takes on the values;

W_0 for poor seasonal conditions
W_1 for average seasonal conditions
W_2 for good seasonal conditions

Therefore in zero-one nomenclature the seasonal dummy variables are : where W_0 is the base class omitted.

	W_{1rt}	W_{2rt}
Poor	0	0
Average	1	0
Good	0	1

The seasonal feed conditions are outlined in Appendix II.

3.8 ASSUMPTIONS UNDERLYING THE NORTH ISLAND STATISTICAL MODEL

1. That the seasonal conditions poor, average and good have the same effect on store cattle prices in all regions and for all classes of store cattle.

2. That the export beef schedule return to producers (Ox GAQ) has the same effect on the price of all classes of store cattle in all regions.

3. That the regional effect on store cattle prices is the same for all classes in a particular region.

The model formulated in Section 3.6 to measure significant differences in observed store cattle prices was estimated using linear regression [31]. The results are discussed in Chapter 4.

CHAPTER FOUR

REGRESSION ANALYSIS RESULTS

INTRODUCTION

The functional relationship described in Chapter 3, Section 3.8 namely :

$P_{krt} = f(C_k, R_r, W_{frt}, S_t)$

was estimated using multiple regression analysis. Consistent estimates of the regression coefficients were obtained using O.L.S. (ordinary Least squares technique).

4.1 RESULTS

The results of the regression analysis are in Table 4.1. The figures in parenthesis are the standard errors of the estimated coefficients.

4.1.1 Significance Tests on Individual Regression Coefficients

The Students - t distribution tests the hypothesis that the individual regression coefficients are significantly different from zero. The Null hypothesis under test in each case is that the coefficients are zero.

If the absolute value of t is greater than the appropriate critical value e.g. at the 5% or 1% limit of the t-distribution, the hypothesis under test is rejected. All but one of the regression coefficients are significantly different from zero at the 1% significance level, and that one is significant at the 5% level. The Durbin Watson, D.W., d-statistic and the multiple regression coefficient, R^2, in Table 4.1 are discussed later in Sections 4.1.3 and 4.1.4 respectively.

4.1.2 Tests on Subgroups of Variables

Analysis of variance tests the contribution to the regression sum of squares of subgroups of variables, i.e. a joint test of the significance of a subgroup of several coefficients. In particular, we wish to know whether the following subgroups of variables make statistically significant contributions to the regression sum of squares :

TABLE 4.1

REGRESSION ANALYSIS RESULTS NORTH ISLAND - STORE CATTLE PRICES

AUTUMN (PER HEAD)

		COEFFICIENTS OF CLASS DEVIATIONS FROM GOOD WEANER HEIFERS								COEFFICIENTS OF REGIONAL DEVIATIONS FROM NORTH AUCKLAND						
P *KRT	=	CONSTANT	COWS BREEDING	COWS CULL	WEANER STEERS GOOD	WEANER STEERS MEDIUM	18 MONTH STEERS	$2\frac{1}{2}$ MONTH STEERS	STORE BULLOCKS	TE KUITI	ROTORUA	TARANAKI	EAST COAST	HAWKES BAY	MANAWATU	WAIRARAPA
		-32.04 (1.45) **	27.75 (1.02) **	11.45 (1.02) **	9.84 (1.02) **	2.13 (1.02) **	23.60 (1.02) **	36.96 (1.02) **	45.41 (1.02) **	3.06 (1.02) *	9.35 (1.02) **	2.25 (1.02) *	8.76 (1.02) **	6.78 (1.02) **	9.28 (1.02) **	7.34 (1.02) **

COEFFS OF SEASONAL DEVIATIONS FROM POOR SEASON					
AVERAGE	GOOD	OX GAQ SCHEDULE	R^2	D.W.	
3.44 (0.64) **	10.82 (0.67) **	3.76 (0.06) **	0.89	1.4789	

NOTES: STANDARD ERRORS ARE GIVEN IN BRACKETS

* INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 5% LEVEL

** INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 1% LEVEL

(1) Class Dummy Variables

(2) Regional Dummy Variables

(3) Seasonal Dummy Variables

Table 4.1.2 sets out the results of the Analysis of Variance and indicates that the subgroups of coefficients for class, region, and seasonal conditions all contribute to the regression sum of squares, i.e. influence store price determination.

The results also indicate that the model as a whole explains a significant proportion of the variation in store cattle prices.

TABLE 4.1.2 ANALYSIS OF VARIANCE - NORTH ISLAND

Source of Variation	D.F.	Sum of Squares	Mean Sum of Squares	Level of Significance of the F statistic
Intercept	1	3 394 345	3 394 345	
Class C_2-C_8	7	243 328	34 761	1%
Region R_2-R_8	7	8 857	1 265	1%
Weather W_1, W_2	2	40 738	20 369	1%
Schedule	1	277 413	277 413	1%
(Total due to Class Schedule	17	570 338	33 549	1%)
Residual	1006	67 121	66.72	

4.1.3 Analysis of the Regression Coefficients in Table 4.1

The Intercept

It was hypothesised that the sign of the intercept would be negative. This is confirmed by the results. The negative sign is consistent with the theory that the purchase price of a store cattle beast may be partitioned into two parts :

(a) A part which will be independent of the current beef schedule - exogenous, and represents the cost of rearing a calf to weaning age.

(b) A part which will bear a direct relationship to

> the current beef schedule price - endogenous, and its value is determined by the system being estimated. Lattimore [34]

In a simple model which relates store cattle price to the schedule, one would expect the intercept term to be negative. The independent (exogenous) component of the store cattle price is incorporated in the intercept coefficient and it requires a positive schedule price sufficient to recover the rearing costs before store cattle prices will be positive.

In our formulation a positive store cattle price only requires the aggregate effect of all the coefficients to be positive, but in general, for this to occur requires a positive schedule price.

Class Coefficients

It was hypothesised that the class coefficient good weaner heifers, set equal to zero, would have the lowest value and that the coefficients of all the other classes of stock would be positive in value in relation to this coefficient.

The class coefficients in Table 4.1 are all positive indicating that the prior hypothesis regarding the sign of the coefficients was correct.

Also it was expected that as store cattle become older (and heavier) the magnitude of the class coefficients would increase. The values of the class coefficients show that this is true.

The t-test (indicated by the asterisks in Table 4.1) shows that all the class coefficients are significantly different from zero. However, we now wish to test the hypothesis that the class coefficients are significantly different from each other.

The Least Significant Difference test, L.S.D. test, using the t-statistic requires the difference between adjacent coefficients to accept the alternate hypothesis that they are significantly different from each other to be;
2.83 at the 5% significance level, and
3.72 at the 1% significance level. (Paterson [42])

(The dummy variable formulation used in the analysis results in the pooled standard error being the same for all pairs of class coefficients tested.)

Applying the above test the coefficients for all classes of store cattle are significantly different from each other at the 1% level, except good weaner steers and cull breeding cows which is of no practical importance in this study.

With the effect of the beef schedule held constant, for all classes of cattle in all regions, these coefficients reflect changes in the age (and weight) of different classes of cattle by shifts in the position of the intercept term.

The coefficient for breeding cows of 27.75 incorporates the value of future breeding potential, whereas cull cows are sold for their meat content only.

The difference between the coefficients for good and medium weaner steers shows that a premium of $7.71 per head exists for good weaner steers.

The relationship between good weaner heifers and medium weaner steers is discussed later in this Chapter.

The remaining coefficients for classes of steers indicate that the older and heavier an animal, the greater the class coefficient.

Regional Coefficients

A hypothesis we wish to test with the model formulated is that the observed store cattle prices do not differ significantly between regions.

The store cattle industry is spatially separated by transport differentials between regions. Testing the hypothesis that the observed store cattle prices are not significantly different from each other will show whether a spatial price separation of the store cattle market exists. However, even if the store cattle prices in different regions are statistically different (the alternate hypothesis) it is only by comparing the observed store cattle prices in these

regions with the transport differentials separating them, that we can ascertain whether present flows of store cattle are the equilibrium flows. This is done in Chapter 6.

Those regions having an absolute advantage for breeding store cattle are expected to have lower observed prices than those regions which have a comparative advantage for finishing rather than for breeding store cattle.

The surplus store producing regions (East Coast, Te Kuiti and the Wairarapa) are expected to have lower regional coefficients than the surrounding growing and finishing regions.

The F-test statistic in Table 4.1.2 indicates that the subgroup of regional dummy variables contribute significantly (at the 1% level) to the regression sum of squares in explaining store cattle prices, i.e. a regional component exists in explaining store cattle prices.

North Auckland was chosen as the base region. North Auckland does not have an absolute advantage over other districts either for producing or finishing store cattle. The regional coefficient for Taranaki, a predominantly dairy and steep hill country farming region was expected to be of similar value to the base region.

Use of Duncan's Multiple Range Test [20]

When testing the significance of differences between a set of coefficients, the null hypothesis is that the coefficients come from the same distribution. That is given more than two coefficients ranked by size, the rank numbers of any pair of coefficients gives some indication of the expected difference between the coefficients. The Larger the in rank numbers the larger the expected difference in coefficient values. Thus it would be inappropriate to test all pairs of coefficients in the ranked order with the same significant difference test. Duncan's Multiple Range Test takes account of the difference in rank number by giving a weighting to the standard error of the coefficients for testing the difference between them. This weighting factor

is equivalent to the t-test for comparing adjacent pairs in the rank order.

The data necessary to perform this test are :

(a) The regression coefficients shown in Table 4.1,
(b) The standard errors of these coefficients, and
(c) The degrees of freedom on which these standard errors are based.

Significant studentized ranges are extracted from Duncan's Table for the appropriate degrees of freedom (infinity in this case). The significant studentized ranges for a test at a 5% level of significance are extracted for samples of sizes, p = 2, 3, 4, 5, 6, 7, 8 (because there are 8 regions). The values obtained in this way are 2.77, 2.92, 3.02, 3.09, 3.15, 3.19 and 3.23 respectively. The significant studentized ranges are then each multiplied by the appropriate standard error to form what may be called the "shortest significant ranges".

We now set out to test the differences in the following order : the largest minus the smallest, up to the largest minus the second largest, then the second largest minus the second smallest, and so on, finishing with the second smallest minus the smallest.

Each difference is significant if it exceeds the corresponding shortest significant range; otherwise it is not significant.

The regional coefficients were ranked in ascending order to ascertain whether significant differences exist between store cattle prices in each region.

Regional coefficients in ascending order

(North Auckland	Taranaki	Te Kuiti	Hawke's Bay	Wairarapa	East Coast	Mana-watu	Rotorua
0.00)	2.25	3.06	6.78	7.34	8.76	9.28	9.35
	a	a	b	b	b	b	b

The coefficients with the same Duncan's letter are not significantly different at the 5% level.

The above results, with reference to Figure 3.7.1 indicate that regions in the centre and lower half of the North Island are statistically different from those in the upper half - namely North Auckland, Te Kuiti and Taranaki.

This suggests that there are two distinct store cattle markets in the North Island. In the upper half of the North Island, Te Kuiti is a surplus store producing region supplying cattle to the Central Auckland and South Auckland areas.

The other market group is Rotorua, the East Coast, Hawkes Bay, Wairarapa and the Manawatu. The East Coast and the Wairarapa are net suppliers of store cattle to the surrounding regions.

One would expect that Rotorua would purchase store cattle from Te Kuiti as well as from the East Coast region which would suggest that the coefficient for Rotorua, with a supply of store cattle at Te Kuiti, should have a lower coefficient than 9.35 (compared with Northland). The high regional coefficient may occur for a number of reasons.

In Chapter 2, Section 2.2 Rotorua is defined as a deficit store producing area because store cattle produced on Lands and Survey farm blocks do not enter the market. McCaw [38] suggests that the store cattle in the region are below average quality; light framed with a dry unattractive coat, but the demand in the region ensures that the prices paid are higher than for cattle of similar quality in other regions. However, the prices for store cattle should be lower than good quality cattle in other regions.

Also, the geographical location of the Ngongataha saleyards, the main saleyard in the area, is conveniently situated close to surrounding areas. The locality of the sale point may result in the price of store cattle being at a premium.

In Chapter 2 the East Coast, Te Kuiti and the Wairarapa are defined as surplus store producing regions. It was expected that their regional coefficients would be less than the surrounding growing and finishing regions, and if

the observed store cattle prices are the equilibrium market price then the prices in each region may be separated only by transport costs. Results of Duncan's Test indicate that the regional coefficients for the East Coast and the Wairarapa are not significantly different from the surrounding growing and finishing regions. This suggests that either cattle are not transported in any great quantity between regions or that factors other than transport costs determine the level of store stock prices among regions.

The high regional coefficients of the store producing regions compared with those of the surrounding store finishing regions (in the case of the East Coast and Wairarapa) contrary to expectations raises the possibility of quality and descriptive differences between classes of store cattle among regions. For instance, the price paid for a weaner steer in Gisborne may be higher on a per head basis, but on a per pound basis it may be less than that paid in a finishing region such as the Manawatu because of quality differences.

Therefore we are trying to compare store cattle prices in different regions where the quality and description of a particular class of store cattle may vary. A prior assumption of this analysis was that the description of classes of store cattle was the same in all regions.

In Chapter 5 the assumption that the quality and description of classes of store cattle is the same in all regions is relaxed so that regional differences between store cattle, that do not exist on a per head basis, may exist on a per unit liveweight basis.

In Chapter 6 the observed store cattle prices and transport costs between selected pairs of regions are compared with each other for particular years to determine whether the observed store cattle prices are the equilibrium market prices. The above analysis "averages" the regional effect over the whole sixteen years of the analysis. However the regions defined as surplus were store producing regions for the whole period of the analysis.

Seasonal Coefficients

The signs of the seasonal coefficients are positive indicating that the effect of an average season and a good season in all regions is positive compared with the base weather coefficient poor. The F-test in Table 4.1.2 shows that the subgroup of weather variables contributes significantly to the regression sum of squares and therefore to the formation of store cattle prices. The weather coefficients are significantly different from each other at the 1% significance level. In Section 4.2.1 the effect of the seasonal conditions in individual regions is discussed.

Beef Schedule Coefficient

The beef schedule price is the only true quantitative variable of all the independent variables. The other variables are dummy variables and only shift the intercept term up or down. The beef schedule coefficient indicates that for every unit or one dollar change (per 100 lb carcase weight) in the OxGAQ beef schedule there will be a $3.76 change in the average price paid per head liveweight for all store cattle in all regions.

4.1.4 The Durbin-Watson, d Statistic Hannan [26]

When the number of observations exceeds 100 and the number of variables exceeds six, the Durbin-Watson d-Statistic approximates an F-test with 1, n-2 degrees of freedom.

The 'd' statistic 1.4789, using the above approximation, indicates that positive autocorrelation of the error terms exists at the 1% significance level. Positive auto-correlation may arises for a number of reasons :

(1) If any relevant explanatory variables are omitted from the relationship. This is simply a consequence of the fact that the fluctuations which otherwise would have been described by the omitted variable(s) are taken up by the error component of the postulated relationship. The omission of relevant explanatory variables such as the level of farmers' income and the availability of credit could have contributed to

positive autocorrelation in this case.

(2) Incorrect specification of the model.

(3) The error terms may also contain a component due to measurement error in the "explained", or dependent variable. This too may be a source of serial correlation in the composite disturbance. It is likely that autocorrelation has also been caused by a measurement error in the "explained" variable, i.e. price of store cattle. The store cattle prices in the analysis are not taken from actual sales but are an average for the region and may be influenced by the reporters' assessment of the general movement in store cattle prices compared with the previous year. Also the reporter tends to maintain a similar margin between classes of store cattle that existed in the past.

Consequence of Autocorrelated Disturbances

Provided that the disturbances retain their other properties, particularly that of homoscedasticity, then application of O.L.S. in the presence of serial correlation yields unbiased regression coefficients. However the estimates of the variance of the coefficients and of the variance of the errors (i.e. the square of the standard error of the estimate for the relationship) will be biased downwards. Thus the t-values for the estimated coefficients are overstated. Also there is some loss in efficiency in estimation and in prediction with the estimated relationship.

No attempt has been made to estimate the autocorrelation coefficients and then to re-estimate the relationship under study. Therefore caution must be taken in interpreting the coefficients estimated, especially the predictive value of the relationship.

4.1.5 Multiple Regression Coefficient, R^2

The high R^2 value, 0.89, shows that a very high proportion of the variance in store cattle prices was explained by the model.

This, combined with the fact that all of the regression coefficients have the expected signs and were significantly different from zero, suggests that a high degree of confidence maybe placed on the model's ability to isolate the determinants of cattle prices and to estimate the associated market parameters. However, the presence of autocorrelation needs to be noted when interpreting the coefficients estimated, especially the predictive value of the relationship.

4.2 ANALYSIS OF INDIVIDUAL REGIONS AND CLASSES OF STORE CATTLE

The assumptions underlying the aggregate North Island model are relaxed to test the hypotheses :

(1) That class and the beef schedule have different effects in each region, and

(2) That region and the beef schedule have different effects on each class

Using the same data as in the North Island Autumn model, the following models were estimated.

(1) For each region, where r = 1 ...8, to test the hypothesis that class and the beef schedule have different effects in each region.

$$P_{krt} = (C_k, W_{frt}, S_t)$$

(2) For each class, where k = 1 ...8, to test the hypothesis that region and the beef schedule have different effects on each class.

$$P_{krt} = (R_r, W_{rt}, S_t)$$

4.2.1 The Results of the Analysis for Each Region are Set Out in Table 4.2.1

Table 4.2.1 indicates that most coefficients in each district are significantly different from zero. In North Auckland the coefficients for good weaner steers and medium steers are not significantly different from zero, and the coefficient for medium weaner steers in all other districts is not significantly different from zero.

Because most store producing farmers retain those heifers

TABLE 4.2.1

REGRESSION ANALYSIS RESULTS FOR SEPARATE REGIONS

AUTUMN (PER HEAD)

P_{KRT} =	CONSTANT	COWS BDG.	COWS CULL	WEANER STEERS GOOD	WEANER STEERS MEDIUM	18 MONTH STEERS	2½ YEAR STEERS	STORE BULLOCKS	AVERAGE	GOOD	SCHEDULE OX GAQ	R^2	D.W.
	COEFFS OF CLASS DEVIATIONS FROM GOOD HEIFERS								COEFFS OF SEASONAL DEVIATIONS FROM POOR SEASON				
REGION													
NORTH AUCKLAND	-34.03 (3.80) **	27.05 (3.01) **	13.99 (3.01) **	4.99 (3.01)	-1.19 (3.01)	20.69 (3.01) **	32.31 (3.01) **	44.12 (3.01) **	5.25 (1.95) **	14.26 (1.97) **	3.84 (0.17) **	.88	1.5272
E KUITI	-23.72 (3.43) **	26.75 (2.14) **	12.37 (2.14) **	8.87 (2.14) **	1.31 (2.14)	24.44 (2.14) **	35.25 (2.14) **	45.25 (2.14) **	7.79 (1.85) **	15.75 (1.92) **	3.16 (0.13) **	.92	1.6781
OTORUA	-26.21 (4.00) **	30.81 (3.17) **	7.69 (3.17) *	7.94 (3.17) *	-1.38 (3.17)	18.31 (3.17) **	30.69 (3.17) **	34.56 (3.17) **	7.42 (1.99) **	12.16 (2.15) **	4.02 (0.18) **	.86	1.3657
ARANAKI	-22.51 (3.58) **	25.99 (2.96) **	7.06 (2.96) *	10.06 (2.96) **	2.49 (2.96)	21.87 (2.96) **	39.31 (2.96) **	48.69 (2.96) **	-2.41 (1.92)	3.71 (1.91)	3.58 (0.16) **	.88	1.5100
AST COAST	-29.12 (3.30) **	25.81 (2.85) **	13.13 (2.85) **	13.19 (2.85) **	4.00 (2.85	23.13 (2.85) **	37.19 (2.85) **	46.50 (2.85) **	4.90 (1.72) **	10.24 (1.80) **	4.11 (0.16) **	.91	1.6937
AWKES BAY	-20.28 (2.94) **	28.94 (2.28) **	16.12 (2.28) **	10.69 (2.28) **	4.25 (2.28)	27.87 (2.28) **	40.19 (2.28) **	47.44 (2.28) **	5.25 (1.45) **	9.74 (1.63) **	3.25 (0.16) **	.93	1.7374
ANAWATU	-30.92 (4.13) **	28.06 (2.86) **	10.69 (2.86) **	11.25 (2.86) **	4.62 (2.86)	26.31 (2.86) **	41.81 (2.86) **	49.69 (2.86) **	2.47 (1.87)	12.24 (2.08) **	4.12 (0.18) **	.91	1.9820
AIRARAPA	-29.87 (3.59) **	28.56 (2.49) **	10.56 (2.49) **	11.74 (2.49) **	2.94 (2.49)	26.19 (2.49) **	38.94 (2.49) **	47.06 (2.49) **	4.53 (1.67) **	14.30 (1.73) **	3.90 (0.17) **	.92	1.5537

NOTES: STANDARD ERRORS ARE GIVEN IN BRACKETS

* INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 5% LEVEL

** INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 1% LEVEL

necessary for replacement, one may expect the observed values in the market place for good weaner heifers to be similar to the value of medium weaner steers, because "good" weaner heifers for sale may in fact only be "average" quality. If this is true, then weaner heifers at store stock sales maybe purchased for growing and finishing rather than for their future productive capacity. The coefficient for medium weaner steers is not significantly different from zero indicating that this prior hypothesis may be accepted.

The seasonal coefficients for Taranaki are not significant, indicating that either the seasonable variable has been mis-specified or that weather has no impact on store cattle values in Taranaki. The average seasonal coefficient for Manawatu is also not significantly different from zero, probably due to mis-specification of the seasonal variables.

The high R^2 values for each regression equation indicates that a large part of the variation in store cattle prices is explained by the hypothesised relationship.

The Durbin-Watson d-statistics indicates that autocorrelation of the residuals exists at the 1% significance level in the estimated equations for North Auckland, Taranaki, Rotorua and Wairarapa but is absent at this level in the regression equations for the other regions.

The L.S.D. test shows that the classes of store cattle for growing and finishing; weaner steers (good), 18-month steers, 2½-year steers and store bullocks are all significantly different at the 5% level.

The hypothesis of interest is that there is significant variation in the size of coefficients between regions. That is, that there are statistically different class effects in each region, a statistically different response to the seasonal conditions and to the prime beef schedule in each region.

It is not possible within the scope of this analysis to test whether the equations overall are significantly different

from each other, or that there is a statistically significant difference between the subgroups of class and weather coefficients in each region.

However, it is possible to test whether there are significant differences between individual coefficients using Duncan's Multiple Range Test.

Significant studentized ranges are extracted from Duncan's Table for the appropriate degrees of freedom (of 100). The significant studentized ranges for a test at a 5% level of significance are 2.80, 2.95, 3.05, 3.12, 3.18, 3.22 and 3.26 respectively.

The standard error used in the following analysis is the average standard error for that coefficient over all regions. For instance the standard error used in the multiple range test for breeding cows is 2.65; the average for the eight regions. Therefore, the shortest significant ranges are : 7.42, 7.82, 8.08, 8.27, 8.43, 8.53 and 8.64. Because of the dummy variable formulation 2.65 is the average standard error for each class of store cattle over the eight districts, and the shortest significant ranges are similarly the same for all classes of store cattle.

Results of Duncan's Multiple Range Test at the 5% Level of Significance

Class Coefficients in each District

Breeding Cows:	No differences in the values for breeding cows exists.
Cull Cows:	Cull cows in Hawke's Bay are different in value from Taranaki only.
Good Weaner Steers:	All regions are different from North Auckland only.
Medium Weaner Steers:	Because the coefficients are not statistically different from zero there are no significant differences between the individual coefficients.

18 Month Steers:	No significant differences exist.
2½ Year Steers:	Manawatu and Hawke's Bay are different from Rotorua.
Store Bullocks:	Store Bullocks in Rotorua are different from all other regions.

The hypothesis under test here is that there are no significant differences at the 5% level between the observed store cattle prices of different classes in each region. The alternative hypothesis indicates that the prices of individual classes of store cattle are significantly different.

Duncan's Multiple Range Test does not indicate any overall identifiable pattern of spatial separation of prices of store cattle. However, taking for example, good weaner steers comparing the shortest significant ranges in this statistical test with the transport costs between regions set out in Table 6.2.1 of Chapter 6, the shortest significant ranges exceed the road transport costs between regions. Therefore if the observed store cattle prices used in this analysis are the equilibrium prices separated only by transport costs, or even approaching the equilibrium prices then, because the test statistic is greater than the transport costs separating store cattle prices in each region, no statistical differences would exist using this test.

Duncan's Multiple Range Test would only identify extreme statistical price differences. If extreme differences existed in an identifiable pattern that could not be explained by transport costs or other factors such as differences in quality or description between regions then the store cattle market is not in equilibrium. In general, where no geographical barrier exists, if an extreme price difference exists that cannot be explained by factors such as transport costs or quality differences then free market forces would ensure that store stock would flow between regions till joint equilibrium prices and flows with the surrounding regions were established. The market is never in equilibrium where it is profitable to transport additional stock from one region to another.

Seasonal Coefficients in each District

The hypothesis under test is that individual regions have a different response to seasonal conditions.

Results of Duncan's Multiple Range test show that there are no significant differences between seasonal coefficients in any region, except for Taranaki whose seasonal coefficients are not significantly different from zero. Thus the above hypothesis is rejected. One would expect store stock prices in districts to respond similarly to the seasonal feed conditions. For instance, for store cattle producing areas when good seasonal conditions occur store animals can be presented for sale in better condition, while surplus or adequate supplies of feed in growing and finishing regions will tend to increase demand for store stock and result in increased prices as farmers compete for a fixed quantity of stock. Farmers will therefore be encouraged to purchase store stock from surrounding regions. Good Seasonal conditions in store growing and finishing regions will shift the aggregate demand curve for store cattle in the surplus producing regions to the right.

Beef Schedule Coefficients in Each Region

Regions may have a different response to the prime beef schedule depending on whether a region's role is predominantly store producing or store finishing.

Using Duncan's Multiple Range Test, significant differences in the beef schedule coefficient between regions are outlined below.

Beef Schedule Coefficients in descending order

Mana-watu	East Coast	Rotorua	Wairarapa	North Auckland	Taranaki	Hawke's Bay	Te Kuiti
4.12	4.11	4.02	3.90	3.84	3.58	3.25	3.16
a	a	ab	ab	ab	bc	c	c

The coefficients with the same Duncan's letter are not significantly different at the 5% level.

Thus the beef schedule coefficient for the Manawatu and the East Coast region are significantly different to Taranaki, Hawke's Bay and Te Kuiti which does not suggest any identifiable

pattern relative to the breeding or growing and finishing status of a region.

4.3 SEPARATE REGRESSION ANALYSIS ON EACH CLASS

The results of the separate regressions on each class are in Table 4.3.

All coefficients are of the expected sign and magnitude. The high R^2 values for each regression equation indicate that a large part of the variation in store cattle prices is explained by the hypothesised relationship. The Durbin-Watson d-Statistics indicate that autocorrelation of the residuals exists at the 1% significance level in the estimated equations for good weaner heifers and 18 month steers but is absent at this level in the regression equations for the other classes of stock.

With the exception of the seasonal subgroup of coefficients for Taranaki analysis of variance indicates that all subgroups of coefficients contribute significantly to store cattle price formation in each region.

Coefficients all have the expected sign in each district, except average weather in Taranaki which is -2.40. (However, it is not significantly different to zero).

Results in Chapter 4 to this point indicate that classes of store cattle are significantly different from each other, in the aggregate North Island model, and all the classes of steers in the individual regional analyses. The hypotheses that we still wish to test are that there are;

1 Significant differences between the seasonal coefficients for individual classes of store cattle.

2 Significant differences between the schedule coefficients for individual classes of stock.

1 Using Duncan's Multiple Range Test there are no significant differences between the seasonal coefficients for classes of store cattle, so the hypothesis that classes of store cattle may respond differently to seasonal conditions is rejected. Thus, although analysis of variance indicates that seasonal conditions are significant in explaining

TABLE 4.3

REGRESSION ANALYSIS RESULTS FOR SEPARATE CLASSES OF STORE CATTLE

AUTUMN (PER HEAD)

P KRT =	CONSTANT	COEFFS OF REGIONAL DEVIATIONS FROM NORTH AUCKLAND							COEFFS OF SEASONAL DEVIATIONS FROM POOR SEASON		SCHEDULE OX GAQ	R^2	D.W.
		TE KUITI	ROTORUA	TARANAKI	EAST COAST	HAWKES BAY	MANAWATU	WAIRARAPA	AVERAGE	GOOD			
CLASS OF STOCK													
GOOD WEANER HEIFERS	-13.00 (2.70) **	1.64 (2.15)	11.03 (2.15) **	0.56 (2.15)	6.04 (2.15) **	2.54 (2.15)	5.44 (2.15) *	4.20 (2.15)	2.60 (1.36)	10.08 (1.42) **	2.68 (0.12) **	.83	1.3816
BREEDING COWS	-10.11 (3.66) **	1.69 (2.92)	15.01 (2.92) **	-0.49 (2.92)	4.89 (2.92)	4.35 (2.92)	7.06 (2.92) **	6.19 (2.92) **	1.56 (2.93)	12.66 (2.94) **	4.15 (0.16) **	.86	1.7617
CULL COWS	-7.48 (3.36) *	0.00 (2.69)	4.69 (2.69)	-6.37 (2.69) *	5.13 (2.69)	4.66 (2.69)	2.05 (2.69)	0.68 (2.69)	2.53 (1.69)	9.61 (1.77) **	3.22 (0.15) **	.81	1.6764
GOOD WEANER STEERS	-21.13 (2.80) **	5.39 (2.24) *	14.03 (2.24) **	5.62 (2.24) *	14.49 (2.24) **	8.32 (2.24) **	11.99 (2.24) **	11.44 (2.24) **	4.13 (2.41) **	12.69 (1.47) **	3.40 (0.13) **	.88	1.7221
MEDIUM WEANER STEERS	-19.23 (2.81) **	3.89 (2.25)	10.81 (2.25) **	4.25 (2.25)	11.42 (2.25) **	8.08 (2.25) **	11.28 (2.25) **	8.57 (2.25) **	4.35 (1.41) **	11.39 (1.48) **	2.92 (0.13) **	.84	1.9647
18 MONTH STEERS	-12.86 (3.42) **	5.12 (2.74)	8.61 (2.74) **	1.75 (2.74)	8.68 (2.74) **	9.84 (2.74) **	11.06 (2.74) **	9.93 (2.74) **	4.49 (1.72) *	11.32 (1.80) **	3.89 (0.15) **	.85	1.5650
2½ YEAR STEERS	-13.69 (3.59) **	4.31 (2.87)	9.28 (2.87) **	7.56 (2.87) **	10.94 (2.87) **	10.48 (2.87) **	14.64 (2.87) **	10.67 (2.87) **	3.78 (1.80) *	9.26 (1.89) **	4.74 (0.16) **	.88	1.8543
STORE BULLOCKS	-1.62 (3.61)	2.45 (2.88)	1.34 (2.88)	5.12 (2.88)	8.48 (2.88) **	5.94 (2.88) *	10.72 (2.88) **	7.04 (2.88) *	4.08 (1.81) *	9.56 (1.90) **	4.71 (0.16) **	.88	1.9814

NOTES: STANDARD ERRORS ARE GIVEN IN BRACKETS

* INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 5% LEVEL

** INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 1% LEVEL

store cattle prices, the seasonal effect is the same for all classes.

2 The hypothesis under test is that individual classes of store cattle have the same schedule coefficient, i.e. does the beef schedule have the same effect on all classes of store cattle.

If we consider those classes of store cattle that are purchased for growing and finishing we would include good weaner heifers which we have assumed may be purchased for growing and finishing (as well as for their future productive capacity).

The results of Duncan's Multiple Range Test shown below indicate those beef schedule coefficients which are significantly different at the 5% level.

Beef Schedule Coefficients in ascending order

Good Wnr. Heifers	Med. Wnr. Steers	Good Wnr. Steers	18 mth. Steers	Store Bks.	2½ year Steers
2.68	2.92	3.40	3.89	4.71	4.74
a	a	b	c	d	d

Those coefficients with the same Duncan's letter are not significantly different at the 5% level.

Apart from the pairs, good weaner heifers and medium weaner steers, store bullocks and 2½ year steers, the beef schedule coefficients are all significantly different from each other.

As the classes of store cattle become older (and their weight increases) the beef schedule coefficient increases. In fact the coefficient tends to approximate the carcass weight or meat equivalent of the class of store cattle in question. Good weaner heifers and medium weaner steers, which have the smallest schedule coefficient, are also the lightest classes of animals. Good weaner steers on the other hand are heavier (and possibly in better condition) which is in turn reflected in a higher beef schedule coefficient.

For younger classes of stock, purchasers of store cattle do

however, pay more than the schedule price for the carcass weight meat equivalent of the store animal. The value of future weight gains is incorporated in the price for the younger animal and reflects the growth potential of the younger animal. This concept is developed further in Chapter 5.

On the other hand, the schedule coefficient for store bullocks and 2½ year steers approximates the actual carcass weight of these animals indicating that they are approaching their optimum slaughter age. (The coefficient acts as a factor, $/100 lb, slaughterweight)
Figure 4.3. shows graphically the results discussed above. As the age of the store animal increases, a unit change in schedule is reflected more directly in the actual carcass weight of the animal. For instance, for a store bullock, for every dollar change in the schedule there is a $4.71 change per 100 lb carcass weight in the value of the store animal, whereas for good weaner steers, for every dollar change in the schedule there is only a $3.40 change per 100 lb carcass weight in the price of the store animal.

4.4 RESULTS OF THE REGRESSION ANALYSIS FOR SPRING

The results for the aggregate North Island regression for Spring are presented in Table 4.4.

The high R^2 value indicates that the hypothesised relationship explains a large part of the variation in store cattle prices for the Spring analysis.

The Durbin-Watson d-statistic indicates that autocorrelation of the residuals occurs at the 1% level of significance.

Analysis of Variance indicated that all sub-groups of coefficients contribute significantly (at the 1% level) to the formation of store cattle prices.

As in the Autumn analysis, Table 4.4 indicates that all the regression coefficients are significantly different from zero (except Taranaki which we would expect to be similar to the base region Northland) and are of the expected sign and magnitude.

Figure 4.3. Relationship Between Store Cattle Prices and the Export Beef Schedule (OxGAQ) - Per Head (Manawatu Region and Average Seasonal Conditions.)

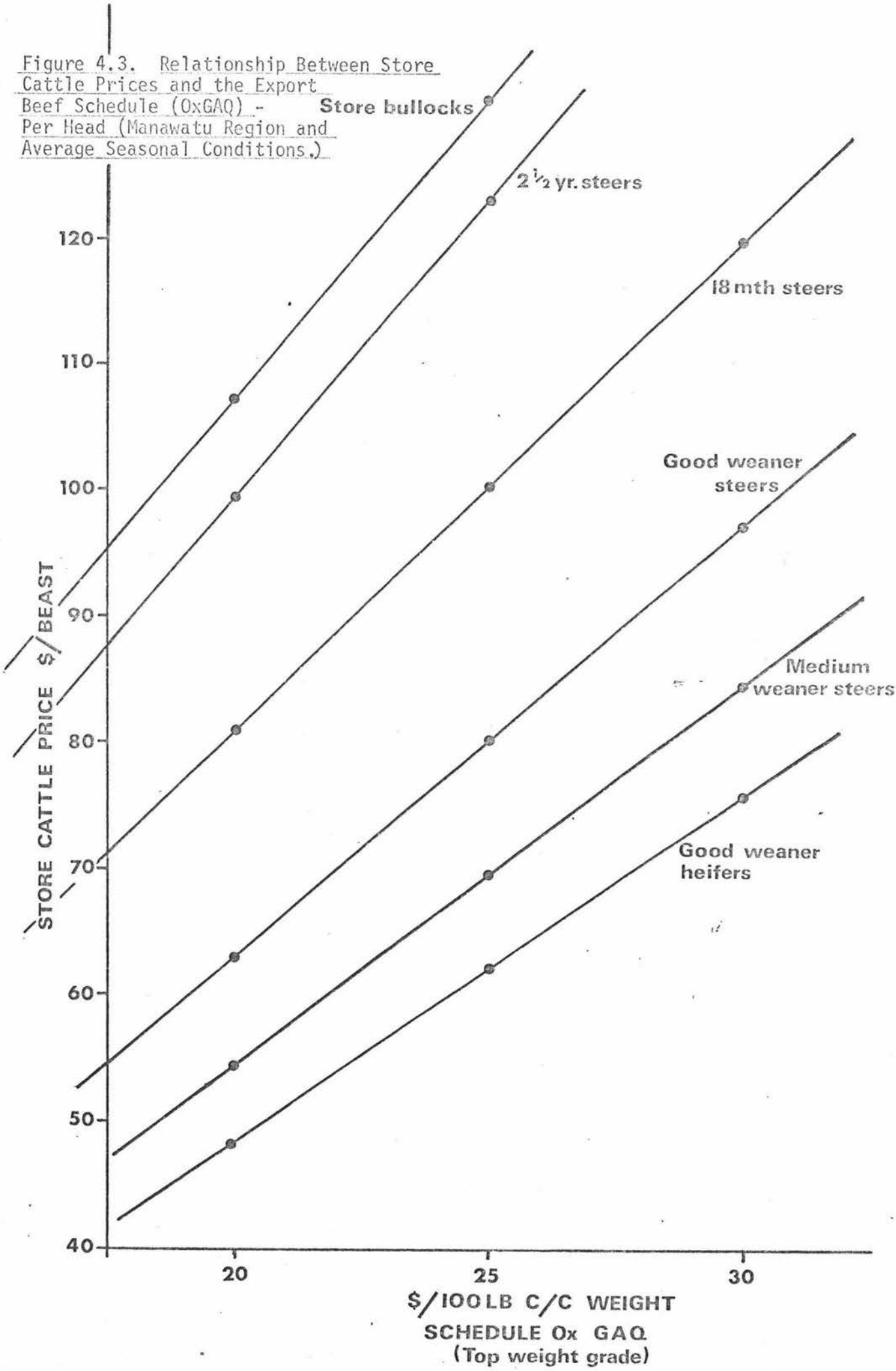


TABLE 4.4

REGRESSION ANALYSIS RESULTS NORTH ISLAND - STORE CATTLE PRICES

SPRING (PER HEAD)

		COEFFICIENTS OF CLASS DEVIATIONS FROM GOOD YEARLING HEIFERS									COEFFICIENTS OF REGIONAL DEVIATIONS FROM NORTH AUCKLAND						
P KRT	=	CONSTANT	DRY 2 YEAR HEIFERS	COWS IN CALF	COWS CULL	YEARLING STEERS GOOD	YEARLING STEERS MEDIUM	2 YEAR STEERS	3 YEAR STEERS	STORE BULLOCKS	TE KUITI	ROTORUA	TARANAKI	EAST COAST	HAWKES BAY	MANAWATU	WAIRARAPA
		-27.77	17.29	23.95	8.81	13.06	4.27	26.45	37.80	42.02	3.47	9.11	0.93	3.53	6.62	7.60	5.12
		(1.57)	(1.22)	(1.22)	(1.22)	(1.22)	(1.22)	(1.22)	(1.22)	(1.22)	(1.16)	(1.16)	(1.16)	(1.16)	(1.16)	(1.16)	(1.16)
		**	**	**	**	**	**	**	**	**	**	**		**	**	**	**

COEFFS OF SEASONAL DEVIATIONS FROM POOR SEASON					
AVERAGE	GOOD	OX GAQ SCHEDULE	R^2	D.W.	
1.81	5.79	4.41	0.87	1.2792	
(0.72)	(0.71)	(0.06)			
*	**	**			

NOTES: STANDARD ERRORS ARE GIVEN IN BRACKETS

* INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 5% LEVEL

** INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 1% LEVEL

Changes in the seasonal conditions appear to have less impact on store cattle prices than in Autumn as evidenced by the lower seasonal coefficients for an average and good season of 1.81 and 5.79 respectively (c.f. Autumn 3.44 and 10.82).

With particular reference to the regional coefficients, the coefficients for the surplus store producing regions Te Kuiti, the East Coast and the Wairarapa are significantly different and lower than the surrounding store finishing regions. This would suggest that these regions have an absolute advantage in producing store cattle or, that at this time of the year there is less demand from growing and finishing regions for stock than in the Autumn so that prices are lower.

However further analysis of the Spring data showed similar results as those in Autumn. Also in terms of the number of store cattle traded, the analysis of the monthly sales of store stock in Hawke's Bay in Chapter 2 Table 2.3.2.2 indicates that far less cattle are traded in the Spring than the Autumn, 15.3% compared with 62.4% of the total traded over the whole year.

4.5 SUMMARY OF RESULTS OUTLINED IN CHAPTER 4

With particular reference to Autumn, the individual regression coefficients for the aggregate North Island model were of the expected sign and magnitude.

Store cattle prices do exhibit regional differences, however, the results of the individual regional regressions indicate that these regional differences do not exist in any identifiable pattern.

In the North Island model the classes of steers are significantly different from each other. However significant differences in class coefficients between regions do not exist in an identifiable pattern.

Although seasonal conditions contribute to store cattle price formation, the effect of changes in seasonal conditions is the same in all regions and on all classes of stock.

Differences in the beef schedule coefficient in different regions

do not display any identifiable pattern.

However the beef schedule coefficients for individual classes of store cattle, apart from the pairs, good weaner heifers and medium weaner steers, 2½ year steers and store bullocks, are significantly different from each other. As classes of store cattle become older, the beef schedule coefficient increases and with older classes of store cattle such as 2½ year steers and store bullocks the coefficient approximates the carcass weight. (Because the coefficient is $/100 lb c/c wt).

In this Chapter it was assumed that classes of store cattle are the same in each region. However descriptive problems exist between regions and the weight and quality of store cattle vary between regions. In Chapter 5, store cattle prices are placed on a per unit liveweight basis to try and remove the descriptive problem that may exist between regions. This will allow the "true" regional differences to be isolated.

CHAPTER FIVE

REGRESSION ANALYSIS OF STORE CATTLE PRICES ON A CENTS/LB LIVEWEIGHT BASIS IN THE NORTH ISLAND

INTRODUCTION

The statistical model formulated in Chapter 3 is used to measure significant differences between classes of store cattle in different regions on a per unit liveweight basis and the results compared with the results in Chapter 4 (per head basis).

5.1 ESTIMATION OF THE LIVEWEIGHT OF CLASSES OF STORE CATTLE

In Chapter 3 and Chapter 4 it was assumed that classes of store cattle are homogeneous products which do not vary between regions or over time. This assumption is relaxed and the weights of classes of store cattle for each region are incorporated in the analysis. Thus the descriptive and quality problems that arise in the reporting of store cattle prices between regions are to some extent removed.

For instance, comparing weaner steers in Gisborne and Northland, a descriptive problem may arise. Weaners bred in Gisborne are larger framed and heavier than those produced in Northland, but their classification may be identical because of the descriptive norms for classes of stock that are accepted in each region. Prices paid for weaner steers in Gisborne may be greater than in Northland, but this regional difference in store cattle prices may be due to differences in quality and description with the price paid on a per unit liveweight similar.

Regional Advisory Officers of the Ministry of Agriculture and Fisheries estimated the liveweight for average lines of store cattle in each region.

The hypothesis under test is that store cattle prices are regionally different when expressed on a per pound liveweight basis. The null hypothesis is that the regional coefficients are similar.

Also we wish to test the hypothesis that the relationships between individual classes of store cattle and the beef schedule on a per pound liveweight basis are the same as those on a per head basis in Chapter 4.

The estimated liveweights for store cattle for Autumn and Spring, for an average line of stock in each class, are set out in Table 5.1. The method used to estimate the weight of classes of store cattle is subjective. However because there is no quantitative data available some measure of liveweight partially removes the descriptive and quality problem that results when reporting prices of store cattle in different regions.

It is assumed that the liveweight of classes of store cattle is constant from 1957 to 1972. However, over time there has been an increase in the liveweight of younger classes of store cattle. The increased profitability of running beef cattle has resulted in the beef herd having access to a greater proportion of the farm's resources (land, labour and capital). Thus weaners bred for growing and finishing are larger and heavier than those in the early 1960's when cattle were run more for development purposes and for the health of sheep.

Therefore the assumption that the liveweight of classes of store cattle is the same over the whole period of the analysis, 1957-1972, may also confound the results.

LW_{kr} is the liveweight for a store cattle beast in the k^{th} class in the r^{th} region. Also for the following analysis the carcass weight of all classes of store cattle is assumed to be approximately 50% of the liveweight.

5.2 SPECIFICATION OF THE MODEL

The model formulated follows that specified in Chapter 4.

$$P_{krt}/LW_{kr} = f(C_k, R_r, W_{frt}, S_t)$$

Where:

P_{krt} / LW_{kr} = store price, in cents per pound liveweight for the k^{th} class in the r^{th} region in the year t (for Autumn and Spring).

S_t = beef schedule price per pound in the year t

C_k is a class dummy variable
= 1 for class k; = 0 elsewhere

R_r is a regional dummy variable
= 1 in region r; = 0 elsewhere

W_{frt} is a seasonal dummy variable where W_f takes the values :

W_0 for poor seasonal conditions

W_1 for average seasonal conditions

W_2 for good seasonal conditions

and k = 1 ... 8 for Autumn and 1 ... 9 in Spring
r = 1 ... 8
t = 1 ...16

5.2.1 Assumptions Underlying the North Island Model

The assumptions for the per unit liveweight model are the same as for the per head model of Chapter 4. Namely :

1. That the seasonal conditions have the same effect on the price of store cattle in each class in each region.
2. That the beef schedule has the same effect on the price of store cattle in each class in each region.
3. That the regional effect is the same for all classes in a particular region.

5.3 RESULTS OF THE AUTUMN REGRESSION ANALYSIS - NORTH ISLAND

The functional relationship described above was estimated for Autumn using ordinary least squares regression. Table 5.3 sets out the results. The figures in parenthesis are the standard errors of the estimated coefficients. All the regression coefficients are significantly different from zero at the 1% level. The Durbin-Watson, d-statistic, and the multiple regression coefficient are discussed in Section 5.3.3.

The results for the Spring analysis are discussed briefly at the end of this Chapter in Section 5.6.

TABLE 5.1

ESTIMATED LIVEWEIGHT OF STORE CATTLE (LBS) - NORTH ISLAND (1973)

	NORTH AUCKLAND (WHANGAREI)	TE KUITI	ROTORUA	TARANAKI	EAST COAST (GISBORNE)	HAWKES BAY (HASTINGS)	MANAWATU (PALMERSTON NORTH)	WAIRARAPA (MASTERTON)
(i) AUTUMN								
GOOD WEANER HEIFERS	375	350	350	350	400	410	375	405
BREEDING COWS	900	900	900	950	900	900	1 000	900
CULL COWS	825	850	850	900	825	825	900	825
GOOD WEANER STEERS	430	400	400	400	460	475	450	470
MEDIUM WEANER STEERS	370	350	350	375	380	390	400	390
18 MONTH STEERS	850	750	700	750	700	725	750	720
2½ YEAR STEERS	1 000	900	900	900	950	960	900	950
STORE BULLOCKS	1 150	1 000	1 000	970	1 130	1 150	1 000	1 150
(ii) SPRING								
GOOD YEARLING HEIFERS	500	500	450	400	500	520	425	515
2 YEAR DRY HEIFERS	700	750	720	550	735	750	600	735
BREEDING COWS IN CALF	900	850	850	950	850	850	1 000	850
CULL COWS	950	950	900	850	960	975	900	965
GOOD YEARLING STEERS	560	550	500	500	610	650	550	625
MEDIUM YEARLING STEERS	490	480	430	450	550	575	475	560
2 YEAR STEERS	1 000	850	800	800	840	880	850	850
3 YEAR STEERS	1 100	1 000	1 000	920	980	1 020	950	1 000
STORE BULLOCKS	1 200	1 150	1 500	970	1 130	1 150	1 100	1 140

SOURCE: REGIONAL AVISORY OFFICES OF THE MINISTRY OF AGRICULTURE AND FISHERIES

TABLE 5.3

REGRESSION ANALYSIS RESULTS NORTH ISLAND - STORE CATTLE PRICES

AUTUMN (PER LB)

P_{KRT}/LW_{KR} =	CONSTANT	COWS BREEDING	COWS CULL	WEANER STEERS MEDIUM	WEANER STEERS GOOD	18 MONTH STEERS	$2\frac{1}{2}$ MONTH STEERS	STORE BULLOCKS	TE KUITI	ROTORUA	TARANAKI	EAST COAST	HAWKES BAY	MANAWATU	WAIRARAPA
	COEFFICIENTS OF CLASS DEVIATIONS FROM GOOD WEANER HEIFERS								COEFFICIENTS OF REGIONAL DEVIATIONS FROM NORTH AUCKLAND						
	-1.16 (0.27) **	-2.95 (0.19) **	-4.26 (0.19) **	0.77 (0.19) **	0.89 (0.19) **	-1.80 (0.19) **	-2.06 (0.19) **	-2.10 (0.19) **	1.11 (0.19) **	2.42 (0.19) **	0.85 (0.19) **	1.55 (0.19) **	1.15 (0.19) **	1.75 (0.19) **	1.15 (0.19) **

COEFFS OF SEASONAL DEVIATIONS FROM POOR SEASON		OX GAQ SCHEDULE	R^2	D.W.
AVERAGE	GOOD			
0.57 (0.12) **	1.80 (0.13) **	0.58 (0.01) **	.82	1.2150

NOTES : STANDARD ERRORS ARE GIVEN IN BRACKETS

* INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 5% LEVEL

** INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 1% LEVEL

5.3.1 Tests on Sub-Groups of Coefficients

Analysis of Variance (Table 5.3.1) indicates that the sub-groups of variables, namely :

1. Class Dummy Variables,
2. Regional Dummy Variables, and
3. Seasonal Dummy Variables

all contribute significantly to store cattle price formation, i.e. to the regression sum of squares.

TABLE 5.3.1 ANALYSIS OF VARIANCE : NORTH ISLAND (c/lb)

Source of Variation	D.F.	S.S.	M.S.S.	Level of Significance of the F Statistic
Intercept	1	77,048	77,048	
Class C_2-C_8	7	3,024	432	1%
Region R_2-R_8	7	401	57	1%
Weather W_1-W_2	2	1,071	535	1%
Schedule	1	6,720	6,720	1%
(Total due to (Class - Schedule	17	1,122	659	1%)
Residual	1,006	2,417	2.4	

5.3.2 Analysis of the Regression Coefficients in Table 5.3

The Intercept

As in Chapter 4 the negative sign of the intercept is consistent with economic theory.

Class Coefficients

Analysis by Yver [53] and Jarvis [28] of investment behaviour and supply response in the Argentine beef cattle industry is relevant to the North Island store cattle industry and price formation in this market.

Yver considers a theoretical cattle producing firm that, at any point in time, holds a mixed portfolio of cattle of different age and sex. The decisions that the firm has

to make are; at what age to slaughter males; and for females, whether to slaughter or retain them for breeding.

It is assumed that a firm wants to maximise its net returns over time, which is equivalent to maximising the net present value of an animal at birth. The decision variable in this maximisation is the time of slaughter. Having derived the necessary and sufficient conditions for this maximum, the capital value (store value) of an animal at any age can be derived. We are particularly interested in the impact of a change in the beef export schedule price and feed prices on these capital values.

The significant conclusions concerning the effect of changes in the price of the beef schedule and feed prices on capital values are summarised below.

(1) The capital value of an animal at any age prior to slaughter is greater than its slaughter value at that age (on a per lb basis).

(2) All cattle transactions will take place at the capital values (assuming a homogeneous set of farms). Thus store cattle prices per lb will be greater than schedule prices per lb; approaching equality at slaughter weights.

(3) The elasticity of store cattle prices per lb with respect to the beef schedule price is :

   (a) Positive and greater than unity for all cattle in the herd below the optimum slaughter age and equal to unity at this age.

   (b) Larger for female animals than for male animals.

   (c) Highest at birth and declines monotonically towards unity as the age of the animal approaches the slaughter age.

(4) The elasticity of store cattle prices per lb., with respect to feed prices (i.e. changes in seasonal conditions which affect the opportunity cost of grass) is :

(a) negative for all animals in the herd below the optimum slaughter age and equal to zero at this age;
(b) larger in absolute value for female animals than for male animals;
(c) largest in absolute value at birth and declines monotonically towards zero as the age of the animal approaches the slaughter age.

(5) If both beef and feed prices increase in the same ratio, store prices (per lb) of all animals will increase in the same ratio.

(6) An increase in beef prices or a decline in feed prices will increase the optimum slaughter age of all animals in the herd.

(7) When both beef and feed prices increase in the same ratio, the optimum slaughter age does not change.

Yver's conclusions have important implications in the short run for the cattle firm. The short run implication of an increase in the beef schedule price is that the firm will choose to hold more animals with a longer horizon (e.g. breeding cows, heifers and young male cattle) and hold fewer (sell more) animals close to the slaughter age (older classes of steers).

When poor seasonal conditions occur and the price of feed increases the cattle firm will choose to dispose first of those animals whose capital values have declined the most; young steers and females.

An important assumption of Yver's analysis is that cattle firms are homogeneous, i.e. he does not have a stratification of cattle firms with specialised growing and finishing units separated from the store breeding units. In fact, in New Zealand our breeding farms cannot physically grow and finish cattle for slaughter (except where land types are heterogeneous).

The conclusions of Yver's analysis are applicable to the North Island cattle industry in the sense that Argentina

and New Zealand breed and finish store cattle under range conditions.

For the class coefficients Yver's conclusions suggest that the coefficients for all classes of store cattle would have a negative sign with respect to good weaner heifers - the omitted class coefficient. Also the coefficients should be more negative the older the class of store cattle.

The class coefficients in Table 5.3 set out below do not support this hypothesis. This does not mean that Yver's results are not applicable to the New Zealand situation. Female calves and female cattle in Yver's analysis are of comparable quality with male (steer) cattle of the same age. But for North Island store cattle sales observed, the lines of heifers described as "good" weaner heifers that are offered for sale are generally those heifers remaining after a store cattle producing farmer has selected (retained) the "best" for future herd replacements. On the other hand, lines of good weaner steers offered for sale are the "best", and the price paid for weaner heifers reflects their growing and finishing potential compared with weaner steers, and does not reflect their future productive capacity as in Yver's analysis.

Class Coefficients in descending order

Good Weaner Steers	Medium Weaner Steers	Good Weaner Heifers	18 mth Steers	2½ year Steers	Store Bullocks	Breeding Cows	Cull Cows
0.89	0.77	(00.00)	-1.80	-2.06	-2.10	-2.95	-4.26
a	a		b	c	c	d	e

Coefficients with the same Duncan's letter are not significantly different at the 5% level.

The coefficients for good weaner steers and medium weaner steers are positive compared with good weaner heifers. This indicates that medium weaner steers may be preferred for growing and finishing before 'good' weaner heifers.

The coefficients for breeding cows and cull cows are more negative than the coefficients for other classes of stock

which indicates that their per unit liveweight store (capital) value is less than the store value for all classes of steers. However female animals in these classes are older than classes of steers sold in store cattle markets. This would make the results consistent with Yver's theoretical beef investment model.

The coefficient for cull cows is most negative. Cull cows have no further productive value and their use for growing and finishing is limited. Cull cows may be sold in a forward store condition and immediately slaughtered for their present meat content at the boner cow schedule rate which is less than the prime beef schedule (OxGAQ).

The above results are also qualified by emphasising that the estimated weights for the classes of livestock are not the actual weights and will not reflect price changes due to seasonal conditions in any year.

Regional Coefficients

The hypothesis tested is that store cattle prices are regionally different on a per unit liveweight basis. In Chapter 4 it was hypothesised that store cattle prices in different regions are separated by transport costs. In particular, it was expected that regions defined in Chapter 2 as surplus store producing regions would have lower regional coefficients than the surrounding growing and finishing regions (because they have an absolute advantage with respect to breeding store cattle). The difference between the coefficients, if the observed market prices were the equilibrium market prices, would approximate the transport costs between pairs of regions. However surplus and deficit store producing regions are not significantly different from each other, although they do separate into two market blocks; an upper North Island market, (Northland, Te Kuiti and Taranaki) and a central-lower North Island block. (The regional differences in store cattle prices compared with transport costs is not investigated till Chapter 6).

However it was considered that regional differences may be obscured by the quality and description problem due to the descriptive norms that exist in different districts.

This assumes that cattle buyers act rationally, with the price paid for store animals related to the buyers' estimate of the live weight amongst other things (such as quality and growth potential).

The F-statistic in Table 5.3.1indicates that the sub group of regional dummy variables contribute to price formation in the store cattle market.

North Auckland was chosen as the base region. The coefficients for all regions were expected to be positive (greater than zero) compared with North Auckland which is a poorer store producing and finishing region than the major store producing; Te Kuiti, East Coast and Wairarapa and the finishing regions; Manawatu and Hawke's Bay.

Duncan's Multiple Range Test tests whether significant differences in store cattle prices (per lb) exist.

Regional Coefficients in ascending order

North Auckland	Taranaki	Te Kuiti	Hawkes Bay	Wairarapa	East Coast	Manawatu	Rotorua
0.00	0.85	1.11	1.15	1.15	1.55	1.75	2.42
	a	ab	ab	ab	bc	c	d

Coefficients with the same Duncan's letter are not significantly different at the 5% level.

The large regional coefficient for Rotorua compared with North Auckland still exists on a per unit liveweight basis.

In Chapter 4 it was suggested that the high regional coefficient for Rotorua was the result of excess regional demand for poor quality store cattle. In Table 5.1 estimated liveweights for store cattle for the Rotorua region are comparable with the poorer store producing and finishing regions; North Auckland and Taranaki. Thus high prices on a per head basis will be even higher on a

per lb basis. The value of the coefficient shows this.

Also, even allowing a premium for the accessability of the Ngongataha saleyards, personal observations indicate that stock are not superior to those found in saleyards in other sale centres such as Te Kuiti, Gisborne, Hastings, Palmerston North and Masterton.

It was expected that the regional coefficients for the surplus store producing regions would be less than the coefficients of the surrounding growing and finishing regions. Also, if the observed store cattle prices are the equilibrium prices each pair of regions would be separated by transport costs, with the surplus store producing regions having lower coefficients (on average over the 16 years) than the finishing regions reflecting the cost of transporting store cattle from the former to the latter.

For example in the Manawatu store cattle are relatively more expensive to produce and the breeding of store cattle cannot compete with finishing enterprises. Farmers in the Manawatu purchase store cattle in other regions and transport them "home" to finish on fat lamb farms. The size of the coefficients and the results of Duncan's test support this hypothesis for the transfer of store cattle from the Wairarapa to the Manawatu, but not for the transfer of store cattle from the East Coast to the Manawatu. The test also suggests that store cattle would be purchased in Te Kuiti and Hawke's Bay. However transport of store cattle from as far north as Te Kuiti does not in general occur. But the flow of store cattle from Hawke's Bay is possible. Although the Hawke's Bay and Waipawa counties are defined as deficit, store cattle are drawn from surrounding counties for sale at Stortford Lodge, Hastings.

Te Kuiti, a net producer of store cattle, has a low regional coefficient. However transfer of store cattle from Te Kuiti is mainly to the South Auckland and Central Auckland areas where we do not have a sale centre. The regional

coefficients also suggest that store cattle should move from Te Kuiti to Rotorua. This does occur.

Thus the statistical model formulated, except for the East Coast, supports the hypothesis that store cattle prices in different regions are separated; with the surplus store producing regions having significantly lower coefficients than the surrounding growing and finishing regions.

In Chapter 4 there were no significant regional differences between coefficients in the central and lower half of the North Island; Hawke's Bay, Wairarapa, East Coast, Manawatu and Rotorua. Adjusting the store cattle prices by the estimated liveweights in Table 5.1 removed the descriptive and quality variation that may exist in the store cattle prices between regions. Results of Duncan's test on a per lb basis showed that significant differences did exist between the coefficients of the surplus store producing regions and deficit regions except for the East Coast; the major surplus store producing region.

The East Coast, a surplus region, has a high regional coefficient which may be due to low liveweight estimates for store cattle in this region. However, on a per head basis the size of the regional coefficient was greater than the coefficient for surrounding regions which purchase store cattle from the East Coast, i.e. Hawke's Bay and Manawatu (but not Rotorua). If the high regional coefficient cannot be explained by the fact that the data is incorrectly specified or that the liveweights are not realistic (too low) for store cattle on the East Coast, then there must be other factors affecting the price of store cattle in Gisborne. However, the large framed, well bred store cattle in Gisborne may command a premium because of their good quality and reputation for good growth rates.

Seasonal Coefficients

The coefficients are also significantly different from each other at the 1% level.

The signs of the weather coefficients are positive as expected,

indicating that the effect of an average season and a good season is positive compared with the base seasonal coefficient (poor). And as expected a good season on a per unit weight basis has a greater impact than an average season on store cattle prices.

Beef Schedule Coefficient

The beef schedule coefficient (Ox GAQ) indicates that for a unit change in the beef schedule price there is an 0.58 cents per lb increase in the price paid per lb for store cattle (of all classes).

Assuming that the carcass weight of an animal for all classes is approximately 50% of the liveweight, then a cent change in the beef schedule price results in a more than proportional increase (i.e.0.5 cents/lb) in the value of store cattle.

The greater than proportional increase in the store cattle price indicates that the value of further weight gains is incorporated in the store price of steers for growing and finishing, and for breeding stock, incorporates their future productive capacity.

5.3.3 Durbin-Watson, d-Statistic

The Durbin-Watson, d Statistic indicates that autocorrelation is present in the residuals. This may result in the variance of the regression coefficients being biased downwards. There is also some loss in efficiency in estimation and in prediction with the estimated relationship. The possible reasons for autocorrelation are discussed in Chapter 4.

The reader needs to be aware of the fact that autocorrelation exists when interpreting the results of the model formulated.

5.3.4 Multiple Regression Coefficient, R^2, 0.82

The high R^2 value, 0.82 shows that a high proportion of the variance in store cattle prices is explained by the model.

5.4 INDIVIDUAL REGION REGRESSIONS

As in Chapter 4, Section 4.7, the assumptions underlying the aggregate North Island model are relaxed and a separate regression run on each region with the data adjusted for liveweight. The results are set out in Table 5.4.

Analysis of variance indicates that, with the exception of the seasonal condition sub group of variables for Taranaki and Rotorua, the sub groups of variables all contribute significantly to price formation in the store cattle market, i.e. to the regression sum of squares.

Therefore within each region store cattle prices still exhibit a class effect even though they have been adjusted for liveweight.

All coefficients, except for an average season in Taranaki, are of the expected sign.

Class Coefficients

In North Auckland good weaner steers as well as medium weaner steers are negative with respect to the base class omitted - good weaner heifers. In general the per unit liveweight coefficients become more negative as store cattle become older. This is consistent with the hypothesis tested on the aggregate North Island model and Yver's theory.

Thus on a regional basis the magnitude and sign of the coefficients for classes of store cattle follow those hypothesised for the North Island model, namely that the store value of a cattle beast is greatest for younger cattle and declines with age.

Seasonal Coefficients

All coefficients are significantly different in each region at the 5% level (except for Taranaki and Rotorua where the F-statistic is not significant). (I.e., ave. significantly different from good.)

Using Duncan's Multiple Range Test the only significant difference that exists between regions is that the seasonal coefficients for Taranaki are lower than the coefficients in other regions. However the F-statistic shows that seasonal conditions in Taranaki (and Rotorua) do not contribute to store price formation.

For all other regions there is no significant difference between the seasonal coefficients.

TABLE 5.4

REGRESSION ANALYSIS RESULTS FOR SEPARATE REGIONS

AUTUMN (PER LB)

$P_{KRT}/_{LWKR}$ =	CONSTANT	COWS BDG.	COWS CULL	WEANER STEERS MEDIUM	WEANER STEERS GOOD	18 MONTH STEERS	2½ YEAR STEERS	STORE BULLOCKS	AVERAGE	GOOD	SCHEDULE OX GAQ	R^2	D.W.
	COEFFS OF REGIONAL DEVIATIONS FROM GOOD WEANER HEIFERS								COEFFS OF SEASONAL DEVIATIONS FROM POOR SEASON				
REGION													
NORTH AUCKLAND	-0.93	-2.38	-3.34	-0.19	-0.02	-2.73	-2.54	-2.39	0.84	2.34	0.56	0.83	1.8969
	(0.58)	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)	(0.46)	(0.30)	(0.30)	(0.03)		
		**	**			**	**	**	**	**	**		
TE KUITI	0.37	-3.33	-4.61	-0.38	0.93	-2.25	-2.39	-2.18	1.41	2.81	0.52	0.85	1.4871
	(0.68)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)	(0.37)	(0.38)	(0.03)		
		**	**		*	**	**	**	**	**	**		
ROTORUA	0.51	-4.47	-6.50	-0.39	0.37	-3.84	-4.48	-4.94	1.22	2.09	0.70	0.80	0.9720
	(0.88)	(0.69)	(0.69)	(0.69)	(0.69)	(0.69)	(0.69)	(0.69)	(0.47)	(0.44)	(0.04)		
		**	**			**	**	**	**	**	**		
TARANAKI	0.91	-3.61	-5.36	0.00	1.26	-2.44	-1.77	-1.41	-0.34	0.87	0.56	0.83	1.6573
	(0.61)	(0.51)	(0.51)	(0.51)	(0.51)	(0.51)	(0.51)	(0.51)	(0.33)	(0.33)	(0.03)		
		**	**		*	**	**	**		**	**		
EAST COAST	-0.60	-2.67	-3.54	1.58	1.56	-0.97	-1.86	-2.33	0.07	1.62	0.63	0.85	1.3935
	(0.62)	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)	(0.32)	(0.37)	(0.03)		
		**	**	**	**		**	**		**	**		
HAWKES BAY	0.44	-1.70	-2.58	1.55	1.02	-0.08	-0.98	-0.23	0.88	1.69	0.48	0.87	1.4924
	(0.51)	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)	(0.25)	(0.28)	(0.03)		
		**	**	**	*		*		**	**	**		
PALMERSTON NORTH	-0.84	-3.61	-4.80	2.17	0.79	-1.73	-1.34	-1.45	0.46	2.12	0.66	0.86	1.5262
	(0.76)	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)	(0.53)	(0.35)	(0.37)	(0.03)		
		**	**	**		**	*	**		**	**		
WAIRARAPA	-0.58	-1.84	-3.36	1.10	1.24	-0.35	-1.13	-1.85	0.60	2.20	0.57	0.90	1.5868
	(0.53)	(0.37)	(0.37)	(0.37)	(0.37)	(0.37)	(0.37)	(0.37)	(0.25)	(0.26)	(0.03)		
		**	**	**	**		**	**	*	**	**		

NOTES: STANDARD ERRORS ARE GIVEN IN BRACKETS

* INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 5% LEVEL

** INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 1% LEVEL

However a different response may exist in some regions if a more accurate measure of seasonal conditions were used. The effect of a good season on store cattle prices in North Auckland may be different from Hawke's Bay, a region which has an absolute advantage compared with Northland for finishing store cattle.

Beef Schedule Coefficients

In Chapter 4 the hypothesis that regions may have different responses to the beef schedule was rejected. Although significant differences did exist on a per head basis, they did not exhibit any identifiable pattern. Similarly on a per unit liveweight basis the significant differences between regression coefficients do not exhibit any identifiable pattern.

Durbin-Watson d Statistic and Multiple Regression Coefficient

The Durbin-Watson d statistic indicates that positive autocorrelation of the residuals exists at the 1% significance level in all regions except North Auckland, Taranaki and the Wairarapa.

The high values of the multiple regression coefficients show that a high proportion of the variance in store cattle prices in each region has been explained by the model.

5.5 REGRESSION ANALYSIS FOR EACH CLASS

The results of the regressions for each class are in Table 5.5. In general the coefficients are significantly different from zero except for the constant (intercept) and medium weaner steers. We do not have any prior hypothesis about the signs or values of the regional coefficients (except that coefficients in the growing and finishing regions should be greater than those for the store producing regions. This hypothesis is tested later in this Section).

The seasonal coefficients are of the expected magnitude, and for each class the seasonal coefficients are significantly different from each other at the 1% level (using the L.S.D. test).

Analysis of variance indicates that the subgroups of variables for each regression contribute significantly (1% level) to store cattle price formation.

In particular this indicates that classes of store cattle adjusted

TABLE 5.5

REGRESSION ANALYSIS RESULTS FOR SEPARATE CLASSES

AUTUMN (PER LB)

P_{KRT}/LW_{KR} =	CONSTANT	COEFFS OF REGIONAL DEVIATIONS FROM NORTH AUCKLAND							COEFFS OF SEASONAL DEVIATIONS FROM POOR SEASON			R^2	D.W.
		TE KUITI	ROTORUA	TARANAKI	EAST COAST	HAWKES BAY	MANAWATU	WAIRARAPA	AVERAGE	GOOD	SCHEDULE OX GAQ		
CLASS OF STOCK													
GOOD WEANER HEIFERS	-3.41 (0.74) **	1.12 (0.59)	3.79 (0.59) **	0.82 (0.59)	0.94 (0.59)	-0.16 (0.59)	1.43 (0.59) *	0.37 (0.59)	0.86 (0.37) *	2.59 (0.39) **	0.71 (0.03) **	.83	1.3513
BREEDING COWS	-0.98 (0.40) *	0.18 (0.32)	1.66 (0.32) **	-0.41 (0.32)	0.54 (0.32)	0.48 (0.32)	0.04 (0.32)	0.68 (0.32) *	0.19 (0.20)	1.40 (0.21) **	0.45 (0.02) **	.86	1.7716
CULL COWS	-0.77 (0.40)	-0.18 (0.32)	0.57 (0.32)	-1.20 (0.32) **	0.62 (0.32)	0.56 (0.32)	-0.25 (0.32)	0.07 (0.32)	0.32 (0.20)	1.16 (0.21) **	0.38 (0.02) **	.82	1.6185
GOOD WEANER STEERS	-5.39 (0.75) **	1.66 (0.60) **	3.61 (0.60) **	1.01 (0.60)	2.76 (0.60) **	1.60 (0.60) **	3.84 (0.60) **	1.75 (0.60) **	1.02 (0.38) **	3.03 (0.39) **	0.81 (0.03) **	.85	1.6825
MEDIUM WEANER STEERS	-4.75 (0.67) **	2.03 (0.53) **	4.18 (0.53) **	2.10 (0.53) **	2.56 (0.53) **	0.88 (0.53)	2.25 (0.53) **	1.67 (0.53) **	0.96 (0.34) **	2.83 (0.35) **	0.78 (0.03) **	.87	1.6833
18 MONTH STEERS	-2.71 (0.48) **	1.56 (0.38) **	2.63 (0.38) **	1.10 (0.38) **	2.62 (0.38) **	2.48 (0.38) **	2.24 (0.38) **	2.55 (0.38) **	0.57 (0.24) **	1.55 (0.25) **	0.53 (0.02) **	.86	1.6650
2½ YEAR STEERS	-1.93 (0.39) **	1.23 (0.31) **	1.77 (0.31) **	1.58 (0.31) **	1.50 (0.31) **	1.37 (0.31) **	2.36 (0.31) **	1.47 (0.31) **	0.41 (0.18) *	0.96 (0.20) **	0.51 (0.02) **	.88	1.8310
STORE BULLOCKS	-0.86 (0.35) *	1.27 (0.28) **	1.16 (0.28) **	1.80 (0.28) **	0.88 (0.28) **	1.97 (0.28) **	2.09 (0.28) **	0.60 (0.28) *	0.40 (0.17) *	0.92 (0.18) **	0.45 (0.02) **	.89	2.0351

NOTES: STANDARD ERRORS ARE GIVEN IN BRACKETS

* INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 5% LEVEL

** INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 1% LEVEL

for liveweight in each class still exhibit regional differences. (This may be due to incorrect estimates of liveweights for classes of store cattle in some regions).

The F-statistic only indicates that there is an overall regional effect and not which regions are significantly different from each other.

Using Duncan's Multiple Range Test significant regional differences for each class do not exist in any systematic or identifiable pattern, i.e. there is no difference in the coefficients for regions defined as surplus or deficit in Table 2.2.8.

Seasonal Coefficients

Yver's conclusions suggest that changes in seasonal conditions will theoretically have a greater impact on the price of female classes of stock, and theoretically a greater impact on the price of younger classes of store cattle than on the price of older classes. Poor seasonal conditions will raise the opportunity cost of grass.

Thus for steers, Yver's theory suggests that average and good seasonal conditions (compared with poor seasonal conditions) will raise the value of younger classes of steers (weaners) more than the value of older classes of steers (i.e. 2½ year steers).

The seasonal coefficients (compared with a poor season) for classes of steers are set out below and the results of the Duncan's test outlined.

(1) Average Seasonal Coefficients in Ascending Order

Store Bullocks	2½ Year Steers	18 Month Steers	Good Weaner Steers
0.40	0.41	0.57	1.02
a	a	a	b

(2) Good Seasonal Coefficients in Ascending Order

Store Bullocks	2½ Year Steers	18 Month Steers	Good Weaner Steers
0.92	0.96	1.55	3.03
a	a	a	b

Coefficients with the same Duncan's letter are not significantly different at the 5% level.

Thus the effect of average and good seasonal conditions (compared with poor) on the price of good weaner steers is significantly different and greater than the impact on older classes of steers.

Consistent with the conclusions earlier in this Chapter and in Chapter 4, the effect of seasonal conditions on 'good' weaner heifers is less than that for good weaner steers. This is contrary to Yver's model, but is in accord with conditions in the market place. However the effect of good seasonal conditions on 'good' weaner heifers is not significantly different from good and medium weaner steers, and is similarly significantly different from older classes of steers.

On inspection the effect of an average and good season (compared with poor) on the price of 18 months steers is greater than that for 2½ year steers and store bullocks. However, the difference is not significant.

This contrasts markedly with the results in Chapter 4 where the seasonal conditions had no effect on the price of steers on a per head basis.

Beef Schedule Coefficients

Yver's model suggests that changes in the beef schedule price will have, in theory, a greater impact on the price of female classes of cattle and a greater impact on the price of younger classes of store cattle than on older classes of store cattle.

Thus for the regression coefficients a cent change in the beef schedule price will result in a greater change in the per lb liveweight of a younger animal. At slaughter, assuming carcass weight is approximately 50% of the liveweight, a cent change in the beef schedule will result in a 0.5 cents/lb change in the value of the animal (on the hoof).

The beef schedule regression coefficients for growing and finishing classes of store cattle are set out below.

Beef Schedule Coefficients in Ascending Order:

Store Bullocks	2½ Year Steers	18 Month Steers	Weaner Heifers	Weaner Steers Medium	Weaner Steers Good
0.45	0.52	0.53	0.71	0.78	0.81
a	ab	b	c	cd	d

Coefficients having the same Duncan's letter are not significantly different at the 5% level.

The results above are consistent with the theory. The regression coefficients indicate that for a change in the beef schedule price there will be a greater increase in the per lb value of younger classes of store cattle.

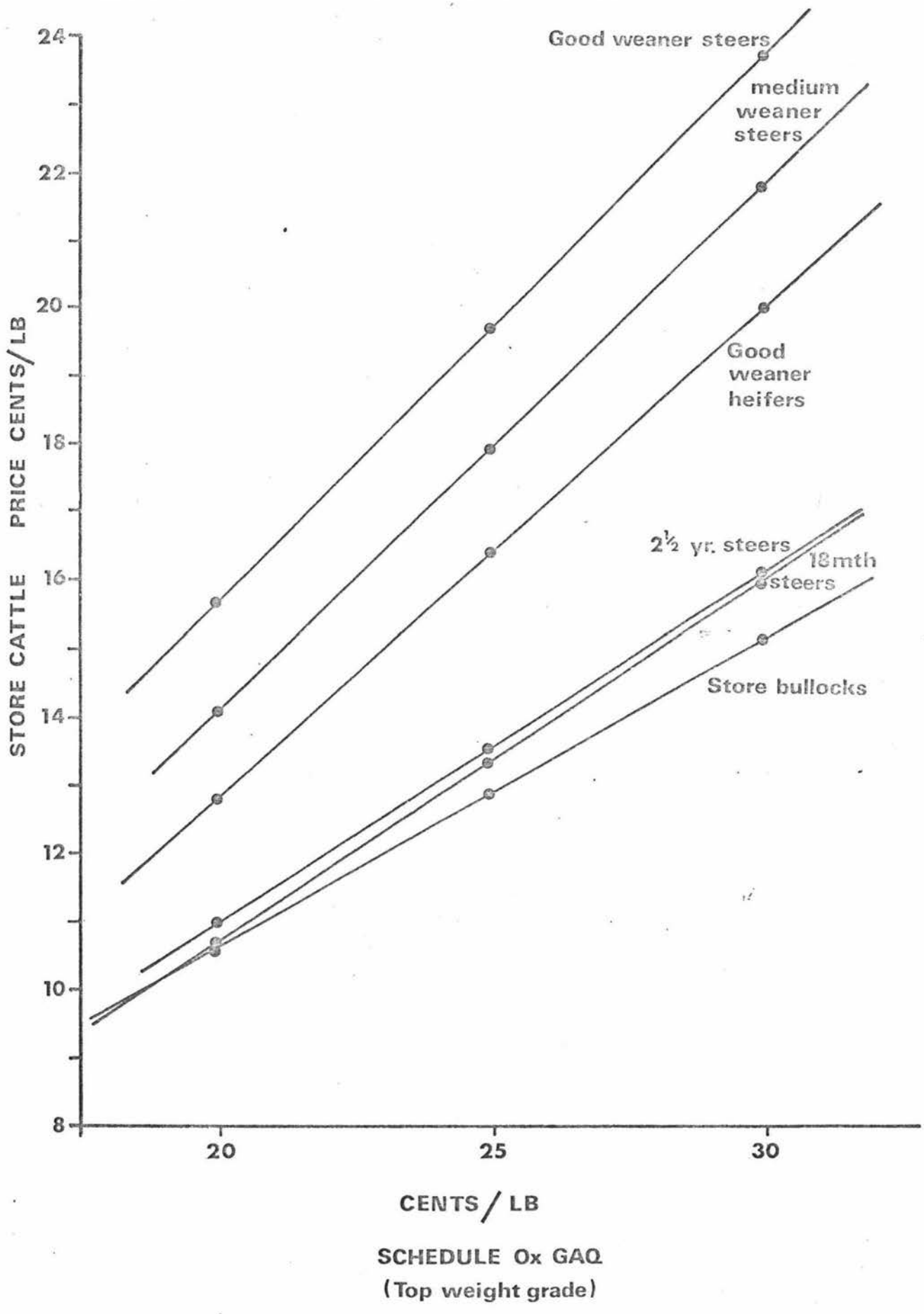
Also in the New Zealand store cattle market weaner heifers are purchased for growing and finishing and not for breeding, so the results are consistent with Yver's theoretical beef investment model.

The schedule coefficient is greatest for good weaner steers. Assuming that the carcass weight is approximately 50% of liveweight, then the value of the coefficient for 18 month steers and 2½ year steers of 0.53 and 0.52 indicate that these classes are near their slaughter age. Store bullocks on the other hand have a coefficient less than 0.5 indicating that their store value is less than their slaughter value. Yver's conclusions suggest that these animals are past their optimum slaughter age. They may have been retained on farms for purposes other than meat production such as breaking in steep hill country. When these supplementary uses are taken into account it may not be irrational to hold these animals past their optimum slaughter age as meat producers.

In Chapter 4 the value of the beef schedule coefficient ($/100 lb) increases as the class of store cattle becomes older. Also the coefficient tends to approximate the carcass weight of the animal, although, for younger classes of steers store cattle buyers pay more than the beef schedule price for the carcass weight suggesting that the value of further weight gain is incorporated in the price for the younger animal. The results in this Chapter show that for a one cent increase in the export beef schedule price, store cattle buyers will pay correspondingly more per lb for a weaner (of both sexes) than they will for older classes of store cattle.

Figure 5.5.1, relationship between store cattle prices and the beef export schedule on a per lb basis, summarises the results discussed above and illustrates the changes that occur, per lb liveweight, for

Figure 5.5.1. Relationship Between Store Cattle Prices and the Beef Export Schedule (OxGAQ) - Per lb.
(Manawatu Region and Average Seasonal Conditions)



different classes of store cattle for a unit change in the price of the export beef schedule.

The slope of the lines for weaner steers and heifers are not significantly different from each other (using Duncan's Multiple Range Test). Similarly the slope of the lines for older classes of steers are not significantly different, but the slope of the lines for weaners are significantly different from the older classes of steers. The slope of the lines for weaners is steeper than the slope of the lines for the older classes of steers. Therefore, for every cent change in the export beef schedule price, there will be a greater change in the value per lb liveweight for weaners than for older classes of steers.

Figure 4.3, which illustrates the relationship between store cattle prices and the beef export schedule on a per head basis indicates that for every dollar per 100 lb change in the price of the beef export schedule there is a greater change in the store cattle price for older classes of stock than for weaners. However, on a per lb basis the response to changes in the beef export schedule is greater for the younger classes of cattle (i.e. weaners).

Figure 5.5.2. Changes in the Export Beef Schedule Coefficient Over the Life of a Male Store Animal

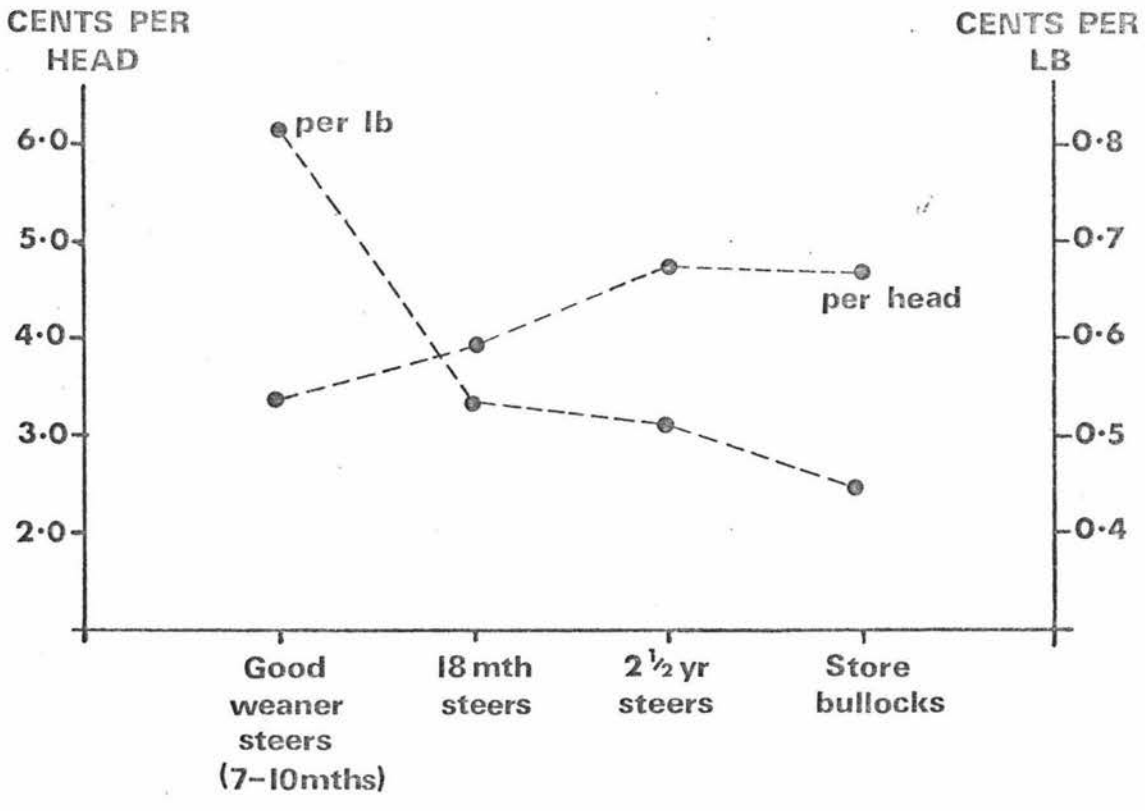


Figure 5.5.2 summarises the change in the value of the beef export schedule coefficient over the life of a male (steer) store animal.

Elasticity of Store Cattle Prices with Respect to the Beef Schedule Price

Yver's conclusions suggest that the elasticity of store cattle prices with respect to the beef schedule price is positive and greater than unity for all animals below the optimum slaughter age and equal to unity at this stage. The elasticity of store cattle price with respect to the beef schedule price is higher for younger steers and declines monotonically towards unity as the age of the animal approaches the optimum slaughter age. (Also the elasticity is higher for female animals than for male animals at all ages).

The elasticity of store cattle prices with respect to schedule prices are set out below, where the elasticity of store cattle prices with respect to beef prices at the mean is defined as :

$$\varepsilon_k = \text{Regression Coefficient for Ox GAQ Schedule for the } k^{th} \text{ class of store cattle} \times \frac{\text{Average Schedule Value per lb.}}{\text{Average store stock value for the } k^{th} \text{ class per lb.}}$$

The elasticity of store cattle prices with respect to beef schedule price for classes of growing and finishing cattle in descending order

Good Weaner Steers	Medium Weaner Steers	Good Weaner Heifers	18 Month Steers	2½ Year Steers	Store Bullocks
1.186	1.140	1.129	1.013	1.009	0.901

The elasticities set out above are consistent with Yver's conclusions and are in the hypothesised direction. The elasticity for 'good' weaner heifers is not greater than good weaner steers. In the North Island saleyards heifers offered for sale are normally purchased for growing and finishing purposes and not for their breeding potential. Average weaner steers are also preferred ahead of 'good' weaner heifers for growing and finishing. The elasticity for store bullocks less than unity is consistent with Yver's conclusions. Although store bullocks are past their optimum slaughter age as meat producing animals, they may be held

on farms for purposes other than growing and finishing such as development work on hill country farms. When these supplementary uses are taken into account it may not be irrational to hold these animals past their optimum slaughter age as meat producers.

However there may be other reasons why the elasticity is less than unity.

The elasticity of store cattle prices with respect to the beef schedule price suggests that if perfect market knowledge exists then store bullocks would never change hands at less than their slaughter value, and hence the elasticity would never be less than unity.

Everitt [22] shows in Figure 2.3.4 that a wide disparity of estimates of the carcass weight of live animals can occur. In particular, there is a marked tendency to underestimate the carcass weight of heavier animals. Therefore the meat content of store bullocks maybe underestimated due to lack of information. Conversely the live weight estimates for store bullocks in each region maybe too high. Both these measurement errors may result in an elasticity less than one.

The elasticities suggest that the optimum slaughter age for growing and finishing cattle in the North Island is approximately 2½ years, i.e. at that age where the elasticity equals unity, (i.e. a unit change in schedule will result in a unit change in the store/slaughter price of cattle).
Lowe's [35] results refer mainly to fat lamb farms where it is possible to grow and finish cattle before the second winter at 18-20 months. However, in the aggregate, for all land types, cattle may not be finished till an older age because of physical restrictions on the growing and finishing of store cattle. This may also take into account the supplementary uses of cattle such as development work on hill country.

Durbin-Watson d Statistic and Multiple Regression Coefficients

The Durbin-Watson statistic indicates that positive autocorrelation of the residuals exists at the 1% significance level in the regression analyses for good weaner heifers and 18 month steers, but is absent at this level in the regression equations for the other classes of stock.

The high value of the multiple regression coefficients show that a high proportion of the variance in store cattle prices in each class is explained by the model formulated.

5.6 RESULTS OF THE REGRESSION ANALYSIS FOR SPRING

The results of the aggregate North Island regression for Spring are presented in Table 5.6.

Analysis of variance indicates that all sub-groups of variables contribute significantly (at the 1% level) to the regression sum of squares.

As in the Autumn Analysis, Table 5.6, indicates that all coefficients are significantly different from zero at the 5% level (except for the intercept and medium yearling steers which are not significantly different from good yearling heifers - the omitted coefficient).

Changes in seasonal conditions appear to have less impact on store cattle prices than in Autumn.

The class coefficients for the aggregate North Island Spring model are consistent with Yver's conclusions and are similar to the results in Autumn (except that all classes of stock are about 6 months older).

The regional coefficients for the store producing regions; Te Kuiti, East Coast and Wairarapa are significantly different and lower than the surrounding growing and finishing regions except for Hawke's Bay, which confirms our prior hypothesis that coefficients of surplus store producing regions should be lower than the surrounding growing and finishing regions.

The Durbin-Watson d statistic indicates that autocorrelation is present in the residuals at the 1% level. The multiple regression coefficient shows that a large proportion of the variance in store cattle prices is explained by the hypothesised relationship.

5.7 SUMMARY OF THE RESULTS IN CHAPTER 5

With particular reference to Autumn, the individual class coefficients

TABLE 5.6

REGRESSION ANALYSIS RESULTS NORTH ISLAND - STORE CATTLE PRICES

SPRING (PER LB)

P_{KRT}/LW_{KR} =	CONSTANT	DRY 2 YEAR HEIFERS	COWS IN CALF	COWS CULL	YEARLING STEERS MEDIUM	YEARLING STEERS GOOD	2 YEAR STEERS	3 YEAR STEERS	STORE BULLOCKS	TE KUITI	ROTORUA	TARANAKI	EAST COAST	HAWKES BAY	MANAWATU	WAIRARAPA
	COEFFICIENTS OF CLASS DEVIATIONS FROM GOOD YEARLING HEIFERS									COEFFICIENTS OF REGIONAL DEVIATIONS FROM NORTH AUCKLAND						
	-0.45	-0.82	-2.24	-4.28	0.34	0.57	-1.53	-1.75	-2.37	0.88	2.18	1.38	0.51	0.68	1.86	0.64
	(0.24)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)
		**	**	**		**	**	**	**	**	**	**	**	**	**	**

COEFFS OF SEASONAL DEVIATIONS FROM POOR SEASON				
AVERAGE	GOOD	OX GAQ SCHEDULE	R^2	D.W.
0.27	0.76	0.60	0.84	0.9921
(0.11)	(0.11)	(0.01)		
*	**	**		

NOTES : STANDARD ERRORS ARE GIVEN IN BRACKETS

* INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 5% LEVEL

** INDICATES THAT THE COEFFICIENTS ARE SIGNIFICANTLY DIFFERENT FROM 0 AT THE 1% LEVEL

for the aggregate North Island and regional models are of the expected sign and magnitude hypothesised by Yver. Lines of 'good' weaner heifers offered for sale in North Island cattle sales are generally those heifers remaining after a store producing farmer has selected the best for future herd replacements. Therefore lines of weaner heifers offered for sale are purchased for growing and finishing so that the results are consistent with Yver's model. The results also suggest that medium weaner steers are preferred for growing and finishing before 'good' weaner heifers.

The statistical model formulated on a per lb basis removes the descriptive and quality variations that exist between regions. Duncan's test shows that significant differences exist between the coefficients of the surplus and deficit store producing regions. Also the coefficients of the surplus store producing regions are lower (except for the East Coast) for the North Island model. However, as in Chapter 4, for each class, systematic regional differences do not exist.

Changes in seasonal conditions have a greater effect on younger classes of store cattle. That is changes in the opportunity cost of feed due to changes in the seasonal conditions have a greater impact on the store (capital) value of younger classes of stock. This seasonal impact on store cattle prices was not evident in the per head analysis of Chapter 4.

Similarly changes in the store (capital) value of an animal, for every unit change in the beef schedule price, is greater for younger classes of store cattle. This is consistent with the conclusions of recent theoretical beef investment models of which Yver and Jarvis are two examples.

The elasticity of store cattle prices with respect to beef schedule price for classes of growing and finishing cattle conform with Yver's conclusions. In particular the elasticity is positive and greater than unity for all cattle in the herd below the optimum slaughter age and declines monotonically towards unity as the age of the animal approaches the slaughter age. The elasticities suggest an optimum slaughter age for growing and finishing cattle for the eight regions of the North Island of approximately 30 months.

CHAPTER SIX

SPATIAL PRICE DISTRIBUTION OF STORE CATTLE.

INTRODUCTION

The objective of this Chapter is to investigate the spatial distribution of store cattle prices in relation to the transport costs between selected pairs of regions.

6.1 SALE CENTRES

Regions are separated, but not isolated by a transportation cost per physical unit which is assumed to be independent of volume. There are no legal restrictions to limit the actions of profit-seeking traders in each region. Sale centres in each region (see Figure 3.7.1) are designated by a single point.

Table 6.1 sets out the shortest main routes to the nearest mile between the eight designated sale centres.

TABLE 6.1 SHORTEST MAIN ROUTE BY ROAD (MILES) BETWEEN SALE CENTRES

	WHANGAREI	TE KUITI	ROTORUA	NEW PLYMOUTH	GISBORNE	HASTINGS	PALMERSTON NORTH	MASTERTON
WHANGAREI								
TE KUITI	241							
ROTORUA	260	119						
GISBORNE	441	306	187					
NEW PLYMOUTH	349	108	227	411				
HASTINGS	397	243	162	254	157			
PALMERSTON NORTH	452	211	224	151	254	103		
MASTERTON	518	282	291	292	218	67	135	

Source: Shell Road Map, 1973 Edition

6.2 TRANSPORT COST DIFFERENTIALS BETWEEN REGIONS

The transport cost differential , C_{pq}, is the per unit cost of shipping a store cattle beast in a particular class from the p^{th} region to the q^{th} region, where C_{pq} may be either on a per head basis, or on a per unit liveweight basis.

A matrix of transport costs, C_{pq}'s between regions for different classes of stock were obtained from the North Island Road Carriers Association for each region. However, the analysis is restricted to two classes of cattle; good weaner steers and 2½ year steers. Table 6.2.1 sets out the transportation costs in 1972 for weaner steers between each sale centre, and Table 6.2.2 the transport costs for 2½ year steers between each sale centre. In both tables the upper value in each cell is in cents/lb and the lower value is in dollars/head.

TABLE 6.2.1 ROAD TRANSPORT COSTS, AUTUMN 1972, FOR WEANER STEERS BETWEEN SALE CENTRES. THE UPPER VALUE, C_{pq}, IN EACH CELL IS THE TRANSPORT COST IN CENTS/LB, WHILE THE LOWER IS IN DOLLARS/HEAD.

	WHANGAREI	TE KUITI	ROTORUA	NEW PLYMOUTH	GISBORNE	HASTINGS	PALMERSTON NORTH	MASTERTON
WHANGAREI								
TE KUITI	1.03 4.48	c/LB $/HEAD						
ROTORUA	1.11 4.84	0.63 2.73	c/LB $/HEAD					
GISBORNE	1.66 7.25	1.26 5.50	0.84 3.68	c/LB $/HEAD				
NEW PLYMOUTH	1.45 6.32	0.62 2.70	1.09 4.75	1.59 6.94	c/LB $/HEAD			
HASTINGS	1.49 6.49	0.95 4.13	0.73 3.20	0.57 2.50	1.11 4.85	c/LB $/HEAD		
PALMERSTON NORTH	1.67 7.35	1.05 4.57	1.09 4.77	1.12 4.89	0.80 3.47	0.48 2.11	c/LB $/HEAD	
MASTERTON	1.95 8.48	1.20 5.21	1.22 5.33	1.11 4.83	0.97 4.24	0.52 2.27	0.34 1.49	c/LB $/HEAD

Source: North Island Road Carriers Association

TABLE 6.2.2 ROAD TRANSPORT COSTS, AUTUMN 1972, FOR 2½ YEAR STEERS BETWEEN SALE CENTRES IN THE NORTH ISLAND. THE UPPER VALUE, C_{pq} IN EACH CELL IS IN CENTS/LB WHILE THE LOWER VALUE IS IN DOLLARS/HEAD.

	WHANGAREI	TE KUITI	ROTORUA	NEW PLYMOUTH	GISBORNE	HASTINGS	PALMERSTON NORTH	MASTERTON
WHANGAREI								
TE KUITI	0.95 8.87	c/LB $/HEAD						
ROTORUA	1.03 9.57	0.56 5.25	c/LB $/HEAD					
NEW PLYMOUTH	1.18 10.97	0.52 4.83	0.95 8.88	c/LB $/HEAD				
GISBORNE	1.45 13.52	1.14 10.61	0.76 7.07	1.36 12.67	c/LB $/HEAD			
HASTINGS	1.32 12.30	0.78 7.26	0.65 6.06	0.90 8.35	0.49 4.61	c/LB $/HEAD		
PALMERSTON NORTH	1.49 13.89	0.90 8.36	0.86 8.00	0.61 5.71	0.92 8.57	0.40 3.69	c/LB $/HEAD	
MASTERTON	1.72 16.05	0.96 8.97	1.00 9.35	0.79 7.39	0.95 8.90	0.45 4.16	0.29 2.73	c/LB $/HEAD

Source: North Island Road Carriers Association

The transportation costs on a per unit liveweight basis, cents/lb, are included to remove the descriptive problem that exists between store cattle for some regions. The transport cost on a per pound basis is calculated by dividing the per head cost by the average weight for weaner steers for all regions, i.e. 435 lbs, and for 2½ year steers by 933 lbs.

Since 1961 there has been no legal restriction on the distance travelled by cattle by road transport. Road transport costs between each pair of regions, in general, will be less than transport costs between pairs incorporating road and rail charges, because the distances travelled by the lower rail charges, are not great enough in the North Island to offset the short hauls necessary by road from farm to railhead and then railhead to farm.

The transport costs in both tables are the average of the rates quoted for each sale centre. Values quoted are for minimum truck loads of 44 weaner steers and 24 2½ year steers.

Rebates for backloading have not been included. However, in general, where the hirer provides at least the prescribed minimum load both ways a rebate of 25% shall be allowed on the schedule rates for the smaller, or if the same, for the return load. Where a back load is provided by a hirer other than the original hirer then a rebate of up to 12½% on schedule rates may be allowed to each hirer.

Since May 1968 the average increases in the North Island road transport rates to May 1972 have been 27.5%. The increases over the period are outlined in Table 6.2.3. These may not reflect the actual increases in any region, but are in general, representative of rates charged by carrier firms over this period.

TABLE 6.2.3 INCREASES IN NORTH ISLAND ROAD TRANSPORT RATES

Year Ending May	Increase %	Cumulative
1968	0.0	0.0
1969	4.5	4.5
1970	5.0	9.5
1971	13.5	23.0
1972	4.5	27.5

Source: North Island Road Carriers Association

For good weaner steers and 2½ year steers the analysis is restricted to three years between 1968 and 1972.

Thus, for weaner steers the 1972 road transport costs in Table 6.2.1 were adjusted to give the appropriate road transport rates for 1970 (by multiplying by 0.820) and for 1968 (by multiplying by 0.725), and for 2½ year steers the road transport costs for 1971 and 1969 were calculated by multiplying the 1972 transport costs in Table 6.2.2 by 0.955 and by 0.770 for 1971 and 1969 respectively to give the corresponding road transport ratesfor these years.

The purpose of this Chapter is to test the hypothesis that the observed prices in each region are the joint equilibrium prices. The hypothesis is tested by comparing the difference between

observed prices for selected pairs of markets with the transport costs between these markets. If the observed store cattle prices are the joint equilibrium prices for a pair of regions, then the difference between these prices will be less than or equal to the transport cost between the two regions.

If the difference between the observed store cattle prices between pairs of regions is greater than the transport cost between the regions then further flows of store cattle may occur before the equilibrium position is reached. Therefore it is profitable to transport additional store cattle between pairs of regions until the equilibrium market prices are reached. Transport of additional store cattle between regions after this is not profitable.

6.2.1 Impact of Seasonal Conditions on Store Cattle Prices

Results of Chapters 4 and 5 indicated that seasonal conditions affect the price of store cattle in a particular region. In this Chapter it is hypothesised that the seasonal differential (difference in seasonal conditions) between two regions in a particular Autumn may influence store cattle prices in both regions. For instance, in a region experiencing good seasonal conditions the demand for store cattle may shift the region's demand curve to the right. Because in any year the supply in a region is predetermined, an increase in demand for store cattle will increase the price of store cattle in that region and thus make it more profitable to transport store cattle from surrounding regions. If the surrounding regions are experiencing average or poor seasonal conditions then the demand for store cattle in these regions may shift to the left. Thus the resulting store cattle price difference between regions may further favour the transfer of store stock to the region experiencing good seasonal conditions.

Thus, depending on the seasonal conditions that exist between any possible pair of regions, the degree of 'surplusness' or 'deficitness' of a region may vary in a particular year.

Seasonal feed conditions referred to in Chapter 3 (and set out in detail in Appendix II) are given in Table 6.2.4.

TABLE 6.2.4 SEASONAL FEED CONDITIONS FOR AUTUMN

	1968	1969	1970	1971	1972
Whangarei	P	A	A	A	G
Te Kuiti	P	A	P	A	G
Rotorua	P	A	P	A	G
Taranaki	A	A	A	P	G
Gisborne	A	P	A	G	G
Hawkes Bay	P	A	G	G	G
Manawatu	P	A	P	P	G
Wellington	P	P	P	P	G

Where P = Poor seasonal feed conditions
A = Average " " "
G = Good " " "

6.3 INVESTIGATION OF THE SPATIAL PRICE DISTRIBUTION OF GOOD WEANER STEERS IN RELATION TO TRANSPORT COSTS BETWEEN SELECTED PAIRS OF REGIONS.

Table 6.2.1 sets out transport costs, C_{pq}'s, for good weaner steers between each possible pair of regions.

For the analysis the pairs of regions were selected between which movements of store cattle were most likely to occur.

In particular, flows from the three surplus store producing regions, the East Coast, Wairarapa and Te Kuiti. These regions have an absolute advantage for breeding store cattle.

Thus, the sale centres, Gisborne, Masterton and Te Kuiti represent the regions from which, in general, there is a net outflow of store cattle. The transfer of store cattle from other regions also occurs, but the net transfer from other regions in any year may be determined to a greater extent by seasonal conditions. Also the quantity and price paid for store cattle purchased in Gisborne, Masterton and Te Kuiti by the surrounding regions will depend on the seasonal conditions on the farms of both vendors and purchasers.

The sale centres for the selected pairs of regions are set out in

Table 6.3 for the three years; 1972, 1970 and 1968.

In Table 6.3 the price difference, b_{pq}, represents the weaner steer price in the p^{th} region minus the weaner steer price in the q^{th} region.

The transport cost, C_{pq}, is the cost of transporting a weaner steer from the p^{th} region to the q^{th} region.

The regional price differential, d_{pq}, is the weaner steer price difference (b_{pq}) minus the transport cost (C_{pq}).

i.e. $d_{pq} = \left| b_{pq} \right| - C_{pq}$

In Table 6.3 only those regional price differentials with an absolute value greater than the transport cost are shown.

If $\left|b_{pq}\right| > C_{pq}$ and d_{pq} has a negative sign, additional flows of weaner steers from the p^{th} to the q^{th} region should theoretically be profitable.
Similarly, if $\left| b_{pq} \right| > C_{pq}$ and d_{pq} has a positive sign, additional flows of weaner steers from the q^{th} to the p^{th} region should theoretically be profitable.

This last result implies that surplus store producing regions would purchase store cattle from surrounding regions. For this reason the discussion is limited primarily to the movement of store cattle from the p^{th} surplus to the q^{th} deficit region as defined in Table 2.2.8. (Also it was recognised in Chapter 5 that there was a large number of store cattle available from the Stortford Lodge sale centre. Even though the region is defined as deficit, store cattle from surrounding counties are brought to Stortford Lodge for sale. It is the largest sale centre for the Hawke's Bay statistical area and therefore attracts a large number of vendors and purchasers).

Therefore, for the selected pairs, flows are in general from surplus store producing regions to surrounding growing and finishing regions.

Table 6.3 sets out the results of the analysis for the selected pairs of regions for 1972, 1970 and 1968. On a per head basis in 1972, the negative regional price differentials, d_{pq}'s, suggest

TABLE 6.3 GOOD WEANER STEERS, ANALYSIS OF REGIONAL PRICE DIFFERENCES AND TRANSPORT COSTS

			$/HEAD			C/LB		
1972			b_{pq}	c_{pq}	d_{pq}	b_{pq}	c_{pq}	d_{pq}
SALE CENTRES (SELECTED PAIRS) (p)		(q)						
TE KUITI	-	WHANGAREI	0	4.5		+1.4	1.1	
TE KUITI	-	ROTORUA	-20	2.7	-17.3	-5.0	0.6	-4.4
TE KUITI	-	NEW PLYMOUTH	- 6	2.7	- 3.3	-1.5	0.6	-0.9
GISBORNE	-	TE KUITI	+15	5.5	+ 9.5	+0.7	1.3	
GISBORNE	-	ROTORUA	- 5	3.7	- 1.3	-4.4	0.8	-3.6
GISBORNE	-	HASTINGS	+ 9	2.5	+ 6.5	+2.5	0.6	+1.9
GISBORNE	-	PALMERSTON NORTH	- 5	4.9	- 0.1	-1.6	1.1	-0.5
HASTINGS	-	PALMERSTON NORTH	-14	2.1	-13.9	-4.1	0.5	-3.6
MASTERTON	-	PALMERSTON NORTH	-15	1.5	-13.5	-4.1	0.3	-3.8
MASTERTON	-	HASTINGS	- 1	2.3		0.0	0.5	
1970								
SALE CENTRES (SELECTED PAIRS)								
TE KUITI	-	WHANGAREI	0	3.7		+0.9	0.9	0.0
TE KUITI	-	ROTORUA	-15	2.3	-13.7	-3.8	0.5	-3.3
TE KUITI	-	NEW PLYMOUTH	- 8	2.2	- 5.8	-2.0	0.5	-1.5
GISBORNE	-	TE KUITI	+15	4.5	+10.5	+3.6	1.0	+2.6
GISBORNE	-	ROTORUA	+ 5	3.0	+ 2.0	-0.1	0.7	
GISBORNE	-	HASTINGS	+12	2.0	+10.0	+3.1	0.5	+2.6
GISBORNE	-	PALMERSTON NORTH	+10	4.0	+ 6.0	+1.8	0.9	+0.9
HASTING	-	PALMERSTON NORTH	- 2	1.7	- 0.3	-1.2	0.4	-0.8
MASTERTON	-	PALMERSTON NORTH	- 2	1.2	- 0.8	-1.1	0.3	-0.8
MASTERTON	-	HASTINGS	0	1.9		+0.2	0.4	
1968								
SALE CENTRES (SELECTED PAIRS)								
TE KUITI	-	WHANGAREI	+10	3.4	+ 6.6	+3.1	0.8	+2.3
TE KUITI	-	ROTORUA	- 5	2.1	- 2.9	-1.3	0.5	-0.8
TE KUITI	-	NEW PLYMOUTH	+ 1	2.0		+0.3	0.5	
GISBORNE	-	TE KUITI	+ 5	4.1	+ 0.9	-0.4	0.9	
GISBORNE	-	ROTORUA	0	2.8		-1.6	0.6	-1.0
GISBORNE	-	HASTINGS	+ 9	1.9	+ 8.1	+2.2	0.4	+1.8
GISBORNE	-	PALMERSTON NORTH	0	3.7		-0.2	0.8	
HASTINGS	-	PALMERSTON NORTH	- 9	1.6	- 7.4	-2.5	0.4	-2.1
MASTERTON	-	PALMERSTON NORTH	- 2	1.1	- 0.9	-0.9	0.3	-0.6
MASTERTON	-	HASTINGS	+ 7	1.7	+ 5.3	+1.6	0.4	+1.2

that it is profitable to transport additional weaner steers from the surplus store producing regions of; Te Kuiti to Rotorua and New Plymouth, Gisborne to Rotorua and Palmerston North, and Masterton to Palmerston North. Weaner steers may also flow from Hastings to Palmerston North. The d_{pq}'s calculated on a cents/lb liveweight basis indicate that these flows are also profitable on a per lb basis.

Seasonal conditions for Autumn 1972 were good in all districts so that no seasonal differential exists between regions.

The possibility of additional flows suggests that the observed prices are not the equilibrium prices and that further flows of store cattle are still profitable and may occur before equilibrium prices will result.

In 1970 the negative d_{pq}'s indicate that additional flows of weaner steers would be profitable from; Te Kuiti to Rotorua and Taranaki; Hastings to Palmerston North; and Masterton to Palmerston North. Also the regional price differentials on a per/lb basis also suggest these flows are profitable.

Seasonal conditions in 1970 in each region suggest that the transfer of weaner steers from Te Kuiti to Taranaki would be assisted by the seasonal conditions. Weaner steers are moving from a region experiencing poor seasonal conditions to a region experiencing average seasonal conditions. Thus the seasonal differential may alter the regional price difference in Taranaki's favour.

Results for 1968 indicate that further flows of weaner steers should be profitable from; Te Kuiti to Rotorua; Hastings to Palmerston North; and Masterton to Palmerston North. Thus the observed prices do not appear to be the equilibrium prices for the above pairs of regions.

Although a negative regional price differential greater than the transport costs does not exist between Gisborne and Rotorua on a per head basis, it does exist on a per unit liveweight basis. This indicates that a descriptive problem may exist on a per head basis between districts and that flows are profitable if the per lb

liveweight prices are considered.

The negative regional price differentials over the three years suggest that additional flows of store cattle from Gisborne and Te Kuiti to Rotorua should be profitable.

Similarly additional flows from Hastings and Masterton to Palmerston North appear to be profitable on a per head and per unit liveweight basis.

The seasonal conditions in their dummy variable form do not seem to have much impact on regional price differentials. However a more precise seasonal index may indicate a more definite relationship between seasonal conditions and regional price differences.

The above results indicate that additional flows of store cattle from the surplus store producing regions to the growing and finishing regions is profitable. This suggests that the observed market prices in each region are not the equilibrium market prices and that additional flows of store cattle are profitable till this equilibrium position is reached.

6.4 INVESTIGATION OF THE SPATIAL PRICE DISTRIBUTION OF 2½ YEAR STEERS IN RELATION TO TRANSPORT COSTS BETWEEN REGIONS.

Table 6.1.2 indicates the matrix of transport costs, C_{pq}'s between each possible pair of regions. However the analysis is restricted to those regions between which inter-regional flows of store cattle are known to occur and are the same as for weaner steers.

Compared with weaner steers the transfer of 2½ year steers between farms are not as important. In fact Table 2.3.2.2 indicates that 2½ year steers constitute only about 8% of store cattle sales for Meat and Wool Board Survey farms in Hawke's Bay, whereas weaner steers comprise 40%.

The results of the analysis are summarised in Table 6.4 for the years 1972, 1971 and 1969 where b_{pq}, C_{pq}, and d_{pq} are the same as for the weaner steer analysis.

In 1972 the negative regional price differentials, d_{pq}'s indicate that further flows of 2½ year steers are profitable from; Te Kuiti

TABLE 6.4 2½ YEAR STEERS, ANALYSIS OF REGIONAL PRICE DIFFERENCES AND TRANSPORT COSTS

			$/HEAD			C/LB		
1972 SALE CENTRES (SELECTED PAIRS)			b_{pq}	c_{pq}	d_{pq}	b_{pq}	c_{pq}	d_{pq}
(p)		(q)						
TE KUITI	-	WHANGAREI	-25	8.9	-16.1	-1.4	1.0	-0.4
TE KUITI	-	ROTORUA	-30	5.3	-24.7	-3.3	0.6	-2.7
TE KUITI	-	NEW PLYMOUTH	-25	4.8	-25.2	-2.8	0.5	-2.3
GISBORNE	-	TE KUITI	+35	10.6	+24.4	+3.1	1.1	+2.0
GISBORNE	-	ROTORUA	+ 5	7.1		-0.2	0.8	
GISBORNE	-	HASTINGS	+16	4.6	+11.4	+1.8	0.5	+1.3
GISBORNE	-	PALMERSTON NORTH	0	8.6		-0.7	0.9	
HASTINGS	-	PALMERSTON NORTH	+10	5.7	+ 4.3	+1.1	0.6	+0.5
MASTERTON	-	PALMERSTON NORTH	- 5	2.7	- 2.3	-1.3	0.3	-1.0
MASTERTON	-	HASTINGS	+16	3.7	+12.3	+2.6	0.4	+2.2
1971 SALE CENTRES (SELECTED PAIRS)								
TE KUITI	-	WHANGAREI	-10	7.7	-3.3	0.1	0.8	
TE KUITI	-	ROTORUA	-20	4.5	-15.5	-2.2	0.5	-1.7
TE KUITI	-	NEW PLYMOUTH	-20	4.2	-15.8	-2.2	0.5	-1.7
GISBORNE	-	TE KUITI	+25	9.2	+15.8	+2.1	1.0	+1.1
GISBORNE	-	ROTORUA	+ 5	6.1		-0.2	0.7	
GISBORNE	-	HASTINGS	+ 4	4.0		+0.6	0.4	+0.2
GISBORNE	-	PALMERSTON NORTH	+ 5	7.4		-0.2	0.8	
HASTINGS	-	PALMERSTON NORTH	0	4.9		0.0	0.4	
MASTERTON	-	PALMERSTON NORTH	- 5	2.4	- 2.6	-1.2	0.3	-0.9
MASTERTON	-	HASTINGS	- 1	2.7		-0.5	0.4	-0.1
1969 SALE CENTRES (SELECTED PAIRS)								
TE KUITI	-	WHANGAREI	-10	6.8	+ 3.2	+1.4	0.7	+0.7
TE KUITI	-	ROTORUA	0	4.0		-0.6	0.4	-0.2
TE KUITI	-	NEW PLYMOUTH	+15	3.7	+11.3	+1.1	0.4	+0.7
GISBORNE	-	TE KUITI	+ 7	8.2		+0.8	0.9	
GISBORNE	-	ROTORUA	+ 7	5.4	+ 1.6	+0.2	0.6	
GISBORNE	-	HASTINGS	+ 7	3.6	+ 3.4	+0.8	0.4	+0.4
GISBORNE	-	PALMERSTON NORTH	- 3	6.6		-0.9	0.7	-0.2
HASTINGS	-	PALMERSTON NORTH	+15	4.4	+10.6	+2.8	0.5	+2.3
MASTERTON	-	PALMERSTON NORTH	0	2.1		-0.6	0.2	-0.4
MASTERTON	-	HASTINGS	+10	2.8	+ 7.2	+1.7	0.3	+1.4

to Whangarei, Rotorua and New Plymouth; and Masterton to Palmerston North.

The existence of the necessary price differentials in excess of the transport costs suggest that the observed prices are not the joint equilibrium prices and that further flows are profitable before equilibrium prices and flows are reached.

In 1972 seasonal feed conditions were similar (good) in all regions.

The results for 1971 indicate that it would be profitable to transport 2½ year steers from; Te Kuiti to Whangarei, Rotorua and New Plymouth; and, Masterton to Palmerston North.

The regional price differentials, d_{pq}'s on a per unit liveweight basis suggest the further flow of 2½ year steers from Masterton to Hastings.

Removal of the descriptive problem that may exist between 2½ year steers in Te Kuiti and Whangarei (by adjusting to a per lb liveweight basis) indicates that no regional price differential (net of transport costs) exists between the two regions for 2½ year steers.

For 1969 the results, only on a per unit liveweight basis, suggest it is profitable to transport additional 2½ year steers from; Te Kuiti to Rotorua, Gisborne to Palmerston North; and, Masterton to Palmerston North which again suggest that the observed market are not the equilibrium market prices.

If flows were to occur from the q^{th} to the p^{th} region suggested by the positive d_{pq}'s, then this would imply that the predominantly store producing regions could purchase store cattle at a cheaper price in surrounding regions than they could produce them. However surplus store producing areas are defined as having a comparative advantage for breeding store cattle.

In general the results for the selected pairs suggest that it is profitable to transport additional 2½ year steers between regions.

6.5 SUMMARY RESULTS IN CHAPTER 6

The results of the analysis in Tables 6.3 and 6.4 suggest that additional flows of weaner steers and 2½ year steers from store

producing areas to growing and finishing areas would be profitable for traders.

In particular, for weaner steers additional flows are profitable from; Te Kuiti to Rotorua, Gisborne to Rotorua and Palmerston North (only in 1972); and, Hastings and Masterton to Palmerston North.

For 2½ year steers, additional flows of 2½ year steers are profitable from; Te Kuiti to Whangarei, Rotorua and New Plymouth (for 1972 and 1971); Masterton to Palmerston North; and, Gisborne to Palmerston North (in 1969).

It was hypothesised that the observed market prices in each region are the equilibrium market prices if they are separated only by the transport costs between regions. If this is true, then the present flows of store cattle satisfy the equilibrium position.

The results in this Chapter suggest that further transfers of weaner steers and 2½ year steers from store producing regions are profitable. Therefore, in general, the observed prices are not the equilibrium prices for each region.

However the Lands and Survey Department prices for each region are an average for the whole of the sale period. Regional differences may exist which result in the transfer of store cattle between regions. Taking the average price for the Autumn sale period may obscure differences in the market prices. Actual sale prices fluctuate and the prices paid at any one sale may result in the transfer of store stock from one region to another.

Seasonal conditions specified in this analysis do not appear to have any impact on the regional price differentials. However changes in seasonal conditions do affect the number of store cattle purchased in a region. The use of a more precise seasonal index, such as a rainfall or soil water moisture index, may indicate a more definite relationship between seasonal conditions and regional price differences.

Finally, the liveweight estimates set out in Table 5.1 represent an appraisal of the average weight in a typical year. In a poor season, the store cattle weights would be expected to be less than

average, but no account of this effect is taken in the analysis.

Therefore the reasons why this movement is not achieved appear to be :

(1) Difficulties of definition and of availability of the appropriate data.

(2) Some regions are virtually self-sufficient in store stock and hence clear inter-regional flows are obscured.

(3) Lack of perfect knowledge on the behalf of the farmers.

CHAPTER SEVEN

SUMMARY AND CONCLUSIONS

INTRODUCTION

The substantial increases in overseas beef prices in recent years have made the farming of beef cattle increasingly important to the New Zealand economy, thus making the cattle industry an important area for research. This study describes the place of the store cattle sector within the cattle industry and investigates price formation in the store cattle market.

7.1 THE AIMS OF THE STUDY

The specific aims of the study were as follows :

1. To identify and describe the various channels and institutions involved in store cattle marketing.
2. To investigate the process of price formation for store cattle on an annual basis.
3. To study the relationship of the prices of various classes of store cattle to each other and to the meat exporters' beef schedule.
4. To investigate the inter-regional price differences for classes of store cattle in relation to the transport cost differentials between regions.

7.2 SUMMARY OF RESULTS

7.2.1 Structure of the Store Cattle Industry

Chapter 2 describes the North Island cattle industry, the store cattle sector, and the institutions and channels involved in the marketing of store and finished cattle. Chapter 2 also outlines the structural changes that have occurred in the North Island beef herd between 1965 and 1971. Over this period there has been a 41% increase in the total number of beef cattle in the North Island (and a 45% increase for New Zealand). Also there has been a build up in the proportion of younger steers in the beef herd at the expense of breeding cows and older steers. Over the same period the number of dairy

calves bred and retained for beef purposes increased from approximately 180,000 to 460,000. The rearing of calves from the dairy herd suitable for beef production has made possible a far greater expansion of beef production than would have been possible from the traditional beef herd alone.

It is also important to note that the structural changes in the traditional beef herd may be disguised, in areas with a large number of dairy cattle, by the presence of dairy beef animals suitable for beef purposes that are classified as beef cattle in the agricultural production statistics.

7.2.2 Price Formation in the Store Cattle Industry

The beef cattle industry is a two-tiered structure with the transfer of store cattle from store producing farms to growing and finishing farms. Given that some areas are more suited to one purpose than the other, this movement of store cattle implies regional movements of cattle - inter-regional flows, which add a spatial element to price formation in the store cattle industry.

Present data limitations made it impossible to investigate the spatial nature of the North Island store cattle industry using the transport model of Judge and Wallace [32]. Also inter-regional flows of store cattle, essential for comparison with the optimum flows generated by the model are not available. All we know is that inter-regional movements of store cattle occur, but these flows have never been quantified.

Though a structural model, incorporating estimated quantities supplied and demanded in each region cannot be formulated it was still possible to achieve the objectives of this study by analysing market prices for different classes of store stock within a regional framework. In theory, joint equilibrium market prices in different markets for store cattle should not vary by more than the observed transport costs between markets. If regional prices differ by more than inter-regional transport costs, the

total market is not in equilibrium (provided there is no other satisfactory explanation for the excess price differences.)

A statistical model similar to that used by Matheson and Philpott [36] was formulated to analyse store market prices for different classes of stock within a regional framework. The factors influencing the price of store cattle included in the analysis were beef schedule price (OxGAQ), seasonal conditions, class of store cattle, and region of origin.

Results of the model estimated on a per head basis show, as expected, that prices paid for store cattle on a per head basis increase as store cattle become older (and heavier). Also as the age of the store animal increases, changes in the beef schedule prices are reflected in greater increases in store prices.

Seasonal conditions contribute to store cattle price formation. The effect of an average season and a good season are positive and of the expected magnitude (i.e. good seasonal conditions increase store stock prices more than an average season). The effect of seasonal conditions is the same in all regions and on all classes of stock.

Store cattle prices exhibit regional differences in the North Island models for Autumn and Spring. However for the individual region analyses there were no systematic differences for classes of store cattle between regions.

The statistical model was re-estimated with store cattle prices on a per lb liveweight basis in an attempt to remove the descriptive (weight and quality) problems that arise in the reporting of store cattle prices on a per head basis between regions. The results obtained were consistent with the conclusions of recent theoretical beef investment models, such as Yver's [53] and Jarvis' [28] which investigate investment behaviour in the Argentine cattle industry.

In particular the results of the statistical model on a per lb liveweight basis indicated that :

1. The store value of an animal on a per lb basis is greater than its slaughter value at any age prior to slaughter, and equal to it at slaughter. The per lb store value of a steer is larger for younger classes of finishing stock (steers) and declines with age.

2. Changes in seasonal conditions (which alter the opportunity cost of grass) have a greater impact on the price of younger classes of store cattle. This difference in the impact of seasonal conditions on classes of stock was not evident in the per head model.

3. The beef schedule price coefficients for individual classes of store cattle (steers) on a per lb basis indicate that a unit change in the beef schedule price has a greater effect on the prices of younger classes of store cattle. This is in direct contrast with the beef schedule price coefficients for the per head model where, as the age of the store animal increases, changes in the beef schedule are reflected in greater increases in store prices.

4. The elasticity of store cattle prices with respect to the beef schedule price, for growing and finishing cattle, is greater than unity for all cattle in the herd below the optimum slaughter age and declines monotonically towards unity as the animal approaches this slaughter age.

   The elasticities suggest that the optimum slaughter age for store cattle in the North Island is approximately 2½ years. Although an optimum growing and finishing policy on fat lamb farms suggests a slaughter age of 18-20 months (Lowe [35]), in aggregate, for all land types in the North Island, cattle may not be finished till an older age because of physical restrictions on the growing and

finishing of cattle that exist in some regions. Also this may take into account the supplementary uses of cattle on many farms such as development work on hill country.

In the per lb liveweight analysis regional price differences do exist for both Autumn and Spring in the aggregate North Island model. However, for the individual regional analyses price differences for classes of store cattle do not exist in any systematic and identifiable pattern.

The investigation of the spatial distribution of store cattle prices in relation to the transport costs between selected pairs of regions for good weaner steers and 2½ year steers suggested that the observed market prices were not the equilibrium market prices. Regional price differential in excess of transport costs exist between the surplus store producing regions and the surrounding growing and finishing regions. This suggests that additional shipments of store cattle by traders would be profitable.

7.2.3 Data Limitations and Possible ways of Overcoming These in Future Research

The absence of a suitably documented series of prices from different regions restricted the scope of the analysis. The Lands and Survey Department price series are an average price for a sale period - Autumn; April and May, Spring; August, September and October. These prices therefore would not take into account within season fluctuations in store prices which could be important in explaining inter-regional shipments of store cattle.

The livestock prices also suffer from reporting bias due to the descriptive (weight and quality) norms that become accepted in different regions. Also between years, a change in reporter will also effect the consistency of the price series.

However, over more recent years McCaw [38] and others have been assembling store stock prices from different sale centres that could be used in a similar type of analysis.

The estimates of liveweights of store cattle used were subjective estimates for a typical year and do not reflect real changes in the weights of animals between years.

However, Beef Plan [50], the revised and expanded National Beef Recording Service started in July 1973 will eventually provide information on the liveweight of beef weaners from commercial herds for several regions. This information could be used to adjust regional store cattle prices for liveweight and thus remove the imprecise descriptive and quality component that now exists in the reporting of store cattle prices. This would allow the 'true' regional effect on store cattle prices to be identified more closely.

Seasonal conditions specified in this analysis do not appear to have any impact on the regional price differences. However changes in seasonal conditions do affect the number of store cattle purchased in a region. The use of a more precise seasonal index, such as a rainfall or soil water moisture index, may indicate a more definite relationship between seasonal conditions and regional price differences.

In general, economic forces tend to restrict the store producing enterprise to the hill country where it has a comparative advantage over the growing and finishing enterprise. Store cattle will flow from the former to the latter. However, this movement of store stock from breeding to finishing enterprises may occur without any inter-regional flows occurring because regions are heterogeneous with land suitable for both breeding and finishing store cattle. Therefore, transfer of store cattle between the regions may be minor compared with the intra-regional flows that occur.

This lack of regional specialisation means that the researcher's ability to initially define regions as surplus and deficit for a transport model is difficult. Also the classification of dairy animals, suitable for beef production as beef cattle in the national statistics disguises the movements and changes in the number of beef cattle in statistical areas.

Inter-regional flows of store cattle, essential for comparison with the optimum flows generated by a transport model are not available. If the recommendations of the Meat Industry Inquiry [40] with respect to the recording of movements of stock is carried out, then future research could more closely investigate the spatial equilibrium hypotheses set out in the Judge and Wallace model.

7.3 CONCLUSIONS

The statistical model formulated adequately explains changes in store stock prices in the period concerned (1957 - 1972) in terms of the beef schedule price for finished cattle with systematic allowance for the differences in store stock prices due to class of stock, region of origin, and seasonal conditions.

The model formulated allows all the data to be analysed simultaneously so that significant differences in the effects of each variable can be collectively tested.

Although the model did indicate regional differences for the per head and per lb liveweight North Island models, no systematic and identifiable regional pattern of store cattle prices was apparent for individual classes of stock when the region models were estimated separately.

However, the results did indicate that the behaviour of farmers in New Zealand with respect to the prices paid for store cattle (on a per lb basis) is consistent with investment behaviour, making due allowance for the time which will elapse between purchase and slaughter.

Also the investigation of the regional price differences of

store cattle prices for selected pairs of regions indicated that regional price differences in excess of the transport costs between regions exist. This suggests that it would be profitable for traders to transfer additional store cattle from the surplus store producing regions to the growing and finishing regions.

REFERENCES

[1] New Zealand Dairy Board
Farm Production Reports 1958-1973

[2] New Zealand Department of Statistics.
Agricultural Statistics 1960-1971.

[3] New Zealand Department of Statistics
New Zealand Official Year Book 1957-1974.

[4] New Zealand Department of Statistics
External Trade of New Zealand. Volume and Value. 1960-1972

[5] New Zealand Department of Statistics
Agricultural Statistics Bulletins

[6] New Zealand Meat Producers' Board
Annual Reports 1957-1973

[7] New Zealand Meat and Wool Boards' Economic Service
Annual Review of the Sheep Industry 1957-1973.

[8] New Zealand Meat and Wool Boards' Economic Service
Sheep Farm Survey and Annual Supplements.

[9] New Zealand Ministry of Agriculture and Fisheries
Annual Reports 1957-1972

[10] New Zealand Ministry of Agriculture and Fisheries
Livestock Slaughtering Statistics

[11] New Zealand Reserve Bank Statistics
Overseas Exchange Transactions

[12] Baker, J.L. and Everitt, G.C. 1968. A survey of vendors and purchasers of dairy beef weaners entered at Frankton Saleyards December 4, 1967.
Beef Developments, 2 (2):13.

[13] Barton, R.A. 1965. New Zealand bobby calf industry: past, present and probable.
N.Z. Agric. Sci., 1 (2):S

[14] Bevin, R.H. 1961. Beef Cattle Production.
Proc. Ruakura Fmr's Conf. Wk. 1961. pp 79 - 84.

[15] Calder, M.W. 1971. Proportion of export beef production from the dairy herd.
Unpublished paper. New Zealand Meat Producers' Board.

[16] Callow, C. 1971. Dairy Beef Weaner Sales.
Unpublished paper. Ministry of Agriculture and Fisheries, Hamilton.

[17] Callow, C. 1971. Special dairy beef yearling sales Pukekohe.
Unpublished paper. Ministry of Agriculture and Fisheries, Hamilton.

[18] Clarke, N.A. 1966 Sheep farming topics.
N.Z. Fmr. 14 Apr : 38, 12 May 1966:40.

[19] Currie, J.D. and Thompson, K.F. 1971 Weight recorded beef weaner sales at Omarama 1971.
Ministry of Agriculture and Fisheries, Otago.

[20] Duncan, D.B. 1955 Multiple Range and Multiple F Tests
Biometrics Vol II No. 1 March 1955. pp 1 - 42.

[21] Enke, S. 1951 Equilibrium among spatially separated markets: Solution by electric analogue.
Econometrica, Vol 19 pp 40 - 48.

[22] Everitt, G.C.; Clark, I.N.; Green, C. and Bennet, J. 1970 Local marketing arrangements for store and slaughtering cattle.
New Zealand Beef Production, Processing and Marketing, NZIAS.

[23] Everitt, G.C. and Baker, J.L.H. 1968 Auction sales for dairy beef weaners.
N.Z. Jl. Agric. 117(5):62.

[24] F.A.O. Trade Statistics 1971. Rome,

[25] Graham, R. 1948. The place of cattle in hill country farming.
Sheepfarming Annual 1948. pp 166 - 174.

[26] Hannan, E.J. 1960. Time series analysis. New York.
John Wiley and Sons Inc. pp 117 - 133.

[27] Hocking, B.J. 1972. Cattle on the hills.
N.Z. Jl. Agric. 124(3):3 pp 21 - 36.

[28] Jarvis, L.S. 1969. Supply response in the cattle industry : The Argentine case.
Unpublished Ph.D. Thesis, Massachusetts Institute of Technology.

Jarvis, L.S. 1973. Cattle as capital goods and ranchers as portfolio managers.
An application to the Argentine Cattle Sector, Dept. of Economics, University of California, Berkeley.

[29] Johnson, R.D. 1972. An economic evaluation of alternative marketing methods for fed cattle.
Farm Economics Division, University of Nebraska and E.R.S U.S.D.A.

[30] Johnson, R.W.M. 1970. A regional analysis of future sheep production in New Zealand.
A.E.R.U. Lincoln College Research Report No. 63.

[31] Johnston, J. 1960. Econometric methods.
International Student Edition, McGraw-Hill.

[32] Judge, G.G. and Wallace, T.D. 1969. Spatial price equilibrium analyses of the livestock economy. Dept. of Ag. Econ. Oklahoma State University Technical Bulletin 78.

[33] Kingma, O.T. 1968. Investigation into the economics and management of beef cattle on the Canterbury Plains. Unpublished Masters Thesis, Lincoln College.

[34] Lattimore, R.G. 1970. The comparative profitability of milk and beef production on seasonal supply dairy farms. Unpublished Masters Thesis, Massey University.

[35] Lowe, K.I. 1971. The profitability of beef production on some New Zealand sheep farms. Unpublished Masters Thesis, Massey University.

[36] Matheson, M.J. and Philpott, B.P. 1967. The regional pattern of the demand for meat in the United Kingdom. A.E.R.U. Lincoln College Research Publication No. 31.

[37] Maunder, W.J. 1971. The value and use of weather information. Technical Bulletin, Meteorological Office, Wellington.

[38] McCaw, J.T. 1974 N.Z. Herald livestock correspondent. Personal comment.

[39] McLatchy, D. 1968. A linear programming study of the supply of store beef cattle from hill country farms. Unpublished Masters Thesis, Lincoln College.

[40] Meat Industry. 1974. Report of the Commission of Inquiry into the Meat Industry. Recommendation No. 153 N.Z. Govt. Printer, Wellington.

[41] Parker, B.W. 1966. On store hill country sheep can give greater returns than cattle. N.Z. Jl. Agr. 113.2 : pp 58 - 61.

[42] Paterson, D.D. 1939. Statistical technique in agricultural research: McGraw-Hill. pp 38 - 42

[43] Philpott, B.P. 1954. Estimating the prices of store stock. Unpublished paper, N.Z. Meat and Wool Boards' Economic Service.

[44] South Auckland Beef Development Committee. 1970. Buying and selling policies. Beef Production and Marketing Bulletin.

[45] Stock and Station Agents Association, N.Z. 1973. Livestock statistics North Island 1970/71, 1971/72 and 1972/73 seasons. Cyclostyled paper.

[46] Taylor, N.W. 1974. Chief Economist Meat and Wool Boards' Economic Service.
Personal Comment.

[47] Tomek, W.G. 1963. Using zero-one variables with time series data in regression equations.
J.F.E. Vol. 45 No. 4 pp 814 - 822.

[48] Trierweiler, J.F. and Hassler, J.B. 1971. Measuring efficiency in the beef-pork sector by price analysis.
Jl. Ag. Econ. Research Vol. 23. No. 1 pp 11 - 17.

[49] Tuck, I.D. and Everitt, G.C. 1969. The special auctions of dairy beef weaners held at Frankton Saleyards on November 11 and December 9, 1968.
Beef Developments, 3(1):5.

[50] Wallace, L.R. 1973. Facts about beef plan - the revised and expanded national beef recording service.

[51] Ward, F.L. 1962. Beef cattle and sheep on hill country farms.
Proc. N.Z. Soc. Anim. Prod. Conf. 28 pp 121 - 130.

[52] Watson, N. 1964. Seasonal livestock values.
Reprint from Sheepfarming Annual 1964.

[53] Yver, R.E. 1971. The investment behaviour and supply response of the cattle industry in Argentina.
Unpublished Ph.D. Thesis, University of Chicago. pp 6 - 23.

APPENDIX I

OX GAQ SCHEDULE - NORTH ISLAND

(TOP WEIGHT GRADE $/100 LB)

	AUTUMN[1]	SPRING[2]
1957	10.00	8.25
1958	13.25	13.00
1959	12.50	13.50
1960	14.00	14.00
1961	12.25	11.50
1962	11.75	12.83
1963	12.50	12.50
1964	14.25	15.00
1965	15.00	15.00
1966	16.00	15.50
1967	14.75	14.00
1968	17.50	18.00
1969	19.10	21.00
1970	24.50	22.50
1971	24.50	25.50
1972	24.00	25.50

1) AUTUMN[1] AVERAGE OF MID-MONTH SCHEDULE PRICE FOR APRIL AND MAY

2) SPRING[2] AVERAGE OF MID-MONTH SCHEDULE PRICE FOR AUGUST, SEPTEMBER AND OCTOBER

SOURCE: NEW ZEALAND MEAT PRODUCERS' BOARD ANNUAL REPORTS

APPENDIX II

SEASONAL CONDITIONS - NORTH ISLAND

		NORTHLAND	TE KUITI	ROTORUA	TARANAKI	EAST COAST	CENTRAL HAWKES BAY	MANAWATU	WAIRARAPA
1957	AUTUMN	G	G	G	G	A	A	A	A
	SPRING	A	P	G	A	G	G	G	G
1958	AUTUMN	A	A	A	G	P	P	A	P
	SPRING	A	A	A	P	P	P	P	P
1959	AUTUMN	G	A	G	P	A	A	A	P
	SPRING	P	A	G	G	P	P	A	P
1960	AUTUMN	G	G	G	G	G	G	G	A
	SPRING	G	A	P	P	A	A	G	G
1961	AUTUMN	A	A	A	A	G	A	P	A
	SPRING	A	A	G	G	G	G	P	A
1962	AUTUMN	P	A	P	G	P	P	A	A
	SPRING	P	P	P	P	P	P	P	P
1963	AUTUMN	A	A	A	A	A	A	A	A
	SPRING	A	G	G	G	G	G	G	A
1964	AUTUMN	A	A	A	A	P	P	P	P
	SPRING	P	A	P	A	P	A	A	A
1965	AUTUMN	G	G	A	G	G	G	A	G
	SPRING	G	G	G	G	G	G	G	G
1966	AUTUMN	G	G	G	G	P	G	G	G
	SPRING	A	A	G	P	A	A	A	P
1967	AUTUMN	P	A	P	P	P	P	A	A
	SPRING	P	P	P	P	P	P	P	A
1968	AUTUMN	P	P	P	A	A	P	P	P
	SPRING	P	P	P	P	P	P	P	P
1969	AUTUMN	A	A	A	A	P	A	A	P
	SPRING	P	A	P	P	A	A	P	P
1970	AUTUMN	P	P	P	A	A	G	P	P
	SPRING	G	G	P	G	G	G	G	G
1971	AUTUMN	A	A	A	P	G	G	P	P
	SPRING	P	A	A	P	P	A	A	A
1972	AUTUMN	G	G	G	G	G	G	G	G
	SPRING	P	P	P	A	P	P	P	P

WHERE P= POOR SEASONAL CONDITIONS
A= AVERAGE SEASONAL CONDITIONS
G= GOOD SEASONAL CONDITIONS

APPENDIX III

CLASSES OF STORE CATTLE IN EACH REGION

I AUTUMN

NORTH AUCKLAND (WHANGAREI)

	Weaner Heifers Good	Cows Breeding	Cows Cull	Weaner Steers Good	Weaner Steers Medium	18 Month Steers	2½ Year Steers	Store Bullocks
1957	20.00	36.00	38.00	24.00	20.00	32.00	42.00	46.00
1958	24.00	52.00	56.00	30.00	24.00	42.00	52.00	58.00
1959	30.00	54.00	56.00	30.00	26.00	44.00	50.00	74.00
1960	30.00	52.00	40.00	30.00	26.00	46.00	60.00	64.00
1961	24.00	46.00	34.00	31.00	26.00	48.00	58.00	70.00
1962	20.00	34.00	22.00	22.00	18.00	26.00	32.00	56.00
1963	20.00	36.00	30.00	24.00	19.00	38.00	52.00	60.00
1964	33.00	44.00	34.00	36.00	33.00	48.00	56.00	68.00
1965	42.00	70.00	50.00	46.00	36.00	52.00	59.00	74.00
1966	52.00	84.00	60.00	54.00	48.00	66.00	76.00	82.00
1967	28.00	54.00	48.00	32.00	26.00	50.00	64.00	76.00
1968	30.00	65.00	45.00	35.00	28.00	45.00	65.00	80.00
1969	38.00	60.00	45.00	50.00	45.00	65.00	75.00	85.00
1970	45.00	90.00	60.00	55.00	45.00	78.00	95.00	112.00
1971	48.00	90.00	80.00	55.00	45.00	95.00	110.00	120.00
1972	70.00	120.00	80.00	80.00	70.00	10.00	125.00	135.00

TE KUITI

1957	24.00	46.00	32.00	28.00	24.00	40.00	50.00	58.00
1958	26.00	56.00	40.00	30.00	26.00	48.00	54.00	70.00
1959	30.00	56.00	48.00	36.00	30.00	51.00	56.00	70.00
1960	32.00	60.00	50.00	40.00	32.00	60.00	64.00	76.00
1961	30.00	52.00	32.00	36.00	30.00	56.00	56.00	70.00
1962	26.00	34.00	26.00	28.00	24.00	52.00	52.00	58.00
1963	24.00	48.00	56.00	28.00	24.00	48.00	56.00	68.00
1964	34.00	50.00	36.00	42.00	36.00	56.00	68.00	76.00
1965	44.00	70.00	56.00	56.00	48.00	72.00	86.00	90.00
1966	44.00	74.00	56.00	60.00	50.00	64.00	80.00	84.00
1967	32.00	60.00	40.00	36.00	30.00	54.00	70.00	72.00
1968	32.00	60.00	44.00	45.00	35.00	55.00	70.00	75.00
1969	40.00	60.00	45.00	50.00	40.00	60.00	80.00	85.00
1970	45.00	80.00	65.00	55.00	45.00	75.00	100.00	110.00
1971	55.00	100.00	70.00	70.00	60.00	80.00	100.00	120.00
1972	60.00	100.00	80.00	80.00	65.00	95.00	100.00	120.00

ROTORUA

1957	24.00	50.00	40.00	28.00	25.00	38.00	42.00	58.00
1958	28.00	56.00	46.00	34.00	28.00	42.00	54.00	58.00
1959	30.00	64.00	48.00	40.00	30.00	44.00	54.00	60.00
1960	36.00	68.00	50.00	44.00	36.00	56.00	64.00	72.00
1961	36.00	56.00	40.00	40.00	28.00	52.00	64.00	68.00
1962	24.00	56.00	36.00	32.00	24.00	40.00	50.00	58.00
1963	26.00	56.00	40.00	36.00	28.00	42.00	55.00	64.00
1964	40.00	60.00	48.00	46.00	36.00	60.00	70.00	76.00
1965	50.00	80.00	60.00	65.00	54.00	74.00	86.00	86.00
1966	60.00	90.00	60.00	70.00	56.00	76.00	88.00	88.00
1967	40.00	80.00	44.00	50.00	36.00	56.00	80.00	80.00
1968	44.00	85.00	50.00	50.00	44.00	70.00	80.00	87.00
1969	55.00	85.00	54.00	60.00	54.00	76.00	85.00	95.00
1970	70.00	85.00	60.00	70.00	62.00	80.00	92.00	66.00
1971	75.00	120.00	85.00	85.00	75.00	100.00	120.00	125.00
1972	85.00	125.00	85.00	100.00	85.00	110.00	130.00	135.00

TARANAKI (NEW PLYMOUTH)

	Weaner Heifers Good	Cows Breeding	Cows Cull	Weaner Steers Good	Weaner Steers Medium	18 Month Steers	2½ Year Steers	Store Bullocks
1957	23.00	32.00	22.00	30.00	23.00	35.00	44.00	46.00
1958	28.00	56.00	48.00	34.00	30.00	48.00	55.00	66.00
1959	28.00	52.00	36.00	36.00	29.00	44.00	56.00	66.00
1960	28.00	56.00	40.00	37.00	30.00	44.00	60.00	72.00
1961	28.00	50.00	40.00	36.00	32.00	52.00	66.00	70.00
1962	24.00	42.00	31.00	23.00	20.00	37.00	50.00	62.00
1963	23.00	44.00	32.00	33.00	28.00	40.00	50.00	64.00
1964	30.00	50.00	38.00	38.00	32.00	56.00	68.00	78.00
1965	40.00	64.00	36.00	52.00	40.00	68.00	77.00	80.00
1966	48.00	72.00	40.00	54.00	44.00	68.00	80.00	90.00
1967	33.00	56.00	40.00	38.00	30.00	56.00	76.00	84.00
1968	35.00	60.00	25.00	44.00	35.00	60.00	70.00	85.00
1969	40.00	70.00	50.00	50.00	40.00	60.00	70.00	90.00
1970	38.00	78.00	65.00	63.00	52.00	87.00	125.00	132.00
1971	45.00	100.00	65.00	70.00	65.00	80.00	120.00	125.00
1972	72.00	97.00	68.00	86.00	73.00	78.00	125.00	132.00

EAST COAST (GISBORNE)

1957	20.00	40.00	32.00	28.00	24.00	35.00	41.00	46.00
1958	16.00	52.00	40.00	22.00	18.00	42.00	54.00	66.00
1959	28.00	58.00	48.00	39.00	31.00	50.00	66.00	70.00
1960	40.00	62.00	54.00	48.00	40.00	54.00	62.00	74.00
1961	32.00	50.00	40.00	46.00	36.00	54.00	72.00	80.00
1962	23.00	34.00	32.00	32.00	23.00	34.00	44.00	60.00
1963	28.00	40.00	30.00	40.00	34.00	48.00	56.00	68.00
1964	30.00	50.00	32.00	40.00	34.00	58.00	66.00	72.00
1965	42.00	60.00	44.00	60.00	52.00	66.00	76.00	92.00
1966	50.00	70.00	56.00	60.00	50.00	66.00	76.00	86.00
1967	40.00	60.00	50.00	48.00	38.00	62.00	78.00	84.00
1968	52.00	80.00	70.00	50.00	38.00	63.00	80.00	104.00
1969	46.00	70.00	60.00	66.00	58.00	71.00	92.00	95.00
1970	56.00	85.00	70.00	80.00	65.00	85.00	110.00	110.00
1971	60.00	115.00	90.00	85.00	75.00	105.00	125.00	130.00
1972	75.00	125.00	100.00	95.00	86.00	115.00	135.00	145.00

HAWKES BAY (HASTINGS)

1957	26.00	40.00	28.00	35.00	30.00	44.00	53.00	56.00
1958	25.00	54.00	40.00	33.00	28.00	48.00	56.00	70.00
1959	32.00	60.00	48.00	38.00	36.00	54.00	66.00	70.00
1960	34.00	66.00	52.00	44.00	40.00	60.00	71.00	79.00
1961	30.00	48.00	40.00	42.00	35.00	59.00	70.00	76.00
1962	20.00	36.00	34.00	27.00	24.00	36.00	43.00	53.00
1963	22.00	47.00	34.00	34.00	26.00	53.00	66.00	68.00
1964	28.00	46.00	37.00	33.00	28.00	54.00	67.00	78.00
1965	44.00	68.00	42.00	51.00	45.00	69.00	79.00	85.00
1966	46.00	75.00	55.00	53.00	46.00	72.00	86.00	90.00
1967	34.00	64.00	50.00	45.00	36.00	66.00	76.00	80.00
1968	32.00	76.00	61.00	41.00	36.00	66.00	80.00	85.00
1969	43.00	78.00	66.00	52.00	46.00	71.00	85.00	95.00
1970	52.00	95.00	86.00	68.00	54.00	86.00	97.00	114.00
1971	57.00	107.00	90.00	81.00	72.00	105.00	121.00	129.00
1972	67.00	95.00	87.00	86.00	78.00	95.00	119.00	123.00

MANAWATU (PALMERSTON NORTH)

	Weaner Heifers Good	Cows Breeding	Cows Cull	Weaner Steers Good	Weaner Steers Medium	18 Month Steers	2½ Year Steers	Store Bullocks
1957	22.00	36.00	28.00	30.00	25.00	33.00	50.00	50.00
1958	25.00	53.00	44.00	35.00	29.00	48.00	57.00	74.00
1959	30.00	62.00	38.00	38.00	54.00	58.00	64.00	76.00
1960	31.00	59.00	46.00	41.00	33.00	60.00	68.00	78.00
1961	28.00	50.00	30.00	36.00	30.00	64.00	74.00	78.00
1962	28.00	36.00	26.00	32.00	28.00	46.00	52.00	64.00
1963	28.00	36.00	24.00	32.00	27.00	44.00	66.00	70.00
1964	32.00	52.00	32.00	36.00	28.00	48.00	70.00	76.00
1965	36.00	76.00	56.00	56.00	50.00	56.00	76.00	84.00
1966	47.00	80.00	60.00	62.00	54.00	70.00	84.00	96.00
1967	28.00	60.00	48.00	38.00	32.00	60.00	74.00	80.00
1968	32.00	75.00	60.00	50.00	45.00	60.00	90.00	90.00
1969	44.00	75.00	45.00	60.00	50.00	75.00	95.00	95.00
1970	60.00	85.00	80.00	70.00	60.00	90.00	110.00	130.00
1971	65.00	100.00	80.00	80.00	65.00	100.00	120.00	130.00
1972	80.00	130.00	90.00	100.00	80.00	125.00	135.00	140.00

WAIRARAPA (MASTERTON)

1957	26.00	40.00	28.00	34.00	26.00	40.00	48.00	52.00
1958	28.00	56.00	28.00	40.00	36.00	50.00	52.00	58.00
1959	28.00	56.00	46.00	36.00	28.00	42.00	46.00	54.00
1960	28.00	56.00	44.00	36.00	30.00	50.00	60.00	80.00
1961	28.00	56.00	36.00	44.00	36.00	56.00	70.00	80.00
1962	24.00	34.00	28.00	32.00	24.00	38.00	52.00	60.00
1963	24.00	44.00	36.00	32.00	26.00	50.00	60.00	66.00
1964	24.00	50.00	36.00	40.00	32.00	52.00	62.00	70.00
1965	36.00	70.00	44.00	50.00	44.00	64.00	84.00	90.00
1966	46.00	80.00	50.00	60.00	50.00	72.00	86.00	96.00
1967	32.00	60.00	44.00	45.00	35.00	55.00	70.00	75.00
1968	38.00	64.00	50.00	48.00	38.00	62.00	82.00	88.00
1969	45.00	70.00	48.00	50.00	40.00	70.00	95.00	100.00
1970	52.00	90.00	78.00	68.00	50.00	85.00	102.00	114.00
1971	57.00	102.00	84.00	79.00	68.00	104.00	115.00	126.00
1972	75.00	120.00	80.00	85.00	75.00	120.00	130.00	135.00

II SPRING

NORTH AUCKLAND (WHANGAREI)

	Yearling Heifers Good	Dry 2 Year Heifers	Breeding Cows In-Calf	Breeding Cows Cull	Yearling Steers Good	Yearling Steers Medium	2 Year Steers	3 Year Steers	Store Bullocks
1957	32.00	46.00	48.00	40.00	40.00	32.00	46.00	52.00	52.00
1958	42.00	50.00	56.00	54.00	46.00	38.00	56.00	62.00	70.00
1959	38.00	56.00	64.00	46.00	40.00	32.00	56.00	63.00	70.00
1960	42.00	56.00	70.00	48.00	50.00	40.00	66.00	70.00	73.00
1961	28.00	44.00	54.00	38.00	33.00	28.00	53.00	67.00	70.00
1962	25.00	37.00	46.00	36.00	31.00	27.00	44.00	56.00	60.00
1963	30.00	34.00	54.00	40.00	34.00	28.00	54.00	60.00	62.00
1964	34.00	46.00	52.00	40.00	42.00	36.00	60.00	70.00	76.00
1965	50.00	62.00	90.00	52.00	60.00	54.00	70.00	80.00	90.00
1966	54.00	72.00	90.00	50.00	60.00	52.00	76.00	86.00	88.00
1967	39.00	60.00	72.00	54.00	45.00	36.00	63.00	70.00	75.00
1968	42.00	52.00	75.00	55.00	60.00	56.00	75.00	90.00	90.00
1969	55.00	62.00	80.00	55.00	65.00	55.00	80.00	90.00	95.00
1970	70.00	85.00	95.00	100.00	90.00	80.00	110.00	118.00	100.00
1971	75.00	90.00	90.00	80.00	90.00	80.00	116.00	120.00	120.00
1972	100.00	120.00	120.00	95.00	125.00	100.00	130.00	140.00	150.00

TE KUITI

1957	40.00	47.00	36.00	26.00	48.00	42.00	58.00	64.00	50.00
1958	48.00	56.00	48.00	30.00	54.00	48.00	64.00	60.00	70.00
1959	44.00	54.00	60.00	50.00	50.00	44.00	64.00	76.00	84.00
1960	44.00	56.00	58.00	44.00	54.00	48.00	64.00	76.00	80.00
1961	40.00	30.00	40.00	36.00	48.00	42.00	56.00	70.00	76.00
1962	32.00	50.00	52.00	44.00	48.00	40.00	54.00	66.00	66.00
1963	38.00	56.00	56.00	50.00	54.00	48.00	60.00	68.00	72.00
1964	48.00	60.00	64.00	52.00	64.00	56.00	72.00	76.00	80.00
1965	59.00	73.00	84.00	60.00	70.00	65.00	80.00	92.00	85.00
1966	60.00	76.00	84.00	60.00	70.00	64.00	80.00	90.00	90.00
1967	40.00	56.00	72.00	50.00	54.00	44.00	66.00	76.00	76.00
1968	50.00	70.00	70.00	60.00	65.00	55.00	70.00	75.00	75.00
1969	55.00	80.00	75.00	65.00	70.00	60.00	85.00	90.00	90.00
1970	65.00	90.00	85.00	75.00	85.00	70.00	100.00	115.00	115.00
1971	75.00	100.00	110.00	80.00	105.00	80.00	110.00	120.00	120.00
1972	90.00	120.00	120.00	90.00	110.00	90.00	130.00	150.00	150.00

ROTORUA

1957	31.00	46.00	62.00	36.00	40.00	34.00	48.00	54.00	54.00
1958	48.00	58.00	68.00	53.00	55.00	48.00	56.00	70.00	80.00
1959	50.00	60.00	70.00	50.00	56.00	48.00	64.00	72.00	76.00
1960	50.00	56.00	70.00	50.00	56.00	48.00	64.00	72.00	76.00
1961	40.00	48.00	56.00	40.00	40.00	30.00	54.00	64.00	72.00
1962	36.00	48.00	52.00	40.00	40.00	30.00	54.00	64.00	68.00
1963	40.00	54.00	60.00	48.00	44.00	36.00	56.00	68.00	72.00
1964	50.00	64.00	70.00	56.00	60.00	54.00	72.00	84.00	90.00
1965	60.00	80.00	90.00	66.00	72.00	60.00	80.00	90.00	100.00
1966	70.00	84.00	96.00	70.00	76.00	70.00	84.00	92.00	104.00
1967	60.00	74.00	90.00	70.00	60.00	50.00	76.00	84.00	90.00
1968	65.00	85.00	95.00	76.00	70.00	64.00	85.00	95.00	105.00
1969	70.00	90.00	100.00	80.00	85.00	75.00	95.00	110.00	110.00
1970	85.00	100.00	110.00	85.00	90.00	83.00	105.00	115.00	120.00
1971	85.00	115.00	125.00	95.00	105.00	95.00	120.00	140.00	140.00
1972	90.00	110.00	140.00	110.00	120.00	100.00	140.00	150.00	150.00

TARANAKI (NEW PLYMOUTH)

	Yearling Heifers Good	Dry 2 Year Heifers	Breeding Cows In-Calf	Breeding Cows Cull	Yearling Steers Good	Yearling Steers Medium	2 Year Steers	3 Year Steers	Store Bullocks
1957	23.00	36.00	30.00	25.00	34.00	30.00	38.00	42.00	42.00
1958	32.00	40.00	44.00	30.00	38.00	38.00	51.00	58.00	62.00
1959	34.00	50.00	52.00	38.00	46.00	38.00	64.00	74.00	76.00
1960	40.00	56.00	60.00	44.00	56.00	50.00	68.00	76.00	82.00
1961	36.00	48.00	50.00	36.00	42.00	35.00	60.00	70.00	72.00
1962	30.00	48.00	50.00	42.00	36.00	30.00	50.00	56.00	62.00
1963	36.00	52.00	52.00	44.00	40.00	32.00	58.00	72.00	80.00
1964	44.00	55.00	56.00	48.00	52.00	44.00	70.00	80.00	80.00
1965	50.00	70.00	76.00	60.00	60.00	50.00	84.00	96.00	96.00
1966	50.00	36.00	80.00	64.00	66.00	56.00	80.00	92.00	96.00
1967	40.00	50.00	70.00	60.00	42.00	32.00	65.00	80.00	80.00
1968	46.00	65.00	70.00	60.00	50.00	45.00	75.00	90.00	95.00
1969	54.00	64.00	80.00	60.00	65.00	55.00	90.00	120.00	125.00
1970	60.00	68.00	97.00	55.00	90.00	75.00	120.00	130.00	140.00
1971	70.00	90.00	120.00	90.00	80.00	72.00	125.00	140.00	145.00
1972	85.00	103.00	115.00	90.00	114.00	89.00	130.00	158.00	159.00

EAST COAST (GISBORNE)

1957	24.00	38.00	40.00	36.00	33.00	28.00	47.00	60.00	64.00
1958	34.00	46.00	48.00	50.00	40.00	34.00	53.00	64.00	68.00
1959	36.00	52.00	56.00	54.00	42.00	36.00	56.00	66.00	74.00
1960	40.00	60.00	60.00	56.00	52.00	44.00	60.00	70.00	76.00
1961	30.00	50.00	50.00	40.00	42.00	36.00	50.00	54.00	70.00
1962	30.00	50.00	42.00	38.00	34.00	28.00	48.00	56.00	68.00
1963	34.00	58.00	44.00	40.00	50.00	40.00	58.00	64.00	70.00
1964	38.00	54.00	48.00	46.00	52.00	46.00	64.00	72.00	76.00
1965	48.00	68.00	62.00	60.00	64.00	56.00	74.00	86.00	92.00
1966	50.00	74.00	68.00	64.00	66.00	58.00	76.00	88.00	92.00
1967	42.00	56.00	62.00	50.00	46.00	42.00	66.00	81.00	83.00
1968	54.00	74.00	68.00	64.00	66.00	60.00	85.00	100.00	120.00
1969	56.00	72.00	84.00	80.00	74.00	65.00	96.00	116.00	130.00
1970	70.00	100.00	100.00	85.00	85.00	70.00	112.00	130.00	150.00
1971	80.00	125.00	120.00	100.00	100.00	88.00	120.00	130.00	145.00
1972	92.00	133.00	126.00	110.00	123.00	98.00	128.00	145.00	150.00

HAWKES BAY (HASTINGS)

1957	32.00	50.00	54.00	34.00	44.00	36.00	56.00	62.00	64.00
1958	46.00	64.00	69.00	45.00	51.00	45.00	66.00	75.00	78.00
1959	46.00	58.00	70.00	72.00	50.00	46.00	64.00	74.00	80.00
1960	44.00	60.00	73.00	50.00	53.00	46.00	72.00	80.00	83.00
1961	32.00	50.00	48.00	44.00	38.00	34.00	60.00	67.00	68.00
1962	33.00	48.00	52.00	40.00	39.00	33.00	55.00	60.00	68.00
1963	34.00	52.00	56.00	36.00	56.00	42.00	66.00	74.00	82.00
1964	54.00	72.00	56.00	44.00	58.00	52.00	72.00	78.00	84.00
1965	57.00	72.00	68.00	57.00	71.00	64.00	84.00	91.00	94.00
1966	52.00	81.00	83.00	54.00	70.00	60.00	85.00	96.00	91.00
1967	42.00	73.00	71.00	64.00	57.00	47.00	68.00	77.00	82.00
1968	48.00	81.00	86.00	72.00	70.00	61.00	86.00	91.00	96.00
1969	56.00	81.00	95.00	86.00	75.00	67.00	90.00	95.00	100.00
1970	67.00	110.00	114.00	95.00	91.00	81.00	109.00	119.00	126.00
1971	77.00	109.00	111.00	83.00	104.00	94.00	118.00	123.00	128.00
1972	89.00	119.00	125.00	115.00	119.00	104.00	123.00	137.00	142.00

MANAWATU (PALMERSTON NORTH)

	Yearling Heifers Good	Dry 2 Year Heifers	Breeding Cows In-Calf	Breeding Cows Cull	Yearling Steers Good	Yearling Steers Medium	2 Year Steers	3 Year Steers	Store Bullocks
1957	29.00	42.00	50.00	39.00	42.00	36.00	54.00	61.00	80.00
1958	36.00	52.00	56.00	54.00	52.00	42.00	64.00	77.00	80.00
1959	40.00	56.00	60.00	58.00	56.00	48.00	68.00	80.00	85.00
1960	42.00	64.00	68.00	52.00	59.00	49.00	75.00	83.00	91.00
1961	32.00	48.00	52.00	36.00	40.00	34.00	60.00	70.00	72.00
1962	31.00	46.00	50.00	32.00	34.00	24.00	56.00	60.00	64. 0
1963	33.00	52.00	56.00	54.00	46.00	36.00	62.00	70.00	76.00
1964	44.00	60.00	64.00	52.00	62.00	52.00	68.00	88.00	80.00
1965	57.00	69.00	76.00	52.00	69.00	62.00	85.00	93.00	96.00
1966	60.00	66.00	74.00	56.00	72.00	66.00	92.00	96.00	96.00
1967	50.00	60.00	80.00	60.00	58.00	50.00	75.00	88.00	92.00
1968	50.00	80.00	100.00	70.00	70.00	62.00	90.00	100.00	100.00
1969	60.00	83.00	105.00	82.00	75.00	64.00	95.00	110.00	120.00
1970	70.00	95.00	110.00	95.00	105.00	90.00	125.00	140.00	150.00
1971	90.00	110.00	110.00	85.00	105.00	95.00	125.00	140.00	150.00
1972	100.00	120.00	125.00	95.00	115.00	105.00	135.00	160.00	170.00

WAIRARAPA (MASTERTON)

1957	30.00	46.00	44.00	36.00	50.00	44.00	54.00	58.00	62.00
1958	32.00	46.00	58.00	48.00	46.00	36.00	64.00	68.00	62.00
1959	36.00	62.00	70.00	52.00	52.00	46.00	54.00	56.00	54.00
1960	40.00	52.00	64.00	46.00	66.00	56.00	72.00	80.00	80.00
1961	26.00	44.00	54.00	46.00	40.00	34.00	52.00	66.00	66.00
1962	30.00	46.00	50.00	46.00	44.00	34.00	56.00	66.00	66.00
1963	33.00	50.00	54.00	48.00	50.00	40.00	64.00	70.00	70.00
1964	34.00	50.00	50.00	40.00	54.00	46.00	70.00	80.00	80.00
1965	46.00	60.00	70.00	50.00	72.00	64.00	80.00	90.00	90.00
1966	44.00	62.00	72.00	55.00	64.00	58.00	76.00	86.00	86.00
1967	40.00	65.00	75.00	60.00	50.00	44.00	66.00	78.00	78.00
1968	45.00	70.00	90.00	60.00	65.00	58.00	80.00	90.00	95.00
1969	60.00	70.00	80.00	65.00	70.00	60.00	85.00	95.00	100.00
1970	70.00	95.00	110.00	95.00	105.00	90.00	125.00	140.00	150.00
1971	90.00	110.00	110.00	85.00	105.00	95.00	125.00	140.00	150.00
1972	95.00	130.00	130.00	120.00	120.00	105.00	140.00	150.00	160.00

SOURCE : DEPARTMENT OF LANDS AND SURVEY UNPUBLISHED DATA