AN EVALUATION OF THE WELFARE EFFECTS OF UNITED STATES MEAT IMPORT QUOTAS USING THE CONCEPT OF ECONOMIC SURPLUS

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

L.I. BRYANT
December, 1974

ABSTRACT

The original objective of this study was to estimate the effect of United States Meat Import Quotas on economic welfare in the United States and New Zealand. Welfare was to be estimated as the changes in the economic rent of United States producers, in United States consumers' surplus, and in revenue of the New Zealand beef industry, resulting from a change in quotas.

An economic model was formulated expressing the relationship between the beef markets in the United States, New Zealand, and the rest of the world. The model was used to estimate the values of endogenous variables assuming the absence of United States meat import quotas. This was done by estimating the coefficients of the model based on those years in which quotas were not effective. It was expected that the projected values for endogenous variables, obtained by experimentation with the model, would provide a basis for the estimation of the welfare effects of quotas. However initial experimentation demonstrated that the estimated values for endogenous variables in the model were inconsistent with economic theory. As the New Zealand sector of the model required the use of inputs generated by the United States sector, experimentation with the New Zealand sector was abandoned.

The points of disagreement between economic theory and the estimated model on the effect of quotas were as follows;

(i) The supply and demand for fed beef was expected to rise, but the model predicted a fall.
(ii) Domestic supply of manufacturing beef was expected to rise, but the model predicted a fall.
(iii) Demand for manufacturing beef was expected to fall, but the model predicted a rise.
(iv) Import supply was expected to fall, but the model predicted a rise.

Disagreement (iv) is the most serious in terms of the objectives of this study as the restrictive effect of quotas on imports is the reason for their use.

It was concluded that the unsatisfactory results obtained in the analysis were due to deficiencies in the econometric model or the data used to estimate the coefficients of the model. Four types of error were considered in term of their possible relevance to the model estimated in the study; specification error; errors in variables; multicollineanity; and autocorrelation. The most important source of error is considered to be in the specification of the model however the other sources of error mentioned are also considered to have been present.

Although this study has not achieved the original objective it demonstrates a method whereby the welfare effects of restrictive trade practices can be assessed. For this reason it is considered that some contribution to applied economics has been made.

ACKNOWLEDGEMENTS

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

Special thanks are due to my supervisor, Professor R.W. Cartwright for his continued advice, constructive comment and encouragement throughout this study.

I gratefully acknowledge the financial assistance and co-operation of the Ministry of Agriculture and Fisheries over the time spent on this thesis and the associated period of study.

Finally I wish to thank my wife, Robbie, for her understanding and co-operation throughout this period of study.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION AND THESIS GUIDE

1.1 Introduction *(1)*

New Zealand's economy is dependant primarily upon the export of agricultural products, 80% of her overseas earnings being derived from this source. Without this income many of the imports necessary for the maintenance of the present high living standard could not be purchased. In 1970-71, more than 40% of this overseas income was derived from exports of beef and veal. The United States was the largest customer for these products, taking more than 70% of New Zealand's total export supply. This represents 18% of total United States imports of beef and veal. Any policies designed to restrict the entry of beef to this market could have a significant effect upon New Zealand's economy.

In 1965, the United States implemented a quota system to control importation of beef, veal, mutton and goat meat. This was an attempt to prevent a repetition of the 1962-63 low domestic prices for cattle and beef. The quota system determines the level of imports for each calendar year under a market sharing principle, which allows for imports up to 7-8% of domestic production of the products concerned. A base quota was set at the average level of imports of the relevant products over the period 1959-63. The allowable quantity of imports in a particular year was equal to the base quota adjusted by the percentage that the average of estimated domestic production for that year, and the preceding two years differs from average annual production in the base period. The trigger for imposition of quotas was based upon quarterly estimates of imports for the calendar year. Quotas were imposed if the estimate exceeded 110% of the adjusted base quota. The President had the power to suspend the quotas if it was considered necessary for overiding economic or national security reasons, or because domestic supply

---

(1) This section draws heavily upon Duymovic, Crom and Sullivan [30] *(2)*

(2) The numbers in brackets refer to references found in the bibliography on page

of the products concerned was considered to be insufficient to meet domestic demand at reasonable prices.

During the period 1965-67, imports were never high enough to trigger the imposition of quotas. It became apparent in 1968 that imports would exceed the trigger point, and to prevent this a voluntary restraint programme was implemented between the exporting countries. This continued through 1969 and the first half of 1970. At that time it became obvious that the trigger level would be exceeded and, as required by the meat import regulations, quotas were imposed. However, the President immediately suspended the quotas and new higher levels were set. The higher quotas continued through 1971 and 1972 but in 1973, due to high domestic prices for beef, they were removed completely for an indefinite period of time.

1.2 Objectives

The original objective of the study was to estimate the effect of United States Meat Import Quotas on economic welfare in the United States of America and New Zealand. Welfare was to be estimated as the changes in the economic rent of United States producers, in the United States consumers' surplus, and in revenue of the New Zealand beef industry, resulting from a change in quotas. In practice, this objective was not met because the estimated values for endogenous variables in a model of the United States beef market were inconsistent with economic theory. The objective of this thesis is therefore one of explaining the results obtained and advancing possible ways of obtaining more meaningful results.

1.3 Research Procedures

The research reported in this thesis begins with a familiarisation with the United States cattle and beef industry. Recourse is made to a number of publications to gain an understanding of the industry structure and market relationships. This information provides a basis on which models of the market can be assessed.

Global trading patterns for beef are examined to obtain a perspective of the importance of New Zealand and the United States as traders of this commodity on the world market.

A comprehensive study of the concepts of consumer surplus and economic rent provides an understanding of the advantages and disadvantages of their use in welfare estimation and permits development of a justification for their use in the measurement of gains from trade.

An economic model is then formulated to express the relationships between the beef markets in the United States, New Zealand, and the rest of the world.

The model is used to estimate the values of endogenous variables, assuming the absence of Unites States meat import quotas. This is done by estimating the coefficients of the model based on those years in which quotas were not effective. It was expected that the projected values for endogenous variables, obtained by experimentation with the model, would provide a basis for the estimation of the welfare effects of quotas. However, as the results obtained for the endogenous variables are not consistent with economic theory, the original objective could not be met.

The parameters of the United States sector of the economic model are estimated by a simultaneous equation model formulated by Langemeier and Thompson [41]. The model is formulated in the annual form. From both a theoretical and practical point of view, this model is felt to be the most suitable of those studied.

The New Zealand model is a very simple one but rests heavily upon the assumption that a change in the average price of beef exported to the United States has no effect on the total supply of beef by New Zealand exporters during the year in which the price change occurs. Because the measurement of economic welfare was to be made for both producers and processors the f.o.b. export price is the appropriate price to use. However as any changes in the export price are determined by variables generated by the United States model, the estimation of consumer surplus and economic rent is not made as the United States model proved unacceptable.

The relationship between the United States model and the New Zealand model is estimated by expressing the total revenue obtained from New Zealand beef exports as a function of the revenue obtained

from exports of selected grades to the United States and the revenue obtained from exports of the same grades to the rest of the world. The revenue from United States exports is expressed as a function of the retail price of non-fed beef in the United States.

The results obtained from experimentation with the United States model for the years 1968 to 1971 are then examined and compared with data on the actual values of the endogenous variables in those years. The results are inconsistent with economic theory and this prevented further experimentation. The remainder of the thesis endeavours to isolate the reasons for this inconsistency and discusses possible future avenues which might be explored in an effort to overcome this difficulty.

1.4 Review of the Literature

The only published study on the effects of United States import quotas that the writer has located is by Duymovic, Crom and Sullivan [30]. Two other studies that analyse the effect of imports on market behaviour are those by Edwards [31] and by Langemeier and Thompson [41]. Both were formulated prior to the time import quotas were implemented and did not consider the effect of quotas on the beef and live cattle markets. However, Edwards [31] does examine desirable features which he considers should be incorporated in an import quota system.

The study by Duymovic, Crom and Sullivan is based on a dynamic price output model of the beef and pork sectors formulated by Crom [23]. This is a recursive quarterly model of the beef and pork sectors of the United States livestock industry. The model is designed as a predictive device and it appears to succeed in this purpose. However, as a descriptive model it is open to question. In some cases the relationships expressed by it do not appear to have any strong theoretical basis but have been included because they provide a good fit for the data. *(1)*

---

(1) An example of this is given in the estimation of placements of cattle on feed. In the first, third and fourth quarter the beef-corn price ratio is one of the variables included. However in the second quarter the variable is the beef price. The reason given by Crom is -
"However, the steer price alone yielded a better estimation in the second quarter than did the beef-corn ratio."

Duymovic, Crom and Sullivan [30] estimate the effect of alternative beef import policies on selected dependant variables for the period 1971-80. The policies considered are zero imports phased in over five years, doubling imports, restricting imports somewhat more than present levels, maintaining the per capita non-fed beef supply and maintaining choice steer prices. These are compared to a base policy which is a continuation of the quota system as introduced in 1965.

The study presented by Edwards [31] estimates the effect of imports on cattle prices. Two market situations are examined using much simpler models than those formulated by Crom [23] and Langemeier and Thompson [41]. The first model considers the effect of predetermined variables on cattle prices. The second model extends this by (i) defining imports as a measure of the extent of disequilibrium in the internal market, and (ii) expressing the change in market price, resulting from a change in non-fed beef supply, as a function of the size of this disequilibrium. The first model assumes that imports are competitive with domestic production while the second model assumes that imports are used as a buffer to equate market demand with supply.

The Langemeier and Thompson model [41] was formulated to study demand, supply and price relationships in the beef sector. It is a simultaneous equation model involving twelve relationships. Four of these are identities. Simultaneity is involved in seven of these equations. One expresses imports as a function of non-fed beef prices and meat industry wage rates. The writer's main criticism of this paper is the lack of information relating to the derivation and processing of data. This makes it very difficult to check on the parameters that were estimated. However, the economic relationships expressed in the paper appear to be theoretically sound. The model estimates per capita demand and total supply. This means that the identities equating demand and supply contain multiplicative relationships. The properties of the estimates obtained from a model of this type are not fully understood. However, this form was required to overcome problems of multicollinearity in the demand equations.

Of the three models examined the Langemeier and Thompson [41] model is the one which lends itself best to the estimation of economic welfare. The modifications that were made to the model so that it could be used in this thesis are explained in detail in Chapter 4.

1.5 Thesis Guide

The content of the remaining chapters of the thesis are described in this section.

A description of the United States beef industry appears in the first section of Chapter 2. This is followed by a discussion of world trade in beef and veal. United States and New Zealand trade is discussed in detail. Finally the restrictions that have been imposed on imports by the United States are discussed.

Chapter 3 discusses and examines methods by which welfare is estimated and justifies the methods used in this thesis.

Chapter 4 has three sections. The first develops theoretic models of market relationships and discusses the parameters relevant to estimation of changes in welfare. The second section draws on both original work and other studies carried out in the United States to develop a framework by which estimates of the parameters of the economic model can be made. The third section discusses the data used in estimating the parameters, estimation procedure, and finally presents the estimates obtained.

Chapter 5 discusses the results obtained from experimentation with the model. The results are compared with actual values of the endogenous variables generated by the market. The inconsistency of the results with economic theory is discussed and possible reasons for this are advanced. Ways of overcoming this problem are considered.

Chapter 6 contains a brief summary of the initial objectives of the thesis and discusses the problems that have arisen in an attempt to meet these objectives. Suggested avenues for future research are discussed and a final assessment of the value of the research attempted by this thesis is made.

CHAPTER TWO

THE UNITED STATES BEEF INDUSTRY AND INTERNATIONAL TRADE

A. The United States Beef Industry *(1)*

2.1 Introduction

The per capita consumption of beef in the United States ranks third in the world. In 1972 per capita consumption of red meat was 188 pounds, 118 pounds of which was beef. This illustrates the importance of beef in the diet of United States consumers.

Figure 2.1 illustrates the principal distribution channels of cattle and beef in the United States. Distribution begins with the breeding unit passing through feedlots to the slaughterer and processor. From the slaughterer and processor it moves into one of a variety of wholesale outlets and thence to retailers, hotels, restaurants, and institutions, and finally reaches the consumer. The first section of this Chapter will briefly describe the structure and functions of components of this distribution chain.

2.2 Production Units

The supply of beef to consumers originates from three main sources, "beef" breeders, "dairy" farmers and "importers".

Most important of these three sources is the beef breeder who specialises in supplying feeder cattle to feedlots. Dairy farmers also supply feeder cattle, most of which are produced by inseminating dairy cows with beef breed semen. Imported animals typically move into the feeding stage of the chain.

---

(1) This section draws heavily on three publications, Armstrong [18], Williams and Stout [58], and Fowler [32].

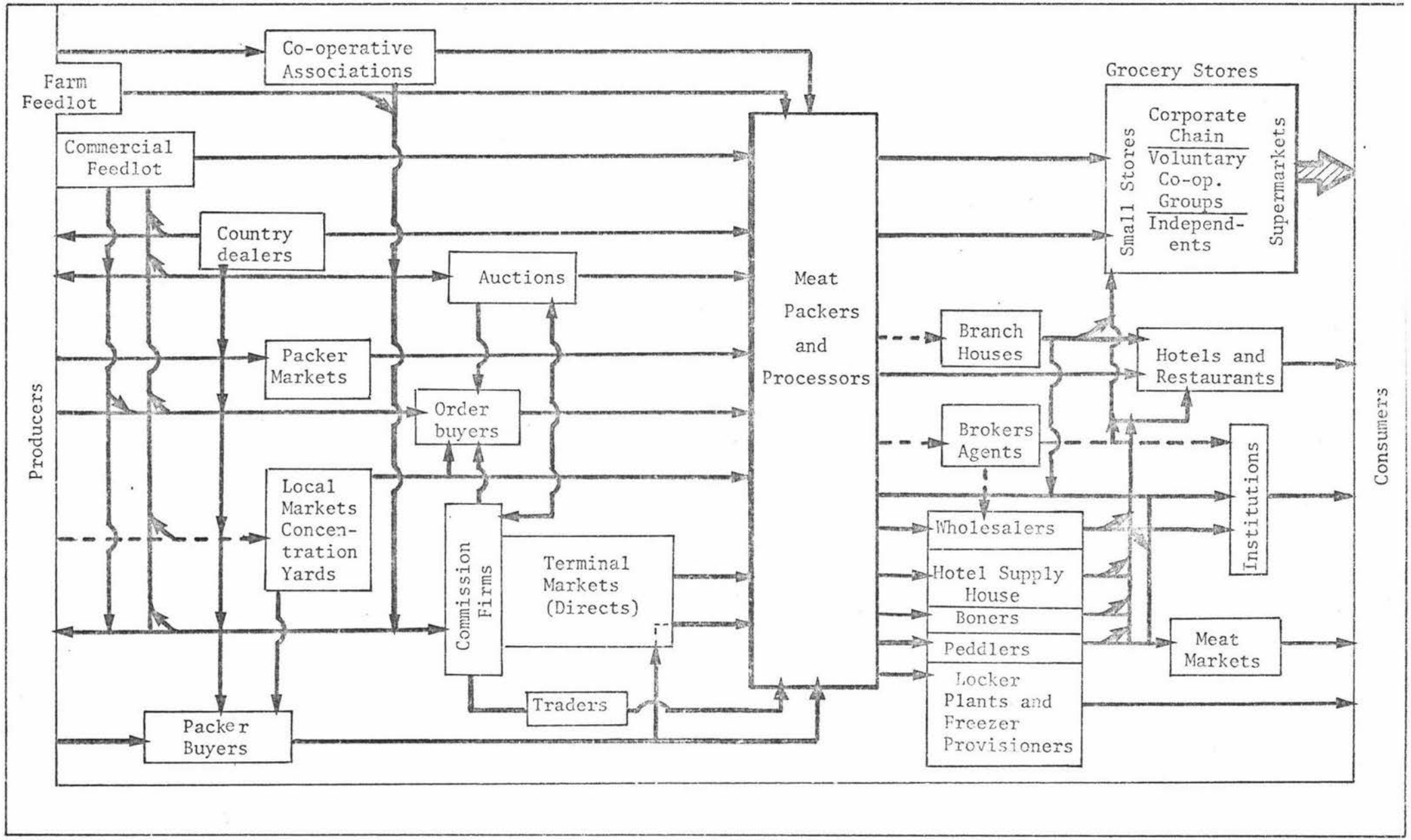


Fig. 2.1 Schematic Diagram of Principle Distribution Channels for Livestock and Meat

Source: *Williams and Stout [58]*

This means that a larger proportion of the value of animals at slaughter is added in the United States in the form of transport, feed and wages.

The greatest proportion of beef cows is found in the Great Plains States from North Dakota to Texas. However, over the last 20 years the greatest percentage increase in numbers has occurred in the Eastern States.

The two major systems of sale of feeder beef are the spot sale, or cash transaction, and contractual pricing arrangements.

Spot sale transactions normally occur in the so called traditional marketing arrangements. Most private arrangements, auctions, terminal and direct marketing transactions involve spot sales. Prices are negotiated through public and private negotiations by individuals, through co-operative group activities, or by some formula pricing arrangement.

Contractual sale transactions are usually more complex. They can be classified generally into advance delivery sales *(1)* and production contracts *(2)*. Advance delivery is the most common. In some cases the producer may obtain a down payment when the contract is signed, thereby reducing his requirements for working capital.

Recently there has been a change in systems of sale towards those which will better supply the needs of commercial feedlot operators. These systems include specialised feeder cattle auctions, specialised feeder cattle dealers and concentration yards, large private auctions, and listing services *(3)* sponsored by feeder cattle producers' associations. There has also been a marked trend towards contractual sales either for future delivery or for specification production.

Many of the changes in marketing systems can be attributed to improvements in transportation. The railroad was the first major development but the one having the most recent effect is

---

(1) Advance delivery sales involve contracting to buy stock at a set time in the future, often specifying the price.

(2) Production contracts are often entered into before production begins and may specify the destination of the product and also details of production.

(3) Buyers are invited to visit the farms to inspect, price and purchase feeder cattle.

the inter-city hire trucking industry which, along with farmer-owned truck transportation, plays an important role in the assembly of feeder cattle.

2.3 Fattening and Finishing

The fattening and finishing section of the beef chain consists of two basic systems, the feedlot operation and more traditional range feeding.

Feedlot fattening is a system by which the animals are confined to a limited space and concentrate feed is produced elsewhere. This is an intensive and specialised farming operation.

Range feeding is a more extensive system, in terms of land use, than feedlot fattening. The cattle graze on pasture which results in lower rates of weight gain than those obtained during feedlot fattening. Because of this the animals are marketed at an older age than under the feedlot system and the product is of more variable quality.

The majority of cattle on feedlots are steers and heifers less than 20 months of age. These cattle comprise the major source of supply to the prime cuts market with only a proportion of the carcass being used as manufacturing beef. By contrast, virtually all range fed cattle are supplied to the manufacturing and institutional markets.

Various forms of feedlot ownership have developed due to the increase in size and accompanying increase in the requirement for capital and specialised management. The two basic systems are farmer feedlots and commercial feedlots. *(1)*

Not all cattle on feedlots are owned by the feedlot owner. Some are owned by packers and other associated interests and fed on a custom feeding basis under which the owner of the cattle pays the feedlot owner to feed the stock.

---

(1) A commercial feedlot is defined by Armstrong [18] as a feedlot with a capacity of 1000 head or more regardless of type of ownership or cattle feeding arrangements.

In the early 1900's the terminal public market was the predominant method of sale but this was superseded by the regional auction markets. These arose due to the high cost of transporting cattle coupled with an improvement in the transport of refrigerated products, especially with the advent of trucking. The auction system reached a peak in the early 1950's and is now losing ground to direct selling methods.

The performance of the transportation and assembly functions for slaughter cattle has been undergoing rapid change. In some areas the assembly function is being performed by the feedlot as part of their operations as well as by the more traditional marketing systems. In other areas the assembly of slaughter cattle is being done by cattle feeders only through the use of various types of marketing systems. The terminal and auction markets continue to play an important role in these areas although in many instances the processors are bypassing established market facilities and assembling slaughter cattle by purchasing them direct from relatively small farmer feeders.

The decentralisation of slaughtering to production areas has in many instances shortened the distance for moving fed cattle. As a result there is a general tendency to increase the distance of transporting both feeder cattle, which are younger and smaller than fed cattle, and beef carcasses and cuts.

In some areas there has been an increase in the percentage of cattle sold on the basis of carcass weight and yield grades, however the purchase of cattle by processors on a liveweight basis is still the most common. As with feeder cattle the main method of sale is on a spot sale basis although in some areas contractual sales are becoming more important as it gives greater uniformity of supply to the processors.

A recent development is the packer practice of purchasing cattle in feedlots several days or weeks in advance. This trend indicates the desire by packers and slaughterers for an ensured supply of animals for processing and some control over carcass quality.

2.4 Slaughtering and Processing

In essence a meat packer is a slaughterer who processes and/or cures meat. However modern packers actually package very little of their output of meat and the term packer is now applied to any slaughterer who sells meat at wholesale. The following are the main types of packaging operation :

1. The so-called large packers or national packers,
2. Medium sized packers engaged in interstate trade,
3. Small local packers,
4. Small town and country butchers.

Livestock slaughter can be classified into wholesale, retail and farm slaughter. Wholesale slaughter involves the greatest number of animals and is carried out by two types of meat packers; those operating under United States federal inspection and those operating non-federally inspected plants. Meat packers engaged in interstate or overseas trade must be federally inspected but it is not required for those packers operating within state boundaries provided that operations are acceptable to state and city sanitary inspectors.

The meat packer performs what is essentially a breakdown process. The basic functions are :

1. The slaughter of livestock followed by the dressing of the meat, curing, processing and canning.
2. The specialised manufacture of by-products, for example hides and tallow into fertiliser and soap.
3. The storage of perishable and non-perishable meat products, and
4. The distribution of meat and meat products.

The function of the wholesaler is to carry meat of various kinds into areas of consumption at the desired time.

The meat is received by the wholesaler in a variety of forms; some as sides of beef, but most as ribbed and quartered fore-quarter and hindquarter or as primal cuts.

With the trend towards decentralisation of slaughter the shipment of fresh meat products through wholesale channels has replaced to a considerable extent the shipment of livestock from surplus

to deficit areas. This is largely carried out by meat packing concerns and non-slaughtering processors. The wholesale structure serves to bridge the gap between packers and processors on the one hand and retail outlets on the other.

Centralisation of the slaughtering industry occurred after the civil war in association with terminal public markets, but in recent years there has been a pronounced reverse trend towards decentralisation. Slaughtering plants have been tending to shift from the central markets to the areas of production. Simultaneously the concentration of firms in the industry has fallen.

Specialisation within the packing and processing industry has also been occurring. Firms in the industry have always specialised in meat, but now a high degree of specialisation is being obtained through packers concentrating on slaughtering and moving away from the processing side of the industry. Specialisation within the slaughtering function is also apparent with many individual plants specialising in only a certain size and grade and often between heifers, steers, bulls and cows.

Horizontal and vertical integration has also been taking place. For instance the national packers are horizontally integrated through ownership or operation of many different processing plants and branch houses. The larger packers are vertically integrated through ownership of feedlots, livestock on feed, concentration yards, transportation facilities, processing and distribution facilities and by-product plants.

2.5 The Retail Sector and Grading

Retail distribution is channelled largely through supermarkets, smaller combination grocery-meat stores and specialised meat markets. Specialised meat markets have declined in importance since the second world war while supermarkets have claimed an increasing market share and now comprise the largest outlet group.

The retail outlets generally buy carcasses, part carcasses or wholesale cuts through wholesale channels, often completing the fabrication and packaging of beef in their own warehouses. However, there is an increasing tendency for wholesale outlets to

cut and prepackage meat in packages of a convenient size for the consumer. Plants also quick freeze some meat for the retail trade. Originally packers canned their products in order to preserve them but now canned meat is a convenience food. There has been an upward trend in production of cooked foods that require only warming before they are served.

Beef carcasses are classified according to two grading systems. Carcasses are graded for quality and on yield. Quality grading is based on the palatability characteristics of lean meat and on carcass conformation and the yield grade estimates the percentage by weight of trimmed boneless major retail cuts that could be derived from the carcass.

B. International Trade in Beef *(1)*

2.6 Production

World production of beef and veal in 1972 was 75,802 million lbs, 18 percent up on the 1963-67 average. This represented 52 percent of total meat production. The largest producer is the United States, where production was 22,851 million pounds in 1972, 30 percent of world production. The U.S.S.R. is the second largest producer with 15 percent of production followed by Argentina with 6.5 percent, Brazil with 6 percent, France with 4 percent, West Germany with 3.5 percent and Australia with 3.4 percent. New Zealand is only a minor producer. Its 1971 production of 878 million pounds was only 1.2 percent of the world total.

There are three broad categories of beef production :

1. The intensive feedlot grain feeding system. This is extensively used in the United States giving a shorter production period and producing a type of meat for which the consumer is prepared to pay premium prices.

---

(1) Total production, exports and imports, referred to in this section, are the totals for those countries included in Tables 2.1 and 2.3. China has not been included. However according to F.A.O. estimates it is the fourth largest producer.

Statistics referring to Australia and New Zealand are based on a June year.

Unless it is stated otherwise production and trade figures are in carcass weight equivalents.

TABLE 2.1 : BEEF AND VEAL: PRODUCTION IN SPECIFIED COUNTRIES
AVERAGE 1963-67, ANNUAL 1968-72 (MILLION POUNDS[1])

REGION AND COUNTRY	AVERAGE 1963-67	1968	1969	1970	1971	1972
NORTH AMERICA:						
CANADA	1,792.4	1,990.1	1,909.0	1,902.9	1,929.1	1,977.0
COSTA RICA	62.4	76.0	89.1	93.1	103.1	108.0
DOMINICAN REPUBLIC	55.2	66.3	70.6	69.3	72.1	81.8
EL SALVADOR	46.6	45.3	45.3	45.1	44.8	52.4
GUATEMALA	98.0	125.5	124.4	125.8	140.6	150.9
HONDURAS	44.4	57.3	63.8	66.1	83.7	90.5
MEXICO	1,090.4	1,031.5	1,159.2	1,214.7	1,344.4	1,552.1
NICARAGUA	61.2	105.5	117.9	131.8	139.8	151.1
PANAMA	60.4	68.9	73.8	77.8	85.0	89.5
UNITED STATES	19,649.6	21,614.0	21,831.0	22,273.0	22,450.0	22,851.0
TOTAL NORTH AMERICA	22,980.8	25,180.3	25,484.0	25,999.7	26,392.6	27,112.3
SOUTH AMERICA:						
ARGENTINA	5,054.0	5,646.7	6,355.8	5,785.0	4,446.7	4,856.8
BRAZIL	3,198.0	3,735.6	4,026.6	4,067.9	4,023.4	4,653.2
CHILE[3]	325.6	379.5	367.5	383.2	335.3	211.6
COLOMBIA	819.8	793.1	893.9	937.9	1,063.3	1,001.1
ECUADOR	87.2	90.4	92.2	98.1	104.2	109.1
PARAGUAY[3]	257.0	260.9	234.9	277.8	238.1	242.5
PERU	208.2	198.4	193.3	187.8	179.9	176.4
URUGUAY	675.4	638.8	524.5	689.3	695.0	639.8
VENEZUELA	366.2	406.3	459.5	440.0	464.0	474.0
TOTAL SOUTH AMERICA	10,991.4	12,149.7	13,168.2	12,874.9	11,449.9	12,164.6
EUROPE:						
WESTERN: EC						
BELGIUM-LUXEMBOURG	504.8	544.5	566.6	595.2	615.1	597.5
DENMARK	398.8	456.6	427.3	422.4	429.5	376.1
FRANCE	3,219.2	3,580.3	3,421.6	3,450.2	3,527.4	3,207.7
GERMANY, WEST	2,598.4	2,375.9	2,793.3	2,989.5	3,033.6	2,621.3
IRELAND	314.8	425.4	436.3	476.9	520.4	454.9
ITALY	1,398.0	1,727.8	1,767.2	1,764.4	1,791.9	1,015.3
NETHERLANDS	605.6	627.7	629.9	718.7	709.4	604.7
UNITED KINGDOM	1,958.0	1,996.8	1,919.7	2,090.2	2,095.8	2,003.7
TOTAL EC	10,997.6	12,094.9	11,961.8	12,507.5	12,723.0	11,681.2
AUSTRIA[4]	316.0	347.0	350.8	339.1	353.6	340.3
FINLAND	201.8	195.1	245.6	233.7	--	--
GREECE	135.6	177.8	189.1	198.6	193.9	198.4
NORWAY	122.8	117.7	129.9	125.0	123.4	120.4
PORTUGAL	113.6	129.0	176.2	195.9	168.3	158.3
SPAIN	435.6	531.3	564.4	679.0	714.5	683.4
SWEDEN	356.4	345.2	365.1	361.1	322.8	282.2
SWITZERLAND	252.4	282.9	279.1	298.7	296.1	277.6
TOTAL WESTERN EUROPE	12,931.8	14,221.0	14,261.8	14,938.5	15,135.9[5]	13,987.9[5]
EASTERN:						
BULGARIA	183.2	237.5	211.5	205.6	--	--
CZECHOSLOVAKIA	513.8	649.7	617.0	612.9	638.6	646.6
GERMANY, EAST	502.4	617.9	634.7	662.6	646.7	--
HUNGARY	227.4	268.6	281.4	262.8	264.8	--
POLAND	966.4	1,170.0	1,248.0	1,211.2	1,174.6	--
YUGOSLAVIA	551.2	692.7	641.3	614.8	656.0	681.1
TOTAL EASTERN EUROPE	2,944.6	3,636.6	3,634.0	3,570.0	3,573.4[5]	3,660.8[5]
TOTAL EUROPE	15,876.4	17,857.5	17,895.8	18,508.5	18,709.3[5]	17,648.8[5]
USSR	8,478.0	11,303.3	11,418.1	11,057.3	11,276.6	11,481.7

REGION AND COUNTRY	AVERAGE 1963-67	1968	1969	1970	1971	1972
AFRICA:						
ANGOLA[3]	25.0	30.7	35.9	38.5	45.5	55.1
CHAD[3]	20.2	25.2	31.1	34.3	--	--
ETHIOPIA[3]	502.4	546.1	546.6	589.3	614.6	--
KENYA[3]	58.8	64.5	58.7	59.9	--	--
MALAGASY REPUBLIC[6]	246.4	255.7	254.6	253.5	257.9	--
MOROCCO[3]	76.2	112.2	139.4	133.8	145.2	---
SOUTH AFRICA	1,024.4	880.2	971.0	978.4	1,111.1	1,200.0
TOTAL AFRICA	1,953.4	1,914.7	2,065.3	2,087.7	2,278.1/5	2,422.5 /5
ASIA:						
CHINA (TAIWAN)	15.2	17.6	19.9	20.0	16.7	--
IRAN	91.6	94.2	101.6	113.8	111.7	111.7
ISRAEL	36.2	41.0	39.2	42.8	42.3	38.1
JAPAN	405.8	353.2	478.1	574.4	606.4	650.4
KOREA, REPUBLIC OF	102.6	81.0	81.7	119.6	105.5	136.7
PHILIPPINES	178.2	165.9	172.7	167.4	172.2	180.6
TURKEY	332.8	363.8	414.3	404.8	364.0	385.4
TOTAL ASIA	1,162.4	1,118.7	1,303.5	1,442.7	1,418.9	1,519.9 /5
OCEANIA:						
AUSTRALIA[7]	2,108.2	1,992.7	2,062.8	2,227.7	2,308.8	2,574.7
NEW ZEALAND[7]	634.2	738.8	803.9	886.8	878.1	--
TOTAL OCEANIA	2,751.4	2,731.5	2,864.8	3,114.5	3,186.9	3,452.8 /5
TOTAL SELECTED COUNTRIES	64,193.8	72,255.8	74,199.7	75,085.3	74,712.2 /5	75,802.5 /5

1 CARCASS WEIGHT BASIS; EXCLUDES OFFALS
2 PRELIMINARY
3 EXCLUDES FARM SLAUGHTER
4 INCLUDES OFFALS
5 TOTALS INCLUDE ALLOWANCES FOR DATA NOT SHOWN
6 SOURCE: FOOD AND AGRICULTURE ORGANISATION OF THE UNITED STATES
7 YEAR ENDING JUNE 30

FOREIGN AGRICULTURE SERVICE. PREPARED OR ESTIMATED ON THE BASIS OF OFFICIAL STATISTICS OF FOREIGN GOVERNMENTS, OTHER FOREIGN SOURCE MATERIAL, REPORTS OF THE UNITED STATES AGRICULTURAL ATTACHES AND FOREIGN SERVICE OFFICERS, RESULTS OF OFFICE RESEARCH AND RELATED INFORMATION.

SOURCE: WORLD RED MEAT PRODUCTION [9]

2. The intensive pasture feeding system. This system is employed in countries such as New Zealand and Australia producing a lean animal at a relatively early age, the meat of which is suitable for the manufacturing and institutional trade.
3. The extensive range feeding system. South American countries are a good example of this production method. The product is a lean meat as in the intensive pasture feeding case but the time period required for production is longer.

2.7 Consumption

World beef consumption has increased with production. There has been little or no build-up of stocks over the reference period.

The countries with the highest per capita consumption tend to be either net exporters, or developed countries who are major producers. Developing countries that do not possess a large beef industry have difficulty in competing with the more affluent countries for imports at present prices.

Table 2.2 shows that although per capita consumption is decreasing in Argentina that country continues to have the largest per capita consumption of beef and veal. In 1972 per capita consumption was 134 pounds compared with an average of 163 pounds over the reference period 1964-68. The second largest per capita consumer is the United States at 118 pounds followed by Uruguay 108 pounds; Canada 96 pounds; Australia 87 pounds and New Zealand 80 pounds. Of the major consuming countries the only one showing a steady increase in per capita consumption is the United States. The South American countries, New Zealand and Australia have all registered falls over recent years. Most other countries have experienced relatively stable consumption.

2.8 Trade

Only 9.5 percent of world production of beef and veal is traded. In absolute terms, trade in 1972 was 45 percent above the base average of 1964-68, however as a proportion of total production trade has only risen from about 8 percent to 9.5 percent. The

TABLE 2.2 : BEEF AND VEAL:[1] PER CAPITA CONSUMPTION IN SPECIFIED COUNTRIES
AVERAGE 1964-68, ANNUAL 1968-72

CONTINENT AND COUNTRY	AVERAGE 1964-68	1968	1969	1970	1971	1972[2]
	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS	POUNDS
NORTH AMERICA:						
CANADA	93	96	97	94	95	96
COSTA RICA	24	18	21	21	24	22
DOMINICAN REPUBLIC	15	13	14	14	14	14
EL SALVADOR	16	14	13	13	12	12
GUATEMALA	18	20	17	17	17	17
HONDURAS	14	15	12	11	14	14
MEXICO	22	21	22	23	22	19
NICARAGUA	28	29	30	30	33	32
PANAMA	46	44	48	48	52	57
UNITED STATES	108	113	114	117	116	118
SOUTH AMERICA:						
ARGENTINA	163	186	196	175	139	134
BRAZIL	39	40	41	41	39	40
CHILE	41	46	43	45	45	31
COLOMBIA	42	40	43	44	47	41
PARAGUAY	97	95	89	91	72	70
PERU	18	17	16	16	14	14
URUGUAY	161	138	92	131	90	108
VENEZUELA	42	42	46	43	43	42
EUROPE: WESTERN: EC						
BELGIUM-LUXEMBOURG	55	57	59	61	62	61
DENMARK	42	43	45	46	45	39
FRANCE	65	66	65	65	64	62
GERMANY, WEST	49	52	52	55	55	53
IRELAND	34	37	38	39	45	45
ITALY	40	43	44	45	46	44
NETHERLANDS	42	44	42	44	42	38
UNITED KINGDOM	54	53	54	55	54	53
EC AVERAGE	51	52	53	54	54	52
AUSTRIA	45	48	49	50	50	49
FINLAND	44	42	46	45	45	47
GREECE	27	33	36	40	34	33
NORWAY	33	33	32	31	34	34
PORTUGAL	16	18	21	21	22	24
SPAIN	20	24	25	27	23	25
SWEDEN	43	43	43	42	38	34
SWITZERLAND	54	56	57	59	59	58
EASTERN:						
BULGARIA	24	28	25	25	--	--
CZECHOSLOVAKIA	39	44	43	43	--	--
HUNGARY	20	20	20	21	20	--
POLAND	31	34	35	35	33	29
YUGOSLAVIA	21	25	22	25	26	27
USSR	39	47	47	46	46	48
AFRICA:						
SOUTH AFRICA, REPUBLIC OF	51	46	50	49	54	55
ASIA:						
CHINA, TAIWAN	1	1	1	1	1	1
IRAN	4	4	4	5	4	4
ISRAEL	39	44	43	42	42	25
JAPAN	4	4	5	6	7	8
PHILIPPINES	6	6	6	5	5	5
TURKEY	11	11	12	11	10	10
OCEANIA: [3]						
AUSTRALIA	97	93	93	88	91	87
NEW ZEALAND[3]	104	109	125	109	96	80

[1] CARCASS WEIGHT BASIS

[2] PRELIMINARY

[3] YEAR ENDING JUNE 30

SOURCE: "RED MEAT PER CAPITA CONSUMPTION" [6]

TABLE 2.3 : BEEF AND VEAL:[1] PRINCIPAL EXPORTING AND IMPORTING COUNTRIES, QUANTITY AND PERCENT OF TOTAL. AVERAGE 1964-68, ANNUAL 1971/72

Country	Quantity			Percent of Total		
	Average 1964-68	1971	1972[2]	Average 1964-68	1971	1972[2]
	Million pounds	Million pounds	Million pounds	Percent	Percent	Percent
EXPORTING COUNTRIES:						
Argentina	1,317.9	1,006.5	1,526.6	26.5	16.7	21.1
Australia[3]	988.3	1,137.1	1,409.3	19.9	18.8	19.5
New Zealand	372.7	593.8	611.0	7.5	5.7	6.9
Brazil	100.4	347.0	502.3	2.0	5.7	6.9
France	246.6	402.9	351.3	4.9	6.7	4.9
Uruguay	219.6	190.5	320.7	4.4	3.1	4.4
Ireland	243.4	388.5	317.4	4.9	6.4	4.4
Netherlands	162.2	248.8	257.4	3.3	4.1	3.6
Denmark	212.9	212.3	185.7	4.3	3.5	2.6
South Africa, Republic of	70.3	110.8	155.6	1.4	1.8	2.1
Mexico	78.5	107.2	130.1	1.6	1.8	1.8
Yugoslavia	178.8	121.7	124.2	3.6	2.0	1.8
United Kingdom	14.3	29.4	112.1	0.3	0.5	1.5
Germany, West	33.0	130.1	106.8	0.7	2.1	1.5
Canada	67.8	115.4	93.6	1.4	1.9	1.3
Nicaragua	39.3	72.9	86.0	0.8	1.2	1.2
Costa Rica	29.6	60.4	75.4	0.6	1.0	1.0
Colombia	5.5	40.4	73.7	0.1	0.7	1.0
USSR	99.7	54.9	70.8	2.0	0.9	1.0
Hungary	60.3	69.8	70.4	1.2	1.2	1.0
Belgium-Luxembourg	29.5	58.5	69.1	0.6	1.0	1.0
Paraguay	60.7	63.0	65.8	1.2	1.0	0.9
Poland	68.4	63.8	64.1	1.4	1.1	0.9
United States	47.6	52.8	62.1	0.9	0.9	0.9
Honduras	17.3	45.9	52.1	0.3	0.8	0.7
Other Countries[4]	209.2	318.5	334.1	4.2	5.3	4.6
TOTAL	4,973.8	6,041.9	7,227.7	100.0	100.0	100.0
IMPORTING COUNTRIES:						
United States	1,215.4	1,755.5	1,996.3	26.4	31.3	29.1
United Kingdom	1,000.9	921.1	1,059.7	21.7	16.4	15.5
Italy	649.0	725.7	771.2	14.1	12.9	11.3
Germany, West	338.5	489.0	752.0	7.3	8.7	11.0
France	120.0	177.3	377.3	2.6	3.2	5.5
Canada	58.1	175.8	217.5	1.3	3.1	3.2
Japan	39.2	138.4	192.7	0.8	2.5	2.8
Spain	181.1	86.4	186.1	3.9	1.5	2.7
Netherlands	90.6	88.2	165.8	2.0	1.6	2.4
Greece	81.6	110.3	97.4	1.8	2.0	1.4
Belgium-Luxembourg	57.1	67.3	96.7	1.2	1.2	1.4
Switzerland	73.7	79.4	94.5	1.6	1.4	1.4
Germany, East	113.1	42.5	93.5	2.5	0.8	1.4
USSR	86.7	96.9	88.4	1.9	1.7	1.3
Chile	25.4	92.6	84.9	0.6	1.7	1.2
Portugal	34.0	50.7	69.2	0.7	0.9	1.0
Other Countries[4]	442.4	509.3	510.5	9.6	9.1	7.4
TOTAL	4,606.8	5,606.4	6,852.7	100.0	100.0	100.0

[1] Carcass weight equivalent basis; excludes fat, offals and live animals

[2] Preliminary [3] Year ending June 30 [4] Includes an allowance for non-reporting countries or areas

Source: "World Red Meat Trade" [7]

main net exporters of beef and veal are Argentina, Australia, New Zealand and Brazil. These countries respectively accounted for 21.1, 19.5, 8.4 and 6.9 percent of total exports in 1970. The main net importers of beef and veal are the United States, United Kingdom, Italy and West Germany. In 1972 these countries respectively accounted for 29.1, 15.5, 11.3 and 11.0 percent of total imports.

Tables 2.4 and 2.5 illustrate the extent of trade in live cattle. This trade is intra-regional, most occurring within the North American and European continents. There is also significant trade across borders in Africa and South America. The largest exporters are France, Mexico, West Germany and Ireland. These countries respectively accounted for 13.8, 13.4, 9.7 and 8.3 percent of the market in 1972. West German and French trade is mainly intra-E.E.C. where there are no restrictions on movement.

The largest importer of cattle is Italy, again through mainly intra-E.E.C. trade. The other major importers are the United States and the United Kingdom. Percentage shares of the market in 1972 were Italy 36.5 percent, United States 16.6 percent and United Kingdom 6.9 percent.

TABLE 2.4 BOVINE CATTLE EXPORTS: SELECTED COUNTRIES

Hundred Head with percentages of world totals in parentheses — 1964-68 Average, 1969-72 Annual

Country	1964-68	1969	1970	1971	1972
Canada	3982	2426(3.8)	2471(3.8)	2453(3.8)	2998(4.1
Mexico	5483	8405(13.3)	9337(14.3)	7568(11.6)	9658(13.4
France	2230	5157(8.1)	7388(11.3)	8439(13.0)	9968(13.8
West Germany	2118	5363(8.5)	5974(9.2)	6072(9.3)	6978(9.6
Ireland	6623	5527(8.7)	5292(8.1)	6156(9.5)	5971(8.3
Poland	1067	1875(3.0)	2279(3.5)	2911(4.5)	3073(4.2
Total Selected	-	28753(45.3)	32741(50.2)	33599(51.7)	38646(53.4
Total World	-	63406(100)	65238(100)	64993(100)	72320(100

Source: F.A.O. Trade Year Book [10]

TABLE 2.5 BOVINE CATTLE IMPORTS: SELECTED COUNTRIES

Hundred Head with percentages of world totals in parentheses — 1964-68 Average, 1969-72 Annual

Country	1964-68	1969	1970	1971	1972
Ivory Coast	-	2150(3.3)	2307(3.5)	2547(3.9)	2800(3.9)
United States	7261	10427(16.2)	11677(17.8)	9906(15.2)	11865(16.6)
Hong Kong	1750	2079(3.2)	2018(3.1)	1843(2.8)	2359(3.3)
Belgium	969	1910(3.0)	1413(2.2)	1114(1.7)	2283(3.2)
Italy	10221	19562(30.3)	21003(32.1)	23330(35.7)	26142(36.5)
United Kingdom	6111	5540(8.6)	5244(8.0)	6196(9.5)	4939(6.9)
Total Selected	-	41668(64.5)	43662(66.7)	44936(68.9)	50388(70.4)
Total World	-	64560(100)	65451(100)	65281(100)	71573(100)

Source: F.A.O. Trade Year Book [10]

2.9 New Zealand Trade

New Zealand is the fifteenth largest producer of beef and veal. However she is the third largest exporter, after Argentina and Australia. Production in 1971 was 878.1 million pounds, an increase of 37 percent over the 1963-67 average. This represents an increase from 1.0 to 1.2 percent of world production. Exports in 1972 were the highest ever at 611.0 million pounds. Per capita consumption however has shown a downward trend since 1969 and in 1972 was 80 pounds per head compared to a high of 125 pounds in 1969.

2.9.1 Exports of Beef and Veal

Table 2.6 illustrates the quantity and destination of New Zealand beef exports. The United States has been the major market for New Zealand beef since the late 1950's. In 1971 exports to this market totalled 239,351 thousand pounds. Most of this trade is in the form of fresh *(1)* or frozen boneless beef. The only

---

(1) There is little or no trade in fresh beef between New Zealand and the United States, however the above classification is found in the statistics.

other major market is the United Kingdom which up until 1968 was a declining one. Since 1968, exports to this market have increased steadily to a total of 37,793 thousand pounds in 1971. Between them these two markets accounted for about 70 percent of New Zealand's total exports of beef and veal in 1971. In some years Canada has been a significant importer (e.g. 1969 and 1970) but this was mainly for transhipment to the United States in order to overcome the quota restrictions. Although Japan is a growing market for beef, demand in that country is primarily for prime beef produced on feedlots. This characteristic may limit growth in New Zealand's exports to this market.

TABLE 2.6 NEW ZEALAND BEEF AND VEAL EXPORTS BY COUNTRIES

Thousand Pounds Product Weight with percentages of world total in parentheses

Average 1964-68
Annual 1969-71

(June years)

Country	Average 1964-68	1969	1970	1971
Barbados	2291(0.9)	2589(0.9)	3194(0.8)	3093(0.8)
Bermuda	1255(0.5)	1145(0.4)	1953(0.5)	2283(0.6)
Canada	4533(1.8)	16350(5.6)	10313(2.6)	6139(1.5)
French Polynesia	2144(0.8)	3091(1.1)	3102(0.8)	3353(0.8)
Guam	2147(0.8)	2182(0.7)	2668(0.7)	2585(0.6)
Hong Kong	900(0.4)	1373(4.7)	1516(0.4)	2294(0.6)
Jamaica	2293(0.9)	2737(0.9)	3335(0.9)	4366(1.1)
Japan	4915(1.9)	4272(1.5)	7470(1.9)	7383(1.9)
Malaysia and Singapore	3920(1.5)	4693(1.6)	6129(1.6)	4944(1.2)
Trinidad and Tobago	3355(1.3)	3541(1.2)	4623(1.2)	5130(1.3)
United Kingdom	40329(15.8)	23742(8.1)	31369(8.0)	37793(9.5)
United States	164045(64.2)	214579(73.1)	196903(50.3)	239351(60.0)
Other	23324(9.1)	13417(4.6)	119197(30.4)	80008(20.1)
Total	255460(100)	293711(100)	391772(100)	398722(100)

Source: New Zealand Year Book [11]

2.10 United States Trade

The United States is the largest producer, consumer and importer of beef and veal. As indicated by Table 2.7 production in 1972 was 22,871 million pounds, 28 percent up on the 1961-65 average. Imports were at their highest ever level of 1996.3 million pounds, an increase of 13.7 percent on 1971. As a proportion of production however imports were only 8.4 percent compared to a high of 9.5 percent in 1963.

United States exports of beef and veal declined from 1968 to 1970. Since then exports have risen to reach 62.1 million pounds in 1972, an increase of 42 percent on the 1961-65 average.

The United States is also a major importer of live cattle, being second only to Italy. The extent of this trade is illustrated in Table 2.8. Imports in 1972 totalled 1,169,035 head which was 16.6 percent of world trade. These imports have been variable in the past ranging from a high of 1,250,000 head in 1962 to a low of 546,100 head in 1964. Over the last five years they have been relatively constant at around one million head.

Exports of cattle have increased over the five year period 1968-72 to reach 105,569 head in 1972. This is an increase of 192 percent on the 1961-65 average. However compared to imports, this trade is small.

TABLE 2.7 U.S. IMPORTS, EXPORTS AND NET IMPORTS OF BEEF AND VEAL IN RELATION TO DOMESTIC PRODUCTION

Million Pounds, Carcass Weight Equivalent
1961-65 Average
1966-72 Annual

Year	Production	Imports	Exports	Net Imports	Percentage of US. Productio		
					Imports	Exports	Net Imports
1961-65	17835	1236.3	43.8	1192.5	7.0	0.2	6.8
1966	20636	1204.2	39.1	1165.1	5.8	0.2	5.6
1967	21011	1327.1	42.2	1285.5	6.3	0.2	6.1
1968	21614	1518.0	38.2	1479.8	7.0	0.2	6.8
1969	21831	1640.5	36.7	1603.8	7.5	0.2	7.3
1970	22273	1815.7	39.8	1775.9	8.2	0.2	8.0
1971	22446	1755.5	52.8	1702.7	7.8	0.2	7.6
1972*	22871	1996.3	62.1	1934.2	8.7	0.3	8.4

*Preliminary

TABLE 2.8 U.S. IMPORTS OF CATTLE, BEEF AND VEAL

1961-65 Average
1967-72 Annual

Item	Average 1961-65	1967	1968	1969	1970	1971	1972*
Beef (carcass weight equivalent)			million	pounds			
Boneless, fresh or frozen	992.8	1116.0	1224.7	1348.9	1484.2	1447.4	1714.5
Fresh or frozen	22.1	11.7	26.8	19.6	24.3	22.1	12.3
Total fresh or frozen	1014.9	1127.7	1251.5	1368.5	1508.5	1469.5	1726.8
Canned	162.5	136.7	165.2	164.4	167.1	127.8	139.8
Pickled or cured	.6	1.8	1.3	1.6	1.8	1.0	0.7
Other processed	37.3	47.3	81.7	80.3	114.8	135.4	92.9
Total	1215.4	1313.5	1499.7	1614.8	1792.2	1733.7	1960.2
Veal							
Fresh or frozen	20.9	14.2	18.3	25.7	23.5	21.8	36.1
Cattle	945655	740448	number 1024235	1021054	1021054	969085	1169035

*Preliminary

Source: Livestock and Meat Situation, [3] May 1967 May 1973

2.10.1 Imports of Beef and Veal

Fresh or frozen boneless beef accounts for more than 80 percent of United States imports of beef and veal. As indicated by Table 2.8 total imports in 1972 amounted to 1960.2 million pounds. The main suppliers are Australia and New Zealand. Imports of fresh or frozen bone in beef were less than 1 percent of total beef and veal imports while canned and other processed beef accounted for just over 11 percent.

Table 2.9 illustrates the importance of selected countries as sources of United States beef imports. Australia is the largest supplier and in 1972 imports from this source amounted to 674.7

million pounds (product weight) and 45.6 percent of the market. New Zealand is the next largest and in 1972 exported 266.4 million pounds which was 18 percent of the market. Third and fourth largest are Argentina and Mexico, 94.1 and 81.9 million pounds respectively in 1972.

Boneless beef imports are similar in type to domestic cow beef and are used primarily in the processing industry for the production of hamburger, frankfurters and other processed meat products.

TABLE 2.9 U.S. BEEF AND VEAL IMPORTS BY COUNTRIES

Million Pound Product Weight
1961-65 Average
1966-72 Annual

Country	1961-65	1966	1967	1968	1969	1970	1971	1972*
Canada	33.8	57.2	26.7	46.7	44.0	80.6	80.1	59.6
Mexico	56.2	57.1	47.8	65.6	66.5	78.6	79.1	81.9
Argentina	63.5	80.6	108.1	132.6	130.0	141.1	88.4	94.1
Brazil	15.9	18.3	9.6	31.6	34.3	28.8	63.0	48.0
Ireland	47.2	38.4	80.6	56.7	66.0	69.0	64.0	31.1
Australia	375.4	404.1	425.6	444.2	491.1	535.8	505.4	674.7
New Zealand	175.1	145.0	170.9	203.1	223.7	241.6	241.8	266.4
All other	89.0	92.6	109.7	147.3	161.0	174.6	188.9	225.1
Total Product weight	856.1	893.3	979.0	1128.0	1216.6	1350.1	1310.7	1480.9
Carcass weight	1236	1204	1328	1518	1640	1816	1756	1996

*Preliminary

Source: Livestock and Meat Situation [3] May 1967 May 1973

2.10.2 Imports of Cattle

As illustrated by Table 2.10 nearly all cattle imports are from Canada and Mexico. Mexico is the largest supplier of the two and in 1972 supplied 915,767 head, 80 percent of total imports. Over the period 1961-1972 there has been a general trend for a

decrease in imports from Canada and an increase from Mexico. The type of animal imported is indicated by Table 2.11, 97 percent of cattle imported in 1972 were 699 pounds and under, indicating that the imported animals enter into the feeding stage of the production process bypassing the less profitable breeding enterprise.

TABLE 2.10 U.S. IMPORTS OF CATTLE FROM SPECIFIED COUNTRIES

Excluding Breeding Animals and Cows for Dairy Purposes, Number

1961-65 Average
1966-72 Annual

Period	Canada	Mexico	Other	Total
1961-65	379821	549290	215	929327
1966	475590	584085	327	1060002
1967	227042	500418	40	727500
1968	306117	702308	27	1008452
1969	187733	810387	58	998178
1970	170947	936583	219	1107749
1971	180721	762209	215	933145
1972*	227850	915767	250	1143867

*Preliminary

Source: Livestock and Meat Situation [3] May 1967 May 1973

TABLE 2.11 U.S. IMPORTS OF CATTLE BY WEIGHT

Excluding Breeding Animals and Cows for Dairy Purposes, Number
1961-65 Average
1966-72 Annual

Period	700 pounds and over	200 to 699 pounds	Under 200 pounds	Total
1961-65				929327
1966	105380	828128	126595	1060002
1967	21920	607842	97738	727560
1968	58509	802547	147396	1008452
1969	46679	792356	159143	998178
1970	31824	906992	168933	1107749
1971	25583	748873	158689	933145
1972*	31363	939168	173336	1143867

*Preliminary

Source: Livestock and Meat Situation [3] May 1967 May 1973

2.10.3 Exports of Beef and Veal

Table 2.12 illustrates that fresh and frozen beef is the main item exported, 41.3 million pounds in 1972. Pickled or cured beef is the next most important, 10.5 million pounds in 1972. These two items together made up 83 percent of total beef and veal exported. The main markets for these exports in 1972 were Canada 34.3 million pounds (product weight), and the Bahamas 6.6 million pounds (product weight). These two markets together accounted for 78 percent of the total.

TABLE 2.12 U.S. EXPORTS OF CATTLE, BEEF AND VEAL

1961-65 Average
1967-72 Annual

Item	Average 1961-65	1967	1968	1969	1970	1971	1972*
Beef (Carcass weight equivalent)		million pounds					
Fresh or frozen	18.1	17.1	15.2	16.2	18.3	28.9	41.3
Canned	2.2	2.8	2.2	2.0	2.4	2.0	2.0
Pickled or cured	18.5	15.9	13.3	10.5	12.3	13.4	10.5
Other processed	3.2	5.2	6.3	6.7	5.7	6.1	5.7
Total	42.0	41.0	37.0	35.4	38.7	50.4	59.5
Veal							
Fresh or frozen	1.6	0.7	0.5	0.6	0.5	1.7	2.0
Total (includes canned)	1.8	1.2	1.2	1.3	1.1	2.4	2.6
		number					
Cattle	36202	55322	35745	39186	88037	92956	105569

*Preliminary

Source: Livestock and Meat Situation [3] May 1967 May 1973

2.10.4 Exports of Cattle

Nearly all cattle exports are to Canada and Mexico. The proportion of exports to imports is increasing but in 1972 was still less than 10 percent.

2.11 Restrictions to Trade

Agricultural commodities are perhaps more affected by import controls

than any other group of products. There is a range of methods by which imports are controlled. The following discussion deals mainly with quantitative controls, especially quotas, but other methods such as tariffs and health restrictions are mentioned.

2.11.1 Quantitative Controls

Quantitative controls can be divided into three general groups, import quotas, import licences, and administered imports. Import licences have been extensively used by New Zealand in the past and continue to be used at the present time, although to a lesser extent. Under this system licences are applied for by an importer who, if successful, obtains a licence to import up to a specified quantity or value of a particular commodity. Administered import controls occur when the right to import a commodity is held by one organisation and this organisation controls the level of imports according to market supply and demand within the importing country. This system exists in New Zealand as well as other countries, notably Japan. The importation of wheat by New Zealand to meet any deficit in local production is controlled solely by the Wheat Board. A similar situation exists with sweet oranges.

Import quotas involve the allocation of quotas to exporting countries specifying the maximum quantity that the exporting country can supply within a particular time period. This system is the subject of the research in this thesis. The most notable examples of this type of import control are United States quotas on meat products and dairy products. Dairy imports are controlled by a relatively simple type of quota whereby the United States allocate quotas to exporting countries or in some cases simply offer global quotas on a non-preferential basis. A time limit is set within which the quota is valid. Meat import quotas are more complex and, as they are the basis of the work of this thesis, will be discussed in more detail.

In 1964 the United States Congress passed the Meat Import Act which took effect from the beginning of 1965. This Act sets a limit to the quantity of chilled and frozen beef, veal, mutton and goat meat that can be imported in any particular year. The quantity of imports permitted is calculated from a base quota which is the average imports of the relevant products over the period 1959-63.

This base quota is adjusted each year by the percentage difference between (a) the estimated average annual domestic commercial production in that calendar year and the two preceding calendar years, and (b) the 1959-63 average. The Secretary of Agriculture is required to issue quarterly estimates of the quantity to be imported during the calendar year. If his estimate equals or exceeds 110 percent of the adjusted base quota the President shall by proclamation limit the total quantity of the relevant products which may be imported. The President may suspend any proclamation or increase the total quantity proclaimed if he determines that :

(1) such action is required by overiding economic or national security interestsof the United States;
(2) the supply of the relevant products will be inadequate to meet domestic demand at reasonable prices; or
(3) trade agreements entered into after the date of the enactment of the Act ensure that the policy set forth will be carried out.

In the first three years after the law was passed, imports were below the quota quantities. However in 1968 it was apparent that the year's imports would exceed the trigger quantity. Instead of invoking quotas, the United States authorities requested voluntary restraints on shipments by exporting countries. Total imports were actually above the quota but below the trigger level. This voluntary restraint programme continued through to mid-1970 at which time two actions were taken due to extremely heavy imports in the first six months :

(1) the President proclaimed and then suspended quotas and a higher restraint level was authorised, and
(2) an embargo was placed on transhipments through Canada.

The higher restraint level contined through 1971.
Due to high domestic prices and consumer pressure the import target in 1972 was raised to a level about 7 percent higher than the 1971 restraint level. In 1973 quotas were removed completely for an indefinite period of time. This has continued through to 1974. However, because of a rise in United States production and a corresponding fall in prices it is possible that quotas may be reimposed in the very near future.

2.11.2 Tariffs and Variable Levies

Tariffs are imposed on imports in order to control the quantity imported using the price mechanism. This provides domestic producers with a degree of protection. A commonly used tariff involves a levy per unit of the commodity but tariffs calculated as a percentage of the value of a commodity are also widely used. The United States has a tariff of 3 cents per pound on all beef imports. Variable levies are incorporated into the Common Agricultural policy of the E.E.C., the size of the levy being set according to the difference between a guide price set each year and the price of imports.

2.11.3 Health Restrictions

Health restrictions are imposed to protect domestic industries and consumers from contamination through diseased or inferior products exported by other countries. The United States has a restriction on imports of frozen and fresh beef from countries that have endemic foot and mouth disease. The United Kingdom also limits imports from these countries with an embargo on bone-in beef.

CHAPTER THREE

ECONOMIC SURPLUS *(1)*

3.1 Introduction

The objectives of this thesis centre around the use of economic surplus in the estimation of changes in welfare. Ordinary surplus and economic rent are the only practical measures which estimate this. However neither of these measures are based on economic theory. Ordinary surplus is defined as "the area above the price line and below the demand curve". Economic rent is defined as "the area below the price line and above the supply curve."

This Chapter develops theoretical measures of economic surplus and compares these to ordinary surplus and economic rent, providing justification for their use.

3.2 Consumer Surplus

Consumer surplus is the difference between what the consumer does pay and what he would be willing to pay rather than do without a commodity. There are several measures of consumer surplus. The two that will be discussed here are compensating variation and equivalent variation. These measures can be defined in different ways for different situations. For the purposes of this thesis they are defined in terms of a trade/no trade situation.

Compensating variation is :
"The amount of money taxed from an individual before he chooses to trade such that the tax just removes the advantage gained from trading."

Equivalent variation is :
"The amount of money an individual would have to be paid if the transaction is nullified in order that he be as well off without the transaction as he would have been with it."

---

(1) This Chapter draws heavily upon Currie, Murphy and Schmitz [27]

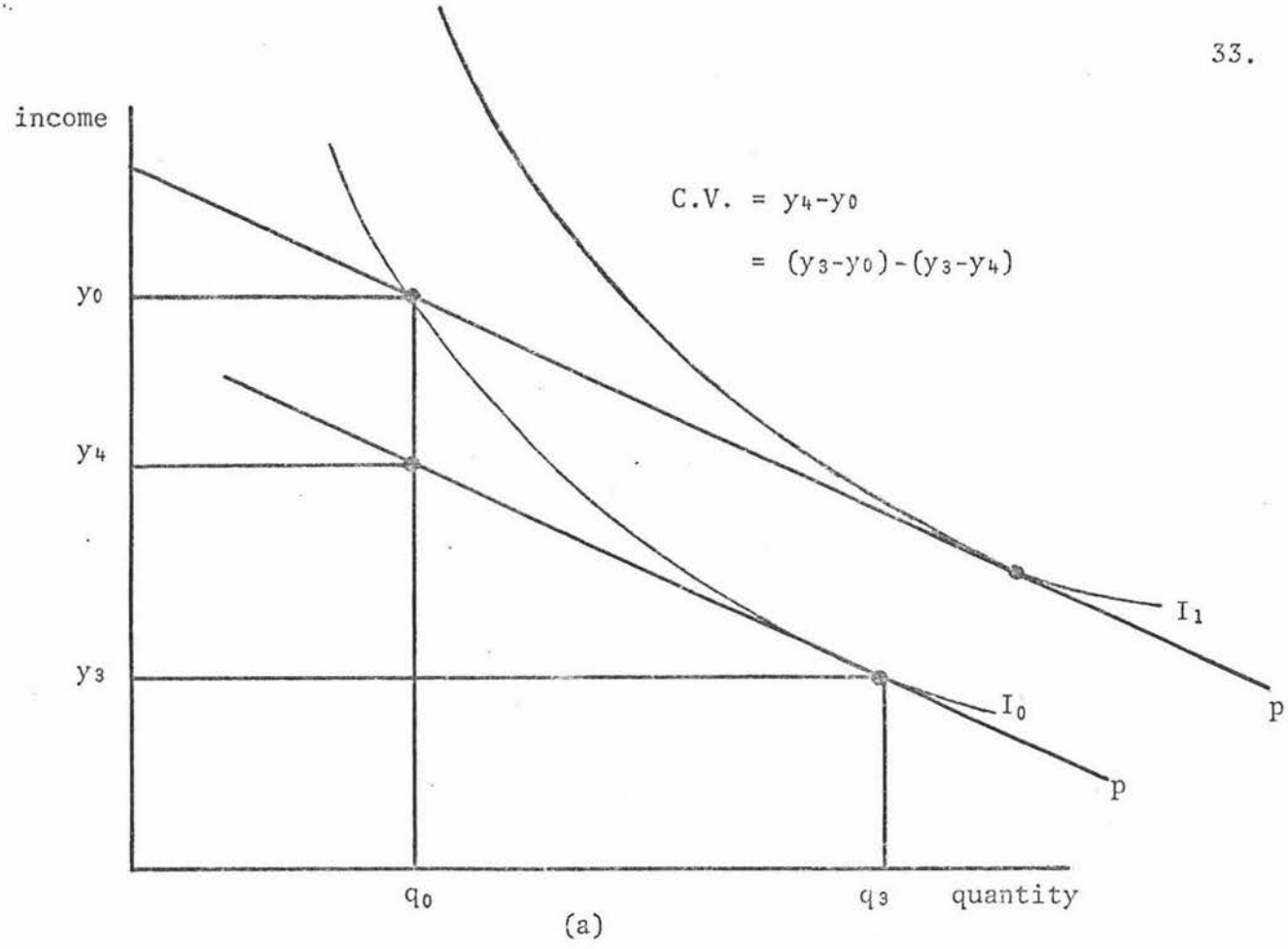
These measures are best explained using graphical analysis. The following discussion explains compensating variation and equivalent variation and compares them to ordinary surplus.

Fig. 3.1(a) illustrates the measurement of compensating variation. The consumer is initially at point y_0q_0 on indifference curve I_0. y_0 represents his income and q_0 his stock of the commodity. The price of the commodity is represented by line p. The consumer decides to trade income for the commodity. In order that he be no better off after trading (i.e. he remains on indifference curve I_0) he must be taxed (y_0-y_4) before he trades, effectively decreasing his income to y_4. The consumer will then trade until he reaches equilibrium point y_3q_3. Compensating variation therefore is (y_4-y_0) which can be expressed as $(y_3-y_0)-(y_3-y_4)$. (Compensating variation is expressed as the negative of the amount taxed).

The situation illustrated in Fig. 3.1(a) can be depicted in price-quantity space as in Fig. 3.1(b). R_0 represents the marginal rate of substitution (MRS) of income for the commodity for all points on indifference curve I_0.

R_1 is the corresponding MRS for indifference curve I_1. Price line p is the slope of the price line in Fig.3.1(a). In Fig. 3.1(b) (y_3-y_0) is the area under curve R_0 between q_0 and q_3. (y_3-y_4) is the area under the price line p between q_0 and q_3. Compensating variation therefore is equal to the shaded area abc below curve R_0 and above price line p.

Fig. 3.2(a) illustrates the measurement of equivalent variation. The initial situation for the consumer is the same as for compensating variation. In this case however we want the consumer to be as well off without trading as he would have been if he had been permitted to trade at price p (i.e. we want the consumer to be on indifference curve I_1. In order for this to occur the consumer must be paid (y_2-y_0) which is defined as the equivalent variation. If trading had been permitted the consumer would trade until point y_1q_1 was reached. (y_2-y_0) can be expressed as $(y_2-y_1)-(y_0-y_1)$.



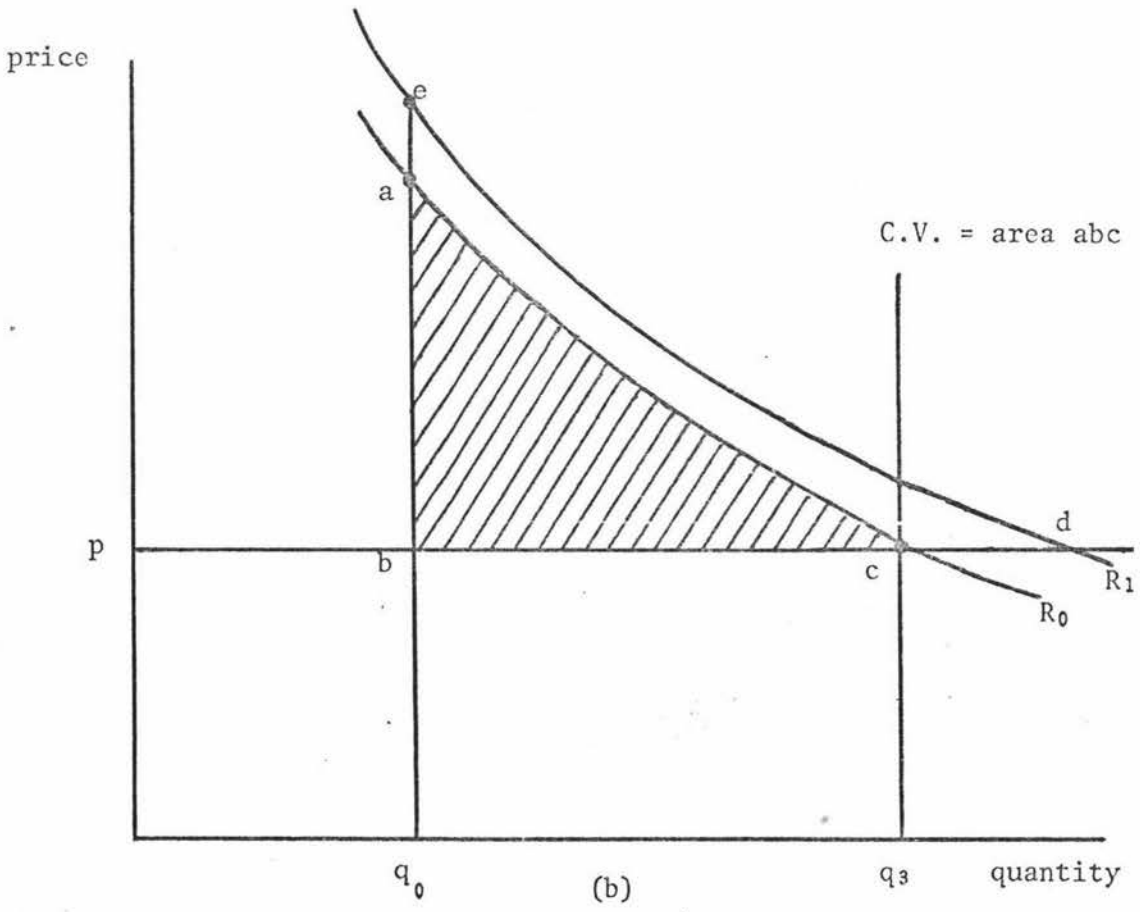
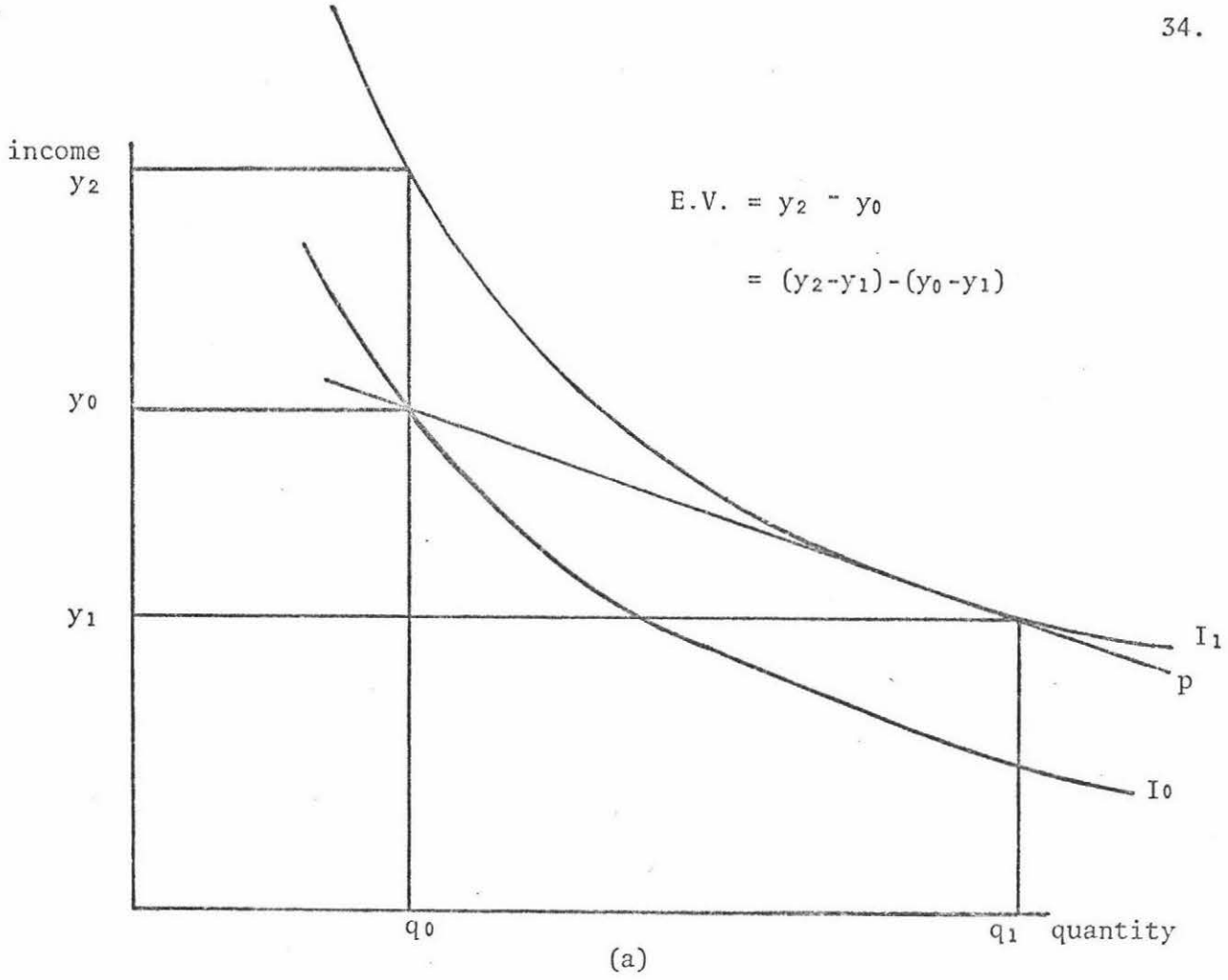


Fig. 3.1 The Measurement of Compensating Variation for a Buyer Under a Trade/No Trade Situation



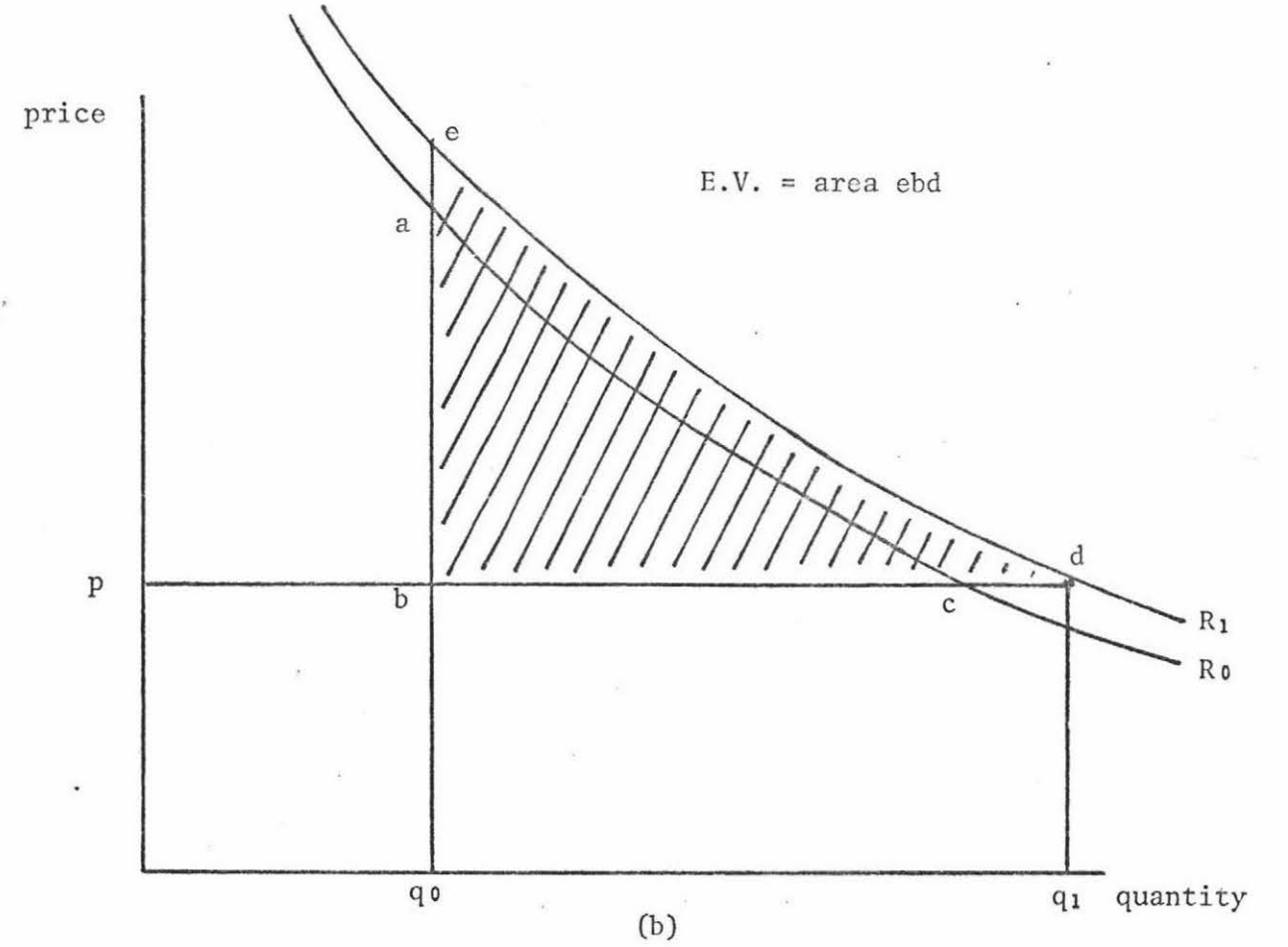


Fig. 3.2 The Measurement of Equivalent Variation for a Buyer Under a Trade/No Trade Situation

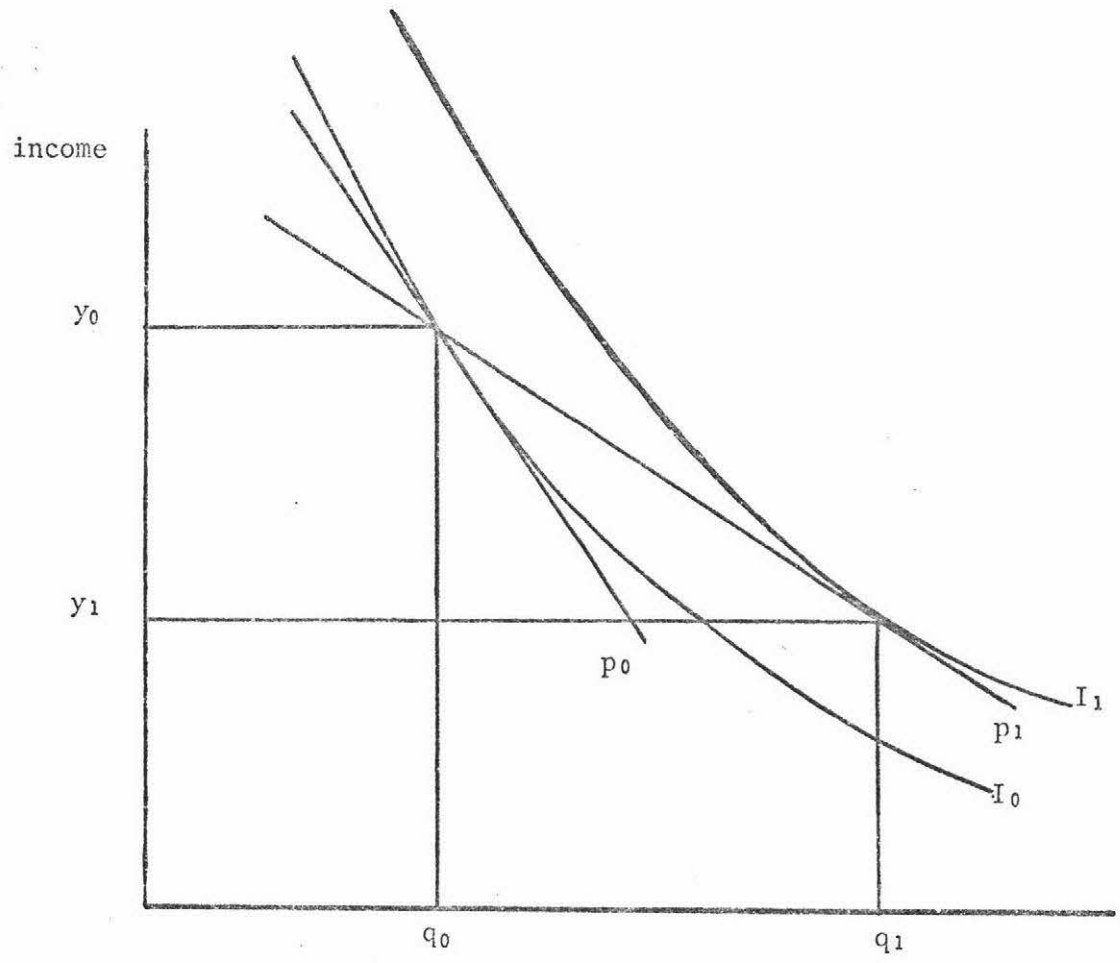
Following a similar procedure to that used for compensation variation the measure of equivalent variation can be expressed in price-quantity space.

Fig. 3.2(b) (y_2-y_1) is the area beneath the curve R_1 between q_0 and q_1. y_0-y_1 is the area below price line p between q_0 and q_1. Equivalent variation therefore is the shaded area edb below curve R_1 and above price line p.

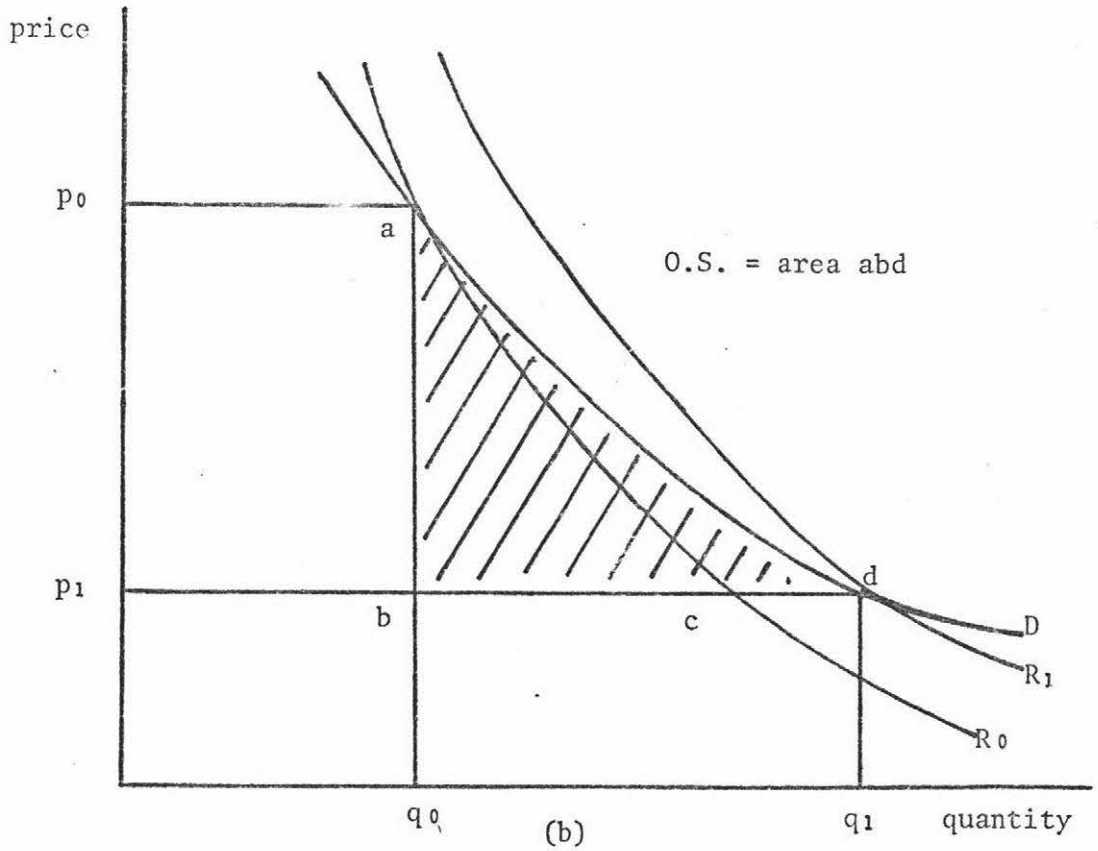
Fig. 3.3 illustrates the derivation of the demand curve from an indifference map. The initial point y_0q_0 is an equilibrium point if the price is p_0 (i.e. q_0 would be the quantity demanded if the price was p_0) At a price p_1 quantity q_1 will be demanded. This can be expressed in price-quantity space as in Fig. 3.3(b). At quantity q_0 the curves p_0 and I_0 are at a point of tangency. Therefore the intersection of the price line p_0, in Fig. 3.3(b) and curve R_0 is a point on the demand curve. Likewise at quantity q_1 the curves p_1 and I_1 are at a point of tangency. Therefore the intersection of the price line p_1 and curve R_1 is another point on the demand curve. Ordinary surplus is the shaded area abd below the demand curve D, obtained by joining these two points, and above the price line p_1, when this is the ruling price.

The three measures of consumer surplus are compared in Fig. 3.4 Whether compensating variation or equivalent variation is the appropriate measure depends on the circumstances. However it is not practical to use either of these for empirical measurement as indifference curves cannot be easily measured. Therefore it is necessary to know what the error will be if ordinary surplus is used instead. Fig. 3.4 indicates that ordinary surplus under-estimates equivalent variation and over-estimates compensating variation. However, there is a situation where these three measures are equivalent. For this to be so, the MRS of income for the commodity on indifference curves I_0 and I_1 must be equal for any given quantity. In this case, curves R_0 and R_1 will coincide. This implies that the income effect is zero (i.e. a change in the income of the consumer will not change the quantity of the commodity he will purchase).

Thus the error incurred by using ordinary surplus as a measure of



(a)



(b)

Fig. 3.3 The Measurement of Ordinary Surplus for a Buyer Under a Trade/No Trade Situation

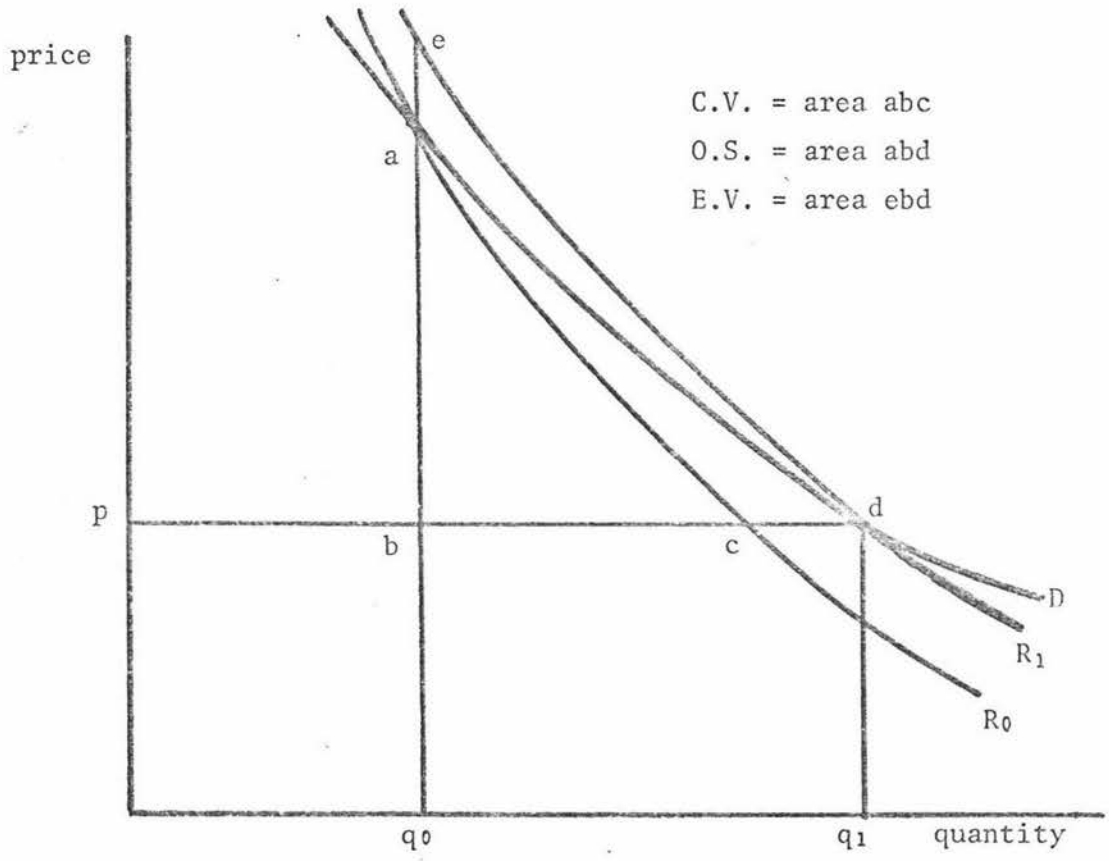


Fig. 3.4 A Comparison Between Equivalent Variation, Compensating Variation and Ordinary Surplus for a Buyer

the change in consumer surplus will be small providing that the income effect is near zero.

3.3 Producer Surplus

Producer surplus is the difference between what the producer is paid and what it is necessary to pay him in order to induce him to supply a given quantity of the commodity. There are several measures of producer surplus corresponding conceptually to the measures of consumer surplus. Again the measures to be considered are compensating variation and equivalent variation defined in terms of a trade/no trade situation. Compensating variation is defined as :

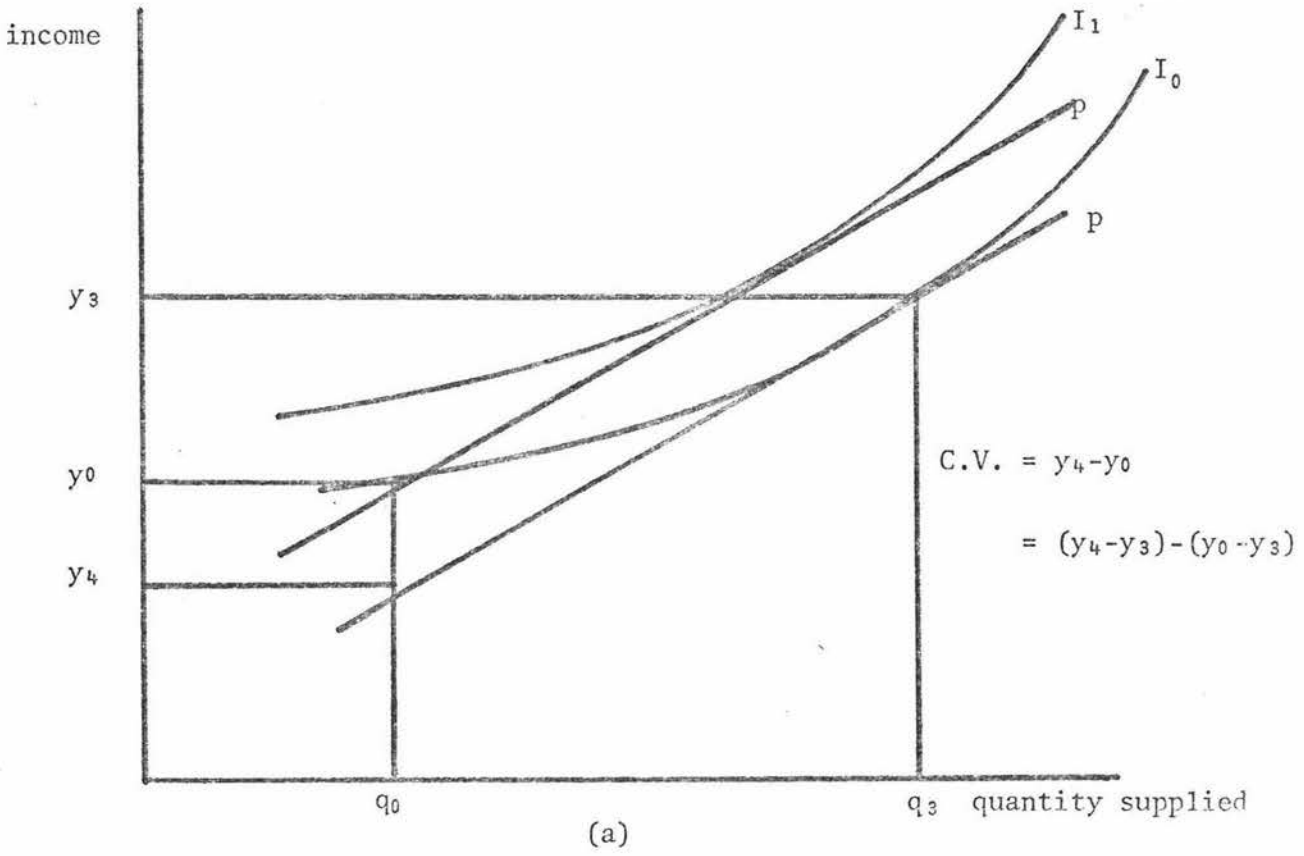
"The amount of money taxed from a producer before he chose to trade such that the tax just removes the advantage gained from trading."

Equivalent variation is defined as :

"The amount of money a producer would have to be paid, if the transaction is nullified, in order that he be as well off without the transaction as he would have been with it."

The following discussion explains these two measures and compares them to economic rent using graphical analysis.

Fig. 3.5(a) illustrates the measurement of compensating variation. The producer is initially at point $y_0 q_0$ on indifference curve I_0. y_0 is his income and q_0 is the initial amount of the commodity he has supplied. Price at which he is selling is represented by line p. The producer decides to trade more commodity for income. In order that he be no better off after trading (i.e. he remains on indifference curve I_0) he must be taxed (y_0-y_4) before he trades. The producer will then trade until he reaches equilibrium point $y_3 q_3$. Compensating variation therefore is (y_4-y_0) which can be expressed as $(y_4-y_3)-(y_0-y_3)$. The situation illustrated by Fig. 3.5(a) can be depicted in price-quantity space as in Fig. 3.5(b). R_0, R_1 and p are defined in the same way as for consumer surplus. In Fig 3.5(b) (y_4-y_3) is the area under the price line p between q_0 and q_3. (y_0-y_3) is the area under curve R_0 between q_0 and q_3. Compensation variation therefore is equal to the shaded area acd below price line p and above curve R_0.



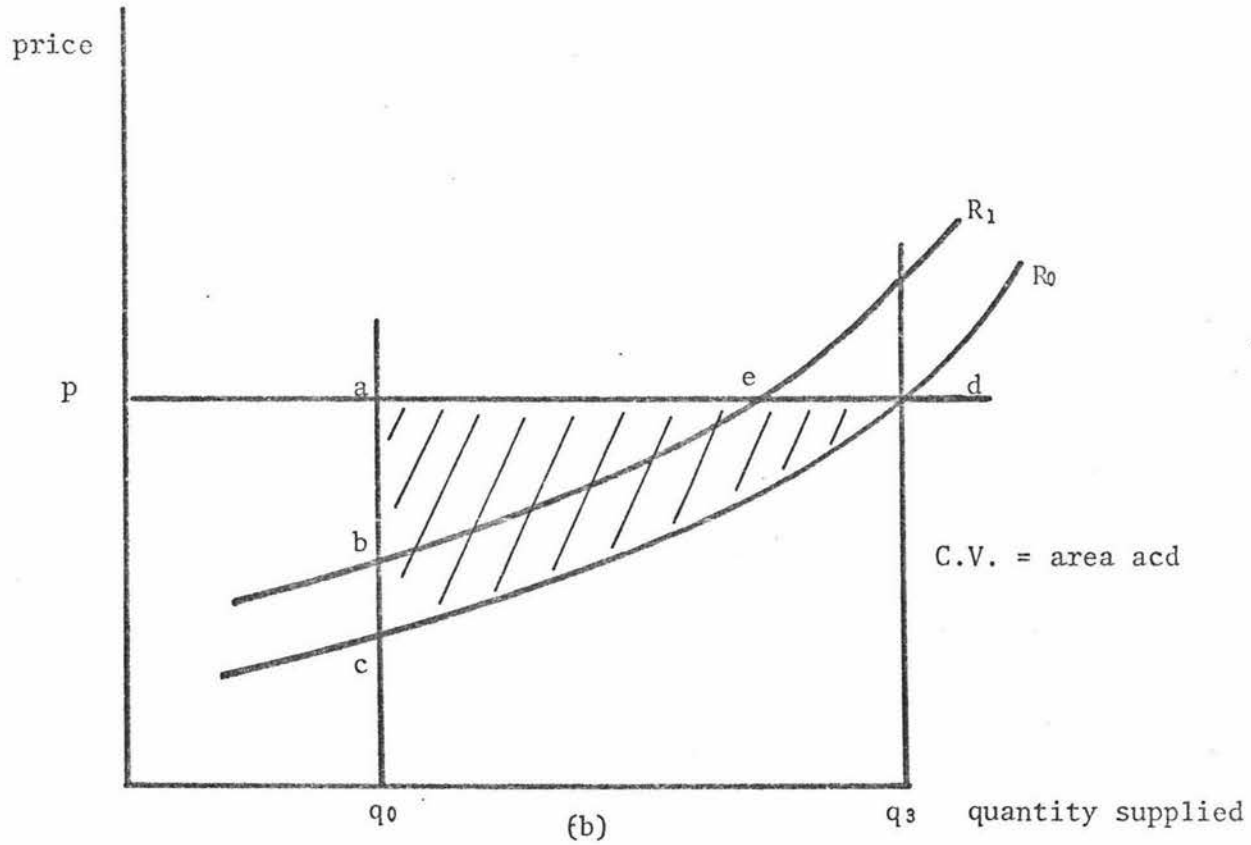


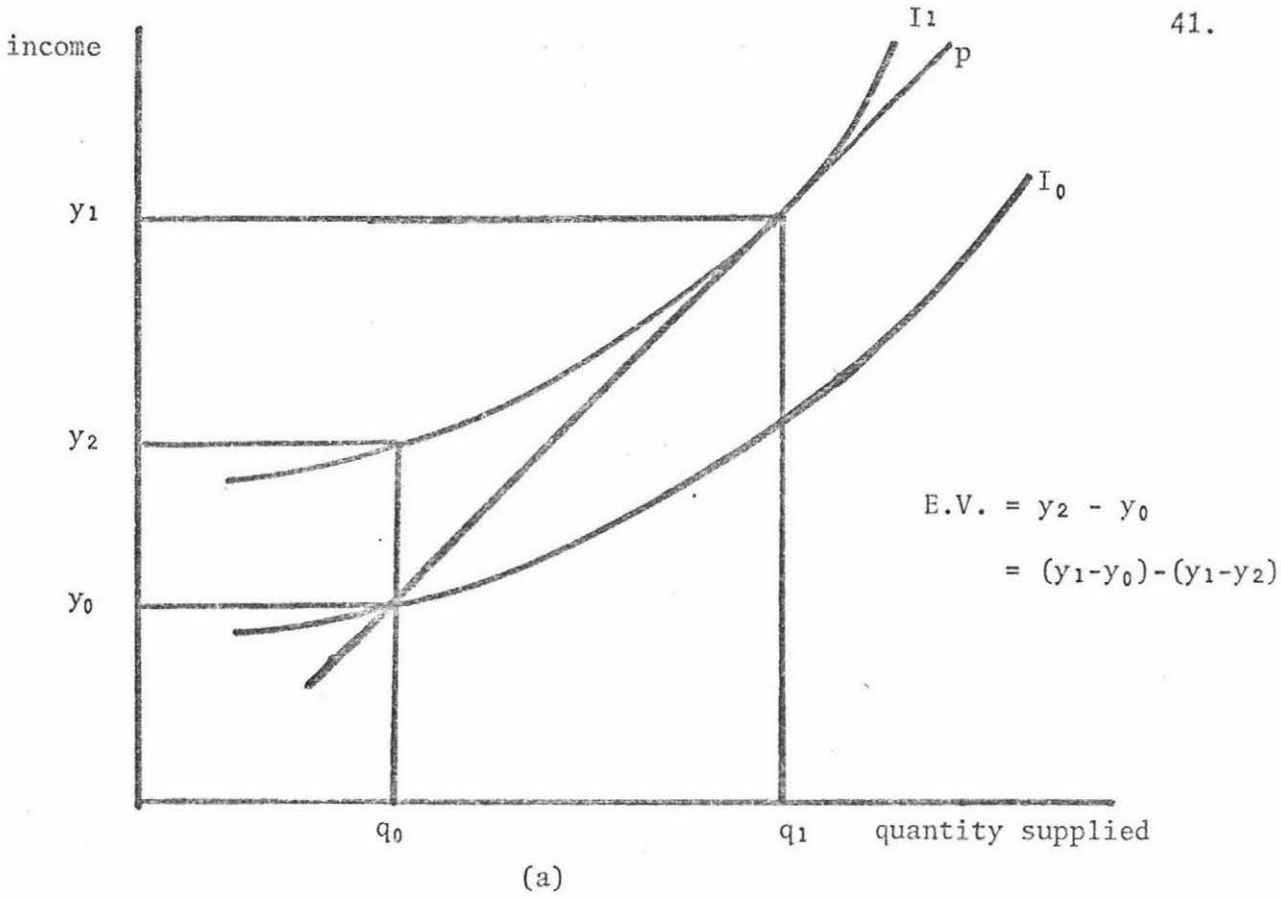
Fig. 3.5 The Measurement of Compensating Variation for a Seller Under a Trade/No Trade Situation

Fig. 3.6(a) illustrates the measurement of equivalent variation. The initial situation for the producer is the same as for compensating variation. In this case however we want the producer to be as well off without trading as he would have been had he been permitted to trade at price p. That is, we want the producer to be on indifference curve I_1. In order for this to occur we must pay the producer (y_2-y_o) which is called the equivalent variation. If trading had been permitted the consumer would trade until point y_1q_1 was reached. (y_2-y_o) can be expressed as $(y_1-y_o)-(y_1-y_2)$. Following a similar procedure to that used for compensating variation the measure of equivalent variation can be expressed in price-quantity space.

In Fig. 3.6(b) (y_1-y_o) is the area beneath the price line p between q_o and q_1. (y_1-y_2) is the area beneath curve R_1 between q_o and q_1. Equivalent variation therefore is the shaded area abe below price line p and above curve R_1.

Fig. 3.7 illustrates the derivation of a supply curve from an indifference map. The initial point y_oq_o is an equilibrium point if the price is p_o (i.e. q_o would be the quantity supplied if the price was p_o). For a price of p_1 however quantity q_1 will be supplied. This can be expressed in price-quantity space as in Fig. 3.7(b). At quantity q_o the curves p_o and I_o are at a point of tangency. Therefore the intersection of the price line p_o in Fig. 3.7(b) and curve R_o is a point on the supply curve. Likewise at quantity q_1 the curves p_1 and I_1 are at a point of tangency. Therefore the intersection of price line p_1 and curve R_1 is another point on the supply curve. Economic rent is the shaded area ace below the price line p_1 and above the supply curve S, obtained by joining the two points.

The three measures of producer surplus are compared in Fig. 3.8. This shows that using economic rent under-estimates compensating variation and over-estimates equivalent variation. As was the case with consumer surplus these three measures will be the same when there is zero income effect (i.e. a change in the income of the producer will not change his desire for leisure and hence the quantity supplied will not change). Thus the error incurred by using economic rent as a measure of the change in producer surplus will be small providing that the income effect is near zero.



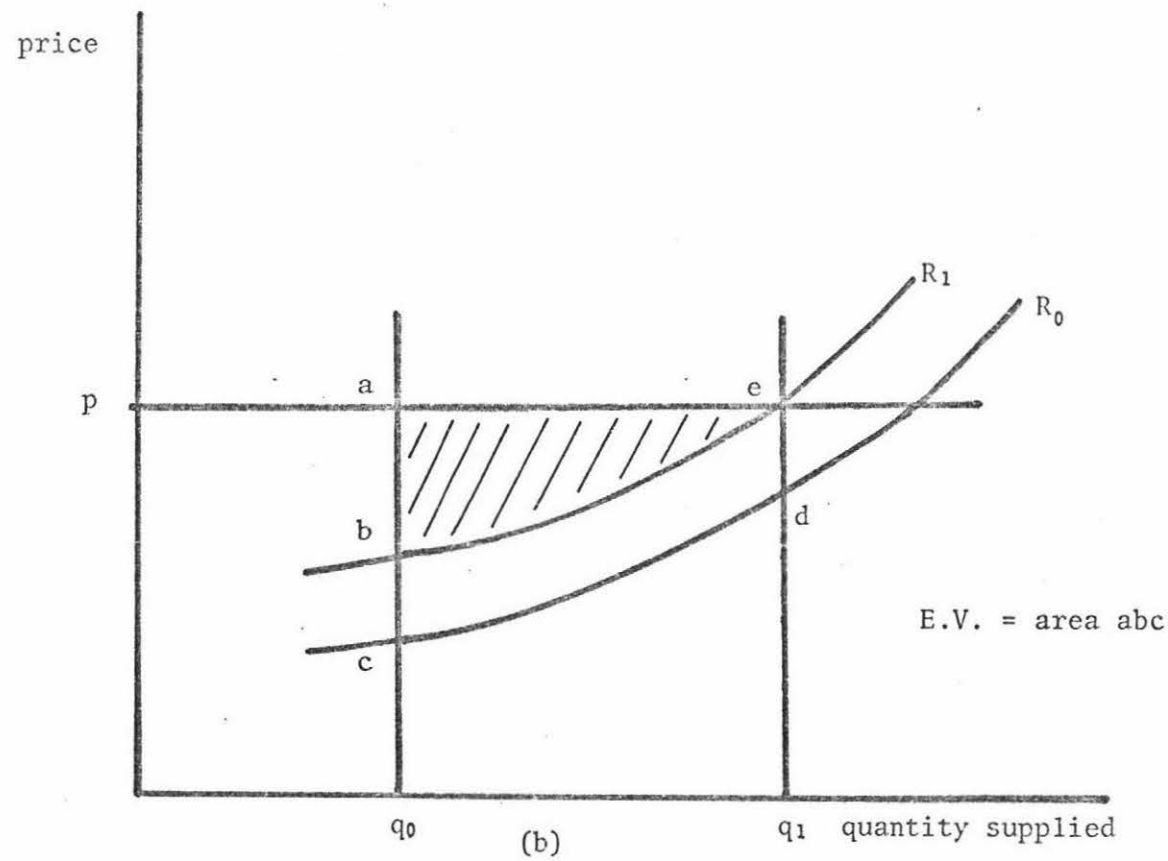
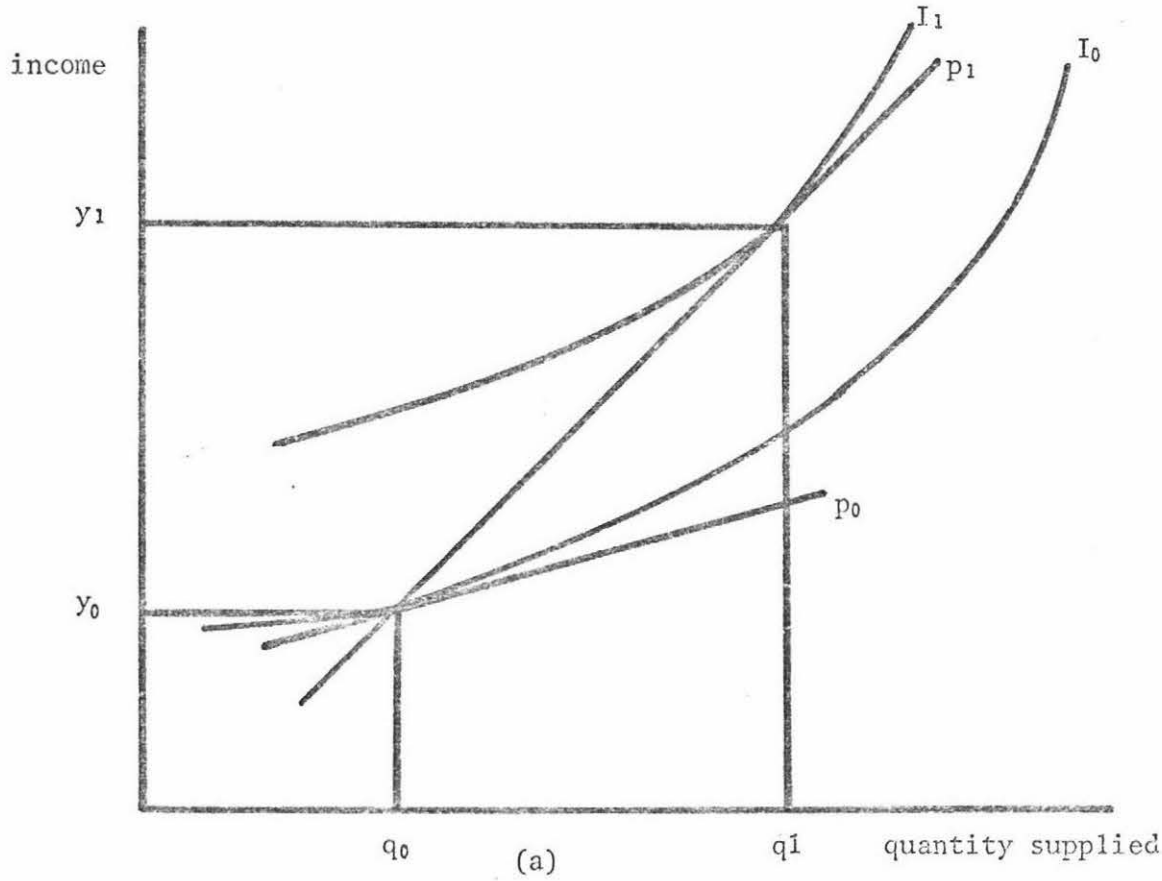


Fig. 3.6 The Measurement of Equivalent Variation for a Seller Under a Trade/No Trade Situation



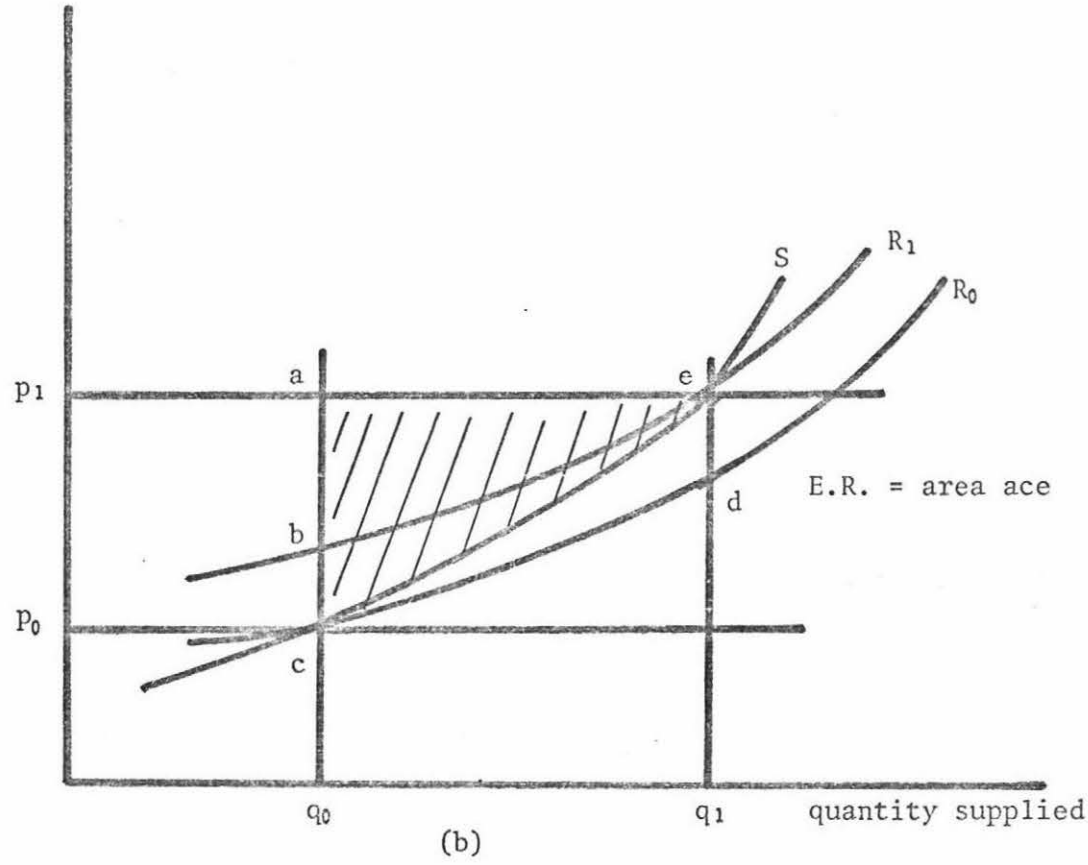


Fig. 3.7 The Measurement of Economic Rent for a Seller Under a Trade/No Trade Situation

C.V. = area acd

E.R. = area ace

E.V. = area abc

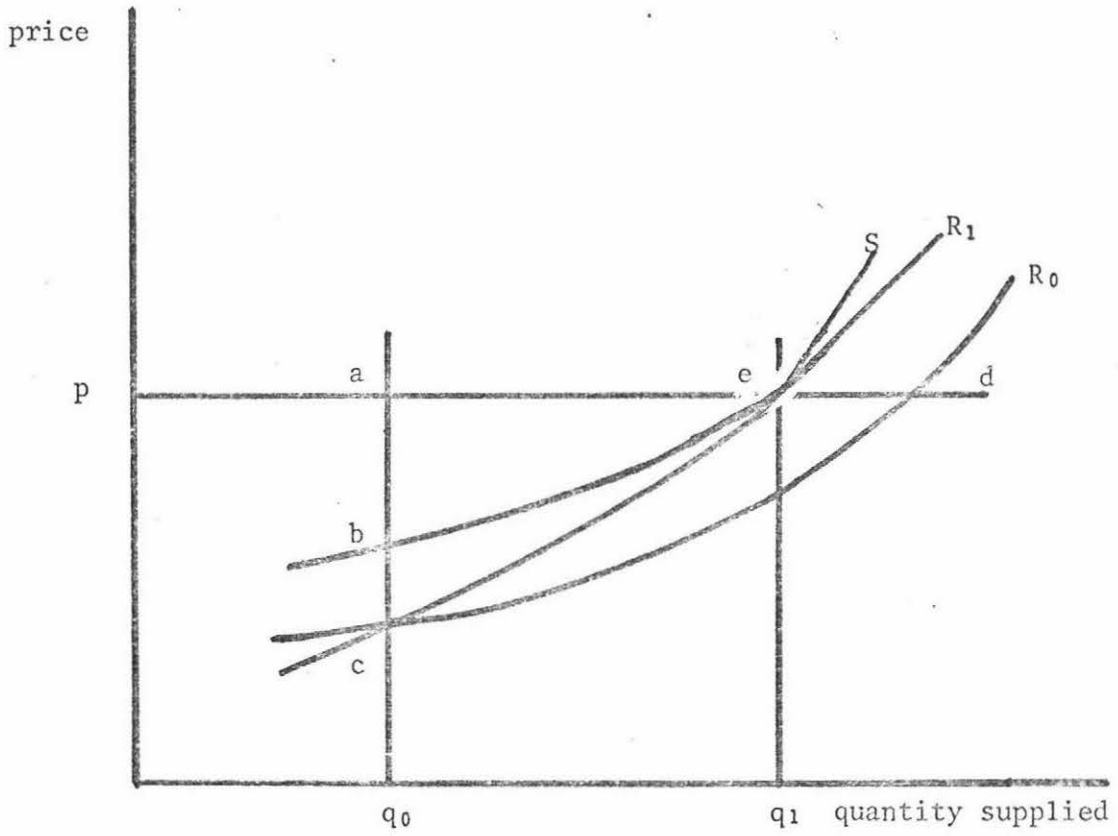


Fig. 3.8 A Comparison Between Equivalent Variation, Compensating Variation and Economic Rent for a Seller

CHAPTER FOUR

THE MODELS AND ESTIMATES

4.1 Introduction

This Chapter deals first with the formulation of economic models of the effect of quota restrictions on economic surplus. It then proceeds to describe the econometric models that were used in attempts to estimate the parameters of the economic models. The data used in the estimation of these parameters is discussed and the estimates obtained are presented.

4.2 Economic Models

The United States beef market has two main product segments, prime cuts and manufacturing beef. The greater part of imports of beef move into the manufacturing trade. The United States model therefore has three supply and two demand functions; supply of prime beef, supply of domestically produced manufacturing beef, supply of imports, demand for prime beef and demand for manufacturing beef. The New Zealand model has one supply function, the total supply of beef exports.

The effect of an import quota is to limit the import supply of manufacturing beef. The following graphical analysis develops the effect of a quota on the various demand and supply functions and indicates the expected change in economic surplus that would result in each case.

Several assumptions have been made for the purpose of simplifying the models presented here :

1. The quota is assumed to be pre-determined and is not dependent upon domestic supply of manufacturing beef;
2. The fed beef demand curve is shifted to the right due to an increase in the price of manufacturing beef but the slope of the demand curve does not change;
3. A change in price of New Zealand exports of manufacturing beef to the United States has no effect upon the total supply of beef for export within the year in which the price changes.

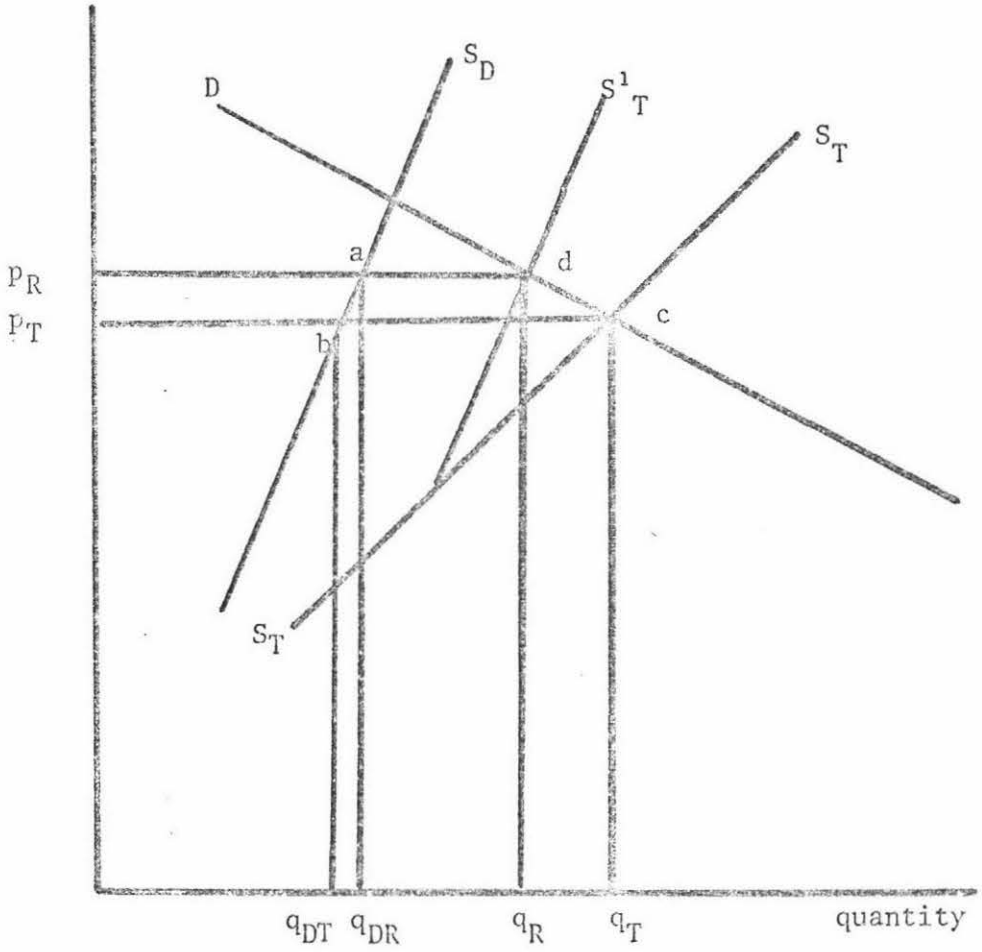
Fig. 4.1 illustrates the effect of an import quota on supply and demand for non fed beef in the United States. Under a free trade situation total supply is represented by curve s_T and domestic supply by s_D. Domestic Demand for non-fed beef is represented by curve D. Imposition of a quota results in the total supply curve $s_T^1 s_T$. Under a free trade situation the market is at equilibrium at price p_T and quantity q_T. The imposition of a quota of magnitude q_R-q_{DR} results in an increase in price to p_R and a decrease in quantity to q_R. Domestic supply increases from q_{DT} to q_{DR}. The decrease in ordinary surplus therefore is equal to $p_R dcp_T$ and the increase in economic rent of domestic suppliers is equal to $p_R abp_T$. The decrease in ordinary surplus exceeds the increase in economic rent by the amount abcd. The revenue accruing to exporters changes from $q_T q_{DT} bc$ to $adq_R q_{DR}$. The net change depends upon the elasticity of the demand and supply curves.

Fed beef is a substitute for non-fed beef and therefore an increase in the price of non-fed beef will cause the fed beef demand curve to shift upwards. This is illustrated by Fig. 4.2 where an increase in the non-fed beef price, resulting from the imposition of a quota, has shifted the demand curve from D_1 to D_2. Price has increased from p_1 to p_2 and quantity from q_1 to q_2. Ordinary surplus has increased from $p_1 ad$ to $p_2 bc$. Economic rent has increased by amount $p_2 bap_1$. The effect of quotas therefore, for substitute products which are normal goods, is to increase economic surplus for both domestic producers and consumers. The effect of an imposition of quotas on New Zealand exports is to cause diversion of the resulting excess to less attractive markets. This means a fall in the average price received for all exports. In Fig. 4.3 the price has fallen from p_1 to p_2. As supply is assumed to be totally inelastic the decrease in economic rent is the amount $p_1 abp_2$.

4.3 The Incorporation of a Quota Variable in an Economic Framework

The effect of quotas on the price-quantity variables can be assessed in two ways. Firstly quotas can be included as an exogenous variable. This method is preferable but problems arise in deciding on how to define a data series for the variable. The quota may be represented by two data sets :

(i) Defining a dummy variable equal to zero when no quota restrictions apply and equal to 1 when quotas are



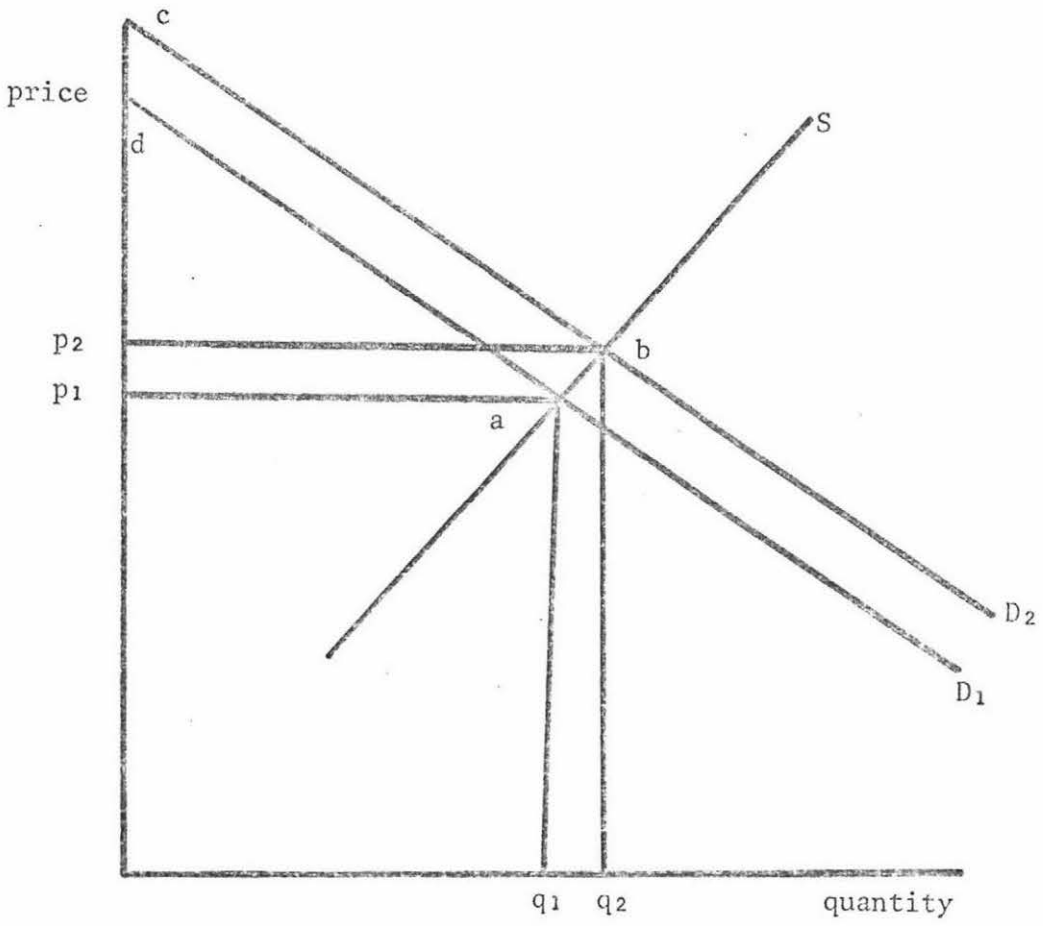
Quota = $q_R - q_{DR}$

Consumer surplus decreases by $p_R dcp_T$

Economic rent increases by $p_R abp_T$

$p_R dcp_T > p_R abp_T$

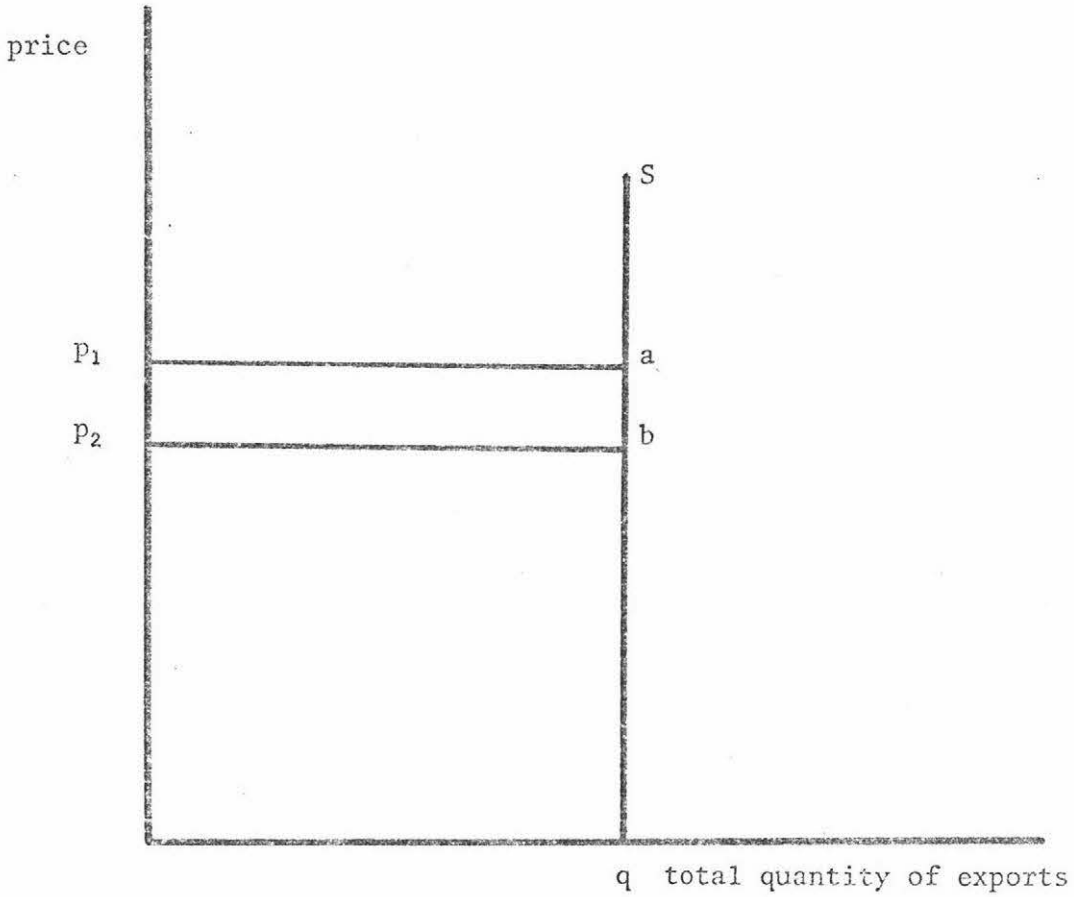
Fig. 4.1 Non-Fed Beef Supply and Demand



Consumer surplus increases by $p_2bc - p_1ad$

Economic rent increases by p_1abp_2

Fig. 4.2 Fed Beef Supply and Demand



Economic rent decreases by p_1abp_2

Fig. 4.3 Export Supply of Manufacturing Beef

effective. However, use of this approach is unsatisfactory because it does not allow for changes in the size of the quota.

(ii) Defining a variable equal to the inverse of the effective quota. When there is no quota on imports the effective quota is infinity. However in this situation the inverse of the effective quota is zero and this variable provides a more convenient data series for purposes of estimation without any loss of theoretical validity.

Secondly, the market can be examined for those years in which quotas were not effective and the values of variables, required for the estimation of economic surplus, predicted for the years in which quotas were effective. The values obtained would be estimates of the values of the variables with the effect of the quota variable removed. The difference between the values of the variables predicted by the model and the values actually occurring can then be inferred to result from the imposition of quotas. This reasoning relies on one very strong assumption : that there is no change in the market structure between those years in which quotas were effective except for that brought about by the imposition of quotas. This latter method was the one attempted in this study.

4.4 Econometric Models

This section describes the procedures by which the parameters of the economic models are estimated.

The parameters of the United States model are estimated by an econometric model based on a model formulated by Langemeier and Thompson [41]. The parameters of the New Zealand model are estimated from an econometric model formulated by the writer.

The Langemeier and Thompson model [41] is a simultaneous equation model containing 12 relationships. Seven of these are simultaneously determined and five are not. Four of the relationships which do not involve simultaneity are identities and the fifth is a simple two variable relationship.

Endogenous Variables

F^W : dressed weight per head of fed beef slaughtered

P_F^P : farm price of fed beef

S^M : supply of non-fed beef from domestic sources (dressed weight)

S^P : supply of fed beef

D^P : per capita demand for fed beef

P_R^P : retail price of fed beef

P_R^M : retail price of non-fed beef

P_F^M : farm price of non-fed beef

M : quantity of imported beef (dressed weight)

D^M : per capita demand for non-fed beef

D^T : per capita demand for beef

Exogenous variables

N^S : number of fed beef cattle slaughtered

N^F : number of cattle on feed January 1

$P^{c/c}$: ratio of the market price for corn to Government support price for corn produced

$P^{c/cL}$: ratio of the average market price for corn in years t-1, t-2, and t-3 to the average Government support price for corn produced in those three years

P_F^{PL} : average price of fed beef in years t-1, t-2 and t-3

N^c : number of cows in inventory on January 1

R^L : range conditions in year t-1 as a percentage of normal

P^M : farm price of milk

Y : disposable income per capita

W : wage rates in the meat packing industry

P_o : civilian population of the United States

G : quantity of beef demanded by the Government

S : net change in beef stocks

X^u : quantity of beef exported

The 12 relationships comprising the Langemeier and Thompson model [41] are :

(1) $N^S = a_o + a_1 N^F$

(2) $F^W = b_o + b_1 P_F^P + b_2 N^F + b_3 P^{c/c} + b_4 P^{c/cL} + b_5 P_F^{PL}$

(3) $S^M = c_o + c_1 P_F^M + c_2 P_F^{PL} + c_3 N^c + c_4 R^L + c_5 P^M$

(4) $M = d_o + d_1 P_R^M + d_2 W$

(5) $D^P = e_o + e_1 P_R^P + e_2 P_R^M + e_3 Y$

(6) $D^M = f_o + f_1 P_R^M + f_2 P_R^P + f_3 Y$

(7) $P_R^P = g_o + g_1 P_R^P + g_2 D^T + g_3 W$

(8) $P_R^M = h_o + h_1 P_F^M + h_2 D^T + h_3 W$

(9) $S^P = F^W \times N^S$

(10) $S^P = D^P \times P_o + 0.5 (G + S + X^u)$

(11) $S^M + M = D^M \times P_o + 0.5 (G + S + X^u)$

(12) $D^T + P_o = D^P \times P_o \div D^M \times P_o$

Langemeier and Thompson do not adequately explain the relationships expressed by the model. However, subject to a necessary constraint on the number of variables included the relationships expressed appear to be theoretically sound.

A brief discussion of each of the relationships now follows, validating each on theoretical grounds.

Equation 1

The number of fed cattle slaughtered is dependant on the availability of cattle of this type. The number of cattle on feed at January 1 has been used as an indicator of this.

Equation 2

The dressed weight of fed beef is simultaneously determined with the farm price of fed beef, reflecting the producers' ability to vary the weight of cattle in response to prices and recognising that this may have an effect on future prices. Because producers must make decisions in advance, due to some inflexibility in beef production, lagged prices for fed beef are included as an exogenous variable. The opportunity cost of feeding cattle is reflected by

the corn price ratio. Again both the lagged and current ratios are included. The number of cattle on feed is the other variable in this equation. The reasoning behind this is difficult to perceive. Also the inclusion of this variable may lead to problems of multi-collinearity as the number of cattle on feed are influenced by the prices for fed beef and corn in preceding years.

Equation 3

The supply of non-fed beef is simultaneously determined with the farm price of non-fed beef in accordance with accepted theory. Other factors which determine supply are those which affect the relative profitability of this enterprise. The relative profitability of breeding as opposed to sale for slaughter is reflected by the lagged price of fed beef. Milk price reflects a similar choice between dairying and slaughter. Range conditions for the previous year represen the supply of supplementary feed and the number of cows in the inventory is an indicator of the available supply of non-fed animals for slaughter.

Equation 4

Import supply of non-fed beef is simultaneously determined with the price received by exporters. The retail price of non-fed beef is included as an indicator of prices received. Marketing costs are represented by meat industry wage rates.

Equation 5

In accordance with economic theory, the per capita demand for fed beef is simultaneously determined with the price of fed beef. The retail price of non-fed beef has been included as this is the most obvious substitute product. The effect of changes in income on demand is provided for in the variable per capita disposable income. Here again a problem of multicollinearity may be introduced by the close relationship between the retail price of fed beef and that of non-fed beef.

Equation 6

The per capita demand for non-fed beef is dependant on similar variables to fed beef. In this case however simultaneity exists between demand and the non-fed beef retail price. The same problems apply in this equation as occur in Equation 5.

Equation 7

This is the margin equation for fed beef. The retail price is simultaneously determined with the farm price. Total per capita demand for beef has been included to allow for the concept of marginal cost pricing. Marginal cost pricing of a product exists when, as throughput increases, only the marginal increase in cost is recouped. Meat industry wage rates is included as an indication of the effect of processing costs.

Equation 8

This is the margin equation for non-fed beef and the same points apply as with equation 7.

Identity 9

This identity equates fed beef supply with the product of dressed weight and numbers slaughtered.

Identity 10

This is the market clearing identity for fed beef allowing for changes in stocks.

Identity 11

This is the market clearing identity for non-fed beef again allowing for changes in stocks.

Identity 12

This equates total demand with demand for both fed and non-fed beef.

Variables representing prices in the supply relationships are deflated by the Index of prices received by farmers. Variables represent prices and incomes in demand relationships are deflated by the United States consumer price index.

The equations described represent the market structure existing in the United States. Naturally not all variables that influence the market are included as this would result in problems of estimation and interpretation. Also the effect of these variables would be too small to be significant.

The model presented above has been modified somewhat for use in this thesis. This has been done firstly to simplify the model, secondly to overcome problems resulting from a lack of data and thirdly to obtain a linear model of the market.

To obtain a linear model it is necessary to express demand and income variables on a total basis rather than a per capita basis. The reason for altering the model in this way is that the properties of the estimates obtained from a model containing multiplicative relationships are not fully understood.

The following equations present the model in the form used in this thesis:

$$(1) \quad S^P = a_o + a_1 P_F^P + a_2 N^F + a_3 P^{c/c} + a_4 P_F^{PL}$$

$$(2) \quad S^M = b_o + b_1 P_F^M + b_2 P_F^{PL} + b_3 N^C + b_4 R^L$$

$$(3) \quad M = c_o + c_1 P_R^M + c_2 W$$

$$(4) \quad D^P = d_o + d_1 P_R^P + d_2 P_R^M + d_3 Y + d_4 P_o$$

$$(5) \quad D^M = e_o + e_1 P_R^M + e_2 P_R^P + e_3 Y + e_4 P_o$$

$$(6) \quad P_R^P = f_o + f_1 P_F^P + f_2 W$$

$$(7) \quad P_R^M = g_o + g_1 P_F^M + g_2 W$$

$$(8) \quad S^P = D^P$$

$$(9) \quad S^M = D^M - M$$

Langemeier and Thompson's [41] division of fed beef supply into numbers slaughtered and dressed weights seems to be unnecessary, as the variable 'cattle on feed' is included in equation 2, as well as equation 1. The supply of fed beef has therefore been expressed by one equation.

Only 13 observations on the data required for estimation are available. It is therefore necessary to omit some of the exogenous variables included by Langemeier and Thompson [41] so that there are

sufficient degrees of freedom to estimate the model. The variables omitted are those which, based on Langemeier and Thompson's [41] results and the writer's understanding of the market, are the least significant of those included. These are the lagged corn price ratio, the milk price, exports, military consumption and changes in stocks. Total demand for beef is also omitted as the concept of marginal cost pricing is not thought to be significant.

The New Zealand model is a recursive model linking the f.o.b. export price for New Zealand beef with the retail price of non-fed beef in the United States and the quantity of beef imported. The following variables are included in this model.

R^U : New Zealand revenue from exports of manufacturing beef to the United States in money terms

R_R^{MI} : Retail price of non-fed beef in the United States in money *(1)* terms

R^{NU} and R^{NC} : The average money price of all beef exported by New Zealand multiplied by the quantity of manufacturing beef exported to the United States and a selected market representing the rest of the world

R^{WC} and R^{WU} : New Zealand revenue from exports of manufacturing beef to a selected market representing the rest of the world. Two markets were considered, Canada (R^{WC}) and United Kingdom (R^{WU})

---

(1) It was unnecessary to deflate the New Zealand model as the endogenous variables in the model are expressed in terms of price or revenue.

P^E : The average f.o.b. export money price for all New Zealand beef exports

X^{NU} and X^{NC} : The sum of exports of manufacturing beef to the United States and a selected market representing the rest of the world

M : Total United States imports of manufacturing beef (dressed weight)

A problem arises when attempting to link up the United States model with the New Zealand model. United States data is available on a calendar year basis while New Zealand data is available on a June year basis. However, when the lag effect of market information and transport is taken into account, the problem becomes less acute. It was decided therefore to estimate the linkage equation in the following functional form:

$$R^U_t = f\left(P^{MI}_{R(t-\frac{1}{2})}, M_{(t-\frac{1}{2})}\right)$$

The following equations indicate the structure of the model:

(1) $$R^U = a_o + a_1 P^{MI}_R + a_2 M$$

(2) $$R^N = b_o + b_1 R^U + b_2 R^{WU}$$
(or $R^N = b_o + b_1 R^U + b_2 R^{WC}$)

(3) $$P^E = \frac{R^N}{X^N}$$

Equation 1 relates the revenue obtained by New Zealand from exports of beef to the United States to the retail price and the quantity of beef imported. It therefore takes into account the effect of an increase in price as well as an increase in the proportion of New Zealand exports sent to this market.

Equation 2 expresses New Zealand manufacturing beef revenue as a function of revenue from the United States market and revenue from a selected market representing

the rest of the world. Manufacturing beef revenue is calculated using the average price of all New Zealand beef exports so that the effect of changes in revenue from the United States market on prices for other classes of beef is automatically taken into account when the model is estimated.

Equation 3 is an identity expressing the average price of all New Zealand beef as equal to the revenue obtained from manufacturing beef divided by the sum of exports of manufacturing beef to the United States and a selected market representing the rest of the world.

4.5 Estimation

This section briefly describes the methods used to obtain satisfactory data. Information on the estimation procedure is then provided and the estimates obtained are presented and discussed.

4.5.1 The Data

The following table provides information on data transformations and data sources:

Variable	Data Transformations	Sources of raw data
Fed beef supply S^P	The product of the weighted average liveweight of steers and heifers sold for slaughter converted to dressed weight using the average dressing-out percentage, and the total number of steers and heifers slaughtered	[3]
Farm price of fed beef P_F^P	The average price of steers and heifers weighted according to numbers and deflated by the index of prices received by farmers	[3]

Variable	Data Transformations	Sources of raw data
Supply of non-fed beef S^M	The difference between total supply of all beef and the supply of fed beef	[3]
Fed beef demand D^P	Calculated as equal to fed beef supply	[3]
Retail price of fed beef P_R^P	The retail price of choice beef deflated by the consumer price index	[2]
Imports M	The quantity of finished product beef imported expressed on a dressed weight basis	[3]
Retail price of non-fed beef P_R^M	The retail price of hamburger deflated by the consumer price index	[2]
Farm price of non-fed beef P_F^M	The average price of cutter and canner cows, and utility and commercial cows weighted according to numbers and deflated by the index of prices received by farmers	[3]
Demand for non-fed beef D^M	The sum of domestic supply and imports	[3]
Number of cattle on feed N^F	The number of cattle and calves on feed at January 1	[4]
Corn price ratio $p^{c/c}$	The ratio of the market price of corn to the government support price of corn	[4]

Variable	Data Transformations	Sources of raw data
Lagged farm price of fed beef P_F^{PL}	The three year average for the period t-1, t-2 and t-3 deflated by the index of prices received by farmers	[3]
Number of cows in the inventory N^C	The number of beef cows and heifers two years and older plus 50 per cent of the heifers between one and two years of age	[3]
Range conditions R^L	The average for the months of May to October as a percentage of normal, lagged one year	[3]
Total Disposable income Y	The per capita disposable income deflated by the consumer price index and multiplied by civilian population	[5]
Civilian population P_o	Civilian population	[5]
Meat industry wage rates W	The hourly rates deflated by the consumer price index	[5]
New Zealand revenue from beef exports to the United States R^U	The f.o.b. revenue for selected classes of beef exports to the United States	[12]
United States retail price of non-fed beef P_R^{MI}	The retail price of hamburger in the United States, not deflated	[2]

Variable	Data Transformations	Sources of raw data
New Zealand revenue from exports of manufacturing beef to the rest of the world R^{WU} and R^{WC}	Represented by the revenue for selected classes of beef exported to either the United Kingdom, R^{WU} or Canada, R^{WC}	[12]
The average f.o.b. export price for all New Zealand beef exports P^E	Calculated from total revenue and total export figures	[13]
The sum of exports of manufacturing beef to the United States and Canada or United Kingdom X^{NU} and X^{NC}	Exports of selected classes to the United States and Canada (or the United Kingdom)	[12]
Total revenue for manufacturing beef exports R^{NU} and R^{NC}	The product of P^E and X^{NU} (R^{NU}) or the product of P^E and X^{NC} (R^{NC})	[12, 13]

4.5.2 Estimation Procedure

The United States model was estimated using the first step of the Indirect Least Squares method. This involved estimating the reduced form equations by Ordinary Least Squares. It was not necessary to estimate the parameters of the structural equations and this was not one of the objectives of this study.

The following discussion illustrates the way in which reduced form equations can be used to obtain estimates of changes in economic surplus.

Fig. 4.4(a) illustrates the change in consumer surplus. The following equation expresses this change :

$$\text{Change in Consumer Surplus} = \int_{q1}^{q_2} f_D(q_D)dq_D - p_1q_1 + p_2q_2$$

Similarly Fig. 4.4(b) illustrates the change in economic rent.

$$\text{Change in Economic Rent} = \int_{q1}^{q_2} f_S(q_S)dq_S + p_1q_1 - p_2q_2$$

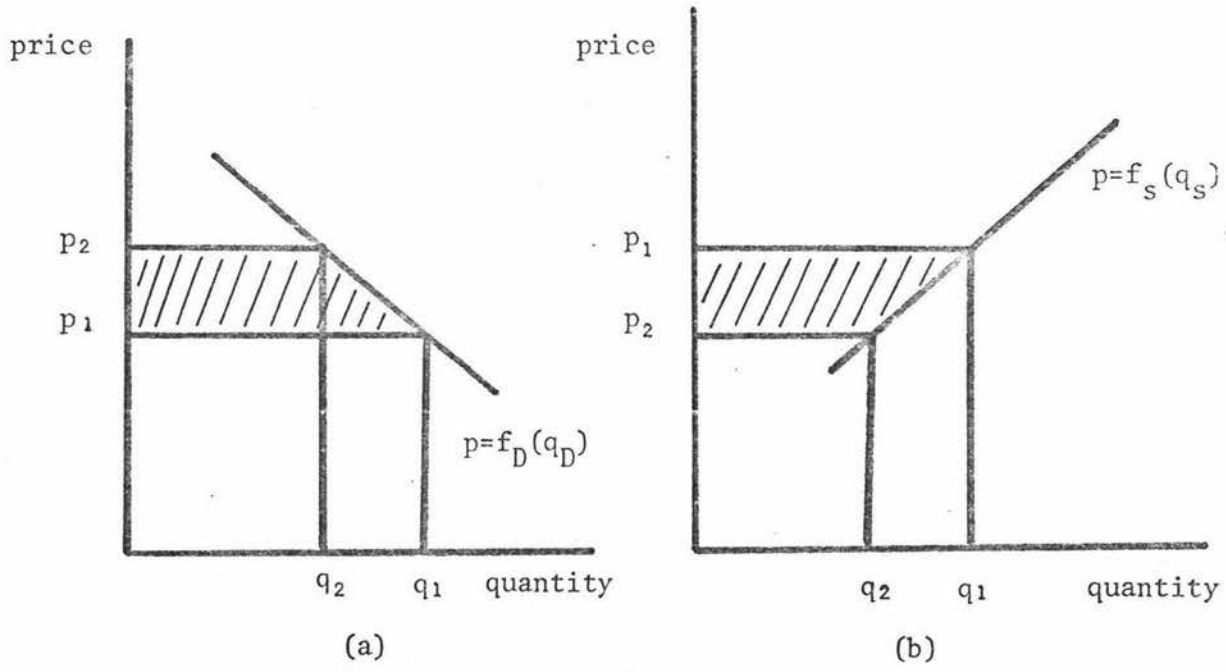


Fig. 4.4 Changes in Consumer Surplus and Economic Rent

In this study the co-ordinate $p_1\ q_1$ in both graphs can be estimated from the reduced form equations. The co-ordinate $p_2\ q_2$ can be obtained from actual data for the years in which quotas were effective. These co-ordinates identify the right hand side of the equations measuring the change in consumer surplus and economic rent and these changes can be estimated.

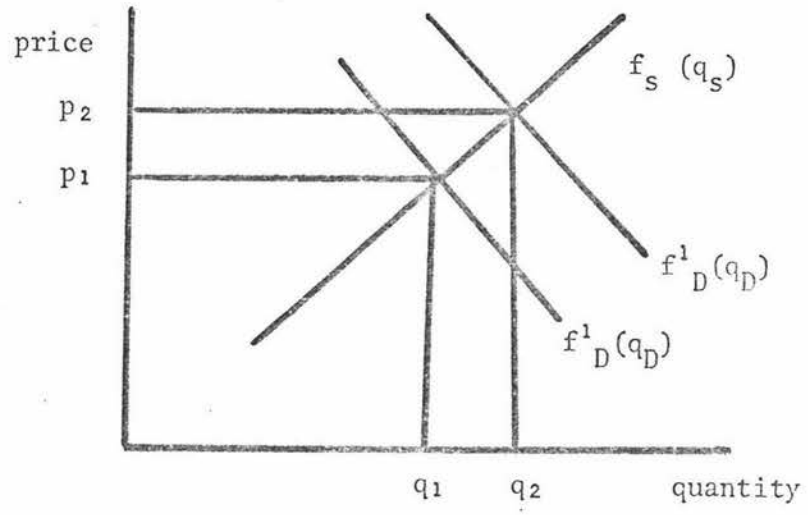


Fig. 4.5 Change in Consumer Surplus Resulting from a Shift in the Demand Curve

Fig. 4.5 illustrates a situation where reduced form equations and actual data do not provide sufficient information to estimate the change in consumer surplus. It is necessary to have a priori information on the slopes of $f_D^1\ (q_D)$ and $f_D^2\ (q_D)$. The following equation expresses the change in quantitative terms.

Change in Consumer Surplus =

$$\int_0^{q_2} f_D^{\ 2}\ (q_D) - \int_0^{q_1} f_D\ (q_D)\ dq_D - p_2q_2 + p_1q_1$$

This problem occurred in this study because the demand curve for fed beef was postulated to shift to the right as a result of the imposition of quotas. To overcome this problem estimates of the elasticity of the demand curve for fed beef, obtained by other studies were examined to obtain an a priori estimate.

The following equations are the reduced form of the United States model:

$$S^P = a_o + a_1 N^F + a_2 P^{c/c} + a_3 P_F^{PL} + a_4 N^C + a_5 R^L + a_6 Y + a_7 P_o + a_8 W$$

$$S^M = b_o + b_1 N^F + b_2 P^{c/c} + b_3 P_F^{PL} + b_4 N^C + b_5 R^L + b_6 Y + b_7 P_o + b_8 W$$

$$D^P = c_o + c_1 N^F + c_2 P^{c/c} + c_3 P_F^{PL} + c_4 N^C + c_5 R^L + C_6 Y + C_7 P_o + C_8 W$$

$$D^M = d_o + d_1 N^F + d_2 P^{c/c} + d_3 P_F^{PL} + d_4 N^C + d_5 R^L + d_6 Y + d_7 P_o + d_8 W$$

$$P_R^P = e_o + e_1 N^F + e_2 P^{c/c} + e_3 P_F^{PL} + e_4 N^C + e_5 R^L + e_6 Y + e_7 P_o + e_8 W$$

$$P_R^M = f_o + f_1 N^F + f_2 P^{c/c} + f_3 P_F^{PL} + f_4 N^C + f_5 R^L + f_6 Y + f_7 P_o + f_8 W$$

$$M = g_o + g_1 N^F + g_2 P^{c/c} + g_3 P_F^{PL} + g_4 N^C + g_5 R^L + g_6 Y + g_7 P_o + g_8 W$$

$$P_F^P = h_o + h_1 N^F + h_2 P^{c/c} + h_3 P_F^{PL} + h_4 N^C + h_5 R^L + h_6 Y + h_7 P_o + h_8 W$$

$$P_F^M = j_o + j_1 N^F + j_2 P^{c/c} + j_3 P_F^{PL} + j_4 N^C + j_5 R^L + j_6 Y + j_7 P_o + j_8 W$$

The model expressing the relationship between New Zealand revenue and the United States retail price and imports of beef is estimated by Ordinary Least Squares in the structural form. As mentioned previously this is a recursive model. The following equations indicate the order of the recursion.

$$R^U = t_o + t_1 P_R^{MI} + t_2 M$$

$$R^{NU} = m_o + m_1 R^U + m_2 R^{WU}$$

$$(\text{or } R^{NC} = n_o + n_1 R^U + n_2 R^{WC})$$

4.5.3 Presentation of Estimates

The estimates of the reduced form equation coefficients of the United States model are presented in Table 4.1 in tabular form. The figures in parenthesis below each estimate are the "t" values. The estimates of the parameters of the New Zealand model are presented in Table 4.2

Table 4.3 presents the values obtained for the Durbin-Watson statistic for the United States model. In all equations the presence or absence of auto-correlation is indeterminate at the 1 percent level of significance. The Durbin-Watson statistic provides little information due to the large number of exogenous variables and the small number of observations.

The presence of multicollinearity can be detected by examination of the standard errors. If these are high then multicollinearity may be present, and the "t" statistic will tend to be insignificant. In Table I the "t" statistic is insignificant for most of the coefficients at the 10 percent level. In some cases this is due to an insignificant relationship between the dependant variable and the exogenous variable. However it is considered a strong possibility that some degree of multicollinearity is present.

TABLE 4.1 ESTIMATES OF THE REDUCED FORM COEFFICIENTS OF THE UNITED STATES MODEL

Endogenous Variables	Exogenous Variables									
	Const.	N^F	$p^{c/c}$	P_F^{PL}	N^c	R^L	Y_{-1}	P_o	W	R^2
S^P	-15235 (1.12)	1.978 (2.27)*	4918 (1.02)	36.6 (0.11)	-0.208 (0.79)	38.4 (0.76)	32.5 (1.32)	-0.468 (1.62)	19203 (1.66)*	0.9897
S^M	-16607 (1.86)*	-0.625 (1.09)	1120 (0.35)	95.2 (0.44)	0.295 (1.72)*	54.2 (1.63)	24.6 (1.53)	-0.198 (1.05)	3220 (0.42)	0.9527
D^P	-15235 (1.12)	1.978 (2.27)*	4918 (1.02)	36.6 (0.11)	-0.208 (0.79)	38.4 (0.76)	32.5 (1.32)	-0.468 (1.62)	19203 (1.66)	0.9897
D^M	-4853 (0.45)	-0.529 (0.77)	-1432 (0.38)	-63.5 (0.24)	0.268 (1.31)	-26.9 (0.68)	0.598 (0.03)	0.053 (0.24)	-3810 (0.42)	0.9049
P_R^P	-21.9 (0.40)	-0.005 (1.55)	-17.6 (0.91)	0.305 (0.23)	0.0004 (0.40)	0.538 (2.64)**	-0.084 (0.85)	0.0018 (1.58)	-71.2 (1.53)	0.9494
P_R^M	-147.0 (3.33)**	-0.003 (1.16)	0.127 (0.008)	-1.291 (1.20)	-0.002 (2.14)*	0.338 (2.06)*	-0.072 (0.91)	0.0024 (2.56)**	-40.6 (1.08)	0.9719
M	-11753 (2.12)*	0.096 (0.27)	-2252 (1.30)	-158.7 (1.17)	-0.027 (0.25)	27.4 (1.33)	-240 (2.41)**	0.252 (2.16)*	-7030 (1.50)	0.9477
P_F^P	-61.5 (2.06)*	-0.004 (1.88)	-7.97 (0.75)	0.015 (0.02)	-0.0005 (0.90)	-0.023 (0.20)	-0.010 (0.19)	0.0014 (2.19)	-39.5 (1.56)	0.9099
P_R^P	-35.9 (8.91)***	0.0001 (0.53)	2.499 (1.76)	-0.785 (7.98)***	-0.001 (18.46)***	0.132 (8.80)***	0.022 (3.13)**	0.0005 (6.30)***	-35.9 (0.31)	0.9987

* significant at the 10 percent level
** significant at the 5 percent level
*** significant at the 1 percent level

TABLE 4.2 ESTIMATES OF THE PARAMETERS OF THE NEW ZEALAND MODEL

	Const	P_R^{MI}	M	R^U	R^{WU}	R^{WC}	R^2
R^U	-164389 (5.03)***	3409 (3.61)***	21.0 (1.24)				0.9015
R^{NU}	736.0 (0.43)			0.974 (28.60)***	0.822 (3.79)***		0.9944
R^{NC}	-1826 (5.01)***			1.031 (130.61)***		0.902 (53.79)***	0.9999

* significant at the 10 percent level
** significant at the 5 percent level
*** significant at the 1 percent level

TABLE 4.3 THE DURBIN-WATSON STATISTICS FOR THE UNITED STATES MODEL

(n = 12, K = 9)

Variable	S^P	S^M	D^P	D^M	P_R^F	P_R^M	M	P_F^P	P_F^M
D - W	2.92	2.82	2.92	2.26	3.35	2.71	2.24	3.35	2.12

4.5.4 Discussion of the Estimates

The majority of the estimates obtained for the coefficients of the United States model are not significantly different from zero at the 10 percent level.

In the prime beef supply and demand equations only the Number of Cattle on Feed, and Wages, are significant at the 10 percent level.

The Number of Cows in the Inventory is the only significant variable in the manufacturing beef supply equation.

The demand for manufacturing beef contains no significant variables at the 10 percent level.

The retail price of fed beef equation contains one variable significantly different from zero at the 5 percent level: Range Conditions.

The retail price of manufacturing beef however contains 2 variables significant at the 10 percent level: Number of Cows in the Inventory and Range Conditions; and one significant at the 5 percent level: Population.

Total Disposable Income is significant at the 5 percent level in the import equation and Population is significant at the 10 percent level.

Number of Cattle on Feed and Population are both significant at the 10 percent level in the farm price of prime beef equation.

The equation expressing farm price of manufacturing beef as a function of the exogenous variables contains 4 variables which are significantly different from zero at the 1 percent level: the Lagged Price of Fed Beef, the Number of Cows in the Inventory, Lagged Range Conditions and Population. Total Disposable Income is significant at the 5 percent level.

All except one of the estimates of the parameters of the New Zealand model are significantly different from zero at the 1 percent level. The one exception is the estimate for the Import variable in the equation expressing Revenue from the United States Market as a function of Imports and the Retail price in the United States.

The value of R^2 is above 0.9 for all equations. However this is to be expected, especially in the United States model, due to the number of variables which are included in each equation.

4.5.5 The Price Elasticity of Demand for Fed Beef

As mentioned previously it is necessary to estimate the slope of the demand curve for fed beef in order to estimate the change in consumer surplus resulting from a shift in the demand curve. The slope of the demand curve is not provided by estimating the reduced forms of the simultaneous equations. Therefore, an independant estimate is required. The independant estimate should satisfy the following conditions to be applicable to the model used:

(i) The estimate should be based on annual data.

(ii) The estimate should be for fed beef demand not total beef demand.

(iii) The estimate should be based on aggregate data as opposed to per capita data.

(iv) The equation should be estimated in the linear form.

No independant estimates were found which satisfied all these conditions. However estimates obtained in other studies for the price elasticity of demand at the retail level ranged from -0.58 to -1.04. Table 4.4 illustrates the studies examined and the estimates obtained by each.

After examination of these estimates an elasticity of -0.95 was chosen for use in this study. Because of the similarity between the Langemeier and Thompson model [41] and the model used in this study more weight was given to their estimate.

TABLE 4.4 INDEPENDANT ESTIMATES OF ELASTICITY OF DEMAND FOR BEEF

Analyst	Elasticity	Observation Period	Data	Method	
Breimyer [21]	-0.64	Annual	per capita	Sgl.Eq.	logs
Fox [33]	-1.04	Annual	per capita	Sim.Eq.	logs
———	-0.94	Annual	per capita	SglEq.	logs
Tomek [54]	-0.90	Quarterly	per capita	Sim.Eq.	linear
Logan and Bowles [43]	-0.65	Quarterly	per capita	Sim.Eq.	linear
Purcell, Raunikar and Elrod [46]	-0.97	Quarterly	household	Sgl.Eq.	linear
Mathews, Hoffman and Womack [43]	-0.67	Semi Annual	Total	Sgl.Eq.	linear
———	-0.58	Semi Annual	Total	Sim.Eq.	linear
Heien and Mathews [36]	-0.70	Annual	per capita	Sim.Eq.	linear
Langemeier and Thompson (1) [41]	-0.98	Annual	per capita	Sim.Eq.	linear

(1) Fed beef only

CHAPTER FIVE

EXPERIMENTATION AND DISCUSSION

5.1 Introduction

This chapter presents and discusses the results of experimentation with the estimated models. The second section indicates the way in which the experimentation was done and discusses the validity of the results. Section 3 examines possible reasons for the unsatisfactory nature of the results, including a discussion of the effect of errors in the formulation and estimation of the model. The final section discusses ways in which the model could be improved for future studies of this kind.

5.2 The Results

This section presents the results obtained by experimenting with the model. The experimentation involves obtaining values for the endogenous variables for those years in which quotas were imposed. The values obtained represent the quantities and prices that would have occurred if quotas had not been imposed.

A Post Sample Parameter Stability Test is incorporated in the 'Give' *(1)* regression programme. This was used to estimate the values of the endogenous variables

---

(1) 'GIVE' stands for General Instrumental Variable Estimation. It is a computer program designed by David F. Henry of the London School of Economics to estimate the coefficients of linear equations containing both current and/or lagged endogenous variables as regressors. The main deficiency of the program is that it does not calculate simple correlations between independent variables. For this reason correlation coefficients have not been reported in this thesis and they were not available to assist examination of the presence or absence of multicollinearity.

TABLE 5.1 RESULTS OF THE EXPERIMENTATION

Variable		1968	1969	1970	1971	$X^2_{(4)}$
S^P	Estimated	18628	19551	21181	19306	81.14
(million lb)	Actual	17324	17386	18333	18275	
S^M	Estimated	4038	3300	3474	4176	9.98
(million lb)	Actual	5322	3740	3319	3595	
D^P	Estimated	18628	19551	21181	19306	81.14
(million lb)	Actual	17324	17386	18333	18275	
D^M	Estimated	4532	4354	4126	4979	19.85
(million lb)	Actual	5022	5355	5111	5328	
P_R^P	Estimated	77.79	77.56	74.16	79.64	91.30
(¢/lb)	Actual	83.10	87.60	84.80	86.00	
P_R^M	Estimated	52.44	52.35	49.90	50.48	51.03
(¢/lb)	Actual	53.80	56.80	56.90	56.10	
M	Estimated	493	1054	651	803	110.63
(million lb)	Actual	1500	1615	1792	1733	
P_F^P	Estimated	11.15	21.50	19.20	23.43	122.13
(¢/lb)	Actual	25.45	26.76	26.50	27.97	
P_F^M	Estimated	17.33	17.55	16.75	15.48	935.67
(¢/lb)	Actual	17.18	18.33	19.02	18.62	

for the period 1968 - 71. Only the United States model is considered for reasons which will become obvious.

Table 5.1 presents the results obtained from the experimentation with the model, and the values which actually occurred. The values of the chi square test of post sample parameter stability are also provided. If quotas have caused a change in the values of the endogenous variables the chi square test will provide evidence of this. In all equations except the supply of manufacturing beef, this test indicated that the probability that the actual and estimated values were drawn from the same distributions is less than 0.05 This supports the hypothesis that quotas have affected the values of endogenous variables.

When the results are interpreted in terms of economic model major differences in the expected effect become apparent. Firstly, although the supply and demand for prime beef was expected to increase with the imposition of quotas, the model predicts a fall. The domestic supply of manufacturing beef was also expected to rise, but again the model predicts a fall. Demand for manufacturing beef was expected to fall but the model predicts the opposite. The retail prices and farm prices for both prime and manufacturing beef however did follow economic theory with the model predicting an increase. The most important result is that concerning the level of imports. Economic theory postulates that the imposition of quotas will result in a fall in imports and this is the reasoning behind their use. However, the model predicts a rise.

At this stage in the study it was apparent that the model contained series deficiencies as a predictor and it was decided not to continue with the experimentation involving the New Zealand model.

5.3 Discussion of the Results

This section discusses the results and considers possible explanations for the results being at variance with economic theory.

The model is a good predictor of the dependent variables for the period over which the model was estimated. The coefficients of determination for all equations are over 90 percent indicating that the exogenous variables explain more than 90 percent of the variation in the endogenous variables. The model is not a good predictor of the endogenous variables for the four years following the estimation period. This is expected as the structure of the market was altered in these four years by the imposition of a quota on imports. However, apart from this, and as previously mentioned, the predictions do not agree with economic theory.

The failure of the model to predict values consistent with economic theory may have several explanations. One is that the economic theory invoked is wrong, but the writer cannot accept this and it will not be discussed further.

The only other explanation is that there are deficiencies in the model or in the data used to estimate the coefficients of the model. The following types of error will be considered in terms of their possible relevance to the model estimated in this study; specification error; errors in variables; multicollinearity; and autocorrelation.

The term specification error covers several different errors in the specification of the model. Firstly one or more significant variables may have been omitted from the model. This will lead to biased estimates

of the included variables. The standard errors will be large due to the over-estimation of the residual variance. Another possible source of specification error is that the form of the model has not been correctly specified. Although the model was estimated in the linear form in this study, it is possible that the relationships that the model attempts to explain are non-linear. Finally, specification error may also arise from use of aggregate data when per capita data should be used.

There is no doubt that there has been some error in the specification of the model. Several variables included in Langemeier and Thompson's model [41] were omitted due to the difficulty of obtaining sufficient obseverations. Even with these variables excluded there were only 3 degrees of freedom. A variable not included in the Langemeier and Thompson model which may be important to the import supply equation is the price of beef in markets other than the United States. This would reflect the relative profitability of exporting to the United States and other markets. The estimation of the model in linear form is open to question, however the writer believes that this form is not seriously at variance with reality. Langemeier and Thompson expressed the demand equations in per capita terms. This resulted in a mulltiplicative relationship in the demand-supply identity. The demand equations in this study have been estimated in aggregate form to remove the multiplicative relationship. This may have resulted in incorrect estimates and contributed to the unsatisfactory nature of the results.

Errors in variables result from errors in the measurement and processing of the exogenous variables. If these errors are present the estimates will not only be biased but also inconsistent. It would be presumptuous to say that these errors do not occur in

this model. However they are not thought to be serious enough to be solely responsible for the unsatisfactory results.

Multicollinearity occurs in most relationships to some degree because of the inter-dependance of many economic factors. When two variables are moving in approximately the same way it becomes difficult to establish the individual influence of each of the regressors on the dependant variable. This does not represent a problem in prediction providing the correlated variables continue to move in an approximately equivalent manner. However if the variables do not continue to move in concert then serious errors in the predictions may result. Multicollinearity of a serious degree can be recognised by the existence of very large standard errors. On examination of 't' values it is probable that serious multicollinearity is present in this model. This may have contributed to the unsatisfactory nature of the results if the correlated variables do not move in an equivalent manner during the prediction period.

Autocorrelation, or serial dependance in the errors, is usually caused by errors in the specification of the model. One such cause is the omission of significant variables from the model. Nearly all economic variables are serially dependent because the value of a variable in time t is usually dependent upon its value in time t-1. This serial dependance is transmitted to the errors if a significant variable is omitted. If the form of the model is incorrectly specified the errors may again show serial dependance. For example if a cyclical relationship is estimated in the linear form the errors will be serially dependant. Finally mis-specification of the true random error can result in autocorrelation. Random factors such as extreme weather conditions or wars may exert influence spreading over more than one time

period. Autocorrelation will result if these effects are not allowed for by the model. Serial dependance in the errors does not result in biased estimates of the model coefficients. However the value of the estimates in any single sample may not be the true value of the coefficient. Also, the variance of the random error may be seriously under-estimated. The variance of the parameter estimates may be under-estimated indicating that a variable is significant when in fact it is not. Finally, autocorrelation will result in inefficient predictions if the model is estimated by ordinary least squares when compared with predictions based on other econometric techniques.

As already mentioned in the discussion of specifiation errors the writer believes that some significant variables may have been omitted. This does not necessarily imply autocorrelation as the combined effect of the omission of more than one variable may cancel out the effect of serial correlation. The Durbin-Watson statistic was presented in Chapter 4.

As previously mentioned the limited number of observations combined with a large number of variables means that in all cases the statistic was indeterminate.

5.4 Suggested Changes in the Model

It is the writer's opinion that in order to overcome the problems which have arisen in this thesis it would be necessary to reformulate the economic model, preferably on a quarterly basis. It is thought that the model would benefit from the inclusion of a variable which relfects the relative profitability of exporting to the United States as opposed to other markets. The formulation of a quarterly model would allow a shorter time period to be used in the estimation of the model. This would reduce the possibility of major structural changes in the market which are not accounted for by the model. The imposition of quotas is decided

on the basis of a quarterly examination of the level of imports. The use of quarterly data would also mean that the period over which quotas were effective could be more clearly defined.

CHAPTER SIX

SUMMARY AND CONCLUSIONS

6.1 Introduction

This chapter contains a brief summary of the original objectives of the study. Progress made towards reaching the objectives and reasons for the failure to reach them are discussed. Finally suggested avenues for future research are discussed and conclusions on the contribution of this thesis are presented.

6.2 Summary

The research attempted by this thesis is summarised in this section under three headings: Original Objectives; Progress Made Towards Objectives and; Reasons For Failure To Reach Objectives.

6.2.1 Original Objectives

The original objective of the study was to estimate the effect of United States Meat Import Quotas on economic welfare in the United States and New Zealand. Welfare was to be estimated as the changes in the economic rent of United States producers, in United States consumers' surplus, and in revenue of the New Zealand beef industry, resulting from a change in quotas.

6.2.2 Progress Made Towards Objectives

An economic model was formulated expressing the relationships between the beef markets in the United States, New Zealand and the rest of the world. The model was used to estimate the values of endogenous variables assuming the absence of United States meat import quotas. This was done by estimating the coefficients of the model based on those years in which quotas were not effective. It was expected that the projected values for endogenous variables, obtained by experimentation with the model, would provide a

basis for the estimation of the welfare effects of quotas. However initial experimentation demonstrated that the estimated values for endogenous variables in the model were inconsistent with economic theory. As the New Zealand sector of the model required the use of inputs generated by the United States sector, experimentation with the New Zealand sector was abandoned.

6.2.3 Reasons For Failure To Reach Objectives

The possible explanations for the failure of this study to reach the original objectives are discussed in Chapter 5.

The points of disagreement between economic theory and the estimated model on the effect of quotas were as follows :

(i) The supply and demand for fed beed was expected to rise but the model predicted a fall.

(ii) Domestic supply of manufacturing beef was expected to rise, but the model predicted a fall.

(iii) Demand for manufacturing beef was expected to fall, but the model predicted a rise.

(iv) Import supply was expected to fall, but the model predicted a rise.

Disagreement (iv) is the most serious in terms of the objectives of this study as the restrictive effect of quotas on imports is the reason for their use.

The possibility that the economic theory involved is wrong was put forward and immediately discounted. Therefore the only explanation is that there are deficiencies in the econometric model or in the data used to estimate the coefficients of the model. Four types of error were considered in terms of their possible relevance to the model estimated in this study: specification error; errors in variables; multicollinearity; and auto correlation.

There is no doubt that there has been some error in the specification of the model and it is the writer's opinion that this is the most significant of the four sources of error mentioned above. Several variables included in Langemeier and Thompson's model [41] were omitted due to the difficulty of obtaining sufficient observations. A variable not included in the Langemeier and Thompson model which may be important to the import supply equation is the price of beef in markets other than the United States. This would reflect the relative profitability of exporting to the United States and other markets. The estimation of the model in linear form is open to question, but the writer believes that this form is not seriously at variance with reality. The demand equations were estimated in aggregate form. This may have resulted in incorrect estimates and contributed to the unsatisfactory nature of the results.

Errors in variables almost certainly occur in this model. However, they are not thought to be serious enough to be solely responsible for the results obtained.

On examination of the 't' values it was considered probable that serious multicollinearity is present in the model. This may have contributed to the unsatisfactory nature of the results.

Autocorrelation is a strong possibility as it has already been recognised that some significant variables may have been omitted. However due to the limited number of observations combined with a large number of variables the Durbin-Watson statistic was indeterminate in all cases.

6.3 Suggested Further Research

Further research would first need to concentrate on the further development of a quarterly econometric model which explains the economic relationships which exist in the United States beef industry and adequately represents the effect of global factors which influence this market. It is considered that a variable should be included which reflects the relative profitability of exporting to the United States as opposed to other countries. The estimation of the welfare effect of changes in quotas could then be made using the methodology followed in this study.

Other research which would contribute to a greater understanding of the effects of quotas is an examination of the medium and long term effects of quotas on the global supply and demand for beef.

Since quotas are not confined only to red meats, the methodology followed by this study could be utilised in the examination of the effect of quota control on imports of other products. One example is the United States quota on imports of dairy products.

6.4 Conclusion

Although this study has not achieved the original objective it demonstrates a method whereby the welfare effects of restrictive trade practices can be assessed. For this reason the writer believes that some contribution to applied economics has been made.

BIBLIOGRAPHY

[1] Anon ; "Decentralization in the Livestock Slaughter Industry", Supplement to Agricultural Economic Report No. 83, E.R.S., U.S.D.A., April, 1966.

[2] _____ ; "Livestock and Meat Situation", E.R.S., U.S.D.A., bimonthly series, 1956-73.

[3] _____ ; "Livestock and Meat Statistics 1962", Statistical Bulletin 333, U.S.D.A., July 1963, and Annual Supplements to Statistical Bulletin 333, 1964-72.

[4] _____ ; "Agricultural Statistics", U.S.D.A., Washington D.C., 1957 -72.

[5] _____ ; "Statistical Abstract of the United States", U.S. Bureau of Census, Washington D.C., 1957 - 72.

[6] _____ ; "Red Meat Per Capita Consumption", Livestock and Meat, Foreign Agriculture Circular, F.A.S., U.S.D.A., Washington D.C., January, 1974.

[7] _____ ; "World Red Meat Trade", Livestock and Meat, Foreign Agriculture Circular, F.A.S., U.S.D.A., Washington D.C., January, 1974.

[8] _____ ; "World Agricultural Production and Trade" F.A.S., U.S.D.A., bimonthly series, 1956-73.

[9] _____ ; "World Red Meat Production", Livestock and Meat, Foreign Agricultural Circular, F.A.S., U.S.D.A., Washington D.C., June, 1973.

[10] _____ ; "F.A.O. Trade Year Book", F.A.O., Rome, annual series, 1964-72

[11] _____ ; "New Zealand Official Year Book", Department of Statistics, Wellington, annual series, 1965-73.

[12] _____ ; "New Zealand Export Statistics', Department of Statistics, Wellington, annual series, 1962/63-70/71.

[13] Anon ; "New Zealand Agricultural Statistics", Department of Statistics, Wellington, Prior to 1969/70 "Farm Production Statistics", annual series, 1962/63-70/71

[14] ———— ; "Survey of International Trade in Beef and Veal", International Bank for Reconstruction and Development, Sec. M70-106, March, 1970.

[15] ———— ; "Beef and Beef Products', Report on Investigation No.332-44 under Section 332 of the Tariff Act 1930. Pursuant to a Resolution of the Committee on Finance of the United States Senate, Adopted November 20 1963, T.C. Publication 128, United States Tariff Commission, June 1964.

[16] Anthony, W.E. ; "Structural Changes in the Federally Inspected Meat Processing Industries 1961-64", Agricultural Economic Report No.129, E.R.S., U.S.D.A., February, 1968.

[17] ———— and W.C. Mots; "Reprint from Agricultural Markets in Change, Agricultural Economic Report No.95, Livestock Marketing," E.R.S., U.S.D.A., October 1966.

[18] Armstrong, J.H; "Cattle and Beef Buying, Selling and Pricing Handbook", Purdue University, 1968.

[19] Barton, R.A. ; "The Economic Importance of Dairy Beef", New Zealand Sheep Farming Annual, 1966.

[20] ———— ; "New Zealand Beef Production, Processing and Marketing, General Introduction, New Zealand Beef Production, Processing and Marketing", New Zealand Institute of Agricultural Science, Wellington 1970.

[21] Breimyer, H.F. ; "Demand and Prices for Meat, Factors Influencing their Historical Development", Technical Bulletin No.1253, U.S.D.A., Washington D.C., December 1961.

[22] Burke, R.L. ; "Characteristics of Beef Cattle Feedlots, California, Colorado, Western Corn Belt", Marketing Research Report No.840, E.R.S., U.S.D.A., 1969.

[23] Crom, R.J. ; "Simulated Inter-regional Models of the Livestock-Meat Economy", Agricultural Economic Report No.117, E.R.S., U.S.D.A., June 1967.

[24] Crom, R.J. ; "Economic Projections Using a Behavioural Model", Agricultural Economics Research, Vol.24, No.1, E.R.S., U.S.D.A., January 1972.

[25] _____ ; "A Dynamic Price-Output Model of the Beef and Pork Sector", Technical Bulletin No. 1426, E.R.S., U.S.D.A., September 1970.

[26] Cromarty, W.A.; "An Econometric Model for United States Agriculture", Journal of the American Statistical Association, Vol.54, September 1959.

[27] Currie, Murphy and Schmitz; "The Concept of Economic Surplus and its Uses in Economic Analysis", Economic Journal, December 1971.

[28] De Graff, H. ; "Beef Production and Distribtuion", University of Oklahoma Press, 1960.

[29] Dietrich, R.A.; "Market Structure Changes in the Livestock and Meat Industry", Department of Agricultural Economics and Sociology, Departmental Information Report No.66-10, Texas A and M. University, Texas Agricultural Experimental Station, December 1966.

[30] Duymovic, A., R. Crom and J. Sullivan; "Effect of Alternative Beef Import Policies on the Beef and Pork Sectors", Agricultural Economic Report No.233, E.R.S., U.S.D.A., October 1972.

[31] Edwards, J.A. ; "Beef Imports and the U.S. Beef Cattle Market", Special Report 178, Agricultural Experiement Station, Oregon State University, 1964.

[32] Fowler, S.H. ; "The Marketing of Livestock and Meat", Interstate, 1961.

[33] Fox, K.A. ; "Demand Functions for Livestock Products Econometric Analysis for Public Policy", Ames, Iowa, 1958.

[34] Fuller, W.A. and G.W. Ladd; "A Dynamic Quarterly Model of the Beef and Pork Economy", Journal of Farm Economics, Vol. 43, November 1961.

[35] Gruen, F.H. ; "Trends in Food Marketing in the United States", Monash University, Australian Journal of Agricultural Economics, Vol. 12,1968.

[36] Heien, D.M. and J.L. Mathews; "An Econometric Model of the Beef Cattle Industry", unpublished manuscript 1972. Source, "Summary of Estimated Demand Relationships for Selected Commodities", R.C. Haidacher, Unpublished, May 1972.

[37] Johnson, R.D. ; "An Economic Evaluation of Alternative Marketing Methods for Fed Cattle", Nebraska Agricultural Experiment Station Cooperating with Farm Economics Division E.R.S., U.S.D.A., SB520, June 1972.

[38] Johnston, J. ; "Econometric Methods", second edition, McGraw-Hill, Kogakusha, 1972.

[39] Koutsoyiannis, A.; "Theory of Econometrics", Macmillan, 1973.

[40] Kulshreshtha, S.N. and A.G. Wilson; "An Open Econometric Model of the Canadian Beef Sector", American Journal of Agricultural Economics, February 1972.

[41] Langemeier, L. and R.G. Thompson; "Demand, Supply, and Price Relationships for the Beef Sector Post-World War II Period", American Journal of Agricultural Economics Vol 49, 1967.

[42] Logan, S.H. and J.N. Boles; "Quarterly Fluctuations in Retail Prices of Meat", American Journal of Farm Economics, Vol. 44, November 1962.

[43] Mathews, J.L., R. Hoffman and A. Womack; "Estimating Semi-Annual Price, Production and Utilization Changes for Livestock and Poultry Products", Unpublished material, 1972.

[44] Patinkin, D. ; "Demand Curves and Consumers Surplus", in Carl Christ et al., Measurement in Economics: Studies in Mathematical Economics and Econometrics in Memory of Yehuda Grunfeld, Stanford, 1963.

[45] Purcell, J.C. ; "Livestock Prices and Meat Supplies, Trends and Interrelationships 1950-59", Georgia Agricultural Experimemt Station, University of Georgia College of Agriculture, Technical Bulletin N.S. 24, May 1961.

[46] _____ : R. Raunikar and J.C. Elrod; "Analysis of Demand for Meat-Altlanta Consumer Panel", College of Agriculture Experiment Station, University of Georgia, Research Bulletin No.72, December 1969.

[47] Purcell, J.C. and R. Raunikar; "Price Elasticities from Panel Data: Meat, Poultry and Fish", American Journal of Agricultural Economics, Vol. 53, No. 2, May 1971.

[48] Seabourg, D. ; "Outlook for Livestock and Meats" E.R.S., U.S.D.A., Talk given at the 1972 National Agricultural Outlook Conference, February 1972.

[49] Shepherd, G.S. ; "The Analytical Problem Approach to Marketing", The Journal of Marketing, Vol. 20, No.2, October 1955

[50] _____ ; "Agricultural Price Analysis", fifth edition, Iowa State University Press, Ames, Iowa, 1963.

[51] Stout, T.T. (Editor); "Long-run Adjustments in the Livestock and Meat Industry - Implications and Alternatives", Ohio Agricultural Research and Development Centre, Research Bulletin 1037, March 1970.

[52] Theil, H. ; "Principles of Econometric", Wiley, 1971.

[53] Tier, T.J. ; "The Market for New Zealand Beef, A Preliminary Assessment", Discussion Paper No.S1, Department of Agricultural Economics and Farm Management, Massey University, New Zealand, May 1969.

[54] Tomek, W.G. ; "Changes in Price Elasticities of Demand for Beef, Pork and Broilers" Journal of Farm Economics, Vol. 47, August 1965.

[55] Trievweila, J.E. and J.B. Hassler; "Orderly Production and Marketing in the Beef-Pork Sector", Research Bulletin 240, University of Nebraska College of Agriculture, November 1970.

[56] Waugh, F.V. ; "Demand and Price Analysis", Technical Bulletin 1316, U.S.D.A., November 1964.

[57] Williams, W.F. and R.A. Dietrich; "An Inter-regional Analysis of the Fed Beef Economy", Agricultural Economic Report No.88, E.R.S., U.S.D.A., April 1966.

[58] _____ and T.T. Stout; "Economics of the Livestock and Meat Industry" MacMillan, New York, 1964.

[59] Working, E.J. ; "Demand for Meat", Chicago Institute of Meat Packing, 1954.

[60] Yandle, C.A. ; "An Econometric Study of the New Zealand Meat Industry", Unpublished M. Agr. Sc. thesis, Lincoln College, 1968.

APPENDIX

THE DATA

The symbols refer to variables defined in Chapter 4.

	S^P	S^M	M	P_F^P	P_F^M	P_R^P	P_R^M
	mill.lb.	mill.lb	mill.lb	¢ lb.	¢ lb.	¢ lb	¢ lb
1956	10426	4036	204	22.15	12.44	81.1	47.3
1957	10487	3715	390	23.72	14.47	83.7	49.8
1958	10530	2800	896	26.37	18.65	93.5	61.1
1959	11248	2332	1047	27.83	18.68	94.9	62.9
1960	12077	2650	760	26.31	16.33	91.3	59.1
1961	12944	2354	1021	25.07	16.37	88.4	57.1
1962	12718	2580	1414	26.78	15.79	91.0	57.5
1963	14130	2298	1651	23.76	15.21	88.3	55.9
1964	15408	3021	1068	23.21	14.19	83.8	53.3
1965	14555	4144	923	24.67	14.18	84.8	53.8
1966	15914	3780	1182	23.80	16.83	84.8	55.8
1967	16848	3336	1313	24.77	16.94	82.6	54.6
1968	17324	3522	1500	25.45	17.18	83.1	53.8
1969	17386	3740	1615	26.76	87.6	56.8	
1970	18333	3319	1792	26.50	19.02	84.8	56.9
1971	18275	3595	1733	27.97	18.62	86.0	56.1

$D^P = SP$ $\qquad$ $D^M = S^M + M$

	N^F	$P^{C/C}$	P_F^{PL}	N^C	R^L	Y	P_o	W
	thou.		¢/lb	thou.	%	bill.dol.	thou.	dol/hr.
1956	5929	0.86	23.10	28474	76	352.4	166055	2.48
1957	6122	0.79	23.05	27497	69	357.5	169110	2.55
1958	5898	0.82	23.06	27117	83	363.2	172226	2.61
1959	6601	0.94	24.08	28391	84	382.5	175277	2.57
1960	7574	0.94	25.97	29862	79	389.1	178153	2.62
1961	8048	0.92	26.84	30660	80	401.0	181207	2.66
1962	8520	0.93	26.40	32414	79	418.7	183796	2.68
1963	9702	0.88	26.05	34643	81	434.0	186667	2.70
1964	9845	0.94	25.20	37100	78	463.2	189372	2.76
1965	9979	0.93	24.58	38733	76	494.7	191894	2.76
1966	10582	0.95	23.88	38896	82	518.1	193767	2.77
1967	11268	0.76	23.89	39246	78	538.3	195671	2.80
1968	11417	0.80	24.41	40069	80	558.6	197584	2.87
1969	12534	0.85	24.67	40884	81	569.3	199682	2.85
1970	13190	0.99	25.66	42260	82	582.4	201722	2.87
1971	12770	0.79	26.24	43500	80	603.0	204254	2.91

	R^{U}	P_{R}^{MI}	R^{WU}	R^{WC}
	thou.dol.	¢/lb.	thou.dol.	thou.dol.
1962-63	42357	52.1	378	1409
1963 -64	38052	51.3	1936	1097
1964-65	24665	49.5	7184	948
1965-66	25788	50.8	8761	697
1966-67	39600	54.2	7135	1355
1967-68	61953	54.6	5831	1763
1968-69	74555	56.1	7633	5197
1969-70	77617	62.4	8556	34432
1970-71	99362	66.2	14444	22260

	X^{NU}	X^{NC}	R^{NU}	R^{NC}
	thou.lb.	thou.lb.	thou.dol.	thou.dol.
1962-63	200021	204162	41384	39264
1963-64	183867	179912	39513	37674
1964-65	143291	116225	30363	30349
1965-66	135139	105157	32758	34082
1966-67	170523	149812	45939	42102
1967-68	219357	207264	67343	63021
1968-69	223974	216767	82378	71851
1969-70	205601	281673	79650	78498
1970-71	259384	286150	109486	104143

Processing of the Data

In obtaining the data series for some of the variables, considerable processing of raw data was required. The following discussion details the methods used in obtaining data for these variables.

The supply of fed beef is calculated as the product of the average dressed weight of steers and heifers and the number of steers and heifers slaughtered. The average dressed weight is calculated as the product of the average dressing out percentage of cattle slaughtered under federal inspection and the average liveweight of slaughter steers and heifers sold at eight markets, weighted by the relative number of steers and heifers sold at each market and the relative numbers of steers and heifers slaughtered under federal inspection. The eight markets are Chicago, Kansas, Omaha, St. Louis, Sioux City, Sioux Falls, St. Joseph and St. Paul. The number of steers and heifers slaughtered is calculated as the product of the total number of cattle slaughtered and the percentage that steers and heifers comprise of federally inspected slaughter.

The farm price of fed beef is calculated as the average price received for steers and heifers at the eight markets mentioned above weighted according to the number of steers and heifers sold at each market and by the number of steers and heifers slaughtered under federal inspection. This is then deflated by the index of prices received by farmers.

In obtaining the lagged farm price of fed beef it is necessary to obtain data for the years 1953 to 1955. However no data on heifer prices is available and only the steer price is used.

The farm price of non-fed beef is calculated as the average price of utility and commercial, and cutter and canner cows weighted according to the relative numbers of each class slaughtered under federal inspection and deflated by the index of prices received by farmers.

The selected classes of beef exports used in calculating the New Zealand revenue data for exports to the United States, United Kingdom and Canada are those classified in the 1970-71 New Zealand Export Statistics under the code numbers 011.140.6 to 011.142.3 inclusive.