Dairy Trade Between New Zealand and the Republic of Korea:
With Special Reference to Casein

This thesis is presented in partial fulfilment of the requirements of Master
of Business Studies at Massey University.

Christopher Gerard Nixon
1991

Abstract

The purposes of this thesis were firstly, to identify and describe Korean non-tariff and tariff barriers for casein and other dairy products and secondly, to quantify how much New Zealand could gain from a liberalisation of the Korean casein trade. To do this a one-product five-nation quadratic programming model was formulated.

How Korea has become a major trading power through industrialisation, while heavily protecting agriculture is described. Measures of protection, the pressure to liberalise and the Japanese liberalisation experience are discussed.

Casein was chosen because it is the single biggest dairy commodity exported to Korea from New Zealand. The model consists of demand for casein from the major consuming countries (America, Korea and Japan) and fixed supply from the two major suppliers (New Zealand and the European Community). Various scenarios are run to gauge the effect of a drop in tariff rates in Korea and Japan and at various levels of European production.

The study concludes with the recommendation to continue pushing for liberalisation in multilateral and bilateral negotiations particularly with the European Community.

Acknowledgements

Table of Contents

CHAPTER ONE

Scope of the Study

1.1 Introduction

New Zealand's economy is heavily dependent on exports of agricultural products. Agricultural exports dominate New Zealand's overseas earnings and will do for many years to come. For example meat, wool and dairy products exports totaled NZ $5239.5 million in 1989[1], representing 44 percent of our total export earnings.

After the United Kingdom joined the European Community in 1973, New Zealand exporters, particularly agricultural exporters, have been under increasing pressure to find new markets for our agricultural products. New Zealand agricultural exporters have found this a very difficult task to accomplish successfully in an international environment which has politicised agricultural trade. Despite efforts through the GATT rounds and numerous bilateral consultations, agricultural exporters have only been moderately successful given that New Zealand's standard of living has fallen relative to other OECD nations.

Diversification is an important part of the strategy to ensure stable export markets and growing revenue for the agricultural sector. There has been a swing away from so-called 'traditional markets' to markets which haven't been tapped before. For instance in 1970, 30 percent of our exports went to the United Kingdom, compared to only 9 percent in 1988. By contrast, our exports to Japan[2] have grown steadily from 8 percent in 1970 to 21 percent in 1988.

----

1. Department of Statistics, New Zealand Offical Yearbook 1988-89 p618 Wellington N.Z.

2. ibid., 1988-9, p608-10

With the push towards finding new markets for agricultural products there has been a growing interest in New Zealand to undertake studies of other countries' customs, consumption patterns and trade policies.

This thesis attempts to address some of these questions, with regard to New Zealand's dairy trade, particularly casein with the Republic of Korea. Casein has been choosen because it is the major dairy product traded with South Korea. The study looks at the protection levels afforded to the Korean Dairy Industry and the reasons they were originally put in place. The barriers to entry to the Korean market and measurement methods of these barriers are examined. This involves an assessment of the internal Korean distribution system for dairy products and the implications for New Zealand following changes in the domestic dairy policies in Korea.

1.2 Trade with Korea

During the last five years New Zealand-Korean trade has increased rapidly, doubling from $140 million in 1985 to over $280 million in 1989. Given the new economic environment which exists in New Zealand's market place (ie lowering of tariff rates), the question that arises is whether New Zealand dairy exports to Korea can grow in the next decade.

New Zealand's major exports to Korea are wool, tallow, aluminum, mutton, hides and skins, pulp, leather, fish and casein (see Table 1.1). These are mainly raw unprocessed goods for further processing in Korea. Growth in New Zealand exports to Korea has historically depended upon re-export. The domestic consumption of New Zealand exports to Korea is very low, but with the increasing affluence of the Korean consumer there is potential for a greater volume of exports from New Zealand. Korean exports to New Zealand include: textile yarns, woven fabrics, iron and steal and communications equipment.

Despite the fact that New Zealand's exports to the Republic of Korea totaled NZ$280 million in 1989, New Zealand exporters face a daunting array of tariff and non tariff barriers when trying to enter the Korean

2

marketplace. This is particularly so when dealing with dairy trade. Casein, some frozen foods and lactose have remained under control of the import surveillance system. Outright bans remain on selected dairy products.

While it is of interest to know why the volumes of dairy products exported to Korea are small, it is of even greater interest to identify the obstacles to dairy exports from New Zealand and to find ways of avoiding these obstacles.

TABLE 1.1

NEW ZEALAND EXPORTS TO THE REPUBLIC OF KOREA

Year ending June

	1985/86	1986/7	1987/8
	($ Millions, fob)		
Wool	35.8	60.5	38.6
Hides, skins and furskins	17.9	57.2	82.0
Aluminum	12.2	26.2	4.2
Sheepmeat	15.5	15.4	21.0
Fish	8.3	14.4	9.1
Leather	11.1	12.9	7.2
Casein	5.5	9.6	12.3
Logs	7.8	9.3	17.1
Wood pulp	8.5	9.1	40.9
Tallow	22.1	23.3	5.7
Other	22.1	23.3	30.2
Total	166.8	261.2	272.6

source : Export News 3/88 p29

1.3 Objectives of the Study

The overall objective of the study is to analyse the economic importance of the trade barriers which the Korean government has built up to protect its dairy industry. These specific objectives are to:

(1) Identify non tariff barriers in the Korean market place. This will include the study of the Korean distribution system for dairy products and its apparent inbuilt protection devices.

(2) Undertake a literature review on measurement of entry barriers, tariff theory and model development, followed by the development of a quadratic programming model of the world casein market with reference to Korean - New Zealand dairy trade. A framework will be constructed to measure the economic impacts of agricultural protection in Korea.

(3) To construct a trade model of the world casein market incorporating the major players. This is done by estimating demand and supply equations, transport and tariff costs. Through various policy scenarios changes in Korean government policy can be quantified.

1.4 Methodology

A descriptive account of Korean agricultural development, including reasons for the startling economic growth; an overview of the Korean dairy sector, measurement of entry barriers, assistance measures to agriculture, non tariff barriers and the distribution system of New Zealand Dairy Board in Korea, precedes work on actual tariff barriers.

Analysis of tariff rates and their economic impact on the world casein market will be gauged by using details on transport costs, product costs, tariff information and world market supply and demand. After the data on prices quantities, trade flows and competing products are collected a quadratic programming model is developed predicting trade flows and prices of casein. Using this information, a single product, two-region model is built to measure tariffs and transport costs. Once this is

4

achieved the model is extended to include the major producers and consumers of casein. In order to assess the impacts of a change in Korean tariff levels, sensitivity analyses will be undertaken. From this, various conclusions and recommendations will be made to assess the viability of increased dairy trade with Korea.

1.5 Organisation of the Study.

This study is divided into seven chapters. Chapter Two draws particular attention to reasons why the Korean government has built up the barriers in its dairy industry. This will explain why New Zealand dairy exporters have not succeeded in establishing a market in the Republic of Korea. Non tariff barriers have served as an effective barrier to entry to the Korean market. Identification and description of these non tariff barriers are documented, including factors in the distribution system which hinder foreign traders from selling products.

Chapter Three will briefly review previous literature on protectionism in trade, giving the reasons for protection and highlighting the literature and the debates which currently exist. Measurement of protection is also looked at in detail. Korean assistance to agriculture is also surveyed detailing tariff rates, rates of protection and the internal distribution system. Future liberalisation scenarios are investigated using the GATT and the Japanese experience as possible pointers.

Chapter Four formulates a partial equilibrium model which will be developed for use in estimating tariff impacts on New Zealand casein trade with Korea. A quadratic programming model is developed to estimate trade flows and prices in each country. World casein trade is modelled with Korean, Japanese, European Community, United States and New Zealand casein supply and demand equations.

In Chapter Five the specification of the quadratic programming model is detailed. A five- country one-product model is developed.

Sensitivity analysis has been carried out to assess the effect of partial removal of barriers in Chapter Six.

Chapter Seven offers some recommendations on the strategies for trade development and draws some conclusions.

CHAPTER TWO

Background and Overview of Korean Agriculture

2.1 Economic History of the Republic of Korea

The Republic of Korea is one of the fastest-growing economies in the world. It has, through exporting, achieved economic growth[1] rates of over 8 percent per annum during the last two decades. Figure 2.1 compares Korean real Gross National Product with other leading industrialised economies. It is clear from Figure 2.1 that the rate of growth of real Gross National Product in Korea since the mid 70's has been well above that of advanced economies such as Canada, United States, Japan and the United Kingdom. The Republic of Korea has developed from a subsistence economy based on agriculture into the world's tenth largest trading nation[2] and a major industrial exporter of manufactured goods in the space of thirty years. Its per capita Gross National Product has increased from NZ$148 in 1962 to NZ$4914 in 1988. The total value of exports has expanded from NZ$97.7 million in 1962 to NZ$504.2 million in 1985.

One fact the world has overlooked is that the Koreans have achieved startling growth rates in a very short space of time:

"The intersectoral transformation of Japan's economy over the past century has been remarkably fast by world standards. Yet South Korea has achieved in the past 20 years almost the same degree of transformation as Japan achieved in the previous 80 years." (Tyers and Anderson 1985.)

----

1. The value of exports was 39% of GNP in 1987

2. Department of Trade and Industry, Export News Vol 32, March 1988, p29.

Figure 2.1

REAL GNP GROWTH RATES OF SELECTED INDUSTRIAL NATIONS

real GNP Growth (%)

Korea

Canada

United States

Japan

United Kingdom

years
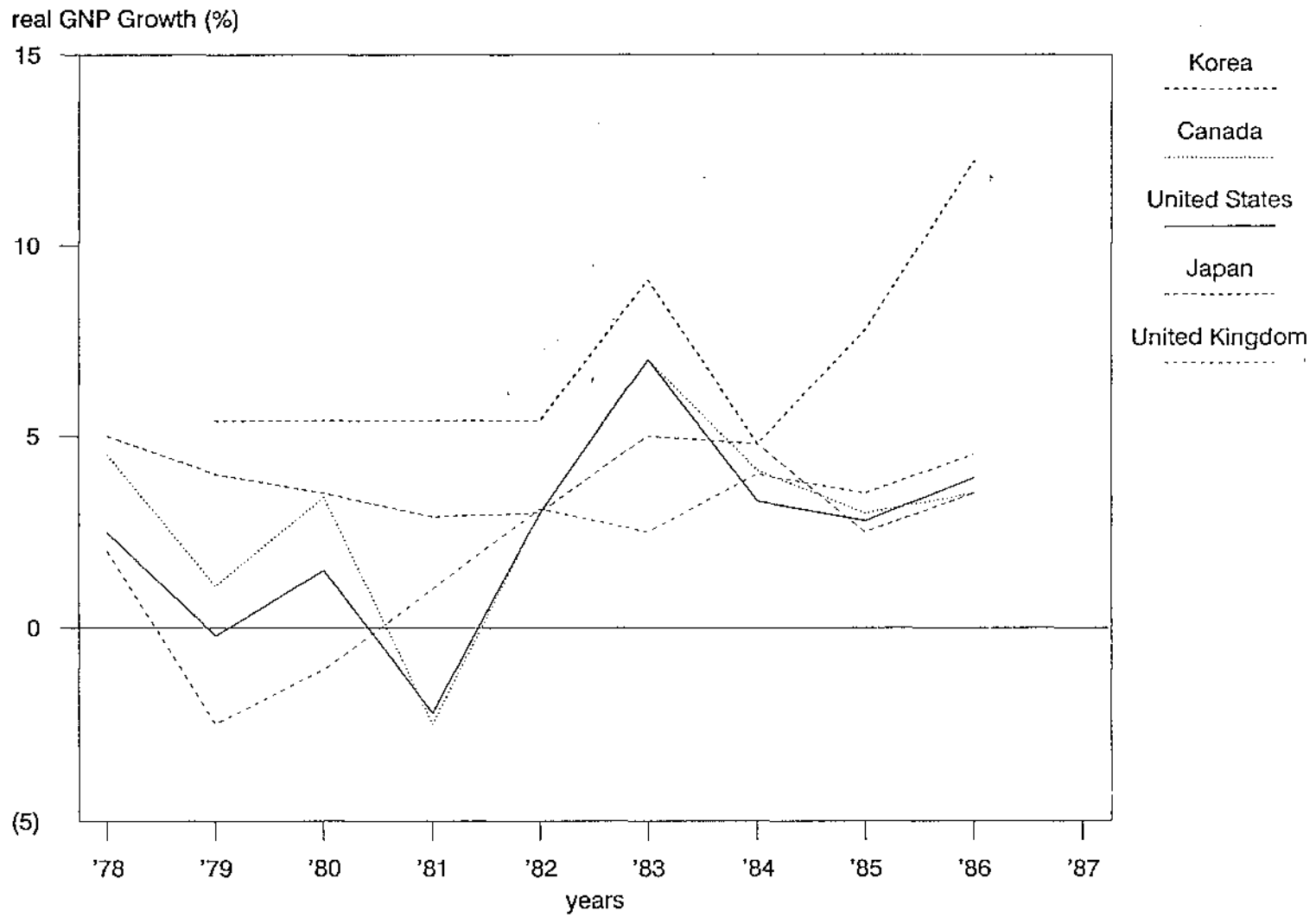
Source: IMF Annual Report 1988, p10.

Careful economic planning based on narrowly focused economic goals has been the hallmark of the Korean success. However, economic success has been achieved with scant regard for the environment and labour. The key to the economic success of the Republic of Korea has been a literate and socially cohesive population of some 43 million people.

Economic development in the Republic of Korea has been supported through overseas borrowings. In 1987 foreign debts amounted to 15 percent of GNP. With growth rates of 12.2 percent (in 1987) aided by the "three blessings" of low oil prices, low international interest rates and a strong Japanese yen (which has made Korean manufactured goods more competitive in relation to Japanese goods), the ability to pay back its debt is of little concern to foreign creditors. The Republic of Korea paid off foreign debt of some NZ$15.5 billion dollars in 1987 reducing the debt to NZ$58.1 billion.[3]

Central planning has been an important feature of the economic development in the Republic of Korea:

"... five-year plans have been the basis of a revolution to transform the economy and industrial base of the country...." (Smith, McLoughlin, Large and Chapman, 1985.)

Goal-orientated programmes, using selective fiscal and credit policies, have been set out for the whole country, giving clear direction in economic policy matters for government, industry (rural and manufacturing) and workers. Resources have been channeled into priority areas identified in the five year plans. The sixth and current five year plan (1986-91) has three national objectives:

    1) Transform Korea's institutional framework from a developing to a developed nation. This involves fewer government controls, deregulation of the economy, liberalisation of trade, enhancement of welfare schemes and improvement of social capital.

---

3. Department of Trade and Industry; Briefing paper, July 1988.

2) Introduce advanced technology and upgrade existing industrial structure.

3) Diminish imbalances between the exporting and other sectors; the rural and the urban sectors, and large, medium and small size businesses.

2.2 Agricultural Development

2.21 Production

"Theory and empirical evidence suggest countries tend to switch from exporting primary products to exporting manufactures as they develop. This switch occurs at an earlier stage of economic development the lower the country's per capita endowment of agricultural land and other natural resources. ... it tends to occur more rapidly the faster the country's industrial growth rate relative to that in other countries. ... the resource-poor, rapidly industrialising countries of Japan, South Korea and Taiwan can be expected to be losing comparative advantage in agriculture." (Anderson K. 1984).

Given the background of rapid industrialisation, agriculture has had to adjust to the changing environment it faces. The socio-political trends are reflected in the development of agriculture in Korea. These include:

1) The gradual change from a rice-based diet to a protein-rich diet. Major adjustments have occurred in the production of agricultural commodities. Rice, along with barley, soyabeans and potatoes still dominate agricultural production but are declining. Livestock, fruit and vegetable production has steadily grown and now represents a greater proportion of the gross farm receipts.

2) The migration of labour from rural to urban areas. Between 1962-1980 employment in manufacturing and mining grew from 8.7 percent to 43.4 percent of the workforce while over the same period employment in agriculture, forestry and fisheries dropped from 63.1 percent to 34 percent. Table 2.1 shows the number of people involved in agriculture in Korea has declined from 49.1 percent in 1970 to only 28.9 percent in 1986.

TABLE 2.1

PERCENTAGE OF PEOPLE EMPLOYED IN

KOREAN AGRICULTURE 1970 - 1986

YEAR	POPULATION (000'S)	% IN AGRICULTURE
1970	31 923	49.1
1975	35 281	42.8
1980	38 124	36.4
1985	41 258	30.1
1986	41 948	28.9

Source: FAO Production Yearbook, 1986.

3) Increased production in agriculture. Table 2.2 shows the total number of dairy cattle on farms in Korea from 1962 - 1987.[4] The increase in the total number of cattle on farms from 2 406 in 1962 to 463 330 in 1987 has been phenomenal and can only be explained by the amount of protection afforded to Korean agriculture. In the late '50's and early '60's food prices were below international prices but as industry grew Korean government planners set about increasing rates of protection for agriculture. Consequently the prices have reached levels which are three times that of world prices. Their reasons for following the protectionist line were (a) food security, and (b) The prevention of disparity in incomes between farms and industry. Table 2.2 reflects how cow numbers increased over the years with the injection of government support funds and protection through tariffs and quotas from foreign competition. Pork production has increased dramatically and is now double beef and chicken production. In addition, both milk (see Table 2.2) and beef production have followed similar trends.

---

4. Livestock Bureau, Ministry of Agriculture Forestry and Fisheries, Korean Dairy Association, Dairy Statistics 1988, Republic of Korea.

4) Increased protection. Anderson and Joo (BAE 1984) have estimated that the effective rates of protection to the agricultural sector between 1968-78 increased from 21 percent to 69 percent. In another study Rae, Wilson and Schroder have shown that smaller farmers are more heavily subsidised than larger farms.[5] Anderson in a later study shows that nominal rates of protection for milk rose to a high of 185 percent in the period between 1975 - 79 and have fallen to 128 percent in 1985.

2.22 Consumption

As the Republic of Korea has become an industrialised nation the pattern of consumption is changing from its traditional rice base to include a more protein-rich diet. Table 3 shows the changes which have occurred in Korean consumption patterns since the early 1970's. Fruits, meat, eggs, milk, marine products and fats and oils have all increased in consumption and are projected to further increase towards 2001. For instances, egg consumption is projected to increase 5-fold by the year 2001. Contrasting this 'All Food Grain' consumption is projected to decrease 29 percent by the year 2001. Huh (1986) attributes this 'dramatic' turnaround to the increased income for Korean workers, the fall in agricultural prices and an increasing population.

2.3 The Korean Dairy Sector

The development of the Korean dairy industry is a relatively recent phenomenon. The dairy industry was established in the 1960's and made up of entirely Holstein - Friesian dairy cattle. Between 1962 and 1982 a total of 91 000 cattle were imported into Korea. The total number of cattle increased from a mere 23 600 in 1970 to 463 330 in 1988 (see Table 2.2).

----

5. 1 - 10 hectare farms could be purchased with a 20% subsidy, 60% loan and 20% own funding. 10 -50 hectare farms: 80% loans and 20% own money. Over 50 hectare farms no subsidy of loan. Rae, Wilson and Schroder, Dairy Development Trade Policy issues, within the Pacific Basin. Centre for Policy Studies, Agricultural Policy Paper No. 11 May 1985.

12

TABLE 2.2

DAIRY CATTLE POPULATION BY YEAR 1962 - 1987

YEAR	FARM HOUSEHOLDS WITH CATTLE	NUMBER OF CATTLE ON FARMS			
		TOTAL	FEMALE	MALE	AVERAGE PERFARM
1962	676	2406	1956	450	3.6
1964	1087	5199	4527	672	4.8
1966	1478	8471	7537	934	5.7
1968	2145	13760	11834	1926	6.4
1970	3126	23624	20510	3114	7.6
1972	3788	36128	30295	5833	9.5
1974	7378	73195	59203	13992	9.9
1976	10174	89688	82753	6935	8.8
1978	16387	135803	129980	5823	8.3
1980	17666	179841	172883	6958	10.2
1981	18229	194205	186558	7647	10.7
1982	22536	228248	221888	6360	10.1
1983	29537	274783	267506	7277	9.3
1984	37646	334352	326592	7760	8.9
1985	43760	390135	390135	-	8.9
1986	42728	437333	437333	-	10.2
1987	38131	463330	463330	-	12.2

Source : Dairy Statistics, Livestock Bureau, Ministry of Agriculture, Forestry and Fisheries; Republic of Korea 1988.

13

TABLE 2.3

CHANGES IN PER CAPITA CONSUMPTION OF

MAJOR AGRICULTURAL PRODUCTS, 1971-2001.

Commodity	1971	1981	1991*	2001*
		- kg's -		
All food grains	269.0	214.5	204.9	191.1
Vegetables	67.5	124.0	163.5	131.7
Fruits	9.9	19.6	32.7	45.9
Meat	6.4	10.2	17.6	24.7
Beef	1.5	2.4	4.3	6.4
Pork	3.4	5.4	8.7	11.6
Chicken	1.5	2.4	4.5	6.7
Eggs	3.2	5.4	10.8	16.1
Milk	2.2	14.4	32.0	54.4
Marine products	14.8	26.0	39.2	50.3
Fats & Oils	2.2	6.0	9.6	12.7
Vegetable oils	1.5	4.4	7.0	9.4
Animal fats	0.8	1.6	2.6	3.3

Source: Shin-Haeng Hun; Livestock and Feedgrains Policies in the Course of Agricultural Development in Korea, PECC papers 30 June - 2 July 1986.

*predicted

Parallel to the rapid expansion in cow numbers, reproduction rates also increased from 75 percent to 85 percent. Milk production has increased from 2 647 tonnes in 1962 to 1 418 198 tonnes in 1987 (see Table 2.4). Average yields per milking cow have risen from 4500kg to 5620kg between 1972 and 1982. Similarly consumption rates have shown spectacular increases from 2647 tonnes in 1962 to 1 424 765 tonnes in 1987 (an increase of 23 percent over the 1986 consumption total.)

These increases reflect the massive amount of money pumped into the farming sector by government agencies to boost production and achieve self-sufficiency. Protection of the agricultural sector is accomplished through import controls, input subsidies and price support mechanisms. Imports of feedstuffs have also encouraged dairy development. Services such as research, extension and veterinarian services are provided free to the farmer.

The development of the Korean Dairy industry sector has relied heavily on imported feed grains.[6] Estimates for future increases in dairy production will mean increased use of imported feedstuffs. In addition to this, all pasture and forage crops seed are imported. Concurrent with the heavy reliance on imported feed the development of forage and pasture crops has proceeded. Larger dairy farms have been most successful in growing pasture (150-200 hectare farms). However, the majority of cultivated pastures have been established on smaller farms from 3-10 hectares (Rae et el 1985); due to poor management practices and the fact that dairy farms have found production of forage crops to be a productive use of limited land resources.

Most dairy farmers are located near urban districts with average dairy herds comprising around 5-15 head of cattle. Of farming households only 1 percent raise dairy cattle. Of that 1 percent , 9 percent of farmers have at least 15 head of dairy cattle. (Rae et el, 1985). With significant numbers of farmers producing small amounts of milk, this suggests how costly it has been for Korea to become self-sufficient in milk production.

---

6. About 70% of inputs into these feeds are imported. It should also be noted that because of the physical limits of the Korean land resource, continuation of imported feed requirements is a necessity.

TABLE 2.4

KOREAN MILK PRODUCTION AND CONSUMPTION

YEAR	PRODUCTION	CONSUMPTION	GNP PER CAPITA	POP
	M/T	M/T	NZ$	per 000's
1977	263 559	254 245	1 470	36 412
1978	324 328	325 867	2 205	36 969
1979	384 714	374 410	2 800	37 534
1980	457 580	411 809	2 591	38 124
1981	517 657	557 722	2 821	38 723
1982	580 124	592 720	3 103	39 331
1983	716 384	728 675	3 241	39 951
1984	814 299	833 504	3 445	40 578
1985	1 011 114	959 742	3 503	41 209
1986	1 159 358	1 155 830	3 916	41 569
1987	1 418 198	1 424 765	4 850	42 082

Source : Livestock Bureau; Ministry of Agriculture, Forestry and Fisheries, Republic of Korea; 1988.

2.4 Summary

This brief background to Korean agriculture suggested how Korean policy makers have used protection to increase agricultural growth.

Section 2.1 also shows the tremendous advances in industrial production through a combination of narrowly focused economic goals and central planning. Four factors have been important in the development of agriculture in the Republic of Korea:

(1) a change from a rice-based diet to a protein diet;

(2) migration of labour from rural to urban areas;

(3) an increase in agricultural production; and

(4) increased protection afforded to the agricultural sector.

The changing nature of Korean agriculture is reflected in the change in production and consumption patterns of the dairy industry. Total cattle numbers have increased from 23 600 in 1970 to 463 330 in 1988. Reproduction rates, average yields and consumption have increased in a similarly massive way.

Despite these quantum leaps in dairy production most herd sizes are between 5 and 15 head of cattle. Without indirect assistance from government agencies (examined in Chapter Three) and outright banning of imported dairy products the Korean Dairy Industry in its present structure would struggle to survive.

CHAPTER THREE

Protectionism in International Trade.

3.1 Introduction

Throughout history countries have been grappling with the debate over the desirability of free trade. The importance of this debate stems from the fact that intervention alters the allocation of resources and the location of industry in an economy. The Mercantilists and the Physiocrats first debated and developed models which attempted to explain the behaviour of cross-border trade. The Mercantilists believed that intervention by the state in economic activity was needed to maximise growth while the Physiocrats advocated free trade and a laissez-faire economy. The underlying themes of these debates between the Mercantilists and the Physiocrats exist today.

The raison d'etre for trade is the potential gains from trade based on comparative advantage. Tariffs, subsidies and quotas distort the free movement of trade, reducing the potential earnings of an exporting nation. The imposition of trade barriers protects domestic industries. The majority of theoretical treatises on international trade suggest that substantial gains from trade could be obtained through the fall of trade barriers given that market power is minimal[1].

Tariff barriers have been the focus of considerable attention by international trade specialists because of the increased competition in world markets, particularly in agricultural trade. As barriers to trade are reduced the competition between rival export nations to gain from these reductions is intense. For example, the recent decision by Japan to restructure its beef importing regime has led to a gearing up of exporters in many different countries to take advantage of what is perceived to be

---

1. A high degree of market power through monopoly can distort pricing by restricting output and increasing price, therefore reducing welfare gains brought about through the reduction of trade barriers.

opportunities for potential gain in the Japanese beef market. Counter balancing this, is the often conflicting objectives of domestic producer groups (which in most countries have substantial political strength) and the desire for governments to follow food security policies. For these reasons both exporting and importing nations have a keen interest in the trade liberalisation process.

This chapter reviews developments in international trade with particular emphasis on protectionism. The basis for trade restrictions are detailed first. The evolution of trade barriers are discussed and recent contributions are evaluated. The concepts of nominal and effective rates of protection are discussed and compared in section 3.4. The nominal rate is also discussed in the context of Korean agriculture. Informal and formal barriers are are defined detailing the Korean experience. In the course of the discussion on protectionism, the liberalisation process, GATT, the Korean Beef case and the Japanese experience of liberalisation are examined.

3.2 The Basis for Trade Restrictions

Trade barriers have been the subject of a continuing debate, on which a large body of literature has been written. Of particularly importance are the welfare effects generated by restrictions. Johnson's (1971) article uses the premise that trade barriers are erected to correct domestic distortions. He examined the following types of cases:

(a) Distortions in the factor and commodity markets;

(b) Infant industry argument;

(c) Non-economic argument.

Arguments in favour of trade restrictions are based on distortions such as natural monopolies and social externalities. Johnson concludes that in cases where a country may be better off through trade restrictions, an economically superior domestic policy should be implemented instead. Johnson indicates that trade restrictions are not 'first best' solutions.

One of the most frequently cited reasons for trade barriers are to protect industries in their infancy. The argument rests on the theory that incurring consumption costs, in the form of higher import costs, for a limited time will bring future benefits. This can be considered an investment in an infant industry. Investment resource efficiency is not-optimised by free trade. Capital markets are, therefore, operating inefficiently in allocating investment resources when in a free market. That is, from a public good standpoint the free market is not operating in the public's best interest. Johnson prefers production subsides to trade restrictions in order to increase domestic production.

Food security or lessening dependence on imports is a non-economic argument used to put up barriers to entry. Import tariffs have more potential to curtail trade than production subsidies. Non-economic arguments favouring import restrictions in the form of tariffs are based mainly on non-econome grounds.

Given Johnson's presentation, it is clear that the Korean tariff protection on dairy products is based on non-economic grounds and the infant industry argument. In purely economic terms the consumers would be better off with the removal of tariffs. From a Korean perspective the policies have been designed to limit imports through import tariffs. The Korean government has formed its policies in order to satisfy the dual purpose of maintaining food security and maintaining farmers incomes. Both are non-economic arguments.

3.3 Evolution of Trade Barriers

Import licensing to control the flow of imports was an early form of trade barrier. The licensing system was used to control import volumes. In some cases this meant monopoly profits to those who were assigned the import licences, even though exporters were aware of the demand for those particular goods. The existence of monopoly profits often causes tension between government, consumers and business despite the fact that import licensing may have led to a reallocation of resources in favour of domestic development. A uniform tariff as opposed to import licencing is advocated by Corden (1963). A uniform tariff would redistribute monopoly profits received and at the same time increase import restrictions. For example, this may be the correct strategy for a country such as Brazil which is rich in resources. Growth would be achieved with the cost of higher consumer prices. For a country such as Japan, with few natural resources and highly dependent on imported inputs it is a highly uneconomic strategy.

The effects of the introduction of export taxes have been examined by Carter, Gallini and Schmitz (1980) and Swallow (1983). Both came to similar conclusions, given a large country assumption. Export taxes would benefit the exporting group or country. Swallow found that significant gains from trade could be made by imposing an export tax.

A recent paper by Schmitz (1988) looks at American agricultural gains from trade by United States exporters. Using a model developed Schmitz, Sigurdson and Doering, he concludes that government attempts to protect agriculture from foreign competition in commodities such as wheat has led to little or no gains from trade. Furthermore, trade liberalisation through the GATT round will be stifled by special interest groups which have vested interests in restricted trade.

Zwart and Blandford, (1989) analysing the effect of interventions by governments on price stability suggest that because of the array of interventions the effect on price stability is uncertain. Given that the

GATT is pressuring for a reduction in assistance the method of reduction of assistance will be as important as the reduction itself for price stability.

3.4 Protection Measurement

Protection and free trade debates also include the sometimes vexing issue of how to measure protection. The use of nominal rates of protection on final goods can be misleading.

Before the introduction of effective rates of protection, nominal rates were the main instrument used to measure barriers to trade. Barber (1955) first applied effective rates of protection measures. This referred to an earlier work by Schuller (1905). Studies in the early and middle part of the century were focused on 'first best' solutions, therefore, it was understandable that work did not progress on effective rates of protection during that time. Since Barber's application other authors have followed. Corden (1971) noted that economists from 'small' countries have led the way in this area of study. Contributions of note have been made by Balassa (1965), Basevi (1966), Corden (1966), Johnson (1965), Soligo and Stern (1965), and Melvin and Wilkinson (1968).

As a measurement device, effective rates of protection provide an index of the level of protection given to a good or service when import tariffs are enacted. Four measures have been developed:

(1) the proportional total value-added in gross output;

(2) the proportional total value-added in the primary factor;

(3) the proportional total in value-added per unit of output; and

(4) the proportional total in value-added to the industry.

For the purposes of illustration the third definition will be used.

22

To examine differences between nominal and effective rates of protection a comparison is illustrated below. When measuring nominal rates of protection prices are recorded before and after protection policies are put into place, whereas effective rates of protection measure added-value in the production process. A numerical example will clarify the difference. A country produces casein, selling on the world market for $900 a tonne. The value of the inputs may be divided between labour and other input costs. Using the assumption that other inputs are valued at $600 a tonne leaving the balance of $300 a tonne for labour costs. If a nominal tariff rate of 20 per cent is applied in the importing country the price increases to $1080 a tonne. If we assume that all other input prices stay the same, the tariff allows $480 per tonne to be allocated towards the input labour. The nominal rate of protection is 20 per cent but the effective rate is 60 per cent for casein.

In general terms nominal and effective rates of protection may be written as:

$$(p^* - p) / p = t \qquad (3.4.1)$$
$$(v^* - v) / v = e \qquad (3.4.2)$$

where: p^* is the price per tonne after the tariff is imposed.

p is the price per tonne before the tariff is imposed.

t is the nominal tariff rate.

v^* is the post tariff value-added rate per tonne.

v is the pre tariff value-added rate per tonne.

e is the effective rate of protection.

The effective rate of protection expressed in terms of the nominal rates is presented next. First, the relationship between the inputs and the outputs before and after the tariff (t) is applied is examined. If we take the case where:

$$v + a = 1 \qquad (3.4.3)$$
$$v^* + a = 1 + t \qquad (3.4.4)$$

where: a is the share of the value of other inputs in the value of output, at world prices, per tonne. Equations (3.4.3) and (3.4.4) can be rearranged as follows:

$$v = 1 - a \qquad\qquad (3.4.5)$$
$$v^* = 1 + t - a \qquad\qquad (3.4.6)$$

Substituting (3.4.3) and (3.4.4) into (3.4.2) gives the effective rate in terms of the nominal rate.

$$[(1 + t - a) - (1 - a)] / (1 - a) = e \quad \text{or} \quad t / (1 - a) = e \qquad (3.4.7)$$

Returning to our example the relationship is shown as:

$$20/ (1 - 600/900) = 0.60$$

The above example shows that effective rates of protection are an increasing function of nominal rates. It follows that a reduction in the nominal rate will lead to bigger reductions in the effective rates of protection.

Grubel and Johnson (1971) argue that the imposition of tariffs on cost of the inputs will also lower effective rates of protection afforded to goods and services. This alters equation (3.4.6) to :

$$v^* = 1 + t - a(1 + t^*) \qquad\qquad (3.4.8)$$

where t* equals the tariff on the imported input.

The adjusted formula measuring effective rates of protection is:

$$e = (t - at^*) / (1 - a) \qquad\qquad (3.4.9)$$

For the purposes of this example we will assume that milk is the only other input needed to make casein. Suppose then that a 5 percent nominal tariff per tonne is imposed on this input. The price of that input would be

$630 per tonne. Assuming the 20 per cent tariff remains on casein, $450 remains for the other specified input labour, leaving a 50 percent effective rate of protection.

$$[(0.20 - (600/900)0.05)] / (1 - 600/900) = 0.50$$

It should be noted that these formulae ignore what happens to the level of input use on domestic price changes: more complex formulae include elasticities to measure these effects.

It is possible, if nominal rates of protection are large enough, that negative effective rates of protection can exist. In the above example, a 20 percent nominal rate on casein coupled with a 40 percent tariff on milk results in a negative 20 percent effective rate of protection. When governments support infant industries, negative rates of assistance can be found. This occurs where the value of the imported good is exceeded by the value of the home produced product. The output may be purchased on world markets more cheaply, however, the government is willing to forgo the welfare cost to promote infant industry with the aim of providing lower costs in the future. Thus effectively taxing the consumer.

3.5 Application to Korea.

Effective rates of protection for the Korean dairy industry are very difficult to estimate because of the problem of taking into account the many different policy interventions that the Korean government has put in place.

Nominal rates have been estimated. Ryland (1981) suggests that the price of domestic milk powder has increased through the seventies relative to the landed cost of imported milk powder. In the ten years ending 1980 the ratio has risen from about 1.5 to over 5, a nominal rate of roughly 400 percent.

Anderson and Joo (1984) using Hong Kong full cream powdered milk import prices converted to a market milk basis suggest that Korean milk prices were two to three times as high as they should have been. Assuming that powdered milk is a close substitute for fresh milk nominal rates of protection were in the region of a 130 percent.

Rae, Wilson and Schroder (1985) estimated 1982 prices for skimmed milk powder and anhydrous milk fat. The cost of raw materials required to recombine milk was roughly US$0.19 per litre, whereas, the Korean price was roughly US$0.42 per litre. The data would suggest that nominal rates of protection were over 120 percent.

De Boer (1982) suggested that Korean butter and cheese prices were quoted as being 46 and 170 percent higher respectively, than those of the imported product.

Anderson (1987) estimated that milk's nominal rate of protection was 128 percent and dairy products as a whole had an average rate of nominal protection of 195 percent.

In 1989, the prices of butter and casein including transport costs to Korea were $US2200 and $US4850 per tonne respectively. The domestic Korean price for the two products were $US5574 and $US8005 per tonne, respectively. Nominal rates of protection for butter are therefore 150 percent and for casein 65 percent.[2]

---

2. Prices sourced from the New Zealand Dairy Board. ie world prices plus freight. Butter transport costs were estimated on New Zealand / Japanese freight costs.

3.6 Types of Assistance to Korean Agriculture.

Unfortunately data is not available to estimate effective rates of protection to Korean agriculture. However, this section attempts to detail forms of protection and classify them by detailing their respective characteristics into formal and informal barriers (Menzie and Prentice, 1987).

As the Korean government comes under mounting pressure to reduce its trade barriers actual details of the form and substance have been difficult to obtain. The following is a sketch of the more important barriers that face the exporter of agricultural goods.

3.6.1 Formal Barriers.

Formal barriers are defined as 'direct actions taken for the purpose of limiting imports. '(Menzie and Prentice, 1987). These are defined as (1) import taxes and border charges; and (2) quantitative restrictions. General tariffs, tariff rate quotas, temporary surtaxes and user fees, plus countervailing and anti-dumping laws are included under (1), while voluntary restraints, licencing, and prohibitions are included under (2).

The tariff levels as shown in Table 3.1 for dairy products are between 20 and 40 percent. Table 3.1 gives a breakdown of the extent to which tariffs affect dairy products in the Korean market. Tariff rates on New Zealand dairy products entering the Korean market place since 1981 are shown.

The overall tariff rates are trending downwards, albeit from a high level ie. the butter tariff was 60 percent in 1981, in 1988 it was 40 percent, Casein, Lactose, Whey, Skimmed Milk, Cheese (raw and processed) and Caseinates have followed similar patterns. Only Whole Milk has gone against the trend by increasing to 40 percent. On average Korean tariff duties for dairy products are between 28 and 29 percent.

27

TABLE 3.1

TARIFFS ON NZ DAIRY PRODUCTS ENTERING KOREA.

PRODUCT	TARIFF						
	1981	1983	1984	1985 (%)	1986	1987	1988
Whey	na	25	20	20	20	20	20
Skimmed Milk	na	25	20	20	20	20	20
Whole Milk	na	25	40	40	40	40	40
Butter	60	40	40	40	40	40	40
Cheese-raw	40	40	40	40	40	40	40
Cheese-processed	60	40	40	40	40	40	40
Casein	40	40	30	30	25	20	20
Caseinates	na	na	30	25	25	25	20
Lactose	40	40	40	35	30	25	20

Note : There are no GATT tariff arrangements covering dairy products.
Source: Department of Trade and Industry briefing papers various years.

Given the gradual downward movement of tariffs in Korea shown in Table 3.1, liberalisation of agricultural products, particularly dairy products, will be a slow process. No sudden movements in policy are expected from the Koreans given past experience in tariff reduction, however the downward trend is expected to be maintained.

Exporters encounter a number of surtaxes[3] which are paid on entry to the Republic of Korea. These include:

(1) A defence tax of 2.5 percent;

(2) A value added tax of 10 percent of duty paid CIF value;

---

3. Dairy products are subject to the first three surtaxes.

(3) A special Excise Duty, imposed on luxury goods at rates ranging from 5 to 100 percent (skimmed milk is subject to a 20 percent luxury tax);

(4) A liquor tax imposed on beer (150 percent) and wine (25 percent);

(5) Additional defence tax, placed on items subject to special Excise Duty and Liquor tax at rates between 30 and 100 percent.

Border charges or user fees are charged by some countries based on the amount and value of the cargo entering the country. It is difficult to distinguish these types of taxes from the list of those presented above. Menzie and Prentice note that: "Although these 'user fees' may seem minor or unimportant, they establish a disturbing precedent." (Menzie and Prentice, 1987 p946)

The use of countervailing duties and anti-dumping laws are weapons used by governments to protect domestic industries from assistance provided to foreign industries. The threatened use of these laws is quite common amongst the trading nations of the world. The basic tenent behind these laws is that if exporters have had assistance from their own government then domestic producers are at a disadvantage, therefore, a tax should be imposed on the subsidised foreign product. The strict nature of the Korean import regime, where prices are controlled, doesn't allow the slightest chance of cheaper products entering the domestic market place whether they are subsidised or not. Use of these types of laws are not needed.

The mechanism for protection is the Foreign Trade Law which regulates Korea's foreign trade transactions through a system of tariffs and enforcement decrees and regulations. The Ministry of Trade and Industry regulates the Foreign Trade Law. Any imports or exports must be approved by the Ministry of Trade and Industry.

Quantitative restrictions are measures imposed to limit the volume of imports to an absolute amount. The Korean government use quantitative restrictions liberally because quotas are the most effective barrier to

trade. Quantitative restrictions play a major part in restricting New Zealand dairy products from entering the Korean market. They are often a preferred protection device because:

'If the increase in protection were in the form of tariffs, it would be simple to show that they retarded trade. But it is nearly impossible to estimate the combined effect of NTB's (non tariff barriers) on the quality or value of a country's imports.' (World Bank 1987)

In the Korean case quantitative restrictions can fall into a number of categories which determine what type of regulation is imposed on the particular product (Table 3.2). Goods are classified on the basis of the Customs Cooperation Council Nomenclature (CCCN) system and are divided into three categories: automatic approval, restricted and prohibited.

Of the 'restricted list' items, in this case dairy products, the goods '...may be imported, subject to the recommendation from the related government departments, business associations[4] or other specific agencies...' (Department of Trade and Industry, 1988). The technique of recommendation has been an effective means of preventing imports entering the country, particularly dairy imports.

Controls on import procedures for goods under the 'restricted category' are used to further retard trade. The government requires products to be directed through specific channels. These channels are controlled by local interests who are less motivated to promote the imported products than general importers.

Table 3.2 shows that Whey, Skimmed Milk, Whole Milk, Butter, Cheese (both raw and processed) are all restricted goods and are subject to special taxes while Casein, Cassinates and Lactose have been automatically approved but are subject to import surveillance ie. quotas.

---

4. For dairy products the Korea Dairy Industries Association.

Special Laws, (Korea has 39) have the power to override administrative regulations giving import approval. In 1989, restrictions covered over 2500 products of which 29 percent are agricultural goods.

In summary, dairy products are restricted as follows:

1) Restricted to Hotels and Commissaries.
Butter and cheese.

2) Dairy products subject to other control methods.
Skim milk powder, whole milk powder, whey, casein and caseinates

3) Products effectively banned.
Milk-based stockfeeds.
Import licences are required by companies wishing to import into Korea. An import licence is required to have an offer sheet duly signed by an offer agent as well as the importer. Whether or not the application is successful or not depends on the classification of the goods. As Table 3.2 suggests this ranges from Automatic Approval (eg. casein) or Restricted (eg. butter.)

3.6.2 Informal Trade Barriers

Informal Trade Barriers come in a wide variety of guises. They include technical and health regulations, government procurement and distribution policies. These are varied in nature, impacting on trade indirectly.

Simpson and Hillman (1975) suggest that:

'it is the proliferation of the variation in interpretation of the standards and the number of different procedures that are to be followed to fulfill the sanitary requirements that act as non tariff barriers...'

Most countries accept the need for health and technical regulations to prevent the spread of disease. However, there is a suspicion that they are used to hamper trade rather than protect domestic plants and animals.

31

TABLE 3.2

STATUS OF NZ DAIRY EXPORTS TO KOREA (1988)

PRODUCT	CATEGORY(a)	REGULATION(b)	IMPORTER(c)
Whey	R	IR	KTHSC
Skimmed Milk	R	SED	KTHSC, FC
Whole Milk	R	IR	KTHSC, FC
Butter	R	IR	KTHSC, FC, SC
Cheese-raw	R	IR	KTHSC, FC, SC
Cheese-pro	R	IR	KTHSC, FC, SC
Casein	AA	IS	–
Caseinates	AA	IS	–
Lactose	AA	IS	–

(a) Category: Restricted List (R)

Automatic Approval (AA)

(b) Regulations: Import Recommendation Item (IR). The recommendation agency for dairy products is the Korea Dairy Industry Association (KDIA). None of the above products are currently imported for domestic consumption. Special Excise Duty (SED). SED is a tax levied on so-called luxury items. Sugared skimmed milk for drinks is taxed 20% on CIF value. Import Surveillance (IS). IS is administered through the allocation of quotas.

(c) Special

Importer: The Korea Tourist Hotel Supply Centre (KTHSC) Foreigners' Commissaries (FS) Licensed Ships Chandlers (Foreign Ships) (SC).

Source: Export News 3/88

Strict technical standards are enforced in Korea. Imports, upon arrival are stored in bonded warehouses on arrival and kept until cleared by customs. Importers must carry out the customs clearance with a customs broker authorised by the Ministry of Finance. Documents must be supplied by the exporter correctly. With these very rigid procedures, a very complicated distribution system is in place. An exporter can often deal with an Offer Agent, Official Importer, Actual importer, Wholesaler, Distributor and Retailer before the consumer is able to purchase the imported product.

The New Zealand Dairy Board has managed to bypass this complex maze of intermediates by setting up a joint venture (see Table 3.3 and 3.4). Table 3.3 shows how the New Zealand Dairy Board have kept the distribution chain to four steps. Most producers face a daunting array of distribution channels which means their product is handled by anywhere between six and twelve operators before it reaches the market place. This can effectively mean that exporters have little control over how their product is marketed. It is interesting to note, given that dairy exports are banned from general sale the direct control by a government central buying agency of diplomatic and hotel purchases (see Table 3.4).

3.6.2.1 Agricultural Subsidies

One of the most important weapons in Korean efforts to compete with foreign imports and develop domestic agriculture is the use of financial assistance to farms. Subsidies and other financial incentives are used extensively in Korea. Domestic supply programmes distort trade flows by changing the pattern of internal supply. They are an indirect, informal barrier.

The rapid development of the Korean agricultural sector has been greatly boosted by the raft of subsidies from government. These subsidies to farmers include:

A) Fertilisers. These are for the cultivation of grains mainly. The annual expenditure on fertiliser subsidies reached NZ$241 million in 1986, and ranged from 50 percent to 80 percent of the manufacture's selling price.

TABLE 3.3
Distribution Channel
for Casein.

```
┌──────────────────┐                      ┌──────────────────────┐
│                  │                      │ Joint Venture 50/50  │
│ Exporter         │ ───────────────────▶ │ NZ Dairy Board and   │
│ NZ Dairy Board   │                      │ Hangseng Food Ltd.   │
│                  │              ◀──      │                      │
└──────────────────┘            ╱         └──────────────────────┘
                              ╱
┌──────────────────┐                      ┌──────────────────────┐
│                  │                      │                      │
│ Industrial       │ ───────────────────▶ │ Consumer             │
│ Manufactures     │                      │                      │
└──────────────────┘                      └──────────────────────┘
```
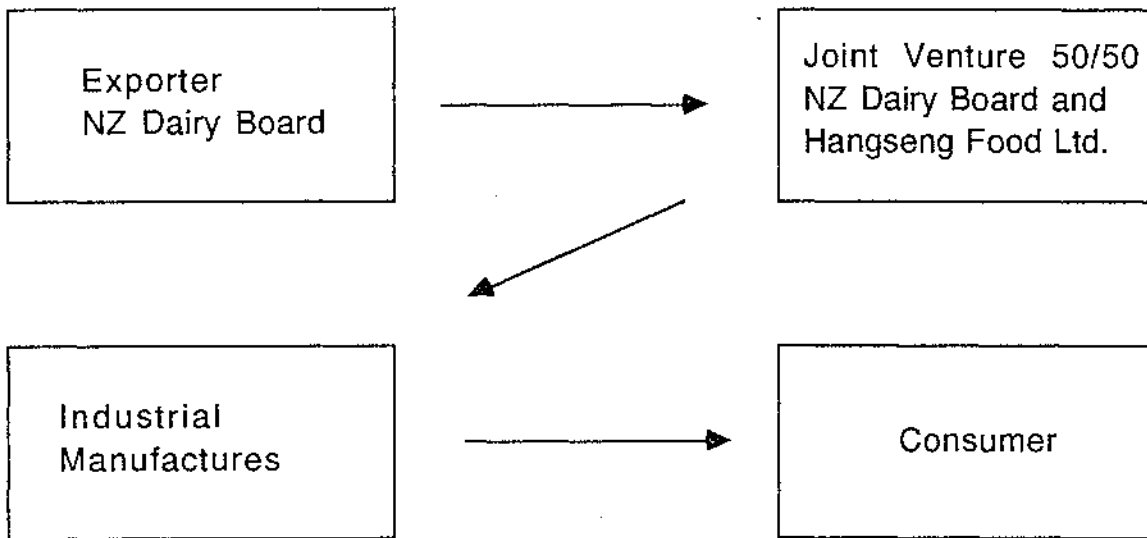
TABLE 3.4
Distribution of Dairy Products
restricted to hotels and Diplomatic
Posts.

```
┌──────────────────┐
│                  │
│ Exporter         │
│ NZ Dairy Board   │
│                  │
└──────────────────┘
        ╲               ┌──────────────────┐
          ╲             │ Central Buying   │
            ╲           │ Agency           │
              ╲         │                  │
                ╲       └──────────────────┘
                  ╲                          ┌──────────────────────┐
                    ╲                        │                      │
                      ▶                      │ Hotels and           │
                                             │ Diplomatic Posts     │
                                             └──────────────────────┘
```
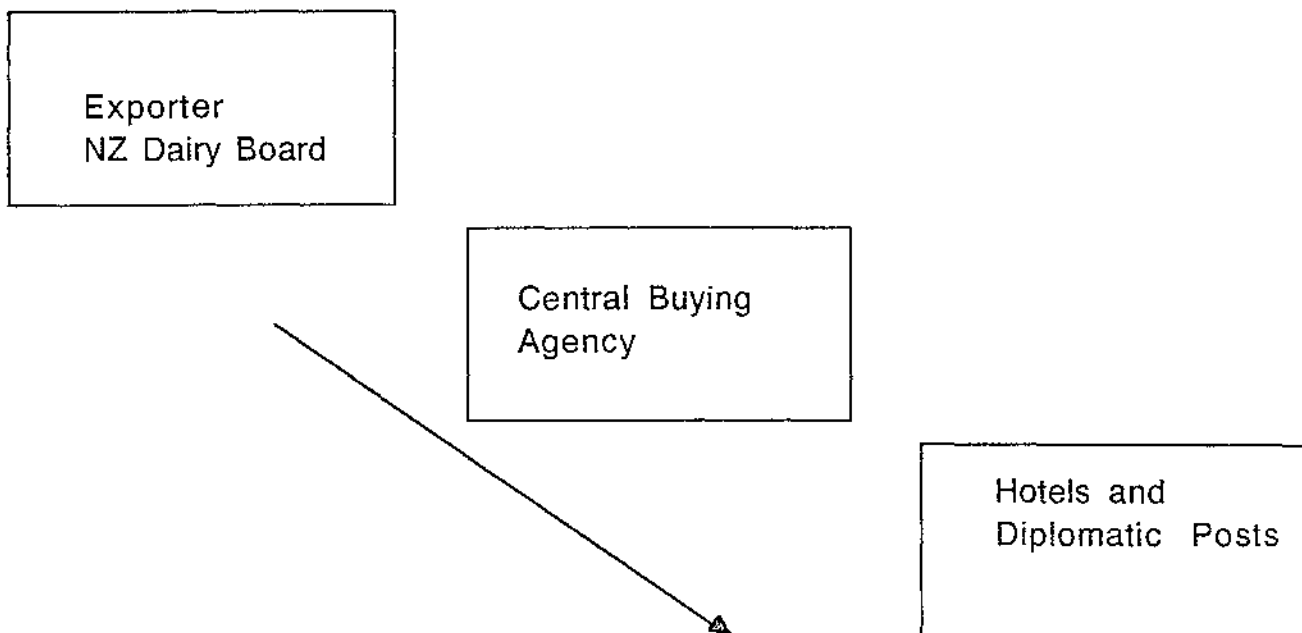
B) Schemes to develop 'Mechanised Farming Estates'. The government has provided loans and finance to Mechanised Farming Estates in order to purchase agricultural implements and machinery. Table 3.5 shows the increase in agricultural implements and machines. The increases in numbers

TABLE 3.5
AGRICULTURAL IMPLEMENTS AND MACHINES
(Owned by farm households)

	Power Tiller	Farm Tractor	Power Pump	Chemical Sprayer	Threshing Machines
1980	289 779	2 664	193 943	331 912	219 896
1983	489 296	7 469	262 608	438 901	269 753
1984	538 273	9 684	273 329	473 501	286 647
1985	588 962*	12 389**	286 298	517 530	301 717∞
1986	683 611	16 167	287 327	586 384	294 264
1987	711 374∩	19 863^n	295 108	628 317	302 572°

Source: National Bureau of Statistics, Korea, Statistical Handbook 1988; Economic Planning Board, Republic of Korea;
The following amount of agricultural implements were provided by government in a particular year.
* 62 000, ** 2 700, ∞ 7 000, ∩ 53 981, ^{n} 4 912, ° 5 871.

of machines are due largely to subsidies provided by government. In 1980 the Korean government provided NZ$51.2 million worth of funds for farm mechanisation. This increased to a peak of NZ$237.6 million in 1983; since then subsidies on agricultural implements have dropped slightly ie. in 1984 NZ$351.6 million was given to farmers while in 1985 the figure was NZ$337.6 million.

Recent figures are not available but a rough guide to the amount of subsidies farmers have received can be gauged by the numbers of implements and machines owned by farm households in any one year. Between 1985 and 1987 the numbers of implements and machines has

roughly stayed the same (see bracketed figures in Table 3.5). Therefore, it is realistic to assume that subsidies in the form of machinery and farm implements have been constant over the past few years. The only changes to have occurred are in the mix of products provided to farmers.

In addition to this: "... the government established farm mechanisation district organisations for villages and groups of farm households in 1981. In 1987, 2 022 additional organisations were established, bringing the total number to 7 907 by the end of the year." (National Bureau of Statistics Handbook)

C) Soft loans to farmers with interest rates of 5 percent compared with the bank interest rate of 11.5 percent. Other examples of 'one-off' subsides include NZ$1088.2 million worth of finance to farmers at 8 percent to replace debt at much higher interest rates in 1987, NZ$810.5 million for the restoration of damage from floods.

D) Government has used price support schemes to protect farmers from lower price foreign competition. By buying local production at prices well above world prices the government enables farmers to produce more commodities, therefore reaching their goals of self-sufficiency and increasing farmer's incomes. For example, 15.9 percent of the total production of rice and 52.8 percent of barley was bought by the government in 1986 (Department of Trade and Industry, 1989). By implication the consumer pays higher prices (that is higher than world prices) for commodities produced. As Anderson comments: 'Little more than lip service has been given to consumers' interests in keeping down the level of food prices...'. (K Anderson, 1983).

E) Other government schemes to assist farmers such as:

(1) The exemption of "Special Excise Duty" on petrol used for agricultural machinery. (There is a 100 percent tax on its gross value.)

(2) Interest-free credit on agricultural medicines and fertilisers. Subsidies on the supply of milk to children at school.

(3) A relatively low rate of income tax for farmers compared with their urban counterparts.

3.7 The Liberalisation Process.

It is not clear who would be the winners from trade if the Korean government reduced its tariff barriers on dairy products. It is clear that the Korean farmer would be a big loser. Protection in the domestic dairy industry is extensive and the withdrawal of subsidies would have major ramifications for the survival of dairying in Korea.

Adjustments from a protected environment in Korea would be substantial and conflict with stated objectives of the Korean five year plan (see Chapter Two). If quotas were phased out, internal adjustment would take the form of a substantial drop in prices sending large numbers of farmers out of business. Incomes would fall and dairy farming would cease to be a viable option.

It is patently obvious that free trade will not occur overnight, particularly in such a sensitive area as dairy trade (since it is not in the interest of the United States either). One international forum which has had success in bringing down protection has been the GATT (General Agreement on Trade and Tariffs). However, Schmitz (1988) states that although the focus of GATT has been compatible with free trade or partial liberalisation of trade and theoretical papers have more often than not expounded the virtues of free trade, barriers to trade have often carried the day when it comes to policy formulation.

Perhaps it is important to focus on the political reasons for trade barriers rather than demonstrating the logic of free trade. Schmitz argues that tariffs 'have been used very effectively by special interest groups to obtain economic rents which would be not available under free trade. '(Schmitz, 1988). It is, therefore, important to identify the special interest groups and understand their motives for protection.

37

Given the apparent reluctance of Korea to engage in free trade it is important to look at the reasons for this:

(a) Food security is a high priority for Korean policy makers. Consumers lose out by not gaining lower prices. Consumers pay and domestic producers gain. In economic terms, therefore, food security has a very high premium ie consumers pay for it through inflated domestic prices.

(b) The maintenance of rural income has been of primary concern to policy makers. With a decrease in farm income bought about by foreign competition the fabric of rural Korea would be threatened (see Table 3.6). This is despite the fact that not all farm income comes from farming.

(c) Other groups which have capitalised on the fostering of rural industries such as suppliers of inputs ie fertiliser and chemicals manufactures would not be keen on trade liberalisation. They would clearly lobby hard within government to protect their interests. However, these groups are keen to see free trade in fertiliser and chemicals.

(d) The politicians, themselves, have to decide. As Schmitz points out 'They ultimately attach the welfare to different interest groups.' (Schmitz, 1988). To complicate matters the different welfare weights can be quite subjective as Schmitz explains:

'Politicians can and have to obtain political support for protectionism from producers, consumers, and taxpayers. Through persuasive arguments, politicians can place small welfare weights on consumer and government revenue effects in favour of producers. In terms of the latter it has often been said that French politicians, for example, would give extra money to French farmers to avoid a farm-led street riot in Paris.'

This definitely applies in Seoul. In Korea the protectionist lobby enjoys strong political support giving domestic producers an advantage when decisions are made on trade matters. Its clear then if the losers, ie. the farm lobby in Korea, are not compensated adequately, they will hamper

efforts or even stop movement towards free trade. Table 3.6 shows how effective the lobby groups have been. Average farm incomes have been consistently higher than the average urban workers income.

3.8 GATT and Liberalisation of Agricultural Trade.

In recent years one of the most important moves towards liberalisation of agricultural trade has been the willingness of the 92 signatory countries to include agriculture in the current GATT round. Since the start of the GATT round this multilateral agreement has become an important forum for discussing and resolving agricultural trade disagreements.

GATT's operating aims are to reduce tariff and non-tariff barriers through the multilateral trade process. Dispute settlement, consultation and conciliation are also an integrated part of GATT's function. When countries protest about regulations which hinder trade imposed by other nations, the GATT has become an important forum through which countries can seek restitution.

The fact that bilateral arrangements have proved slow in settling disagreements has been a major reason why agriculture has been included in the GATT round. GATT's aim is to make trade subject to a uniformly applied tariff barrier and do away with non-tariff barriers all together. To illustrate the workings of the GATT process, an outline of the case brought against Korea by New Zealand, Australia and the United States on beef import restrictions is analysed in the next section.

3.8.1 Korean Beef GATT Case.

The Koreans progress towards developing a major industrial trading nation has been an outstanding success. As the tenth largest trading nation it has penetrated world markets with low-cost industrial and consumer goods. This success, particularly in the United States market has led for calls to liberalise its domestic agricultural industry. In terms of its position in the GATT, the Koreans are verging on developed country status. (Full membership of the the OECD is expected in 1992). Therefore, its success

as a trading nation has created strong pressure on Korea in the GATT to liberalise. Most of this not inconsiderable pressure has come from the United States.

TABLE 3.6

KOREAN NATIONAL AVERAGE OF FARM INCOME AND URBAN WORKER'S FAMILY INCOME, 1970 - 1986

Year	Annual Income Per Farm Household	Annual Income Per Urban Worker's Family
	(1000 Won)	(1000 Won)
1970	256	292
1971	356	347
1972	429	396
1973	481	427
1974	674	521
1975	873	786
1976	1156	1959
1977	1433	1271
1978	1884	1734
1979	2227	2337
1980	2693	2809
1981	3218	3371
1982	4465	3805
1983	5128	4363
1984	5549	4828
1985	5736	5172
1986	5995	5772

Source: Park J.H. Socioeconomic Problems of Small-Size Farm Structure in the Process of Economic Development in Korea. Cooperative Review, Vol 11, Feb 1989.

Table 3.6 shows higher farm incomes relative to urban workers. Information recently received from the Korean MAFF suggest that farm household incomes are between 85 and 90 percent of urban incomes in 1991, reflecting the pressure to liberalise Korean agricultural markets.

To review events leading up to the GATT beef case the following sequence of events occurred:

1984 In November the Korean Government passed laws that suspended imports of beef for the domestic market.

1984 – 1987 New Zealand made repeated requests to the Korean government to re-open the beef market.

1988 In February GATT found that Korea could not justify restrictions on imports on the grounds of Balance of Payments problems and set up the Livestock Product Marketing Organisation to regulate beef imports. A surcharge to equalise price of domestic and imported beef was implemented, to be used to subsidise domestic beef production.
Korea partially opens beef market in time for the Olympic Games
Under Article XXIII of GATT's disputes settlement mechanism the United States, New Zealand and Australia initiated a formal complaint.

1989 In November the GATT Council adopted a report by its Disputes Committee which looked at complaints by Australia, the United States and New Zealand on restrictions maintained by Korea on beef imports. The report found that Korean policies were inconsistent with the GATT.

With this ruling GATT no longer sanctions the Korean argument that the reason for restrictions on beef access are problems with their balance of payments. With a Balance of Payments running at surpluses US$10 billion in 1987, US$14 billion in 1988 and forecast at US$4 billion in 1989 The GATT panel decided: 'authorities had shown their ability to deal with balance of payments problems' (GATT Focus, 1989).

Korea has accepted the recommendations of the panel, albeit with serious reservations. Bilateral talks are under way to discuss the liberalisation of the beef market with Australia, New Zealand and the United States. In July 1990 the Korean Government in talks with American negotiators agreed to the GATT panel recommendations to liberalise the beef trade fully by 1997. In the intervening period Korea will lift its ceiling quota from 58 000 tonnes to 66 000 tonnes within three years. Part of this quota is a Simultaneous Buying and Selling (SBS) agreement which is seven percent of this quota. The Australians in their negotiations have succeeded in inserting a 'non discriminatory clause' in the SBS agreement between grain and grass fed-beef. A Joint Study Team (JST) has also been set up to study the Korean beef industry. New Zealand, Australia, Canada and United States, in cooperation with the Koreans, are examining production of beef in Korea, the beef trade and sales and marketing of beef in Korea respectively. Despite these advances the JST findings are recommendations only and not binding on them. It seems likely that agricultural liberalisation will continue and new opportunities will arise for agricultural exporters, however, these opportunities will take time to be realised. This point is reinforced by the Korean governments attitude to liberalisation of the beef market ie. that they advocate the retention of beef quotas for another 10 - 15 years.

3.9 The Japanese Experience

Korean agricultural policy has followed the same protectionist path that Japanese policy makers decided upon in the late 1950's. By giving a very brief overview of Japanese agricultural policy direction some conclusions may be drawn for the Korean experience.

After recovering from the Second World War in the mid 1950's, Japanese farmers began to increase production, increasing food supplies, resulting in a downward pressure on prices and farmers incomes. Japanese policy makers responded by intervening in the market. The main objectives were to increase agricultural production and raise farm incomes. These policies achieved their objectives, however, support prices by the early 1970's were higher levels than most European countries (Johnson, 1987).

During the 1970's the grain crisis (1972-3) and the establishment of 200 mile fishing zones (1972-8) increased the desire of the Japanese to be self sufficient in primary products. Subsidy levels were maintained or increased.

Increasing international pressure has been brought to bear on Japanese policy makers to reduce the amounts of assistance to agriculture in the 1980's. The criticism has become harsher as the Japanese balance of payments surplus has increased. This sharp criticism has led to increased agricultural trade between Japan and agricultural exporting nations. The tariffication of the beef market with the progressive reduction in tariffs plus the duty free entry of fresh oranges, whipped cream and orange and mixed fruit juices are examples of this pressure.

The Japanese have responded in the domestic market by shifting the emphasis from production to productivity. Increasing productivity is being achieved through increasing the size of farms, reducing labour costs and expanding operations.

Rather than complete liberalisation the Japanese have opted for 'managed change'. Support prices have dropped since 1978, but this has to be kept in context, since the price of rice in Japan is five times the world price and New Zealand cheese has a border price of US$2 200 a tonne but retails for US$5 600 per tonne.[5]

In the Japanese dairy sector milk production continues to grow as does the demand for milk. However, if the liquid milk market was deregulated, trade gains would not be so clear cut because:

(1) It is unlikely that large amounts of liquid milk could be imported given present technology, therefore, only milk products would be affected. This is further confused because not much is known about the demand for milk.

---

5. Prices quoted from the New Zealand Dairy Board.

Elasticities are unknown, therefore, what would happen if we had a drop in milk prices is not able to be empirically tested (OECD Country Study of Japan, 1987).

(2) Under the present subsidy regime the cost of production is borne by the government and the consumers. Consumption levels are depressed and production levels are encouraged to the extent that international prices are below domestic Japanese prices. The structure of the LIPC (the sole importer) dictates that imports can only take place when the prices are above the stabilisation price which they set.

(3) A substantial amount of skim milk powder has been imported as feed for dairy cows over the past ten years. Natural cheese has been imported with no quota applied while other cheeses have import quotas applied. Added to this large amounts of grain are imported for dairy cattle. If deregulation occurred, a substantial decline in feed imports would follow upsetting major grain exporters such as the United States, Canada and Australia.

It is important to note that the Republic of Korea is under more pressure to liberalise than the Japanese were at the same stage of its growth. This is the case in both a bilateral and multilateral negotiations. Therefore, it difficult to forecast what pathway the Koreans will take given what we know of the Japanese experience particularly with regard to agricultural liberalisation. However, given the strong pressure on Korea to lift restrictions on beef imports it is logical to assume given the Japanese experience that concessions will be made on beef to appease American demands. What is also clear is that these concessions will only be given after long and protracted negotiations.

Given the complex array of subsidies that the Koreans and the Japanese maintain, the relaxation of barriers to trade will have an uncertain effect on agricultural trade. Given the theory, we know that world welfare will increase with a freer trading environment. Foreign governments will keep

pressing for liberalisation. The Australian, United States and New Zealand efforts to take Korea to the GATT disputes tribunal is one example of the pressure applied by foreign governments.

3.10 Summary

International trade theory and protectionism were briefly examined in this chapter. Arguments in favour of protectionism were reviewed. Methods of restricting trade through formal and informal barriers were explained and applied to Korea.

Measurement of tariff protection were presented in order to compare effective and nominal rates of protection. The effective rate measures the rate of protection afforded an activity while the nominal rate measures the rate that is afforded the product.

Formal and informal barriers were discussed in section 3.6.1 and 3.6.2.. Formal barriers were defined as actions which are directly related to the specific purpose of halting or limiting imports, while informal barriers include technical and health regulations as well as government procurement regulations and are indirectly involved in distorting trade.

Section 3.7 looked at the chances for liberalisation. The current GATT round and specifically the case against Korea on beef restrictions was reviewed. From the indications given in this section the liberalisation process is going to be long and difficult.

In the next chapter a simple two region model will be used to illustrate the impact of free trade in casein. A mathematical model will be presented and expanded to include five regions.

CHAPTER FOUR

Modelling Spatial Market Equilibrium Conditions[1]

4.1 Introduction

World trade in dairy products is restricted to five percent of world production. But only three percent of world production can be described as unrestricted trade accessible to countries such as New Zealand.[2] The New Zealand Dairy Board along with the European Community exporters are the main supplies and competitors in the export of dairy products.

The objective of this study is to examine world trade in casein between the major exporters (New Zealand and European Community) and importers (United States, Japan and South Korea), and to analyse the effects on trade from ad valorem tariffs imposed by Japan and South Korea. Given estimates of country demand and supply functions for casein, between country casein transport costs and ad valorem tariff levels imposed by importing countries, a method is required to determine spatial market equilibrium conditions (country prices, trade flows, country demand and supply quantities).

In order to illustrate the spatial market equilibrium model used in this study, a two region, one good model is developed. In the following chapter this model is expanded to analyse the five country market equilibrium conditions for trade in casein.

---

1. The author is grateful to Professor RJ Townsley for his assistance with this Chapter.

2. New Zealand Dairy Board, Background and Perpectives, Published by NZBD, February 1988.

4.2 Mathematical Programming Model of Spatial Market Equilibrium Conditions.[3]

The problem of finding spatial market equilibrium conditions can be formulated as a mathematical programming problem. The nature of the mathematical programming problem depends on the form of the demand and supply equations in the trading regions and the form of the transport cost functions. Where country demand and supply functions are linear and per unit costs of transportation are fixed, the spatial equilibrium model can be formulated as a Quadratic Programming problem. In this case, two alternative Quadratic Programming formulations are possible: a) maximising a social welfare function, as proposed by Samuelson (1952), (expressed indirectly as a function of consumer and producer surpluses in the trading countries or regions), or b) maximising a net revenue function (sum of country or region net revenues). In both cases, constraints are imposed to ensure spatial market equilibrium conditions are met.

The standard spatial equilibrium model (indirect or quasi welfare function) is outlined in detail in Takayama and Judge (1971) and the simplified net revenue model (net social monetary gain model) is given in Martin (1981).

To develop the general formulation of the net revenue model to be used in this study, consider the two country single commodity case where an ad valorem tariff is imposed on imports.

Country 1

Demand: $\quad y_1 = a_1 - b_1 P_1$

Supply: $\quad x_1 = c_1 + d_1 P_1$

where P_1 is the domestic price facing consumers and producers in country 1.

---

3. This work follows the work of Martin LJ (1981).

Country 2

Demand: $\dot{y}_2 = a_2 - b_2 P_2$

Supply: $x_2 = c_2 + d_2 P_2$

where P_2 is the domestic price facing consumers and producers in country 2.

The following definitions are necessary:

Denote t_{12} as the per unit transport costs of exports to country 2 from country 1; and t_{21} as the per unit transport costs of exports to country 1 from country 2.

Denote z_{12} as the quantity of commodity exported from country 1 to country 2 (quantity imported by country 2 from country 1).

z_{21} is the quantity of commodity exported from country 2 to country 1 (quantity imported by country 1 from country 2).

In the two country, single commodity case, if $z_{12} > 0$ then $z_{21} = 0$, and if $z_{21} > 0$ then $z_{12} = 0$.

Denote T_{12} as the per unit tariff imposed by country 2 on the imports from country 1. (Exports from country 1 to country 2.)

Similarly, denote T_{21} as the per unit tariff imposed by country 1 on the imports from country 2. (Exports from country 2 to country 1.)

Country Net Revenue

Country (or region) Net Revenue (CNR) is defined as: revenue from domestic consumption plus net revenue from exports minus cost of domestic supply minus cost of imports. Since the net revenue formulation maximises the sum of country net revenues, it can be noted here that all prices and transport costs must be expressed in a common unit of currency ($NZ in this study).

Revenue from tariffs on imports is assumed to accrue to the government sector and not the country trading (demand and supply) sectors. An ad valorem tariff is levied on the landed cost of imports. Thus, given P_1 as the commodity price in country 1 and t_{12} as the unit transport cost of exports from country 1 to country 2, the tariff levied on a unit of commodity imported into country 2 from country 1 is:

$$T_{12} (t_{12} + P_1)$$

and the total tariff levied on exports of z_{12} from country 1 to country 2 is:

$$T_{12} (t_{12} + P_1)z_{12}$$

This is a cost to exporters in country 1.

Gross revenue received by country 1 from exports of z_{12} to country 2 is $P_2 z_{12}$. Total transport cost is $t_{12}z_{12}$. Thus net revenue received by country 1 from exports of z_{12} units of commodity to country 2 is:

$$[P_2 - T_{12} (t_{12} + P_1) - t_{12}]z_{12}$$

Similarly, net revenue received by country 2 from exports of z_{21} units of commodity to country 1 is:

$$[P_1 - T_{21} (t_{21} + P_2) - t_{21}]z_{21}$$

49

The cost to country 2 of imports from country 1 is : $P_2 \ z_{12}$; and the cost to country 1 of imports from country 2 is : $P_1 \ z_{21}$.

Revenue from consumption of y_1 units of commodity in country 1 is: $P_1 y_1$. ($P_2 y_2$ for country 2.)

The cost of procuring x_1 units of commodity in country 1 is : $P_1 x_1$. ($P_2 x_2$ for country 2)

Thus the net revenue for each country is:

$$CNR_1 = P_1 y_1 + [P_2 - T_{12} \ (t_{12} + P_1) - t_{12}]z_{12} - P_1 x_1 - P_1 z_{21}$$

$$CNR_2 = P_2 y_2 + [P_1 - T_{21} \ (t_{21} + P_2) - t_{21}]z_{21} - P_2 x_2 - P_2 z_{12}$$

the function to be maximised in the net revenue model is :

$$Q = CNR_1 + CNR_2$$

4.2.1 Spatial Market Equilibrium Conditions; Country Supply and Demand

For any individual country, domestic supply plus imports can not be less than domestic consumption plus exports. Thus for the two country model we have :

Country 1: $(x_1 + z_{21}) \geq (y_1 + z_{12})$

Country 2: $(x_2 + z_{12}) \geq (y_2 + z_{21})$

4.2.2 Equilibrium Price Conditions.

At spatial market equilibrium, there is no price incentive for exporters in country 1 to change the level of exports to country 2 (and no price incentive for exporters in country 2 to change the level of exports to

country 1). Thus the price received for sales to domestic consumers in country 1 must be greater than or equal to the net price exporters in country 1 would gain by exporting to country 2:

$$P_1 = P_2 - T_{12} (t_{12} + P_1) - t_{12} \quad \text{if } z_{12} > 0 \text{ at equilibrium}$$
$$P_1 > P_2 - T_{12} (t_{12} + P_1) - t_{12} \quad \text{if } z_{12} > 0 \text{ at equilibrium}$$

where the right hand side is the net unit price received by exporters in country 1 from exports to country 2. (Unit commodity price in country 2 less ad valorem tariff less unit transport cost.)

The equilibrium price conditions above can be rearranged as:

$$P_1 - P_2 (1 + T_{12})^{-1} \geq -t_{12}$$

The corresponding equilibrium price conditions for country 2 is :

$$P_2 - P_1 (1 + T_{21})^{-1} \geq -t_{21}$$

4.2.3 Mathematical Programming Formulation of the Spatial Market Equilibrium Problem.

Maximise: $Q = CNR_1 + CNR_2$

subject to: $(x_1 + z_{21}) - (y_1 + z_{12}) \geq 0$

$(x_2 + z_{12}) - (y_2 + z_{21}) \geq 0$

$P_1 - P_2 (1 + T_{12})^{-1} \geq -t_{12}$

$P_2 - P_1 (1 + T_{21})^{-1} \geq -t_{21}$

$(P_j, y_j, x_j, z_{ji}, z_{ij}) \geq 0 \text{ all } i,j$

The form of the country net revenue functions, together with the spatial market equilibrium conditions (constraints), ensures that the mathematical programming model drives Q to zero at the spatial market equilibrium solution. {Martin (1981), MacAulay, Batherham and Fisher (1989)}. Furthermore, at the market equilibrium solution CNR equals zero for each country, since if this were not the case arbitrageurs would be in a position to trade profitably in the commodity (export from the country where CNR < 0, to the country where CNR ≥ 0).

4.2.4 Quadratic Programming Formulation of the Spatial Market Equilibrium Problem (Price Domain)

Since, in this example, commodity supply and demand quantities have been expressed as a function of domestic commodity prices, the mathematical programming problem can be reformulated as a Quadratic Programming problem and solved in terms of the (P_j, z_{ij}) values, (Price Domain). Given equilibrium domestic prices, country commodity supply and domestic consumption (demand) quantities can be computed from the original demand and supply equations. However, this formulation requires the addition of constraints to ensure $(y_j, x_j) \geq 0$, though of course these constraints can be expressed in terms of corresponding country prices via the demand and supply equations.

Substituting for y_1 and x_1 from country 1 demand and supply equations gives:

$$CNR_1 = P_1(a_1 - b_1 P_1) + P_2 z_{12} - t_{12}(1 + T_{12}) z_{12}$$

$$- T_{12} P_1 z_{12} - P_1(c_1 + d_1 P_1) - P_1 z_{21}$$

$$= (a_1 - c_1) P_1 - (b_1 - d_1) P_1^2 + P_2 z_{12}$$

$$- t_{12}(1 + T_{12}) z_{12} - T_{12} P_1 z_{12} - P_1 z_{21}$$

Similarly,

$$CNR_2 = (a_2 - c_2)P_2 - (b_2 - d_2)P_2^2 + P_1 z_{21}$$

$$- t_{21}(1 + T_{21})z_{21} - T_{21}P_2z_{21} - P_2z_{12}$$

$Q = CNR_1 + CNR_2$ is a quadratic function of $(P_1, P_2, z_{12}, z_{21})$.

Written in matrix form we have:

$$Q = [(a_1 - c_1), (a_2 - c_2), -t_{12}(1 + T_{12}), -t_{21}(1 + T_{21})] \begin{bmatrix} P_1 \\ P_2 \\ z_{12} \\ z_{21} \end{bmatrix}$$

$$+ [P_1, P_2, z_{12}, z_{21}] \begin{bmatrix} -(b_1 - d_1) & 0 & -(2)^{-1}T_{12} & 0 \\ 0 & -(b_2 - d_2) & 0 & -(2)^{-1}T_{21} \\ -(2)^{-1}T_{12} & 0 & 0 & 0 \\ 0 & -(2)^{-1}T_{21} & 0 & 0 \end{bmatrix} \begin{bmatrix} P_1 \\ P_2 \\ z_{12} \\ z_{21} \end{bmatrix}$$

The country (or region) supply and demand spatial market equilibrium conditions become:

Country 1: $c_1 + d_1P_1 + z_{21} - a_1 + b_1P_1 - z_{12} \geq 0$

therefore, $(d_1 + b_1)P_1 + z_{21} - z_{12} \geq (a_1 - c_1)$

Country 2: $(d_2 + b_2)P_2 + z_{12} - z_{21} \geq (a_2 - c_2)$

The $(y_j, x_j) \geq 0$ conditions are:

$$-b_1P_1 \geq -a_1$$

$$-b_2P_2 \geq -a_2$$

53

$$d_1 P_1 \geq -c_1$$

$$d_2 P_2 \geq -c_2$$

In matrix notation the constraint set may be written as:

$$
\begin{bmatrix}
(d_1 + b_1) & 0 & -1 & 1 \\
0 & (d_2 + b_2) & 1 & -1 \\
b_1 & 0 & 0 & 0 \\
d_1 & 0 & 0 & 0 \\
0 & -b_2 & 0 & 0 \\
0 & d_2 & 0 & 0 \\
1 & -(1 + T_{12})^{-1} & 0 & 0 \\
-(1 + T_{21})^{-1} & 1 & 0 & 0
\end{bmatrix}
\begin{bmatrix}
P_1 \\
P_2 \\
z_{12} \\
z_{21}
\end{bmatrix}
\geq
\begin{bmatrix}
(a_1 - c_1) \\
(a_2 - c_2) \\
-a_1 \\
-c_1 \\
-a_2 \\
-c_2 \\
-t_{12} \\
-t_{21}
\end{bmatrix}
$$

and $(P_1, P_2, z_{12}, z_{21}) \geq 0$

The first two constraints are the country market supply and demand conditions required for a feasible solution. The next four constraints ensure non-negative solution values for (y_j, x_j). The last two constraints are the market equilibrium price conditions.

Note this formulation assumes $P_j = P^j$, ie. demand prices = supply prices in the jth country. Since we don't observe zero supply/demand prices in the real world, and on the assumption that the estimated demand and supply equations are realistic, this assumption should not give rise to difficulties. If, however, a solution containing $P_j = 0$ was obtained, the problem would need to be reformulated allowing $P^j \geq P_j \geq 0$, ie. the conditions of excess supply.

As noted by MacAulay et al (1989), the price form of the net revenue model can be substantially reduced in size if the assumption is made that the possibility of irregular cases occurring, as illustrated by Takayama and Judge (1971), is excluded.

4.3 Worked Example

This section presents a graphical exposition of the two country, single commodity market equilibrium conditions.

Country 1

Demand: $y_1 = 200 - 10P_1$

Supply: $x_1 = 50 + 5P_1$

Country 2

Demand: $y_2 = 187.5 - 7.5P_2$

Supply: $x_2 = -150 + 15P_2$

4.3.1 Market Equilibrium 'Without' Trade

The 'without trade' market equilibrium conditions in each country are presented in Figure 4.1.

Equilibrium market prices (where supply equals demand) and quantities for each country are:

Country 1

$$P_1^* = 10 \qquad y_1^* = x_1^* = 100$$

Country 2

$$P_2^* = 15 \qquad y_2^* = x_2^* = 75$$

Consumer plus producer surplus in country 1 is proportional to the area: triangle abd; and triangle a'b'd' in country 2.

Figure 4.1 Market Equilibrium - No Trade and Trade Scenario 3

Country 1

P_1

20   a

S1

P_1^* 10

c   b

D1

d

0   100   200   Q1

$y_1^* = x_1^*$

Country 2

P_2

a'

20

S2

P_2^* 15   c'   b'

d'

10

D2

0   75   200   Q2

$y_2^* = x_2^*$

56
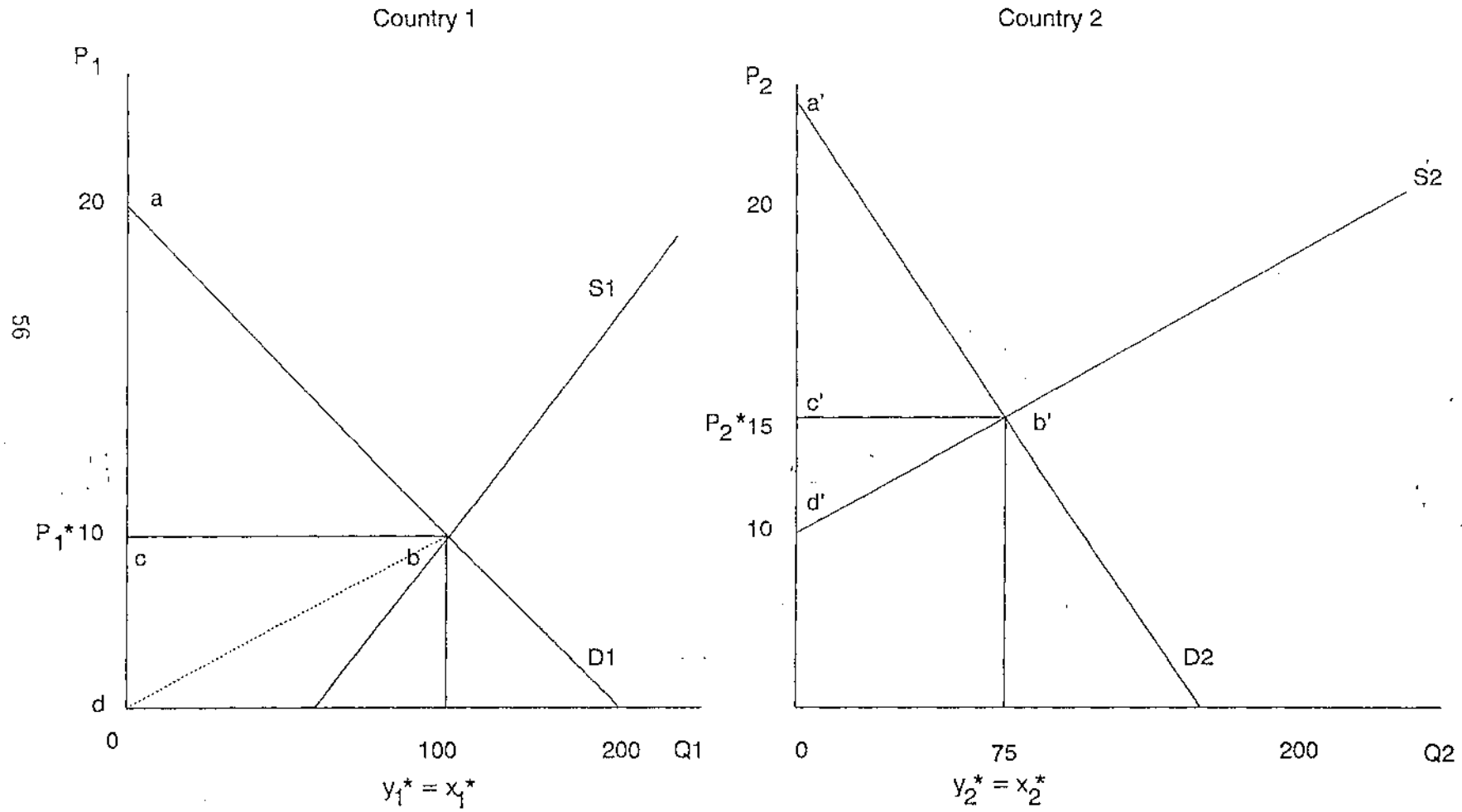
Clearly,

$$CNR_1 = P_1^* y_1^* - P_1^* x_1^* = 0$$

and

$$CNR_2 = P_2^* y_2^* - P_2^* x_2^* = 0$$

From Figure 4.1 it is clear that suppliers in country 1 have a price incentive to export product to country 2, and consumers in country 2 have a price incentive to import product from country 1.

Note that for country 1, any value for $P_1 < 10$ results in an infeasible market condition of excess demand. Similarly, for country 2, any value for $P_2 < 15$ results in an infeasible market condition $(y_2 > x_2)$.

4.3.2 Market Equilibrium With Trade - Scenario 1

In the first trade scenario it is assumed that unit commodity transport cost is zero and no ad valorem tariff is levied on imports. The with trade market equilibrium conditions can be found by deriving the excess supply (country 1) and excess demand (country 2) functions.

<u>Country 1</u>

Excess Supply: $x_1 - y_1 = -250 + 15P_1$

<u>Country 2</u>

Excess Demand: $y_2 - x_2 = 337.5 - 22.5P_2$

At market equilibrium equilibrium, exports from country 1 to country 2 (z_{12}) equal imports to country 2 from country 1:

$$z_{12} = x_1 - y_1 = y_2 - x_2$$

In this example, exports from country 2 to country 1 equal zero $(z_{21} = 0)$. In the trade with zero transport cost and no ad valorem tariff on imports

scenario, equating excess supply and excess demand gives:

$$P_1^* = P_2^* = P^* = 13$$

and,

$$z_{12} = 45$$

This market equilibrium is illustrated in Figure 4.2.

In this situation we have:

$$y_1^* = 70 \qquad x_1^* = 115$$

$$y_2^* = 90 \qquad x_2^* = 45$$

$$CNR_1 = P^*y_1^* + P^*z_{12} - P^*x_1^* = 0$$

$$CNR_2 = P^*y_2^* - P^*z_{12} - P^*x_2^* = 0$$

In Figure 4.2 the gain from trade in terms of a country's social welfare (consumer plus producer surplus) is triangle abc for country 1; and triangle a'b'c' for country 2. From Figure 4.2 it is clear that for country 1, trade resulted in a reduction in consumer surplus but a greater increase in producer surplus; while for country 2 there has been a reduction in producer surplus but a greater increase in consumer surplus. For both countries there has been an increase in net social welfare resulting from trade, though without redistribution, consumers in country 1 and producers in country 2 are relatively worse off compared to the no trade market equilibrium.

Consider now a feasible non-equilibrium solution: P = 14

Country 1

$$y_1 = 60 \qquad x_1 = 120$$

Excess supply: $x_1 - y_1 = 60$

Figure 4.2 Market Equilibrium - Trade Scenario 1
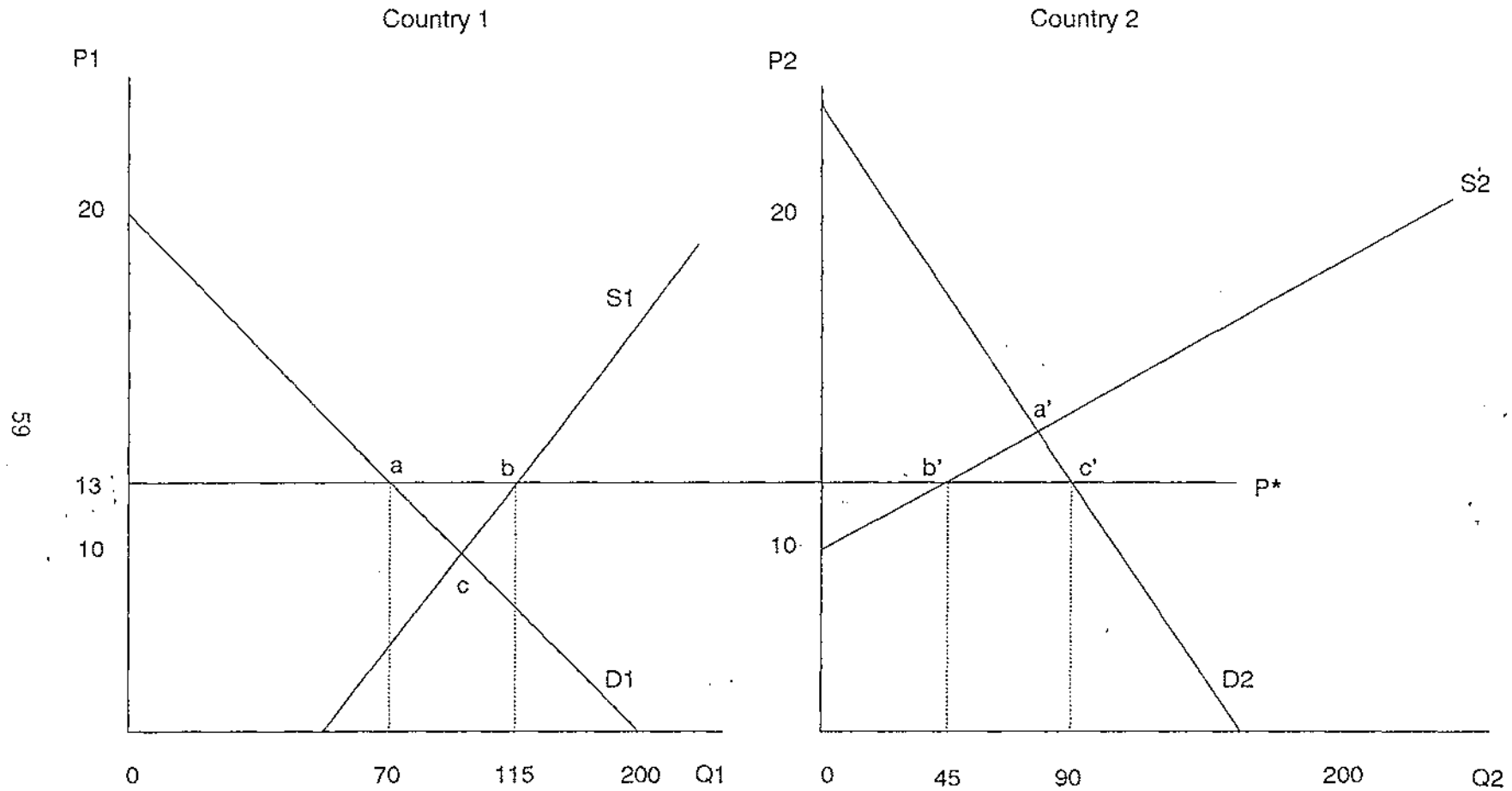
Country 2

$$y_2 = 82.5 \quad x_2 = 60$$

Excess demand: $y_2 - x_2 = 22.5$

Assume country 2 imports 22.5 units of the product to just satisfy excess demand, ie $z_{12} = 22.5$. Then:

$$CNR_1 = Py_1 + Pz_{12} - Px_1 = -525 < 0$$

$$CNR_2 = Py_2 - Pz_{12} - Px_2 = 0$$

In this situation, exporters in country 1 are holding stocks $(x_1 - y_1 - z_{12})$ of 37.5 units of product for which they are receiving zero revenue, while facing a market price $P = 14$. The market is not in equilibrium, as indicated by $CNR_1 < 0$. As stated in section 4.2, market equilibrium is characterised by feasible supply and demand conditions and $CNR = 0$ for each country; or equivalently, feasible supply and demand conditions and maximum social welfare.

Since this study focuses on changes in producer revenue in an exporting country (New Zealand) resulting from trade, it is worthwhile to compute the increased revenue to producers in country 1 for this example.

Country 1 (exporter)

Without trade: $P_1^* = 10$, $x_1^* = 100$. $P_1^* x_1^* = 1000$
With trade: $P_1^* = 13$, $x_1^* = 115$. $P_1^* x_1^* = 1495$

Increase in producer revenue from trade is $1495 - 1000 = 495$
As might be expected, the zero transport cost, zero ad valorem tariff on imports scenario gives the maximum increase in revenue to producers in the exporting country, (trade versus no trade case).

4.3.3 Market Equilibrium With Trade - Scenario 2

In the second trade scenario it is assumed that unit commodity transport costs of exports from country 1 to country 2 (t_{12}) equals 1.25. In this case the equilibrium unit price received by exporters in country 1 is:

$$P_1 = P_2 - t_{12} = P_2 - 1.25$$

Equating excess supply (exports) in country 1 with excess demand (imports) in country 2 gives:

$$P_2^* = 13.5$$

$$P_1^* = 12.25$$

and

$$x_1^* = 111.25 \qquad y_1^* = 77.5$$

$$x_2^* = 52.5 \qquad y_2^* = 86.25$$

$$z_{12} = 33.75$$

This market equilibrium solution is illustrated in Figure 4.3.

At this market equilibrium solution, $CNR_1 = CNR_2 = 0$.

If $P_1 < P_2 - t_{12}$, then there is a price incentive for country 1 to export to country 2, since it is profitable for supplies of the commodity to be diverted from the domestic market (receiving P_1) to the importing market (receiving $P_2 - t_{12}$). Thus, the equilibrium price condition for the two market, single commodity scenario (where we can see from Figure 4.1 that country 1 is the exporter and country 2 is the importer) is: $P_1 = P_2 - t_{12}$.

In the two country, single commodity case where it is unknown which country is the exporter or importer, the equilibrium (no incentive for further trade) condition is:

$$P_1 \geq P_2 - t_{12}$$

Figure 4.3 Market Equilibrium - Trade Scenario 2
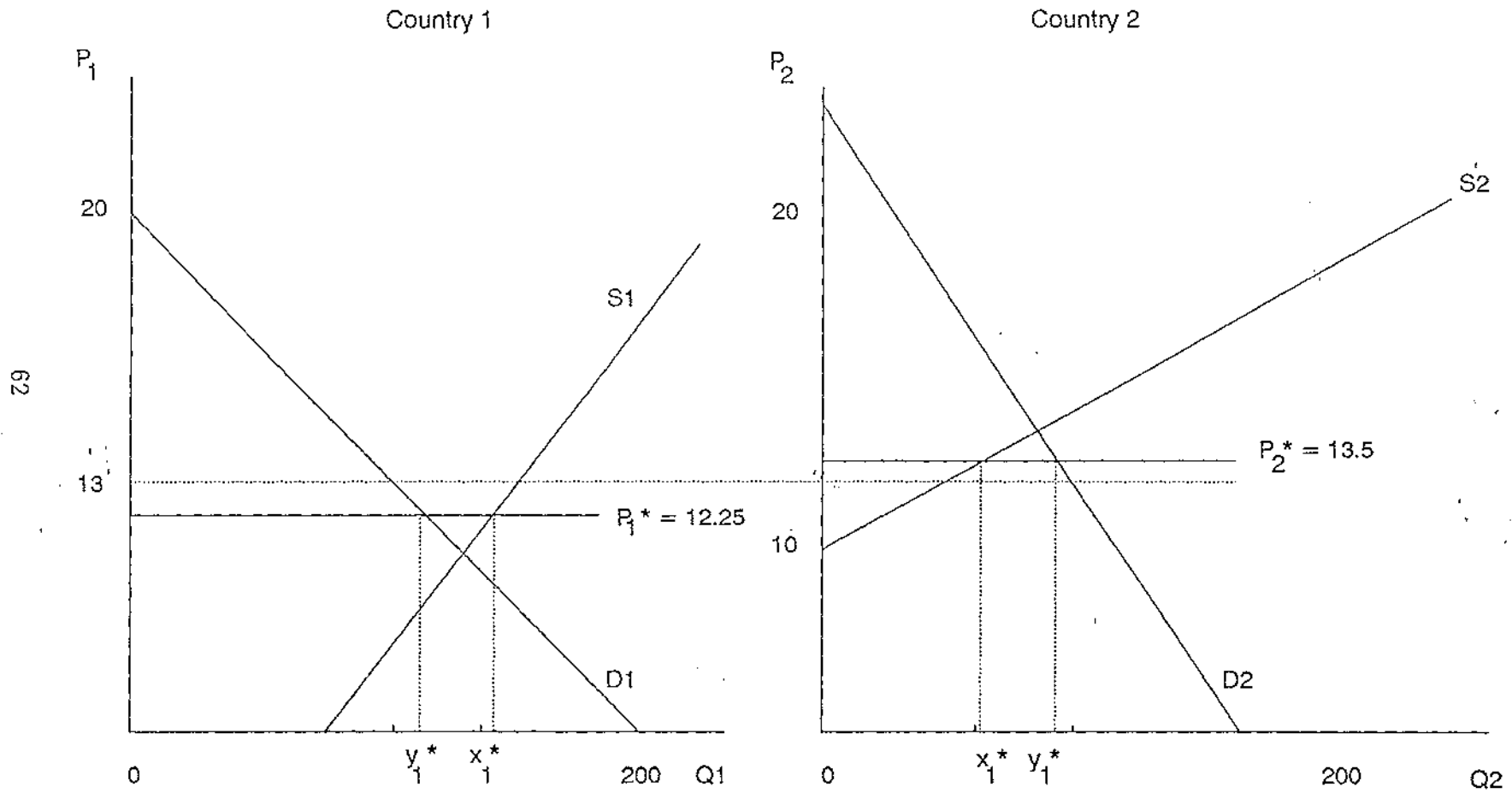
$$P_2 \geq P_1 - t_{21}$$

where t_{21} is the unit commodity cost of exporting from country 2 to country 1.

It is clear from Figure 4.3 that a unit commodity transport cost (of 1.25) has resulted in reduced returns to producers in country 1, relative to scenario 1. Figure 4.3 also shows that a unit commodity transport cost (of 1.25) has reduced consumer plus producer surplus in both countries relative to scenario 1.

4.3.4 Market Equilibrium With Trade – Scenario 3

In the third trade scenario it is assumed that in addition to $t_{12} = 1.25$, an ad valorem tariff on imports is imposed by country 2: $T_{12} = 1/3$. This tariff is imposed on the landed cost $(P_1 + t_{12})$ of imports from country 1. In this scenario the unit commodity price received by exporters in country 1 is:

$$P_2 - T_{12}(P_1 + t_{12}) - t_{12}$$

and at market equilibrium this price equates to the domestic price in country 1:

$$P_1 = P_2 - 1/3(P_1 + 1.25) - 1.25$$

Equating excess supply (exports) in country 1 with excess demand (imports) in country 2 gives:

$$P_1{}^* = 10 \qquad P_2{}^* = 15$$

$$x_1{}^* = y_1{}^* = 100$$

$$x_2{}^* = y_2{}^* = 75$$

$$z_{12} = 0 \text{ (ie no trade)}$$

This market equilibrium solution is illustrated in Figure 4.1. In comparison with Figure 4.3, it can be seen (as expected) that imposition of an ad valorem tariff on imports by country 2 has resulted in a further reduction of returns to producers in country 1, and a further reduction in consumer plus producer surpluses in both countries.

Imposition of an ad valorem tariff on imports by country 2 in the range:

$$0 < T_{12} < 1/3$$

will give an intermediate solution between that illustrated in Figure 4.3 and that illustrated in 4.1.

4.4 Summary

A simple two country single commodity spatial equilibrium model has been presented with a worked example. This model can easily be expanded to the multi-region (or country) case. In the following chapter this model is expanded to analyse spatial market market equilibrium conditions for a five - region, single commodity (casein) case.

CHAPTER FIVE

Specification of the Casein Model

5.1 Introduction

The object of this chapter is to model the major players in the world casein market in order to determine:

(1) the extent to which New Zealand would gain from a drop in tariffs on casein in the domestic Korean market; and

(2) the effect of European production on the prices and trade flows of casein.

For this purpose a one commodity, five country model is created focusing on production and consumption in these five major regions. The regions are New Zealand and the European Community[1] (the major exporters of casein), the United States, Japan and Korea (the major customers). There are other players in the casein market but consistent time series data on these countries are almost impossible to obtain and their export quantities are small. They include Poland, USSR, and Argentina.

The relationship between consumption and production is initiated by the demand for the final product in each region. Casein has a variety of commercial process uses. It is dried and used in edible foods as diverse as meat products, coffee whiteners, bakery products; its industrial uses include technical applications such as adhesives, artificial silk and plastics as well as animal feeds. The demand for casein is, therefore, complex to model.

---

1. EC is treated as one region because the countries in the Community are covered by the same subsidy regime.

To establish a demand function in each region, the data on the major use of casein in that region was used. This simplifies the problem and abstracts from the potential minefield of estimating four or five different demand equations (for different casein product uses) in each region. In most regions the substitutes for casein are other milk based products such as cheese[2] and skimmed milk powder.

The quadratic programming matrix reviewed in the last chapter is applied to a five country one commodity model, to analyse the world casein market. Demand and supply equations for casein are estimated, tariffs and transport costs are calculated and used in a quadratic programming matrix to produce market equilibrium prices and trade flows.

5.2 World Casein Trade

The world casein market is dominated by the European Community. Compared with the European Community, New Zealand is a very small producers of milk.[3] New Zealand's small domestic market, however, allows large quantities of dairy products to be exported. Coupled with this, New Zealand's competitive production costs enable the New Zealand Dairy Board to compete favorably with the European Community.

To make their farmers price competitive the European Community have developed a raft of subsidies to protect its producers. This has lead to an oversupply of milk in the European Community and depressed world dairy prices. To restrain milk production, Community planners introduced a milk quota system in 1984. The effect of the quota system has been to reduce the amount of milk produced. For example milk production has fallen from 103 678 thousand tonnes in 1984/85 to 94 509 thousand tonnes in 1989/90.

---

2. Casein is used in pizzas as a cheese substitute.

3. The EC producers 26 percent of world-milk production while New Zealand produces 1.7 percent.

The world price, because of its dominating influence in the market, is determined by the level of European Community assistance to its farmers. The reduction of European Community production subsidies has had a significant bearing on the recent dramatic rise and fall of world dairy prices. For casein the scenario is no different, with European Community production outstripping all other regions. International prices are set by the policy makers in the European Community. This is reflected by the fact that as quotas are curbed in the European Community, production has dropped pushing up world casein prices by $2\frac{1}{2}$ times over the past two years.

5.3 Demand for Casein

The simple linear demand equations for casein take the form of:

$$D_{jt} = A_j + B_{cj} P_{cjt} + \sum_i B_{ij} P_{ijt} + B_{Yj} Y_{jt}$$

and were estimated for the United States, the Republic of Korea, Japan and the European Community, where:

D_{jt} = demand for casein in the jth country in year t;

P_{cjt} = price of casein in the jth country in year t;

P_{ijt} = price of ith casein substitute in the jth country in year t;

Y_{jt} = per capita income in the jth country in year t.

The quadratic programming model used to find a competitive market equilibrium solution in this study, (for a particular year t = 1987), uses casein demand equations expressed as a linear function of the casein price:

$$D_{it} = \overline{A}_{jt} + B_{cj} P_{cjt}$$

The coefficient $\overline{A}_{jt}$ in the 'collapsed' demand equation is obtained simply by setting the independent variables, other than casein price, to their 1987 values, multiplying these by their estimated coefficient values, summing, and adding (or subtracting) the resultant value to (from) the estimated demand equation intercept coefficient.

The quadratic programming model also requires prices to be denominated in a single unit of currency (New Zealand dollars in this study). If for example j = United States, then P_{cjt} is \$US per tonne of casein. If the NZ/US \$ exchange rate is \$NZ1.66 = \$US1, then the equivalent \$NZ casein price is P_{cNt} = 1.66 P_{cjt}. The collapsed demand equations then becomes:

$$D_{jt} = \overline{A}_{jt} + B_{cj} \, P_{cjt}$$

$$= \overline{A}_{jt} + (B_{cj} \, / \, 1.66) \, (1.66 \, P_{cjt})$$

$$= \overline{A}_{jt} + \overline{B}_{cj} \, P^{N}_{cjt}$$

where: EC, j = 1; USA, j = 2; Korea, j = 3; Japan, j = 4; NZ, j = 5. P^{N}_{cjt} is the United States casein price denominated in New Zealand dollars.

5.3.1 Demand for Casein in New Zealand

Over 99 percent of casein production in New Zealand is exported to world markets, therefore, modelling domestic demand is unnecessary. A base year of 1987 is used as a representative year. The quantity exported to the three major casein markets from New Zealand was 40 836 tonnes. The other 21 164 tonnes was exported to at least twenty other countries. Since we are interested in the major players in the casein market and the other countries buy casein irregularly they are not included in the casein model.

5.3.2 Demand for Casein in the United States

The major use of casein in the United States market is as a cheese substitute in pizzas. The structure of the subsidy regime in the United States makes it unprofitable to produce casein domestically. The major suppliers are the European Community and New Zealand. Table 5.1 shows consumption of casein in the United States market with New Zealand's share of the market shown in percentage terms.

The casein demand equation for the United States ($j = 2$) includes the wholesale price of cheese since casein is used as a cheese substitute. The t ratio is given underneath each variable in brackets. The estimated demand equation for casein is presented below.

$$D_2 = 30051 - 26.42\ P^N_{c2} - 22.72\ P_{S2} + 16.62\ P_{C2} + 7.002\ Y_2$$
$$\quad\quad (2.53)\quad (-2.11)\quad\quad (-0.94)\quad\quad (0.64)\quad\quad (4.85)$$

$$(5.1)$$

$R^2 = 87.7\%$, Durbin-Watson Statistic $= 2.27$, $n = 17$.

where:

D_2 = United States Consumption (imports) of casein (tonnes);

P_{c2} = Wholesale price (US$) of Casein per tonne;

P_{S2} = Wholesale price (US$) of Skimmed Milk Powder per tonne;

P_{C2} = Wholesale price (US$) of Cheese per tonne;

Y_2 = US per capita income in the United States.

To obtain the collapsed demand equation, the independent variables other than P_{c2} were set at their 1987 values:

P_{S2} = US$ 1742.92

P_{C2} = US$ 2715.00

Y_2 = US$ 17826.00

To obtain the collapsed demand equation expressed as a function of the New Zealand dollar price of casein in the United States, the coefficient for P_{c2} is divided by the \$NZ/\$US exchange rate (1.66), giving a New Zealand dollar rate ie 26.42/1.66 = 15.916.

The United States collapsed demand equation for casein becomes:

$$D_2 = 160\ 392.80 - 15.916\ P^N_{c2}$$

for 1987.

TABLE 5.1

CONSUMPTION OF CASEIN IN THE UNITED STATES 1971 - 1987

YEAR	CONSUMPTION	NZ SHARE
	000'S tonnes	%
1971	43.9	39
1972	44.1	30
1973	51.2	28
1974	51.2	30
1975	26.5	25
1976	50.9	50
1977	65.4	58
1978	62.2	74
1979	68.4	61
1980	69.0	50
1981	50.8	51
1982	80.2	48
1983	72.4	43
1984	87.0	49
1985	103.0	50
1986	103.0	50
1987	95.0	31

Source : New Zealand Dairy Board.

In 1987 United States imported casein from countries other than New Zealand and the European Community amounting to 10 270 tonnes. On the assumption that these imports are not sensitive to United States casein prices[4], the United States demand for imports for the European Community and New Zealand is given as:

$$D_2 = (160392.8 - 10270) - 15.916 \; P^N_{c2}$$

$$= 150122.8 - 15.916 \; P^N_{c2}$$

The R^2 of 87.7% is acceptable. The t statistic values for the intercept and US per capita income are significant at the 5 percent level, while the Casein price coefficient is significant at the 6 percent level. The Skim Milk powder and the cheese price coefficient are not significant at the 20 percent level, and this may explain the unexpected negative sign on the Skim Milk powder price coefficient (and the positive sign for cheese). Another possible reason for obtaining a negative coefficient for Skim Milk powder price (and the positive cheese coefficient) in the estimated casein demand equation is the United States dairy price subsidy regime which may distort market prices. The Durbin-Watson statistic is well within its acceptable range.

5.3.3 Demand for Casein in the Republic of Korea

The casein market in Korea is dominated by the consumption of coffee whiteners. As the Korean economy becomes stronger, Korean consumers have increased consumption of western goods, hence the increased demand for coffee whiteners and casein. Table 5.2 shows the consumption of casein in Korea.

Although the demand for casein is smaller in Korea than in the United States, European Community and Japan, it is New Zealand's most important dairy product exported to the Republic of Korea. Casein and

---

4. So that imports do not de(in)crease dramatically as prices de(in)crease.

sodium caseinate, used in industrial applications and in coffee whiteners are the chief money earners. Casein exports to Korea earned New Zealand NZ\$9.6 million compared with NZ\$1.9 million for all other dairy products. The major outlet for New Zealand dairy products is the hotel trade which is worth some NZ\$8.3 million.

The estimated casein demand equation for Korea is as follows:

$$D_3 = -990 - 0.3054\ P^N_{c3} + 0.0002928\ P_{C3} + 0.0000246\ P_{W3} + 0.0027003\ Y_3$$
$$(-0.45)\quad (-1.25)\qquad (1.28)\qquad\qquad (0.19)\qquad\qquad (9.99)$$
$$(5.2)$$

$R^2 = 96.9\%$, Durbin-Watson Statistic $= 1.27$, $n = 17$.

where:

D_3 = Korean Consumption (imports) of casein (tonnes);

P_{c3} = Wholesale price (US\$) of Casein per tonne;

P_{C3} = Wholesale price (won) of Cheese per tonne;

P_{W3} = Wholesale price (won) of Wholemilk Powder per tonne;

Y_3 = Korean per capita income.(won)

Although the signs of the coefficient in equation 5.2 are as expected, the estimated coefficients other than for per capita income are not significant at the 10 percent level, (t-statistic values are given in brackets in equation 5.2). A possible reason for non-significance of the price coefficients is the price fixing arrangements entered into by the Korean government. As documented in earlier chapters, the Korean dairy industry is highly protected,this distorts market pricing and therefore consumption. The R^2 value (96.9%) indicates that the estimated equation explains a very satisfactory proportion of the yearly variation in Korean casein consumption. However, the Durbin-Watson statistic is low, indicating the possible presence of positive error autocorrelation.

To obtain the collapsed demand equation, the independent variables other than P_{c3} were set at their 1987 values:

P_{C3} = won 3 517 965

P_{W3} = won 6 070 000

Y_3 = won 2 323 574

Remembering that we divide the P_{c3} coefficient by 1.66 to get a New Zealand dollar equivalent, the collapsed demand equation expressed as a function of the New Zealand dollar price of casein in the Republic of Korea is:

$$D_3 = 6463.73 - 0.184 \ P^N_{c3}$$

TABLE 5.2

KOERAN CONSUMPTION OF CASEIN 1971 - 1987

YEAR	CONSUMPTION	YEAR	CONSUMPTION
	(Tonnes)		
1971	247	1980	2414
1972	304	1981	1322
1973	562	1982	2469
1974	489	1983	3270
1975	470	1984	3976
1976	1011	1985	4146
1977	1908	1986	5373
1978	2330	1987	5508
1979	3499		

Source : Dairy Statistics 1988, Livestock Bureau, Ministry of Agriculture and Forestry and Fisheries, The Republic of Korea.

5.3.4 Demand for Casein in Japan.

Japan is important market for world casein producers. Japan is the third biggest market for casein behind the United States and the European Community. As with the Korean market, the major application for casein is coffee whiteners. Combined with infant milk powder, casein makes up 80 percent of New Zealand's dairy trade with Japan. Table 5.3 shows casein consumption in the Japanese market. New Zealand's share of the market is shown in percentage terms.

The estimated demand equation for the Japanese casein market is as follows:

$$D_4 = 20200 - 1.10015\ P^N_{c4} + 0.0045664\ P_{S4} - 0.000781P_{W4} + 0.134Y_4$$

$$(9.33) \quad (-2.71) \quad\quad (0.55) \quad\quad\quad\quad (-0.37) \quad\quad (1.18)$$

$$(5.3)$$

$R^2 = 61.8\%$, Durbin-Watson Statistic $= 2.01$

$D_4 =$ Japanese Consumption (imports) of casein (tonnes)

$P^N_{c4} =$ Wholesale price (NZ$) of casein in Japan.

$P_{S4} =$ Wholesale price (yen) of skimmed milk powder in Japan.

$P_{W4} =$ Wholesale price (yen) of wholemilk powder.

$Y_4 =$ per capita income (US$)

To obtain the collapsed demand equation, the independent variables other than PCA4 were set at their 1987 values:

$$P_{S4} = \text{Yen } 572000$$
$$P_{W4} = \text{Yen } 1100000$$
$$Y_4 = \$US\ 19465$$

The collapsed demand equation expressed as a function of the New

74

Zealand dollar price of casein in the Japan is:

$$D_4 = 24558.63 - 1.1 \; P^N_{c4}$$

The t statistic values (given in brackets underneath the equation) are low for skimmilk powder and the wholemilk powder coefficients. The signs are as expected except for wholemilk powder which has a negative sign. Given that Japanese milk production is heavily subsidised and imports are subject to restrictions the negative sign for wholemilk is not unexpected. The R^2 of 61.8% is acceptable while the Durbin-Watson Statistic shows no evidence of autocorrelation.

TABLE 5.3

JAPANESE CASEIN CONSUMPTION 1971-1987

YEAR	CONSUMPTION	NZ SHARE OF MARKET
	(000'S Tonnes)	(%)
1971	24.6	56
1972	20.8	57
1973	21.2	57
1974	23.5	60
1975	9.6	52
1976	9.5	61
1977	17.5	73
1978	21.4	58
1979	23.5	60
1980	22.3	60
1981	18.7	63
1982	17.4	66
1983	23.3	52
1984	22.6	49
1985	24.4	55
1986	23.4	51
1987	19.6	50

source: NZ Dairy Board.

5.4 Calibration of the Model

The objective of this study is to use the estimated demand equations, presented in the previous sections of this chapter, to analyse equilibrium casein consumption and prices in response to supply and tariff rate changes, relative to the actual situation in 1987.

For a number of reasons, the estimated demand equations fail to exactly predict 1987 casein consumption levels in each country. The most obvious reasons for prediction errors include omission of relevant explanatory variables and incorrect functional form of the estimating equations. Also, the method of ordinary least squares, used in this study, minimises the prediction error variance at the mean value settings of the explanatory variables included in the estimating equations. Since the 1987 values of the explanatory variables are in general some considerable distance from their mean values, the prediction error variance for 1987 casein consumption will be correspondingly greater. Although estimating procedures designed to minimise forecasting error variance are available, for example autoregressive moving average models, their use was beyond the scope of this study.

Since the estimated demand equations fail to exactly predict 1987 casein consumption levels, their use in a spatial equilibrium analysis of the casein market is likely to produce results that are unrealistic when compared to the observed pattern of prices and consumption in 1987. To overcome this problem, the estimated demand equations were calibrated for 1987 by adjusting the constant term value so that the 1987 casein consumption prediction error is zero for each country at the observed 1987 casein price. A similar approach has been reported by McCall and Townsley[5]

---

5. See McCall D.G. and R.J. Townsley, A Use of Calibration in the Development of Simulation Models, Mathematics and Computers in Simulation 30 (1988) 27-32 North-Holland.

where, given a range of equation and coefficient values as reported in the scientific literature, models were calibrated (coefficient values found) to minimise forecasting error variance. The calibrated demand equations are:

United States

c - 15.916 (3552*) = 84730*
c = 141263.63

where c = a constant and * = actual prices and quantities respectively.

Adjusted Demand Equation: $141263.63 - 15.916P^N_{c2}$

Republic of Korea

c - 0.184 (4243*) = 5508*
c = 6286.7

where c = a constant and * = actual prices and quantities respectively.

Adjusted Demand Equation: $6286.7 - 0.184P^N_{c3}$

Japan

c - 1.1 (3932*) = 19600*
c = 23925.2

where c = a constant and * = actual prices and quantities respectively.

Adjusted Demand Equation: $23925.2 - 1.1 P^N_{c4}$

TABLE 5.4

UNADJUSTED AND ADJUSTED DEMAND EQUATIONS

	Adjusted	Unadjusted
United States	$141263.63 - 15.916\ P_2$	$160392.8 - 15.916\ P_2$
Japan	$23925.2 - 1.1\ P_4$	$24558.39 - 1.1\ P_4$
Korea	$6286.7 - 0.184\ P_3$	$6463.73 - 0.184\ P_3$

NB P_2, P_3 & P_4 represent the price of casein in US, Korea and Japan respectively.

The adjusted demand curves are used in the next chapter for the base result and scenario analysis. Table 5.4 compares the adjusted and unadjusted demand equations for the United States, Japan and Korea.

5.5 Supply of Casein.

New Zealand and the European Community dominate the world casein market, producing over 80 percent of casein on the world market. In this model they are assumed to be the only producers and exporters. Lack of data on Eastern European and South American producers hinders the extension of the model to cover these regions.

5.5.1 Supply of Casein New Zealand

Stocks of casein are assumed to be zero[6], therefore, supply is assumed to equal production in any particular year. Casein production for New Zealand and the European Community is shown in Table 5.5.

---

6. Over 99% of casein produced in any year is exported in that year.

New Zealand production has been relatively static[7] over recent years. In the quadratic programming model both the European and New Zealand quantities have been kept constant. The 1987 exports values have been used as a base year in the quadratic programming model. Since we are concerned with the major markets, only the tonnage exported to these markets is used in subsequent analysis, ie. 40 836 tonnes.

5.5.2 Supply and Demand of European Community Casein.

The European Community is the largest producer of casein in the world. The major producers in the European Community are West Germany, France, Denmark and the Irish Republic. West Germany and France have traditionally been the major producers of casein. Subsidies have encouraged increased production not only in West Germany and France but also in Ireland and Denmark. Aid to casein producers has gone up substantially over the past twenty years.

The European Community has built up a complex raft of subsidies to cover its dairy industries. Prices have been driven by these subsidies rather than by market demand. Given that the EC has such a large influence on world dairy trade it also means that world dairy prices are largely influenced by EC subsidies. For example when the EC decided to increase export subsides on a wide range of dairy products international dairy prices fell virtually instantaneously in direct correlation with the subsidy increase.

---

7. Apart from 1973 where drought and poor returns contributed to a slump in casein production.

TABLE 5.5

PRODUCTION OF CASEIN IN NEW ZEALAND AND THE EUROPEAN
COMMUNITY:1971 - 1987

YEAR	CASEIN PROD. NZ	EC	YEAR	CASEIN PROD. NZ	EC
	(000's tonnes)			(000's tonnes)	
1971	42.2	42.0	1980	51.6	101.9
1972	37.1	47.2	1981	52.0	82.5
1973	24.1	53.0	1982	57.0	105.4
1974	35.4	62.0	1983	67.0	123.6
1975	34.5	43.0	1984	60.0	102.0
1976	52.7	44.0	1985	71.0	116.0
1977	67.8	55.3	1986	73.0	119.0
1978	71.9	65.7	1987	62.0	138.0
1979	68.7	78.0			

source: New Zealand Dairy Board.

Part of the reason for the difficulty in predicting European casein export volumes is that casein production depends upon not only casein prices and subsidies but subsidies and prices of joint products such as skimmilk and wholemilk powder. Casein production in the EC depends almost entirely on the amount of subsidy paid out rather than the world price. Therefore, in one scenario (scenario 5) EC production is set at different levels (ie. between 30 000 and 100 000 tonnes at 10 000 intervals) to simulate various levels of government intervention. In all other scenarios European casein supply has been held constant in the quadratic programming model. Using this approach a supply profile can be built up without delving into the complex subsidy support given to European producers. What drives the product mix for European milk products is an area beyond the scope of this thesis. (For further work in this area see Clough and Isermeyer and Lattimore et al.)

80

The intention in this study has been to vary the amount of casein supplied by the European Community on to the world market to see its effect on Korean, New Zealand, United States and Japanese prices and trade flows.

5.6 Transportation Costs

Transportation costs have been estimated for the shipment of casein from the EC and New Zealand to each of Japan, Korea and the United States. All costs are ocean freight rates. These rates are port to port rates only. (Transportation rates are made up of ocean freight rates only.) Table 6 shows the various freight costs between suppliers and their markets.

TABLE 5.6

TRANSPORTATION COSTS

	EC	US	KOREA	JAPAN	NZ
		NZ$ per tonne			
EC	–	260.10	169.56	169.56	–
NZ	–	308.06	150	150	–

Source: New Zealand Shipping Line, Wellington.

5.7 Tariff Costs

Tariffs are imposed in Korea and Japan (20 and 10 percent respectively). Ad valorem tariffs are use in both cases. Ad valorem tariffs are incorporated inside the quadratic programming matrix (Takayama and Judge p272).

5.8 Quadratic Programming Model

The net revenue of the quadratic programming model developed in Chapter Four is used to find market equilibrium solutions in this study. The model is a simplified version of that presented earlier since three countries demand casein (United States, Japan and Korea) but do not supply casein, while two countries (Europe and New Zealand) have export supplies of casein (but no explicit supply functions).

Denote P_j as the casein price ($NZ) in the jth country, where:

$$
\begin{array}{lll}
j & = & 1 & \text{Europe} \\
j & = & 2 & \text{United States} \\
j & = & 3 & \text{Korea} \\
j & = & 4 & \text{Japan} \\
j & = & 5 & \text{New Zealand}
\end{array}
$$

In order to progress, some definitions are necessary for transport costs, ad valorem tariffs and export flows. t_{12}, t_{13}, t_{14} are the unit transport costs from Europe to United States, Korea and Japan respectively; and t_{52}, t_{53}, t_{54} as unit transport costs from New Zealand to the same three countries.

T_3, T_4 are the ad valorem tariff rates (percentage divided by 100) imposed by Korea and Japan on casein imports respectively. The United States imposes no tariff on casein imports. S_1, S_5 are European and New Zealand supplies of casein for export respectively.

New Zealand exports to the United States, Japan and Korea are defined as X_{52}, X_{53} and X_{54}; while European export flows to the United States, Japan and Korea are X_{12}, X_{13} and X_{14} respectively.

The adjusted (calibrated) demand equations are:

United States $\quad D_2 = A_2 - B_2 \, P_2$

Korea $\qquad\qquad D_3 = A_3 - B_3 \, P_3$

Japan $\qquad\qquad D_4 = A_4 - B_4 \, P_4$

Quadratic programming is used to find market equilibrium values for the vector of prices and export quantities:

$$\pi' = [P_1, \; P_2, \; P_3, \; P_4, \; P_5, \; X_{12}, \; X_{13}, \; X_{14}, \; X_{52}, \; X_{53}, \; X_{54}]$$

by maximising net revenue summed over countries, subject to market equilibrium constraints, as discussed in Chapter Four.

5.8.1 Country Net Revenue

Europe : $\quad$ CNR (1) $= \quad [P_2 - t_{12}] \, X_{12} + [P_3 - T_3 \, (P_1 + t_{13}) - t_{13}] \, X_{13}$
$\qquad\qquad\qquad\qquad + [P_4 - T_4 \, (P_1 + t_{14}) - t_{14}] \, X_{14} - P_1 S_1$

(assuming available export supplies are in fact exported.)

New Zealand: CNR (5) $= \quad [P_2 - t_{52}] \, X_{52} + [P_3 - T_3 \, (P_5 + t_{53}) - t_{53}] \, X_{53}$
$\qquad\qquad\qquad\qquad + [P_4 - T_4 \, (P_5 + t_{54}) - t_{54}] \, X_{54} - P_5 S_5$

United States $\quad$: CNR (2) $= P_2 \, (A_2 - B_2 \, P_2) - P_2 \, X_{12} - P_2 \, X_{52}$

Korea $\qquad\qquad$: CNR (3) $= P_3 \, (A_3 - B_3 \, P_3) - P_3 \, X_{13} - P_3 \, X_{53}$

Japan $\qquad\qquad$: CNR (4) $= P_4 \, (A_4 - B_4 \, P_4) - P_4 \, X_{14} - P_4 \, X_{54}$

The net revenue function maximised by quadratic programming is:

$$\text{CNR} = \sum_j \text{CNR (j)}$$

$$\text{CNR} = \pi' q + \pi' Q \, \pi$$

83

where:

$$q = \begin{bmatrix} -S_1 \\ A_2 \\ A_3 \\ A_4 \\ -S_5 \\ -t_{12} \\ -t_{13}\ (1\ +\ T_3) \\ -t_{14}\ (1\ +\ T_4) \\ -t_{52} \\ -t_{53}\ (1\ +\ T_3) \\ -t_{54}\ (1\ +\ T_4) \end{bmatrix}$$

and $Q =$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & -\tfrac{1}{2}T_3 & -\tfrac{1}{2}T_4 & 0 & 0 & 0 \\ 0 & -B_2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -B_3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -B_4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\tfrac{1}{2}T_3 & -\tfrac{1}{2}T_4 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -\tfrac{1}{2}T_3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -\tfrac{1}{2}T_4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -\tfrac{1}{2}T_3 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -\tfrac{1}{2}T_4 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

5.8.2 Quadratic Programming Constraints.

As described in Chapter 4, market equilibrium constraints in the form of the net revenue (price) formulation of the model are of four types.

(1) Country exports must not exceed country supply (Europe and New Zealand). For example:

$$X_{52} + X_{53} + X_{54} \leq S_5 \text{ and } X_{12} + X_{13} + X_{14} \leq S_1$$

$$\text{or } -X_{52} - X_{53} - X_{54} \geq -S_5 \text{ and } -X_{12} - X_{13} - X_{14} \geq -S_1$$

Country imports must be greater than or equal to country demand (United States, Korea and Japan). Thus:

$$X_{12} + X_{52} \geq A_2 - B_2 P_2$$
$$X_{13} + X_{53} \geq A_3 - B_3 P_3$$
$$X_{14} + X_{54} \geq A_4 - B_4 P_4$$

Therefore,
$$B_2 P_2 + X_{12} + X_{52} \geq A_2$$
$$B_3 P_3 + X_{13} + X_{53} \geq A_3$$
$$\text{and } B_4 P_4 + X_{14} + X_{54} \geq A_4$$

(2) Product price in an exporting country must be greater than or equal to the net revenue per unit of a commodity exported to a second country;

$$P_5 \geq P_2 - t_{52}$$
therefore,
$$-P_2 + P_5 \geq -t_{52}$$

Similarly,
$$-P_2 + P_1 \geq -t_{12}$$
$$-P_3 + P_5 \geq -t_{53}$$
$$-P_4 + P_5 \geq -t_{54}$$

As discussed in Chapter Four, where an importing country imposes an ad

Valorem tariff (eg. Korea), this condition becomes:

$$-(1+T_3)^{-1} P_3 + P_5 \geq -t_{53}$$
$$-(1+T_3)^{-1} P_3 + P_1 \geq -t_{13}$$
$$-(1+T_4)^{-1} P_4 + P_5 \geq -t_{54}$$
$$-(1+T_4)^{-1} P_4 + P_1 \geq -t_{14}$$

(3) Total consumption (demand) in a country must be non-negative, for example

$$A_2 - B_2 P_2 \geq 0$$

therefore,

$$-B_2 P_2 \geq -A_2$$

Similarly

$$-B_3 P_3 \geq -A_3$$
$$-B_4 P_4 \geq -A_4$$

(4) Equilibrium trade flows and market prices must be non-negative, therefore: $\pi \geq 0$. The complete constraint set may be written as:

$$A\pi \geq b$$
$$\pi \geq 0$$

For this study, we have:

$$\pi' = [P_1, P_2, P_3, P_4, P_5, X_{12}, X_{13}, X_{14}, X_{52}, X_{53}, X_{54}]$$

$$A =$$

$$
\begin{bmatrix}
0 & 0 & 0 & 0 & 0 & -1 & -1 & -1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & -1 & -1 \\
0 & B_2 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\
0 & 0 & B_3 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & B_4 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\
1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & -(1+T_3)^{-1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & -(1+T_4)^{-1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -(1+T_3)^{-1} & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & -(1+T_4)^{-1} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -B_2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -B_3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & -B_4 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
$$

and:

$$
b = \begin{bmatrix}
-S_1 \\
-S_5 \\
A_2 \\
A_3 \\
A_4 \\
-t_{12} \\
-t_{13} \\
-t_{14} \\
-t_{52} \\
-t_{53} \\
-t_{54} \\
-A_2 \\
-A_3 \\
-A_4
\end{bmatrix}
$$

Minimisation of $\quad -CNR = \pi'[-q] + \pi'[-Q]\pi$

Subject to: $\qquad A\pi \geq b$

$\qquad\qquad\quad \pi \geq 0$

ensures that, at the optimum (market equilibrium) solution, we have NCR = 0.

5.8.3 Quadratic Programming Base Solution.

The EO4NAF (Nag Library Routine Document) was used to find the market equilibrium solution when S_1 = 69000 tonnes, S_2 = 40836 tonnes, T_3 = 0.20, and T_4 = 0.10 (other parameters values are given in earlier sections of this chapter). In this solution it was found that X_{12} = S_1 and X_{13} = X_{14} = 0 and X_{52} + X_{53} + X_{54} = S_5. (This result is discussed further in Chapter Six).

Market demand and supply equilibrium over the five markets modelled in

this study requires that:

$$\sum_{j=1,5} S_j = \sum_{j=2,3,4} (A_j - B_j P_j)$$

therefore, $\quad B_2 P_2 + B_3 P_3 + B_4 P_4 = A_2 + A_3 + A_4 - S_1 - S_5$

The four operative price constraints corresponding to X_{12}, X_{52}, X_{53}, $X_{54} > 0$ were:

$$P_1 - P_2 = -t_{12}$$
$$P_5 - P_2 = -t_{52}$$
$$P_5 - (1 + T_3)^{-1} P_3 = -t_{53}$$
$$P_5 - (1 + T_4)^{-1} P_4 = -t_{54}$$

For the scenarios analysed in this study it was found that all solutions to the following set of simultaneous equations satisfied market equilibrium conditions.

$$\overline{A} \, \overline{\pi} = \overline{b}$$

where:

$$\overline{\pi}' = [P_1, P_2, P_3, P_4, P_5]$$

$$\overline{A} = \begin{bmatrix} 0 & B_2 & B_3 & B_4 & 0 \\ 1 & -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 1 \\ 0 & 0 & -(1 + T_3)^{-1} & 0 & 1 \\ 0 & 0 & 0 & -(1 + T_4)^{-1} & 1 \end{bmatrix}$$

$$\overline{b} = \begin{bmatrix} A_2 + A_3 + A_4 - S_1 - S_5 \\ -t_{12} \\ -t_{52} \\ -t_{53} \\ -t_{54} \end{bmatrix}$$

88

Given the solution values for (P_2, P_3, P_4) the corresponding values for D_2, D_3, and D_4 can easily be computed.

Then:
$$X_{12} = S_1$$
$$X_{52} = D_1 - X_{12}$$
$$X_{53} = D_3$$
$$X_{54} = D_4$$

This solution corresponds to market equilibrium so long as all solution values are non-negative and:

$$P_1 - (1 + T_3)^{-1} P_3 > -t_{13}$$
$$P_1 - (1 + T_4)^{-1} P_4 > -t_{14}$$

In this study considerable savings in computation time were possible through solving this set of five simultaneous equations rather than successive runs of the quadratic programming algorithm.[8]

5.9 Summary

The general mathematical form of the net revenue model was specified for the casein market. The objective function was given along with the linear constraints which required the model to satisfy spatial price equilibrium and optimal consumption and production conditions.

The components of the casein model were specified while estimates of demand for products were presented. Regional supply levels, transported and tariffs which existed in 1987 were identified.

The quadratic programming model way presented in section 5.8. This section contained the objective functions to be maximised, spatial price equilibrium conditions and optimal consumption and production conditions.

----

8. The Author is extremely grateful to Professor Robert Townsley for his assistance in this area of the study.

CHAPTER SIX

Alternative Scenarios and Empirical Results

6.1 Introduction

Using the base year of 1987 various policy scenarios were run using the quadratic programming model presented in Chapter Five. Tariff, transportation costs and other exogenous variables were given 1987 values. No strict statistical methods exist to validate the quadratic programming model results, but predicted prices and quantities traded should reflect actual 1987 prices and quantities. When the 1987 policy environment is simulated inconsistencies with actual values result from inaccurate cost data and demand equations, actual market clearing conditions not characteristic of a competitive equilibrium, and the exclusion of production and consumption regions from the model.

The quadratic programming model provides the base for the study. To speculate on various market opportunities given a 'freer' trading environment and to facilitate evaluation of the solutions, six scenarios involving various levels of tariffs and European supplies are examined relative to the base scenarios. These are:

1. A reduction in the Korean tariff on casein from 20 percent to 10 percent;

2. Removal of Korean tariff;

3. Removal of Japanese tariff, and a 20% Korean tariff;

4. Removal of Japanese tariff, and a 10% Korean tariff;

5. Sensitivity analysis on the quantity of European Community casein exported to the world market with a) 20 percent Korean tariff and b) tariff barriers removed;

6. 'Freer' trade ie EC exporting 69 000 tonnes and no tariffs on casein entering the Japanese or Korean markets.

The six scenarios are examined because of the difficulty in judging the pace of liberalisation and in determining which country in East Asia or Europe will be first to liberalise. At the moment it seems that the Japanese are more willing to consider liberalisation than the Koreans (given their liberalisation of the beef market) but this could change quite rapidly. The solutions to the six scenarios are compared to the base scenarios.

6.2 Quadratic Programming Matrix Results.

6.2.1 Base Scenario and Solutions

After calibrating the demand equations, the base solution along with actual values for 1987 are presented in figures 1 and 2. Actual and estimated prices and trade flows are compared.

The base scenario is calculated from the specified fixed supply volumes and the calibrated demand equations. The transport and tariff costs are also used to constrain the model so that realistic trade flows and volumes result (see Chapter 5 section 8 for further detail).

Although no rigorous statistical tests exist for measuring the model's predictive ability. The base price results approximate the 1987 values. Japan (4.65 percent) and Korea (3.61 percent) shows the largest difference between prices, whereas European, New Zealand and American prices are within 1.5 percent of the actual prices (see Figure 1 and Appendix C graphical and tabulated results).

The major difference between the model and actual results is that the model did not predict casein trade flows from the European Community to Korea and Japan. In none of the scenarios did the model predict European

Figure 6.1

BASE RESULT PRICES

(Tariff: Korea 20%, Japan 10%)

Prices

NZ $ per tonne, FOB
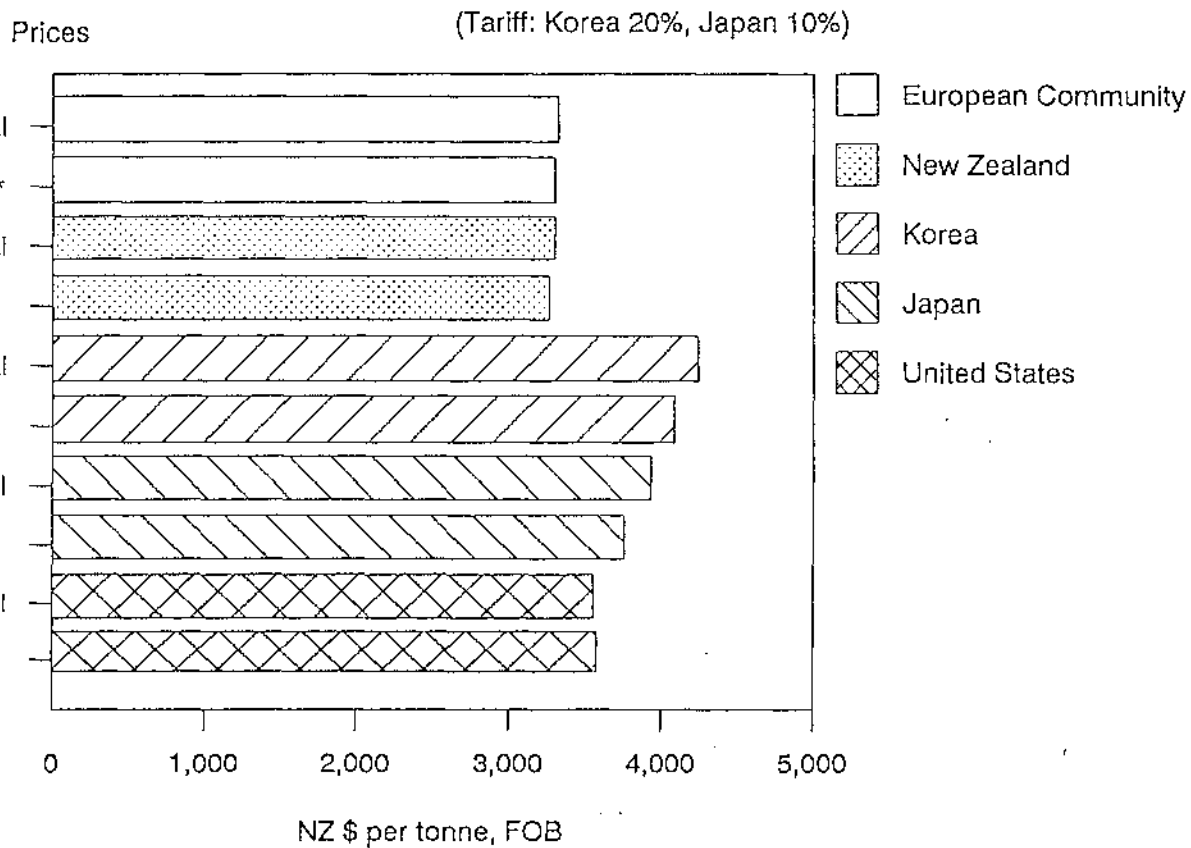
*Estimated, see text in Appendix C for further discussion.

Figure 6.2

PREDICTED TRADE FLOWS

(Tariffs: Korea 20%, Japan 10%)

Source: NZ Department of Statistics (Actual Data)

product to be shipped to the East Asian market (see figure two). All European casein exported was consumed in the American market. New Zealand supplied all three markets (Korea, Japan and the United States).

Reasons for the difference between the actual and estimated prices are political and economic. Too much reliance on one region is good reason for diversifying markets. There are obvious risks in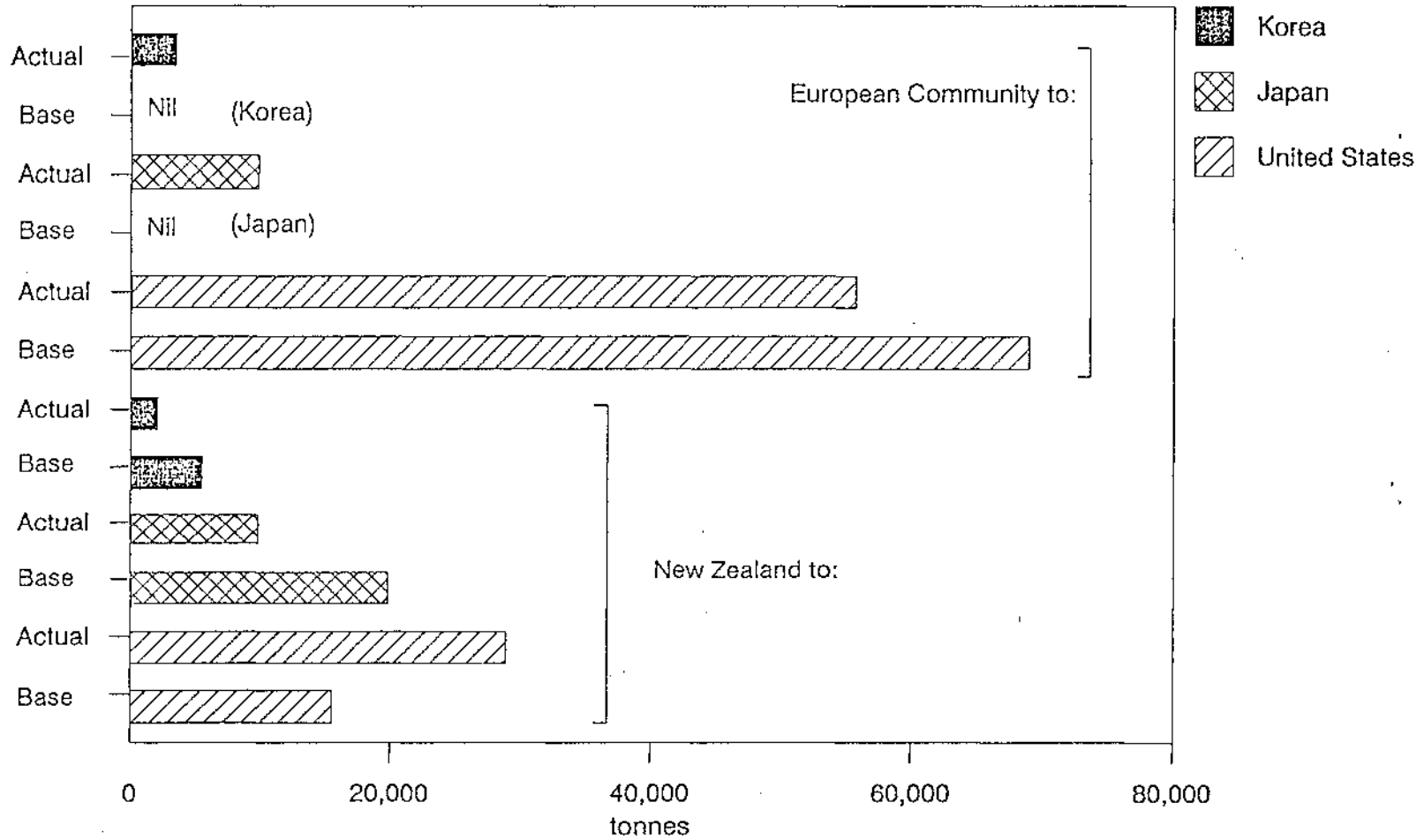 investing all commercial eggs in one basket, therefore diversification can become a powerful strategic reason for actively seeking out new markets.

Moving into the East Asian market requires set up costs. The Europeans may be looking at the potential this market offers and not so much at its set up costs. For example, Nestle have just entered the coffee whiteners market in Korea stating that they see large potential for growth in this market over the next five years

As the multilateral and bilateral pressures for trade liberalisation increase, markets in East Asia will open up, allowing opportunities for suppliers. The current GATT round has focused attention on the highly protected markets of Asia. The Europeans will look to exploit a freer trading environment.

These reasons reinforce the naive nature of this type of model. Strategic and political objectives are ignored when modelling the market equilibrium trade flows and prices.

The base result gives an fob revenue return for the New Zealand casein exports to the three major markets of NZ$133.06 million.

6.2.2 Scenario 1: A reduction in the Korean tariff on casein from 20 percent to 10 percent.

Graphical results are given in figures 3 and 4, while Appendix C has tabulated results. Since we are concerned with the increase in the casein trade between New Zealand and the Republic of Korea this scenario is compared with the base result.

Figure 6.3

BASE RESULT PRICES

(Tariff: Korea 10%, Japan 10%)**
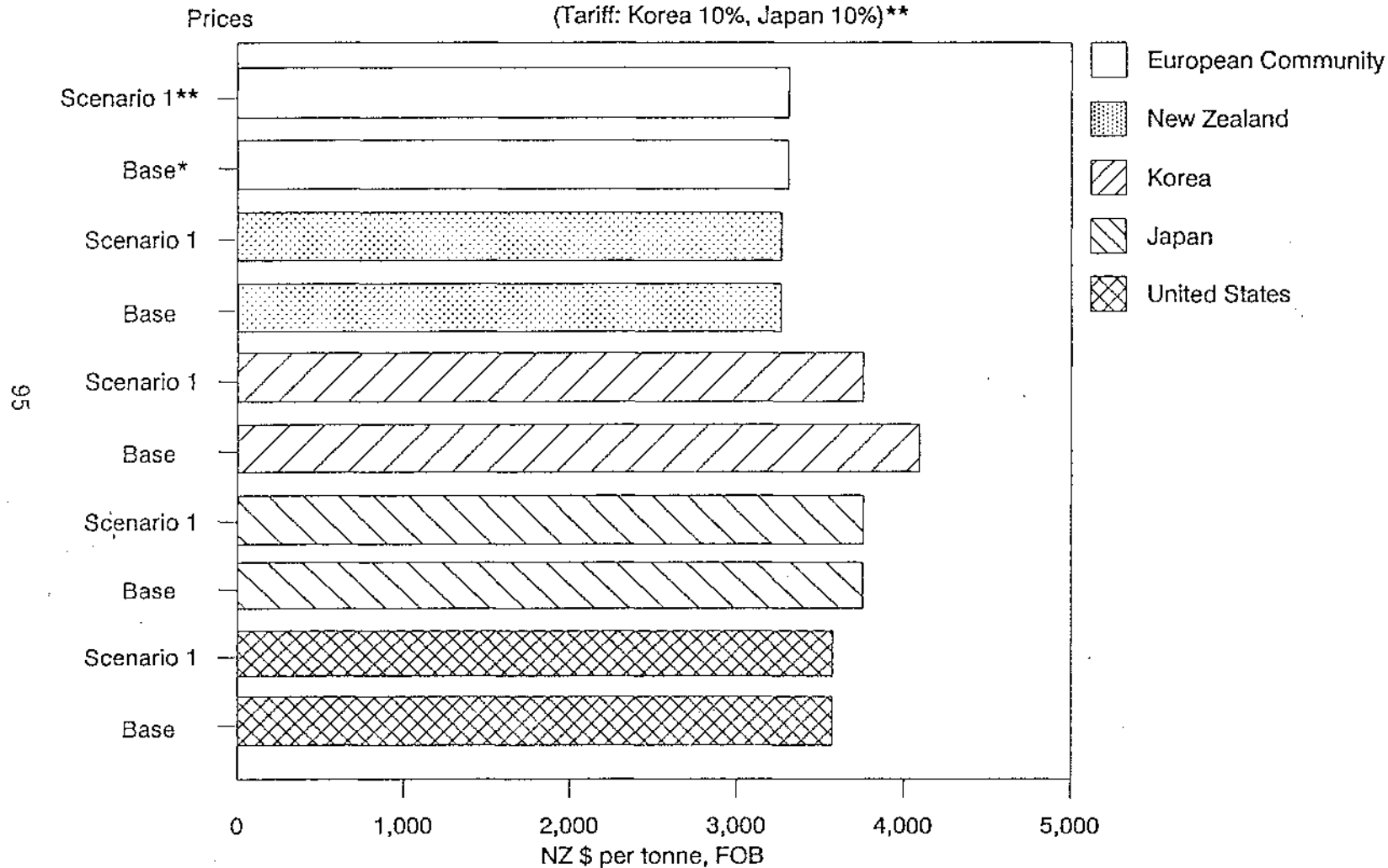
Prices

* Base Prices, see text in Appendix C for further discussion.

Figure 6.4
SCENARIO 1 PREDICTED TRADE FLOWS
(Tariffs: Korea 10%, Japan 10%) **
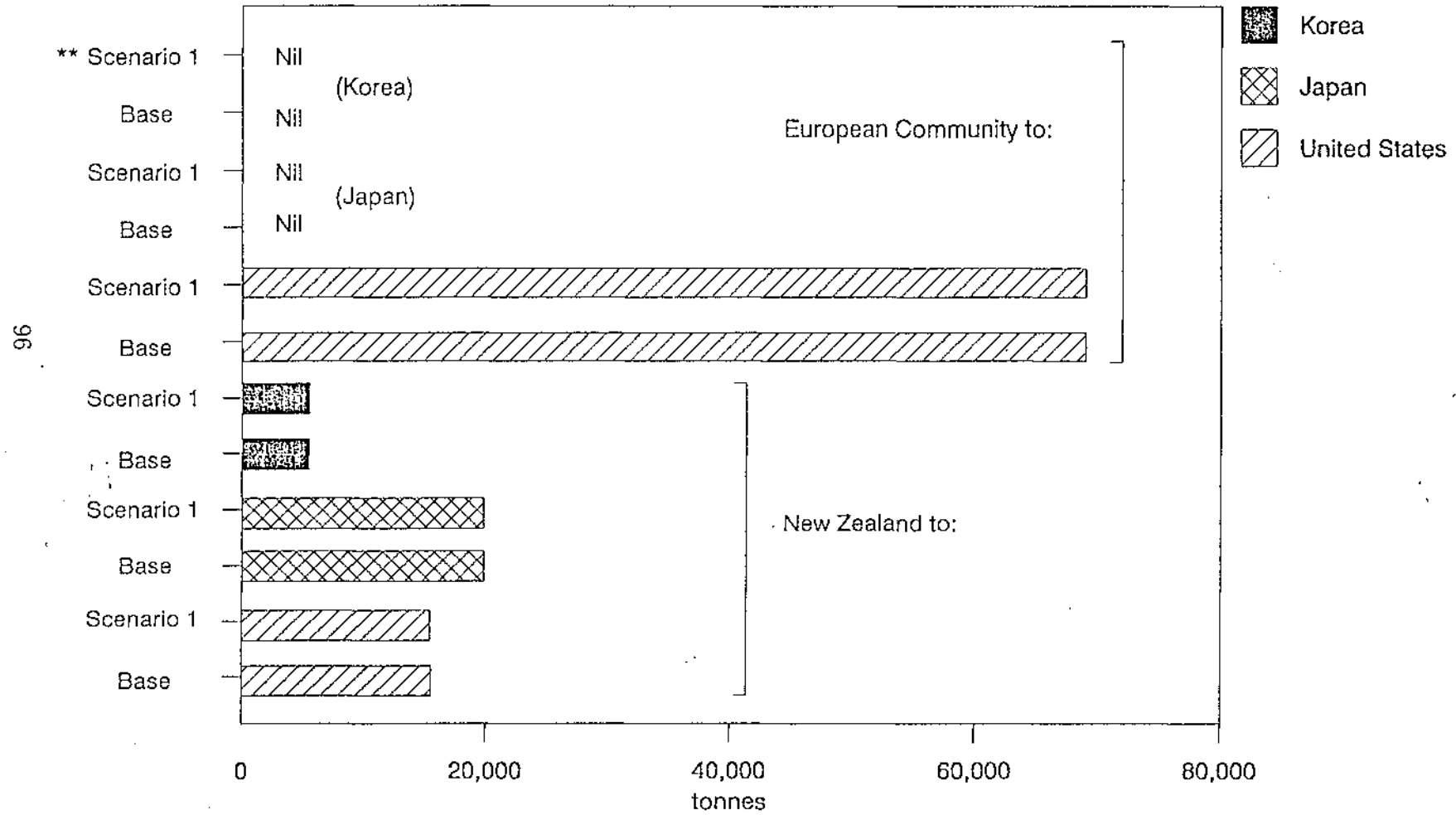
With the reduction in the tariff, the New Zealand and European prices for casein increase slightly, as do prices in Japan and the United States. The Korean price drops by 8.2 percent from NZ$4090 to NZ$3753.2. The Japanese drops by less than the tariff decrease, increasing the fob return to the New Zealand producer. Not only does the Korean price drop but world prices rise slightly increasing returns to all producers.

Figure 4 shows the predicted world trade flows in casein. The Japanese and American traded quantities are slightly down while Korean imports are up by 1.1 percent from 5534 tonnes to 5596 tonnes. The base results show only a slight change when measured against a 10 percent reduction in the Korean tariff.

The increase in trade following the reduction in Korean tariffs will mean an increase of NZ$ 150 000 (fob) to New Zealand exporters, rising from $133.06 million to $133.21 million.

Given the base situation, two points have to be remembered. Firstly, the Korean casein market is divided between Europe and New Zealand. The gain from trade resulting from an implementation of 10 percent Korean tariff would not be as great, remembering that in the base scenario all of the product is supplied by New Zealand. Secondly, New Zealand would most likely export more casein to Japan and the United States where the prices have risen marginally.

6.2.3 Scenario 2 : removal of the Korean tariff on casein.

Results are given in figures 5 and 6, where they are compared with the base result. With the further reduction in the tariff rate, New Zealand and European prices for casein increase slightly, as do the prices in Japan and the United States. The Korean price drops by 16.4 percent from NZ$4090 to NZ$3415.6, a change of NZ$674.4 per tonne (fob). Here also returns to producers are increased because the percentage drop in price of casein in Korea is lower than the actual tariff removal.

97

Figure 6.5

SCENARIO 2: PRICES

(Tariffs: Korea Nil, Japan 10%) **

Prices

tonnes
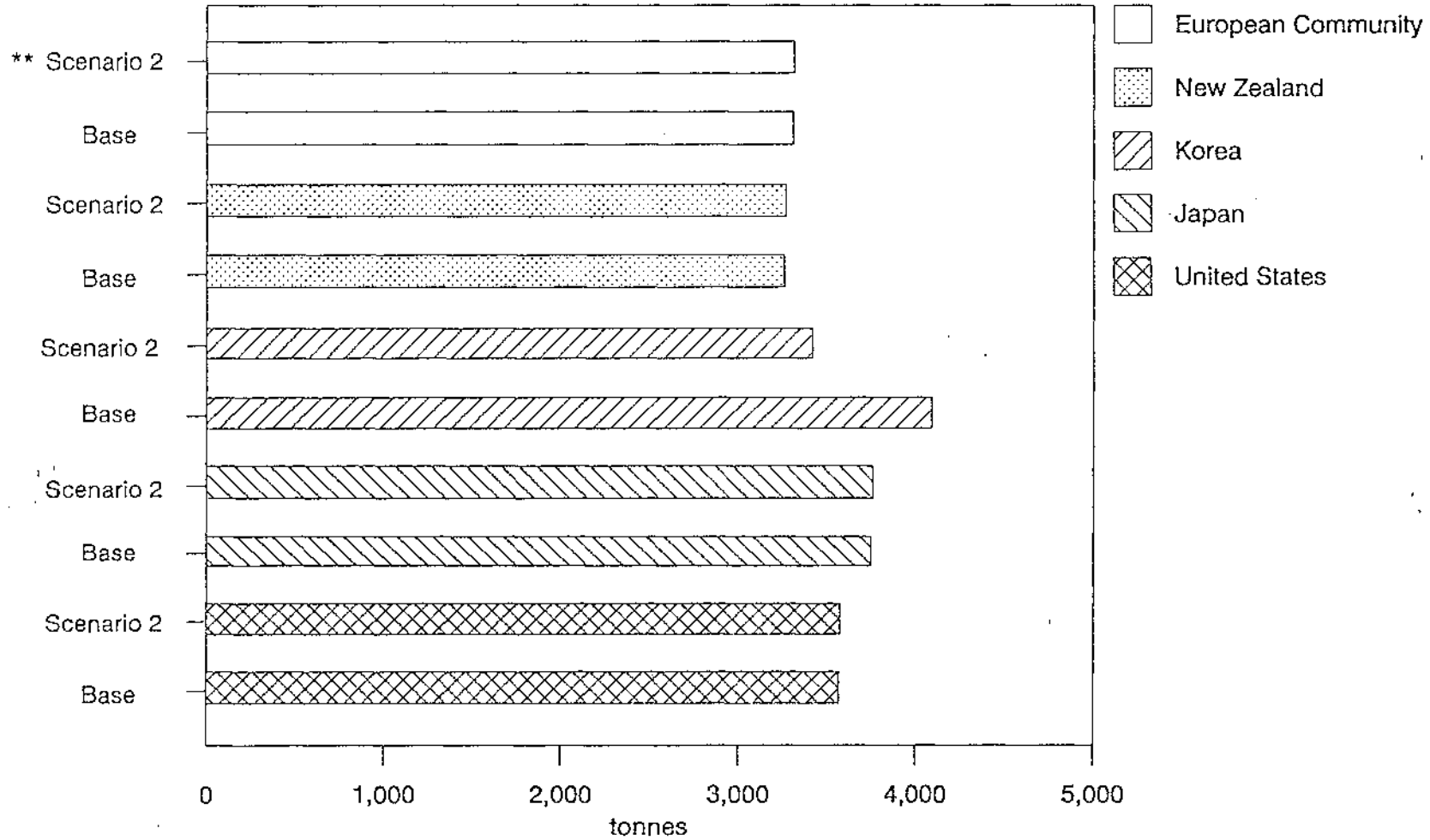
Figure 6.6

SCENARIO 2 PREDICTED TRADE FLOWS

(Tariffs: Korea 0%, Japan 10%) *

* Scenario 2 — Nil
  (Korea)
  Base — Nil

  Scenario 2 — Nil
  (Japan)
  Base — Nil

European Community to:

Scenario 2
Base

New Zealand to:

Scenario 2
Base

Scenario 2
Base

Scenario 2
Base

0   20,000   40,000   60,000   80,000

tonnes

Korea

Japan

United States

66
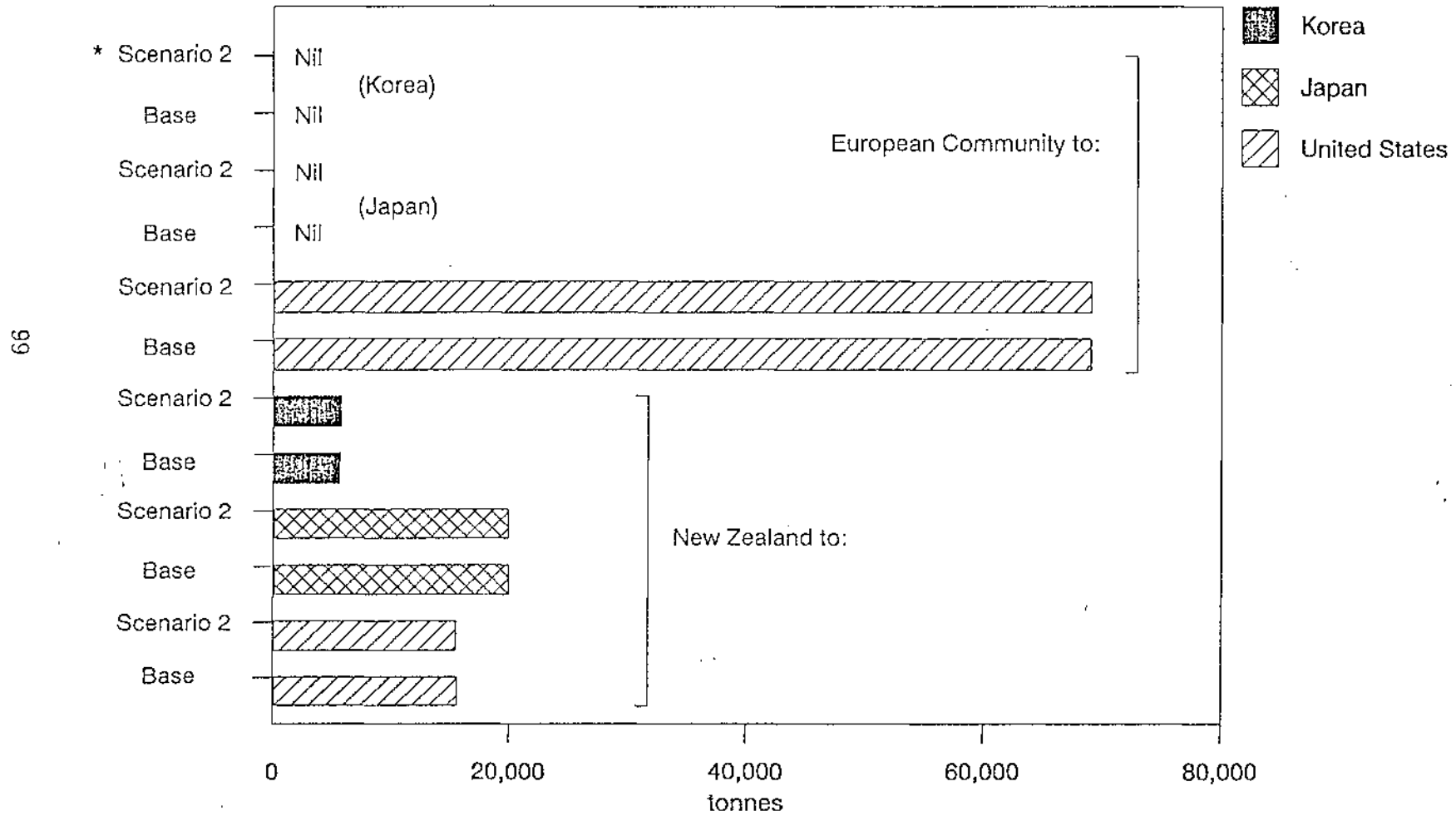
Figure 6 shows the predicted world trade flows in casein following the removal of the Korean tariff. The Japanese and American traded quantities are slightly down while the Korean trade is up by 2.2 percent compared to the base scenario. This is an increase from 5534 tonnes to 5656 tonnes, an increase of 122 tonnes.

As expected the removal of the tariff in Korea increases returns to producers. Comparing scenarios 1 and 2 it can be seen that the higher the tariff drop, the better the return to the exporter.

Not surprisingly trade volumes in the Korean market increase with the partial and total removal of the tariff. Total removal of the tariff in scenario 2 increases volumes more than the partial removal of tariffs.

The increase in trade with the removal of the Korean tariff means New Zealand revenue increases to NZ$133.35 million fob. This is an increase of NZ$290 000 over the base result. As in the first case the same caveats apply to this result.

6.2.4 Scenario 3 : Korean tariff 20%, Japanese tariff 0%

With the removal of the tariff rate in Japan the New Zealand, United States and European prices for casein increase by NZ$21.8 when compared to the base result. The price in Japan drops by NZ$319.1, or 8.5 percent, from NZ$3749.2 to NZ$3430.1. Figure 7 shows this graphically comparing base results with scenario 3 results.

Figure 8 shows the predicted world trade flows in casein with the removal of the Japanese tariff. The rise in the amount of casein shipped to Japan is offset by the decrease in American imports and a slight decrease in Korean imports.

The increase in trade with the removal of the Japanese tariff means New Zealand revenue earned from casein increases to NZ$133.95 million. Compared to the base result this is an increase of NZ$ 890 000.

Figure 6.7

SCENARIO 3

Prices

(Tariffs: Korean 20%, Japan Nil) *

☐ European Community

▨ New Zealand

▨ Korea

▨ Japan

▨ United States

101
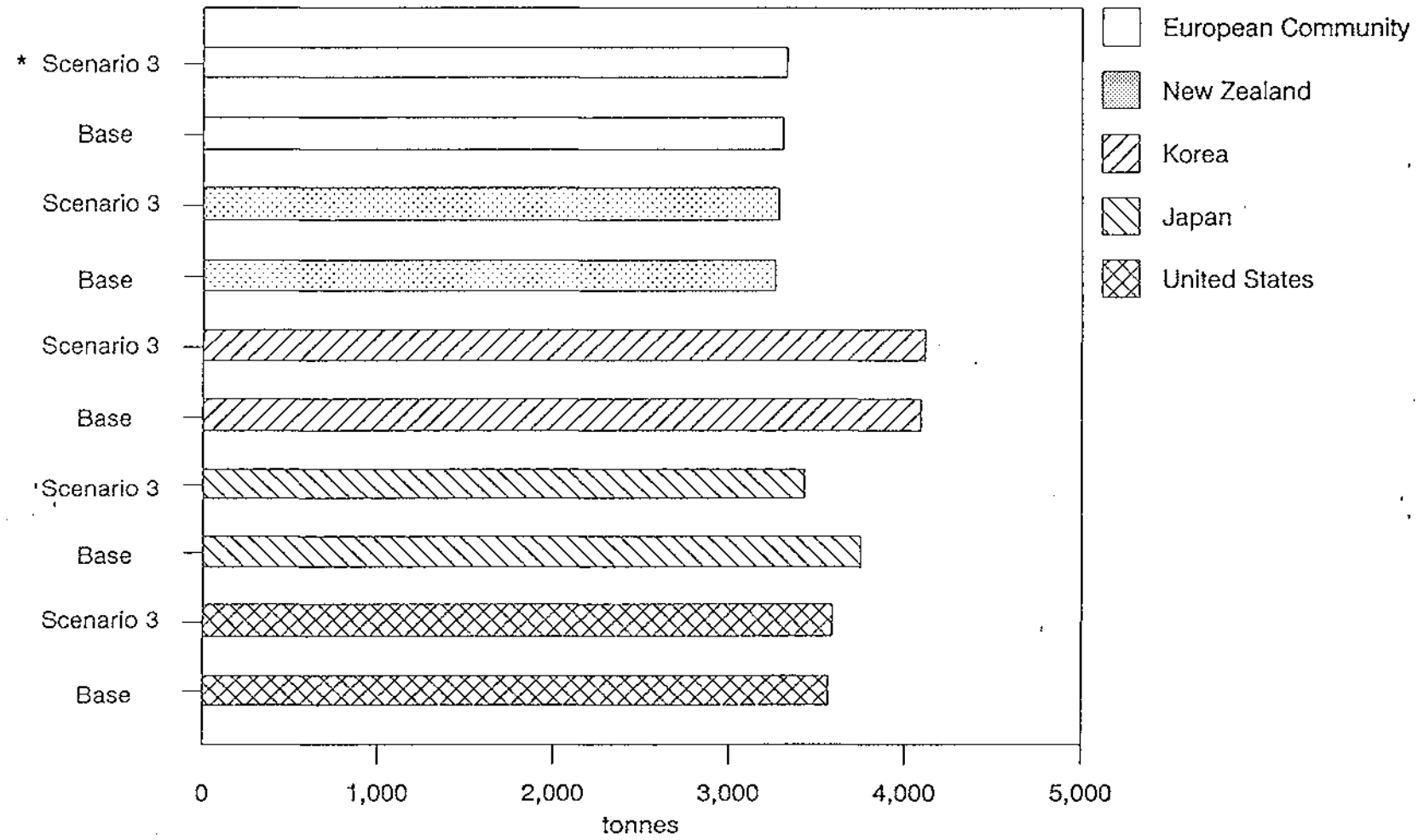
Figure 6.8

SCENARIO 3 PREDICTED TRADE FLOWS

(Tariffs: Korea 20%, Japan 0%) *
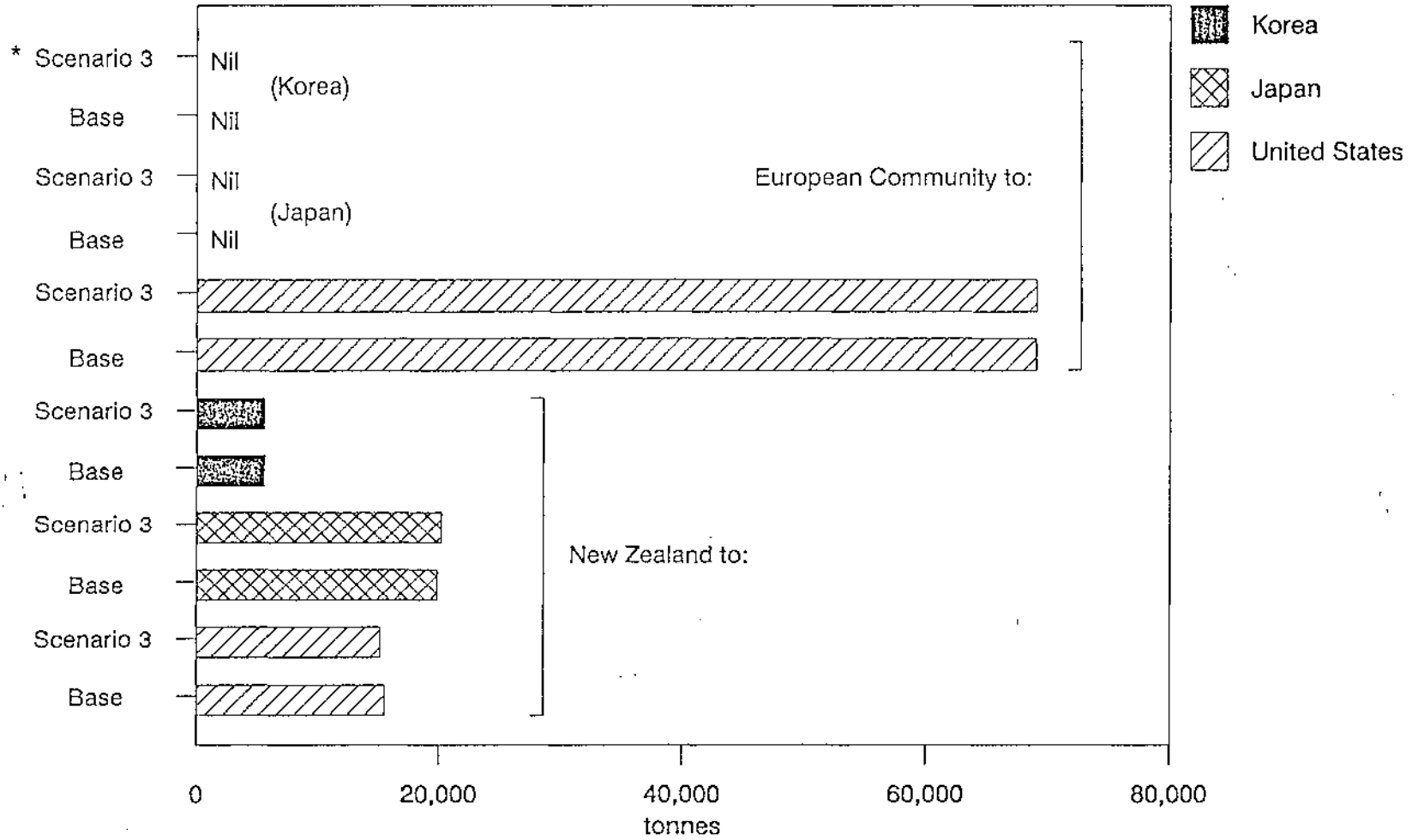
If we compare scenarios 1 and 2 with 3 we find that the removal of the Japanese tariff of .10 percent will benefit New Zealand producers more than the removal (or partial removal) of the 20 percent Korean tariff. The reason for this is the larger trade flow between Japan and New Zealand.

World prices are also slightly higher in scenario 3 than in either scenario 1 or 2.

6.2.5 Scenario 4 : Korean tariff 10%, Japanese tariff 0%

This simulation reduces the Korean tariff from 20 to 10 percent and removes the 10 percent Japanese tariff. The results are shown in figures 9 and 10.

With the elimination of the Japanese tariff the New Zealand, United States and European prices for casein increase by approximately NZ$25.5, using the base results as a benchmark. Figure 9 illustrates the effects of this scenario showing the price in Japan dropping by NZ$315.4 or 8.4 percent from NZ$3749.2 to NZ$3433.8. Again, note that the 10 percent tariff drop is matched by the lesser price drop of 8.4 percent in Japan.

Figure 10 shows the predicted world trade flows of casein after the removal of the Japanese tariff. The rise in the amount of casein shipped to Japan is offset by the decrease in the American market and slight decrease in the Korean imports.

The increase in trade with the removal of the Japanese tariff means returns to New Zealand producers increase by NZ$1.4 million over the base result.

Not surprisingly scenario 4 offers an increased return to producers in New Zealand over the first 3 scenarios. As tariff barriers come down, world prices and trade flows increase to North Asian markets. With a 10 percent

Figure 6.9

SCENARIO 4

Prices

(Tariffs: Korean 10%, Japan Nil) *

Legend:
- □ European Community
- ▨ New Zealand
- ▨ Korea
- ▨ Japan
- ▨ United States

tonnes
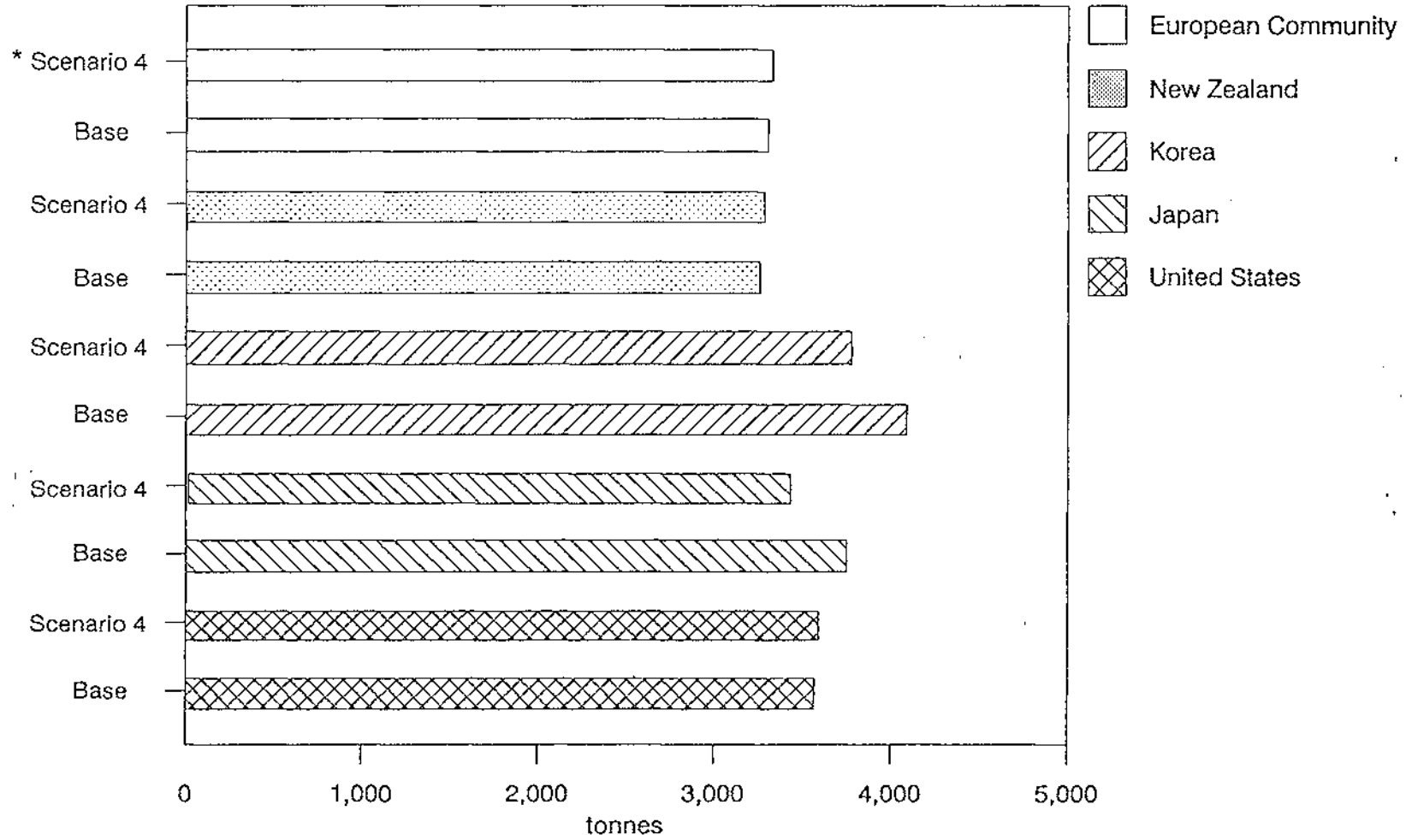
Figure 6.10

SCENARIO 4 PREDICTED TRADE FLOWS

(Tariffs: Korea 10%, Japan 0%) *
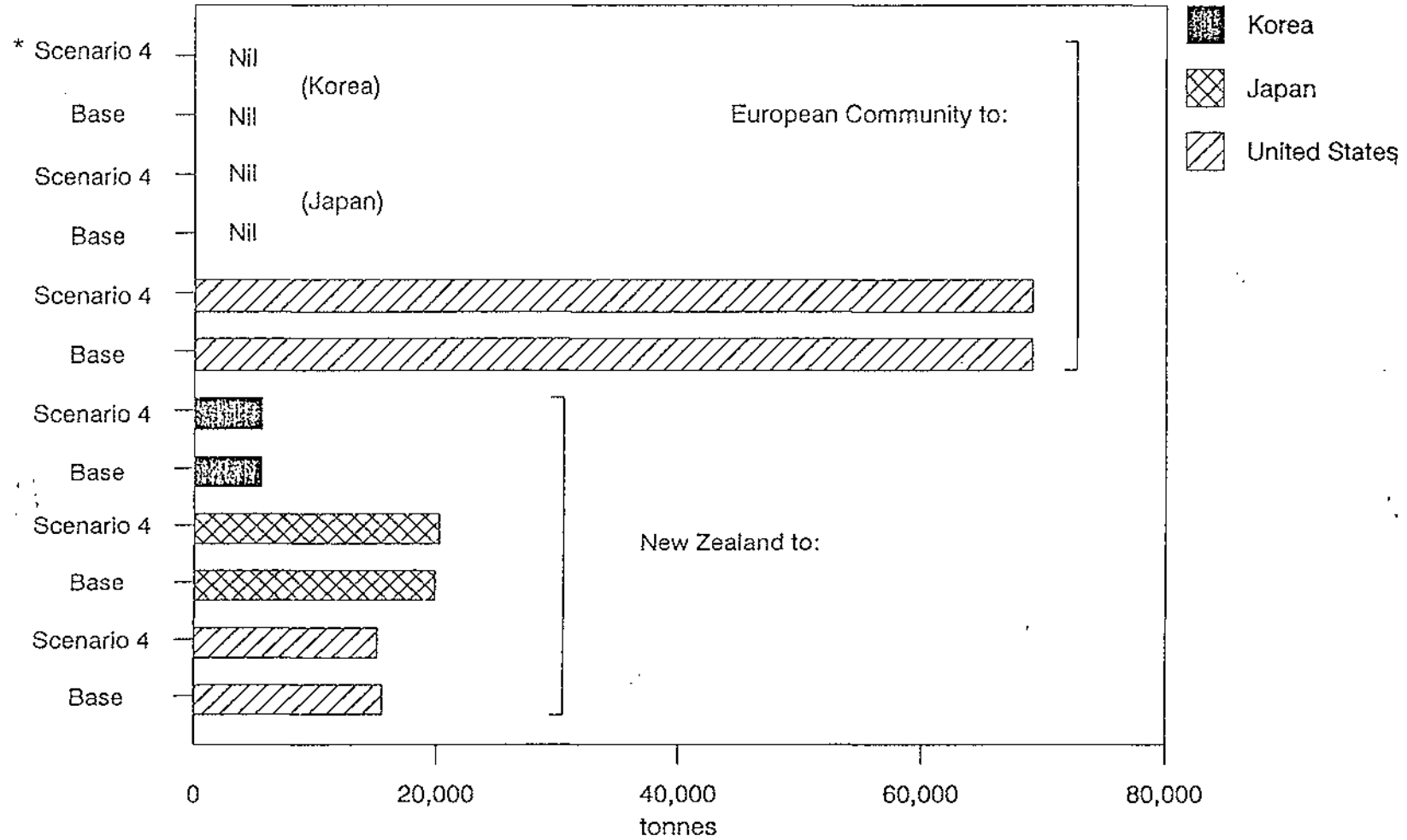
tariff barrier applied in the Korean market only, revenue increased to New Zealand producers by $150 000 over the next highest revenue earning scenario ie scenario 3.

6.2.6 Scenario 5 : sensitivity analysis on the quantity of European Community casein exported to the world market.

6.2.6.1 Scenario 5A : with existing tariffs

Scenario five is designed to show the effect of the European Community subsidy regime on the world casein market. Figure 11 varies the amounts of European casein exported to the rest of world from 30 000 through to 100 000 tonnes (shown by the bar graphs in figure 11). The tariffs are set at the levels for 1987 ie 20 percent in Korea and 10 percent in Japan. As European production increases, prices (as shown by the line graphs in figure 11) decrease.

In each case the model predicts that at no stage will product be traded between the European Community and Japan or Korea. Competition from New Zealand makes this prohibitive.

In figure 11, for every 10 000 tonnes increase in quantity supplied by the European Community, prices in Europe, New Zealand and United States decrease by NZ$576.3. The price in Korea and Japan decreases by NZ$691.56.

For every 10 000 tonne increase in European Community supplies exports from New Zealand to the United States decrease by 828 tonnes, exports from New Zealand to Korea increase by 127 tonnes, while exports from New Zealand to Japan increase by 697 tonnes.

As figure 11 shows, the relationship is linear, since we are moving along a linear world excess demand curve. Linearity implies that no other factors (except EC production), shift the price locus as European Community supply increases.

Figure 6.11

SCENARIO 5A:WORLD PRICES WITH VARYING EC SUPPLY

(Tariffs: Korea 20%, Japan 10%)

Prices

EC Casein Exports (Tonnes)

European Community

New Zealand

United States

Korea

Japan

European Net Exports

EC Casein Exports (Tonnes)
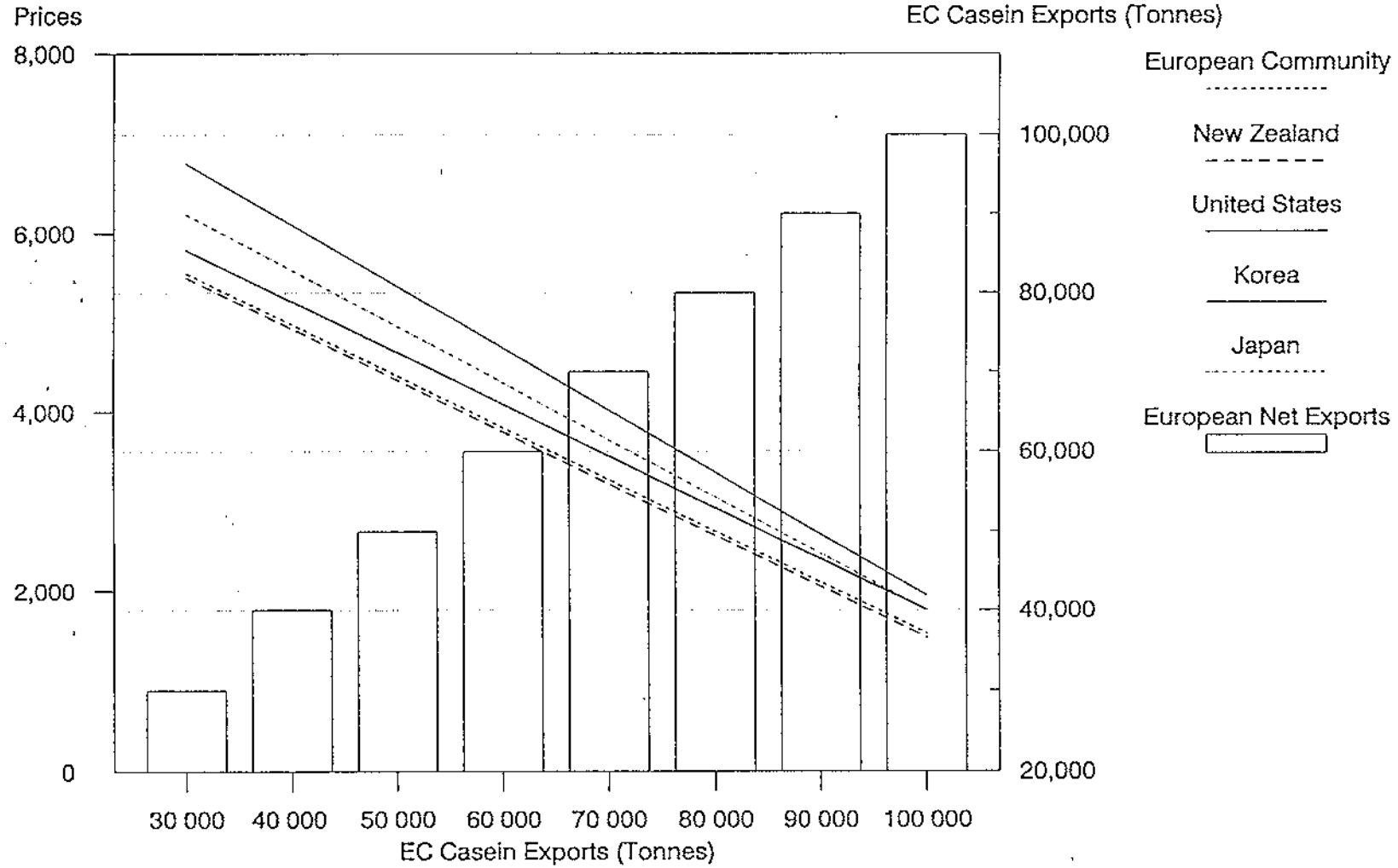
Trade flows in figure 12 also exhibit a linear relationship as European Community supply increases. In the North Asian markets volumes increase as exports of casein from the EC increase. This reflects the increased supply of European casein into the American market diverting New Zealand casein onto the Asian markets.

New Zealand's fob revenue peaks when EC supply is at its lowest scenario level ie. NZ$224.96 million when EC export supply is 30 000 tonnes. For every 10 000 tonne increase in European Community supply, New Zealand's revenue received by producers decreases by NZ$23.57 million.

6.2.6.2. Scenario 5B : With Korean and Japanese tariffs removed

A comparison between figures 11 and 12, 13 and 14 suggests similar results to those obtained under scenario 5A. As expected prices are higher in the producing nations and the United States while lower in the East Asian countries in the 'no tariff'scenario.

For every 10 000 tonne increase in quantity supplied by the European Community, prices in Europe, New Zealand, United States, Korea and Japan decrease by NZ$581.25. As the European Community supply increases in 10 000 tonne amounts, exports from New Zealand to the United States decrease by 749 tonnes, exports from New Zealand to Korea increase by 107 tonnes, while exports from New Zealand to Japan increase by 640 tonnes.

Slightly more casein goes to the markets of Asia under the 'no tariff' scenario, reflecting increasing returns to producers with removal of the tariff.

With EC production at its lowest scenario tonnage, New Zealand producers benefit the most in revenue terms, ie. NZ$226.91 million when European supply is 30 000 tonnes. For every EC export tonnage increase of 10 000, New Zealand's revenue decreases by NZ$23.17 million.

Figure 6.12

SCENARIO 5A:WORLD TRADE WITH VARYING EC SUPPLY
(Tariffs: Korea 20%, Japan 10%)
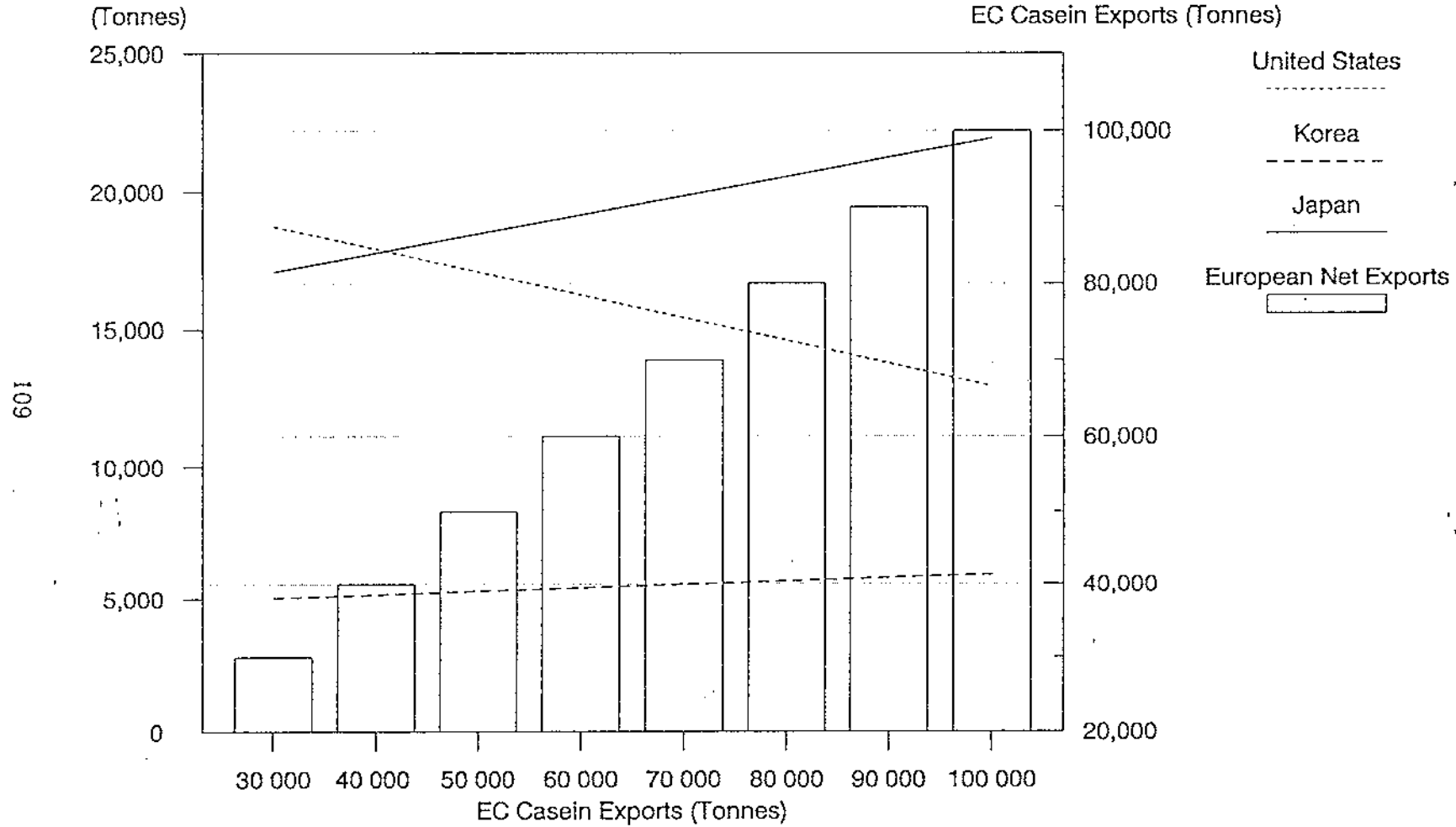
NB: All European Production is taken up by USA.

Figure 6.13

SCENARIO 5B:WORLD PRICES WITH VARYING EC SUPPLY

(Tariffs: Korea 0%, Japan 0%)
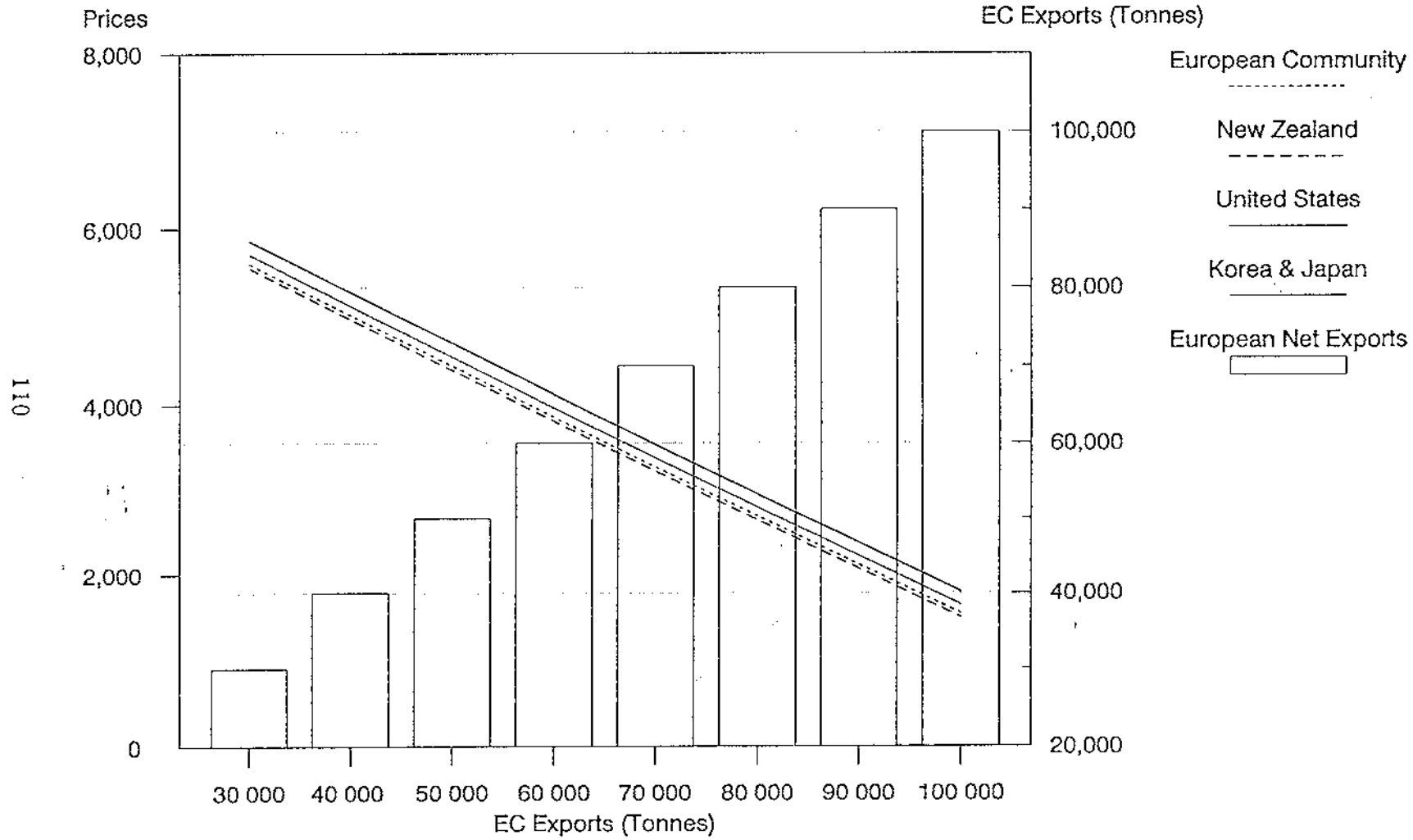
Figure 6.14

SCENARIO 5B:WORLD TRADE WITH VARYING EC SUPPLY

(Tariffs: Korea 0%, Japan 0%)
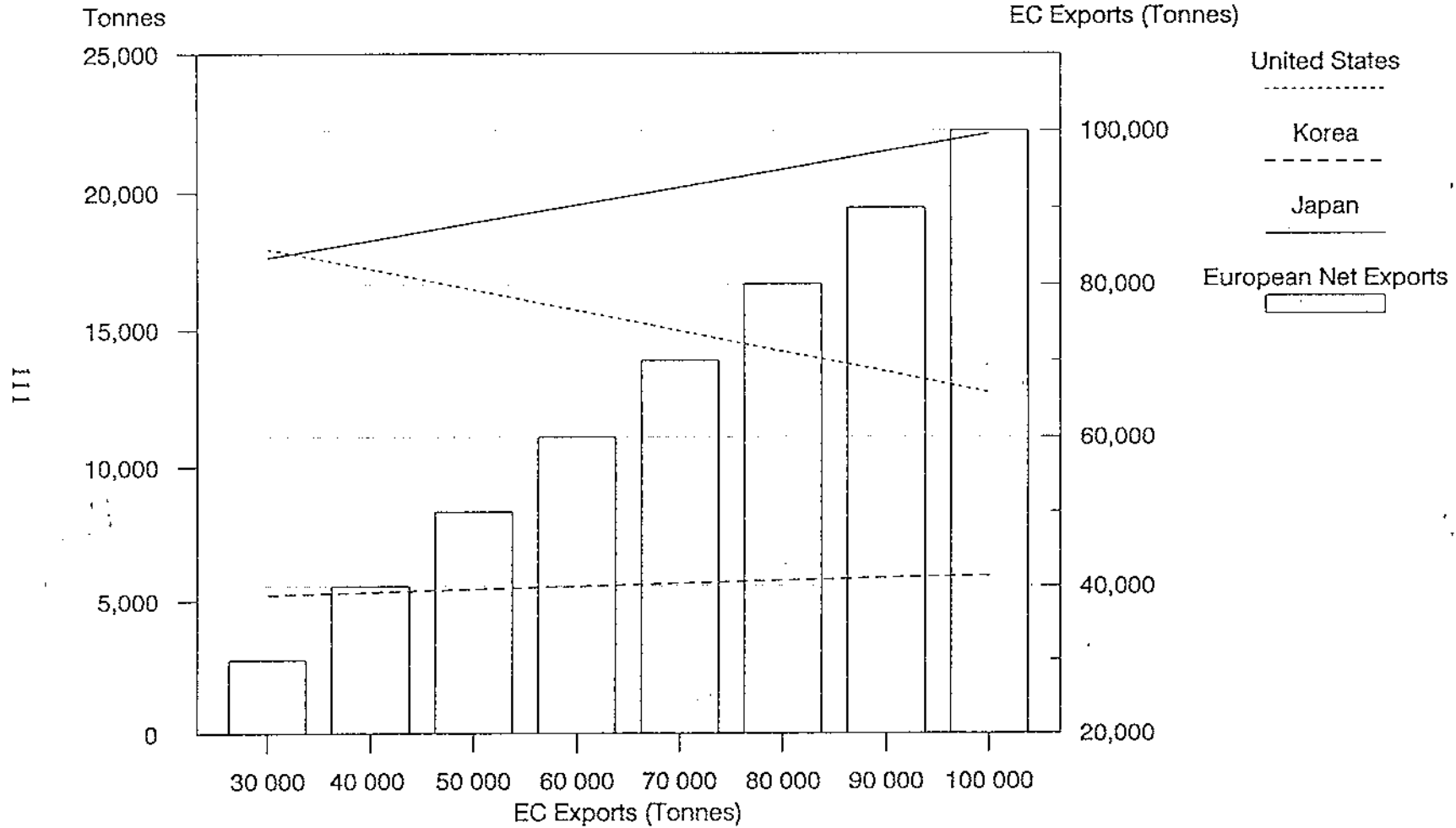
NB: All European Production is taken up by USA.

Scenarios 5A and 5B contrast sharply with scenarios 1 to 4. As EC producers vary production the effect on New Zealand producers is substantial[1]. This reinforces the dominance of the EC in world dairy markets.

6.2.7 Scenario 6 : nil tariff barriers.

Figures 15 and 16 illustrate the effect of the removal of all tariff barriers on the casein trade between the countries in this study.

Predictably, prices in Korea and Japan are equalised because the transport costs are the same between New Zealand and each of these East Asian markets. Prices in these markets drop by between four and six hundred dollars. The Korean price takes the biggest fall because they have the largest tariffs. Prices in Europe and New Zealand increase slightly (0.9 percent) while the American price drops (by 4 percent).

Excluding 5A and 5B the nil tariff barrier scenario is the best case scenario for New Zealand producers in terms of revenue. Results are in line with the scenarios already produced. Trade flows between New Zealand and East Asia are slightly up on the base results, and correspondingly, New Zealand exports of casein to the United States decrease.

World prices also increase in scenario 5 over scenarios 1 to 4, contributing to the increased revenues to New Zealand exporters. The removal of all tariffs means New Zealand revenue increases to NZ$134.25 million, an increase of NZ$1.19 million.

---

1. Historically EC casein export supply has been less than the 69 000 tonnes set in the QP model. Over the past 10 years it has ranged between 30 000 and 80 000 tonnes availble for export.

Figure 6.15

SCENARIO 6: Nil Tariffs

(Tariffs: Korean 0%, Japan 0%) *

113
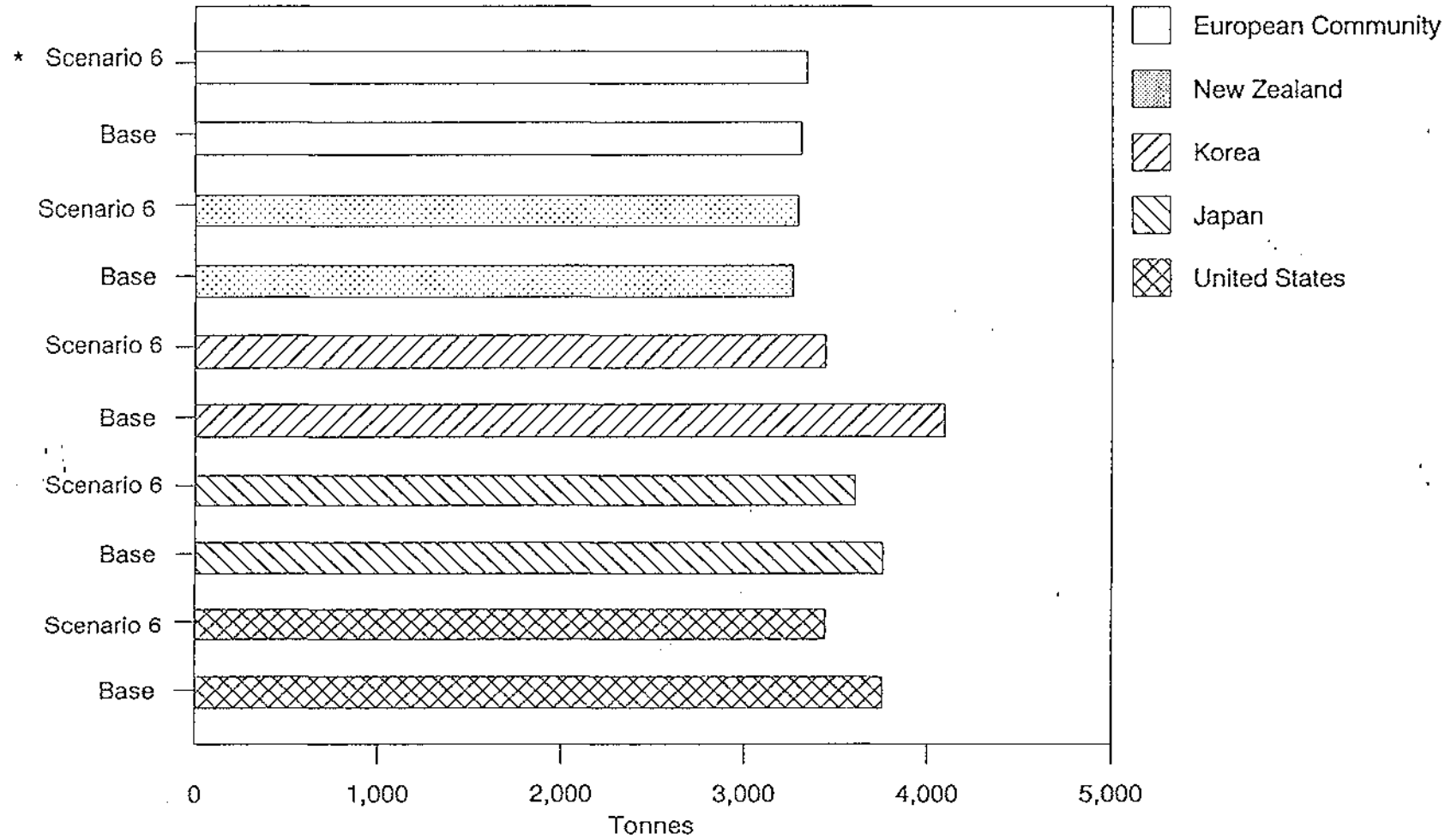
Figure 6.16

SCENARIO 6 PREDICTED TRADE WITH NIL TARIFFS

(Tariffs: Korea 0%, Japan 0%) *
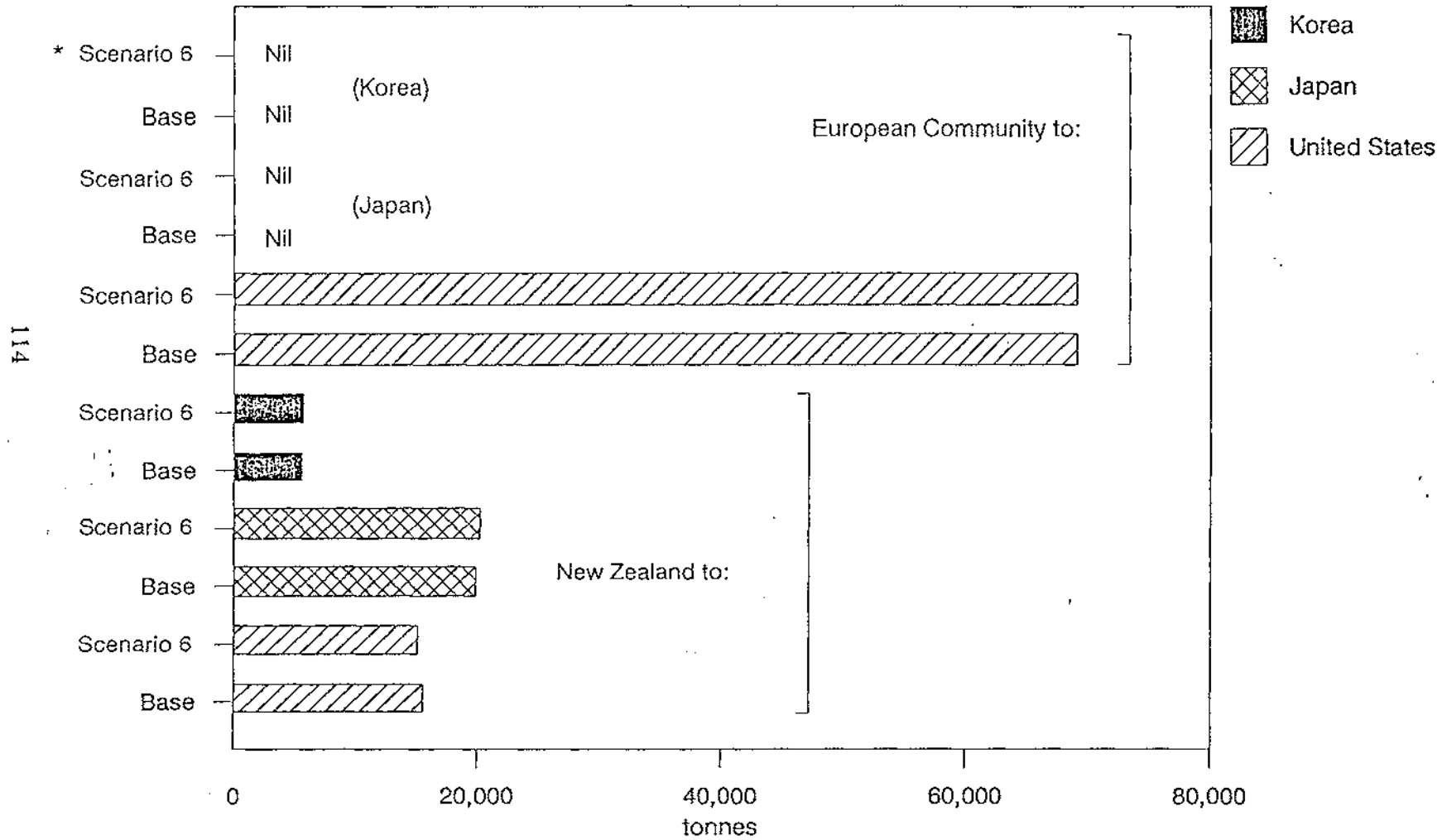
6.3 Summary

The scenario analysis can be divided into two parts: firstly the scenarios which do not manipulate European Community production, scenarios 1 to 4 and scenario 6. The revenues predicted for these scenarios are set out in table 6.1.. Secondly, scenario 5 which is designed to vary quantities of EC exports on to the world market and gauge the effect on revenues to New Zealand producers is set out in table 6.2.

TABLE 6.1

REVENUE RETURNS TO NZ PRODUCERS: VARIOUS TARIFF SCENARIOS

		Japanese Tariff	
		0%	10%
		(NZ$, millions)	
	0%	134.25	133.35
Korean	10%	134.10	133.21
Tariff	20%	133.95	133.06

European Community supply = 69 000 tonnes.

If we take the first set of scenarios the results were as expected. In each case, exports from the European Community were directed exclusively to the United States. As tariff barriers came down in East Asia, exports from New Zealand to the United States decreased. This occurs because the world price of casein increased as demand in East Asia increased (stimulated by the tariff drop) diverting casein from the United States to East Asian markets. In revenue terms the best case scenario occurs where tariff barriers are completely removed. However, the tariff barrier drop only increases revenue by 0.9 percent. For a policymaker the removal of North Asian tariff barriers would be something of a pyrrhic victory because the revenue gains are small compared to what could be gained from the reduction in EC exports. More specifically a reduction in subsidises paid to European farmers under the Common Agricultural Policy.

As Japan and Korea liberalise, domestic prices of casein in East Asia fall, while world prices increase. For the two exporters, New Zealand and the European Community, prices received increase slightly while demand increases in East Asia and decreases in the United States.

In table 6.2 the second group of revenue scenarios are represented. The amount of EC casein export production has been varied in steps of 10 000 tonnes. Obviously, of these possibilities, the best case scenario for New Zealand dairy exporters would be where the European Community exports was set at 30 000 tonnes (or less) and East Asian countries removed its tariff barriers. The fob revenue to New Zealand exporters is estimated at NZ$133.06. With the EC restricting exports to 30 000 tonnes and no North Asian tariff barriers New Zealand exporters would expect to earn NZ$224.96 million, an increase of over NZ$90 million dollars. Even with tariff barriers in place, the gains from trade for New Zealand are almost as great with the a European casein production decrease.

It is implicitly assumed that the EC greatly influences the world price of casein through production subsidies. EC export production in 1987 stood at 69 000 tonnes making them the largest exporter of casein in the world. Any increase in production is shown to have a serious impact on revenue gains by New Zealand producers.

TABLE 6.2
REVENUE TO NZ PRODUCERS WITH VARYING EC EXPORTS

EC Exports Tonnes	Revenues	
	With Tariffs (Korea 20% Japan 10%)	Tariffs Removed
	(NZ$, millions)	
30 000	224.96	226.91
40 000	201.39	203.15
50 000	177.83	179.40
60 000	154.28	155.66
70 000	129.54	133.95
80 000	107.17	108.13
90 000	83.62	84.39
100 000	60.07	60.60

CHAPTER SEVEN

Summary and Conclusions

7.1 Summary

The modelling of major players in the world casein market has shown the benefits to New Zealand producers of a reduction in EC supplies and the removal of tariffs in East Asia. The reduction in Korean and Japanese tariffs increases world prices and decreases domestic prices. A reduction in EC supply and by implication EC export subsidies will bring the biggest gains to New Zealand producers.

Korean imports of dairy products are largely controlled by the government. Imports of dairy products, except casein are banned outright. This suggests that given the very high prices in the Korean market place, that country's dairy industry would suffer drastically if a free market in dairy products was introduced.

The major objectives of this study were to analyse the impact of tariff reductions in the Korean casein market and to measure their effect on New Zealand's revenue from casein exports. Other objectives were: (1) to review protectionism in the international casein market place; (2) to develop a model of the major players in the world casein market, ie the Republic of Korea, Japan, United States, New Zealand and the European Community; (3) to incorporate into the trade model tariff barriers put up by nations to hinder trade; and (4) to assess the impacts on casein prices and trade flows when tariff reductions are instituted.

In Chapter Two the growth of agriculture in the highly successful industrialised nation of Korea was reviewed. Agriculture in Korea has been propped up with an elaborate series of informal and formal trade barriers

which have proven very difficult to penetrate.

Protectionism in the international casein market was reviewed in Chapter Three where measurement of protection and its impacts on the international market were evaluated in the context of the dairy market in Korea. A general model of the casein market was constructed in Chapter Four.

Casein demand and supply equations for the major players were estimated in Chapter Five. Various trade policy scenarios were analysed using the quadratic programming model in Chapter Six. This enabled the study of the effects of a tariff reduction on New Zealand's revenue from casein exports. The impacts on prices and trade flows were presented and conclusions noted.

7.2 Conclusions

It was estimated that gains to New Zealand dairy producers would be made following the removal of tariffs and a reduction in the amount of casein supplied to the world market by the European Community. Sensitivity analyses predicted that gains from a given percentage reduction in the Japanese tariff would be more than in the Korean case. The larger volume of casein exported to the Japanese market (in relation to the Korean market) and the more elastic demand equation in Korea (than the Japanese market) contribute to this result.

According to the analyses, the complete removal of Korean and Japanese tariffs will lead to increases in the value of imports of 2.2 and 1.7 percent respectively. Revenue from New Zealand casein exports will increase by NZ$1.19 million (fob). The higher world price results in higher returns to producers in New Zealand.

Sensitivity analyses also showed that greater revenue gains to New Zealand can be achieved through reductions in the volume of EC exports, ie a reduction in EC production and export supports. More pressure focused on European policy makers to reduce these subsidies (which will reduce

119

European Community supply) will lead to greater net revenue returns will accrue to New Zealand. Even with Korean and Japanese tariffs in place, a decrease in European supply of 10 000 tonnes would result in an increase of NZ$23.53 million (fob) in New Zealand's export receipts. In the best case scenario examined (no East Asian tariffs and European Community production at 30 000 tonnes) New Zealand's revenue increased by NZ$93.85 million (fob) from the base result. With East Asian tariffs and European production at 30 000 tonnes, total revenue is NZ$1.95 (fob) million less than in the best case scenario. Clearly, greater gains to New Zealand's casein export revenue can be achieved with the reduction in European Community export supply than through tariff reduction in Asian markets.

7.3 Limitations of the model

New protein-rich products, particularly those derived from soya beans, are appearing as substitutes for casein. Lack of price data on these products precluded their use in the model. The specification of the demand equations was limited to those products for which price series existed. This could mean that the model is biased as a result of bias in the estimation of its demand coefficients. Autocorrolation and insignificant t statistic results could also be an outcome of substitutes not being included.

The assumption of fixed casein supplies for New Zealand and the European Community do not take into account changes in technology. The nature of dairy supply in the European Community is a possible area of further study. What drives the 'product mix' for dairy products in the European Community, and how that affects world prices, production and trade flows is an important area of study for New Zealand.

The QP model used in this study estimates a perfectly competitive equilibrium solution. However, given that the European Community dominates the world casein market, price setting in this environment is far from perfectly competitive. This is one of the major drawbacks of this model to describe behavior in the world casein market.[1]

The QP model did not accurately describe the world casein bilateral trade flows. The QP model did not predict trade flows from the EC to East Asia, whereas in reality half the market in East Asia is taken up by EC supply. Other approaches such as Armington-type models (see Dixit and Roningen, 1986) have been shown to more accurately describe bilateral trade flows by assuming that products produced in many countries are not homogenous. This leads to the conclusion 'that the law of one world price does not hold'.

7.4 Recommendations

The quadratic programming model highlighted areas on which New Zealand policy makers are focused. These are:

(1) The amount of casein exported to world markets from the European Community has a large influence on the world market price. Continued pressure on the European Community to reduce subsidies and, therefore, quantities exported will bring increased export revenues to New Zealand.

(2) Given the potential for New Zealand's dairy trade in East Asia, bilateral pressure to reduce tariffs and improve market access for New Zealand dairy products should be maintained.

---

1. QP can also model other competitive structures.

Bibliography

Agra Europe. Agra Europe Dairy Supplement. Various Years.

Agricultural Reform Efforts in the United States and Japan. Editor: D. Gale Johnson. New York Press. 1987.

Anderson, K. "Food Pricing Policy in Korea 1955 to 1985" Australia - Japan Research Centre. Canberra Australia. 1986.

----- "On Gains and Losses from Beef Import Quotas in Japan and Korea" Pacific Economic Papers. No. 90 1984.

----- "Economic Growth, Comparative Advantage and Agricultural Trade" Review of Marketing and Agricultural Economics. Vol 51 (3) 1983 pp231 - 48.

----- & Y.J. Joo. "South Korea's Rapid Industrialisation. Implications for Agricultural Trade". BAE, 1984.

Barber C L. "Canadian Tariff Policy". Canadian Journal of Political Science". 21 Nov 1955. pp513 - 30.

Balassa B. "Trade Protection in Industrial Countries: An Evaluation". Journal of Political Economy. Vol 73 Dec 1965. pp573 - 94.

Bannock G., Baxter R.E. & Rees R., Dictionary of Economics. Penguin. 1984.

Basevi G. "The United States Tariff Structure: Estimates of Effective Rates of Protection of United States Industries and Industrial Labour". Review of Economics and Statistics. Vol 48 1966. pp147 - 60.

Bhagwati J. & T.N. Srinivasani, Lectures in International Trade. MIT Press Cambridge Massachusetts. 1983.

Carter C., N. Gallini & A.Schmitz. "Producer - Consumer Tradeoffs in Export Cartels". American Journal on Agricultural Economics. Vol 62 No 5 Nov 1980.

Clough P.W.J. & F. Isermeyer. "A Study of the Dairy Industries and Policies of West Germany and New Zealand" Institut fur Agrarokonomie der Universitat Gottingen. 1986.

Corden W.M. "The Tariff". Editored by Hunter A. The Economics of Australian Industry. Melbourne University Press. Melbourne. 1963.

----- "Protection". Economic Record. Vol 42 March 1966. pp129 - 48.

----- The Theory of Protection. Toronto: Oxford University Press. 1971.

De Boer A.J. Livestock Development: The Asian Experience 1982. in Fine and Lattimore, opt cit.

Department of Statistics. <u>NZ Offical Yearbook 1988/89</u>. Wellington New Zealand 1989.

Department of Trade and Industry. <u>Export News</u>. Wellington. August 1988.

Milk Marketing Board. <u>EEC Dairy Facts and Figures</u>. Surrey England 1988.

Enke S. "Equilibrium among Spatially Separated Markets: Solution by Electric Analogue". <u>Econometrica</u>. Vol 19 1951. pp40 -47.

Furtan W.H., J.G. Nagy and G.G. Storey. "Impact on the Canadian Rapeseed Industry from Changes in Transport and Tariff Rates". <u>American Journal of Agricultural Economics</u>. May 1979. pp238.

GATT Newsletter. <u>Focus</u>. Vol 66 Nov 1989.

Grimwade N. <u>International Trade: New Patterns of Trade, Production and Investment</u>. Routledge 1989.

Grubel H. and H.G. Johnson. <u>Effective Rate of Tariff Protection</u>. Geneva 1971.

Lattimore R., J. Roberston, and G. Griffiths. "Domestic Dairy Policies and International Market Adjustment". <u>The Livestock and Grains Study Programme of the Pacific Economic Cooperation Conference, Proceedings of the Second Workshop</u>. Editors A.N Rae and R.W.M. Johnson, Centre for Policy Studies. Massey University Palmerston North. October 1988.

Lindert & Kindleberger. <u>International Economics</u> R.D. Irwin, 1982.

International Dairy Arrangement. <u>Status Report on World Market for Dairy Products</u>. GATT. Various Years.

International Monetary Fund. <u>Annual Report 1988</u>. IMF. 1988.

Johnson H.G. <u>The Theory of Tariff Structure, with Special Reference to World Trade Development</u>. in Johnson H.G. and P.B. Kenen, Trade and Development, Librairie Droz, Geneva 1965.

----- "Effective Protection and General Equilibrium Theory." in Johnson H.G. <u>Aspects of the Theory of Tariffs</u>. Allen and Unwin, London, 1971.

Johnson C.N. <u>Impact of the Tariff Barriers on the Canadian Canola Crushing Industry</u>. Unpublished thesis, University of Manitoba 1987.

MacAulay T.G., R.L. Batterham and B.S. Fisher. "Solution of Spatial Trading Systems with Concave Cubic Programming". <u>Australian Journal of Agricultural Economics</u>. Vol 33 No.3 Dec 1989. pp170-186.

Martin L.J. "Quadratic Single and Multi - Commodity Models of Spatial Equilibrium: A Simplified Exposition." <u>Canadian Journal of Agricultural Economics</u>. Vol 29 (1) 1981.

McCall D.G. and R.J. Townsley. "A Use of Calibration in the Development of Simulation Models". Mathematics and Computers in Simulation Vol 30 1988 pp27-32.

Melvin J & B.W. Wilkinson. Effective Protection in the Canadian Economy Economic Council of Canada, Ottawa, 1968.

Menzie E.L. and B.E. Prentice. "Formal and Informal Barriers to Trade in Agricultural Products, Canada - United States". Amercian Journal of Agricultural Economics. Dec 1987. pp947.

Ministry of Agriculture and Forestry. Abstract of Statistics on Agriculture, Forestry and Fisheries. Ministry of Agriculture and Forestry. Japan. Various Years.

Ministry of Agriculture Forestry and Fisheries. Dairy Statistics 1983 - 8. Livestock Bureau. Korean Dairy Association. Various Years.

National Bureau of Statistics. Korean Statistical Handbook 1984-8 Economic Planning Board, Republic of Korea. Various Years.

OECD. National Policies and Agricultural Trade, Country Study, Japan. OECD Paris 1987.

New Zealand Dairy Board. Background and Perspective. NZDB February, 1988.

New Zealand Dairy Board. Annual Report. NZDB. Various Years.

Park J.H. "Socio - Economic Problems of Small - Size Farm Structure in the Process of Economic Development in Korea". Cooperative Review Vol 11 Feb. 1989.

PECC. Pacific Economic Outlook: Dynamism and Adjustment. Committee for Pacific Economic Cooperation. Osaka May 1988.

Rae AN., Wilson and W. Schroder. Dairy Development, Trade and Policy Issues, within the Pacific Basin. Centre for Policy Studies, Agricultural Policy Paper No. 11. May 1985.

Ryland G.J. "Korea: Protection or Trade Liberalisation ?". The FAO Livestock/Feed Sector Policy Mission 1980. Paper presented to the 25th Conference of Australian Agricultural Economics Society, Christchurch New Zealand. 1981.

Samuelson P.A. "Spatial Price Equilibrium and Linear Programming". American Economic Review. Vol 42 1952 pp283 - 303.

Schmitz A. "United States Agricultural Trade: Where are the Gains?" Western Journal of Agricultural Economics. 13 (2) 1988. pp337 -364.

----- "GATT and Agriculture: The Role - of Special Interest Groups" American Journal of Agricultural Economics Dec 1988. pp994.

Schuller R. Schuzzoll Und Freihandel Vienna and Liepzig 1905, pp149-50.

Simpson J.R. and Hilman J.S. "Influence of Technology Change on Future United States Beef Exports to the EEC". Quantative Journal of International Agriculture. No.3, Jul - Sept 1988.

Smith, McLoughlin, Large and Chapman, Asia's New Industrial World. Methuen 1985.

Soligo R and Stern J. "Tariff Protection, Import Substitution and Investment Efficiency" Pakistan Development Review. Vol 5 1968 pp249-270.

Statistics Bureau. Japanese Statistical Yearbook. Management Coordination Agency. Tokyo. 1988.

Swallow B. Policy Analysis of Canadian/Japanese Trade of Rapeseed and Rapeseed Products. Unpublished Thesis, University of Sakactchewan, June 1983.

Takayama T. and G.G. Judge. Spartial and Temporal Price and Allocation Models. North-Holland Publishing Company 1971.

Tyers and Anderson. "Price, Trade and Welfare Effects of Agricultural Protection: The Case of East Asia". Review of Marketing and Agricultural Economics Vol 53 No 3 Dec 1988.

United States Department of Agriculture. Agricultural Statistics. Government Print, 1988.

United States Department of Agriculture. Government Intervention in Agriculture, Measurement, Evaluation and Implications for Trade Negotiations. International Economics Division, National Economics Economics Division, Economic Research Service. Government Print. 1987.

United States Department of Agriculture. Modeling Bilateral Trade Flows with the Static World Policy Simulation (SWOPSIM) Modeling Framework. International Economics Division, National Economics Economics Division, Economic Research Service. Government Print. 1986.

Whalley J. Trade Liberalisation Among Major World Trading Areas" MIT Press. 1986.

World Bank. Country Economic Report, Korea - Problems and Issues in a Rapidly Growing Economy. John Hopkins Uni. Press 1976.

World Bank. World Development Report 1987. Oxford University Press.

UNKRA. Agriculture, Forestry and Fisheries in South Korea. Columbia University Press 1954.

Varian H.R. Intermediate Microeconomics: A Modern Approach. W.W. Norton and Co. 1987.

Appendix A

Appendix A contains the data and Ordinary Least Squares Regression calculations.

MTB > PRIN C4 C6 C40 C31 C46

ROW	CAQ2	CAP2	SKP2VA	CHP2VA	GDPOP2
1	43900	750	910.75	1478.00	5104
2	44100	1250	925.65	1572.99	5605
3	51200	1140	1013.84	1528.47	6209
4	51200	1020	1281.85	1656.09	6705
5	26500	1480	1393.77	1820.50	7401
6	50900	1240	1383.67	2122.45	7878
7	65400	1150	1467.86	2012.69	8708
8	62200	1270	1582.69	2134.13	9720
9	68400	1580	1760.43	2375.71	10741
10	69000	1700	1952.92	2726.35	11995
11	50800	2305	2056.55	2992.04	13262
12	80200	2400	2005.67	2941.90	13614
13	72400	2420	2096.55	2947.17	14605
14	87000	2100	2005.34	3040.69	15913
15	103000	2130	1852.68	2814.95	16797
16	103000	2070	1777.30	2805.69	17324
17	95000	2140	1742.92	2715.00	17826

MTB > REGRESS C4 ON 4 C6 C40 C31 C46;
SUBC> DW.

The regression equation is
CAQ2 = 30051 - 26.4 CAP2 - 22.7 SKP2VA + 16.6 CHP2VA + 7.00 GDPOP2

Predictor	Coef	Stdev	t-ratio	p
Constant	30051	11875	2.53	0.026
CAP2	-26.42	12.52	-2.11	0.057
SKP2VA	-22.72	24.07	-0.94	0.364
CHP2VA	16.62	25.97	0.64	0.534
GDPOP2	7.002	1.443	4.85	0.000

s = 8901   R-sq = 87.7%   R-sq(adj) = 83.6%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	4	6766494720	1691623680	21.35	0.000
Error	12	950780416	79231704		
Total	16	7717275136			

SOURCE	DF	SEQ SS
CAP2	1	3281243720
SKP2VA	1	102980264
CHP2VA	1	1917023104
GDPOP2	1	1865143672

Unusual Observations

Obs.	CAP2	CAQ2	Fit	Stdev.Fit	Residual	St.Resid
5	1480	26500	41350	5684	-14850	-2.17R
12	2400	80200	64146	5010	16054	2.19R

R denotes an obs. with a large st. resid.

Durbin-Watson statistic = 2.27

where:

$CAQ2 = D_2$
$CAP2 = P_{c2}$
$SKP2VA = P_{S2}$
$CHP2VA = P_{C2}$
$GDPOP2 = Y_2$
(see page 69)

MTB > PRIN C34 C10 C12 C13 C45

ROW	CAQ3VA	CAP3	CHP3	WMP3	GDPOP3
1	247	923	4222180	9750000	1003304
2	304	1326	4111070	10005001	1207710
3	363	1431	4297704	11460000	1544667
4	409	1710	5740935	8210000	2173245
5	470	1862	4275735	9065000	2820270
6	1011	1532	4268842	9020000	3723577
7	1908	1477	4728175	8095000	4966900
8	1930	1588	4658175	8140000	4474880
9	2400	1980	4570401	8725000	8160017
10	2414	2838	3700740	7995000	9419141
11	2400	3074	3621189	7145000	11653354
12	2469	2798	3546631	7055000	12898859
13	3270	2541	3222630	7010000	14779975
14	3774	2281	3577742	6990000	16435516
15	4146	2054	3632184	6900000	17352277
16	5373	2375	3613964	7004999	20932044
17	5509	2555	3517965	6970000	23425574

MTB > REGRESS C34 ON 4 C10 C12 C13 C45
SUBC> DW.

The regression equation is
CAQ3VA = -990 - 0.305 CAP3 +0.000293 CHP3 +0.000025 WMP3 + 0.00270 GDPOP3

Predictor	Coef	Stdev	t-ratio	p
Constant	-990	2191	-0.452	0.659
CAP3	-0.3054	0.2437	-1.253	0.234
CHP3	0.0002528	0.0002285	-1.106	0.204
WMP3	0.0000246	0.0001583	0.156	0.851
GDPOP3	0.0027003	0.0002704	9.99	0.000

s = 394.6   R-sq = 96.9%   R-sq(adj) = 95.9%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	4	48190974	11297744	95.19	0.000
Error	12	1425026	118752		
Total	16	49616076			

SOURCE	DF	SEQ SS
CAP3	1	18751750
CHP3	1	3759328
WMP3	1	12560128
GDPOP3	1	11843771

Unusual Observations

Obs.	CAP3	CAQ3VA	Fit	Stdev.Fit	Residual	St.Resid
4	1710	409.0	868.0	292.0	-459.8	-2.51R

R denotes an obs. with a large st. resid.

Durbin-Watson statistic = 1.32

where:

CAQ3VA = D_3
CAP3 = P^{c3}
CHP3 = P^{c3}
WMP3 = P^{w3}
GDPOP3 = Y_3
(see page 73)

```
MTB > PRIN C24 C14 C15 C16  C49
```

ROW	CAQV1	CAP4	SKP4	BUP4	GDPOP4
1	20500	505.05	338000	647000	2171.0
2	20000	753.32	338000	647000	2796.9
3	21200	782.76	402000	731000	3277.9
4	21600	835.73	437000	741000	4103.7
5	21500	1165.87	506000	979000	4456.0
6	20500	1010.64	366000	1160000	4922.1
7	19750	1436.42	501000	1253000	6070.6
8	21400	2090.00	501000	1253000	6474.6
9	20750	2300.00	501000	1253000	6574.7
10	19500	2630.00	501000	1253000	8905.5
11	19700	3283.00	501000	1253000	7599.7
12	18000	3451.00	507000	1253000	8956.7
13	18300	3763.00	536000	1302000	9675.0
14	18200	3479.00	536000	1302000	10456.8
15	20400	3685.00	541000	1276000	10996.7
16	20000	3805.00	541000	1225000	16092.8
17	19600	3932.00	572000	1100000	19465.0

```
MTB > REGRESS C24 ON 4 C14 C15 C16 C49;
SUBC> DW.

The regression equation is
CAQV1 = 20200 - 1.10 CAP4 + 0.00456 SKP4 - 0.00078 BUP4 + 0.134 GDPOP4
```

Predictor	Coef	Stdev	t-ratio	p
Constant	20200	2166	9.33	0.000
CAP4	-1.1015	0.4070	-2.71	0.019
SKP4	0.004564	0.009222	0.55	0.589
BUP4	-0.000781	0.002088	-0.37	0.715
GDPOP4	0.1340	0.1136	1.19	0.261

```
s = 803.5        R-sq = 61.0%        R-sq(adj) = 45.0%
```

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	4	12517454	3129464	4.85	0.015
Error	12	7747733	645644		
Total	16	20265188			

SOURCE	DF	SEQ SS
CAP4	1	10001114
SKP4	1	643321
BUP4	1	775254
GDPOP4	1	878167

```
Durbin-Watson statistic = 2.01
```

where:
$CAQV1 = D_4$
$CAP4 = P^N_{c4}$
$SKP4 = P_{S4}$
$BUP4 = P_{W4}$
$GDPOP4 = Y_4$
(see page 74)

Appendix B : Data Sources

D_1 Demand for Casein in the European Community, tonnes. EEC Dairy Facts and Figures, Milk Marketing Board, Surrey England. 1972 -1988.

D_2 Demand for Casein in the United States, tonnes. New Zealand Board Annual Reports

D_3 Demand for casein in Korea, tonnes. Dr Shin-Haeng Huh, Korean Rural Economics Institute.

D_4 Demand for casein in Japan. New Zealand Board Annual Reports

S_1 Supply of Casein in the European Community, tonnes. EEC Dairy Facts and Figures, Milk Marketing Board, Surrey England. 1972 -1988.

P_{c1} Agra Europe Dairy Supplement / USDA Dairy Outlook and Situation / International Dairy Arrangement, Status Report on World Market for Dairy Products, GATT, Various Years

P_{c2} Agra Europe Dairy Supplement / USDA Dairy Outlook and Situation / International Dairy Arrangement, Status Report on World Market for Dairy Products, GATT, Various Years

P_{c3} Price of Casein in Korea (US$), Dr Shin-Haeng Huh, Korean Rural Economics Institute.

P_{c4} Price of casein in Japan, Abstract of Statistics on Agriculture, Forestry and Fisheries, Ministry of Agriculture and Forestry, Japan, various years.

P_{S1} Skimmilk Powder price in the European Community. (ECU's per tonne.) EEC Dairy Facts and Figures, Milk Marketing Board, Surrey England. 1972 -1988.

P_{S2} Price of Skimmed Milk in the United States. (US $ per tonne). Agricultural Statistics. United States Department of Agriculture, Government Print Washington.

P_{S3} Price of Skimmed Milk in Korea. (won per tonne) Dr Shin-Haeng Huh, Korean Rural Economics Institute.

P_{S4} Price of skimmed milk powder in Japan. Abstract of Statistics on Agriculture, Forestry and Fisheries, Ministry of Agriculture and Forestry, Japan, various years. / National Policies and Agricultural Trade Country Study, Japan OECD, Paris 1987.

P_{W1} Wholemilk Powder price in the European Community. EEC Dairy Facts and Figures, Milk Marketing Board, Surrey England. 1972 -1988.

P_{W3} Price of Wholemilk in Korea (won per tonne) Dr Shin-Haeng Huh, Korean Rural Economics Institute.

P_{W4} Price of wholemilk powder in Japan. Abstract of Statistics on Agriculture, Forestry and Fisheries, Ministry of Agriculture and Forestry, Japan, various years. / National Policies and Agricultural Trade Country Study, Japan OECD, Paris 1987.

P_{C2} Price of cheese in the US. (US \$ per tonne). Agricultural Statistics. United States Department of Agriculture, Government Print Washington.

Y_1 Per Captia income in the European Community. European Marketing Data 1988/89 24th edition, Euromonitor.

Y_2 Per captia income in the US. Statistical Abstracts of the United States US Department of Commerce, Bureau of the Census.

Y_3 Per Captia Income for Korea. Japanese Statistical Yearbook, Statistics Bureau, Management and Co-ordination Agency.

Y_4 Per Captia Income for Japan. Japanese Statistical Yearbook, Statistics Bureau, Management and Co-ordination Agency.

Appendix C − Quadratic Programming Results

Appendix C1 − Base Results

Table C1.1
BASE RESULT PRICES (TARIFFS: KOREA 20%, JAPAN 10%)

Countries	Actual	Estimated	(%) d i f f
	(NZ$ per tonne, FOB)		
European Community	3313.53*	3306.3	-0.002
New Zealand	3298.36*	3258.3	-0.012
Korea	4243	4090	-3.6
Japan	3932	3749.2	-4.6
United States	3552	3566.4	0.004

* Estimated, see text for further discussion.

TABLE C.1.2
PREDICTED TRADE FLOWS (TARIFFS: KOREA 20% ,JAPAN 10%)

Countries	Actual	Estimated	(%)diff
	(tonnes)		
European Community to			
Korea	3470	Nil	~
Japan	9800	Nil	−
United States	55730	69000	23.81
New Zealand to			
Korea	2036	5534	171.81
Japan	9800	19801	102.05
United States	29000	15501	46.55

In Table C.1.1, New Zealand and European 'actual' prices estimated by dividing country net exports receipts by total country exports. Using the notation developed in Chapter Five, net export receipts (NER) for Europe are computed as:

$$P_2 X_{12} - t_{12} X_{12} + P_{13} X_{13} - T_3 [P_1 + t_{13}] X_{13} - t_{13} X_{13} + P_4 X_{14} - T_4 [P_1 + t_{14}] X_{14} - t_{14} X_{14} = NER(1)$$

Setting NER(1) = $P_1 S_1$,
we can then solve for P_1 estimates European casein price ($NZ/tonne). This procedure is repeated to estimate P_5, New Zealand casein price. The actual 1987 values for prices (other than for Europe and New Zealand) and trade flows are presented in Tables C.1.1 and C.1.2.

It is interesting to note that the 1987 actual prices, given 1987 tariff and transport costs, do not satisfy the competitive market equilibrium price conditions.

European Price Conditions

$P_1 \geq P_2 - t_{12}$ 3313.53 $\geq$ 3552 - 260.1 = 3291.9
(SATISFIED)

$P_1 \geq (1 = TP_3)^{-1} P_3 - t_{13}$ 3313.53 $\geq$ 3535.83 - 169.56 = 3366.3
(Not SATISFIED)

$P_1 \geq (1 + T_4)^{-1} P_4 - t_{14}$ 3313.53 $\geq$ 3574.54 - 169.56 = 3405
(Not SATISFIED)

New Zealand Price Conditions

$P_5 \geq P_2 - t_{52}$ 3298.36 $\geq$ 3552 - 308.06 = 3243.94
(SATISFIED)

$P_5 \geq (1 + T_3)^{-1} P_3 - t_{53}$ 3298.36 $\geq$ 3535.83 - 150 = 3385.83
(Not SATISFIED)

$P_5 \geq (1 + T_4)^{-1} P_4 - t_{54}$ 3298.36 $\geq$ 3574.54 - 150 = 3424.54
(Not SATISFIED)

Appendix C2 - Japanese Tariff 10% Korean Tariff 10%

Table C2.1
SCENARIO 1: PRICES (TARIFFS: KOREA 10% ,JAPAN 10%)

Regions	Estimated Base Price	With 10% Tariff	difference
	(NZ$ per tonne)		%
European Community	3306.3	3309.9	0.109
New Zealand	3258.3	3262.0	0.114
Korea	4090.0	3753.2	-8.2
Japan	3749.2	3753.2	0.107
United States	3566.4	3570.0	0.101

TABLE C2.2
SCENARIO 1: PREDICTED TRADE FLOWS
(TARIFFS: KOREA 10%, JAPAN 10%)

Regions	Estimated Base result	With 10% Tariff	difference
	(tonnes)		%
European Community to			
Korea	Nil	Nil	–
Japan	Nil	Nil	–
United States	69000	69000	0
New Zealand to			
Korea	5534	5596	1.1
Japan	19801	19797	-0.002
United States	15501	15443	-0.374

Appendix C3 -- Japanese Tariff 10% Korean Tariff nil

Table C3.1
SCENARIO 2: PRICES (KOREA 0%, JAPAN 10%)

Regions	Estimated Base Price	With Nil Tariff	difference
	(NZ$ per tonne)		%
European Community	3306.3	3313.6	0.2
New Zealand	3258.3	3265.6	0.2
Korea	4090	3415.6	-16.4
Japan	3749.2	3757.1	0.2
United States	3566.4	3573.6	0.2

TABLE C3.2
SCENARIO 2: PREDICTED TRADE FLOWS
(TARIFF: KOREA 0%, JAPAN 10%)

Regions	Estimated Base result	With Nil Tariff	diff
European Community to	(tonnes)		%
Korea	Nil	Nil	--
Japan	Nil	Nil	--
United States	69000	69000	0
New Zealand to			
Korea	5534	5658	2.2
Japan	19801	19797	-0.03
United States	15501	15385	-0.8

Appendix C4 Japanese Tariff nil, Korean Tariff 20%

Table C4.1
SCENARIO 3: PRICES (TARIFFS: KOREAN 20%, JAPAN 0%)

Regions	Estimated Base Price	With Nil Tariff	diff
	(NZ$ per tonne)		%
European Community	3306.3	3328.1	0.659
New Zealand	3258.3	3280.1	0.669
Korea	4090.0	4116.1	0.638
Japan	3749.2	3430.1	-8.5
United States	3566.4	3588.2	0.611

TABLE C4.2
SCENARIO 3: PREDICTED TRADE FLOWS
(TARIFFS: KOREAN 20%, JAPAN 0%)

Regions	Estimated Base result	With Nil Tariff	diff
European Community to	(tonnes)		%
Korea	Nil	Nil	–
Japan	Nil	Nil	–
United States	69000	69000	0
New Zealand to			
Korea	5534	5529	-0.9
Japan	19801	20152	1.8
United States	15501	15155	-2.23

Appendix 5C - Japanese Tariff 10%, Korean Tariff 0%

Table C5.1
SCENARIO 4: PRICES
(TARIFFS: KOREAN 10%, JAPAN 0%)

Regions	Estimated Base Price	With Nil Tariff	diff
	(NZ$ per tonne)		%
European Community	3306.3	3331.7	0.8
New Zealand	3258.3	3283.8	0.8
Korea	4090	3777.1	-7.7
Japan	3749.2	3433.8	-8.4
United States	3566.4	3591.8	0.7

TABLE C5.2
SCENARIO 4: PREDICTED TRADE FLOWS
(TARIFFS: KOREAN 10%, JAPAN 0%)

Regions	Estimated Base result	With Nil Tariff	diff
	(tonnes)		%
European Community to			
Korea	Nil	Nil	–
Japan	Nil	Nil	–
United States	69000	69000	0
New Zealand to			
Korea	5534	5592	1.0
Japan	19801	20148	1.8
United States	15501	15096	-2.6

Appendix C6 - Sensitivity Analysis on European Community Production.

TABLE C6.1
SCENARIO 5A: WORLD PRICES OF CASEIN WITH VARYING EC SUPPLY
(TARIFFS: KOREA 20%, JAPAN 10%)

EC Supply	PE	PN	PU	PK	PJ
		(all prices in NZ dollars)			
30000	5552.84	5504.88	5812.94	6785.85	6220.36
40000	4976.54	4928.58	5236.64	6094.29	5586.43
50000	4400.24	4352.28	4660.34	5402.73	4952.50
60000	3823.94	3775.98	4084.04	4711.17	4318.57
70000	3247.64	3199.68	3507.74	4019.61	3684.64
80000	2671.34	2623.38	2931.44	3328.05	3050.71
90000	2095.04	2047.08	2355.14	2636.49	2416.78
100000	1518.74	1470.78	1778.84	1944.93	1782.85

PE - Price in the European Community.
PN - Price in the New Zealand.
PU - Price in the United States.
PK - Price in Korea.
PJ - Price in Japan.

TABLE C6.1.2
SCENARIO 5A: WORLD TRADE FLOWS OF CASEIN WITH VARYING
EUROPEAN COMMUNITY SUPPLY
(TARIFFS: KOREA 20%, JAPAN 10%)

EC Supply	EEU	ENU (tonnes)	ENK	ENJ
30000	30000	18745	5038	17083
40000	40000	17917	5165	17780
50000	50000	17090	5293	18477
60000	60000	16262	5420	19175
70000	70000	15434	5547	19872
80000	80000	14607	5674	20569
90000	90000	13779	5802	21267
100000	100000	12952	5929	21964

EEU - Exports from the European Community to the United States.
ENU - Exports from New Zealand to the United States.
ENK - Exports from New Zealand to Korea.
ENJ - Exports from New Zealand to Japan.

TABLE C6.2.1
SCENARIO 5B: WORLD PRICES OF CASEIN WITH VARYING EC SUPPLY
(TARIFFS: KOREA 0%, JAPAN 0%)

EC Supply	PE	PN	PU	PK	PJ
		(all prices in NZ dollars)			
30000	5601.38	5553.42	5861.42	5703.42	5703.42
40000	5020.13	4972.17	5280.3	5122.17	5122.17
50000	4438.88	4390.92	4698.98	4540.92	4540.92
60000	3857.64	3809.68	4117.74	3959.68	3959.68
70000	3276.40	3228.43	3536.49	3378.43	3378.43
80000	2695.14	2647.18	2955.24	2797.18	2797.18
90000	2113.86	2065.94	2373.99	2215.94	2215.94
100000	1532.65	1484.69	1792.75	1634.69	1634.69

PE - Price in the European Community.
PN - Price in the New Zealand.
PU - Price in the United States.
PK - Price in Korea.
PJ - Price in Japan.

TABLE C6.2.2
SCENARIO 5B: WORLD TRADE FLOWS OF CASEIN WITH VARYING
EUROPEAN COMMUNITY SUPPLY
(TARIFFS: KOREA 0%, JAPAN 0%)

EC Supply	EEU	ENU	ENK	ENJ
		(tonnes)		
30000	30000	17972	5237	17651
40000	40000	17223	5344	18291
50000	50000	16475	5451	18930
60000	60000	15726	5559	19573
70000	70000	14977	5665	20209
80000	80000	14228	5772	20848
90000	90000	13479	5879	21488
100000	100000	12730	5957	22127

EEU - Exports from the European Community to the United States.
ENU - Exports from New Zealand to the United States.
ENK - Exports from New Zealand to Korea.
ENJ - Exports from New Zealand to Japan.

Appendix C7 - Nil Tariff Barriers

TABLE C7.1
SCENARIO 6: NIL TARIFF BARRIER PRICES

Regions	Base Prices	Nil Tariff Estimates	difference
		NZ$/tonne	%
European Community	3306.3	3335.4	0.9
New Zealand	3258.3	3287.4	0.9
Korea	4090.0	3437.4	-16.0
United States	3749.2	3595.5	- 4.1
Japan	3749.2	3437.4	- 8.2

TABLE C7.2
SCENARIO 6: NIL TARIFF TRADE FLOWS

Regions	Base Trade Flows	Trade Flows (Nil Tariffs)	difference
	(tonnes)		%
European Community to			
United States	69000	69000	-
Korea	Nil	Nil	-
Japan	Nil	Nil	-
New Zealand to			
United States	15501	15038	-0.3
Korea	5534	5654	2.1
Japan	19801	20144	1.7

Appendix C8 – Revenue Returns to New Zealand Producers (fob)

TABLE C8.1
REVENUE FOR NEW ZEALAND WITH TARIFF SCENARIOS (fob)

		Japanese Tariff (%)	
		0	10
		(NZ$, millions)	
	0	134.25	133.35
Korean	10	134.10	133.21
Tariff(%)	20	133.95	133.06

European supply : 69000

TABLE C8.2
NET REVENUE FOR NEW ZEALAND WITH VARYING EC PRODUCTION

Tonnes	Korea 20%, Japan 10%	Nil Barriers
	(NZ$, M, fob)	
30000	224.96	226.91
40000	201.39	203.15
50000	177.83	179.40
60000	154.28	155.66
70000	129.54	133.95
80000	107.17	108.13
90000	83.62	84.39
100000	60.07	60.60