ECONOMIC ANALYSIS OF PHYTOSANITARY BARRIERS IN THE AUSTRALIAN APPLE MARKET

A Thesis
submitted in partial fulfilment
of the requirements for the degree
of
Master of Commerce and Management
at
Lincoln University

by

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Lincoln University

1993

Abstract of a thesis submitted in partial fulfilment of the requirements for the Degree of Master of Commerce in Economics.

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The most common non tariff barriers that affect New Zealand (NZ) trade in apples are phytosanitary ones. This research focused on the economic analysis of this type of barrier. It especially refers to the potential apple trade between Australia (importer) and NZ (exporter) which is currently prohibited due to the existence of Fire Blight disease in NZ.

A partial equilibrium model of eight simultaneous equations was developed. It was simulated under four alternative policies as a means of determining the effects of a reduction in the Fire Blight phytosanitary barrier. The policies involved changes in the exogenous variables: the non tariff barrier, the cost of the Fire Blight control in NZ and the cost of Fire Blight in Australia. Policy one involved a reduction in the ban without cost requirements for either country. Policy two involved a reduction in the ban and an imposition of requirements for Fire Blight control in NZ in order to minimize the risk of the disease entering Australia. Policy three involved a reduction in the import ban and disease control costs in Australia. Policy four involved a reduction of the import ban and shared disease control costs in both countries. The effects of a reduction in the import ban was evaluated by considering the changes in economic welfare with respect to the base line (current situation) in both countries.

The model predicted that the change in the consumer surplus in NZ was negative in all cases, but this was compensated by positive changes in the NZ producer surplus which was almost four times higher. Therefore, in NZ, the changes in total economic welfare were positive for all policy changes.

For the Australian market, the model predicted ambiguous welfare effects. The Australian producer surplus was negative but the total consumer surplus was positive and its value varied depending on the particular policy. A rent to the non tariff barrier was established once NZ apple imports were permitted. The rent represented the difference between the import price and the Australian price of apples. The existence of this rent is a part of the distorting effect of this barrier in the Australian market. This research identified that with a reduction of ten percent of the tariff equivalent of the non tariff barrier, the best alternative policy for both countries was the reduction in the non tariff barrier with shared costs of Fire Blight disease control (policy four).

Key words: apples, international trade, non tariff barriers, Fire Blight, phytosanitary barriers, simultaneous equations, partial equilibrium model, alternative policies, welfare analysis.

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ABBREVIATIONS

ABARE	= Australian Bureau of Agricultural and Resources Economics
AFBR	= American Farm Bureau Federation
ANZCERTA	= Australia New Zealand Closer Economic Relations Trade Agreement
AQIS	= Australian Quarantine and Inspection Service
ARS	= Agricultural Research Service (USDA)
BQA	= Bilateral Quarantine agreement Australia NZ
BRR	= Bureau of Rural Resources Australia
CAP	= Common Agricultural Policy
CS	= consumer surplus
DSIR	= NZ Department of Scientific and Industrial Research
DPIE	= Australian Department of Primary Industry Energy
EC	= European Community
ED	= excess demand
EDF	= Environmental Defense Fund
EPA	= Environmental Protection Agency
ES	= excess supply
FAO	= Food and Agriculture Organization of the United Nations
FCDA	= Food, Drug, and Cosmetics Act.
FDA	= Food and Drug Administration US
FRC	= Fruit Research Committee NZ
GATT	= General Agreement on Tariffs and Trade
HEWUS	= Department of Health, Education and Welfare, US
HPC	= Horticultural Policy Council
IAI	= International Apple Institute
IPPC	= International Plant Protection Convention
MAF	= Ministry of Agriculture and Fisheries NZ
MAFF	= Ministry of Agriculture Forestry and Fisheries of Japan
MAFQUAL	= Ministry of Agriculture and Fisheries Quality Management
MAFTECH	= Ministry of Agriculture and Fisheries
MERT	= Ministry of External Relations and Trade
MPL	= maximum pest limit
MRLs	= maximum residual levels

MTN	**= multilateral trade negotiations**
NACA	**= National Agricultural Chemical Association**
NAS	**= National Academy of Sciences**
NASS	**= National Agriculture Security Service NZ Quarantine Service**
NB	**= net benefit**
NEPA	**= National Environment Protection Act (1969)**
NFU	**= National Farmers Union**
NRDC	**= Natural Resources Defense Council**
NTBs	**= non tariff barriers**
NZ	**= New Zealand**
NZAPMB	**= NZ apple and pear marketing Board**
OECD	**= Organization for Economic Co-operation and Development.**
OFCSA	**= Orchardists and fruit cool store Association Australia**
PS	**= producer surplus**
QRA	**= quantitative risk assessment**
rNTB	**= rent to the non tariff barrier**
RPAR	**= Rebuttable presumption against registration**
SITC	**= The Standard international trade classification**
SPS	**= sanitary and phytosanitary measures**
TBTs	**= technical barriers to trade**
UNCTAD	**= United Nations conference on trade and development**
US	**= United States**
USDA	**= Department of Agriculture US**
USDI	**= Department of the interior US**
VRA	**= Voluntary restraint agreements**
WAC	**= Washington apple Commission**
WHO	**= World Health Organization**

CHAPTER 1

INTRODUCTION

1.1. INTRODUCTION

After World War II, there was a general movement towards a reduction in barriers to international trade throughout the world. This liberalised trade movement coincided with a period of twenty years of world economic stability and rapid technological change.

Trade barriers were particularly reduced for manufactured products. However, tariff and non tariff barriers to trade in agricultural and food products were not part of this trend.

Global economic stability was shaken from 1970 onwards, first by the commodity price of 1972-74 and then by the two major oil-shocks of 1973 and 1979. One response to the ensuing instability was an increase in trade protectionism, particularly (but not exclusively) in agricultural products including apples.

This period of increased protectionism has been notable for its increase in the use of non tariff barriers to trade. These barriers to trade take the form of specific measures on apples to limit access from imports and to stimulate domestic production reducing excess demand in markets.

Apples are a major horticultural export crop in New Zealand (NZ), with high volume export undergoing rapid expansion. The majority of apple orchards are intensively planted with high yielding varieties. The NZ apple trade has an advantage with its out-of-season production vis a vis Northern Hemisphere countries.

This research goes some way towards documenting the general context of non tariff barriers that affect NZ apples export, specifically in the markets of the United States (US), European Community (EC), Japan and Australia. One of the key reasons for choosing these markets is that they are the most important real and potential markets. However, only one market was selected for economic analysis because of the diversity of non tariff barriers discovered.

Australia is a potential market for NZ's apples, but at the moment no apple trade exists. The reason for banning NZ exportation is on phytosanitary grounds: the "Fire Blight" problem. This represents an interesting case, when considering the trade relationship between both countries and existing trade agreements such as ANZCERTA. It also presents a suitable environment for the analysis of the effects of the NTBs, because both countries are at a similar stage of economic development, with similar market characteristics. Also, both have a common language, similar culture and similar British-type institutions.

In the current GATT round, the US and the Cairns group are focusing on the removal of non tariff barriers around the world. This case of a phytosanitary barrier on NZ apple exportation to Australia because of Fire Blight was selected by the AQIS, BRR and ABARE to trial the methods for undertaking Bio-economic risk assessments as part of decision making on quarantine matters during 1990/91.

There are only a few previous studies of non tariff barriers in a specific commodity. This issue will be analyzed using the Partial Equilibrium model, in which two participating countries face alternative policies.

1.2. RESEARCH OBJECTIVES

The general objective of this research is to examine the non tariff barriers affecting import access for NZ apples to Australia, European Community, Japan and the United States. The analysis of the economic effects was concentrated on trade protection given by the quarantine barrier for Fire Blight on NZ apples into Australia. The specific objective is the overall evaluation of the simulation of reduction in the phytosanitary barrier (NTB) and its economic welfare effects in NZ and Australia.

1.3. OUTLINE OF THIS STUDY

In Chapter 2 the theoretical background of non tariff barriers is reviewed. The literature review discusses the role of the state and non tariff barriers to trade and its classification.

Chapter 3 focuses on general aspects of the NZ apple industry and its most relevant characteristics of production and trade considering real and potential imports of NZ apples (four selected markets: Australia, EC, Japan and US). Some perspectives on the position of the different apple markets with respect to non tariff barriers are described.

Chapter 4 concentrates on the Australian phytosanitary import barrier for Fire Blight disease. The bioeconomic risk embodied in the potential trade of NZ apples to Australia has been addressed in previous research and these results are discussed in the same section.

Chapter 5 focuses on the development of an economic model to evaluate the effect of reducing phytosanitary barriers.

Finally, in Chapter 6, a summary is presented and some conclusions and suggestions made in order to aid future research.

CHAPTER 2

LITERATURE REVIEW

The purpose of this chapter, is to review the different theories of non tariff barriers. The first part is concerned with the role of the state and protectionism. The second section discusses non tariff barriers to trade. In the third section the multilateral agreements are reviewed in the context of non tariff barriers on agricultural trade. The last section of this chapter comprises a literature review of the trade models.

2.1. PROTECTIONISM

The first priority, for whatever nation, is the welfare of its citizens. One role of government is to intervene to assure a strategic position or to provide a credible commitment for strategic policies of domestic firms confronting foreign rivals (Hillman, 1989; Hillman, 1991).

Free trade has been proposed within the framework of the traditional trade theory which argues that it is the first best policy. It maximizes a country's national income and permits the achievement of maximal aggregate consumption possibilities, subject to qualifications deriving from the identification of various 'distortions' which underlie market failures (Hillman 1989). For Vanberg (1990), the theory of free trade enhances the welfare of a nation even if it is practised unilaterally. Free trade has the advantage of allowing individual countries to make the best use of their available resources (Vanberg, 1990). Regarding free trade, neoclassical theorems present propositions about efficiency and aggregate welfare, and argue that protection produces deadweight costs (Hillman, 1991).

Buchanan (1988) notes that while Government plays an essential role in facilitating free trade, its coercive power can also be employed to inhibit free trade through protectionist measures.

Protectionist measures are usually intended to meet two broad objectives: firstly provide visible and immediate relief to industries, and notably to their workforce and secondly, to allow on-going adjustment to changing circumstances. In trade policy debates it is argued that domestic industries should receive temporary protection from import competition in order to introduce new technologies, thereby effectively competing with their foreign rivals (Matsuyama, 1990). Rowlex (1988) suggests that: governments use protectionist policies to shield domestic industry from foreign competition, and their justification of protection is based on economic and non economic grounds.

2.2. NON TARIFF BARRIERS TO TRADE

Barriers that affect trade can be either tariffs or non tariff barriers (NTBs). Economists often refer to NTBs as administered protection, because they typically do not imply legislative enactment of each act of protection. In this situation the administrators (bureaucrats) have at least some choice regarding the extent and/or the height of the barrier. These restrictions are customarily applied through institutions and processes set up to regulate imports, including the exercise of political power by the executive branch in making trade restraining arrangements with other countries (Bhagwati, 1989).

Non tariff trade restrictions, usually involve some legitimate exercise of a state's authority to regulate its domestic commerce for the health, safety and well-being of its citizens. These regulations may include written or unwritten potential barriers to trade (Hillman, 1989; Hillman, 1991). In general terms, NTBs help to regulate and protect domestic production. A non tariff measure is defined as any device or practice other than a tariff, which directly impedes the entry of imports into a country and/or which discriminates against imports whilst not applying with equal force on all domestic production. Therefore, NTBs distort international trade (Baldwin, 1989).

If the regulations apply with equal force to domestic as well as to imported products, those regulations cannot be considered as non tariff measures (Deardorff, 1985). NTBs will include all those restrictions other than traditional customs duties which distort international trade, such as impediments at national borders. All types of domestic laws and regulations that discriminate against imports aimed at stimulating domestic production (Hillman, 1991).

There is a growing consensus in the trade policy community that NTBs to trade may now be more important than tariffs in terms of the extent to which they distort and restrict international trade (Deardorff, 1985). The attempts by international negotiators to control NTBs to date have been risky, unsystematic, and ultimately ineffectual (Hillman, 1991).

Some NTBs by their nature tend to discriminate among trading partners, while others are not necessarily discriminatory but can be used to discriminate (Pomfret, 1988). Oxley (1990), suggests that NTBs should be eliminated over a ten-year period. He proposed that all barriers to agricultural trade should be transformed into tariffs, then those tariffs should be progressively reduced to very low levels.

2.2.1. Classification of non tariff barriers

A wide range of NTBs affects horticultural trade. They include quotas and related restrictions, voluntary export constraints, variable import levies, minimum price systems, and countervailing taxes and duties, as well as technical specifications, especially health restrictions, sanitary regulations, quality requirements and strict labelling and packaging specifications (Appendix 1). There are other non tariff measures that are used to restrict trade in agricultural products such as restrictions of imports of some products during certain periods of the year, generally when domestic product is to begin to be marketed.

These barriers imposed by an importing country are sometimes used to reduce imports. Licences to import horticultural products increases the transaction costs of the import trade (Hillman, 1991; Islam, 1990). For Bhagwati (1989), two classes of NTBs can be distinguished: those that bypass GATT's rule of law and those that capture and pervert it.

The United Nations Conference on Trade and Development (UNCTAD) and other writers have classified non tariff measures into three types. Type I "*are those where the specific intent is to restrict imports and to stimulate exports in a way will inevitably cause trade distortion*". Type II "*are those measures the primary intent of which is to deal with economic, social and political* *problems but which are occasionally used to restrict imports or stimulate exports*". Type III "*are measures or policies that are not intended as instruments of trade protection but nevertheless, inadvertently cause trade distortion*" (Hillman, 1991:40).

2.2.2. Health and sanitary regulation

Trade in agricultural products is subject to health and phytosanitary controls on imports as well as on domestic products. Phytosanitary regulations constitute a class of NTBs (Hillman, 1991).

One problem with the enforcement of phytosanitary and sanitary regulations is the variation in standards among different countries. Policy implications of debates at the international level may be translated into national regulatory contexts. International harmonization will require changes in regulations domestically and for import products (Boardman, 1986; Rhodes, 1990).

2.3. THE GENERAL AGREEMENT ON TARIFF AND TRADE

The General Agreement on Tariffs and Trade (GATT) was part of the scheme to restructure international relations after the Second World War. Its main objective is to eliminate the adverse effects of unfair polices, barriers and protectionist measures on trade. The purpose of GATT was to persuade signatories to commit themselves to liberal trading principles and to lock into arrangements that progressively pegged their economies to international market prices.

NZ has been a member of the GATT Agreement on technical barriers to trade since 1980. NZ is a member of the Cairns Group along with 14 other countries such as Australia, Canada, and other Latin American, European and Asian countries. The Cairns Group has sought the reduction of barriers, subsidies and other measures affecting the international trade of commodities.

The GATT negotiations on sanitary and phytosanitary measures (SPS) are important for horticultural trade because these exports are regulated by the sanitary standards prescribed by importing countries. A movement towards harmonization of quarantine procedures internationally, is being pursued in those negotiations and also the reduction of the adverse effect that unfair health and safety standards and technical regulations may have on agricultural trade. The agreement on technical barriers to trade, more commonly known as the "Standards Code", entered into force on January 1980. Article XX of the GATT provides for the adoption and enforcement of phytosanitary and sanitary restrictions if they are necessary to protect human, animal or plant life of health[1].

The fundamental principle of GATT is that open markets are most efficient. The operating premise is that measures which impeded trade should have the least distorting effect on markets and therefore it should be gradually reduced (Oxley, 1990). In past GATT rounds it was proposed that export subsides will be prohibited and that import quotas, variable levies, "voluntary" export restraint agreements, and other NTBs would be replaced by tariffs that would be reduced in concert with the reductions in domestic support. This concept called "Tariffication", would make protection more transparent and more readily negotiable and make the domestic markets more responsive to world market conditions (Sanderson, 1990:14).

SPS measures are a major concern in the current GATT Uruguay Round negotiations. Technical barriers to trade where they are unjustified as legitimate protection against pest and diseases, are under scrutiny in these negotiations. Any success in the Uruguay Round in bringing into line the use of quotas, tariffs, and other barriers to trade could be negated by countries using technical barriers to trade in an unjustified manner (AQIS, 1990; Landos, 1990). At the time of writing no final GATT agreement on these issues had been announced.

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[1] "*ensure transparency and the existence of an effective notification process for national regulation process which ensures an opportunity for the bilateral resolution of disputes; to improve the effectiveness of multilateral dispute settlement process; to provide necessary input of scientific expertise and judgment, relaying on relevant international organizations*". (Islam, 1990:23)

2.4. TRADE MODELS

In international trade the estimation of trade models is an important aid to understanding the behaviour of the market. According to Labys (1973), flow models apply to a system of export and import equations that, together with a trade flow matrix, explain the effects of changes in economic conditions upon trade between countries. There are two recognized general models of trade that " have dominated the empirical literature, namely the imperfect substitutes model and the perfect substitute model" (Jones, 1985:1044). The "imperfect substitutes model" is one that focuses on the analysis of trade of differentiated goods[2]. The perfect substitutes model, on the other hand, concentrates on the trade of close or perfect substitutes[3].

According to Jones (1985), the main characteristics of the imperfect substitutes model are: the consumer is postulated to maximize utility subject to a budget constraint and the resulting demand function for imports and exports thus represent the quantity demanded as a function of the level of (money) income in the importing region, the price of the imported good and the price of domestic substitutes.

Recent developments in partial equilibrium trade models such as presented by Laird S & Yeats (1992) have simulated the likely magnitude of effects of NTBs on international trade. Other studies have used partial equilibrium models in ex post analyses of multilateral trade negotiations (MTNs) to quantify the gains or losses accruing to participating countries.

Trade elasticities provide a means of analysing the effect of government policies and represent an important contribution to the process of designing and evaluating policy options (Carter, 1988). Some international trade theories of demand for tradable goods, assumed that

[2] The key assumption in this "imperfect substitutes model" is that neither imports nor exports are perfect substitutes for domestic goods (Jones, 1985).

[3] With respect to the "perfect substitutes model" there is the argument that if domestic and foreign goods were perfect substitutes, then: either the domestic or foreign good swallowing up the whole market when each is produced under constant (or decreasing)cost and each country as an exporter or importer of trade but not both. (Jones, 1985:1045)

merchandise of a given kind supplied by sellers in one country is a perfect substitute for merchandise of the same kind supplied by any other country[4]. An alternative approach uses differences among suppliers rather than in product characteristics. Product differentiation is an important factor in international trade.

According to Armington (1969), there are three important characteristics of International Trade flows: the kind of merchandise involved, the country or region of the seller, and the country or region of the buyer. In Armington's " Theory of demand for products distinguished by place of production", the fundamental assumption is that: "products of different countries competing in the same market are imperfect substitutes"[5] (Armington, 1969:159).

Armington's model (1969) allows for different prices in each market based on market loyalty and other characteristics by country of origin.

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[4] Which implies constant price ratios and infinite elasticities of substitution between these supplies.

[5] It assumes: (i) Constant elasticities of substitution between products competing in any market (they do not depend on market share). (ii) The elasticity of substitution between any two products competing in a market is the same as that between any other pair of products competing in the same market. (Armington, 1969)

CHAPTER 3

NTBS IN NEW ZEALAND'S APPLE IMPORT MARKETS: BACKGROUND

The objective of this chapter is to review the most important characteristics of New Zealand's apple production and the non tariff barriers affecting its apple trade. Additionally, it gives some historical perspective on the position of the NZ apple exports with respect to the most important current markets (European Community and United States) and potential markets (Japan and Australia).

3.1. WORLD APPLE TRADE

The world market for apples has two sets of seasonal producers in the Northern and South Hemisphere. Production in the main Northern Hemisphere markets is important as improved storage technology may restrict off-season demand for imports. Demand for apples has a seasonal dimension and it faces competition from other close substitutes such as other fresh fruits. Increased imports from the South Hemisphere countries are due to the rising consumer demand for off-season fruit and changing consumer preferences for new varieties and high quality apples (OECD, 1991).

In 1987, the most important producer countries in the world apple trade were France (24%), Italy (11%) and NZ (10%), followed by the United States (US) and Chile (Appendix 2). The main importer countries were EC off-season, specially West Germany, Netherlands and the US (Satyanarayana, 1989).

3.2. NZ APPLE INDUSTRY

Apple growing began in NZ in the 1840's. Since 1980's apples planting has been stimulated. In 1986 there were 7818 ha planted (Nicholson, 1990).

3.2.1. Production

Apple production in NZ is located principally in Hawkes Bay, Nelson, Otago, Canterbury and Marlborough. Canterbury is an area identified as having considerable potential for apple production (Nicholson, 1990). NZ's per capita consumption is one of the highest in the world. The domestic fresh apple market is expected to remain stable at around 40 thousand tonnes per year in the medium term. The major share of apple production is derived from orchards over 30 hectares which are managed by well trained producers (OECD, 1991).

The most important apple cultivars are: Granny Smith, Red Delicious, Braeburn, Royal Gala, Cox's Orange, Gala and Fuji. In 1986, Granny Smith and Red Delicious made up 60 per cent of NZ's apple crop. The new varieties such as Braeburn, Royal Gala and Fuji have been well received by consumers, they comprise around 10 per cent of NZ production. The ability to supply these varieties should give to NZ a comparative advantage over competitors (MAF, 1987; Monigatti, 1991).

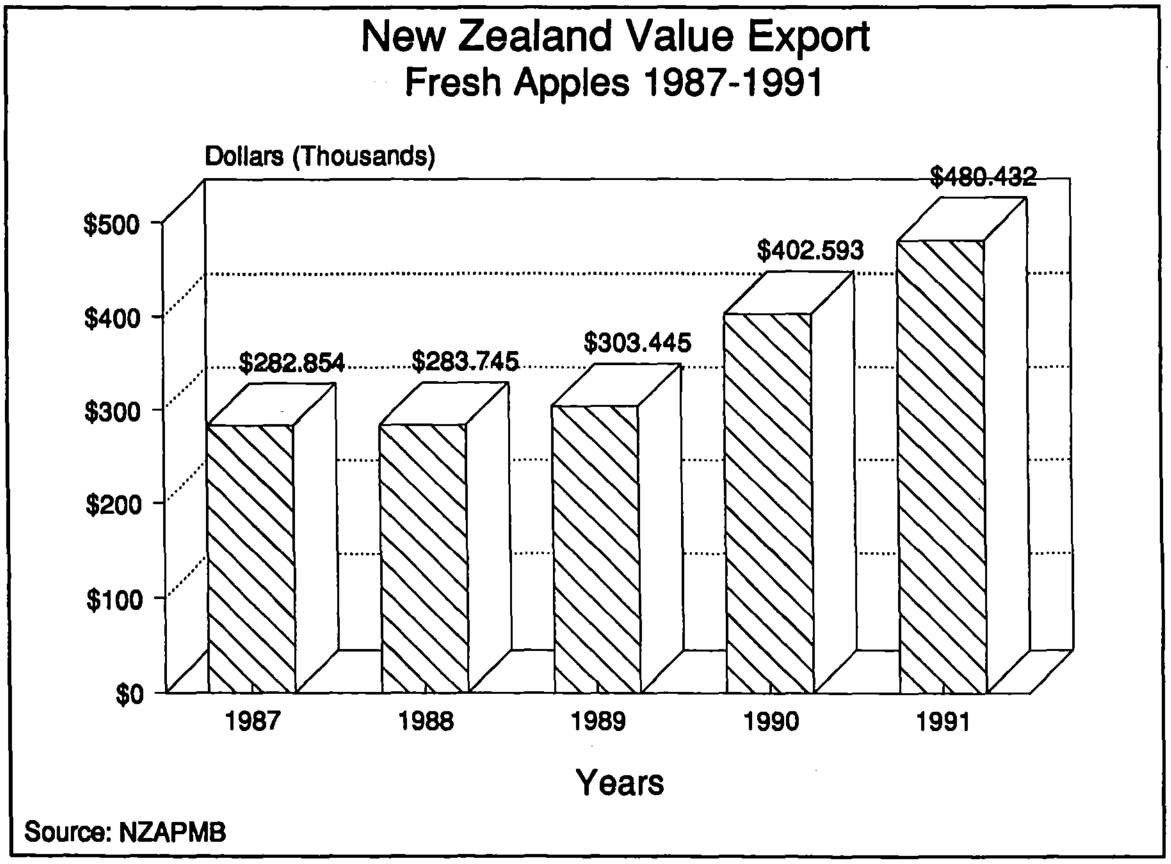

Figure 3.1. Value of New Zealand Apples Fresh Fruit Export

In the last five years the NZ value export of fresh apples rose from $ 283 million to $480 million NZ dollars in 1991. Figure 3.1. shows us the value of NZ apple exports (Appendix 3). About 55 per cent of NZ's apple crop is exported fresh (MAF, 1987).

Figure 3.2. shows that the months of high volume apples exports from NZ are between March and June with around 98 per cent of the total fresh fruit export (Appendix 4.1.).

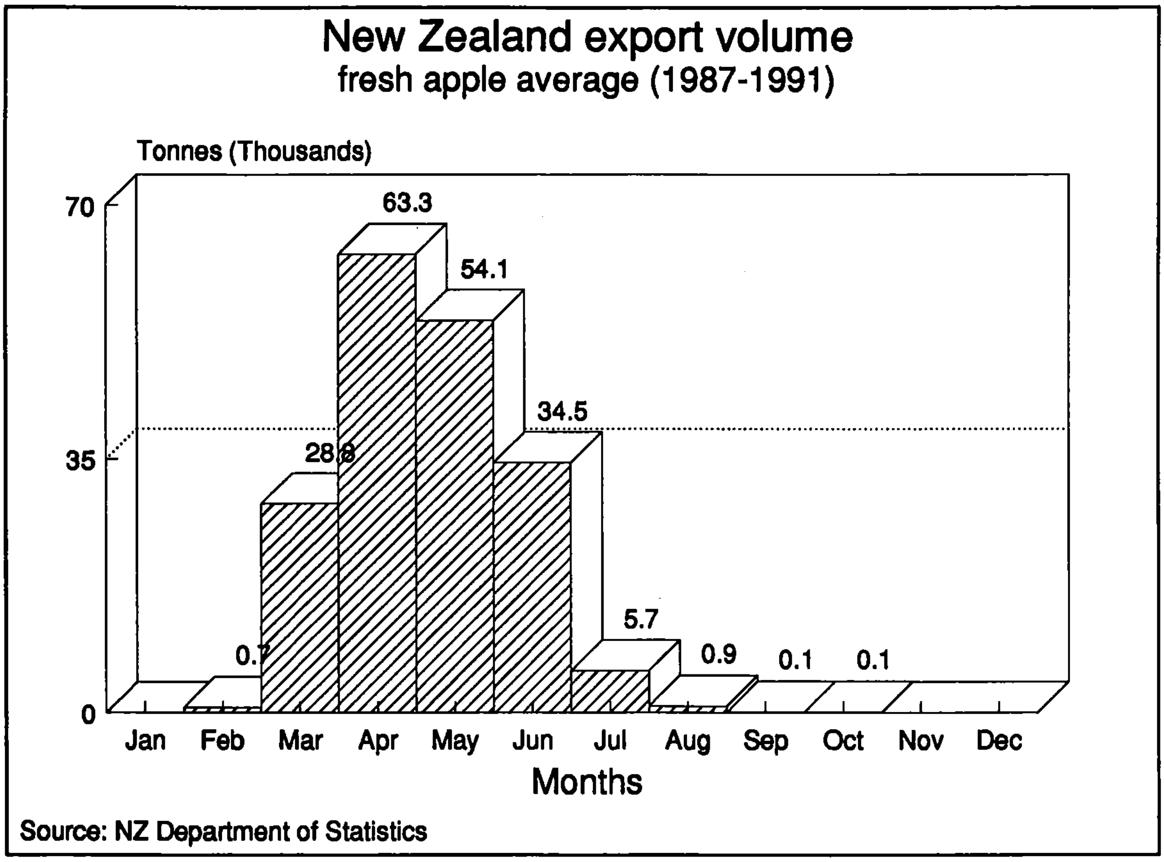

Figure 3.2. Monthly export volume NZ fresh apples

NZ quarantine services are administered by the National Agriculture Security Service (NASS). It comprises MAF Policy which is responsible for standards, specifications and audits and MAF Quality which is responsible for service delivery and operational procedures. NASS protects the NZ environment from pests and diseases that impede the country's ability or competitiveness to export.

3.2.2. New Zealand Apple and Pear Marketing Board

In NZ the apple industry is controlled by a statutory producer/marketing board. The New

Zealand Apple and Pear Marketing Board (NZAPMB) was established to set up a central organisation to receive and market all apples and pears grown in NZ. The NZAPMB has the power to intervene in the apple trade and it represents a long-standing feature of the NZ commercial environment. This organisation has certain marketing rights in the domestic market and it has the sole right to import apples and pears. The NZAPMB has monopoly control over fresh apple exports except to Australia since July 1990 (MERT, 1990; Nicholson, 1990).

The Board operates with the NZ image as a generic description. The NZAPMB believes that designing programmes to meet specific markets would be unworkable so no attempt is made to have certain growers producing for particular markets (Grundy, 1989).

3.2.3. Barriers for NZ fresh apples

Table 3.1. Barriers to Access for New Zealand Fresh apples 1988

Importing Country	ACCESS BARRIER TYPE				Brief Comment
	Phyto	Economic	Quota	Forex	
Australia	X				bacteria
Canada/US	X				leaf roller
EC			X		new in 1988
Japan	X				codling moth
Korea	X				codling moth
China				X	counter trade
India		X			government ban
Indonesia		X			government ban 1983
Philippines					reopened 1988
Taiwan			X		ban in 1988
Venezuela		X			government ban

Source: Seminar for Trade Journalists NZAPMB, 1988

The Government and the NZAPMB encourage producers to adapt their traditional production and marketing routines to persuade other countries to allow NZ apples to enter into their markets.

NZ has an interest in seeing that standards, technical specifications and testing procedures do not become technical barriers to trade and that certification and accreditation by NZ agencies are accepted internationally (MERT, 1990).

All the importers of apples maintain a system of marketing orders to regulate and protect their domestic production, even though the system differs widely in its restrictive impact on trade.

As seen in Table 3.1., NZ faces a variety of import barriers in world markets. The most important types are: phytosanitary, economic, quota restrictions and lack of foreign exchange or central regulations. These barriers affect major current and potential markets.

3.3. CURRENT NZ APPLE MARKETS

The main NZ apple export markets are countries located in Northern Hemisphere (figure 3.3.), because seasonal characteristics offer advantage for NZ supplies (Appendix 3.3.). As NZ's season is offset six months from northern hemisphere producers, NZ apples have not traditionally conflicted with sales of local producers. However, new storage technology has tended to increase the competition.

The rate of growth of apple exports and market shares has changed over time. Exports have grown from half a million cartons (18.5 kg) exported in 1949 to over seven million cartons today. Apple export production in 1990 was 20 thousand tonnes (NZ Dept. of Statistics).

The export of fresh fruit requires a certain level of skill and sophistication in postharvest operations, including grading, packaging, storing and transporting. Quality control, compliance with strict health and sanitary standards, and efficient packaging are important for export marketing.

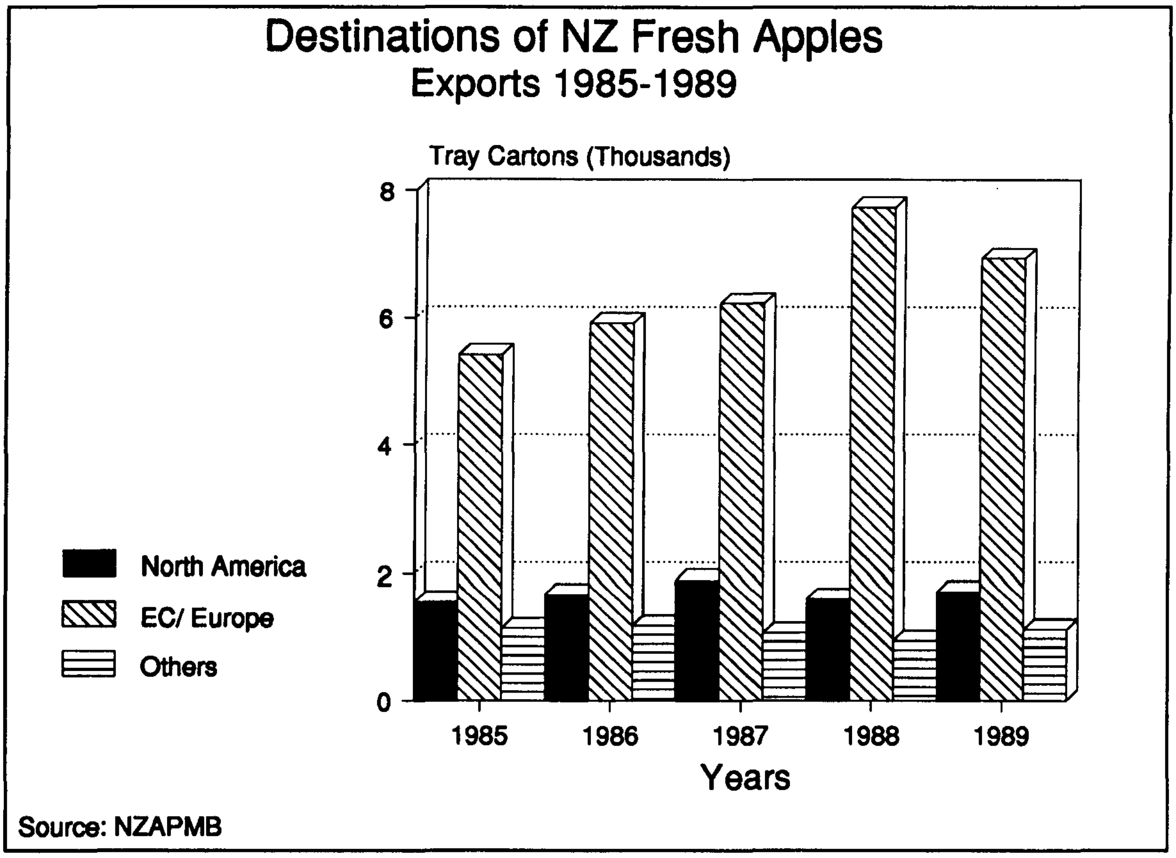

Figure 3.3. Destination of New Zealand Exports of Fresh Pipfruit

The most important importing and rapidly expanding markets for NZ apples are EC and US (Figure 3.3.), with about 70 per cent and 19 per cent respectively of total NZ apple exports (NZAPMB, 1990a). Other markets such as Asian countries, have increased their imports in recent years (NZAPMB, 1991).

3.3.1. European Community

The major apple producers in EC are: Italy, France, Germany and Spain. The share of apples in the total value of EC agricultural production is about 2 per cent and it is one-third of the fruit and nut sector total production value. EC is also an importer of apples. The volume of imports reached 610 thousand tonnes in 1989 (OECD, 1991).

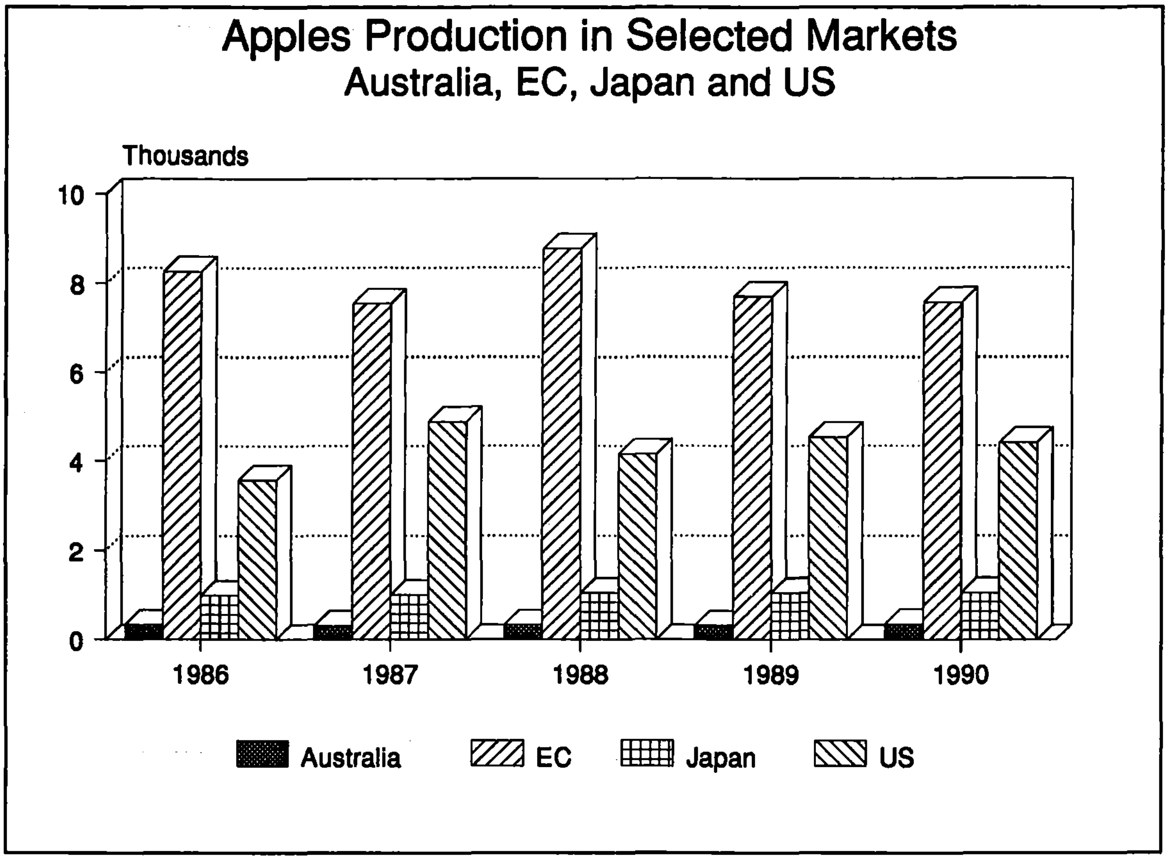

Figure 3.4. Apples Production in selected markets

3.3.1.1. EC Policy

The EC wants to ensure a fair standard of living for the agricultural community, availability of supplies, reasonable prices to consumers and steady market conditions protected from price fluctuations. EC implemented the Common Agricultural Policy (CAP) which protects European markets by putting up barriers to imports. The general framework of the apple market in the CAP is based on: quality standards applying at all marketing stages; producer organisations; producer price support and trade policies, with imports subject to tariffs, the reference price system and preferential agreements (OECD, 1991).

3.3.1.2. Apple Trade between NZ and EC

The EC is the most important export market for NZ apples. In 1986, imports from the Southern Hemisphere were increased with a record of 440 thousand tonnes. Of this, 95 thousand tonnes

were from NZ. Import controls, such as a form of import licence system, were considered prior to the 1987 season, but were not imposed. In 1989, the EC was the major export market with around 66 per cent of all NZ's apple exports. In 1991, exports to the EC increased by more than 5 per cent with respect to 1990 (MAF, 1987; MAF, 1991; NZAPMB, 1991).

The EC attempts to have a transparent trade, and only once did they impose a NTB on NZ apples. This was in 1988 when the EC established a quota of 115 thousand tonnes, 12 per cent below expected NZ exports. This quota was contrary to a GATT ruling allowing sales to Europe by Southern Hemisphere producers in the off-season. Four months later, the quota was lifted (Hoadley, 1989).

During 1989, The Economic Commission regulated imports on two bases: firstly, the quota was restricted to 130 thousand tonnes per year and secondly, size restrictions were imposed (Grundy, 1989; Nicholson, 1990; Monigatti, 1991; OECD, 1991).

Apples have two types of nontariff measures applied in EC: health and sanitary regulations (HS) and other price distorting restrictions (OM) (Hillman, 1990).

Within Europe, Switzerland constitutes a special case, as it is free of Fire Blight. To control the entrance of the disease, it selects the certification of the apples from an area free of this disease, or absent of symptoms of the disease in the orchard during the corresponding growth period. Before 1985 imports of NZ apples into Switzerland were permitted without restriction (AQIS, 1989). Switzerland's requirement for NZ apples is only that of a visual survey for each export block (MAFQual, 1990f).

There is no formal voluntary restraint agreement (VRA) between NZ and the EC. Instead, NZ supplies estimates of proposed exports which are non finding but provide market information to the EC Commission. Once in a while, VRAs are agreed to with some other apple exporters to the EC. The Commission seeks data involving production and export projections, before the beginning of the South Hemisphere season and commits itself not to take measures as long as imports do not exceed an amount which can be absorbed by the market without creating difficulties. Between 1989 and 1991, the total VRA amount has been maintained annually at 580 thousand tonnes (OECD, 1991).

Apple imports into the EC are subject to a combination of ad valorem import tariffs and the reference price system, and sometimes a VRA for some exporters to the EC. Import tariffs for apples vary during the year as follows: at 14 per cent from August to December, 8 per cent from January to March, and 6 per cent from April to July. More than 80 per cent of the imports are subject to an import tariff of 6 per cent. A reference price may be used to impose a countervailing duty. This price is determined by the average producer price during the preceding three seasons and the trend in the internal EC production and transport costs. Under this system no apple exporter to the EC has an incentive to price below the reference price as this will trigger the application of the countervailing duty. The reference price system determines that poor quality imported apples of less value cannot compete with other imported higher quality produce in the EC. Therefore, it attracts high-quality apple imports into the Community (OECD, 1991).

The EC provides clear specifications that offer transparency to its market's requirements. They refer to size, quality, sanitation, etc., and could have a protective effect on health and sanitary domestic conditions.

3.3.2. The United States of America

The US is the world's largest producer of commercial apples, with about 10 per cent of world apple production (Appendix 2). The high yielding modern orchard planting system is located in Washington State, Michigan and California (Appendix 5.2.1.). In the US, there were difficulties because of the rapid expansion of the production (greater than the increase of consumption). Fresh apple consumption accounts for over 50 per cent of production (MAF, 1991; OECD, 1991).

In 1990 the US apple industry produced just over forty four hundred thousand tonnes of apples, of which 58 per cent were sold in the fresh apple market. The volume of fresh apples marketed in the US during the 1980s increased about 10 per cent overall (Derek, 1991). The per capita consumption of fresh apples rose by around 10 per cent during the period of 1985-1995 (OECD, 1991).

Most US fresh apple imports come from Canada and the Southern hemisphere countries like NZ and Chile, especially during the February- May period. This market has potential growth in demand for some varieties. In 1987, the US apple imports totalled 139 thousand tonnes. The US is NZ's second largest apple export market, importing about 20% of NZ total apples exports (36 thousand tonnes) (Appendix 5.2.2.). The market gap was mainly filled by Chile and Argentina, which have earlier marketing seasons than NZ (MAF, 1987-1991).

The share of imported apples in the US fresh apple consumption is low, around 5 per cent. In the medium term, it expects apple yields to remain stable. Apple exports could eventually expand, especially in some Asian and Nordic countries (OECD, 1991).

3.3.2.1. Apple sector in US

The Apple sector in the US is relatively free from government policy intervention. Import of apples in the US have some constraint related to considerations of health, security and phytosanitary reasons (OECD, 1991).

During 1989, 333 thousand tonnes were exported to US, which is around 18% of the total fresh apple export for that year. The value of domestic production is US$1 billion, contributing 0.6 per cent of all agricultural production and 12.5 per cent of the total for the fruit and nut sector (Hay, 1991; OECD, 1991). Export revenues for Washington apples were estimated at more than $140 million for 1990 (Beer, 1990).

There are some institutions that support apple growers and traders in the US. The best known are the International Apple Institute (IAI), and Washington Apple Commission (WAC). These can provide a powerful lobby for growers and traders in time of difficulty (Ray, 1991).

3.3.2.2. Apple Trade between US and NZ

The NZ apple industry has an excellent reputation in the US market. It has created a niche in the US market with supplies of Gala, Braeburn, Spartan, Golden Delicious, and Granny Smith apples (Ray, 1991).

Imports from some sources have occasionally been adversely affected by US health and phytosanitary regulations (OECD, 1991). From time to time, particular problems with quarantine pests have placed the USDA preclearance programme at severe risk. This is the case of Hawkes Bay and Nelson in the past.

3.4. NZ POTENTIAL MARKETS

3.4.1. Japan

The liberalisation of the restrictions concerning fruit might have important implications for Japanese apple growers. The importation of apples could lead to a more competitive domestic market, and thus, in turn, act to depress producer prices (OECD, 1991).

3.4.1.1. Apple industry in Japan

Policy formulation for the apple sector is coordinated by the Japanese government jointly with producer cooperatives (Beer, 1990; OECD, 1991).

During 1970s the government stimulated the move of rice land into other crops including apples, but in 1980s new plantings of apple trees have been discouraged to avoid the probability of excessive production. Japan is a major apple producer and accounts for 2.5 per cent of world fresh apple production with more than one million tonnes in 1989. Apples are cultivated in the harsher climates of North-western Tohoku: Aomori (47%), Yamagata (7%), and Naganao (21%) in the Japanese Alps (OECD, 1991).

The current gross value of apple production is US $1010 million, contributing 1.3 per cent of all agricultural output in Japan, and around 20% of the total value of fruit production (OECD, 1991; Rothacher, 1989).

In the long term, the Ministry of Agriculture Forestry and Fisheries of Japan (MAFF) projections expect an increase of fresh apple production of 1 per cent per annum up to the year 2000. Japanese trade in apples is an insignificant share of total production. Exports, mostly destined to Asian countries, are about one thousand tonnes annually which is less than 0.1% of the marketed production (OECD, 1991).

Japanese health measures and sanitary regulations are applied to imports of apples. Quarantine problems have arisen regarding the access of apples to Japanese markets (MAFQUAL, 1988; Anderson, 1986; Hillman, 1990; Grundy, 1989).

Before 1990 Japan did not approve the entry of apples from any country because of the quarantine regulations relating to colding moth (AQIS, 1990). However, after 10 years of negotiation, the US could earn the right to export its apples to Japan in 1990. The US Access to Japan was approved in March 1989, but only in January 1990 did MAFF formally accept USDA's proposal for a two component treatment for colding moth on Red Delicious and Golden Delicious apples (Beer, 1990). The access of US apples to this market, opens new possibilities for NZ's apples (MAFQUAL, 1989c).

3.4.1.2. NZ apples Access Proposal to Japan

NZ has been negotiating access for fresh NZ apples to the Japanese market from 1970. Japan is a potential major market but maintains zero imports of NZ's apples because of phytosanitary reasons.

The matters related to this access are being jointly worked out by NZ DSIR, MAF, and NZAPMB (MAFQUAL, 1990b). The first meeting between authorities from NZ and Japan took place in 1987 (MAFQUAL, 1991c). The Japanese draft protocol for NZ apples referred to the most important phytosanitary problems: Fire Blight, leaf roller, colding moth, and mite control. Japan's legislation does not specifically prohibit the entry of apples and pears from countries where Fire Blight occurs, but, it is regarded as a serious pest. Thus, only apples free from Fire Blight will be exported to Japan (MAFQUAL, 1989c).

Negotiations towards establishing an acceptable protocol with Japan are still being held.

NZ has now met most of the Japanese quarantine regulations for fresh apples and is waiting for a final agreement to market access (OECD, 1991). NZ hopes to gain access to this market within the next three years (NZAPMB, 1991).

There is agreement on basic points on the measures to prevent Fire Blight such as: no other host plants, or plants infected with the disease should exist within the distance of 500 metres of the designated orchards, and appropriate disinfestation measures should be taken. Concerning the export check on Fire Blight: apples should be selected and treated to prevent live bacteria from being found on it. Also, apples should be packed with new packing materials and they should be collected using sterilized collection boxes kept exclusively for their use (MAFQUAL, 1991e).

Government support to Japanese apple growers is provided indirectly through Phytosanitary regulations. These regulations essentially prohibit all apple imports into Japan from countries which do not fulfil Japanese quarantine standards (OECD, 1991).

3.4.2. Australia

Australia is a major exporter of agricultural products and also it imports a wide range of them. It is the chairman of the Cairns Group in GATT. Ansley 1990, suggests that Australia is a major free-trade mover, which is fighting for open farm markets.

3.4.2.1. Australian apple industry

Australia was once the biggest apple and pear exporter in the southern hemisphere. In 1971, it exported eight million cartons of apples, while NZ exported only three. Now NZ exports nearly ten million cartons and Australia in 1989 did not manage a million (NZAPMB, 1989).

The Australian apple and pear industry comprises some 3,500 individual growers and several co-operatives. In 1986, it had a total annual harvest of around 17 million boxes of apples and seven million boxes of pears. Australia's total apple export levels have been declining largely due to the increasing cost difficulties that the exporters had faced in the movement of fruit to their traditional markets 20 thousand km away in the UK and Europe. Apple exports to these markets in 1984 were 267 thousands of cartons. Since 1982 Australia is looking for nearby markets of South East Asia in particular Malaysia and Singapore (National Farmer's Federation, 1986).

There are seven major apple growing regions in Australia. All six states have apples and pear production. Each of the fruit growing states of Australia has a different type of administration. Australian industry bodies are: The Australian Apple and Pear Corporation, The Australian Apple and Pear Growers Association, and the Apple and Pear Industry Research Foundation. In general, apple growers individually maintain the status of a principal in growing, harvesting, storage, and selling the crop. This situation is opposite to NZ where the crop is acquired by a single body and marketed on a national basis by the NZAPMB (National Farmer's Federation, 1986).

The Quarantine Proclamation No. 20P made under the Quarantine Act 1908, prohibits the importation into Australia, (except with the permission of the Minister) of all plants or parts of plants that are hosts of Fire Blight that are grown in any country where it exists (AQIS, 1989).

NZ seems to be the most competitive market for Australian apples. They are competitive producers that are intending to enter into Japan and other Asian markets. Also, this rivalry occurs in other countries because of their off-season production with respect to the Northern Hemisphere (NZAPMB, 1988; OECD, 1991).

3.4.2.1. NZ-Australia Bilateral Agreements

The trade liberalisation movement has been encouraged in Australia and NZ by the Bilateral Closer Economic Relations Trade Agreement and by the unilateral reduction of protectionism. There are some bilateral agreements where Australia has obligations with NZ for example under the Australia-New Zealand Protocol of Harmonisation of Quarantine Procedure to the ANZCERTA signed in 1988. This agreement provided for the phased removal of duty rates by

1 January 1988 and the progressive elimination of quotas and technical barriers to trade (TBTs) by 1995 (AQIS, 1990; Hoadley, 1989).

ANZCERTA promised to achieve harmonisation of common quarantine standards and procedures by 1 July 1990; to apply any quarantine on related import restrictions based on regional rather than national distribution of diseases or pests where this occurs in the exporting country; to work towards a prompt solution of the quarantine problems hindering trans-Tasman trade in certain goods, including apples and to establish a consultative group to oversight progress under the protocol (AQIS, 1990). This trade Agreement centres on the removal of the visible trade barriers between those two nations. ANZCERTA is also trying to change a range of other polices to co-ordinate them[6]. The major change in policies should lead to the liberalisation of apple import barriers for Australia under ANZCERTA. It could lead to development of NZ exports of apples once Australia ratifies the protocol to remove its quarantine regulations against Fire Blight.

3.5. NZ SELECTED MARKETS: GENERAL ANALYSIS

In this section the aim is to compare the different markets' situations with respect to the apple trade from NZ. Phytosanitary regulations constitute the most common nontariff barriers in NZ apples.

In general, all the markets should want apples with the characteristics of high levels of purity and safety, and of good quality without damage from insects and disease. High standards of sanitation and quality control are desirable for any country. We discover different cases. The US, and EC, do not directly have non tariff barriers affecting exports of NZ apples. However, they have solid norms for quality and sanitary characteristics. Japan and Australia have closed their markets to NZ apples, both of them are using phytosanitary regulations.

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[6] The objective 10 of the proposed arrangements states that: " *the gradual and progressive liberalisation of trade across the Tasman on all goods produced in either country on basis that would benefit both nations*" (McCurran, 1986).

In contrast, the US and the EC continue an open market. Their domestic apple industry may not be in direct competition with imports from NZ, because the time of supply is different. The transparency of information is important with respect to the specific apples' characteristics and requirements.

Quarantine concerns of overseas governments are often the official reason against allowing entry of imported fruit.

In all the case studies, there are different measures and systems of barriers that tend to protect their domestic production. Clearly, the agreements of trade have different implications at the bilateral level. It is not possible to study all the countries in the same context.

CHAPTER 4

A CASE STUDY: FIRE BLIGHT BARRIER AFFECTING NZ APPLE EXPORTS TO AUSTRALIA

In this section we will explore the process and the implications of phytosanitary barriers (Fire Blight) on NZ apple exports to Australia. This chapter begins with a brief technical review of the Fire Blight disease. The second part is concerned with a description of the NZ proposal to gain access to the Australian market. This is followed by the bioeconomic risk analysis used to evaluate the risk of this disease from Australia's point of view. The last part focuses on the international political ground and a discussion of the banning of this potential market from a NZ and Australian view point.

4.1. FIRE BLIGHT DISEASE

Fire Blight occurs in most of the major apple producing countries, including US, Canada, Chile, most of Europe and NZ. Only few producer countries do not have the disease such as South Africa, Japan and Switzerland (AQIS, 1989).

Fire Blight is caused by the bacterium *Erwinia amylovora* (Burrill, Winslow et al.) which is a necrogen[7]. Hosts vary widely in susceptibility, they are in the family Rosaceae, and the most susceptible are in the sub-family Pomoideae (apples and pears) (Bradbury, 1986).

The disease may attack blossoms, twigs, spurs, fruit, shoots and branches. Infection occurre through blossoms or wounds and multiply. The bacteria may be spread to blossoms, young shoots and wounds from exudate by man, birds, insects (including bees) and mechanical means (wind and driving rain). Infected blossoms and new shoots die and discolour suddenly. Progressively they become translucent, then turn brown and finally black as if damaged by fire. Cankers develop on branches and twigs following invasion of the tissues, and are initially reddish

[7] Necrosis refers to local areas of cell death. Pathogens causing necrosis will be called necrogens (Billing, 1987:3)

in colour. Severely infected trees look as though scorched by fire, a symptom which gave the disease its name (Atkinson, 1971; AQIS, 1990). At one extreme, a canker may form a progression cease at the base of a blossom cluster; at the other, a young tree may be invaded from top to bottom and killed in a single season (Bradbury, 1986; Billing, 1987).

In spring the symptom is death of small fruits shortly after petal fall. Infected young fruits show a brown, soft rot, with characteristic droplets of ooze on the surface. Fruits nearing maturity are apparently immune to attack (Billing, 1987).

Table 4.1. Some field factors used in Fire Blight risk assessment

Characteristics	field factors
host phenology	flowering and shoot growth periods
host susceptibility	cultivar age, cultural factors
number of susceptible targets	blossoms, shoots
risk of damage	storms, insects
risk of inoculum spread	rain, wind insects
inoculum potential	past and current infections
alternative hosts	hawthorn, cotoneaster

Source: Billing, 1987

As can be seen in Table 4.1., there are a wide range of field factors that have influence for accurate risk assessment. Some of the epidemiological factors to consider with respect to this disease are: establishment of infection, disease development rates, host susceptibility, damaging storms, presence of alternative hosts nearby, pre-bloom infection, blossom infection, calcium and potassium nutrition, etc. (Billing, 1989; Wimalajeewa, 1990).

4.1.1. Transmission and Detection

The bacteria are poor competitors with other organisms and are unable to withstand exposure to sunlight and drying conditions. According to AQIS (1990), these microorganisms are not likely to survive long enough to transfer to apple seedlings which have grown from the seed of an infected apple. In fully mature and packed fruit *E. amylovora* has only been detected in washing from the calyx end and not from the fruit epidermis. The pathogen is more likely to survive in association with the dried remnants of the flower parts. In experiments with trees showing symptoms, the disease was not detected in seeds (pips) of apple fruit samples from any of the fruits with either calyx or peduncle infestations.

Trade in apparently healthy mature apple fruit has not been proven to be responsible for establishment of Fire Blight in a country previously free of the disease. Thus, it is unlikely that seeds of fruit exported from orchards without the disease symptoms constitute a means of disseminating the disease (Hale, 1987; Hale, 1989; AQIS, 1990).

AQIS (1989) remarked that there is no evidence that this disease has been introduced into a free country by imported apple fruit. Very little research had been done in relation to the transmission of the disease through movement of fruit (Landos, 1990). Billing (1990) stated that many concepts in Fire Blight research rest on probabilities rather than on certain knowledge.

4.1.2. Control measures

There is a wide range of control strategies for this disease. Primary prevention relies on strict quarantine conditions on the entry of budwood and plant material. If the disease is established, it is possible to use chemical sprays, pruning, sanitation, tree surgery, removal of other host plants, cultural practices, insect control, and biological and integrated controls. The cost will depend on the selected system (AQIS, 1990).

Varietal susceptibility is present in pears and apples. In a prediction model of Thompson (1987) used to estimate Fire Blight in NZ, the results show that many areas of NZ are conducive to the disease. However, disease incidence is much less than predicted suggesting other environmental factors may be restricting Fire Blight development. Populations of epiphytic and saprophytic bacteria (*E. herbicola*) may be restricting the development of the bacteria in NZ by providing some degree of biological control. There are some areas in NZ where Fire Blight would not be likely to occur very often. The apple production in Riwaka areas of the South Island did not have any risk years in the years investigated (Thompson, 1987).

4.1.3. Economic losses

Cunningham 1931 (cited by Atkinson, 1971), stated that when the disease first appeared in NZ during the 1920s, it destroyed many acres of pear trees, but after two or three years its effects were limited to the death of a few pear branches. In later years, it became regarded by most growers as a minor disease.

In response to the initial outbreak, the Fire Blight Act 1922 defined and gazetted fruit growing districts and regulations, making it compulsory to cut back hawthorns in those areas. When this disease appeared an embargo was placed on export to Australia from NZ of susceptible nursery trees. Later this embargo was extended to apple and pear fruit and is still in force (Atkinson, 1971). Losses from Fire Blight arise from a loss of production and from direct costs due to spray applications[8].

4.2. ACCESS PROPOSALS: HISTORICAL REVIEW

The purpose of this section is to review the proposals made by NZ to gain access to the Australian market, in which NZ apples have been banned for phytosanitary reasons especially Fire Blight.

During the last six years, scientists from both countries in the "Australian Access Committee Meeting" had been working together on the development of the protocol access of NZ apples into the Australian market as contained in Table 4.2.

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[8]With respect to the economic consequences of the disease Wimalajeewa said: "*the most serious economic losses would result from the restriction of overseas market opportunities, by those considerations which presently apply to countries where Fire Blight is known to occur*" (Wimalajeewa, 1987:59)

Table 4.2. Timescale of the Access Proposal of NZ's apples to Australian market

1985		Conference on Fire Blight indicating that NZ was affected by the disease
1986	Nov	Start the Negotiations. Purpose: prevent the establishment of the disease in Australia through the importation of NZ apples.
		Basically the proposal submitted by NZ for Switzerland was provided to Australia.
1987		AQIS requested the BRR to examine this issue
1988		The proposal was rejected, following technical evaluation (BRR)
		There is no evidence that this disease has been introduced into a free country following carriage by imported apple fruit.
		Australian Pathologists visited NZ production areas
1989	Jun	Requirements: low risk area, no disease host within 0,25 km, treatment with chlorine and sampling checked by DNA probe.
1990		Inspection is a NZ responsibility (Draft Agreement).
		HPC recommends protocol not to be ratified. Reason: possibility of establishment of the disease from this source.
		AQIS has ruled that a draft proposal for NZ imports did not provide sufficient safeguards against Fire Blight.
1991	Mar	Conditions: MPL =1 infected apple/ million pieces arrival in Australia. (NZ would need to sample 6 million fruit if tolerance P =0.95)

Source: MAFQUAL, 1989; MAFQUAL, 1990; MAFQUAL, 1991 ; AQIS, 1990; HPC, 1990; The Press, 1990.

In 1985 a paper was presented at an international conference on Fire Blight indicating that the bacterial disease was widely distributed throughout NZ. Negotiations for apple access to Australia started in early 1986, when the subject was formally raised at the annual Australian and NZ technical consultations on plant quarantine. The sanitary requirements holding for apple imports into Australia are contained into a protocol outlined by quarantine authorities (AQIS, 1990; Landos, 1990; MAFQUAL, 1990f). Basically the same proposal submitted by NZ to Switzerland to gain access for NZ apples was provided to Australia in 1986.

In 1986 a Swiss Government official came to NZ to investigate Fire Blight in apple orchards. He said that his impression before he arrived in NZ was that NZ was riddled with Fire Blight. However, he discovered that the bacterial disease was extremely difficult to find and that orchard management practices against it were well-developed and effective (Massey, 1986).

Before the Australian Department of Primary Industry Energy (DPIE) signed the agreement in 1988, they circulated copies of it among industry groups and other scientific bodies for comment. The proposal specified measures that would be employed to minimise the risk of the disease becoming established in Australia as a result of imports. The proposal was rejected in 1988 following technical evaluation by the BRR with other Australian institutions. Australia believed that there was ample justification maintaining the prohibition on the import of apples (MAFQUAL, 1986). In NZ, Fire Blight was not considered important as a domestic problem with apples and could be readily controlled. On the other hand it was regarded in Australia as a problem that should be excluded at all costs, but there was clearly still imperfect knowledge on the epidemiology of the disease (See Section 4.1.).

Between 1988-89 the Australian Access Committee Meeting worked on this issue. The draft of the agreement between MAFQUAL and the Australian Quarantine and Inspection Service (AQIS) concerning the access of apples into Australia included various strategies. A maximum pest limit (MPL) was suggested of nil detection of bacteria on one thousand fruit per ten thousand trees using the DNA hybridisation method. The requirements for export apples to Australia were: production from a low risk area followed by a chlorine treatment; phytosanitary certificate; inspection by AQIS (visiting production areas and laboratories in NZ at any time) to validate the performance of the treatment becomes necessary. Registration of the packhouses and storage apart from other lines of fruit was also considered.

The production requirements suggested by Australia for use in NZ include: selection of regions which are disease free, registered growers, absence of orchard symptoms, sampling and testing of export fruit (one thousand immature fruits per variety to be exported, per orchard block), inspection zones and inspection of apples pollination, packing and storage inspection. Plans within Australia include: notification of failure in the treatment by MAFQUAL and Detection of failure in the treatment by AQIS (AQIS, 1989-90; MAFQUAL, 1989b). No Fire Blight host is permitted within 0.25 km of apples sourced for export to Australia. However, AQIS has ruled that the draft proposal for NZ imports does not provide sufficient safeguards against

Fire Blight (The Press, 1990). AQIS based decisions on biological, and, on economic analysis and other risks associated with importation (AQIS 1990; Landos, 1990).

In 1990, the Horticultural Policy Council (HPC), submitted the Fire Blight working group's report to the Minister. The HPC 1990, concluded that the risk of Fire Blight establishing itself in Australia following carriage by apples from NZ is low. Nevertheless, it recommended the draft protocol not be ratified. The reason was: the possibility of establishment of the disease from this source (Landos, 1990).

Since 1991, technical consultations have continued on the adequacy of NZ protocol conditions. NZ invited the Australian officials to provide an indication of the MLP of infested fruit. The Australian authorities suggested conditions such as the level of protection of the MPL of infested fruit being of one infected apple per two million pieces on arrival in Australia. However, this level of MPL is not realistic, as to meet this tolerance at a 95 per cent probability requires that six million NZ fruit would need to be sampled (MAFQUAL, 1991c). The sample fruit will be drawn from all growers in the designated inspection, six hundred fruit sample from each shipment lot. This is to give a 95 per cent confidence that a 0.5 per cent infection rate would be detected (Landos, 1990). This would be a very costly monitoring requirement.

Inspection of the apples is a responsibility of the NZ authorities under the conditions of the draft agreement. AQIS accept field inspections by overseas' authorities as a basis for phytosanitary certificate issue. It considers that there is no justification for testing for Fire Blight on arrival of fruit to Australia to provide added quarantine security above that achieved by the producers in NZ (AQIS, 1990).

In the Australian Access Committee Meeting, several steps have been incorporated to provide further assurance that the disease will not be introduced and established in Australia. The proposals specified measures that would be adopted to minimise the risk of the Fire Blight becoming established in Australia as a result of imports. Therefore, the access strategy was forced to take that of proving an area was highly unlikely to be conducive to Fire Blight coupled with a series of additional treatments.

During this period of time NZ carried out a great deal of research work in Fire Blight.

It included: detection tests, infection, transmission, control and other important technical research in the disease. It had developed criteria for exporting NZ apples, they included sourcing apples from an area with low risk, a post harvest dip treatment (chlorine), mature apples, visual orchard assessment, using a DNA probe, 0.25 km from alternative hosts and introducing the ISO 9002 certification system (MAFPOL, 1990; Monigatti, 1991).

4.3. BIOECONOMIC RISK ASSESSMENT

Australia has maintained that importation of apples increases the risk of Fire Blight. These phytosanitary barriers can be analyzed using the concept of bio-economic risk assessment as carried out as part of decision making on quarantine matters. A special review of the disease was made before banning it. During this review process, the aim was to examine the risks and the benefits of the importation of apples.

The assessment was carried out in two parts. The Australian Bureau of Agricultural and Resource Economics (ABARE) has made an assessment of the economic components of the overall risks. The Australia Bureau of Rural Resources (BRR) was in charge of evaluating the biological impact of the decision of the access of NZ apples.

4.3.1. The Biological impact

The BRR considers low risk of introduction of Fire Blight into Australia by the importation of mature and apparently healthy apples from NZ (AQIS, 1990).

Roberts of BRR in his paper: " The consequences of Establishment of Fire Blight in Australia, A Biological risk Assessment" suggested that apple production could drop 15 to 20 per cent and pear production 48 to 50 per cent, if all apple and pear production areas in mainland Australia became diseased (the worst scenario) (AQIS, 1990:18).

The potential risks of Fire Blight infection are speculative because the applicability of the models to Australian conditions cannot be tested (Billing, 1989; Wimalajeewa, 1990).

Although Australia has so far remained free from Fire Blight, there is increasing risk of the disease being introduced with propagating material from apples. All propagation wood from apples and other rosaceous sources will only be imported from approved sources and should have originated from properties free of Fire Blight during the current and previous seasons (Wimalajeewa, 1987; Wimalajeewa, 1990).

4.3.2. The economical Impact

ABARE's report represents the economic component of a new way in which risk assessment can be embraced when dealing with quarantine issues (MAFQUAL, 1990d). ABARE's analyst on bioeconomic risk assessment, Hall, described the approach as one of "Probability x money"[9]. In this approach the greater the economic impact on the domestic industry of the unintended introduction of a disease, the lower the acceptable risk of introduction of a disease, and vice versa (MAFQUAL, 1990e; MAFQUAL, 1990f).

The Cost-Benefit analysis used by ABARE considers the problem in the importer country. It focused on Australian supply side effects but does not take into account the bilateral trade relationship.

The ABARE analysis of NZ apple access proposal identifies probabilities of gains and losses if imports are allowed. It looked at the impact on domestic producers of competition from imported apples. In Australia, the effect that NZ apples could have on the domestic pear industry was regarded as an externality. Any intervention is based on the existence of a market failure. Quarantine, the solution implemented, is considered as a public good. However, it represents a form of government regulatory intervention in a competitive market economy. (Hinchy, 1990; Hinchy, 1991)

In order to measure the impact of the disease, ABARE ran simulation experiments. It

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[9] He said that this exercise would make transparent the monetary value of the quarantine barrier, and ensure that Ministers were aware of the extent to which this concern might be driving the industry's opposition (MAFQUAL, 1990e)

used a model of an orchard in which 79 per cent of the area was planted in apples and 21 per cent in pears. These simulation experiments are based on the forecast that NZ exports of apples to Australia could grow at between three thousands tonnes and seven thousands tonnes a year. They also estimate losses from Fire Blight of 20 per cent of apples and 50 per cent of pears, in the absence of control measures. The cash flow of the sample orchard was estimated to decline by 36 per cent. It was estimated using these simulations that Australia would benefit between A $0.2 millions and A $2.8 millions a year by 1995. However, there is considerable uncertainty in this analysis about the cost effectiveness of available control measures at the orchard level (AQIS, 1990).

Victoria's Goulburn Valley is the dominant pear and apple producing region. Studies suggest that if the disease took hold in this Valley, 90 per cent of Australia's main pear crop would be affected. The possibility exists that it would spread to other regions[10] (Ansley, 1990).

It is considered impossible to estimate the probability of an apple carrying Fire Blight bacteria leading to the establishment of the disease in Australia[11] (AQIS, 1990)

Under these specific assumptions, the estimated annual loss if Fire Blight became established in one major apple growing region was A $39 millions[12] and an average loss for Australia of A $44.4 millions (AQIS, 1989-1990).

In this ABARE's assumption, the critical probability for the entry, infestation and

[10] If the disease became established in the Valley, the estimated annual loss was $77 millions.

[11] " *If the probability of transmission was assumed to be 1 in 10,000,000 then the establishment of this disease in Australia from imported fruit might be expected to occur once every 22 years, based on the worst case scenario. This worst case assumes that 0.45% of all apples entering Australia carry Fire Blight* " (AQIS, 1990:11).

[12] When it was considered over the seven major apple growing regions, the estimated loss of $ 39 millions for an apple growing region was weighted by a factor of 6/7 and added to the estimated loss of $77 millions for the Goulburn Valley weighted by a factor of 1/7 (AQIS 1990).

dissemination of Fire Blight is one in 1040[13] (AQIS, 1990).

There is a high degree of uncertainty about the basic biological and economic data used in the ABARE analysis (AQIS, 1990). The conclusions by ABARE do not influence the AQIS decision because they are linked to probabilities of Fire Blight establishment which cannot be assessed. In the process of finalizing the decision on the above, some impact groups have made representations.

4.4. POLITICAL CONSIDERATIONS OF THE IMPORT BAN

Australian policy can be interpreted in different ways. From one point of view, prohibiting access to NZ apples can be seen as a way to reduce the risk of introduction of Fire Blight disease. However, there are no technical studies in transmission, propagation, detection, infection and reproduction of the disease in the Australian environment. From another view point, this policy can make sense to protect Australia's domestic production from foreign competition.

None of Australia's existing markets for apples and pears have restrictions on the import of fruits from countries where Fire Blight occurs. However, Australia has a favoured position in obtaining access to Japan because Fire Blight is not present (AQIS, 1989).

In the event, the rejection of the access proposal for importing apples from NZ produced different reactions. On the one hand it was easy to identify those who agreed with this decision, most of the producers in the industry. On the other hand, there were those who support free trade schemes and were against Sanitary and Phytosanitary (SPS) measures being used without scientific basis. Political pressures resulting from the characteristics of Australian production and trade underlie this decision (See Section 3.4.2.).

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[13] On one hand, if the assessed probability were less than 1 in 1040, the benefits would exceed the costs if imports were permitted. On the other hand, if they were greater than 1 in 1040, the cost would exceed the benefits.

4.4.1. International obligations

As a contracting party to the GATT, Australia has agreed not to use quarantine measures in an unjustified way to protect its industries against foreign competition in domestic markets. There are two important features in the principle of equivalency of different SPS: measures meeting and procedures for consultation and dispute settlement (AQIS, 1990).

The measure of the protection accorded Australian apple growers by the Fire Blight related quarantine restrictions will come under scrutiny by competitor apple producing countries. There are some international organisms that can be helpful in this trade issue such as: ANZCERTA, GATT and IPPC (MAFQUAL, 1990g).

4.4.2. Australia View Point

The rejection of the Proposal is believed to have been influenced by interested Australian groups and growers. To those who view trade regulation as the proper province of economists and risk analysts alone, these findings may be discouraging. On the other hand, those taking the view that regulation, is inherently a political act, may find it encouraging that affected parties not only participate actively in the regulatory process but do so quite effectively (Ansley, 1990).

For AQIS, Fire Blight research in Australia must necessarily be restricted to that which can be done under strict quarantine security. It does not consider funds for Fire Blight research (AQIS 1990).

The HPC 1990, accepts that quarantine must not be used as a barrier to protect domestic industries from foreign trade competition. The Council also believes that there is substantiated doubt of the level of risk, regarding a quarantine decision. They consider technical inadequacies of the strategies on which the draft agreement is based[14].

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14 They based on: (a) There are no Fire Blight free district in NZ. (b) The risk of introducing this disease from apparently healthy apple fruit, if there are large volumes and ideal conditions a real possibility exists for an outbreak if the

4.4.3. NZ View Point

On the other hand, many New Zealanders disagreed with the decision of rejecting the protocol. MAF believed the apples would be no threat to Australia's agricultural security.

Ansley (1990), said that the argument is over well-advanced plans to accept high technology control measures in NZ which would give as much protection as possible against the disease slipping into Australia. The biological threat posed to Australia by Fire Blight may not be sufficiently understood to make a definitive decision. The gap which exists in the knowledge of fundamental aspects of the disease (See Section 4.1.), and the rapidity of the continuous advances in technology produce a scientific complex problem (MAFQUAL, 1990e).

All imports, involve a level of risk (Landos, 1990). Australian Apple and Pear growers' association Fire Blight task force would acknowledge that there is a level of risk attached to the illegal importation.

4.4.4. General Considerations

The Australian regulation in NZ apples through a phytosanitary barrier results in an increase of the cost of NZ export apples. This has different effects on the producer, the Board and at the national level as well. The cost of producing in NZ within Australia's requirements may increase to a similar or higher level than the cost of producing in Australia. In fact, there are some implicit costs in the proposal of exportation. The costs involved include: field trials, fees of the inspection control (ports and airports), administrative cost, the phytosanitary certificate, the

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disease to arise from this source. (c) This disease is considered one of the most infectious and devasting diseases known to affect plants. (d) Once established the disease would be extremely difficult and costly to contain and, would be impossible to eradicate. (e) Over the last 120 years there has been a big amount of research on this topic around the world and it is still considered one of the most erratic and unpredictable disease of apples and pears. (f) They consider technical inadequacies with each of the four principal strategies on which the draft agreement is based. (HPC, 1990) destructive sampling of the fruit inspection, quality assurance, certification of local growers and extension costs. These costs also include research and development in the new technology applied in the apple industry, regulatory system for the norms, the time and resources involved in six years of work on the access of this market. For the grower, the higher cost will be related to the application of a new technology (agrochemicals, spray programmes of control and prevention, labor force, post-harvest disinfection (dip), packaging, container etc). It would be appropriate to do an economic analysis of the proposals that include the time, the resources: people, research in the technical issue, etc. There are opportunity costs such as the selection of export areas and maintaining one specific kind of phytosanitary regulation in NZ as supplying country.

It is difficult to conclude that the reason for the rejection of the NZ proposal, is one of just a technical nature. The general impression is that this ban decision may have involved political and economic as well as technical issues.

CHAPTER 5

ANALYTICAL MODEL

The first section of this chapter refers to the analytical framework using a partial equilibrium model. The second section refers to the assumptions of the model. The third section focuses on the development of an eight simultaneous equations model, its differentiation and solution using matrix algebra. It evaluates the effect of the Australian apples import ban on NZ. The final section is concerned with the empirical analysis. In seeking to understand the pattern of distortion of NTBs, the economic effects of Australian quarantine restriction on NZ and Australia were examined, with respect to the current situation, if the ban is reduced. The analysis is concentrated on four alternative policies changing the current ban and measuring the consequent welfare effects in Australia and NZ.

5.1. ANALYTICAL FRAMEWORK: PARTIAL EQUILIBRIUM MODEL

A partial equilibrium model of the two countries NZ (exporter) and Australia (importer) has been used to evaluate the economic effect of the Fire Blight restrictions.

The quantities traded, produced and consumed in each market relate to the price through the specified demand and supply functions. The domestic supply and demand of importer and exporter countries permit us to obtain information, which is used to construct excess supply (ES) and excess demand (ED) curves. An equilibrium price is defined for given static, supply and demand functions. The supply-demand diagram represents an equilibrium but does not imply that price and quantity are constant in a purely competitive market. Moreover, in a real dynamic economy, the forces which influence both the level and the slope of demand and supply curves are changing.

There are separate import demand or export supply functions. The parameters of export supply and export prices are the elasticity of both export demand and import supply. The equilibrium market conditions for a commodity are usually expressed in terms of ES and ED curves. The ES is the horizontal distance between the supply and demand curves in the exporting country. The ES curve is positively sloped like conventional supply schedules since the gap between supply and demand extends as the price increases. The ED schedule is negatively sloped since the gap between the demand and supply curves widen as the price declines.

Partial equilibrium trade models permit an understanding of the relationship between the endogenous variables: ED, ES and Prices: Australian apples price P_A and NZ apples price P_{NZ} in response to variation in exogenous variables such as regulatory costs in NZ. Changes in exogenous variables produce falls or increases in the endogenous variables P, ED and ES.

The domestic price index (P_{NZ}) serves a dual role in the supply functions. First, for a given level of the export price, the level of exports falls when factor costs in the export industries increase. As these factor costs are likely to move with the general level of domestic prices, P_{NZ} serves as a proxy for them. Second, to the extent that resources involved in exportable apple production can be transferred to other uses or that the export price can be kept different from the domestic price, the relative profitability of exporting apples falls with an increase in domestic prices.

5.2. MODEL FOR NZ APPLE TRADE

Apples are considered to come in two types: NZ-type apples featuring the varietal mix available in NZ, and Australian-type apples featuring the varietal mix available in Australia. The current world market for NZ-type apples is represented by panels (a) and (b) of Figure 5.1. The Australian market is represented by panel (c) of Figure 5.1.

S_{NZ} and D_{NZ} represent the supply and demand curves for NZ apples respectively in Figure 5.1. (a). Figure 5.1. (b) and (c) represent the total world market for apples facing NZ separated into the Australian market (c) and the 'all other countries' market (b).

The demand for NZ-type apples outside NZ is represented by the excess demand curves, ED_{Rw} the rest of the world (except Australia) and ED_A Australia. It may be noted that the excess demand curves are actually demand curves because the product, NZ-type apples, is considered

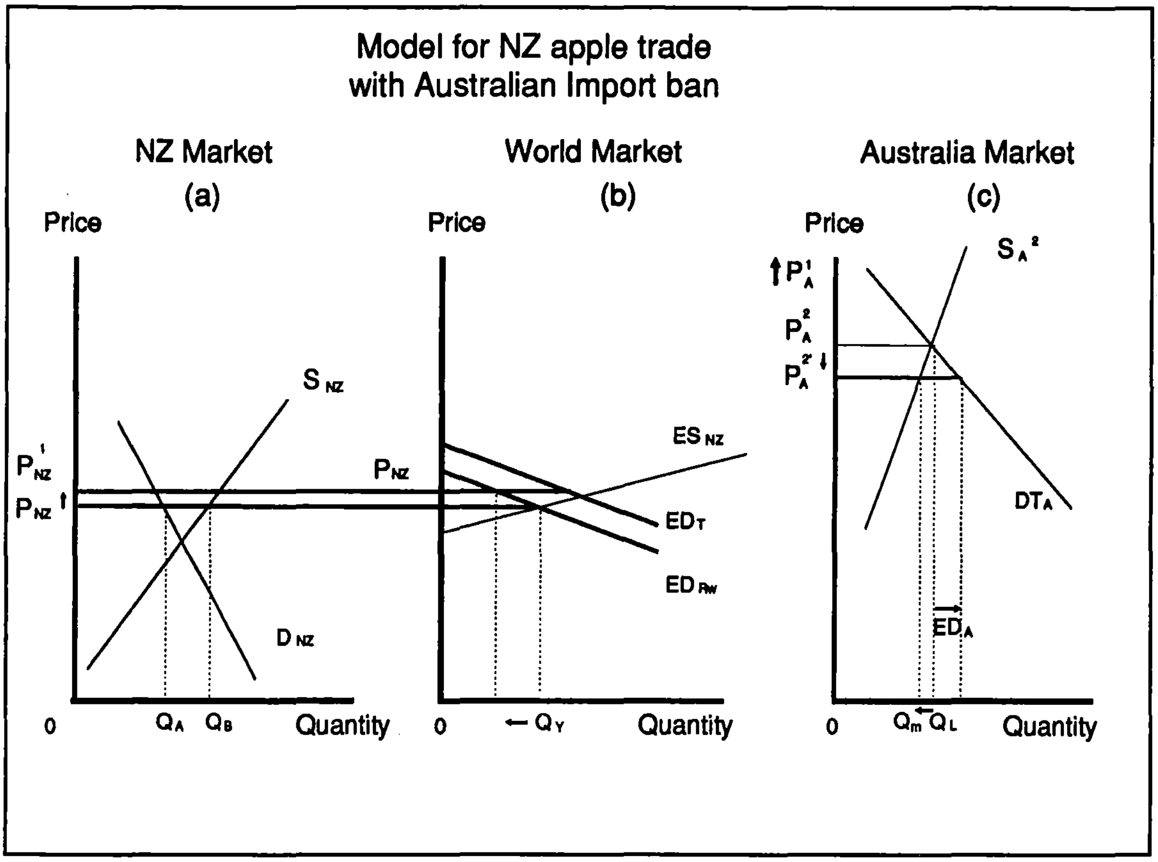

Figure 5.1. Model for New Zealand apple trade.

unique to NZ in this model.

In the current policy environment, the excess demand curve for NZ-type apples in Australia (ED_A) is zero in Figure 5.1.(c), given the import ban due to Fire Blight. In the absence of international transactions costs, the export price of NZ-type apples and the NZ domestic price P_{NZ} will be equal where NZ excess supply ES_{NZ} equals the excess demand for NZ-type apples for the rest of the world (ED_{Rw}) (Figure 5.1.(b)).

At that price the quantity of apples supplied in NZ is Q_B and the quantity demand Q_A. NZ exports to the rest of the world are Q_y (equal to Q_B - Q_A). NZ exports to Australia are zero (Figure 5.1.(c)). DT_A represents the total demand function for apples in Australia, it includes NZ-type apples and Australian-type apples.

In the Australian market (Figure 5.1.(c)) the quantities supplied and demanded is Q_L and the price of Australian-type apples is P_A^2, given the unavailability of NZ-type apples. If the import ban on NZ type apples into Australia is lifted, the price of NZ-type apples, P_A^1, in Australia is reduced.

When the increase in export demand facing NZ from Australia is added to the excess demand of the rest of the world, ED_{Rw}, the total excess demand facing NZ is increased to ED_T. The NZ export price is increased to P_{NZ}^1 and the price of NZ-type apples in Australia is reduced to P_A^2. If the import ban adjustment is less than complete P_A^1 will remain higher than P_{NZ} with the difference being the tariff equivalent of the import protection remaining.

The reduction in P_A^1 will move the demand curve for their substitutes (Australian-type apples) and to the left, Figure 5.1.(c). The quantity demanded and supplied of Australian-type apples will decrease to Q_m and the price of Australian-type apples will fall to P_{A2}'.

5.2.1. Assumptions

The assumptions in this model are:

(i) NZ-type apples are distinguished as an imperfect substitute for Australian-type apples.

(ii) NZ is the only producer country for NZ-type apples.

(iii) The supply of NZ fresh apples is a function of P_{NZ}, and the cost of the requirements for controlling Fire Blight disease for Australian market α. In the Australian case S_A is a function of P_A^2 and the control cost of the disease in the case that it will be established γ.

(iv) In the long run, NZ may expand the area devoted to apples or expand cultivated area. Any change in the price requires sufficient time for adjusting the supply level.

(v) The introduction of a phytosanitary barrier is represented as a shift in exogenous variables. The levels of these variables in this model represent policy alternatives for control of Fire Blight disease in Australia.

5.3. MODEL EQUATIONS

The algebraic version of the model outlined in figure 5.1. is given by the following set of equations (1 - 8).

The parameters α and γ represent the control cost of Fire Blight disease in NZ and

Australia respectively. And, κ represents the non tariff barrier (ad valorem equivalent) in the Australian market, which affects directly the price of NZ-type apples in Australia.

The general model formulates the Fire Blight problem in NZ-type apples functions as:

$$DT_A = DT_A(P_A^2) \; ; \qquad \eta_{DT_A} < 0 \tag{1}$$

$$S_A^2 = S_A^2(P_A^2, \gamma) \; ; \qquad \eta_{S_A^2} > 0, \; \eta_\gamma < 0 \tag{2}$$

$$P_A^2 = P_A^2(P_A^1) \; ; \qquad \eta_{CP_A^{21}} > 0 \tag{3}$$

$$P_A^1 = P_A^1(P_{NZ}^1, \kappa) \; ; \qquad \eta_{PT_A^{NZ}} > 0, \; \eta_\kappa > 0 \tag{4}$$

$$S_{NZ}^1 = S_{NZ}^1(P_{NZ}, \alpha) \; ; \qquad \eta_{S_{NZ}^1} > 0, \; \eta_\alpha < 0 \tag{5}$$

$$D_{NZ}^1 = D_{NZ}^1(P_{NZ}) \; ; \qquad \eta_{D_{NZ}^1} < 0 \tag{6}$$

$$ED_{Rw}^1 = ED_{Rw}^1(P_{NZ}) \; ; \qquad \eta_{ED_{Rw}^1} < 0 \tag{7}$$

$$S_{NZ}^1 = D_{NZ}^1 + (D_A^T - S_A^2) + ED_{Rw}^1 \tag{8}$$

Where:

^{1} and ^{2} = NZ and Australian-type apples respectively.

Own price elasticity of the Australian total demand for apples

$$\eta_{DT_A} = -\left(\frac{\partial DT_A}{\partial P_A^2}\right) \times \left(\frac{P_A^2}{DT_A}\right).$$

Own price supply elasticity of the Australian-type apples

$$\eta_{S_A^2} = \left(\frac{\partial S_A^2}{\partial P_A^2}\right) \times \left(\frac{P_A^2}{S_A^2}\right)$$

Supply elasticity of own price New Zealand-type apples

$$\eta_{S_{NZ}^1} = \left(\frac{\partial S_{NZ}^1}{\partial P_{NZ}}\right) \times \left(\frac{P_{NZ}}{S_{NZ}^1}\right)$$

Elasticity of the NZ control cost of the disease of the NZ-type apples supply

$$\eta_{\alpha} = \left(\frac{\partial S_{NZ}^1}{\partial \alpha} \right) \times \left(\frac{\alpha}{S_{NZ}^1} \right)$$

Demand elasticity of own price of the NZ-type apples

$$\eta_{D_{NZ}^1} = - \left(\frac{\partial D_{NZ}^1}{\partial P_{NZ}} \right) \times \left(\frac{P_{NZ}}{D_{NZ}^1} \right)$$

Elasticity of the control cost of the disease with respect to the supply of Australian-type apples

$$\eta_{\gamma} = \left(\frac{\partial S_A^2}{\partial \gamma} \right) \times \left(\frac{\gamma}{S_A^2} \right)$$

Cross price elasticity of the Australian demand for apples

$$\eta_{CP_A^{21}} = \left(\frac{\partial P_A^2}{\partial P_A^1} \right) \times \left(\frac{P_A^1}{P_A^2} \right)$$

Price transmission elasticity of the Australian price apples and the price of NZ-type apples

$$\eta_{PT_A^{NZ}} = \left(\frac{\partial P_A^1}{\partial P_{NZ}} \right) \times \left(\frac{P_{NZ}}{P_A^1} \right)$$

Elasticity of the ad valorem NTB on the Australian price of NZ-type apples

$$\eta_{\kappa} = \left(\frac{\partial P_A^1}{\partial \kappa} \right) \times \left(\frac{\kappa}{P_A^1} \right)$$

Elasticity of the NZ-type apple excess demand of the rest of the world

$$\eta_{ED_{Rw}^1} = - \left(\frac{\partial ED_{Rw}^1}{\partial P_{NZ}} \right) \times \left(\frac{P_{NZ}}{ED_{Rw}^1} \right)$$

The total demand function for apples in Australia DT_A *(equation 1)* includes NZ-type apples and Australian-type apples. The price P_A^2 is used as a proxy for the weighted average price of NZ-type apples and Australian type apples. The demand of apples is expected to be negative related with the price. From equation (1):

$$dDT_A = -\left(\frac{\partial DT_A}{\partial P_A^2}\right) \times dP_A^2 \quad (9)$$

Dividing by DT_A then, we obtain the proportionate change in the left-hand side (LHS) variable, which is represented by the hat (^):

$$\frac{dDT_A}{DT_A} = \hat{DT}_A = -\left(\frac{\partial DT_A}{\partial P_A^2}\right) \times \left(\frac{dP_A^2}{DT_A}\right) \quad (10)$$

Expanding by multiplying by P_A^2/P_A^2, then:

$$\hat{DT}_A = -\left(\frac{\partial DT_A}{\partial P_A^2}\right) \times \left(\frac{P_A^2}{DT_A}\right) \times \left(\frac{dP_A^2}{P_A^2}\right) \quad (11)$$

Replacing with elasticities and variables hat:

$$\hat{DT}_A = -(\eta_{DT_A} \times \hat{P}_A^2) \quad (12)$$

The Australian supply of fresh apples is modeled as a function of P_A^2, and gamma (γ), which represents the control cost of Fire Blight in Australia, equation 2.

Differentiating equation (2):

$$dS_A^2 = \left(\frac{\partial S_A^2}{\partial P_A^2}\right) \times dP_A^2 - \left(\frac{\partial S_A^2}{\partial \gamma}\right) \times d\gamma \quad (13)$$

Dividing by S_A then, we obtain the proportionate change in the left-hand side (LHS) variable, which is represented by the hat (^):

$$\frac{dS_A}{S_A} = \hat{S}_A = \left(\frac{\partial S_A}{\partial P_A^2}\right) \times \left(\frac{dP_A^2}{S_A}\right) - \left(\frac{\partial S_A}{\partial \gamma}\right) \times \left(\frac{d\gamma}{S_A^2}\right) \quad (14)$$

Expand by multiplying the first term by P_A/P_A, and the second one by gamma/gamma. Then:

$$\hat{S}_A = \left(\frac{\partial S_A}{\partial P_A^2}\right) \times \left(\frac{P_A^2}{S_A}\right) \times \left(\frac{dP_A^2}{P_A^2}\right) - \left(\frac{\partial S_A}{\partial \gamma}\right) \times \left(\frac{\gamma}{S_A}\right) \times \left(\frac{d\gamma}{\gamma}\right) \qquad (15)$$

Replacing with elasticities and variables hat:

$$\hat{S}_A^2 = \eta_{S_A^2} \times \hat{P}_A - \eta_\gamma \times \hat{\gamma} \qquad (16)$$

That is the percentage change in the Australian apple supply is given by the algebraic sum of the percentage change in the explanatory variables, weighted by this respective elasticities.

Similiarly equations (3) to (7) are transformed so that the model in rate of change form is by equations (17) to equation (21):

$$\hat{P}_A^2 = (\eta_{CP_A} \times \hat{P}_A^1) \qquad (17)$$

$$\hat{P}_A^1 = (\eta_{PT_A} \times \hat{P}_{NZ}) + (\eta_\kappa \times \hat{\kappa}) \qquad (18)$$

$$\hat{S}_{NZ} = (\eta_{S_{NZ}} \times \hat{P}_{NZ}) - (\eta_\alpha \times \hat{\alpha}) \qquad (19)$$

$$\hat{D}_{NZ} = -(\eta_{D_{NZ}} \times \hat{P}_{NZ}) \qquad (20)$$

$$\hat{ED}_{Rw}^1 = -(\eta_{ED_{Rw}^1} \times \hat{P}_{NZ}) \qquad (21)$$

The price of Australian-type apples in Australia is a function of the price of NZ-type apples in Australia (P_A^1). This price P_A^1 is a function of the price of NZ apples and a exogenous variable kappa (κ), which represent the ad valorem equivalent non tariff barrier in Australia.

The NZ demand of apples (equation 6) is expected to be negative related with the price. The NZ supply of fresh apples (equation 5) is modeled as a function of its own price P_{NZ} and the control cost of the Australian requirements regarding Fire Blight disease, which is represented by alpha (α). It is expected to be positively related to the price and negatively related to the cost of Fire Blight control (α). As noted by the sign above the explanatory variables.

The percentage change in the NZ apple supply is given by the algebraic sum of the percentage change in the explanatory variables, weighted by these respective elasticities.

Differentiating totally equation (8):

$$dS_{NZ}^{1} = dD_{NZ}^{1} + dDT_{A} - dS_{A}^{2} + dED_{Rw}^{1} \tag{22}$$

$$dS_{NZ}^{1} + dS_{A}^{2} = dD_{NZ}^{1} + dDT_{A} + dED_{Rw}^{1} \tag{23}$$

Dividing by $(S_{NZ} + S_{A})$ and $(D_{NZ} + DT_{A} + ED_{Rw})$:

$$\left(\frac{dS_{NZ}^{1}}{S_{NZ}^{1}+S_{A}}\right)+\left(\frac{dS_{A}^{2}}{S_{NZ}^{1}+S_{A}^{2}}\right)=\left(\frac{dD_{NZ}^{1}}{D_{NZ}^{1}+DT_{A}+ED_{Rw}^{1}}\right)+\left(\frac{dDT_{A}}{D_{NZ}^{1}+DT_{A}+ED_{Rw}^{1}}\right)+\left(\frac{dED_{Rw}^{1}}{D_{NZ}^{1}+DT_{A}+ED_{Rw}^{1}}\right) \tag{24}$$

Then, replacing for variables hat (^):

$$w_1 \times \hat{S}_{NZ}^{1} + w_2 \times \hat{S}_{A}^{2} = w_3 \times \hat{DT}_{A} + w_4 \times \hat{D}_{NZ}^{1} + w_5 \times \hat{ED}_{Rw}^{1} \tag{25}$$

Where:

$$w_1 = \left(\frac{S_{NZ}^{1}}{S_{NZ}^{1} + S_{A}^{2}}\right)$$

$$w_2 = \left(\frac{S_{A}^{2}}{S_{NZ}^{1} + S_{A}^{2}}\right)$$

$$w_3 = \left(\frac{DT_{A}}{DT_{A} + D_{NZ}^{1} + ED_{Rw}^{1}}\right)$$

$$w_4 = \left(\frac{D_{NZ}^{1}}{DT_{A} + D_{NZ}^{1} + ED_{Rw}^{1}}\right)$$

$$w_5 = \left(\frac{ED_{Rw}^{1}}{DT_{A} + D_{NZ}^{1} + ED_{Rw}^{1}}\right)$$

That is the percentage change in the Australian and NZ apple supply is given by the algebraic sum of the percentage change in the total demand of Australia New Zealand and the excess demand from the rest of the world, weighted by these respective proportions in the total.

5.4. DATA SPECIFICATION

5.4.1. Parameters

The parameters for the model were obtained from past studies. Parameters are available relating to the Australian and NZ domestic apple markets in Hinchy (1990) and Hinchy (1991), who reported the following estimates: $\eta_{SA}^{2} = 0.3$, $\eta_{SNZ}^{1} = 0.3$ and $\eta_{DNZ}^{1} = -0.3$.

Since the analysis concentrates on the effects of apple trade between Australia and NZ, some additional parameters are needed for forecasting excess demand and supply and therefore potential exports if the ban is reduced. Stern (1976), stated that the "long-run" excess demand elasticity has a median of -0.78. Therefore, this value (-0.78) will be used in the model as price elasticity of excess demand of NZ apples facing for the rest of the world η_{EDRw}^{1}. The elasticity of Australian demand for imports with respect to relative price of fruit in general has been estimated as -0.73 (Stern, 1976:349). The cross price elasticity of demand for Australian-type apples with respect to the price of NZ-type apples was taken to be 0.5. The price transmission elasticity between P_{NZ} and P_{A}^{1}, (η_{P}) was taken as one (1).

Table 5.1. Summary of the Parameters (Price elasticities) used in the equations model:

Parameters	Estimated Value	Source
η_{SNZ}	0.3	Hinchy, 1990
η_{DNZ}	-0.3	Hinchy, 1990
η_{SA}^{2}	0.3	Hinchy, 1990
η_{DTA}	-0.9	Assumption
η_{EDRw}	-0.78	Stern, 1976
η_{CP}^{12}	0.5	Assumption
$\eta_{PT}^{1\text{-}2}$	1	Assumption

The "Homogeneity condition" in demand theory (Philips, 1983) states that the algebraic sum of all price elasticities for a product and its income elasticity of demand should be zero. The income elasticity of demand for apples in Australia is likely to be positive. Let us assume it has a value of 0.4, accordingly the cross price elasticity between NZ-type and Australian-type apples is high, say 0.5, then the Australian demand elasticity ought to be of the order of 0.9.

The cost of Fire Blight control is assumed to affect production in the opposite direction from the product price but to the same degree. Accordly, the supply elasticity of the cost of Fire Blight control in NZ (η_α) and Australia (η_γ) are both assumed to be -0.3. The price transmission elasticity of the Australian price of NZ-type apples and NZ price apples is taken as one because the barrier is expressed in ad valorem tariff equivalents.

5.4.2. Model Solution

In matrix form equations (12), (16) to (21) and (25) may be summarised as in equation (26).

$$[\ \textit{Parameters}\ ] \times \begin{bmatrix} \textit{Endogenous} \\ \textit{Variables} \end{bmatrix} = \begin{bmatrix} \textit{Exogenous} \\ \textit{Variables} \end{bmatrix} \qquad (26)$$

If equation (26) is pre-multiplied by the inverse of the parameter matrix then we get equation (27).

$$\begin{bmatrix} \textit{Endogenous} \\ \textit{Variables} \end{bmatrix} = [\ \textit{Parameters}\ ]^{-1} \times \begin{bmatrix} \textit{Exogenous} \\ \textit{Variables} \end{bmatrix} \qquad (27)$$

The endogenous variables are: $\hat{S}_{NZ}$, $\hat{D}_{NZ}$, $\hat{S}_A^2$, $\hat{DT}_A$, $\hat{P}_A^2$, $\hat{P}_A^1$, $\hat{ED}_{Rw}^1$, $\hat{P}_{NZ}$

The parameters are η_{SNZ}^{1}, η_{DNZ}^{1}, η_{SA}^{2}, η_{DTA}, $\eta_{EDR_w}^{1}$, η_{CP}^{12} and η_{PTANZ}. The exogenous variables are α, γ, κ. Equation (27) in expanded form is given as equation (28)

$$\begin{bmatrix} \hat{DT}_A \\ \hat{S}_A^2 \\ \hat{P}_A^2 \\ \hat{P}_A^1 \\ \hat{S}_{NZ} \\ \hat{D}_{NZ} \\ \hat{ED}_{Rw}^1 \\ \hat{P}_{NZ} \end{bmatrix} = \begin{bmatrix} 1 & 0 & \eta_{DT_A} & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & -\eta_{S_A} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & -\eta_{CP}^{21} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & -\eta_{P_T^{21}} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & -\eta_{S_{NZ}} \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & \eta_{D_{NZ}} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & \eta_{ED_{Rw}} \\ -0.47 & 0.47 & 0 & 0 & 0.53 & -0.27 & -0.26 & 0 \end{bmatrix}^{-1} \times \begin{bmatrix} 0 \\ -\eta_\gamma \times \hat{\gamma} \\ 0 \\ -\eta_\kappa \times \hat{\kappa} \\ \eta_\alpha \times \hat{\alpha} \\ 0 \\ 0 \\ 0 \end{bmatrix} \qquad (28)$$

Putting the numerical values into this matrix, we solved for the endogenous variables. In numerical form equation (28) becomes equation (29):

$$
\begin{bmatrix} \hat{DT}_A \\ \hat{S}_A^2 \\ \hat{P}_A^2 \\ \hat{P}_A^1 \\ \hat{S}_{NZ} \\ \hat{D}_{NZ} \\ \hat{ED}_{Rw}^1 \\ \hat{P}_{NZ} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0.9 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & -0.3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & -0.5 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & -0.3 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0.3 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0.78 \\ -0.47 & 0.47 & 0 & 0 & 0.53 & -0.27 & -0.26 & 0 \end{bmatrix}^{-1} \times \begin{bmatrix} 0 \\ -0.3 \times \hat{y} \\ 0 \\ -0.3 \times \hat{k} \\ 1 \times \hat{a} \\ 0 \\ 0 \\ 0 \end{bmatrix} \qquad (29)
$$

The inverse matrix in equation (26) was obtained using Lotus 1-2-3 V. 2.01 spreadsheet package, at PC Network Lincoln University 650 Mb disk, 7 Mb memory. This inverse is given in Appendix 7.

5.5. ECONOMIC EVALUATION OF A REDUCTION IN IMPORT PROTECTION

The model developed in the previous section is used to evaluate the impact of modifying the apple import ban into Australia.

5.5.1. Current situation

The current values of the endogenous variables in the Australian and NZ markets is shown in Table 5.2. This situation was taken as the base model scenario. The excess demand of Australia (ED_{A1}) in the current situation is zero. (See Section 5.1.).

Table 5.2. Current situation in Australian and NZ apples markets.

Endogenous Variables	Current Situation X_0
S_{NZ}^1	410 000 tonnes
D_{NZ}^1	206 000 tonnes
S_A^2	363 000 tonnes
D_A^2	363 000 tonnes
P_A^2	NZ $ 881.00 (*)
ED_A^1	0
ED_{Rw}^1	204 000 tonnes
P_{NZ}^1	NZ $ 410.00

Source: (OECD, 1991). (*) Exchange rate = A/NZ $ 0.77

5.5.2. Alternative Policies

Four alternative policies that the Australian Government could choose if it decided to reduce NTB against NZ apples are considered. These policies were represented in the model with changes in κ, α and γ (See section 5.1.2.).

The model to be used in the evaluation is in rate of change form. The differentials used to construct the model are subject to "*ceteris paribus*" conditions so that the model can only be legitimately used for small changes in the exogenous variables. In these simulations, the exogenous variable (κ) that represents the NTB's ad valorem equivalent was decreased by ten per cent.

1. In the first alternative policy (Policy 1) Australia reduces the ban on NZ apples ($\kappa = -0.1$), without putting a restriction on NZ apples exports ($\alpha = 0$) and no control cost for Australia ($\gamma = 0$).
2. The second alternative policy involves some of the requirements that Australia has suggested be imposed on NZ-type apples in order to minimize the risk and uncertainty of infection in its crops (See section 4.1.3.). The cost of Fire Blight prevention is assumed to

be paid by NZ. Australia does not assume any cost so that with the initial assumption to reduce the ban $\kappa = -0.1$ then $\alpha = 0.1$ and $\gamma = 0$.

3. The third alternative policy involves reducing the import ban on NZ-type apples in Australia and Australia assumes the risk of control cost if the disease affects its own producers. Australia does not impose requirements to NZ apples. That is, $\alpha = 0$ and now $\gamma = 0.1$ and $\kappa = -0.1$.

4. The fourth policy consists of a change in all the exogenous variables. As Australia reduces the ban ($\kappa = -0.1$), it is assumed to simultaneously impose some requirements on NZ apples ($\alpha = 0.1$) and it assumes part of the risk of the disease ($\gamma = 0.1$).

5.5.3. Cost Benefit Analysis

Cost-benefit analysis is used to evaluate the welfare effects of the alternative policies. This analysis includes estimates of the level and the distribution of economic costs and benefits from the reduction of the phytosanitary restriction.

Consumer surplus (CS) is a measure of changes in consumer welfare with respect to the data base line under a particular policy decision. The welfare of consumers is determined by both the quantity and the price of goods that they are able to consume. The change in the net benefit in New Zealand (NB_{NZ}) is the difference between the changes in producer surplus (PS_{NZ}) and the consumer surplus (CS_{NZ}). The net benefit in Australia (NB_A) includes the rent to the non tariff barrier. It represented the difference between the import price and the Australian price of NZ-type apples. This rent is a part of the distorting effect of the phytosanitary barrier in the Australian market.

The following formulae were used to compare the changes in the surpluses:

$$\Delta PS_{NZ} = \Delta P . Q_1 + 1/2 \, (\Delta Q . \Delta P)$$

$$\Delta CS_{NZ} = CS_{NZ}^{1} - CS_{NZ}^{0}$$

$$\Delta NB_{NZ} = \Delta CS_{NZ} + \Delta PS_{NZ}$$

$$\Delta CS_{A} = CS_{A}^{1} - CS_{A}^{0}$$

$$\Delta PS_A = \Delta P.\, Q_1 + 1/2\, (\Delta Q.\, \Delta P)$$

$$rNTB = (P_A{}^1 - P_{NZ}{}') \times ED_A$$

$$\Delta NB_A = \Delta CS_A + rNTB + \Delta PS_A$$

Where:

ΔP = change in price between the base line and the policy simulation

$\Delta P = P_1 - P_0$

ΔQ = change in quantities between the base line and the policy simulation

$\Delta Q = Q_1 - Q_0$

P_1 = new price result from the policy simulation

P_0 = initial price (base line)

P_{NZ}' = price of NZ-type apples as result of the policy simulation

P_{A1}' = price of Australian-type apples as result of the policy simulation

Q_1 = new quantity of fresh apples result from the policy simulation

Q_0 = initial quantity of fresh apples (base line)

ED_A = Australian apples imports from NZ

rNTB = rent to the non tariff barrier

CS_{NZ} = consumer surplus in NZ

PS_{NZ} = producer surplus in NZ

NB_{NZ} = net benefit in NZ

CS_A = Australian consumer surplus of apples

PS_A = Australian producer surplus

NB_A = Australian net benefit

5.6. RESULTS

5.6.1. Alternative policy one

A summary of the effects of the reduction of the ban in 10 per cent (Policy one) on the endogenous variables is presented as Table 5.1. The price of NZ-type apples in NZ increased while the price of apples in Australia (P_A^2) decreased. The percentage changes were higher in the prices than in the quantities because the elasticities are less than one in absolute value (Figure 5.2). The rise in the price of NZ-type apples (P_{NZ}) was NZ $15.90/tonne. Simultaneously P_A^2 decreased NZ $26.97.

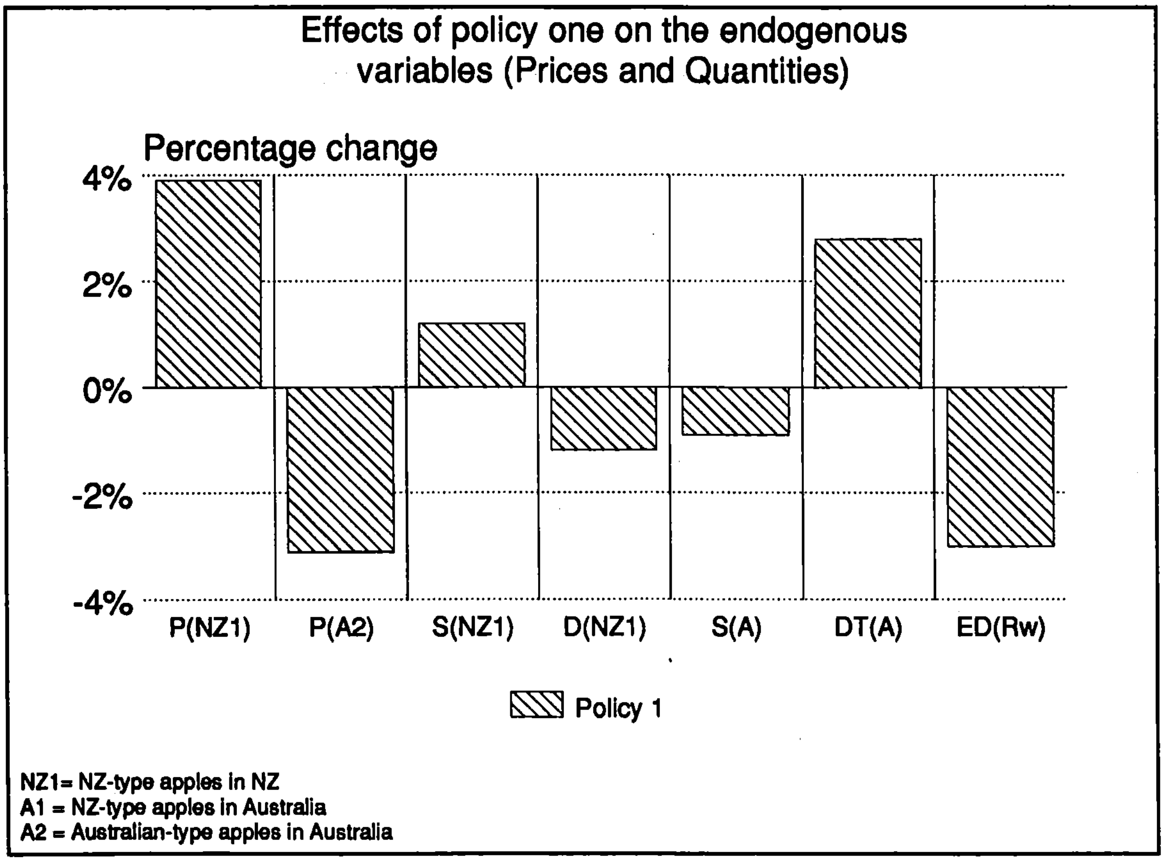

Figure 5.2. Effects of Policy 1 on the endogenous variables

The supply of NZ-type apples (S_{NZ}^1) increased 1.2 per cent with a new supply of 415 thousand tonnes. The demand of NZ-type apples in NZ (D_{NZ}^1) decreased 1.2 per cent with a new quantity of 204 thousand tonnes. The supply of Australian-type apples SA decreased 0.9 per cent

Table 5.4. Effects of the simulation Police one (1)

5.4.1. Results of Policy 1 on the endogenous variables

ENDOG VAR.	% CHANGES	NEW SITUATION X_1	ABSOLUTE CHANGES (Xo-X1)
S_{NZ}	1.2	414 769	4 769
D_{NZ}	-1.2	203 604	2 396
S_A^2	-0.9	359 666	3 334
D_A^2	2.8	373 001	10 001
P_A^2	-3.1	$ 854	-26.97
ED_A^1		13 335	13 3335
ED_{Rw}	-3.0	197 830	-6 170
P_{NZ}	3.9	$ 426	15.90

5.4.2. Welfare effects of Policy 1 in NZ $(000s)

POLICY 1	
CS_{NZ}	NZ $ -823
CS_A	7 047
r NTB	5 709
PS_{NZ}	6 556
PS_A^2	-9 655
NB_{NZ}	5 733
NB_A	3 101
NB_T	8 834

Where:

S = supply
D = demand
P = price
ED = excess demand
CS = consumer surplus
rNTB = rent to the non tariff barrier
PS = producer surplus
NB = net benefit

with a new equilibrium point of 360 thousand tonnes of Australian-type apples supplied. The total demand in Australia (DT_A) increased 2.8 per cent with a new total demand of 373 thousand tonnes of apples. Therefore, the excess demand (ED_A^1) rised to 13.34 thousand tonnes, which will be import of NZ-type apples. The decrease in Australian protection increasing the Australian import demand for NZ-type apples. Apples price goes up in NZ and down in Australia as a result.

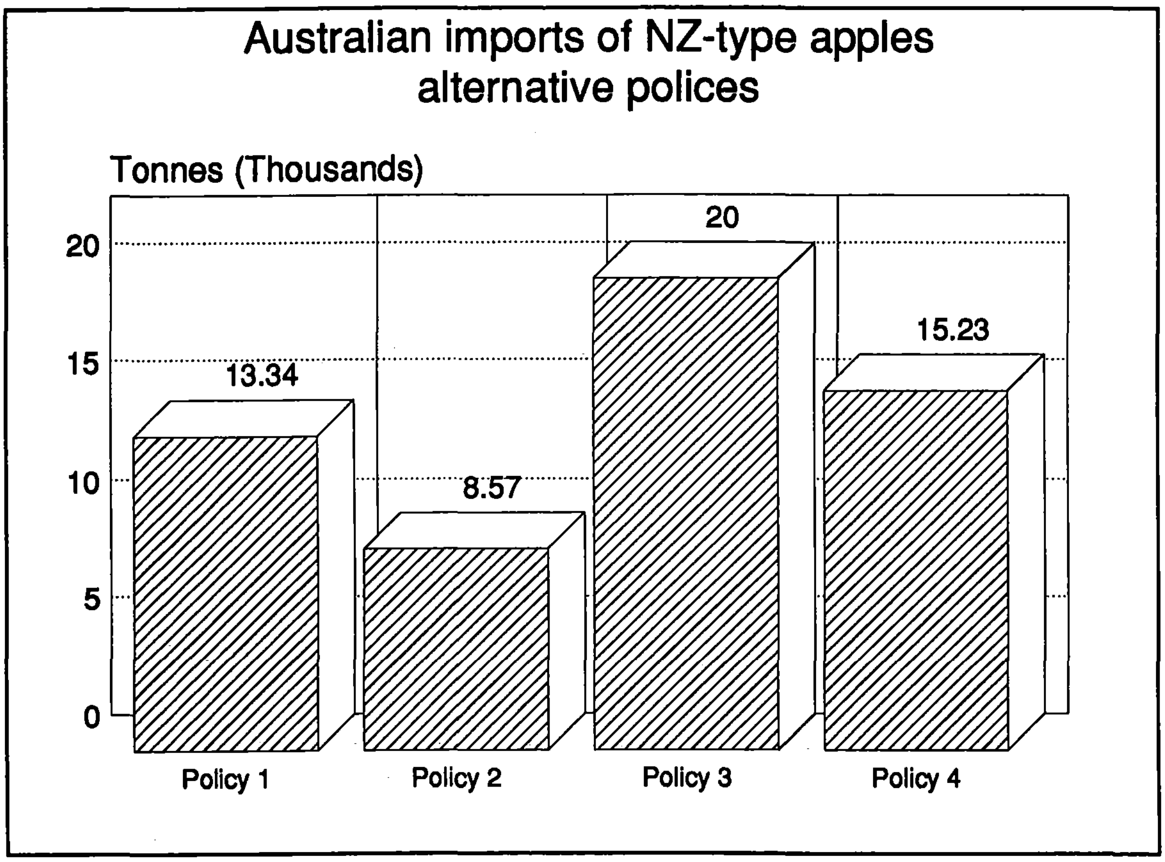

Figure 5.3. Australian excess demand for NZ-type apples

In Australia a rent to the NTB (rNTB) was produced. This rent represents the difference between P_A^1 and P_{NZ} times the quantity of NZ-type apples imported. The rent was $5 709 thousand dollars and it was lower than the consumer surplus in Australia (CS_A) NZ$7 047 thousand.

Table 5.1.2. shows the welfare effects of policy one. The change in the producer surplus in NZ (PS_{NZ}) was positive NZ $6 556 thousand, and the change in the consumer surplus (CS_{NZ}) was negative $823 thousand. The overall welfare change in NZ (NB_{NZ}) was positive $5 733 thousand.

5.6.2. Alternative policy two

The effects of the reduction of the ban and the imposition of requirements on NZ-type apples because of the disease (policy two) on the endogenous variables have a similar trend to the effect of policy one.

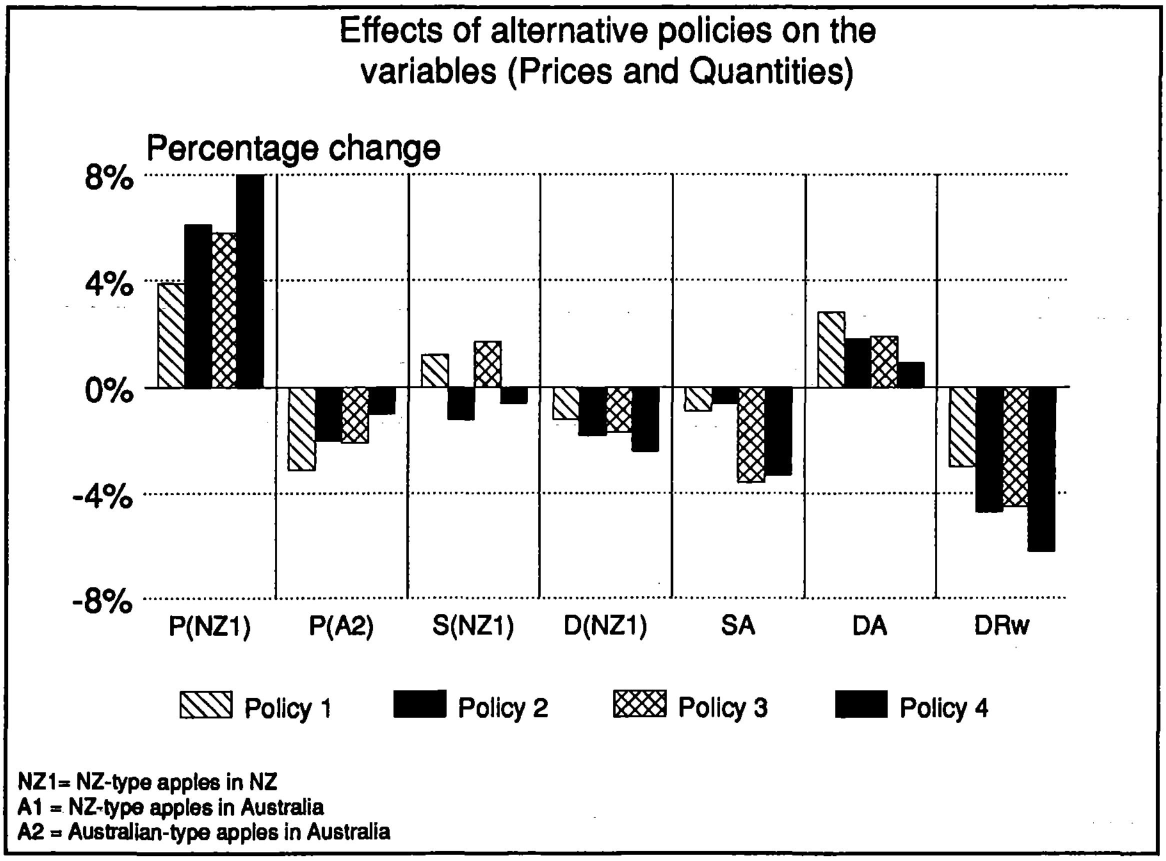

Figure 5.4. Effect of the alternative policies on the endogenous variables

The price of NZ type apples increased 6.1 per cent, with a new price of $410. This new price of P_{NZ} was higher than the price obtained as a result of policy one because the costs of the requirements were paid by NZ. The prices of apples in Australia (P_A^2) decreased 2 per cent and the new price of Australian apples was $864.

S_{NZ}^1 decreased 1.2 per cent and the D_{NZ}^1 decreased 1.8 per cent. S_A^2 decreased in 0.6 per cent and DT_A increased in 1.8 per cent with respect to the base line.

The excess demand for apples in Australia increased to 8.6 thousand tonnes with this policy. The rises in ED_A^1 with Policy 2 were smaller than the rises with policy one. The import

Table 5.5. Effects of the simulation of Policy two (2)

5.5.1. Results of Policy 2 on the endogenous variables

ENDOG VAR.	% CHANGES	NEW SITUATION X_1	ABSOLUTE CHANGES
S_{NZ}	-1.2	405 163	-4 837
D_{NZ}	-1.8	202 251	-3 749
S_A^2	-0.6	360 859	-2 141
D_A^2	1.8	369 424	6 424
P_A^2	-2.0	$ 864	-17.32
ED_A^1		8.6	8.6
ED_{Rw}	-4.7	194 346	9 653
P_{NZ}	6.1	$ 435	24.88

5.5.2. Welfare effects of Policy 2 NZ $(000s)

POLICY 2	
CS_{NZ}	NZ $ -1 288
CS_A	4 496
r NTB	3 674
PS_{NZ}	1 001
PS_A^2	-6 233
NB_{NZ}	8 731
NB_A	1 936
NB_T	10 667

Where:

S = supply
D = demand
P = price
ED = excess demand
CS = consumer surplus
rNTB = rent to the non tariff barrier
PS = producer surplus
NB = net benefit

of NZ-type apples in Australia is 8.6 thousand tonnes. The reduction in imports with respect to policy one is explained by the rise in the cost of requirements for NZ. The percentage change in the NZ apple price increased with respect to policy one when the cost of the requirements increased in 10 per cent. The absolute change of the price of NZ apples P_{NZ} is $ 10 dollars /tonne higher than the price estimated for policy one.

The change in producer surplus in NZ (PS_{NZ}) was positive $1 001 thousand dollars, and the change in consumer surplus in NZ (CS_{NZ}) was negative $ 1 288 thousand dollars. The change in net benefit in NZ (NB_{NZ}) was positive $ 8 731 thousand dollars. In Australia CS_A was lower than policy one $4 496 thousand dollars, because of the rise in the price of NZ-type apples and the reduction in the imports. The rent to the NTB (rNTB) was positive and lower than policy one. The rNTB was almost as high as the change in the consumer surplus in Australia (CS_A). With policy two, the r NTB was lower than policy one, because the excess demand of Australia decreased and the quantity of NZ-type apples imported decreased from 13.3 thousand tonnes in policy one to 8.6 thousand tonnes in policy two. The total change in net benefit for Australia was positive $1 936 thousand dollars.

5.6.3. Alternative policy three

Policy three involved the reduction of the ban and the risk of control cost of the disease only from Australia. P_{NZ} increased to NZ $434 and P_A^2 decreased from $881 to $863 dollars/tonne. S_{NZ}^1 increased with a new supply of 417 thousand tonnes and the D_{NZ}^1 decreased to 202 thousand tonnes. The import of NZ-type apples to Australia (ED_A) was 20 thousand tonnes. S_A^2 decreased 3.6 per cent 350 thousand tonnes supplied from Australia and D_A^2 increased 1.9 per cent with a new quantity demanded of 370 thousand tonnes.

The change in total demand from Australia is higher than the change in total demand in policy two. Nevertheless, the supply of Australia had different effect: with policy two supply increases and with policy three it decreased. The reason was the cost of the diseases.

Table 5.6. Effects of the simulation of Policy three (3)

5.6.1. Results of Policy 3 on the endogenous variables

ENDOG VAR.	% CHANGES	NEW SITUATION X_1	ABSOLUTE CHANGES
S_{NZ}	1.7	417 154	7 153
D_{NZ}	-1.7	202 406	-3 594
S_A^2	-3.6	349 832	13 168
D_A^2	1.9	369 834	6 834
P_A^2	-2.1	$ 863	-18.43
ED_A^1		20	20
ED_{Rw}	-4.5	194 745	9 255
P_{NZ}	4.5	$ 434	23.85

5.6.2. Welfare effects of Policy 3 in NZ $(000s)

POLICY 3	
CS_{NZ}	NZ $ -1 234
CS_A	4 786
r NTB	8 576
PS_{NZ}	9 862
PS_A^2	-6 326
NB_{NZ}	862
NB_A	7 036
NB_T	15 664

Where:

S = supply
D = demand
P = price
ED = Excess demand
CS = consumer surplus
rNTB = rent to the non tariff barrier
PS = producer surplus
NB = net benefit

The effect in producer surplus of NZ (PS_{NZ}) was positive with respect to the base line, \$9862 thousand dollars, and the change in consumer surplus in NZ (CS_{NZ}) is negative \$1 234 thousand dollars. The change in the net benefit for NZ and Australia were positive (\$8 628 and \$7 035 respectively). Australia CS_A change was \$4 786 thousands because of the imports from NZ. The rent to the NTB was \$8 576 thousand NZ dollars.

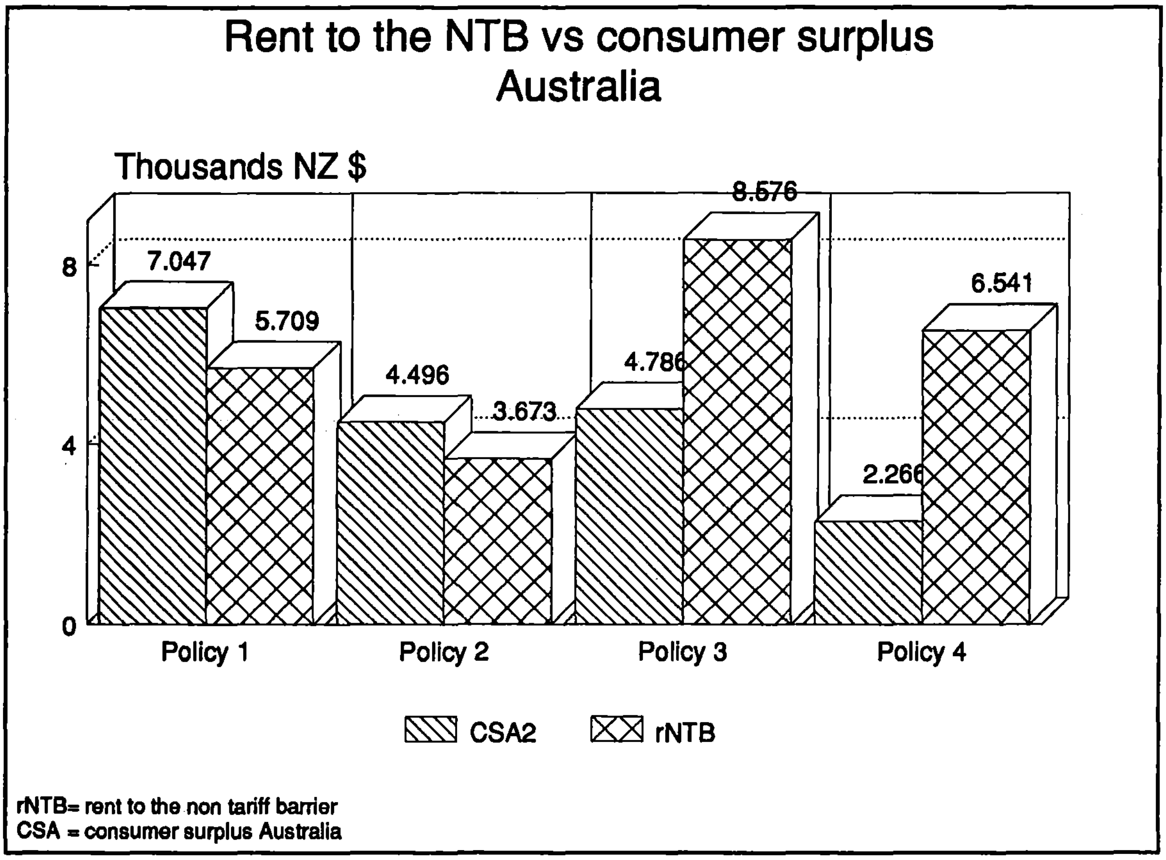

Figure 5.5. Rent to the non tariff barrier vs consumer surplus in Australia

5.6.4. Alternative policy four

The effects of the reduction of the ban and the increase of the control cost of Fire Blight for both countries sharing the costs (policy four) in the endogenous variables are presented in Table 5.4.1. The price of NZ-type apples in NZ (P_{NZ}) increased 8 per cent (\$32.82 dollars/tonne) with a new price of \$443/tonne. The P_A^2 decreased 1 per cent (\$8.78/tonne) with a new price of apples in Australia of \$872.

Table 5.7. Effects of the simulation of Policy four (4)

5.7.1. Results of Policy 4 on the endogenous variables

ENDOG VAR.	% CHANGES	NEW SITUATION X_1	ABSOLUTE CHANGES
S_{NZ}	-0.6	407 547	-2 453
D_{NZ}	-2.4	201 052	-4 948
S_A^2	-3.3	351 024	-11 976
D_A^2	0.9	366 258	3 258
P_A^2	-1.0	$ 872	-8.78
ED_A^1		15.2	15.2
ED_{Rw}	-6.2	191 261	-12 739
P_{NZ}	6.1	$ 443	32.82

5.7.2. Welfare effects in NZ $(000s)

POLICY 4	
CS_{NZ}	NZ$ -1 699
CS_A	2 266
r NTB	6 541
PS_{NZ}	13 337
PS_A^2	-3 136
NB_{NZ}	11 638
NB_A	5 671
NB_T	17 309

Where:

S = supply
D = demand
P = price
ED = Excess demand
CS = consumer surplus
rNTB = rent to the non tariff barrier
PS = producer surplus
NB = net benefit

The S_{NZ}^1 and the D_{NZ}^1 decreased 0.6 per cent and 2.4 per cent respectively. The quantities of Australian-type apples supplied decreased because its price decreased with respect to the base line. There was a rise in the cost of production in both countries. ED_A^1 was 15.2 thousand tonnes. The rNTB was $ 6 541 thousand NZ dollars. S_A^2 decreased 3.3 per cent (12 thousand tonnes) and D_A^2 increased 0.9 per cent. In NZ the change in PS_{NZ} was positive, and the change in NZ CS_{NZ} was negative.

5.6.5. General Analysis

All the alternative policies produced a fall in the price of NZ-type apples in Australia as well in the price of Australian type apples. When the effect of the cost of Fire Blight disease was evaluated, the change in the price of NZ and Australian-type apples was highest in policy two, but the difference in absolute values was only $1 dollar in the price in Australian-type apples and the price of NZ-type apples between policy two and policy three. The excess demand of NZ-type apples in Australia (ED_A) varied between 20 thousand tonnes (policy three) and 8.5 thousand tonnes (policy two).

The smallest change in the price of NZ-type apples in Australia (P_A^2) was in policy four and the high change was the result of policy one. In all the alternative policies simulated, the supply of Australian-type apples decreased and the total demand of apples in Australia was projected to increased. The greatest change of supply of Australian-type apples was in policy three, and the greatest change of total demand of apples in Australia was the result of policy one. The smallest relative change of Australian supply was the effect of policy two. The change in the price of Australian-type apples P_A^2 was slightly lower in policy four. The largest change in P_A^2 was in policy one. The P_A^2 decreased with all the alternative policies, it was because the reduction in the ban. The control cost of the disease affects the supply of the Australian-type apples.

In Australia, as an importing country the relaxation of NTB's on the apple trade was positive for total consumer surplus in all the policies. However, the consumer surplus of NZ-type

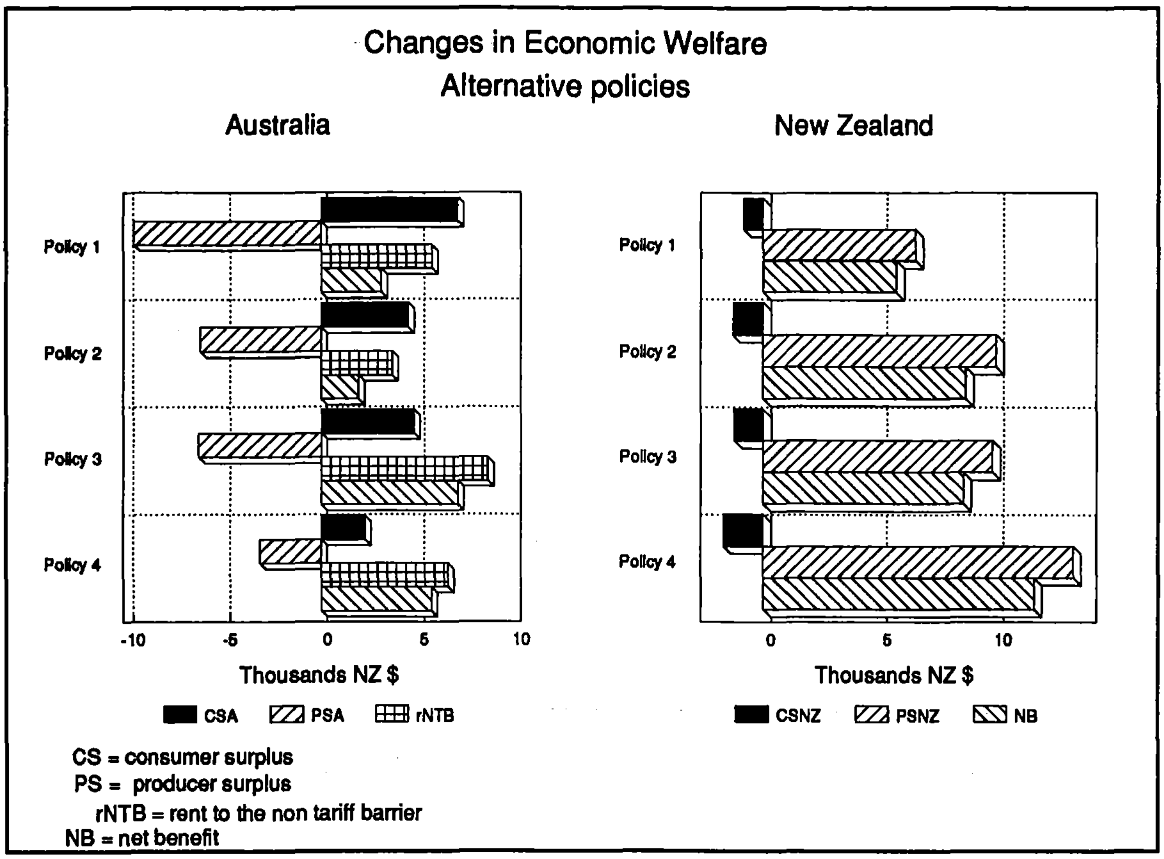

Figure 5.6. Evaluation of the economic welfare effect of the alternative policies

apples in Australia CS_A^1 depends on the amount of apple trade. The consumer surplus of Australian-type apples CS_A^2 was highest with policy three because the importation from NZ increases. The price of the Australian-type apples P_A^2 decreased with all the alternative policies. The quantities of D_A^2 increased and S_A^2 decreased in all the alternative policies. With policy two, when was simulated that Australia imposed requirements over NZ apples the rent to the NTB decreased because the import of NZ-type apples decreased.

In NZ the welfare trend was similar for all the alternative polices. The change in CS_{NZ} was negative in all the simulations. CS_{NZ} decreases but, it was compensated by the rise in PS_{NZ} which was around three times greater. Any policy to reduce the ban is expected to benefit the NZ producer surplus (PS_{NZ}) and increase the net benefit in NZ. Policy four produced highest net benefit in NZ. The highest NB for NZ and Australia were the result of policy four and policy three respectively. When policy four was simulated, the P_A and P_{NZ} increased because both countries shared costs.

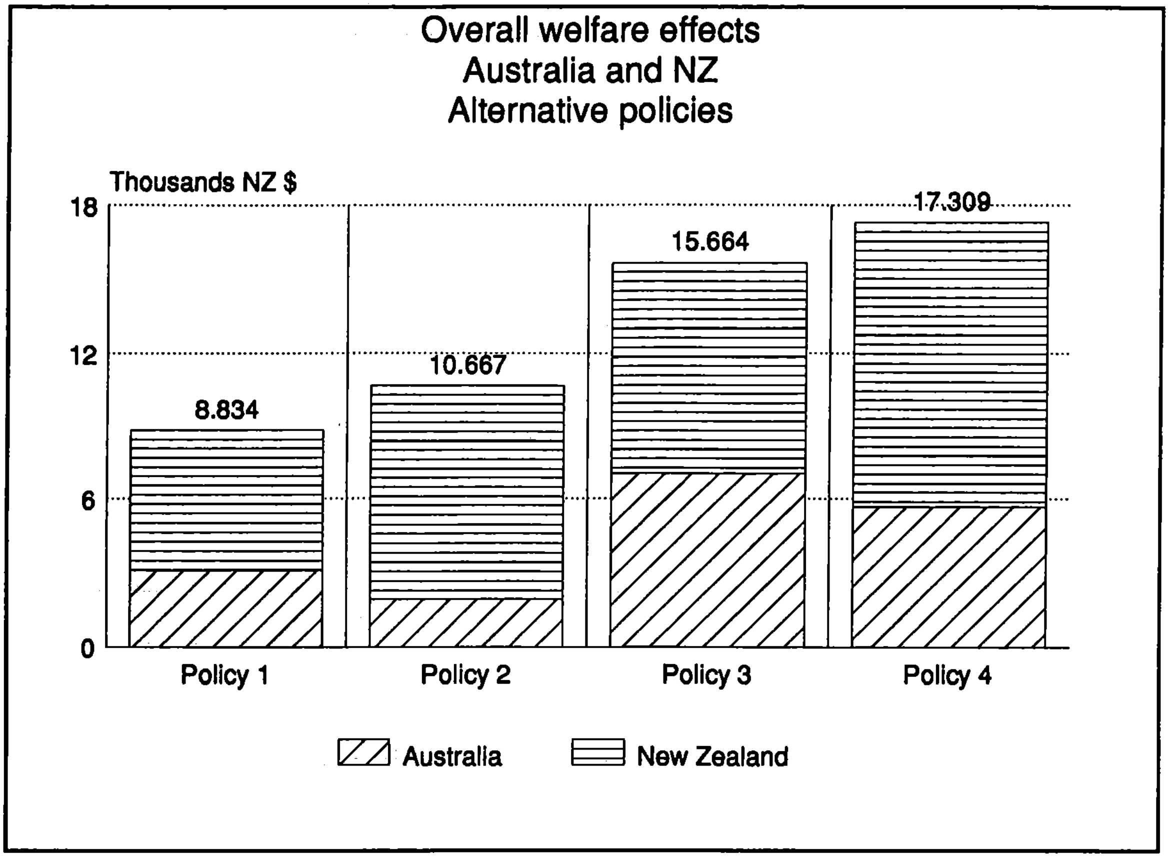

Figure 5.7. Total welfare effect on Australia and New Zealand

The change in the consumer surplus in NZ is negative when it was simulated any policy, but it is compensated with the positive change in the producer surplus which is almost four fold higher. Therefore, in NZ, the changes in total economic welfare are positive for any policy. The highest Net benefit in NZ was produced as a result of policy four ($11 638).

The Australian producer surplus was negative but the total consumer surplus in Australia for NZ-type apples and Australian-type apples is positive. A rent to the non tariff barrier was established once NZ apple imports were permitted. The greater net benefit in Australia was the result of policy 3 ($7 036) but in that situation the rent to the NTB was higher than the total net benefit ($8 576).

It can be validly postulated that the best alternative policy for both countries if we only take into account consumer and producer surplus is the reduction of the ad valorem non tariff barrier with the share of the cost of Fire Blight disease (policy four).

CHAPTER 6

DISCUSSION AND CONCLUSIONS

This chapter contains three parts. The first part discusses the results of this study. The second one draws the conclusions of the research, the aim of this research being to analyse the change in economic welfare arising from a reduction in the Australian phytosanitary barrier. The last part presents some recommendations for future research in this topic.

6.1. DISCUSSION

The New Zealand apple trade has been subjected to phytosanitary regulations by many importer countries. Sanitary controls are severe, particularly those related to the prevention of the introduction and spread of plant diseases. Fire Blight disease is a major phytosanitary barrier which restricts the apple trade between Australia and NZ.

Not much work has been done in the area of economic evaluation of the reduction of phytosanitary barriers. Nevertheless, it has been analyzed using the concept of bio-economic risk assessment. This analysis was carried out as part of decision making on quarantine matters in Australia. There are biological and economic uncertainties related to the prediction and to the spread and establishment of the disease and consequent production losses. These approaches deal with high values of risk, uncertainty and technical constraints. This kind of analysis was undertaken for the importer country.

The potential benefit to Australia if the ban is reduced will be represented by a greater variety of apples available at a lower price level for consumers. On the other hand, the cost of free trade is the increased risk of the disease becoming established in Australia, with the consequent impact on Australian producers competitiveness. The importation of apples to Australia will place pressure on growers to restructure orchards and improve their efficiency.

This phytosanitary barrier has bred inefficiency in the Australian apple industry, because they protect producers that have high unit costs when compared to world standards. Then, this barrier produces an inefficiency in the allocation of resources.

In the short run this ban protects the Australian domestic market from external competition. Also, the apple industry gains stability in the market, the domestic relative price increases and there is no incentive to acquire knowledge about the Fire Blight that still has not arrived in Australia. In the long-run this ban may allow the internal market to prepare itself for the competition.

The possibility of Fire Blight entering Australia is high in the long-run. One efficient course of action is to be ready to detect and control the disease if it appears in Australia. This is possible through the implementation of new research programmes that will enable them to develop the most appropriate method for managing this disease. Both exporter and importer countries may benefit from such an exchange and the development of new technology. The cost of prevention with the desire of maintaining the level of infection at zero is very large.

Despite this technical difficulty Australia and NZ have been looking for a way to cut down this barrier without causing negative impact upon their economies. This case under examination illustrates a change that provides an opportunity for the development of a true regional free-trade zone, creating a large and growing market.

6.2. CONCLUSIONS

This research was an analysis of the effects on economic welfare of a reduction in the Australian phytosanitary barrier. A partial equilibrium model with eight simultaneous equations under four alternative policies was developed as a means of determining the effects of the reduction of this barrier. This case was studied by modelling domestic and trade markets in both countries. The information obtained about the domestic supply and demand curves of both countries, was used to construct excess supply and excess demand curves.

The role of the government was included in this partial model as an exogenous variable. The different combinations of the exogenous variables α (NZ control cost of the disease), γ (Australian control cost of the disease) and κ (Ad valorem equivalent non tariff barrier) gives us the four alternative policies to evaluate the welfare economic effect if the ban is reduced. Nevertheless, the estimation of the gains and losses that arise in the context of this partial equilibrium model are restricted to small changes in the exogenous variables and we maintain the "*ceteris paribus*" condition.

To analyse the effects of this deregulation, account has been taken of the changes in the endogenous variables: P_{NZ}, P_A^2, S_{NZ}, D_{NZ}, S_A^2, D_A^T, due to changes in the exogenous variables α, γ and κ. Also, the changes in economic welfare, consumer and producer surpluses have been examined.

Comparison between the current situation of no trade between NZ and Australia and a relaxation of this regulation was attempted. The effect of the reduction of κ, an ad valorem equivalent of the phytosanitary restriction, was simulated. In order to reduce the bias due to data limitations, the demand elasticity of all apples in Australia was assumed to be -0.9. In this partial equilibrium model of the trade between the two countries there are three exogenous variables: α, γ and κ. If the effect of the import ban is reduced it could be under one of these four alternative policies:

1. A reduction on the phytosanitary restrictions on NZ apples. The cost of NZ requirements and the Australian cost of controlling the disease are zero. ($\alpha = 0$ and $\gamma = 0$).
2. Australia regulates NZ-type apples through a phytosanitary barrier including requirements which increase the cost of NZ export apples, represented by α (See Chapter 4) ($\alpha = 0.1$ and $\gamma = 0$).
3. Risk and uncertainty of control of the disease are borne by Australia ($\alpha = 0$ and $\gamma = 0.1$)
4. Control costs are shared by Australia and NZ ($\alpha = 0.1$ and $\gamma = 0.1$)

The simulated effect on the base line increased Australian excess demand for NZ-type apples resulting from the drop of the price when the restriction was reduced. Australian ED_A^1 increases and the price of apples P_A decreases in Australia, when the ad valorem equivalent non tariff barrier decreases the price of NZ apples increases.

This welfare analysis shows that reducing the NTBs on NZ apples does not have the same effect in the NZ and Australian markets. In the Australian market there are three different welfare effects: consumer surplus, producer surplus and rent to the non tariff barrier. The total Australian consumer surplus CS_A includes the consumer surplus for NZ-type apples and consumer surplus for Australian-type apples. The CS_A from Australian-type apples increases because of the fall of the price of Australian-type apples, the consumer surplus of NZ-type apples rises from zero and the total (CS_A) is positive for all the policy choices. The overall result from the import of NZ apples is a gain in the change in the consumer surplus in Australia. The gain in CS_A from policy one is the highest.

There is a rent to the non tariff barrier that does not contribute to the producer surplus in Australian PS_A and neither is it captured by the consumers. However, it increases the benefit of the importers and therefore the net benefit in Australia. The rent to the NTB is almost as high as the change in the consumer surplus in Australia (CS_A). In policies three and four this rNTB is higher than the CS_A. In policies one and two the CS_A is higher than the rent to the NTB. The main reason for this behaviour is the distorting protective effect on the Australian market of its own NTBs.

The losses in the change of producer surplus in Australia PS_A are almost as high as the gain in Australian consumer surplus CS_A from Australian and NZ-type apples. In policy 1 the losses in PS_A are higher than in the other policies because the price of Australian-type apples is the lowest. The change in the producer surplus PS_A and change in the net benefit in Australia NB_A are positive. Australian producer losses could occur from disease control cost, but the strong reason seems to be the substitution effect (Australian-type vs. NZ-type apples). The NZ control cost of the disease has an inverse effect on the price of NZ apples. The alternative policies one and two produce the biggest reduction in PS_A. But, the effect of policy three and policy four have less negative effect for PS_A. This is due to the rise in P_A and that in the policy four P_{NZ} increases producing the reduction in the quantities of NZ-type apples in Australia.

The economic welfare of NZ consumers CS_{NZ}, decreases because the price P_{NZ} rises, consequently NZ demand for apples falls. However, if we take into account the fact that 50 percent of total NZ production is for export, the change in the amount of exports offsets the rise in P_{NZ} and increases total welfare. The apples that were formerly consumed domestically, are exported overseas and producers receive an increased producer surplus that offsets the NZ loss in consumer surplus. The PS_{NZ} increases more than proportionally to the decrease of CS_{NZ}. In every alternative policy-simulation combination the gains in the PS_{NZ} offset the losses in CS_{NZ} and therefore the NB_{NZ} was positive for all cases.

If the importing country increases the requirements for NZ (α), the D_A^1 curve will shift up the demand curve and quantities traded will decrease (policy 2). Changes in the requirements raises the price of NZ apples, for instance, causing the NZ supply curve to shift to the left. P_A^1 will decrease and the P_{NZ} will increase. In this case if $\gamma = 0$, then all the cost involved in controlling the disease is borne by NZ. If there are some requirements from Australia associated with the access of NZ-type apples (α) and they want to assume some risk, then the cost of control Fire Blight (γ) increases. The effect between both is inverse, ie. (while $\alpha \downarrow$, $\gamma \uparrow$). With the application of the phytosanitary regulation, when α (the cost of NZ control of Fire Blight) increases, the internal cost of the producers in NZ increases.

The price of apples in Australia changed as a result of allowing NZ access to the Australian apple market. Therefore, this leads to a new price for Australia and alters the partial equilibrium model, with different prices and quantities for import. The P_{NZ} apples increases and the consumption decreases, because of the substitution effect in all policies. The supply of NZ apples increases (policy one and policy three) because of the higher price of NZ-type apples and no cost of requirements for NZ. When the consequences of NZ cost of requirements (α) were evaluated (policy two and policy four), its influence on the supply of NZ-type apple was to reduce it directly. With respect to the Producer Surplus, PS_{NZ} is positive and PS_A is negative in all cases, because while NZ increases its production Australia decreases it. When the NZ cost of requirements for Fire Blight disease are zero, the supply of NZ apples increases (policy one and policy three).

In these simulations Australia still maintains part of the NTB. Therefore, it produces a distortion in the welfare effects. The distorting effect of this barrier in the Australian market is reflected in rNTB. The r NTB is positive in all the cases.

It seems that the distorting effect of this ban in the economy is higher in Australia than in NZ. Depending on the policy, the change in NB_A could be better off in Australia.

The high relative magnitude of the fall in PS_A results from a substitution effect and is not due to the Australian cost associated with the disease. With respect to the net benefit we can see that it is positive for Australia. The NB in NZ is also positive with all the alternative policies.

This study is a first approach which established a model to analyze the economic effects and interaction of reducing NTBs on the different markets of exporter and importer countries. The objective of the Fire Blight restrictions is a technical one, but the end result is a distortion and restriction of international trade.

6.3. RECOMMENDATIONS FOR FURTHER RESEARCH

Further research into the elasticities of supply and demand of apples in the Australian and New Zealand markets is required. The cost of Fire Blight control needs also to be investigated. Analyses of phytosanitary restrictions under game theory could prove to be particularly fruitful in order to evaluate a possible deal from negotiation.

Future studies in NTBs could choose to analyze these barriers from an agricultural political economic perspective. The theoretical framework of quarantine restrictions could be analyzed using a number of economic concepts, such as public goods, externalities, government policy, risk-aversion, import competing industry, production function and technology in international trade. A number of perspectives can be taken on this problem: a trade perspective, a public policy perspective or a managerial economics perspective. The analysis of NTBs could be improved using sensitivity analyses.

ACKNOWLEDGEMENTS

I thank my supervisor Professor Ralph Lattimore, Department of Economics and Marketing, Lincoln University, for his supervision, his guidance, counselling and constant encouragement given throughout all the time of this study.

I thank Professor Jimmye Hillman for his constructive suggestions during the project of this research. I also wish to thank Richard Ivess (MAFQUAL) and Clive Durand (NZAPMB) for their co-operation during the first part of the Thesis. I am also grateful for the support given to me by the Head of the Department of Economics and Marketing, Professor Tony Zwart, Les Wood, Paul Calcott, Paul McKeown and Glen Thompson. Thanks to Joan Gomez Douglas (Student Learning Centre) for her assistance with my writing in English.

I wish to express my warmest thanks to my friends for their support and encouragement over the entire period of my studies. Thanks to all the staff and postgraduates students of the Economics and Marketing Department and friends at Lincoln University, especially Carlos, Daniela, Chris y Juan, Christi, Rob, Mike, Shane, Cath, Tala and Frasier. Javier and Ayalsew (Plant Sciences Department), Isabel, Luis, Gerardo, James and Lala, whose friendship and support have made my study at Lincoln a pleasant experience.

Finally, a very special thank you to my parents Carlos and Flor María for their assistance, support and for being so close although so far away from me during these last two and a half years.

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DEFINITIONS

Maximum permissible level (MPL): is set for each food that may contain a pesticide residue, according to the amount of that food consumed in daily nutrition. (Kagan, 1991).

Pest: any form of plant or animal life, or any pathogenic agent, injurious or potentially injurious to plants or plant products (The International Plant Protection Convention 1991).

Pesticide: a chemical which will kill some kind of living organism constituting a nuisance to the human (Guthrie, 1980:264).

Quarantine: Form of government regulatory intervention in a competitive market economy. In terms of economic efficiency, the only valid around recognised by economist for such intervention is if there is some type of market failure. Used as a synonym for the activity of reducing the disease content of imports (Public Good). (Hinchy, 1991:17)

Quarantine pest: pest of potential national economic importance to the country endangered thereby and not yet present there, or present but not widely distributed and being actively controlled (The International Plant Protection Convention 1991)

Risk: With respect to the impact of a disease, in a situation of risk there would be minimal disagreement among experts in assigning probabilities to the events in question (Hinchy 1991:3)

Risk aversion: means that an individual would be willing to pay more than the average value of a loss to insure against the risk of a loss (ABARE 1991:3)

The residue level: is what sets the tolerances for pesticides, as long as it does not exceed a certain portion that Average Daily Intake ADI. (Rhodes, 1990)

Time path of a disease: economic difference between eliminating a disease in the year in which it become established and the disease becoming endemic, affecting production indefinitely into the future (Hinchy, 1991:3)

Tolerance: the permitted concentration of a pesticide chemical, its derivatives and adjuvants in or on a food. (Headley, 1970:92).

Toxicity: the capacity of a substance to produce injury. (Graham, 1980).

Uncertainty: With respect to the impact of a disease, in a situation of uncertainty there may be wide disagreement among experts in assigning probabilities and some may feel unable to assign them (Hinchy, 1991:3).

Zero Tolerance for a pesticide means that no (detectable) amount of that pesticide chemical may remain on a specified food (Ekstrom, 1990).

LIST OF APPENDICES

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APPENDIX 1

MAJOR CATEGORIES OF NON-TARIFF MEASURES

I. Quantitative restrictions and similar specific limitations

1. Import Quotas
2. Export limitations
3. Licensing
4. Voluntary export restraints
5. Exchange and other financial controls
6. Prohibitions
7. Domestic content and mixing requirements
8. Discriminatory bilateral agreements
9. Counter trade

II. Non tariff charges

1. Variable levies
2. Advance deposit requirement
3. Antidumping duties
4. Countervailing duties
5. Border tax adjustments

III. Government participation in trade and restrictive practices

1. Subsidies and other aids
2. Government procurement policies
3. State trading, Government monopolies and exclusive franchises
4. Government industrial policy and regional development measures
5. Government financed research and development and other technology policies
6. National systems of taxation and social insurance
7. Macroeconomic polices
8. Competition polices
9. Foreign investment polices
10. Foreign corruption polices
11. Immigration polices

IV. Customs procedures and administrative practices

1. Customs valuation procedures
2. Customs classification procedures
3. Customs clearance procedures

V. Technical barriers to trade

1. Health and sanitary regulations and quality standards
2. Safety and industrial standards and regulations
3. Packaging and labelling regulations including trademarks
4. Adverting and media regulations

Source: Deardorff (1985:13-14)

APPENDIX 2
APPLES WORLD MARKET

2.1. Apples trade flows 1987 (Metric Ton)

	Exportation	%	Importation	%
Argentina	233678	7.2	870	0.0
Australia	44012	1.4	117	0.0
Chile	275685	8.6	40	0.0
France	772810	24.0	97404	3.0
Germany West	44087	1.4	870403	27.1
Italy	348949	10.8	65858	2.0
Netherlands	192114	6.0	247558	7.7
New Zealand	320920	10.0	2885	0.1
United States	278234	8.6	133769	4.2
Others	707467	22.0	1799052	55.9
World	3217956		3217956	

Source: Satyanarayana 1989

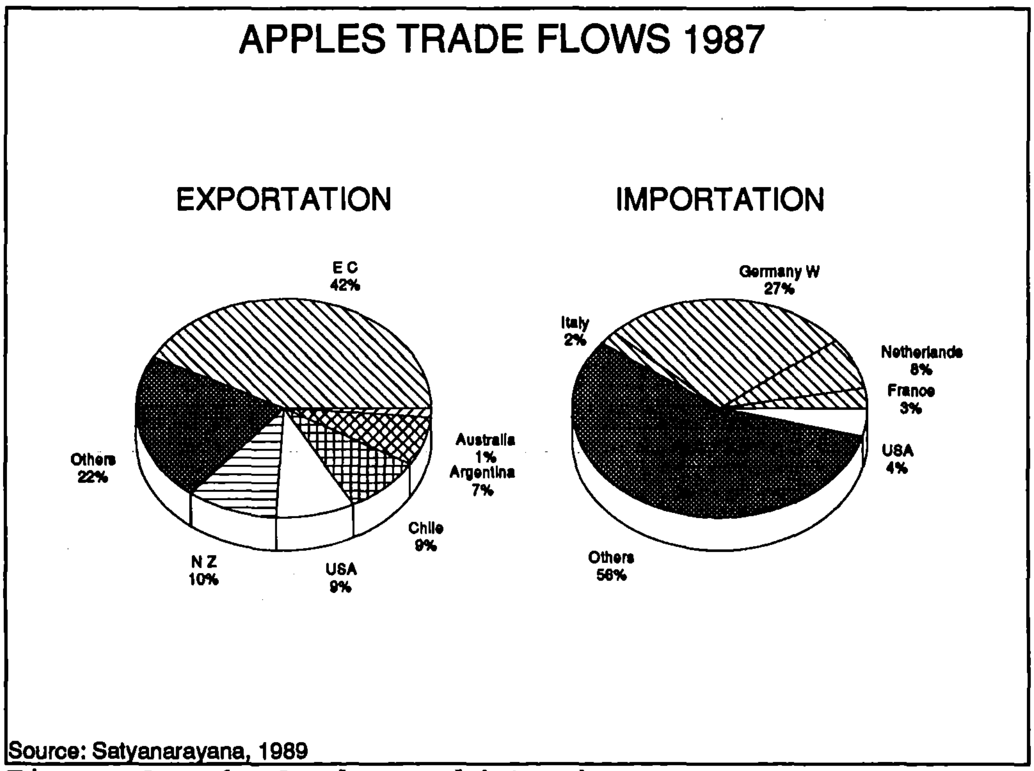

Figure App 1. Apple world trade

APPENDIX 3
NEW ZEALAND APPLE MARKET

3.1. New Zealand fresh fruit export. $'000

Year	Export $'000
1987	282,854
1988	283,745
1989	303,445
1990	402,593
1991	480,432

Source: New Zealand Apple and Pear Marketing Board 1991

3.2. New Zealand imports 1987

Country	Ton	%
Australia	304	11
Canada	343	11
United States	2238	78
World	2885	100

Source: Satyanarayana 1989

3.3. Destinations of New Zealand exports of fresh pipfruit (in 000s Tray Cartons)

	1985	%	1986	%	1987	%	1988	%	1989	%
N.America	1571	19	1694	20	1903	21	1681	16	1731	18
EC/Europe	5415	66	5908	67	6221	67	7728	75	6935	71
Others	1153	14	1194	13	1079	12	948	9	1136	11
Totals	8139		8796		9203		10357		9802	

Source: NZAPMB. Include pears but these only represent just over 1% of export volumes. Others includes: Caribbean Pacific Islands, Middle East and SE Asia.

APPENDIX 4

4.1. New Zealand export volume tonnes fresh apple 1987-91

	1987	%	1988	%	1989	%	1990	%	1991	%
Jan	62	0	0	0	0	0	3	0	1	0
Feb	0	0	103	0	349	0	278	0	3013	1
Mar	18059	11	21435	11	24501	14	40173	20	39907	20
Apr	49199	29	56250	30	78220	44	67070	33	66007	32
May	49424	29	58861	31	42771	24	53315	27	66123	32
Jun	42856	26	49788	26	24082	14	32555	16	23165	12
Jul	6905	4	3658	2	6045	3	6679	3	5556	3
Aug	1062	1	278	0	1762	1	990	1	603	0
Sep	106	0	291	0	40	0	111	0	20	0
Oct	31	0	58	0	0	0	11	0	469	0
Nov	1	0	24	0	1	0	1	0	5	0
Dec	7	0	1	0	0	0	0	0	0	0
Tot	167712		190747		177771		201186		204869	

Source: New Zealand Department of Statistics.

4.2. New Zealand export FOB Value ($000) fresh apples 1987-1991

	1987	1988	1989	1990	1991
Jan	341	0	0	10	2
Feb	0	156	446	434	4270
Mar	13444	17551	21973	54851	58234
Apr	36008	45779	69886	75431	94376
May	36410	47789	37394	44952	99020
Jun	31816	40473	21570	29826	33630
Jul	5118	3011	5442	6696	8373
Aug	845	259	1617	896	638
Sep	128	318	45	138	25
Oct	37	56	0	13	586
Nov	2	29	1	1	8
Dec	9	1	0	1	0
Tot	124558	155422	158374	213249	299162

Source: New Zealand Department of Statistics.

APPENDIX 5
OTHER APPLES MARKETS

5.1. European Community

5.1.1. Apple's production and trade in the EC

	1986	1987	1988	1989	1990	1992	1995
Production	8260	7539	8767	7690	7572	7953	7979
Area	316	316	316	316	304	292	279
Tot cons.	8257	7519	8530	7844	7852	8103	8200
Fresh	5055	5187	6650	5643			
Proces	3202	2332	1880	2201			
F. con p/c	15.7	16.0	20.5	17.3			
Imports	538	615	577	610			
% Im From NZ	20.1	22.1	24.9	22.9			
Exports	187	197	174	150			

Source: OECD, 1991.

5.1.2. Apple consumption in EC countries

Country	Kg per head year
Holland	33.3
U.K.	12.5
Greece	24.7
West Germany	24.3
Belgium & Luxembourg	20.9
Spain	20.3
Italy	20.2

Source: MAF Economic Division 1987

APPENDIX 5.2.

5.2. United States

5.2.1. Important US apple producing states ('000 tonnes)

Region	States	1988	1989	1990	%1990
East	New Y.,Pennsl., Oth.	1,337	1,350	1,077	24
Central	Michigan, Others	717	561	654	15
West	Wash. Calif., Oth.	2,822	2,243	2,789	62
Total	Total	4,876	4,154	4,520	100

Source: USDA, MAFPolicy 1991. Year Ending June

5.2.2. US apple production and trade.

	1986	1987	1988	1989	1990	1992	1995
Production	3565	4873	4142	4520	4401	4574	4835
Area	179.2	183.2	188.0	194.4	194.0	201.0	212.0
Tot Cons	3532	4690	3997	4294	4401	4350	4595
Fresh	2003	2494	2255	2459	2394	2343	2469
Process	1529	2196	1742	1835	1823	2007	2126
F Con p/c	8.3	10.2	9.2	9.9	9.5	9.2	9.6
Imports	140.7	119.2	116.3	106.5			
% Impo NZ	20.4	25.7	22.3	23.3			
Exports	173.8	301.6	261.0	333.3			

Source: OECD, 1991

5.2.3. US apples trade ('000)

Year ending in June	1985	1986	1987	1988	1989	1990
Exports[1]	177	181	209	290	250	330
Imports	124	132	133	123	116	106
Off Season S.	622	471	533	719	701	680

[1] Calendar Year.

Source: USDA, MAFPolicy 1991.

5.3. Japan

Apples production and trade in Japan.

	1986	1987	1988	1989	1990*	1992*	1995*
Production	986	998	1042	1045	1050	1062	1080
Area	48.6	49.3	49.6	49.8	55	55	55
Tot. consum.	985	997	1041	1044			
Fresh	772	729	796	809			
Process	212	268	245	234			
F. con per/c	6.4	6.0	6.5	6.6			
Imports	0	0	0	0			
Exports	1.4	1.2	1.0	1.4			

Source: OECD, 1991

APPENDIX 6

AUSTRALIA APPLE MARKET

6.1. Australian apples 1982-1990

Period	Production kt	Q Export Fresh kt	Price Exp $/t	Domestic kt	Price Dom $/t
1982-83	301	33	518	166	520
1983-84	267	16	622	186	693
1984-85	352	29	632	189	769
1985-86	288	26	590	172	946
1986-87	328	38	767	150	756
1987-88	304	22	781	159	1226
1988-89	344	21	844	180	846
1989-90	308	22	861	159	861
SUM Σ	2,492	207	5,615	1,361	6,617
Aver	312	26	702	170	827

Source: ABARE

6.2. Apple's production and trade Australia.

	1986	1987	1988	1989	1990	1992*	1994*
Production	328	309	328	315	350	363	370
Tot Cons	299	275	310	293	326	333	340
Fresh	150	159	180	159	192	187	200
Process	149	116	140	134	134	146	140
Fr. con/c	9.4	9.8	10.9	9.5	11.2	10.6	11
Imports	0	0	0	0	0		
Exports	8.8	11.0	5.5	7.0	6.9		

Source: OECD, 1991.

6.3. Production and Marketing of Australian Apples. Apples ('000 18 kg cartons or equivalent)

	Production	Domestic	Export	Other
1982	16,197	10,603	1,814	3,780
1983	16,534	9,113	1,802	5,619
1984	14,000	9,934	882	3,184
1985	18,100	10,410	1,490	6,200

Source: National Farmers' Federation 1986.

6.4. Exchange rate Australia and New Zealand

Period	Exchange Rate US$/NZ	Exchange Rate US$/Aus$
1982	0.752	1.017
1983	0.669	0.902
1984	0.577	0.879
1985	0.497	0.667
1986	0.522	0.671
1987	0.591	0.700
1988	0.655	0.782
1989	0.598	0.791
1990	0.596	0.781

Source: Department of Statistics

APPENDIX 7

MATRIX

1.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00
0.00	1.00	-0.30	0.00	0.00	0.00	0.00	0.00
0.00	0.00	1.00	-0.50	0.00	0.00	0.00	0.00
0.00	0.00	0.00	1.00	0.00	0.00	0.00	-1.00
0.00	0.00	0.00	0.00	1.00	0.00	0.00	-0.30
0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.30
0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.78
-0.47	0.47	0.00	0.00	0.53	-0.27	-0.26	0.000

Inverse matrix

0.71	0.29	-0.55	-0.28	0.33	-0.17	-0.16	-0.62
0.10	0.90	0.18	0.09	-0.11	0.06	-0.05	0.21
0.32	-0.32	0.61	0.31	-0.36	0.18	0.18	0.69
0.65	-0.65	-0.78	0.61	-0.73	0.37	0.36	1.38
0.19	-0.19	-0.23	-0.12	0.78	0.11	0.11	0.41
-0.19	0.19	0.23	0.12	0.22	0.89	-0.11	-0.41
-0.50	0.50	0.60	0.30	0.57	-0.29	0.72	-1.07
0.65	-0.65	-0.78	-0.39	-0.73	0.37	0.36	1.38

APPENDIX 8

ALTERNATIVE POLICIES

Policy One (1)

$$\begin{bmatrix} 0.00 \\ 0.00 \\ 0.00 \\ -0.10 \\ 0.00 \\ 0.00 \\ 0.00 \\ 0.00 \end{bmatrix}$$

Policy Two (2)

$$\begin{bmatrix} 0.00 \\ 0.00 \\ 0.00 \\ -0.10 \\ -0.03 \\ 0.00 \\ 0.00 \\ 0.00 \end{bmatrix}$$

Policy Three (3)

$$\begin{bmatrix} 0.00 \\ -0.03 \\ 0.00 \\ -0.10 \\ 0.00 \\ 0.00 \\ 0.00 \\ 0.00 \end{bmatrix}$$

Policy Four (4)

$$\begin{bmatrix} 0.00 \\ -0.03 \\ 0.00 \\ -0.10 \\ -0.03 \\ 0.00 \\ 0.00 \\ 0.00 \end{bmatrix}$$