MODELLING THE TASMANIAN BLACKCURRANT INDUSTRY

by

David

Charles D. Jones, B.A.

Submitted in Fulfilment of the Requirements

for the degree of

Master of Economics

University of Tasmania

May 5, 1986

TABLE OF CONTENTS

TABLE OF CONTENTS--CONTINUED

I hereby declare that this thesis, which is submitted in fulfilment of the requirements for the degree of Master of Economics at the University of Tasmania, contains no material which has been accepted for the award of any other higher degree or graduate diploma in any university. Furthermore, I state that to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of this thesis.

Charles D. Jones

LIST OF ILLUSTRATIONS

LIST OF TABLES

ACKNOWLEDGEMENTS

I began researching this thesis part-time in 1982. It has progressed slowly, but continuously with the support and direction of several persons and institutions. I would like to acknowledge their support at this time.

Foremost, I would like to thank my wife, Margaret, for putting up with the long hours involved in a project such as this. I acknowledge the frustration she undoubtably felt when private plans had to be modified to accommodate research requirements. I appreciate her understanding of my seemingly manic obsession with blackcurrants. In short, it would not have been possible to complete this project without her understanding and support.

Secondly, my thesis advisor, Mr. R.P. Rutherford, was integrally involved with the refinement and direction of the thesis. Being aware of the perils of part-time research, his encouragement and guidance kept momentum from deteriorating during the years over which the research progressed.

Thirdly, Dr. N. Groenewold read various drafts and offered a much needed commentary on the econometrics chapters. Other members of the Economics Department at the University of Tasmania contributed at various points, especially Dr. B.S. Felmingham and Mr. A. Hocking. I am grateful for their advice.

Finally, I would like to acknowledge the assistance provided by my employer, Cadbury Schweppes Pty. Ltd., throughout the period of research. In particular I would like to thank Messrs. Alastair McDonald and Graham Louden, who allowed me the use of Company resources for research purposes.

As far as thesis presentation goes, I am solely responsible for any remaining errors.

ABSTRACT

This study models the Tasmanian blackcurrant industry in a partial equilibrium context. The model developed is then used to address two policy issues, the impact of the Closer Economic Relationship (C.E.R) with New Zealand and an assessment of the impact on the industry of the Tasmanian Soft Fruit Industry Board as a statutory marketing authority.

The models developed include both those based on adaptive expectations and on rational expectations. The preferred adaptive expectations model is then used to assess the welfare implications of the modification of the sales tax exemption for fruit under the auspices of C.E.R. The study indicates considerable effects on the industry as a result.

The effect of the Tasmanian Soft Fruit Industry Board is found to largely duplicate the pricing decisions of another statutory authority, the Fruit Industry Sugar Concession Committee.

CHAPTER I

THE BLACKCURRANT INDUSTRY STRUCTURE

1.1 Introduction to the Problem

The Tasmanian berry fruit industries, on examination, have contributed a rather small amount to the state's economy historically. Thus, it might be difficult to justify any more than token interest in the stability and workings of these markets. Table 1 illustrates the position of the soft fruit industries relative to the mainstays of the Tasmanian fruit industries, apples and pears. Furthermore, the production of soft fruits is more diminutive when considering the state's total value of agricultural crops, as shown in Table 2.

However, when one considers the decline in the apple and pear industries over the last decade together with the geographical location of the majority of the apple and pear orchards, the decline in the soft fruits industries (which are located principally in the south of Tasmania) takes on a different hue. Moreover, the existence of fruit processors spatially proximate to the producers confers significant cost advantages to consumers Australia-wide, while providing employment opportunities for additional Tasmanians.

TABLE 1. GROSS VALUE OF FRUIT, TASMANIA

($'000)

Kind of fruit	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Orchard fruit -						
Apples (a)	12 546	11 736	12 815	16 662	16 572	16 706
Apricots	42	56	83	92	97	220
Cherries	33	41	52	62	67	101
Pears (a)	489	280	r 499	656	665	737
Other	28	24	16	41	37	18
Total	13 138	12 137	r 13 465	17 513	17 438	17 782
Berry and small fruit -						
Blackcurrants	234	316	474	569	859	618
Loganberries	72	126	104	108	137	116
Raspberries	328	328	410	369	488	449
Strawberries	115	130	139	174	186	256
Other	45	43	99	130	112	(b) 7
Total	794	943	1 226	r 1 351	r 1 782	1 446
Grapes	n.a.	n.a.	n.a.	11	15	30
Total fruit	(c) 13 932	(c) 13 080	(c)r 14 691	18 875	19 235	19 258

(a) Includes net payments to growers (i.e. payments to growers less contributions by growers), under Government price support schemes, as follows:

Apples - 1975-76, plus $3 282 000; 1976-77, plus $605 000; 1977-78, plus $436 000; 1978-79, plus $3 885 000; 1979-80, minus $110 000 and 1980-81, plus $3 273 000.

Pears - 1975-76, plus $19 000; 1976-77, minus $50; 1977-78, minus $2 000; 1978-79, minus $4 300; 1979-80, minus $7 600 and 1980-81, nil.

(b) From 1980-81, blackberries have been excluded from agricultural statistics.
(c) Excludes grapes.

Source: A.B.S. "Fruit, Tasmania 1980-81"

TABLE 2 CROPS : GROSS AND LOCAL VALUE (a), TASMANIA

($'000)

Particulars	Gross value						Local value					
	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Crops												
Cereals for grain												
- Barley	1 817	2 729	2 339	3 293	2 138	2 742	1 718	2 615	2 110	3 063	2 036	2 500
Oats	276	947	524	1 395	1 008	1 819	247	802	513	1 315	942	1 743
Wheat	168	322	133	312	477	355	154	287	129	288	431	329
Legumes mainly for grain -												
Peas, field	88	138	156	364	222	191	79	127	139	326	195	182
Crops for hay (b)	146	478	161	290	235	358	145	465	149	269	215	356
Orchard tree fruit -												
Apples (c)	12 546	11 736	12 815	16 662	16 572	16 706	6 517	6 952	9 398	11 202	11 648	10 821
Pears (c)	489	280	499	656	665	737	156	132	366	442	496	515
Other	103	121	151	195	201	339	91	112	134	175	173	321
Berry and small fruit -												
Currants	234	316	474	569	859	618	234	316	474	569	859	618
Raspberries	328	328	410	369	488	449	327	327	410	369	488	442
Other	232	299	342	413	435	(d)379	225	294	328	398	416	(d)375
Vegetables for sale for human consumption -												
Beans, French and runner	1 176	1 377	1 103	1 918	1 007	1 856	1 176	1 377	1 103	1 918	1 007	1 856
Carrots	485	1 191	1 296	1 627	1 379	2 261	454	1 086	1 188	1 490	1 266	2 231
Onions	1 171	1 240	1 478	2 033	2 699	4 182	1 033	1 036	1 330	1 830	2 413	3 719
Peas, green	3 039	4 956	4 307	4 778	4 082	4 710	3 039	4 955	4 306	4 777	4 081	4 707
Potatoes	7 340	9 355	8 879	12 640	14 206	17 186	6 926	8 767	8 214	12 143	13 459	16 358
Other	r3 144	r3 239	r3 510	r4 206	r4 174	4 505	r2 890	r2 933	r3 234	r3 936	r3 865	4 357
Other crops -												
Hops	1 575	2 254	2 351	3 209	3 021	4 678	1 421	2 185	2 104	2 856	2 659	4 091
Other (b)	2 972	5 794	8 807	13 085	8 345	7 906	2 751	5 535	8 328	12 499	7 474	7 372
Pasture harvested -												
Pasture for hay	5 628	8 478	4 141	8 301	7 751	7 687	5 597	8 274	3 810	8 291	7 143	7 560
Pasture for seed	52	128	85	621	433	660	50	126	80	604	390	645
Total crops	43 009	55 706	53 961	76 936	70 397	80 324	35 230	48 703	47 847	68 760	61 656	71 098

(a) Excludes crops and pasture harvested for green feed or silage.
(b) Excludes pastures harvested for hay or seed - see 'Pasture harvested' below. (Note : Lucerne is classified as a component of sown pastures.)
(c) Includes net payments to growers (i.e. payments to growers less contributions by growers), under Government price support schemes, as follows:

Apples - 1975-76, plus $3 282 000; 1976-77, plus $605 000; 1977-78, plus $436 000; 1978-79, plus $3 885 000; 1979-80, minus $110 000 and 1980-81, plus $3 273 000.
Pears - 1975-76, plus $19 000; 1976-77, minus $50; 1977-78, minus $2 000; 1978-79, minus $4 300; 1979-80, minus $7 600 and 1980-81, nil.

(d) From 1980-81, blackberries have been excluded from agricultural statistics.

Source: A.B.S. " Value of Agricultural Commodities Produced, Tasmania 1980-81"

Hence, the interest in research into the structure of the industries appears to warrant more than values alone might indicate. Furthermore, as the blackcurrant crop has been the predominate industry amongst the various soft fruits, as shown in Table 1, the current thesis shall focus upon that industry. The dominance of blackcurrants can be seen to be under pressure from raspberries in recent years, but from a regional point-of-view Tasmania alone supplies the domestic blackcurrant market, whereas raspberries are produced on the mainland of Australia. Thus, to say "the Tasmanian blackcurrant industry" implies "the Australian blackcurrant industry" at least on the supply side of the market.

The purpose of this study, then, is to examine the factors affecting the demand for and the supply of blackcurrants in Tasmania, to measure the strength of the various influences, to assess the usefulness of such results in making pricing decisions, and to assess the performance of the statutory marketing board for the soft fruit industry, the Soft Fruit Industry Board.

1.2 Structure of the Tasmanian Industry

The geographical location of the industry, as mentioned above, lies predominately in southern Tasmania. Table 3 illustrates the number of establishments, area under cultivation, and production for a recent year by local government area. Production of blackcurrants (as well as other berry fruits) has tended to be associated with production of other mixed farm produce. Part-time and hobby farming are also characteristics of the industry, as only approximately 35 percent of the total production is derived from "dedicated" berry farms (Edwards, 1973).

Cultivation techniques have tended to be traditional methods yielding high production per hectare, but at high costs per tonne. Technological advances have been forthcoming, especially with regards to mechanical harvesting. However, the feasibility of mechanical harvesting is dependent upon the location, as well as

TABLE 3

GEOGRAPHICAL LOCATION 1974-75

LOCAL GOVT AREA	NO. HOLDINGS	NON-BEARING AREA (HA)	BEARING AREA (HA)	PRODN (TNE)
Glenorchy	13	3	8	28
Esperence	6	2	3	18
Huon	44	9	26	129
Kingborough	59	6	43	171
New Norfolk	67	17	68	379
Port Cygnet	18	6	10	35
N. Central (Tamar)	3	3	0	0
N. West	2	0	0	0
N. East	2	4	0	0
Hamilton	26	5	55	318
West	2	0	0	0
Total	249	96	228	1086

Source: A.B.S.,"Fruit Production, Tasmania, 1974-75".

the size, of the blackcurrant plantation. That is, mechanical harvesters cannot be used on the hilly terrain with which blackcurrant plantations have typically been associated. Furthermore, it has been estimated that the plantations must be of at least 10 hectares before a harvester could become profitable to a sole operator (I.A.C., 1981).

However, the trend emerging is one where large producers are exploiting the economies of size in moving to large scale production dependent upon mechanical harvesting. Data illustrates that for the 1981/82 season 85.4% of the crop of blackcurrants was produced by growers who produced over 5 tonnes. More indicative is the fact that five or six growers each produce in the range of 40 to 50 tonnes per year (Soft Fruit Industry Board data).

There are only two major processors of blackcurrants in Tasmania, those being Cascade Cordials Pty. Ltd. and Clements and Marshall Pty. Ltd. Cascade have established long-term contracts with blackcurrant growers, thus supplying their needs for the production of "Ultra-C" blackcurrant juice.

Clements and Marshall act principally as an agent whereby fruit is juiced then sold to Anchor Foods Pty. Ltd. of South Australia, who market the "Anchor" brand of blackcurrant juice. Other processors are also provided with blackcurrants in block frozen form by Clements and Marshall.

The major usage of Tasmanian blackcurrants, then, is the production of juice. As mentioned, there are two major domestically produced products which compete against Beecham Foods Ltd.'s "Ribena" blackcurrant extract. Beecham bottle Ribena domestically but source their blackcurrant content externally due to the lack of a processing plant within Australia. It is understood that blackcurrant extract is the product of a different process than that used in juice production.

A minor usage of blackcurrants is in the production of jam. However, jam has been said to be a diminishing outlet due to consumer attitudes and the relative cost of berry fruit compared to stone fruit (Dr. R. Clarke, private interview). Henry Jones-IXL produce a blackcurrant jam, as do Cottee's and Monbulk.

The marketing of blackcurrants in Tasmania comes under the auspices of the Soft Fruit Industry Board (SFIB), a statutory body set up by Tasmanian government under the Soft Fruit Industry Act 1972. The Board consists of an equal number of grower and processor representatives, an independent chairman, and a secretary.

Control by the SFIB over the industry is limited to the amount of the crop to be disposed to the processing firms, that is there is no control over the fresh produce side of the market. However, the portion of Tasmanian blackcurrants going to the fresh produce market has been estimated to be approximately two percent of the total crop (Dept. of Agriculture, Tasmania). Thus, for all intents and purposes, the SFIB can be said to exert dominance over the industry.

More specifically, the SFIB is empowered to require registration of producers and processors, with an annual license to trade blackcurrants to be issued. However, the main purpose for the existence of the SFIB is to set prices. Therefore, its dominance of the industry is in this regard, where in fact the board effectively becomes an arbitration council for the use of the producers and processors in setting prices. The result of this arbitration system is a minimum price payable ex-farm gate, for that season's produce.

Pricing of blackcurrants prior to the introduction of the Soft Fruit Industry Board was not statutorily enforced. However, minimum prices for fruit were announced each year by the Fruit Industry Sugar Concession Committee as qualification for rebates on the price of sugar used in manufacture. This domestic sugar rebate is payable on the sugar content of all fruit manufactures including blackcurrant products.

Government assistance takes the form of tariff protection as recommended in the Industries Assistance Commission (IAC) report "Fruit and Fruit Products." These recommendations have been estimated by the IAC to provide an effective protection rate of 10 percent to the berry fruit industries (I.A.C., 1981).

More specifically, the tariff protection applies to imports of berry fruit juice at an ad valorem rate of 10 percent in general, with juice from New Zealand being admitted duty free. Under the New Zealand Australia Free Trade Agreement (NAFTA) and continued under Closer Economic Relations between Australia and New Zealand (CER) imports of fresh or frozen berry fruit are duty free sourced from New Zealand but dutiable at two percent sourced from elsewhere.

In addition to this tariff protection, in 1983 the growers of berry fruits have been given a bounty amounting to $100 per tonne of berry fruit going to the processing market. This bounty has been limited to a five year duration.

Finally, and perhaps most important in terms of protection for the industry, is the existance of a sales tax exemption for the users of domestic blackcurrant juice which hinges upon a local contents scheme. That is, the end uses of blackcurrant juice are exempt from a 20% sales tax if the local blackcurrant content was at least 25% of the total by volume. In the 1983 Federal Budget the term "local" was redefined to include juice from New Zealand, in the spirit of CER. Section (6.3) investigates the implications of the protective structure of the industry in more detail. It is interesting to note that a relevant I.A.C. report was prepared in 1981 concerning (amongst others) the blackcurrant industry. A personal communication with the IAC on the question of the impact of such a local content scheme was met with the reply that the sales tax exemption was not considered to be significant for these industries (I.A.C., personal communication).

1.3 Structure of the New Zealand Industry

The New Zealand blackcurrant industry has emerged in the last five years as the chief source of competition to the Tasmanian industry. In fact it has been stated by the Soft Fruit Industry Board (personal communication) that the emergence of New Zealand as a major blackcurrant producer was due to the encouragement made by Cascade Cordials Pty. Ltd. This encouragement came at a time when the Australian demand for blackcurrants was not being satisfied by domestic production.

The recent developments in the New Zealand industry can be seen in the data presented in Table 4. From 1967-68 to 1977-78 the industry appeared to be relatively stable. Total area under cultivation doubled in size over this period, although the number of growers only increased marginally. However, begining 1978-79 the industry began growing at a rate which led to a sevenfold increase in area and a threefold increase in number of growers by the end of 1981-82. Total production increased over this period,

TABLE 4

NEW ZEALAND BLACKCURRANT INDUSTRY STATISTICS

YEAR	NO.	AREA (ha)	FRESH (tne)	PROCESS (tne)	TOTAL (tne)	YIELD (tne/ha)	PRICE ($NZ)	EXPORTS (tne)
67-68	68	105	157	66	223	2.12		
68-69	71	110	71	152	223	2.03		
69-70	67	123	90	119	209	1.71		
70-71	76	153	131	88	219	1.43		
71-72	80	200	89	222	311	1.56		
72-73	78	221	144	202	346	1.57		
73-74	79	335	99	201	300	0.90		
74-75	74	153	147	265	412	2.69		
75-76	na	131	202	281	483	3.69	0.82	225
76-77	84	160	145	365	510	3.19	0.98	250
77-78	76	194	66	619	685	3.53	1.05	387
78-79	89	311	134	615	749	2.41	0.96	558
79-80	177	778	94	743	837	1.08	0.82	111
80-81	224	1368	75	1158	1233	0.90	1.24	43
81-82	na	1449	na	2347	2347	1.62	na	na

SOURCE: MINISTRY OF AGRICULTURE AND FISHERIES, NEW ZEALAND but at a reduced rate due to the lag between planting and harvesting. As mentioned above, it appears that the exports to Australia during the period 1975-76 to 1978-79 might have had an influence upon the subsequent plantings in 1978-79 to 1981-82. The size of holdings in New Zealand are presented in Table Five and for Tasmania in Table Six. It is apparent that the size of the average plantation is larger in New Zealand than in Tasmania, with the majority of area (78%) being in plantations of greater than six hectares, but held by only 34% of the growers. Yields per hectare have been lower in New Zealand than in Tasmania. However, this phenomena, at least in the last few years, must be seen as symptomatic of the increase in area under cultivation which had not come into full production.

There are a number of export assistance schemes operating in New Zealand, those being the Export Performance Taxation Incentive (EPTI), the Export Manufacturing Investment Allowance (EMIA), and the Export Market Development Grant (EMDG). The EPTI allows a taxation credit for the sale of processed exports based upon an export classification (banding) scheme. Section (6.3.2) quantifies the incentive for blackcurrant products and provides more information on this incentive. The EMIA is based upon the proportion of production which has been exported, while the EMDG encourages exports to new markets. These two incentives have not been quantifiable, as they relate primarily to individual company policies, e.g. asset acquisition decisions, which are difficult to generalise. It has been stated that the EPTI is the most significant incentive (New Zealand Dept. of Trade and Industry, private communication).

Table 5

New Zealand Blackcurrant Plantations

No. of Farms	Size (Ha)	% of Farms
604	< 1.2	56.6
321	1.2 - 6	30.6
79	> 6	7.4
58	Not Available	5.4

Source: E. Beaumont, "Closer Economic Relations (CER) with New Zealand and the Tasmanian Apple & Berry Fruit Industries," unpublished paper, Australian Institute of Agricultural Science, p. 3.3.

Table 6

Tasmanian Blackcurrant Production 1981-82

Range (tne.)	Number of Growers	Production (tne.)
0-1.9	94	67.0
2-4.9	30	93.0
5-9.9	23	148.2
10-19.9	15	220.6
20-29.9	6	142.7
30-39.9	2	68.7
40-49.9	5	214.9
50 & over	2	141.9
Total	177	1097.0

Source: Soft Fruit Industry Board Data

In a survey of the New Zealand industry, Langford and Mavromatis (New Zealand Ministry of Agriculture and Fisheries, 1981) characterise the industry as being made up of several cooperatives of growers, processing companies, exporters, and government departments. The common connection between these groups is a body known as the Blackcurrant Market Development Council. This council acts on behalf of the industry and is responsible for action on problem areas such as marketing strategies, production problems and communications between the diverse groups involved in the industry. However, the Council has no statutory authority with regard to price, production controls, or marketing.

1.4 Other Major Producers of Blackcurrants

Unfortunately, data availablility for international production and consumption of blackcurrants are not published in any consistent manner. Langford and Mavromatis have published statistics, however, which allow conclusions to be drawn concerning the major producing countries of the world and the relative size of the Tasmanian industry in comparative terms. Tables 7 and 8 illustrate the major producers. It is obvious by comparison that the Tasmanian industry, along with that of New Zealand, are relatively minor producers of blackcurrants. Although price data was not available from major producing countries, any differences in price levels between Australian and the "world" price are assumed to reflect transportation costs and differences in protective levels imposed by various countries.

TABLE 7

EAST EUROPEAN CURRANT PRODUCTION

1977

COUNTRY	'000 TONNES
Bulgaria	1.3
Czechoslavakia	16.4
East Germany	20.0
Hungary	10.0
Poland	85.0
Yugoslavia	10.0

Source: Langford & Mavromatis, 1981.

TABLE 8

U.K. BLACKCURRANT PRODUCTION

YEAR	AREA (HA)	PRODN ('000 T)	YIELD (T/HA)	PRICE (STL./T)
1970	4301	20.4	4.74	167.36
1971	3833	23.1	6.03	229.50
1972	3809	26.2	6.88	204.80
1973	3880	21.1	5.44	266.00
1974	4028	22.9	5.69	293.70
1975	4136	23.8	5.75	248.60
1976	3909	17.7	4.53	419.50
1977	3792	8.4	2.22	916.90
1978	3879	17.7	4.67	756.60
1979	4091	21.7	5.30	517.20

Source: Langford & Mavromatis, 1981

1.5 A Summary of the Institutional Features

At this point it is appropriate to recapitulate by summarising the institutional features of the Tasmanian blackcurrant industry. As these features will become encapsulated in a model at a later stage in this thesis, this summary will provide a criteria for model selection.

Briefly, the supply side of the industry is characterised by a large number of producer of a homogeneous product. The nature of the blackcurrant is perennial with an average gestation lag of approximately four years. Due to the perennial nature and combined with the long period between planting decisions and harvesting, it appears that producers' expectations concerning the profitability of the product are important determinants of area under planting, that is supply. The gestation lag also indicates that it is impossible for producers to adjust their production to long-run desired levels within one year, and hence, a partial adjustment mechanism is suggested.

The demand side is characterised by a small number of processors. The fruit purchased is generally juiced then block frozen and stored until such time as required by production. The predominant use of the fruit is in the manufacture of juice, with a minor use being for jam production. The major processor has offered long-term contracts to attract production, the terms of which state the willingness of the processor to accept all qunatities produced under contract at the ruling price.

The price of blackcurrants has been regulated by the Soft Fruit Industry Board since its inception in 1972. The Board is made up of equal numbers of producer and processor representatives with an independent chairman. Board activities also encompass quality standards, registration of producers and processors, and other non-trading activities. Prior to 1972 the ninimum prices were announced by the Fruit Industry Sugar Concession Committee.

Various government policies apply to the industry. An IAC recommendation (1981) gave the producers of blackcurrants a $100 per tonne bounty. Closer Economic Relations affected the tariff structure for imports of blackcurrant fruit and concentrated juices. Appendix 1 provides more explicit information on C.E.R. In the spirit of C.E.R. a sales tax exemption for users of local blackcurrant juice was recently modified to include fruit juice from New Zealand.

Tasmania accounts for a small proportion of world production of blackcurrants. Although total production statistics on a world-wide basis are not available, leading producers include east European countries and the United Kingdom.

CHAPTER 2

THE SOFT FRUIT INDUSTRY BOARD AND REGULATION

2.1 The Economics of Marketing Boards

In this section the economic aspects of marketing boards will be discussed with reference to the Soft Fruit Industry Board.

The economics of marketing boards falls under the broad heading of the economics of regulation. Due to fluctuations in agricultural prices, farmers and producers have sought relief from the consequent fluctuations in their incomes by exerting political pressure upon governments. One such outcome of this political pressure has been the establishment of statutory marketing boards.

The traditional view of regulation, that termed "the public interest" theory of regulation by Posner (1974, p.336) states that principle government interventions:

> ...were simply responses of government to public demands for the rectification of palpable and remediable inefficiencies and inequities in the operation of the free market. Behind each scheme of regulation could be discerned a market imperfection, the existence of which supplied a complete justification for some regulation assumed to operate effectively and without cost.

By assuming that the government is impartial in rectifying inequities, the distributional aspects of government intervention are avoided under this theory of regulation. The allocative efficiency questions can be examined with the aim of correcting for the market failure through intervention.

The traditional classification of market failure is given by Bator (1957):

a. failure by existence (no price for the output);

b. failure by signal (non-optimal price for the output);

c. failure by incentive (negative profits at the optimal price;

d. failure by structure (no perfectly competitive market);

e. failure by enforcement (arbitrary legal imperfections).

Seiper (1982) has described various barriers to the efficient working of agricultural markets which can illustrate some of the above classifications of market failure, and which have been used to justify market intervention in Australian agriculture. Firstly, the existence of a large number of intermediaries typical of the marketing of agricultural produce can obscure the price mechanism from the producer. Price signals given to the producer should reflect conditions in the product's final market. According to Bator's classification, failure is by signal.

Secondly, the market for an agricultural product may fail from the existence of imperfect competition. Monopsonistic exploitation is often cited as a problem in agriculture, for example when farmers sell to large, highly concentrated processing firms. Government intervention on this count is aimed at equalising the bargaining power of the farmers with that of the processing firms. Various other forms of intervention are used to protect consumers and producers from the effects of market power by processors, including standards of labelling and packaging, food standards, etc. In all of these cases market failure is by structure.

Thirdly, the market for an agricultural product may fail due to inertia, inefficiency, or lack of innovation by marketers and distributors. Intervention by government in this case has been through vehicles such as marketing boards. Market failure is by existence.

Fourthly, agricultural markets may fail due to the lack of information, that is the existence of risk or uncertainty. Intervention to reduce this form of inefficiency is evident by the number of government agencies which support agricultural production, including marketing boards, state agricultural departments, the Bureau of Agricultural Economics, etc. Uncertainty, as applied to agricultural products usually reflects the lack of adequate insurance markets. Quiggin and Anderson (1979) point out that producers are faced with three types of risk:

a. risk about the price they receive;

b. risk about factors affecting the relationship between planned total output and actual total output, e.g. droughts, epidemics;

c. risk about factors affecting their own output only, e.g. local weather, personal mismanagement.

Finally, markets may fail due to the presence of governmental intervention elsewhere in the economy. In this case foreign government policy could impact on local agricultural industries. Protective measures are examples of government intervention in this instance. Market failure is by enforcement.

The traditional public interest theory of regulation, as noted above, has assumed away any distributional considerations in its explanation of why governments intervene into markets. Stigler (1971) developed an alternative, later termed the "positive theory of regulation." Stigler (1971,p.4) observed that the coercive powers of a government could be used by an industry to increase its profitability. It is therefore necessary according to Stigler to view intervention in terms of political coalitions, whereby intervention is the product of a political bargain between various interested parties.

Viewing intervention basically as a product, it becomes apparent that there should be a market in which this product is bought and sold. Peltzman (1976,p.212) stated that from an intervention point-of-view:

> The essential commodity being transacted in the political market is a transfer of wealth, with constituents on the demand side and their political representatives on the supply side. Viewed in this way the market here, as elsewhere, will distribute ore of the good to those whose effective demand is highest.

A distributive theory of regulation should have something to say about the conditions which allow certain groups to obtain regulation. Stigler mentions a few conditions drawing from the theory of cartels which could influence the political effectiveness of a group in obtaining favourable regulation.

Firstly, the size of the group was pointed out as a relevant factor. In this regard Stigler mentioned that there would be a law of diminishing return to group size in politics. To begin with the group itself will be a minority in terms of the size of the group in proportion to the population as a whole. With the voting on a particular issue, a voter will incur costs for acquiring information on the consequences of the issue. A voter will not generally incur such costs if the size of his interest is small. Consequently, those with a small stake in the matter, although quite possibly representing a majority in numbers overall, may not defeat a policy against their best interests, as they will be unaware of the policy's implications.

A further limitation to the size of the group is due to the costs of organisation. The group must organise itself to find and support the politician or political party which will implement the desired policies of the group. As the group size increases, the total per capita value of the desired policy declines, again supporting the concept of a diminishing return to group size.

A second condition pointed out by Stigler was that the degree of concentration of the group or industry would be a factor in the successful acquisition of regulation. Stigler pointed out that the more highly concentrated industries would have more resources at its disposal which could be invested in acquiring favourable regulation. However, Posner (1974) pointed out that there should be an inverse relationship between the degree of concentration and regulation, as a cartel may be a less costly alternative to regulation when the number of participants is small.

A final condition for obtaining regulation pointed out by Stigler was the absense of a cohesive opposition to the proposed regulation. This condition again is supported by condition one above, in that if a voter has only a small stake in the question he will not incur the cost of acquiring information about a proposed policy, a particular candidate, or a particular political party. If the individual voters, however, can organise themselves around the law of diminishing returns, an effective opposition campaign might defeat a proposition.

It is apparent from this brief survey that it is possible to adopt either a positive or public interest approach to the problems of the industry under study. While a discussion of distributional questions will be undertaken at a later point in this thesis, it should be pointed out that a public interest approach will be used to model the Tasmanian blackcurrant industry.

2.2 Types of Marketing Boards

In this section marketing boards shall be catagorised, providing a criterion for classification of the activities of the Soft Fruit Industry Board, which will be undertaken in the subsequent section. A marketing board can be defined as a public body which has been delegated under its enabling legislation various legal powers which it holds compulsorily over the producers of that particular commodity. In some cases the processors are also bound by the marketing board. A marketing board is distinct from growers' cooperatives primarily in the power of compulsion held by the board. By its nature a cooperative is a voluntary agreement which has no power of enforcement. A marketing board is also distinct from direct government intervention in that the board has been delegated a degree of authority for the commodity. Along with the delegated authority comes an element of autonomy of management which can separate the board from the government.

Veeman (1972) has classified the types of statutory marketing boards into two major types: non-trading boards and trading boards. Within these two major classifications the following subdivisions were denoted: non-trading boards could be advisory and promotional, regulatory, or stabilisation; trading boards could be stabilisation, export monopoly, or domestic monopoly. The designation of a particular board depended largely upon the enabling legislation, which usually defined the functions and limits of the board. According to this classification system the functions of the different types of boards roughly conforms to the following description.

Non-trading advisory and promotion boards, as the name indicates do not trade in the particular commodity. Their predominant purpose is to conduct market research, promote sales campaigns, and to develop new uses for markets for the product. This type of board is usually funded by a levy on the sales of the commodity.

Non-trading regulatory boards, again, do not trade in the commodity but do develop quality standards or grading systems. Enforcement of the standards is usually guaranteed by the right to inspect premises carrying out production. Furthermore, licensing requirements for producers, handlers, and processors can be a characteristic of the powers of this type of board.

Non-trading stabilisation boards attempt to stabilise the price of the commodity by various means such as: administering the trading price; by using reserve levy funds to subsidise prices when necessary; by supply management; or by import controls.

Trading stabilisation boards usually own marketing and storage facilities. By entering the market, the board can stabilise price through purchasing or selling "buffer" stocks. In this case the marketing authority would attempt to buy its buffer stock in a market characterised by a falling price while selling its stock in an increasing market.

Export monopoly and domestic monopoly boards are both characterised as being the sole buyer and seller for a particular commodity, either for, respectively, export sales or domestic whether prices yielding monopoly profits would be permitted.

2.3 Soft Fruit Industry Acts of 1972 and 1973

The legislation which set up the Soft Fruit Industry Board was the Soft Fruit Industry Act of 1972. This Act was amended in 1973. The legislation was typical of the enabling legislation for marketing boards as described by Veeman (1972) and Campbell & Fisher (1982). In this section the Act (as amended) will be discussed.

Part One of the Act defined relevant terms. An important term was the definition of soft fruit to include: strawberries; raspberries; blackcurrants; gooseberries; and fruit of the Rubus genus. Also defined were a soft fruit processing business which was taken to mean a business involving the processing of any kind of soft fruit, or the buying of any kind of soft fruit for the purpose of sale to a processing firm. Processing was taken to include the canning or bottling; the extraction of juice; use for the manufacture of any substance; treating for the purpose of preserving in a state fit for human consumption.

Part Two of the Act established the Soft Fruit Industry Board and defined the composition of its members and specified some of its powers. The composition of the Board included an independent Chairman, two producer members, two processor members, deputies for the producer and processor members, and a secretary. The Board members are tenured for a period of three years and are appointed by the Governor of Tasmania. The Chairman, in addition to presiding at meetings of the Board, may exercise a casting vote if there is an equality of votes on a matter, but may not vote otherwise.

The powers delegated to the Board as described in Section Two relate mainly to non-trading activities. These powers include: advising the Minister for Primary Industry on any matters concerning the administration of the Act; making recommendations or representations to any authority or body on any matter that concerns the interests of the producers or processors of soft fruit; taking action on the promotion of the use of soft fruit; disseminating information concerning soft fruit; and fixing grades or standards for any type of soft fruit.

Part Three of the Act spells out the Board's powers over the industry. In this section the registration of processors and licensing of producers is detailed. In essence, a soft fruit processor must be registered by the Board before he is permitted to become party to a sale of soft fruit. Upon notification from a registered processor that he is willing to purchase a quantity of soft fruit, licenses are issued by the Board to producers for the supply of that quantity. The issuance of a license to a producer is tantamount to a contract and is binding upon all parties to the "production agreement."

Section 19 delineates the Board's authority to set prices for the industry along with any other conditions and terms which it might consider to be appropriate. This section, then, embodies the Board's monopoly pricing powers in that it may determine the price both to the processor and producer.

Intervention into a market, as shown above, can be justified on several grounds, for example: if particular individuals or groups exploit market power; if there are significant externalities in production or consumption; if the distribution of income is regarded to be inequitable.

For the Tasmanian soft fruit industry, all of the conditions could be viewed as relevant at the time the Act was conceived. In particular, as noted above, the duopsonistic nature of the demand side indicates the potential for the exploitation of growers by Cascade and Clements and Marshall. Prior to Cascade becoming the dominant processor, that role was played by Henry Jones and Co.

Economies-of-scale were the possible production externalities which could have been promoted through the establishment of a marketing authority. Mechanical harvesting technology was becoming available at this stage. However, the adaption of this technology to Tasmanian conditions required the relocation of production from the small hill-sides traditionally associated with diversified farms to specialised plantations of at least 10 hectares located on flat land. The riskiness of such a venture would have been apparent due to the relatively high cost of establishing a "dedicated" berry farm.

The principle location of soft fruit production, as mentioned above, was the Huon Valley. This setting provided the third criteria for government intervention, due to the declining importance of the apple and pear industries in that area. During debate on the Soft Fruit Industry bill, in speaking for the bill, the member for Franklin, Mr. Clark, reinforced the concern for the stabilisation of income to the Huon Valley by noting that the area's farmers should diversify into the production of soft fruit, beef, and vegetables. Clark indicated that "each is a potential industry for the area." (Mercury Extracts, 1972)

It appears from the above conditions of the industry at the time that the market was not functioning so as to allocate resources properly. In a sense there appeared to exist market failure due to incorrect signals given to participants. That is, the market price was not sufficient to compensate the producers of soft fruit, blackcurrents in particular, to bear the risk of reestablishing their enterprises into specialised, large-scale plantations which could make use of the mechanical harvesting technology. Furthermore, the risk of entry into an "exploited" market would have presumably been built into the cost structure of a potential soft fruit grower, again adding to the price which would have needed to be received to call forth the needed production.

2.4 Evaluation of Marketing Boards

In this section guide-lines for evaluation of marketing boards will be discussed.

In a recent address Hocking (1985) stated that due to the diversity of marketing arrangements for agricultural products, the assessment of a particular statutory authority must be made with respect to its underlying enabling legislation. Furthermore, the assessment should highlight the intentions of establishing the marketing board, the potential for meeting its objectives, and the success or failure of achieving its objectives.

It has been pointed out above that the Soft Fruit Industry Board was established under producer pressure to reduce the price associated risks involved in developing large, specialised berry fruit plantations. The Board was implicitly charged with stabilising the industry by attempting to match the supply of berry fruit to the perceived demand by processors.

The enabling legislation as shown above allowed the Board to effectively meet its objectives through its price fixing and licensing powers over berry fruit production in Tasmania. What was left was the necessity for the Board to forecast the market-clearing price.

A problem with state marketing boards which influences the abilities of the boards to meet their objectives occurs where the jurisdiction of the board doesn't extend sufficiently to ensure compliance with its regulations. For the SFIB this problem exists where processors of soft fruit are located outside Tasmania. In this case, the processors are not constrained to trade with the Tasmanian industry.

The effectiveness of a marketing board is frequently debated on the grounds that the board is not changing the situation which existed before it came into existence. That is, charges of "rubber stamping" the market are made. In this sense, any administrative costs associated with the board would be seen as unnecessary since the market would have been doing as well without the board.

Blandy (1981) has considered the question of rubber stamping by the Australian Arbitration Commission. In his article, Blandy found that the wage structure for Australian industries under the arbitration system was not greatly different from the wage structure in the United Kingdom under a "free market" system of collective bargaining. Part of this reasoning by Blandy was on the basis of a study by Handcock and Hughes (1973) who computed a simple coefficient of correlation between the two countries' wage structure. As the coefficient of correlation was high (r=0.732) it was taken that the wage results under arbitration were approximately the same as those of the "free market."

A similar test was performed for the blackcurrant industry to quantify the possibility of rubber stamping. Data was available for the New Zealand blackcurrant industry, which is characterised as a non-administered "free" market. The calculation of the correlation coefficient (r) between New Zealand's blackcurrant prices to the SFIB price series indicated a very low degree of correlation, with the coefficient being 0.0739. On the basis of this data, it seems apparent that the SFIB was not rubber stamping the market, but had exercised an influence over the pricing of blackcurrents.

Judging the SFIB on the criterion of using its potential to meet its objectives of price stabilisation, the above test indicates that the Board is effectively using its price setting powers. A further test of the effectiveness of the Soft Fruit Industry Board's pricing powers can be made on the basis of an econometric model of the industry. It is proposed that the model developed and estimated in later sections of this thesis be used in this regard.

Due to the comparatively recent introduction of the SFIB, there exists an opportunity to compare market participants' reactions to price changes under the conditions of both free markets and of supported markets, and hence, under differing degrees of price uncertainty. It is apparent that the price responsiveness of participants under supported markets should be more rapid than to free market prices as the level of riskiness associated with supported prices would be reduced.

The method of analysing this hypothesis will be to split the collected data into subsections corresponding to the existence (or otherwise) of the SFIB. The Chow test will be applied to the two sets of regression coefficients to formally test for differences which could imply institutional or structural changes due to the introduction of the SFIB.

2.5 The Measurement of Welfare Effects

In attempting to evaluate the effects of policy changes on society, it is apparent that some measurement of welfare needs to be made. Traditionally, the measurement of consumer's and producer's surplus have been used in this regard to value the change in prices and quantities exchanged on the market after the imposition of some policy. In this context the policies of marketing boards can be evaluated.

The traditional concept of the consumer's surplus arose from Marshall's (1920) notion that "the price which a person pays for a thing can never exceed, and seldom comes up to that which he would be willing to pay rather than go without it." Marshall's measure of consumer's surplus, then, is this difference between what the consumer actually pays for a product and what he would be willing to pay for, that is the area under the demand curve but above the price line.

Similarly, the producer's surplus is derived from the idea of earning a "rent" on factors in the production of a product. In this case, the price received by the producer is higher than the minimum which he would be willing to receive to produce his output. The area under the price line but above the supply curve defines the producer's surplus.

The evaluation of a policy change is often couched in analysing the changes in the above measures of surplus. For example, the introduction of a minimum price for a product can be analysed by measuring the transfer of surplus from either the consumer to the producer or vice versa. Also important in this measure of welfare for some policies is the so-called "deadweight loss" in welfare. For example, a minimum pricing scheme where price is set above the competitive equilibrium price introduces an inefficiency into the market, as at the higher price quantity traded is reduced. Welfare is reduced because at the new quantity traded the area under the demand curve and above the supply curve has been reduced.

The use of the Marshallian surplus measures, however, is dependent upon the assumption that the marginal utility of income was constant. The implication of this assumption is that because of a price change for a commodity, the consumer's real income will be changed as well. If the consumer's marginal utility of income is different at different levels of income, defining the surplus at the change in price times the quantity will incorrectly value the welfare gains or losses.

Hicks (1945) developed alternative measures of surplus for the case where the marginal utility of income was not assumed to be constant. Using indifference curves Hicks defined the concepts of compensating and equivalent variations as measures of welfare. The compensating variation was defined as the maximum amount that a consumer would give up to remain on his original indifference curve after a price fall. The equivalent variation is that amount which a consumer would require to forego a price fall but enabling him to achieve the same gain in welfare as he would have received as a result of the price fall. The compensating and equivalent variations will only be the same when there is no income effect, that is when the marginal utility of income is constant. We have seen, though, that in this case the Marshallian measurement of surplus is appropriate and furthermore, equal to the compensating and equivalent variation measures. When the income effect is positive, the consumer surplus will be less than the compensating variation, which itself will be less than the equivalent variation. When the income effect is negative the consumer surplus will again be underestimating the welfare change, however in this case the equivalent variation will be less than the compensating variation.

The point of contention for empirical measurement of welfare using the Marshallian concept of consumer and producer surplus arises from the assumption of constant marginal utility of income. It is usual to consider this assumption to be valid in cases where the expenditure on the commodity is relatively small when compared to the total expenditure. However, if the income from the sale of a good forms a large portion of total revenue, the effect of a price change would be expected to be accompanied by some form of an income effect. An example often cited in this regard is the surplus attached to the supply of labour. Given that most workers derive the majority of their income from one type of labour, the change in the rate paid for this labour would have a significant effect on the individuals' real income. In the case of agricultural commodities, non-diversified establishments would also be subject to significant income effects.

In the eventuality that income effects are assumed to be significant, the use of the Marshallian measures are less desirable than the Hicksian measures, as the former underestimate the welfare effect. To obtain the Hicksian measures empirically it would be necessary to estimate Hicksian income-compensated demand curves, whereby the income effect of a price change had been compensated for. In this case the area under the income-compensated demand curve but above the price line would correspond to the correct measure of the welfare. Although income effects may be assumed to be present, it is usual for agricultural policies to be evaluated in terms of changes in consumer & producer surpluses. Varian (1978) points out that the correct Hicksian income-compensated demand curves and their associated measures of welfare are not empirically observable. Thus, applications using the Marshallian measures of surplus require the inclusion, according to Willig (1976), of an "apology" to the theoreticians for using an inappropriate measure. In this thesis, as is usual practice in empirical applications, the Marshallian measures will be used to evaluate policy decisions, assuming the income effects are insignificant, given the diversified nature of blackcurrant establishments in Tasmania, as pointed out earlier [cf. p.3, supra.].

Nerlove (1958) has shown that under these usual assumptions, the elasticities of supply and demand can be used to measure the changes in surplus caused by a change in a minimum pricing arrangement. Nerlove has shown that the percentage change in surplus when evaluated from the equilibrium value of the crop, can be expressed as:

(2.1) Consumers' Surplus: $CS = x\ (1 - .5\ x\ ed)$

(2.2) Producers' Surplus: $PS = x - x^2 ed\ (1 + .5\ \frac{ed}{es})$

where elasticities are taken at their absolute values, and where $x = \Delta P/P0$. The net welfare effect is given in percentage terms as:

(2.3) $$CS - PS = .5x^2 ed\ (1 + \frac{ed}{es}).$$

It can be seen that if the price of a commodity is decreased, the net welfare effect shall be positive, while for a price rise the effect will be negative. Also apparent in this analysis is the relative impact on the producers and consumers of the commodity. It can be seen that the elasticity of supply and demand govern which group absorbs the majority of the impact of the price change. That is, if the elasticity of supply is less than the elasticity of demand in absolute values, the producers of the commodity will lose (gain) more from a price increase (decrease) relative to the consumers of the commodity.

This procedure for evaluation of policy changes will be used at a later point in this thesis to consider the effect of a change in the sales tax exemption for fruit juices, and shall be contrasted with the above-mentioned objectives of the Soft Fruit Industry Board.

The welfare implications of a minimum pricing scheme can be shown for a perfectly competitive industry by considering the changes in consumer and producer surpluses resulting from the move from an equilibrium price to the higher minimum price. Figure One illustrates the basic model for a minimum pricing arrangement, assuming that the marginal utility of income is constant.

Prior to the introduction of a minimum price into the market, the equilibrium position is given by the price OP^* and the quantity OQ^*. When the minimum price is proclaimed, there will be a misallocation of resources towards the industry resulting in over-production given that the minimum price is effective. This is shown in Figure One by the price OP_1, which would induce the supply OQ_2 and the demand OQ_1. In conjunction with this over-production will be the existence of inequities in production. Due to the existence of the minimum price, producers whose marginal costs are less than or equal to OP_1 will be willing to supply at that minimum price. However, as only OQ_1 units will be taken up by the market, there will be a surplus of these suppliers, which indicates the necessity for some form of rationing of production. On efficiency grounds, the production should be taken up by the most cost effective producers, i.e. those whose marginal costs are equal to or less than OP_2.

A further inefficiency generated by the minimum price is the above-mentioned dead-weight loss in consumer and producer surpluses. It is clear from Figure One that for a minimum price set above the competitive equilibrium price, there is a transfer of surplus from the consumer to the producer, amounting to the area (P^*P_1AB). However, the dead-weight loss in surplus is the area (ABCD), made up of the reduction in both consumer and producer surplus due to the reduced quantity demanded.

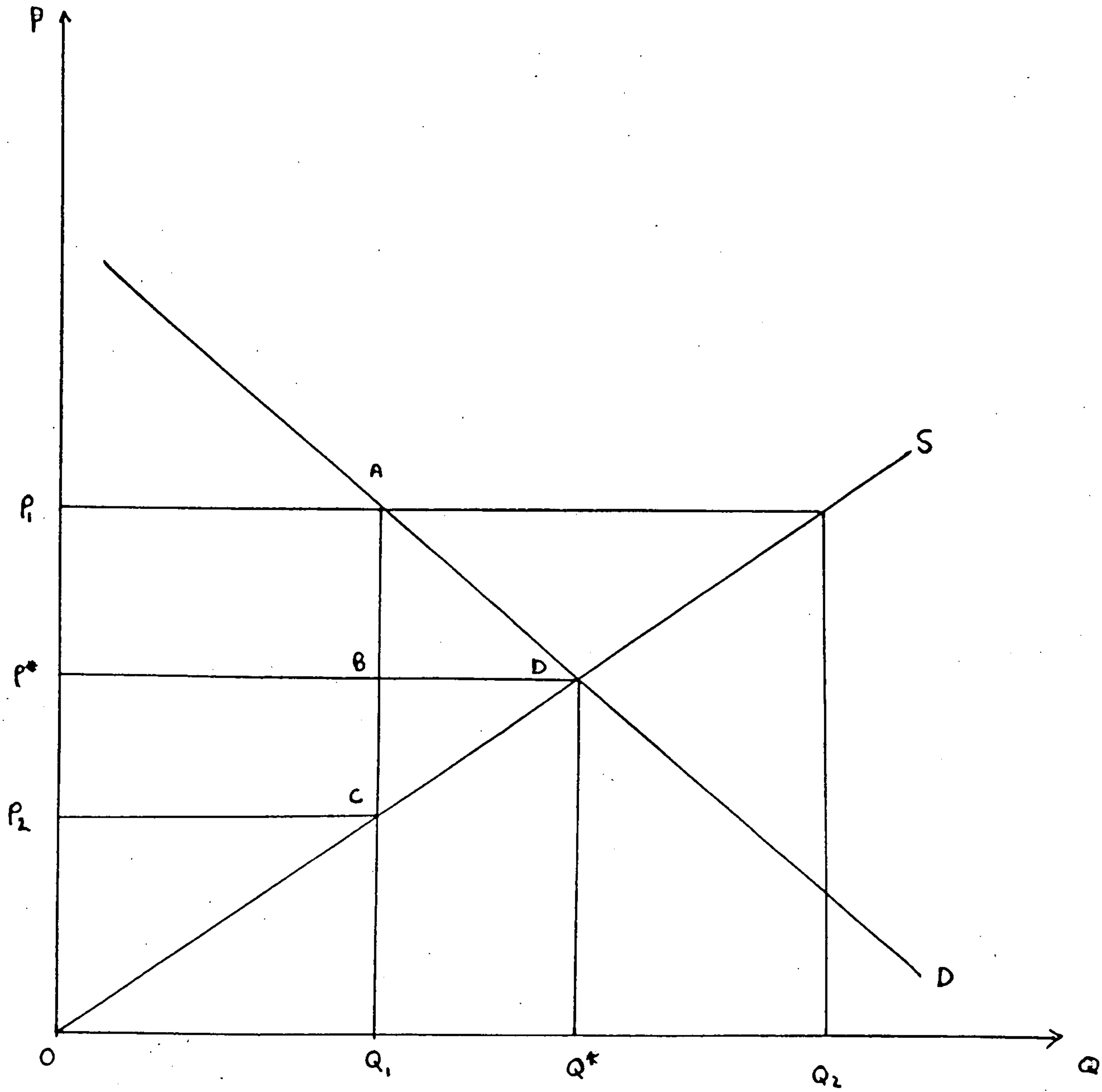

FIGURE I: MINIMUM PRICING SCHEME

CHAPTER III

MODELLING APPROACHES

3.1 Analytical Models

A discussion of models analytically specifying the causal relationships of industry supply and demand shall now be presented. Ideally, a review of models previously specified for the industry of interest should be included. However, a computer-aided search of the literature on blackcurrants only indicated one model relating to the blackcurrant industry, a supply response model of the U.K. industry. This model will be discussed below at the relevant point.

With this obvious lack of literature to build on, it is intended to develop a model for the Tasmanian blackcurrant industry by reviewing various approaches to the modelling of agricultural markets. The approaches considered here shall be the traditional static market equilibrium model, the naive expectations (cobweb) dynamic model, the adaptive expectations model, and the rational expectations model.

3.2 Model One: Traditional Static Equilibrium Market Model

For a price-taking profit maximising producer it can be shown that the supply function of the individual producer is the marginal cost curve over the range where marginal cost is rising and is greater than, or equal to average variable cost. For prices lower than average variable cost, the supply function for the producer is not defined. The traditional derivation of supply comes from the producer's profit maximising output decision. The producer seeks to set his output such that his profit is maximised subject to his production function and a given cost funtion. Mathematically, for a single output produced by N variable factors and one fixed factor, the problem is to maximise the function :

$$\Pi = PQ - \sum_{i=1}^{n} r_i L_i - K \qquad (3.1)$$

subject to: $$Q = f(L_1, \ldots, L_n, \bar{K}) \qquad (3.2)$$

where: P = price of the commodity;
Q = quantity produced;
r_i = ith variable factor's wage rate;
L_i = quantity of the ith variable factor;
$\bar{K}$ = cost of the fixed factor.

Substituting the production function into the profit function yields:

$$\Pi = Pf(L_1, \ldots, L_n, \bar{K}) - \sum_{i=1}^{n} r_i L_i - K. \qquad (3.3)$$

The first-order conditions obtained by maximising this function with respect to the variable input show that a profit maximiser will employ a variable input until the marginal revenue product is equal to its wage rate, that is:

$$\frac{\partial \pi}{\partial L_i} = Pf'_{L_i}(L_i, \ldots, L_n, \bar{K}) = r_i \qquad (3.4)$$

These expressions may be solved for the factor demand functions:

$$L_i = L_i \ (P, r_1, \ldots, r_n, \bar{K}). \qquad (3.5)$$

Substitution of these N factor demand functions into the production function yields the producers supply function:

$$Q_s = f \ L_1(P, r_1, \ldots, r_n, \bar{K}), \ldots, L_n(P, r_1, \ldots, r_n, \bar{K}) \qquad (3.6)$$

or:

$$Q_s = Q_s(P, r_1, \ldots, r_n, \bar{K}). \qquad (3.7)$$

This function states that the individual producer's supply decision is based on the commodity price, N input prices, and the current technology (embodied by the fixed factor $\bar{K}$). The industry supply is derived as the horizontal summation of the individual producers' supply functions, assuming technology and factor prices are independent of industry output. The industry supply function over m individual producers can be written as:

$$Q_s = \sum_{i=1}^{m} Q_{si}(P, r_1, \ldots, r_n, \bar{K}) \qquad (3.8)$$

Given upward sloping individual supply functions, the industry supply function will be upward sloping in the absense of external effects.

For a perfectly competitive buyer of an input of production, the demand for that input is derived from the demand for the produced output. The input demand functions are determined from the firm's first-order conditions, solving for the quantity demanded as a function of own price, output price, and other factor prices. The derivation of the factor demand functions as shown above for the producer is identical for a profit maximising buyer of an input. Although the problem facing both the supplier and the purchaser are couched in identical terms, it must be remembered that the output from one industry is (in this case) used as an input into a different industry. The input demand function for the ith input by the jth user (analogous to the input demand functions derived above) are:

$$L_{ij} = L_{ij}(P, w_1, \ldots, w_n, \bar{K}) \quad \begin{matrix} i=1,2,\ldots,n \\ j=1,2,\ldots,m \end{matrix} \qquad (3.9)$$

The aggregate demand for the ith input is obtained by summing the M individual users' input demand functions, i.e.:

$$D_i = D(L_i) = \sum_{j=1}^{m} L_{ij} = \sum_{j=1}^{m} L_{ij}(P, w_1, \ldots, w_n, \bar{K}) \quad i=1,\ldots,n \quad (3.10)$$

It can be shown from the second-order conditions for a profit maximum that the slope of the individual firm's factor demand curve is always negative, given the assumptions of perfect competition. Hence, the aggregate demand curve will be unambiguously downward sloping.

To bring the two segments of the market together it is necessary to postulate an equilibrium condition. Traditionally, the form of this identity is that quantity demanded and supplied at each point in time are equal, that is, the market clears. Walras portrayed the market as obeying a "tatonnement" mechanism whereby the price was bid up or down until the equilibrium price was obtained and the market cleared.

The traditional market model for a factor can be expressed by three equations in three endogenous variables (Qs, Qd, p):

$$Q_s = Q_s(P, r_1, \ldots, r_n, \bar{K}_1) \qquad (3.11)$$

$$Q_d = Q_d(OP, P, w_2, \ldots, w_n, \bar{K}_2) \qquad (3.12)$$

$$Q_d = Q_s \qquad (3.13)$$

where: Qs = quantity supplied;

Qd = quantity demanded;

p = producers' output price;

ri = producers' ith input price;

OP = buyers'output price;

wi = buyers' ith input price;

$\bar{K}1$ = producers' fixed factor cost;

$\bar{K}2$ = buyers' fixed factor cost.

Often in the case of agricultural markets there is contention concerning the presence of significant market power. In the Tasmanian blackcurrant industry, for example, growers have charged the major processor with exploitation. It is appropriate, then, to consider the modelling of monopsonistic demand for an input given a competitive supply of that input.

A profit-maximising monopsonist does not take the input price as given, as does a perfectly competitive buyer of a factor of production. Because the monopsonist faces the market supply function, he must pay more for each additional unit purchased. The input level is set by maximising the profit function:

$$\Pi = PQ - \sum_{i=1}^{n} r_i L_i - K \qquad (3.14)$$

subject to: $$Q = f(L_1,...,L_n,\bar{K}). \qquad (3.15)$$

as shown above. Substitution of the production function into the profit function yields:

$$\Pi = Pf(L_1,...,L_n,\bar{K}) - \sum_{i=1}^{n} r_i L_i - K. \qquad (3.16)$$

The first-order condition obtained by maximising this function with respect to the variable input (whose price is now dependent upon the quantity demanded), i.e.:

$$\frac{\partial \Pi}{\partial L_i} = Pf'_{L_i}(L_1,...,L_n,\bar{K}) - r_i - \frac{\partial r_i}{\partial L_i} L_i = 0. \qquad (3.17)$$

In this case, the monopsonist maximises profits by setting his input demand for the ith factor such that the marginal revenue product equals the marginal cost of that factor. The exploitation concept arised from the fact that the marginal cost is less than the price paid to the factor. The above first-order condition can be written as:

$$\frac{\partial \Pi}{\partial L_i} = Pf'_{L_i}(L_1,...,L_n,\bar{K}) - r_i - \frac{r_i}{\varepsilon_i^s} = 0. \qquad (3.18)$$

where: ε_i^s= elasticity of supply of the ith factor.

It is apparent that the profit maximising input demand depends upon supply considerations. Substitution of the first-order conditions into the production function and solving for the ith factor demand function yields:

$$L_i = f(P, r_1, \ldots, r_n, K, \varepsilon_i^S). \qquad (3.19)$$

This input demand function shows the quantity demanded of the ith factor of production based on a given factor supply function and thus differs from the traditional concept of a cet. par. "demand" function where quantity demanded varies with alternative prices.

3.3 Model Two: Naive Expectations (Cobweb) Model

The traditional model presented above is based on the asssumption of instantaneous, non-storable production. That is, the economic agents are assumed to arrive at the market place, arrive at the equilibrium price by tatonnement, produce the corresponding market-clearing quantity, then go away until the next market day.

However, because of lags in production, it has been perceived that the supply of an agricultural product may depend upon the price in a previous time period. For example, time delays between planting and harvest would imply that the decision to plant (and hence, to supply the commodity) was based upon the price expected at harvest. A naive extrapolation of expected price is the price experienced at the time of the decision. So, in its most elementary state, the supply function for a good with a one period "gestation" lag could be expressed as:

$$S = f(P_{t-1}). \qquad (3.20)$$

where pt-1 is the own price of the commodity in the previous period.

Assuming the demand and equilibrium functions hold as expressed in Model 1 above, the model has become a dynamic equilibrium model with lagged adjustment whereby, _ceteris paribus_, demand is a function of current price and supply is a function of the previous period's price. The model embodies a behavioural assumption, however, which requires that supply equals demand. Thus, price must adjust to clear the market once the supply emerges upon the market, generating a time path of price as a function of time which, due to oscillations around equilibrium, has been termed a "cobweb" model.

Ezekiel (1938), in his theoretical explanation of the cobweb model, has pointed out three implicit assumptions regarding the model. He states (p.272) that the model is applicable only to commodities:

> (1) where production is completely determined by the producers' response to price, under conditions of pure competition (where the producer bases plans for future production on the assumption present prices will continue, and that his own production plans will not effect the market);
>
> (2) where the time needed for production requires at least one full period before production can be changed, once plans are made;
>
> (3) where the price is set by the supply available.

Ezekiel points out that with respect to production plans for many commodities, once underway, little could be done to increase production. However, the quantity actually marketed could be reduced at any point during the production process, e.g. by pulling out plants, slaughtering livestock, etc. Natural conditions affecting production were also pointed out as a serious limitation of the cobweb model. For example, unusual weather could affect production, changing a "normal" crop into a "bumper" crop.

Furthermore, in relation to price setting, Ezekiel points out that if prices are set by an administered method, the model will break down. Finally, the equilibrium assumption implies that quantity supplied equates quantity demanded. Thus, there is no possibility of holding stocks of the commodity. Clearly, this is a limitation for any but the more perishable commodities.

The cobweb model, then, can be expressed as:

$$Q_t^d = a - b(P_t) \quad (3.21)$$

$$Q_t^s = c + d(P_{t-1}) \quad (3.22)$$

$$Q_t^d = Q_t^s \quad (3.23)$$

where a,b,c,d are parameters and where all other factors are unchanged.

3.4 Model Three: Adaptive Expectations Model

The cobweb model, as noted by Ezekiel, is a rather naive formulation of which some of the limitations have been pointed out above. However, the model serves as a convenient departure point for the development of more sophisticated models of more specialised industries.

M. Nerlove (1958) has expanded the scope of the naive cobweb model by incorporating an equation expressing the supply of a commodity as a function of expected price. In Nerlove's words (p.231):

> farmers take past prices into account when forming their expectations of future "normal" price, but they do not give all the weight to one particular price. When current price increases, farmers may be expected to discount some of the increase, i.e. they will not believe in the permanance of the entire change. Arrow and I have called such induced expectations "adaptive."

The form of the expectations generating mechanism specified by Nerlove was expressed as:

$$(P^*_t - P^*_{t-1}) = \beta(P_{t-1} - P^*_{t-1}) \qquad 0<\beta\leq 1 \tag{3.24}$$

where p^*_t is defined as expected "normal" price in period t, and where β is a parameter to be known as the coefficient of expectations. Thus, previous expectations of normal price are revised in proportion to the difference between actual and what was previously considered to be the normal price.

Hence, the adaptive expectations model of a commodity market could be expressed as:

$$Q_t^d = a - bP_t \tag{3.25}$$

$$Q_t^s = c + d(P_t^*) \tag{3.26}$$

$$Q_t^d = Q_t^s \tag{3.27}$$

$$(P_t^* - P_{t-1}^*) = \beta(P_{t-1} - P_{t-1}^*) \quad 0<\beta\leq 1 \tag{3.28}$$

It can be seen that if β is equal to unity, the model reduces to the naive cobweb model as expressed above.

A criticism often made of the adaptive expectations hypothesis is of the ad hoc way that the expectations generating mechanism has been specified. By simple rearranging the expectations generating mechanism can be written as the first-order difference equation:

$$P_t^* = \beta P_t + (1-\beta)P_{t-1}^*. \tag{3.29}$$

It can be shown that given the appropriate initial conditions a general solution to the above equation is:

$$P_t^* = (1-\beta)\sum_{i=0}^{\infty} \beta^i P_{t-i-1}. \tag{3.30}$$

Expected price, then, is a geometrically-declining weighted average of past prices. It has been pointed out that the ad hoc criticism is due to the restrictions placed on the distributed lag parameters which are not the result of an optimisation process. That is, nothing from the producer's or buyer's profit maximisating output decision problem deals with the formulation of expectations, nor imposes the restriction that the weights on the previous prices decline in a geometric fashion.

A variation of Nerlove's adaptive expectations model widely used in explaining the variation of agricultural supply is known as a supply response model. Askari and Cummings (1977), in a recent survey summarise more than 600 published studies using this model. The structural equations of the model can be written in the most elementary form as:

$$A_t^* = a_0 + a_1 P_t^* + a_2 Z_t + u_t \quad (3.31)$$

$$P_t^* = P_{t-1}^* + \beta(P_{t-1} - P_{t-1}^*) \quad 0<\beta\leq 1 \quad (3.32)$$

$$A_t = A_{t-1} + \gamma(A_t^* - A_{t-1}) \quad 0<\gamma\leq 1 \quad (3.33)$$

where: At=actual area under cultivation at time t;
At*=desired area under cultivation at time t;
pt=actual price at time t;
pt*=expected price at time t;
Zt=other exogenous factors at time t.

It is noted that the above model is a supply model only, which would require the addition of a demand relationship and an equilibrium condition to complete the market model. It is interesting to note however, that two adjustment mechanisms are embodied in the supply response model. Firstly is the mechanism (3.32) whereby price is expressed as a geometrically declining weighted average of past actual prices. There is also a partial adjustment mechanism (3.33) which states that farmers change their actual plantings in proportion to the difference between their desired level and their previous actual level of plantings. This proportion, γ, is the rate of adjustment from actual to desired levels. If $\gamma=1$, the adjustment from actual to desired levels occurs within one period, while if $\gamma<1$, the adjustment is not completed within a period. This mechanism is used in empirical studies of agricultural production to capture certain technological constraints, for example the perennial nature of certain crops. It can also account for asset fixity whereby, due to the low salvage values of most agricultural projects, actual plantings are not adjusted to desired levels.

G.T. Jones (1961) utilised the Nerlovian model to estimate the elasticities of supply response for various agricultural products in the United Kingdom. Of particular note was the inclusion of an annual blackcurrant model as well as other soft fruits models in this study. Jones' model was expressed as:

$$x_t^* = a + bP_t^* \quad (3.34)$$

$$P_t^* = (1-k)P_{t-1}^* + kP_{t-1} \quad (3.35)$$

$$x_t = (1-r)x_{t-1} + rx_t^* \quad (3.36)$$

where: x^*t = long-run equilibrium supply;
p^*t = long-run equilibrium price;
xt = observed supply;
pt = observed price;
k = rate of price adjustment;
r = rate of technical adjustment.

If r or k are assumed equal to unity the above system can be reduced to:

$$x_t = d + eP_{t-1} + fx_{t-1}. \quad (3.37)$$

In this case k (or r depending upon which rate of adjustment was set equal to unity) is equal to (1-f). Jones defined x to be area under production after finding no evidence in support of a relationship between price and yield. To consider "supply" equal to area under production caught a technical constraint of blackcurrant production, being the lag between planting and harvesting. Had output been the dependent variable, the gestation period would be discounted.

Jones pointed out a few problems with estimating the supply response elasticities using equation (3.37). In particular, for soft fruits it is probable that there will exist autocorrelation in the residuals due to the perennial nature of the commodity. Furthermore, it was considered impossible to set the value of r equal to unity, that is assuming that production adjusts to its long-run equilibrium within one year. It was also considered improbable that price uncertainty was negligible even with the existence of significant numbers of contractual arrangements. In this case, where it is impossible to set either k or r equal to unity the estimating equation becomes:

$$x_t = d + eP_{t-1} + fx_{t-1} + gx_{t-2} \qquad (3.38)$$

In this case, the long-run elasticity of supply response (b in equation (3.34)) can be written as:

$$b = \frac{e}{1-f-g}, \qquad (3.39)$$

however, r and k will not be separably identifiable. In the Appendix to Jones' article it was pointed out that the simple form of the model (equation (3.37)) could be used in this case as an approximation. However in this case the estimates obtained would be biased upwards, although if r or k was near unity, the bias would be less.

The short- and long-run elasticities of supply were estimated by Jones using OLS. In the simple model (3.37) the short-run elasticity was calculated to be .29, while the long-run elasticity was calculated to be 1.16. In the case where r or k were not constrained to be unity (3.38), the short-run elasticity was .18 while in the long-run was .62.

3.5 Model Four: Rational Expectations Model

The models presented above have largely explained variations in supply as some function of expected price and other variables. In the case of the simple cobweb model expected price was expressed as the previous period's price. Nerlove generalised this result to give the "adaptive" expectations hypothesis whereby expected price was expressed as a geometrically weighted distributed lag of past actual prices. The essence of these expectations models are that they introduce unobservable variables into the specification of the model. By deriving some expectations-generating mechanism, the unobservable variable is substituted for by an observable variable.

Muth (1960)introduced the concept of a model which embodies "rational" expectations. That is, it is assumed that the economic agents in a market do not waste information, rather if a supply/demand framework is representative of the market, this information will be used by the participants in forming their expectations. The reduced-form of the relevant model can be used in forecasting expected price, which can then be used as the relevant expectations variable in estimating the model's structural parameters.

The rational expectations hypothesis can be incorporated into a general supply/demand model in the following manner:

$$Q_t^d = a - bP_t + eZ_t + u_{1t} \quad (3.40)$$

$$Q_t^s = c + dP_t^* + fX_t + u_{2t} \quad (3.41)$$

$$Q_t^d = Q_t^s \quad (3.42)$$

$$_{t-1}P_t^* = E(P_t \mid I_{t-1}) \quad (3.43)$$

where Zt, Xt are exogenous variables and all other variables are as described above. The symbol It-1 denotes the available information at the end of time (t-1). Under appropriate conditions a rational expectation is an unbiased estimate of the actual price given the information available at the time when the expectation if formed. Rationality in this sense implies that it is impossible to add an equation which appears to be a reasonable explanation of how expectations might be formed. The price expectation equation must satisfy (3.43) which implies that it should be derived from the structure of the model.

The reduced form equation for price can be expressed as:

$$P_t = \frac{a-c}{b} - \frac{d}{b}P_t^* + \frac{e}{b} Z_t - \frac{f}{b} X_t + \frac{1}{b}(u_{1t}-u_{2t}). \quad (3.44)$$

Taking expectations, where E(pt)=pt*, after rearrangement:

$$P_t^* = \frac{a-c}{b-d} + \frac{e}{b-d} E(Z_t) - \frac{f}{b-d} E(X_t) \quad (3.45)$$

given that the disturbance terms of the supply and demand functions are equal to their mean values of zero.

The expected price is expressed as a function of the expectations of the exogenous variables Zt and Xt. Expressing these expectations as E(Zt)=Zt* and E(Xt)=Xt* and substituting into the structural system of equations above yields the non-linear system:

$$Q_t^d = a + bP_t + eZ_t + u_{1t} \tag{3.46}$$

$$Q_t^s = \frac{b(a-c)}{b-d} + a + \frac{be}{b-d} Z_t^* - \frac{bf}{b-d} X_t^* + fX_t + u_{2t} \tag{3.47}$$

$$Q_t^d = Q_t^s. \tag{3.48}$$

In order to estimate the parameters of the model it is necessary to specify forecasting functions for the exogenous variables Zt* and Xt*. Wallis (1980) has suggested using a first-order autoregressive model, that is:

$$X_t{}^* = \Phi X_{t-1} + e_t. \tag{3.49}$$

Taking expectations:

$$X_t^* = \phi X_{t-1}, \tag{3.50}$$

where E(Xt)=Xt*. The structural system, then, consists of the equations (3.46) to (3.48) and the forecasting functions:

$$Z_t^* = \phi_1 Z_{t-1} \tag{3.51}$$

$$X_t^* = \phi_2 X_{t-1}. \tag{3.52}$$

Nerlove, <u>et. al.</u> (1979) point out that rational expectations from an economic point of view are more consistent with the underlying structure of economic behavior than alternative models of expectations such as the cobweb or adaptive expectations models. The rational expectations model is theoretically satisfactory but presents problems in empirical usage. Technically, the model is difficult to estimate compared with the other expectations models.

3.6 A Model for the Tasmanian Blackcurrant Industry

As indicated above, very little empirical work aimed specifically at the blackcurrant market has been reported in the literature, with the only contribution being the study by Jones (1961) and (1962). The foregoing sections of this chapter have had the purpose of outlining the predominant approaches to modelling a partial equilibrium model of an agricultural market. Criticisms of these approaches have been included throughout this discussion, which will now form the basis of establishment for a model of the Tasmanian blackcurrant industry. A guide to the institutional constraints on the market was given above, which should also be considered in specifying the estimated model. The supply function shall be considered firstly, followed by the demand function and equilibrium condition.

Model One is extremely general in its specification of supply. Its major contribution to the explanation of supply resides in the inclusion of variables other than own price. Traditionally empirical studies have added variables such as alternative product prices, input prices, weather and technological proxies, etc. with the aim to capture shifts in the supply function, caused by such things as changes to relative profitability to other production alternatives, changes to cost structures, improvements in technology, etc. To include or exclude these variables should be justified by the characteristics of the particular market.

For blackcurrant production the question of the effect of relative profitability appears to warrant inclusion. Although due to the fixity of assets in perennial production, switching to a more profitable alternative may not be feasible in the short-run, especially for enterprises using mechanical harvesting technology. However, long-run alternatives must affect blackcurrant production.

Changes in cost structure would appear to have an obvious effect on production. However, again, due to the perennial nature of the product the only apparent variable cost which will impact upon production is the cost of harvesting labour. That is, after a blackcurrant plantation is established and becomes mature, production of fruit will occur irregardless of the cost of maintaining the plantation. Harvesting costs will impact on production however, which is why fruit is usually harvested as long as the revenue generated is greater than the cost of harvesting. Harvesting costs, then, should be included in the supply function. These costs involve such items as casual picking labour and variable picking machine costs such as petrol. For the predominate part of the sample period blackcurrants were harvested by hand picking. The appropriate variable to include in the supply function would be the wage rate for casual agricultural workers.

Weather has an obvious effect on the production of agricultural products and blackcurrants in particular. Rainfall is a very important factor in determining the yield. In addition to providing nutrients and moisture, rains provide frost protection for blackcurrant plants. Again it appears appropriate to include a variable representing the weather influence on supply, preferably an index of rainfall. As the production of blackcurrants is predominately located in the same geographical location, an index of rainfall would be a reasonable proxy.

A variable to explain technological improvements might also be thought of as appropriate in a supply function for blackcurrants. The adoption of mechanical harvesting would be the main source of technological improvement for blackcurrant production. As with the weather variable mentioned in the preceding paragraph, several methods of modelling the effects of technology have been used in empirical research. The predominant approach has been to include a trend variable, assuming that technological improvements occur as a linear progression through time. An alternative is Griliches' (1957) method of fitting a logistic growth curve which would allow the improvements to be introduced over a period of time, in a non-linear fashion.

The cobweb model presented as Model Two contributes to the supply function through the introduction of a naive formulation of expected price as a relevant variable. As mentioned above the cobweb supply function assumes that producers expect that the price they receive in the current period shall continue into the future. This naive expectations formulation is important, however, as the remainder of the models presented above build on this idea of supply as a function of expected price.

Nerlove's adaptive expectations market model adds a more specific formulation of how price expectations are formed. Through his expectations generating mechanism, Nerlove's supply function contributes the idea that lagged production as well as lagged price are important in explaining agricultural production.

Again, using lagged supply appears to capture the perennial nature of the production of blackcurrants. However, the inclusion of lagged supply may only capture the effect of any persistent trends in the data. Ladd (1959) has suggested the inclusion of a time trend when using this form of Nerlove's model.

Nerlove's supply response model takes the adaptive expectations framework from Model Three and adds a stock adjustment mechanism to relate the change of actual to desired levels. The dependent variable most often used in empirical studies utilising this model is area planted on the assumption that producers couch their production decisions in terms of area planted rather than output produced. In this sense the stock adjustment equation relates how a producer adjusts his planted area from actual to desired levels. As mentioned above, for a perennial commodity with a long lead time to produce, the adjustment to long-run desired levels would certainly be greater than one year.

The rational expectations supply function, like that of Model One is completely general in presentation. The contribution it makes to the theoretical model of supply for blackcurrants lies in its differing approach to the modelling of price expectations, as was pointed out above in the discussion of the model. It is feasible to derive a comparable model using the rational expectations approach to that using the adaptive expectations approach. Hence the supply response approach attributed to Nerlove could be adapted to utilise rational expectations by removing the expectations generating mechanism, solving for the reduced form of the price variable and continuing as outlined above.

The possibility of using essentially the same model but utilising differing assumptions about the form of the expectations generating mechanism is appealing in that the competing hypotheses could be tested. Sheffrin (1984) has provided this rationale for the comparison of adaptive vs. rational expectations by suggesting that of the over 600 reported studies surveyed in Askari and Cummings (1977) perhaps many would be consistent with the rational expectations hypothesis. Hence, the supply response model outlined by Nerlove for agricultural products will be adopted as the preferred modelling approach for the Tasmanian blackcurrant industry and will be estimated using both the adaptive and the rational expectations mechanisms.

The supply response model necessitates disaggregating the supply function into two equations, an area function and a yield function. The area function should, theoretically, capture the planning or "desired" component of quantity supplied while the yield function should capture the harvesting decisions. The appropriate explanatory variables in the area function would include expected price, an index of costs, an index of alternative products' prices, an index of technology, and lagged area, assuming a partial adjustment of actual to desired area. The functional form with all variables in logarithmic form is given by:

$$A_t = a_0 + a_1P_t^* + a_2PP_t + a_3PR_t + a_4T_t + a_5A_{t-1} + u_{1t} \quad (3.53)$$

where: At = area under cultivation at time t;
pt* = expected real price at time t;
PPt = index of prices paid by farmers at time t;
PRt = index of prices received by farmers at time t;
Tt = time trend at time t;
Ult = stochaistic disturbance at time t.

The yield function should include the explanatory variables of actual price (as prices are announced prior to harvest), the cost of harvesting labour, and an index of rainfall. The logarithmic functional form is given by:

$$Y_t = b_0 + b_1P_t + b_2L_t + b_3RAIN_t + U_{2t} \tag{3.54}$$

where: Yt = yield per hectare at time t;
pt = actual price of blackcurrants at time t;
Lt = index of farm wages at time t;
RAINt = index of rainfall at time t;
U2t = stochaistic disturbance at time t;

In application of the adaptive expectations hypothesis the following equation specifying the formulation of expectations will be used:

$$P_t^* = P_{t-1} + (1-b)P_{t-1}^* \qquad 0<b\leq 1. \tag{3.55a}$$

In estimating the supply function in the context of the rational expectations hypothesis, it will be assumed that expectations are the predictions given by the theory, that is:

$${}_{t-1}P_t^* = E(P_t \mid I_{t-1}). \tag{3.55b}$$

To close the supply response component of the model, the identity equating quantity supplied to the product of area and yield is given again in logarithmic form by:

$$QS_t = A_t + Y_t \tag{3.56}$$

where QSt = quantity supplied during period t.

Like that of supply, the demand function of Model One is very general, but again, allows for non-price influences as demand curve shifters. The demand function described for an input included such additional influences as the price of the final product, prices of other inputs, and the state of technology. Other influences which might be considered to be important and which have been included in empirical studies for derived demand functions are income, and the prices of substitute and complementary products.

For the Tasmanian industry the demand for blackcurrants largely is for the production of juice. Therefore it appears that the price of blackcurrant juice should be included in the demand function. Due to the predominance of Cascade Cordials Pty. Ltd. in the local industry, the price of its product, "Ultra-C" has been used as a proxy for output price.

The input prices which are considered relevant to the industry other than the own price of blackcurrants are those of sugar and labour.

Income variations are assumed to affect the demand for blackcurrant juice and hence, the demand for blackcurrant fruit. As this income variable would normally be included for a consumer demand function we are, by including it in the input demand function, assuming away the significance of the wholesale and retail markets. This practice is usual in research for derived demand studies [cf. Goodwin and Sheffrin, 1982].

Again the technology factor is included to account for any shifts in the input demand curve due to productivity improvements, new technology, etc. Like that of the supply function, a linear time trend shall be used to proxy for technological improvements.

The possibility of non-competitive buying by processors of blackcurrants has been mentioned above. If this possibility is correct input demand functions would not be defined, rather there would be one profit maximising input "demand" for any given input supply function. Identification of demand behavior in this case would be difficult in that the elasticity of supply would be required as datum. To avoid this identification problem, we recall a purpose of establishing the Soft Fruit Industry Board as being to increase the competitiveness of the industry. We also point to the evidence that the Board has been using its price setting powers effectively as mentioned above. Hence, although the possibility of non-competitive behavior cannot be modelled directly, the evidence suggests that the possibility is less important in the presence of the Soft Fruit Industry Board. For the purposes of this thesis it will be assumed that the market for blackcurrants is competitive both on the side of supply and of demand.

The cobweb, adaptive expectations, and rational expectations models all use essentially the same demand function. For expository reasons, demand is expressed as a function of price and other relevant exogenous variables. The predominant reason for such a simple model of demand is that in all of the above three cases, supply behavior, more particularly the response of supply to price expectations, has been the focus of attention. Furthermore, it has been assumed in the above models that the commodity of concern was non-storable.

Blackcurrants, however, are storable through freezing. The question of modelling inventories is therefore appropriate to consider. However, due to the lack of statistical information on the quantities of stocks held in frozen form by the processors, it was not possible to model inventories. It is therefore assumed that the quantity demanded relates to requirements for both production and changes in stock levels.

The demand for Tasmanian blackcurrants then, can be expressed mathematically in logarithmic form by the equation:

$$QD_t = c_0 + c_1P_t + c_2OP_t + c_3INC_t + c_4AWE_t + c_5SUGAR_t + u_{3t}. \quad (3.57)$$

where QDt = quantity demanded at time t;
OPt = price of blackcurrant juice at time t;
INCt = national income per capita at time t;
AWEt = index of average weekly earnings at time t;
SUGARt = deflated price of sugar at time t;
U2t = stochaistic disturbance at time t.

The equilibrium condition which closes the model, will as in the traditional case, state that quantity demanded will equate quantity supplied. Due to the importation of significant quantities of blackcurrants from New Zealand during the sample period, quantity supplied will be expressed as the quantity supplied from domestic sources plus that imported from New Zealand. The equilibrium definition then is:

$$QD_t = QS_t + QM_t \quad (3.58)$$

where QMt = the quantity of imports from New Zealand at period t.

To utilise the rational expectations approach in additon to the above equations (3.53) to (3.58) forecast values for the exogenous variables must be obtained. Following Wallis (1980) first-order autoregressive forecasting equations shall be used to predict the relevant series. The complete model is given by the equations (3.53), (3.54), (3.55b), (3.56), (3.57), and (3.58) along with the values forecast for the exogenous variables. The endogenous variables are QSt, QDt, At, Yt, pt, and pt*.

Equation (3.55b) and its associated endogenous variable pt* can be eliminated from the model by solving for the reduced form equation of the price variable, pt. Taking its expectation allows, after manipulation, the derivation of a reduced for equation for expected price which may then be substituted into equation (3.53). The expected price reduced form equation is given by:

$$\begin{aligned} P_t^* = (\gamma_1 - \alpha_1 - \beta_1)\{ \alpha_0 + \beta_0 + \gamma_0 + \alpha_2 PP_t + \alpha_3 PR_t \\ + \alpha_4 T_t + \alpha_5 A_{t-1} + \beta_2 L_t^* + \beta_3 RAIN_t - \gamma_2 OP_t^* \\ - \gamma_3 INC_t - \gamma_4 AWE_t - \gamma_5 SUGAR_t + IMP_t^* \} \end{aligned} \qquad (3.59)$$

Substituting this equation in equation (3.53) yields the non-linear area function:

$$\begin{aligned} A_t = \alpha_0 + \alpha_1 \{ (\gamma_1 - \alpha_1 - \beta_1)^{-1} (\alpha_0 + \beta_0 + \gamma_0 + \alpha_2 PP_t + \alpha_3 PR_t + \alpha_4 T_t \\ + \alpha_5 A_{t-1} + \beta_2 L_t^* + \beta_3 RAIN_t - \gamma_2 OP_t^* - \gamma_3 INC_t^* - \gamma_4 AWE_t^* - \gamma_5 SUGAR_t \\ + IMP_t^*)\} + \alpha_2 PP_t + \alpha_3 PR_t + \alpha_4 T_t + \alpha_5 A_{t-1} + u_{1t} \end{aligned} \qquad (3.60)$$

The complete model of 5 equations is given by the equations (3.60), (3.54), (3.56), (3.57), and (3.58) again along with the forecast values of the exogenous variables. The endogenous variables are now QDt, QSt, At, Yt, and pt.

To utilise the adaptive expectations approach the unobservable variable pt* must be eliminated. Rearranging (3.53):

$$P_t = \frac{\alpha_0}{\alpha_1} - \frac{1}{\alpha_1}A_t + \frac{\alpha_2}{\alpha_1}PP_t + \frac{\alpha_3}{\alpha_1}PR_t + \frac{\alpha_4}{\alpha_1}T_t + \frac{\alpha_5}{\alpha_1}A_{t-1} + \frac{1}{\alpha_1}u_{1t} \quad (3.61)$$

Lagging (3.61) by one period yields:

$$P_{t-1} = \frac{\alpha_0}{\alpha_1} - \frac{1}{\alpha_1}A_{t-1} + \frac{\alpha_2}{\alpha_1}PP_{t-1} + \frac{\alpha_3}{\alpha_1}PR_{t-1} + \frac{\alpha_4}{\alpha_1}T_t + \frac{\alpha_5}{\alpha_1}A_{t-2} + \frac{1}{\alpha_1}u_{1t-1} \quad (3.62)$$

Substituting (3.61) and (3.62) into (3.55a), after manipulation leads to:

$$\begin{aligned} A_{t-1} = {} & (1-\lambda)\alpha_0 - ((1-\lambda)-\alpha_5)A_{t-1} + (1-\lambda)\alpha_2 PP_{t-1} + (1-\lambda)\alpha_3 PR_{t-1} \\ & + (1-\lambda)\alpha_4 T_t + (1-\lambda)\alpha_5 A_{t-2} + \lambda P_{t-1} - \alpha_2 PP_t - \alpha_3 PR_t - \alpha_4 T_t \\ & - u_{1t} - (1-\lambda)u_{1t-1} \end{aligned} \quad (3.63)$$

Again, one equation and one endogenous variable (pt*) has been eliminated from the model. The adaptive expectations model, then, is expressed by the equations (3.63), (3.54), (3.56), (3.57), and (3.58). The endogenous variables are At, Yt, QSt, QDt, and pt.

An alternative to the full information extimation of a model using the rational expectations hypothesis has been outlined by Sheffrin (1982) based on the work of McCallum (1976), who adopted an instrumental variables approach to estimation of the parameters of a single equation in a partial equilibrium market model.

Under the assumption of rational expectations, the difference between the expected price and the true price can only differ by a random element uncorrelated with the information available when the expectation was formed, that is:

$$P_t = {}_{t-1}P_t^* + \phi_t \qquad (3.64)$$

Given that ϕt is uncorrelated with the information set when the expectation was formed, this implies that:

$$E(\phi | I_{t-1}) = 0 \qquad (3.65)$$

and hence,

$$E(P_t) = {}_{t-1}P_t^* \qquad (3.66)$$

Substituting (3.64) into the supply function allows the rational expectation hypothesis to enter giving:

$$Q_t^S = c + dP_t + fX_t + (u_{2t} - d\phi_t). \qquad (3.67)$$

Clearly the error term is correlated with pt in which case applying OLS will not yield consistent estimates of the parameters. An instrumental variable estimateor will yield consistent estimates, however. Choice of appropriate instruments will allow the construction of a "first stage" forecast of pt*, which may then be substituted for pt in equation (3.67).

McCallum (1976) utilised various combinations of variables in constructing his "instrument." The seven options he outlined included:

1. using all predetermined variables for the entire system as instruments;
2. in addition to all predetermined variables for the system adding lagged values of those variables which had the greatest explanatory power in option (1);
3. in addition to all predetermined variables for the system adding lagged values of the "expectations" variable;
4. using current and lagged values of all predetermined variables in the entire system;
5. using the "expectations" variable as its own instrument;
6. using only those predetermined variables which enter the system with lags as instruments;
7. using only those predetermined variables which enter the system with lags, along with lagged values of the "expectations" variable.

Sheffrin points out that advantages of the limited information approach include the simplicity of application as compared to that of a full-information maximum likelihood estimation of an entire model. Furthermore, the limited information technique allows the examination of one equation without being overly concerned with the specification of the other equations in the model. However, a draw back of the approach is that as a limited information technique, the resulting estimates would not be as efficient as those obtained via a full information maximum likelihood estimator. A further draw back to the use of the instrumental variables estimator is that the rational expectations hypothesis cannot be explicitely tested.

CHAPTER IV

DATA

4.1 Introduction

Having outlined the modelling approach for this thesis in the previous chapter, it is now necessary to consider the data requirements of the proposed model. The first section of this chapter shall survey the published data available for the blackcurrant industry in Tasmania. The second section of this chapter shall assess the data requirements in light of the requirements of the proposed model.

4.2 Available Statistical Information

The data surveyed in this section shall be included in Appendix 2.

4.2.1 Total Production of Blackcurrants in Tasmania.

Annual time-series data for this variable are published by the Australian Bureau of Statistics (ABS) in 'Fruit: Tasmania' for the picking season of November to February. The production tonnage includes red currants; however, the quantities of this variety are small. Thus, no attempt was make to exclude the production. This series is assumed to reflect supply to fresh and processing markets.

4.2.2 Yield per Bearing Hectare.

Annual time series data for this variable are published by the ABS in 'Fruit: Tasmania'. Relevant comments made in (3.2.1) above apply to this variable as well. This variable is obtained by dividing total production by bearing area. This series is used as the dependent variable in the yield function of the supply response model.

4.2.3 Own Price of Blackcurrants.

Annual time series data for this variable are derived from data published by ABS in 'Fruit: Tasmania'. Gross value of blackcurrants obtained therein is divided by total production (cf. (3.2.1) above) to obtain the required series. This data represents the 'farm gate' price paid to growers and includes any bounty paid.

4.2.4 Processed Production

Annual time series data for this variable are obtained from the Tasmanian Soft Fruit Industry Board (SFIB) annual reports. Quantities refer to blackcurrants only. This series is assumed to reflect demand by processors. The fresh market is excluded from SFIB jurisdiction.

4.2.5. Imports of Frozen Blackcurrants.

Annual time series data for this variable are obtained from the SFIB for the picking season November to February. The data refer to imports from New Zealand, the principle source of residual demand by Tasmanian processors.

4.2.6. New Zealand Price of Frozen Blackcurrants.

Annual time series data for this variable are derived from SFIB figures, being the value of exports, divided by the quantities of exports. The price is quoted in $NZ per kilogram at f.o.b. values. Ideally, the price would need to be in c.i.f. terms for comparative purposes.

4.2.7. New Zealand/Australian Exchange Rate.

Annual time series data for this variable are derived from the bulletin of the New Zealand Reserve Bank. The annual data are derived by taking the arithmetic mean of the four quarterly values ending March of each particular year.

4.2.8. Costs of Production.

The annual series of costs of production used was 'the Index of Total Prices Paid by Farmers, Australia' published by the Bureau of Agricultural Economics (BAE) in its "Quarterly Review of the Rural Economy". The Index measures the change in costs of labour, services, overheads, marketing expenses, equipment, and supplies. It is assumed that this series is indicative of factor prices faced by producers of blackcurrants in Tasmania.

4.2.9. Time Trend.

A time trend was specified as a proxy for technological change throughout the sample period. The initial value of the trend was set to one and incremented by one, annually.

4.2.10. Alternative Return To Production.

The annual series of alternative returns used was the 'Index of Prices Received by Farmers, Australia' published by the BAE in its "Quarterly Review of the Rural Economy". The index measures the change in prices received for various produce. It is assumed that this series can be used as a proxy for relative returns in alternative markets.

4.2.11. Index of Inflation.

Two alternative measures of inflation in annual terms are available from the ABS, the popular 'Consumer Price Index' (CPI) and the Price Deflator of Gross Domestic Product. Of the two, the CPI could be perhaps more relevant, as CPI figures are published for Hobart as distinct from a "national" measure implied by the GDP Deflator or even the national CPI figure, at least for the purpose of supply deflating. For the purpose of demand deflating, the GDP deflator or national CPI would be more relevant.

4.2.12 Stock Levels

No quantitative data was available for the level of block-frozen blackcurrants held by the major processors from any source. Processors were unwilling to reveal quantities of stocks either in absolute or relative terms, due to corporate requirements of confidentiality. A personal communication with a major processor did allow the construction of a qualitative, or dummy, variable. In this communication an informed opinion was given concerning the state of stock levels for the entire duration of the study. Consequently, the qualitative variable was constructed whereby a value of zero represented a year in which excessively high stocks were held by processors, while a value of unity represented normal stock levels. The assignment of zero to represent high stocks was chosen as to reflect the depressing effect excess stock would have on price and quantity demanded.

4.2.13 Blackcurrant Juice Price Series

The data for this series was derived from a survey of advertisements in the local Hobart newspaper, the Mercury, over the period 1963 to 1983. The sampling procedure used involved a visual search of the Wednesday edition of each week in the sample period. Wednesday was chosen due to the volume of supermarket advertisements in this edition relative to other days in the week.

Price data was collected on proprietary brand names including Cascade's "Ultra-C", Anchor Food's "Blackcurrant Juice", Beecham's "Ribena", and other generic or house brands. Data recorded also included the date of the advertisement, the advertising supermarket or store, and the unit size of the product.

The price series was then constructed by taking the arithmetic mean of each product over each year. Due to discontinuities in the product range and the lack of data on market shares for each product it was decided that the Cascade Ultra-C price series would be used as the proxy for finished goods price in estimating the demand function. This assumption doesn't seem untenable given the dominance of the market by Cascade in all but the last few years.

4.2.14 Orange Juice Price Series

The data for this series was derived in the survey mentioned above for the blackcurrant juice price series. Price data was collected for proprietary brands such as "Valencio", "Orchy", "Mr. Juicy", "Berri", and "Huon Vale". Again the data recorded the date of the advertisement, the advertising supermarket or store, and the unit size of the product. Again discontinuities were present with the addition of new brands and deletion of older brands. In the case of orange juice an average price per litre was constructed by calculating the price per litre based on the advertised price. These resulting prices were averaged over all products for the year, giving the average annual price used.

4.2.15 Average Weekly Earnings

Data for this series was obtained from various editions of the ABS publication "Wages." The series was used in estimating the yield function as a proxy for the costs of inputs into the production process for blackcurrants. The series was also to be used to proxy for the costs of the production of blackcurrant juice in the demand function. The average weekly earnings data relates to Australia as a whole, rather than only Tasmania.

4.2.16 Sugar Price

Data for this series was obtained from a private communication with Colonial Sugar Refiners Ltd. (CSR). The series, as was the case for average weekly earnings, was to be used to represent an alternate input into the production of blackcurrant juice. Due to the institutional constraints placed on the domestic marketing of sugar in Australia, this sugar price reflects the cost of sugar in any capital city in Australia. It is therefore considered that the series would be valid for blackcurrant juice production in Hobart. A differential price for other centres would reflect transportation costs. This would not seem to be a problem for the present case, as the majority of blackcurrant juice is processed in Hobart.

4.2.17 Area under Cultivation

Annual time series data for this variable are published by the ABS in "Fruit: Tasmania" for the picking season of November to February. The area includes red currants as well as blackcurrants. Relevant comments made in (3.2.1) above apply to this variable as well. This variable has been used as the dependent variable in the area equation of the supply response function. This variable is used to reflect producers' desired supply, as farmers have control over the area planted, but little control over yields, together which determine the quantity of output produced.

4.2.18 Rainfall Index

This series has been obtained from the A.B.S. publication Yearbook: Tasmania, in various editions. The series for rainfall is the average annual rainfall recorded in millimeters for the Huon Valley area of Tasmania, and is to be used as the weather proxy in the yield equation of the supply response model.

4.2.19 Gross Domestic Product per Capita

This series has been obtained from the A.B.S. publication Yearbook, Australia, in various editions. This series is used as the consumer income variable in the demand function for blackcurrants. The series "Gross Domestic Product" was divided by the "Population Estimates" to obtain the required series.

4.3 Assessment of Available Statistical Information

The purpose of this section is to assess the usefulness of the data outlined in the previous section of this chapter. Modifications required will also be discussed. This assessment will be based upon the model developed in Chapter Three, and shall be presented in an equation by equation fashion.

4.3.1 Area Function

The area function [cf. equation (3.53), supra.] has as its dependent variable area under cultivation. As mentioned in the preceding section, the variable which the blackcurrant producer has the most control over in a decision-making sense is his level of plantings. Area under cultivation, then, must include area which is currently being harvested and area which has been planted, but which is not yet to the "bearing" stage. The dependent variable used in the area equation has been constructed as the sum of bearing and non-bearing area from A.B.S. statistics.

The price expectations variable for use in the area function depends upon the hypothesis employed for that particular model. For the adaptive expectations model, price is given as a geometrically-declining weighted average of past prices. For the rational expectations model, expected price is the price which is expected given the structure of the supply/demand model. The modelling technique takes care of the proper form of the price variable; however, irregardless of which hypothesis is used, the price referred to in theory is real price. Hence, it is appropriate to deflate price. The Hobart C.P.I. was used to deflate price for the supply model.

The proxy variable for costs of production is given by the B.A.E. index of prices paid by farmers. This index is derived as a weighted average of prices paid by farmers in a particular sample of production. Costs include labour, services, overheads, marketing expenses, equipment, and supplies. Production costs would have to be weighted similarly in the blackcurrant industry for this index to be strictly comparable. However, as no alternative series of cost data is available for the blackcurrant industry, it is assumed that the B.A.E. series will be a reasonable proxy. The index, again, is in nominal terms and so should be deflated as for the price variable.

The proxy variable for alternative products prices is given by the B.A.E. index of prices recieved by farmers. Again, the index is a weighted average of various prices, of which all must be viable alternatives to blackcurrant production for the index to be strictly valid as measuring alternatives. A different approach to using this index would be to include specific product prices as alternatives. For blackcurrants, alternatives such as raspberries or loganberries might be appropriate. However, as production of blackcurrants has moved towards large-scale plantations using less-hilly terrain, the alternatives to blackcurrant production must have grown. Therefore, the B.A.E. index was used as a proxy for alternative returns. As for the index of prices paid, the index of prices received is in nominal terms and so should be deflated before use in the regression analyses.

As mentioned in the preceding section, a time trend has been added to proxy for technological change. The addition of a linear trend will de-trend the other independent variables in a regression. In this sense, the inclusion of a this variable picks up any persistent trend in the data which is assumed to be caused by technological advances.

4.3.2 Yield Function

The yield function has been specified to capture the short-run impact of price and other variables on the supply of blackcurrants, that is the actual harvest in a particular season. The independent variable is production per bearing hectare. Non-bearing area is excluded, as production is not yet obtainable from this area.

Again, as for the area function, real price is the variable of concern. Thus, nominal price is again deflated by the Hobart C.P.I. No expectations framework is required, as the price affecting the harvest of blackcurrants is announced by the Soft Fruit Industry Board prior to the beginning of harvesting.

The weather proxy variable is an attempt to account for the influence of weather on the dependent variable. As mentioned above, rainfall is the major aspect of climatic conditions which affects the production of blackcurrants. Several approaches for the treatment of weather effects on agricultural production have been surveyed by Mules (1972), of which the above is included. Mules commented that the above approach can yield fruiful results but rejected it when production was spread over a wide area with diverse weather conditions. However, because the production of blackcurrants is confined for the most part to a few areas in southern Tasmania, it is felt that using average rainfall data for the Huon Valley would be an appropriate proxy for rainfall as it affects the production of blackcurrants.

The labour variable is included in the yield function to capture the effect of harvesting costs in the production of blackcurrants. According to the Tasmanian Department of

Agriculture, the single-most costly component of harvesting is labour associated costs, especially for those plantations not using mechanical harvestors. Ideally, a time series of casual picking rates would be required. However, as this data is not available, a proxy again had to be chosen. In this case the A.B.S. published series "Average Weekly Earnings per Employed Male Unit-Hobart" was chosen to represent labour rates. It is assumed that relative movements in this series reflect movements in the casual farm labour rates.

4.3.3 Demand Function

The demand function [cf. equation (3.57), supra.] has as its dependent variable annual quantity of blackcurrants produced. The series was constructed as a composite of data from the Soft Fruit Industry Board (Processed Production) after 1972, and from the A.B.S. (Total Production of Blackcurrants in Tasmania) prior to 1972. Thus, the function shall be measuring the demand for domestic blackcurrants to be used in the production of consumer goods. As has been mentioned elsewhere in this thesis, the demand is a derived one. Furthermore, using this series to reflect demand by the processors does not allow for the separation of demand into components for production and inventories. Thus the demand function modelled shall be demand for both production and inventory requirements.

The own price of blackcurrants in the demand function again is real price per tonne. An expectations formulation has not been assumed for demand, as the hypotheses of price expectations are only being modelled on the supply side. Although it seems reasonable that processors would form expectations about prices and take these expectations into account in formulating their demands for a particular season, it is doubtful that these expectations are formed in the same fashion as the expectations of the producers, which is implied by the rational expectations hypothesis.

The price of blackcurrant juice has been added to the demand equation to capture the effects of the consumer product market. Again, juice is the major product use for blackcurrants. The price variable for blackcurrant juice has been constructed from a survey of newspaper advertisements. As Cascade Cordials is the predominant processor, its product's price has been used as the proxy for output price. The variable has been expressed in real terms by dflating it using the Hobart C.P.I. Ideally, information would be available giving the prices for various blackcurrant products, market shares, and profit margins which would allow the construction of a weighted average price series for blackcurrant consumer products, or the separate treatment of demand for each product group. Much of this information is unpublished or unobtainable from any source. Hence, the adoption of the newspaper series is the best, and perhaps only, alternative.

The price series for alternative inputs into the production of blackcurrant products include sugar and labour. The sugar price series has been obtained from C.S.R. Ltd. as the price of sugar in any Australian capital city. This series would, ideally, be weighted by the proportion sugar is used in blackcurrant products. As this proportion is not known with certainty it is assumed that the proportion has remained constant over the sample period. Thus the sugar price in real terms has entered the analysis with weights. Similarly, the real price of labour (Average Weekly Earnings per Employed Male Unit-Hobart) has entered the analysis without weight assuming that labour productivity has remained constant throughout the sample period.

The time series for real gross domestic product per capita again reflects the market conditions for blackcurrant products, that is the effect of consumers' income on the demand for blackcurrant products. This series is the widest possible interpretation of national "income" including wages and salaries, gross operating surplus, indirect taxes, and subsidies.

CHAPTER V

EMPIRICAL RESULTS

5.1 Introduction

In this chapter, we will discuss the results of estimating the parameters of the model for the Tasmanian blackcurrant industry based upon the data described in the previous chapter. Before presenting the regression results some preliminaries will be discussed in this introductory section. These relate to problems encountered in estimating the demand function, estimation methods used, the statistical problems encountered, the test statistics used, and alternative hypothesis employed.

As mentioned above, the traditional model of demand assumes that quantity demanded is a function of price and other variables. This was the working hypothesis for the Tasmanian blackcurrant industry from the beginning of this study. However, after successive attempts to model the demand function failed to achieve significant estimates of the coefficient of own price, an alternative hypothesis was proposed, that being that the demand for Tasmanian blackcurrants was infinitely elastic. In this case, the simultaneous nature of supply and demand collapses into a recursive model whereby price determines quantity supplied.

The hypothesis of an infinitely elastic demand can be justified by three observations. Firstly, we recall that under the SFIB regime Cascade established long-term contracts for the purchase of blackcurrants. Among the terms and conditions of these contracts was stipulated that Cascade would purchase all quantities produced under contract, at the ruling SFIB price.

Secondly, the size of the Tasmanian industry is relatively small compared with that of the major producing countries of the world. Although complete statistics on a world-wide basis are not published, the relative size of the Tasmanian industry can be seen by comparison of data in Tables 6, 7, and 8 above.

Finally, empirical observation suggests an infinitely elastic demand for Tasmanian blackcurrants. A scatter diagram of real price and quantity pairs is suggestive of no relationship between price and quantity, as shown in Figure 2.

Given the assumption of an infinitely elastic demand function, the market model can be represented by the supply function alone. However, in this study, the supply component of the blackcurrant model is disaggregated into an area function, a yield function, and an identity defining supply as the product of area and yield, that is equations (3.53), (3.54), and (3.56).

Turn now to a consideration of some statistical questions. To begin with, all equations were estimated by single equation methods, either ordinary least squares (OLS) or instrumental variables (IV) techniques. Since estimation is of the components

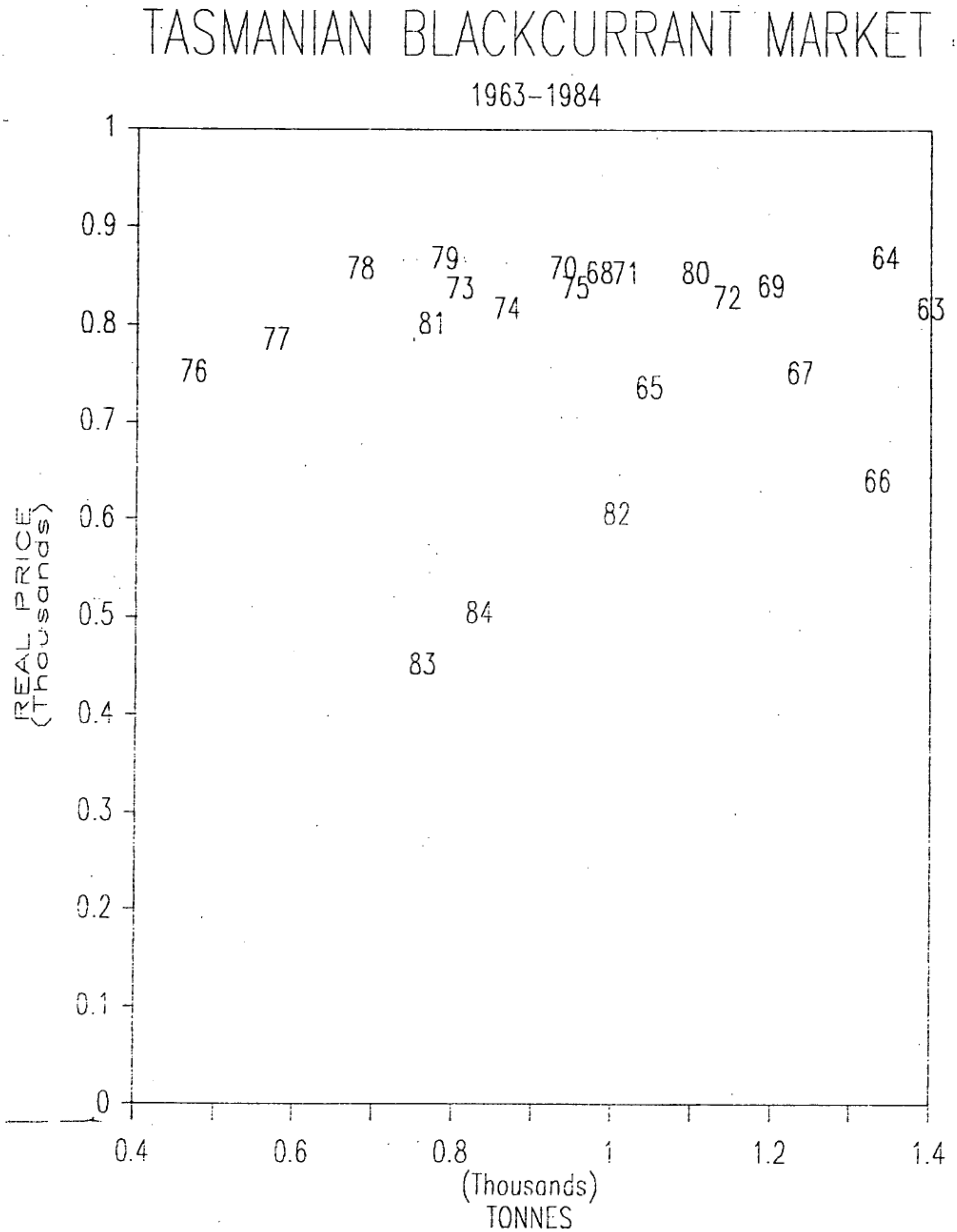

FIGURE II: REAL PRICE VS. QUANTITY

of a market model which is assumed to be recursive, the OLS estimates will be unbiased and consistent. In this study the relative simplicity of using single equation techniques which are unbiased and consistent counters any other advantages associated with more complex methods, such as three stage least squares or full information maximum likelihood techniques.

Secondly, the test statistics used should be identified at this point. The statistics presented with each equation in this chapter are $\bar{R}2$, the t-ratio for each estimated coefficient, and the Durbin-Watson statistic. For equations estimated with lagged dependent variables on the right-hand-side, the Durbin-Watson statistic is inappropriate to test for the presence of first-order serial correlation in the residuals. In this case Durbin's h statistic is presented. In selecting a preferred equation, four criteria have been used:

a. a good tracking performance as given by the adjusted coefficient of multiple determination ($\bar{R}2$) close to its upper limit of unity;

b. individual parameter estimates which are statistically significant at the 5 percent level, as given by the standard t-test;

c. a lack of serial correlation of the disturbance term at the 5 percent level, as given by the Durbin-Watson statistic (or the Durbin h statistic, if appropriate);

d. individual parameter estimates which are consistent with theory and other relevant prior information.

Furthermore, it should be noted that the problem of multicollinearity was encountered in many equations, as is often the case in empirical examinations based on time series data, especially where current and lagged values of the same variable appear in the same equation. Multicollinearity is a data problem of which there are no clear-cut solutions. Alternatives do exist for treating multicollinearity, including expanding or improving the data set, removing one of the offending variables, or changing the functional form of the equation. Where the parameter estimates are to be used in a structural analysis, the multicollinearity problem is quite serious as multicollinearity makes OLS estimates rather imprecise. On the other hand, if the estimated model were to be used for forecasting, the multicollinearity problem would not be as serious, as predictions would be based on the multicollinearity continuing into the future. In this study multicollinearity was treated by experimentation with alternative variables where possible. Where no improvement was found, one of the offending variables was deleted from the equation.

Finally, as pointed out above [cf. p.58, <u>supra.</u>] it has been perceived as desirable to model the Tasmanian blackcurrant industry using two alternative hypotheses about the formulation of price expectations, that is, the adaptive expectations hypothesis of Nerlove (1958) and the rational expectations hypothesis of Muth (1961). Due to the problems encountered in estimation of the demand function as mentioned above, it was assumed that the model for the blackcurrant industry was recursive rather than simultaneous. In this case it was decided to estimate the model using single equation methods rather than the systems methods with which the rational expectations hypothesis have traditionally been estimated with. Again, as mentioned in Chapter Three, McCallum (1976) has outlined an approach to the estimation of the parameters of a single equation in a rational expectations context using an instrumental variables (IV) estimator. A similar approach was used in estimating the parameters for the Tasmanian blackcurrant model under the hypothesis of rational expectations.

5.2 Prior Expectations

In this section the a priori expectations of the various coefficients will be discussed, equation by equation.

5.2.1. Area

Supply theory suggests that a direct relationship exists between price received and quantity supplied. The coefficient of the price expectations variable, RP, is expected to be positive.

An inverse relationship is suggested between supply and costs of production. The coefficient of the proxy variable for the costs of inputs into the production of blackcurrants (PP), is expected to be negative.

The coefficient of the alternative product prices proxy variable (PR) is ambiguous as alternatives could be either complements or substitutes for blackcurrants. In the case of substitutes, there would be an inverse relationship implying that as the price of alternative products rose, the producer would reduce production of blackcurrants. In the case of complements, a direct relationship would be expected. However, as the B.A.E. index of Prices Received by Farmers is used as this proxy variable it is expected that the composition of the index will be predominantly substitutes. Hence it is expected that this coefficient shall be negative.

The coefficient of the time trend (T) is expected to be positive. This expectation is based on the idea that technological improvements will occur in a linear fashion over the sample period. However, this variable may catch any persistent trend in area which could not be explained by any other independent variable.

The coefficient of the lagged dependent variable (AREA(-1)) is also expected to be positive. For perennial products production levels in any given year are usually associated with their levels in the previous year.

5.2.2. Yield

Again the price received for a product is expected to be directly related to the quantity supplied. The dependent variable in the equation is quantity supplied per hectare and therefore reflects the harvesting decisions of the producer. High prices should, cet. par., lead to high yields. The coefficient of price is expected to be positive.

The coefficient of the harvesting labour proxy variable, like that of the costs of production variable in the area equation, is expected to be negative. High picking costs would tend to depress the harvested yield.

The coefficient of the rainfall proxy is expected to be positive. As pointed out above, rainfall provides frost protection as well as providing essential nutrients and moisture.

5.3 Estimated Area Functions

In this section estimates of the area function shall be presented and discussed for both the adaptive expectations hypothesis and the rational expectations hypothesis. A comparison of the results will be presented in the conclusion to this chapter.

5.3.1 Adaptive Expectations Hypothesis

In applying the adaptive expectations hypothesis to the supply response model, various formulations of expectations were experimented with. To begin with, the standard adaptive expectations mechanism (equation (3.55a)) was used. However, this lead to a rather poor result with the signs of the estimated parameters different from prior expectations and with relatively large standard errors compared to the estimates. Table 9 illustrates the estimates of the parameters using the standard adaptive expectations mechanism.

Two modifications to the standard adaptive expectations mechanism were then experimented with. Firstly, it was assumed that the geometrically declining distributed lag should not begin with the current period, but should begin at some discrete point in the past, suggesting a gestation period. In the case of blackcurrants, it was assumed that due to the four year gestation lag, it would be appropriate to begin the geometric lag in period (t-4). The form of the price expectations variable, then, is given by:

$$P_t^* = (1-b) \sum_{i=1}^{\infty} b^i P_{t-4-i} \qquad 0<b\leq 1.$$

Table 10 illustrates the estimates of the parameters using the parameters using the "delayed formulation of the adaptive expectations hypothesis. Again, as was the case with the standard form, the criteria for selection of a preferred equation is not well satisfied using this form. Few, if any, of the the parameter estimates are significantly different from zero based on the t-test, $\bar{R}^2$ values are relatively low, and Durbin's h statistic indicates the presence of first-order serial correlation in the residuals. It can be assumed, then, that this autocorrelation is due to use of an incorrect functional form.

The second modification to the standard adaptive expectations hypothesis derives from the notion of a finite length on the distributed lag. The geometrically declining lag is truncated at some discrete point in time, implying that after this point, the producer disregards completely any further past prices in formulating his current expectation of price. The form of the price expectation variable, then, is given by:

$$P_t^* = (1-b) \sum_{i=0}^{\infty} b^i P_{t-1-i} \qquad 0<b\leq 1.$$

Table 11 illustrates the estimates of the parameters using the truncated lag functional form of the adaptive expectations hypothesis. Compared to the earlier results presented using other forms of the adaptive expectations hypothesis, the truncated lag form is by far the preferred form. Reasonable tracking performance is evident by $\bar{R}^2$ values greater than .70. The signs of the estimated parameters are in most cases consistent

TABLE 9

STANDARD ADAPTIVE EXPECTATIONS

AREA FUNCTION

EQN	CONSTANT	RP (-1)	PP (-1)	PR (-1)	AREA (-1)	AREA (-2)	T	R2	DW(h)
5.1	316.784	.1318	-1.051	.0125	.3883	.1641	7.5161	.4780	0.0660
	(1.572)	(1.8781)	(1.7849)	(.0488)	(1.3046)	(.4993)	(2.3330)		
5.2	81.8045	.0677	.0339	-.0002	.8033	-.3074		.2847	-1.3132
	(.4003)	(.8957)	(.8082)	(.0007)	(2.8756)	(1.0133)			
5.3	322.4070	.1326	-1.0653		.3915	.1699	7.5128	.5213	-0.0952
	(2.0346)	(2.0206	(2.1711)		(1.0476)	(.5804	(2.4359)		
5.4	81.7023	.0677	.0342		.8033	-.3075		.3397	-1.8176
	(.5616)	(.9614)	(.1512)		(3.0965)	(1.2033)			
5.5	15.0219	.0930		.2371	.5461	-.2129	2.9745	.3829	-0.4716
	(.1259)	(1.2819)		(.9811)	(1.7673)	(.7779)	(1.3844)		
5.6	95.5101	.0677		-.0201	.8113	-.2995		.3394	-2.3059
	(.8860)	(.9321)		(.1260)	(3.2334)	(1.0861)			

NOTES:

Figures in parentheses are t-statistics.

Durbin's h statistic is given by DW(h).

Sample period is 1967-1984 in annual terms.

TABLE 10

DELAYED ADAPTIVE EXPECTATIONS

AREA FUNCTION

EQN	CONSTANT	RP (-4)	PP (-4)	PR (-4)	AREA (-1)	AREA (-2)	T	R2	DW(h)
5.7	226.3622	.0353	.3334	-.3191	.5298	-.3572	-2.5640	.3390	0.0660
	(0.788)	(0.2632)	(0.679)	(1.1214)	(1.5054	(1.4523)	(1.0761)		
5.8	330.4216	-.0112	-.0194	-.2593	.5434	-.3341		.3303	-1.3132
	(1.2136)	(.0877)	(.0527)	(.9230)	(1.5349)	(1.3546)			
5.9	22.9119	.0612	0.5602		.7765	-.4640	-2.0422	.3248	-0.0952
	(0.1246)	(.4506)	(1.2388)		(2.7970)	(2.0238)	(0.8647)		
5.10	101.9444	.0178	.2328		.7495	-.4282		.3379	-1.8176
	(.9044)	(.1450)	(.9504)		(2.7437)	(1.9178)			
5.11	386.7628	.0057		-.3987	.4824	-.3241	1.4838	.3687	-0.4716
	(2.4217)	(.0458)		(1.5732)	(1.5732)	(1.3755)	(0.8560)		
5.12	318.1938	-.0102		-.2483	.5489	-.3366		.3817	-2.3059
	(2.3270)	(.0838)		(1.3737)	(1.6910)	(1.4463)			

NOTES:

Figures in parentheses are t-statistics.

Durbin's h statistic is given by DW(h).

Sample period is 1967-1984 in annual terms.

TABLE 11

TRUNCATED ADAPTIVE EXPECTATIONS

AREA FUNCTION

EQN	CONSTANT	RP (-1)	PP (-1)	PR (-1)	AREA (-1)	T	R2	DW(h)
5.13	-88.1912 (.3822)	.3639 (2.6533)	-0.3285 (0.5709)	.1709 .7044)	.6349 (3.9843)	3.0731 (1.1429)	.7175	-0.1999
5.14	-247.446 (1.3327)	.3874 (2.8301)	.2188 (.6797)	.1860 (.7606)	.5413 (3.9227)		.7121	0.7264
5.15	16.1892 (0.0930)	.3684 (2.7332)	-0.5354 (1.0997)		.6944 (5.2225)	3.1764 (1.2022)	.7264	-0.2997
5.16	-139.3350 (1.1812)	.3932 (2.9139)	.0130 (.0757)		.6028 (5.4609)		.7193	-0.4954
5.17	206.630 (2.0887)	.3765 (2.8424)		.2416) (1.1833)	.5761 (4.8417)	1.7952 (1.2308)	.7294	0.2072
5.18	-134.232 (1.6626)	.3812 (2.8362		.0463 (.3550)	.5844 (4.8470)		.7212	0.6345

<u>NOTES</u>:

Figures in parentheses are t-statistics.

Durbin's h statistic is given by DW(h).

Sample period is 1967-1984 in annual terms.

with prior expectations. In general, the t-statistics support the hypothesis that the parameters are different from zero at the 5 percent level of significance. Durbin's h statistic also indicates the lack of serial correlation at the 5 percent level of significance.

There appears to be a problem of multicollinearity between the alternate product prices index (PRt) and the cost index (PPt). By excluding one of these two variables and reestimating the equation, $\bar{R}^2$ values are not greatly affected, while the t-statistic is increased significantly. This test of multicollinearity should lead one to exclude one of the offending variables from the regression. However, as multicollinearity is a sample data problem only and is normally encountered in empirical research when time series data is used, it is felt that the theory should prevail. Theory in this case posits that both the cost variable and the alternative products price variable should be included in the preferred equation. The preferred equation, then, for the adaptive expectations hypothesis area function is given by:

$$(5.13)\quad AREA_t = \underset{(0.3822)}{-88.1912} + \underset{(2.6533)}{.3639(RPt)} - \underset{(.5709)}{.3285(PPt)} + \underset{(.7044)}{.1709(PRt)}$$

$$+ \underset{(3.9843)}{0.6349(AREAt-1)} + \underset{(1.1429)}{3.0731(Tt)}$$

$\bar{R}^2 = 0.7175$

$h = -.1999$

$n = 21$

Based on the above preferred equation, the price elasticity of area can be derived. Similarly to the derivation shown above [cf. p.51, supra.] the long-run elasticity can be calculated as:

$$b = \frac{e}{1 - f},$$

where e is the estimated short-run price elasticity and f is the estimated coefficient of the lagged dependent variable. The short-run elasticity when evaluated at sample means is 0.7547, while the long-run elasticity is 2.0671. The estimated elasticities are consistent with prior expectations in that it is usually assumed that agricultural production will be price inelastic in the short-run but elastic in the long-run. These estimates are significantly different from those obtained by Jones (1961,1962) in his study of the blackcurrant industry in the United Kingdom, where the short-run price elasticity of area was found to be .29, while the long-run elasticity was 1.16.

Estimating the area function with equation (3.53) implies that either the coefficient of adjustment (Jones' "r") or the coefficient of expectations (Jones' "k") is equal to unity. As was pointed out by Jones [cf. p.50, <u>supra.</u>] it was thought improbable that either of these coefficients could be set equal to unity <u>a priori</u>. for the United Kingdom blackcurrant industry. However, Jones did estimate this equation for his study with the knowledge that doing so would upwardly bias the estimated parameters. But as Jones noted if either r or k were close to unity, the bias would be reduced.

<u>5.3.2 Rational Expectations Hypothesis</u>

Single equation estimation of the area function expressed as equation (3.53) using the rational expectations hypothesis has been performed following the technique outlined above [cf. p.67, supra.]. The various options experimented with in constructing instrumental variable estimators shall now be discussed. The estimations were obtained using a instrumental variables option with correction for first-order autocorrelation. Table 12 lists the combination of variables used as instruments in each of these regressions. The results of these estimations are shown in Table 13.

To begin with the area function was estimated using all predetermined variables in the supply model as instruments. The resulting estimates are reasonable, based upon the usual criteria. The estimates are, in general, of the correct sign and have t-statistics which indicate significance from zero. The adjusted coefficient of multiple determination is reasonably close to one.

The second option in constructing the instrumental variables estimator adds the lagged variable which has the greatest explanatory power in the first option to the list of instruments. In the present case lagged area was the most significant variable in the first option, so was lagged one period further and added to the list of instruments. Little change was noted in this option compared to the first.

The third option added the lagged "expectations" variable to the instruments, that is, lagged real price. Once again, little change was noted compared to earlier options.

The fourth option included lagged and unlagged values of all of the predetermined variables in the supply system as instruments. Once again, parameter estimates did not alter significantly.

The fifth option was using the expectations variable alone as its own instrument. This option is identical to estimating equation (3.53) using OLS. In this option, the estimated parameter values did not change significantly.

In choosing a preferred equation for the rational expectations hypothesis it has been noted by Fair (1970) that to produce consistent estimates using instrumental variables techniques with autoregressive disturbances, it is necessary to include lagged dependent and independent variables to the list of instruments. In this case, it apprears reasonable to choose option 4 as the preferred method in estimating the rational expectations area function. The preferred equation, then is

TABLE 12

INSTRUMENTS FOR RATIONAL EXPECTATIONS AREA FUNCTION ESTIMATION

REGRESSION NO.

INSTRUMENTS	1	2	3	4	5
	C	C	C	C	C
	RP	RP	RP	RP	RP
	PP	PP	PP	PP	PP
	PR	PR	PR	PR	PR
	AREA(-1)	AREA(-1)	AREA(-1)	AREA(-1)	AREA(-1)
	Yield	YIELD	YIELD	YIELD	T
	AWE	AWE	AWE	AWE	
	T	T	T	T	
	W	W	W		
		AREA(-2)	RP(-1)	RP(-1)	
				PP(-1)	
				PR(-1)	
				AREA(-2)	
				AWE(-1)	
				T(-1)	
				W(-1)	

TABLE 13

RATIONAL EXPECTATIONS

AREA FUNCTIONS

EQN	CONSTANT	RP	PP	PR	AREA (-1)	T	R2	DW
5.19	108.8497	.1523	-.8823	.0546	.9677	7.3446	.7221	2.3479
	(.8131)	(3.7765)	(2.4057)	(.3073)	(6.5380)	(4.2609)		
5.20	109.1007	.1508	-.8799	.0615	.9612	7.3475	.7220	2.3475
	(.8143)	(3.7544)	(2.3974)	(.3479)	(6.5333)	(4.2589)		
5.21	104.1813	.1558	-.8761	.0479	.9735	7.3170	.7219	2.3667
	(.7803)	(3.9249)	(2.3905)	(.2702)	(6.5960)	(4.2480)		
5.22	128.8550	.1549	-.9489	.0402	.9790	7.6403	.7229	2.3646
	(.9882)	(3.9657)	(2.6528)	(.2393)	(6.8566)	(4.5531)		
5.23	109.9551	.1561	-.8967	.0434	.9804	7.3930	.7224	2.3617
	(.8254)	(3.8103)	(2.4328)	(.2440)	(6.4930)	(4.2525)		

NOTES:

Figures in parentheses are t-statistics.
Sample period is 1964-1984 in annual terms.

given by:

$$\text{(5.22)} \quad AREAt = \underset{(0.9882)}{128.8550} + \underset{(3.9757)}{0.1549(RPt)} - \underset{(2.6528)}{0.9489(PPt)} + \underset{(0.2393)}{0.0402(PRt)} + \underset{(6.8566)}{0.9790(AREAt)} + \underset{(4.5531)}{7.6403(T)}$$

$\bar{R}^2 = .7229$
DW = 2.3646
n = 20

Based upon this preferred equation, the price elasticity of area can be derived as done for the adaptive expectations hypothesis above [cf. p. 95, supra.]. In the case of the rational expectations hypothesis, the short-run elasticity is calculated at sample means as being 0.4017, while the long-run elasticity is calculated as being 19.1279.

5.4 Estimated Yield Function

The yield function expressed as equation (3.54) above was used as the starting point for estimation of the yield function of the supply model. As theory gave no indication as to the functional form of this equation, the linear and double logarithmic were experimented with in the empirical examination. Table 14 shows the results from this experimentation. These results indicate that the prototype yield function did not offer a good explanation of variation in observed yields. In particular, prior expectations of the signs of the coefficients were incorrect, the estimates were small compared to their standard errors, and the goodness-of-fit was rather poor. Autocorrelation was also indicated.

A labour scarcity variable was added at this stage to the regressors to reflect the possible lack of blackcurrant pickers during the sample period. Again, as the predominant area of blackcurrant production is in the Huon Valley, estimates of the labour force for this area were used as a scarcity proxy. The regressions were performed by OLS, corrected for first-order serial correlation.

A further problem encountered in the estimation of the yield function was the presence of multicollinearity between the real price and real wages variables. By excluding one of these variables from the regression, the corresponding $\bar{R}^2$ was effected very little, while the t-statistic of the remaining variable was increased significantly. Once again, it is necessary to accept the consequences of having an estimated equation exhibiting multicollinearity.

Adding the labour scarcity variable improved the statistical precision of the estimates. The over-all fit of the estimates improved. The t-statistics indicated that the estimated coefficient of the cost variable and the labour scarcity variable were significantly different from zero at the usual level of significance. However, the estimated coefficients for the real price and rainfall variables were not significantly different from zero, as given by their t-statistics. Theory has indicated that these variables should be included in the yield equation, however. Again it is presumed that the lack of significance from zero of the real price variable is due to the multicollinearity problem mentioned above. It is presumed that the insignificance from zero of the rainfall variable is due to the quality of the time series for rainfall.

The preferred estimated equation for yield, given the above qualifications is:

TABLE 14

YIELD FUNCTION

EQN	CONSTANT	PRICE	AWE	RAIN	POPN	TIME	$\bar{R}^2$	DW
5.24	437.8318	.2392	-2.5849	-.3753	-40.2229		.9901	2.5164
	(4.7924)	(.9941)	(4.5042)	(1.3851)	(4.5105)			
5.25	472.5774	.5533		-.3405	-44.9998	-.6387	.9847	2.4276
	(3.7588)	(1.9251)		(.9474)	(3.6464)	(2.9382)		
5.26	385.6596	-.0013	-4.9089	-.3203	-34.0140	.6973	.9782	2.3091
	(3.7798)	(.0045)	(2.9006)	(1.2382)	(3.3019)	(1.4232)		
5.27	408.3003	-.0669	-5.3160		-36.2015	.8422	.6900	2.0549
	(3.5473)	(.2122)	(3.2316)		(3.1532)	(1.7413)		

NOTES:

Figures in parenthesis are t-statistics

Durbin-Watson statistic is given by DW.

Sample period is 1967-83 in annual terms

$$(5.24)\ YIELDt = \underset{(4.7924)}{437.8318} + \underset{(.9941)}{.2392}\ (RPt) - \underset{(4.5042)}{2.5849}\ (AWEt) - \underset{(1.3851)}{.3753}\ (RAINt) - \underset{(4.5105)}{40.2229}\ (POPNt).$$

$\bar{R}2 = .9901 \qquad DW = 2.5164$

The estimated price elasticity of yield, then, is .2392, indicating an inelastic response to price, as expected.

5.5 Conclusions

The stated purpose of this chapter was to present estimates of the parameters of the supply model utilising the assumptions of the adaptive expectations hypothesis and the alternative assumptions of the rational expectations hypothesis. The preceding sections have met those objectives. It is the purpose of this section to discuss the two hypothesies in light of the estimates presented and contrast those results with similar results published by Jones (1960,1961) for the United Kingdom blackcurrent industry.

Jones (1960,1961) assumed an adaptive expectations approach including a stock adjustment mechanism due to the nature of the industry. He felt that it was impossible to assume that producers could achieve desired levels of plantings within one year due to the long lead times involved in blackcurrant plantation establishment. Furthermore, the adaptive expectations mechanism was included as it was felt that producers did anticipate future prices based on past prices even with a degree of price certainty afforded by the existence of long term contracts from U.K. processors. Jones used OLS to estimate the parameters of his supply model noting that a unique estimate of the elasticities of adjustment and expectations could not be separately identified [cf. p. 50, supra.]. Jones was, however, able to estimate price elasticities from his model.

The structure of the United Kingdom industry roughly corresponds to that of the Tasmanian industry, and so the model Jones used was chosen as a comparison reference, especially as a similar model was utilised in examining the Tasmanian industry.

As pointed out above, the adaptive expectations model when applied to the Tasmanian industry yields a long-run price elasticity significantly greater than that reported by Jones. This is surprising in that the Tasmanian market for blackcurrants is controlled, where the United Kingdom is characterised as a free-market. The estimated price elasticity implies that the Tasmanian market is more price responsive that of the United Kingdom. However, it is necessary to recognise that the estimated long-run price elasticity is a composite of different rates of adjustment and price expectations, which were not separately identifiable. Hence it is impossible to assess whether this result is due to the elasticity of price expectations or that of technical adjustment being greater in Tasmania compared to the United Kingdom. Irregardless, the estimated elasticites are consistent with a priori information in that agricultural products are usually characterised as being inelastic in the short-run, but elastic in the long-run.

The estimated elasticities derived from the rational expectations model again yield a similar conclusion. However, it is felt that the long-run price elasticity was significantly less than that actually derived from the empirical results. The model embodied a stock adjustment mechanism which allowed the separate estimate of the elasticity of technical adjustment, that is the coefficient of the lagged dependent variable. In this case the elasticity of adjustment was 0.979, which implies a very rapid adjustment to long-run or "desired" plantings. Again, this result is doubtful based on the biological constraints of blackcurrant development.

The elasticities estimated for the area function and the yield function are the components of the traditional measure of the price elasticity of supply. For the short-run price elasticity of supply the short-run price elasticity of area must be added to the price elasticity of yield. For the long run, however, there is no concept of a long-run price elasticity of yield as it is doubtful that producer's decisions in response to price levels will have any other than an immediate or short run impact on yields. For this reason Jones disregarded the yield function entirely in his study of the U.K. blackcurrant industry. The long-run price elasticity of supply, then, is equal to the long-run price elasticity of area.

In conclusion, it is apparent that the estimated rational expectations model does not closely resemble that of the adaptive expectations model for the blackcurrant industry in Tasmania, which would have reinforced the notion that rational xpectations were consistent with industry behavior. Furthermore, he rational expectations model does not agree with prior xpectations concerning the magnitude of the estimated parameters lthough the model does exhibit other desirable statistical roperties. Hence the adaptive expectations model shall be dopted as the preferred model for the Tasmanian industry, and hall be used in analysis of the applications addressed in the ext chapter.

CHAPTER VI

APPLICATIONS

6.1 Applications: An Introduction

As noted in the introduction to Chapter One, the purpose of the investigation into the blackcurrant industry in Tasmania was to examine the factors affecting demand and supply, to measure the various strengths of those factors, and to assess the performance of the Soft Fruit Industry Board.

Chapter One described the structure of the industry. Chapter Two surveyed the literature of regulation and marketing boards. Chapter Three outlined various modelling approaches with respect to the estimation of comparable commodities. Chapter Four surveyed and assessed the available statistical information while Chapter Five utilised the information of those two chapters in a statistical sense, to form an empirical estimate of the coefficients of the proposed model. The estimated coefficients were manipulated to yield the measures of the relevant elasticities.

The purpose of this chapter is to make use of the estimated model in an attempt to address the original purposes of the research. An assessment of the Soft Fruit Industry Board shall be considered first. Subsequently, the model will be used to assess the effect of recent policy decisions upon the industry. Specifically, the effect of the introduction of Closer Economic Relations between Australia and New Zealand will be addressed.

6.2 Assessment of the Soft Fruit Industry Board

As pointed out above (cf. Section 2.5) it is possible to use the estimated econometric model to further assess the performance of the Soft Fruit Industry Board in meeting its objectives of price stability. The "Chow" test has been performed to assess the structural change in a similar study by Hallam (1978) on the British Egg Marketing Board. In using the Chow test, the sample data has been split into two subsamples corresponding to the period before and the period after the introduction of the SFIB. The preferred equation of the econometric model was then reestimated for each of the subsamples, essentially estimating the relationships:

$$Y_t = a_0 + a_1 P_t + a_2 Z_t + \ldots$$

and: $$Y_t = b_0 + b_1 P_t + b_2 Z_t + \ldots$$

The null hypothesis is that of no structural change, with the alternative of structural change, that is:

$$Ho: a_0=b_0,\ a_1=b_1,\ a_2=b_2$$

$$Ha: a_0=b_0,\ a_1=b_1,\ a_2=b_2,\ \ldots$$

The test statistic is given by:

$$\frac{(SSEc - SSE1 - SSE2)/K}{(SSE1 + SSE2)/(n + m - 2K)} \sim F_{K,n+m-2K}$$

where: SSE1 = sum of squared residuals from subsample 1;
SSE2 = sum of squared residuals from subsample 2;
SSEc = sum of squared residuals from the pooled subsamples;
K = number of regressors not including the constant;
n = number of observations in subsample 1;
m = number of observations in subsample 2.

The null hypothesis is rejected in favour of the alternative for a test statistic greater than the corresponding entry from the F table for K,n+m-2K degrees-of-freedom for a level of significance equal to 1-a.

Applying the Chow test to the estimated area function lead to a calculated test statistic of 3.119. The corresponding entry from the F table is 3.18 at the 95 percent level of significance with (14,13) degress-of-freedom. Clearly, the calculated test statistic does not fall within the critical region. Hence the null hypothesis cannot be rejected at the 95 percent level of significance.

The implication of this test for structural change in the Tasmanian blackcurrant industry due to the introduction of the Soft Fruit Industry Board is rather surprising. One would have expected a statutory marketing board with price-setting powers and a mandate to stabilise the industry to have effected the structure of the industry. This conclusion also seems to contradict a conclusion drawn earlier concerning the allegation of rubber stamping the free market by the SFIB. These two apparently conflicting results can be reconciled by the existence of the Fruit Industry Sugar Concession Committee, which (as indicated by the industry description in Chapter

One) announced recommended prices for blackcurrants for which sugar rebates would be payable. The test for rubber stamping appears to imply that the pricing policies of the FISCC were significantly different from those of a "free market."

The Chow test implies, then, that no significant structural change occurred during the sample period and implicitely indicates that the Soft Fruit Industry Board's pricing decisions were not significantly different from those of the FISCC. It appears that the SFIB was redundant from a pricing point-of-view. Essentially the SFIB was rubber stamping the pricing decisions of the FISCC. This conclusion is supported by the recent I.A.C. report on Fruit and Fruit Products (1981) wherein the comment was expressed that:

> . . . SFIB sets prices for fruit delivered in Tasmania and these are generally similar to FISCC prices.

The promotional powers of the SFIB also seem to be redundant. Cascade Cordials' stated objectives were to obtain local supplies of blackcurrants, an objective which was backed by the issuance of long-term contracts. It is apparent that it was in Cascade's interest, then, to promote the industry as it would be tied into long-term contracts irregardless. Again, the promotion of industry interests seem to have been proceeding without the need for a statutory authority to duplicate existing efforts.

6.3 Protection of the Industry

In this section an examination of the effective protection afforded to the Tasmanian industry shall be examined. The discussion shall centre on a domestic content scheme and shall be contrasted against protective measures used in New Zealand. A final summary of the net effective protection for the industry shall be made.

6.3.1 Domestic Content Schemes

As pointed out in (1.2) above, the blackcurrant industry is afforded the protection of a local content scheme in the form of a sales tax exemption for juice products which use at least 25% (by volume) of domestic blackcurrant juice. Obviously this exemption will have an impact upon the local blackcurrant industry in that it virtually guarantees demand for domestically produced fruit. The assistance provided by this scheme is in the form of a higher price for processing fruit which is passed on from the premium paid for domestic juice above the equivalent imported juice price.

The Industries Assistance Commission considered this type of a protective scheme to be undesirable in a report concerning assistance to the orange juice industry. In the Report (No.302) the Commission stated:

> The assistance provided by the discriminatory exemption is inherently unstable as moderate changes to production, consumption, or world prices could result in significant changes in the level of assistance provided to the industry....This is not conducive to efficient resource use in general and increases the uncertainty facing growers and processors in making investment decisions or budgeting.

The sales tax is levied at the wholesale level and is usually based on the wholesale price. To calculate the tariff equivalent of the sales tax exemption, the wholesale price can be calculated for two scenarios, one where the sales tax is avoided by conforming to the local contents requirements, and the other where sales tax is paid, as a result of not conforming to local requirements. In the case where sales tax is avoided by using the required local contents the wholesale price is given by:

$$P_w = (1-x)P_f + xP_d + m \qquad (6.1)$$

where:
Pw = wholesale domestic price
Pf = CIF imported price
Pd = domestic price
x = required percentage of local product
m = wholesale markup and packing costs
ST = sales tax as a percentage of 1.

For blackcurrant juice the required local content for sales tax exemption is 25% by volume. Furthermore, the blackcurrant juice product must have at least 25% by volume of blackcurrant juice under national food standards. Therefore, to qualify for the sales tax exemption the blackcurrant juice component (25% by volume) must be entirely composed of local blackcurrant juice. Hence, equation (6.1) becomes:

$$P_w = P_d + m \qquad (6.1A)$$

In the second instance sales tax is paid, therefore:

$$P_w = (1+ST)((1-x)P_f + xP_d + m). \qquad (6.2)$$

If the domestic price in this context is greater than the foreign price, the minimum wholesale price (and therefore minimum sales tax payable) will be given by using all foreign product. Therefore the equation (6.2) becomes:

$$P_w = (1+ST)(P_f + m) \qquad (6.3)$$

The maximum amount of protection is afforded when the wholesale price in these two situations are equated, that is:

$$P_d + m = (1 + ST)(P_f + m) \qquad (6.4)$$

which leads to the domestic price:

$$P_d = P_f (1 + ST) + ST.m \qquad (6.5)$$

which is the maximum the processors will pay for the domestic input. The tariff equivalent of the protection afforded to the local industry then is:

$$(P_d - P_f) / P_f = ST (1 + m/P_f) \qquad (6.6)$$

It can be seen that the level of protection given by the existence of this local content scheme will increase with increases in the sales tax and the wholesalers' margin, and will decrease with increases in the foreign price.

Applying this calculation to the Tasmanian industry, the protection afforded by the scheme can be quantified. Due to the nature of the variable, it was not possible to obtain a direct estimate of the wholesalers' markup. However, a private communication with a purchaser of blackcurrant juice enabled an indirect estimate to be used. Appendix III details the derivation of this estimate. Furthermore, the CIF import price has been estimated as the current CIF price of New Zealand blackcurrant juice. The tariff equivalent, then, is given by:

$$t = \frac{Pd - Pf}{Pf} = .2\{ 1 + (1.09/1.31) \} \qquad (6.7)$$

$$= .366$$

6.3.2 New Zealand Taxation Incentive Scheme

As mentioned in (1.2) above, the New Zealand blackcurrant industry enjoys the protection afforded by the Export Performance Taxation Incentive scheme which allows New Zealand exporters to claim a tax credit for exports of berry fruit products. These products are catagorised in a schedule of export goods which qualify for the scheme. Table 15 specifies the export incentive for each catagory. The tax credit for blackcurrant juice (band C) is 9.1 percent of the FOB sales value. H. Lipton (1982) showed the effective pricing advantage this tax credit yielded for potatoes. The calculation can be used for blackcurrants after substituting the band C rate of 9.1 percent for the band B rate of 10.5 percent. To calculate this price advantage let:

post-tax income with the export incentive

$$= y - cost - (tax - 0.091(y)) \qquad (6.8)$$

equivalent post tax income without the incentive

$$= EY - cost - E(tax) \qquad (6.9)$$

where: y = nominal export return
cost = production cost
tax = before tax income multiplied by the tax rate, i.e. (y - cost)t
t = New Zealand tax rate (.45)
EY = effective export return
E(tax) = post tax income multiplied by the tax rate, i.e. (EY - cost)t.

To solve for EY set equations (6.8) and (6.9) equal to each other:

$$EY - cost - (EY - cost)t = y - cost - [(y - cost)t - 0.091(y)]$$

then:

$$EY(1 - t) = y(1.091 - t)$$

$$EY = \frac{y(1.091 - t)}{(1 - t)} \qquad (6.10)$$

Table 15

New Zealand Export Performance Taxation Incentive

Product	Band	Nominal Rate	Effective Rate
Fresh Berry Fruit	F	4.2	7.6
Frozen Berry Fruit	D	7.7	14.0
Blackcurrant Juice	C	9.1	16.6

Source: Department of Trade and Industry, New Zealand (private communication)

Thus at the normal New Zealand company tax rate of 45 percent, the incentive creates an effective increase in the price received by the New Zealand exporters of 16.6 percent.

6.3.3 Net Effect on Protection of the Blackcurrant Juice Industry

As noted above in (1.2) the Sales tax exemption was modified in the 1983 Federal Budget to allow the sourcing of fruit juices from New Zealand. The impact of the modification, then, can be seen as reducing the protection of the Tasmanian blackcurrant juice processors (or producers if it is assumed that wholesalers' margins remain stable) by 36.6 percent.

However, as previously noted, the New Zealand industry is afforded the luxury of a 16.6 percent tariff equivalent taxation incentive which will be removed progressively by 1987. Therefore, the net decrease in protection of the blackcurrant juice industry upon the phasing out of the New Zealand taxation incentive will be 18.4 percent.

The upshot of a decrease in protection to an industry is that the local price received should fall by that amount. In the present case the actual price received by farmers will continue to be set by the Soft Fruit Industry Board. However, it will be less expensive for a processor to use New Zealand blackcurrant juice after CER relatively. Hence, to remain competitive, the Tasmanian blackcurrant price must fall by the 18.4 percent.

The price elasticity of supply estimated above indicated a relatively inelastic response to price for blackcurrants in the short-run. Due to the nature of the phasing out of New Zealand's incentive schemes, the short-run effect on the supply of blackcurrants should be evaluated by the rate for which no adjustment has been made for the New Zealand incentives. As pointed out in Section (6.3.1) the decrease in protection was calculated to be 36.6 percent for the change to the sales tax exemption on fruit juices. Using the estimated short-run elasticity of supply of .9939, the decrease in protection due to this policy change would be in the order of 36 percent, which if applied to the mean value of production would be approximately 343 tonnes per annum.

The long run effects of the change to protection to the blackcurrant industry is slightly higher, being in the order of 38 percent. This effect is due to the phasing out of New Zealand incentives giving a net decrease in protection of 18.4 percent evaluated at a long-run elasticity of supply of 2.0671. Hence, the decrease in production in the long run would be approximately 359 tonnes per annum.

6.4 Welfare Effects

Using the concepts of surplus it is possible to assess the efficiency of a policy decision. The basic model of consumer and producer surplus hs been presented in Section (2.5) above. As the results of the empirical examination only allowed the estimation of the price elasticity of supply, it is only possible assess the implications of Closer Economic Relations in a welfare sense from the supply side . As pointed out in Section (6.3.3) above, the net change in protection on the blackcurrant juice industry amounts to an estimated 18.4 percent upon the phasing out of the New Zealand Export Performance Taxation Incentive. Thus, one would expect the price of Tasmanian blackcurrents to fall by this same percentage if the industry is to remain competitive with New Zealand growers.

We have shown that on efficiency grounds this cut back in price will lead to a decrease in quantity supplied, thereby giving an decrease in the producers' surplus.

The elasticity of supply can be used to assess the change in producer's surplus. When evaluated from the pre-change equilibrium, Nerlove (1957) has shown that the elasticity of supply can be approximated as:

$$\varepsilon^S = \frac{\Delta Q}{Q_0} * \frac{P_0}{\Delta P} \qquad (6.11)$$

We define the percentage change in price as $x = \Delta p/p0$. The change in surplus is given by the area p*CDp2 less the area BCD in Figure 3. The percentage decrease in producers surplus (PS) when evaluated at equilibrium values is given by:

$$\Delta PS = \frac{\Delta P(Q_0 - \Delta Q)}{P_0 Q_0} - \frac{.5\Delta Q\Delta P}{P_0 Q_0} \qquad (6.12)$$

After algebraic manipulation the percentage change in producers' surplus is given by:

$$PS = x(1 - \frac{3}{2}\varepsilon^S x) \qquad (6.13)$$

This concept of surplus as a measurement of the welfare effects of a policy change is from the traditional Marshallian measure of welfare.

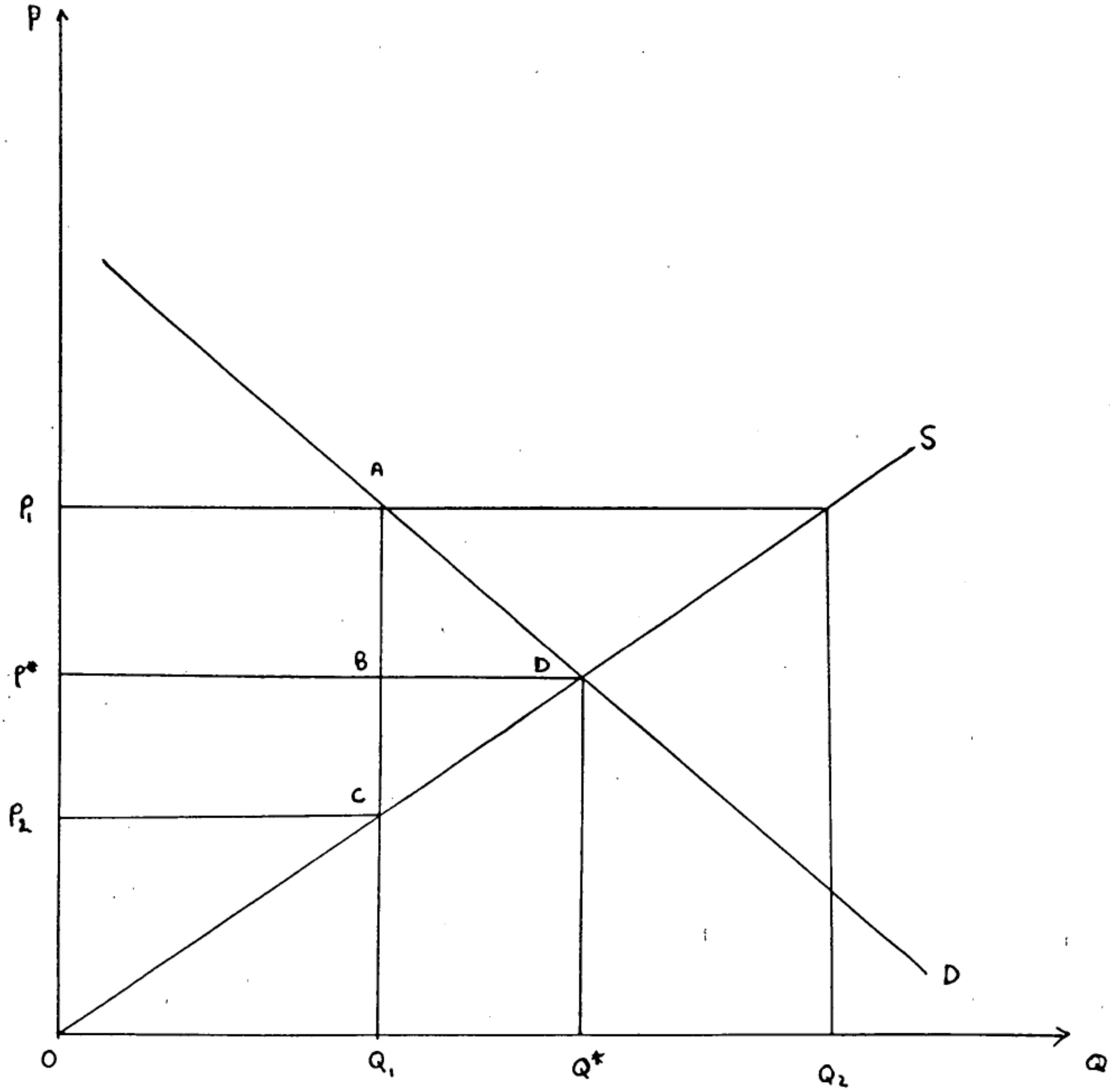

FIGURE III: WELFARE EFFECTS

For the blackcurrant juice industry then, the welfare effect of a decrease in protection of 18.4 percent can be readily seen to be 7.9 percent, when evaluated using the estimated long-run price elasticity of supply of 2.0671 as presented in Chapter Five.

As mentioned in Section (2.2) above one of the justifications for government intervention into a market was if the distribution of income towards a group was considered to be inequitable. It was pointed out that this is, in general, the attitude of governments towards agricultural producers. It was also mentioned that in the case of soft fruits, due to the predominant location of the majority of the production being in the Huon Valley, the distributional concerns were apparent. It is therefore appropriate to consider that one of the principle aims of the Soft Fruit Industry Board must have been to help redistribute income towards these producers with the potential to counter the stifling effects of monopsonistic demand.

The approximate maintenance of real prices throughout the period of its existence has shown the SFIB to be effective in continuing the pricing policies started by the FISCC . It is also apparent that this result would not have occurred if the farm-gate price had been left to the free market to determine, in that it has been shown that the SFIB is not rubber stamping the free market.

It is therefore apparent that the SFIB has been successful in redistributing income towards the blackcurrant growers from, ultimately, the consumers of blackcurrant juice. However, with this success in mind, the introduction of the change in the treatment of New Zealand blackcurrant juice as a part of C.E.R. is in obvious contrast. As shown above, the introduction of this policy change leads to a negative welfare effect seen as a Pareto and a redistribution of income away from growers. The policy change is obvioustly inconsistent with the implied nature of the SFIB.

6.5 Conclusions

To sum up, we have shown that the Soft Fruit Industry Board has been continuing the policies (in tandem) of an existing marketing board, albeit effectively. Secondly, we have seen that the major processor has such a major committment to the processing of blackcurrants so as to remove the justification of a marketing board for promotional reasons. Thirdly, we have shown that a Federal government policy change will have major repercussions on the blackcurrant industry despite the lobbying by the Soft Fruit Industry Board.

In conclusion, then, it appears that the only justification for the existence of the Soft Fruit Industry Board is to act as a "watch dog" over the market, in an attempt to give producers a more effective bargaining position in negotiations with processors. Producer sentiment, although being unquantifiable, suggests that this role for the Soft Fruit Industry Board is not being effectively performed.

APPENDIX I

Closer Economic Relations (C.E.R.)

Package for Blackcurrants

1. Fresh Blackcurrants

Situation under NAFTA

No Australian tariff or quantitative restrictions;
No New Zealand tariff;
New Zealand quantitative restrictions;

New Zealand Export Performance Taxation Incentive Scheme rate of 4.2 percent (nominal).

C.E.R. Package

New Zealand Export Performance Taxation Incentive Scheme rate to be phased out over the period April 1, 1983 to April 1, 1986 as follows:

April 1, 1983 -- 75 percent of rate applies;
April 1, 1984 -- 50 percent of rate applies;
April 1, 1985 -- 25 percent of rate applies;
April 1, 1986 -- nil.

New Zealand import licenses liberalised over 1983-1995 period.

2. Frozen Blackcurrants:

Situation under NAFTA

No Australian tariff or quantitative restrictions;
New Zealand tariff;
New Zealand quantitative restrictions;

New Zealand Export Performance Taxation Incentive Scheme rates of 7.7 percent (nominal).

C.E.R. Package

New Zealand Export Performance Taxation Incentive Scheme rate to be phased out using the same schedule as for fresh blackcurrants.

The New Zealand tariff will be phased out as follows:

1983 5 percent tariff to apply;
1984 Duty free.

3. Blackcurrant Juice

Situation under NAFTA

No Australian tariff or quantitative restrictions;
20% New Zealand tariff;
New Zealand quantitative restrictions;

Australian Sales Tax exemption of 20 percent (nominal) on products using at least 25 percent (by volume) of local fruit juice;

New Zealand Export Performance Taxation Incentive Scheme rates of 9.1 percent (nominal).

C.E.R. Package

Australian Sales Tax Exemption changed in 1983 Federal Budget to include New Zealand fruit juice as "local" fruit juice;

New Zealand Export Performance Taxation Incentive Scheme rate to be phased out using the same schedule as for fresh blackcurrants.

The New Zealand tariff will be phased out as follows:

1983 15 percent tariff to apply;
1984 10 percent tariff to apply;
1985 5 percent tariff to apply;
1986 Duty free.

APPENDIX II

DATA

YEAR	PRODN (TNE)	YIELD (TNE/HA)	BEARING AREA (TNE/HA)	NON BEARING AREA (HA)	PRICE ($/KG)	JUICE PRICE ($/LTR)
57-58	1169	0	0	0	0.275	0
58-59	1319	0	0	0	0.270	0
59-60	1345	0	0	0	0.270	0
60-61	1405	0	0	0	0.257	0
61-62	996	0	0	0	0.257	0
62-63	1399	3.562	383	52	0.250	0
63-64	1342	3.386	396	39	0.260	0
64-65	1044	2.947	354	32	0.230	0
65-66	1333	4.302	310	21	0.210	0
66-67	1233	4.381	281	19	0.250	0
67-68	981	4.417	222	36	0.290	0.44
68-69	1197	5.015	239	26	0.290	0.42
69-70	936	4.007	234	35	0.310	0.45
70-71	1015	4.268	238	42	0.330	0.49
71-72	1140	4.793	238	64	0.330	0.53
72-73	806	3.910	232	89	0.350	0.56
73-74	865	4.003	216	98	0.390	0.54
74-75	951	4.167	228	96	0.470	0.62
75-76	470	2.257	208	74	0.500	0.72
76-77	575	2.772	207	68	0.550	0.80
77-78	681	3.253	209	69	0.700	0.94
78-79	787	3.874	203	74	0.720	1.02
79-80	1102	4.507	245	105	0.780	1.16
80-81	772	3.059	252	112	0.800	1.36
81-82	1005	4.220	238	82	0.665	1.48
82-83	761	3.092	246	58	0.549	1.56
83-84	832	3.749	222	36	0.654	1.71

APPENDIX II (CONTD)

YEAR	RAIN	SUGAR	AWE	PRECD	PPAID	CPIHOB	POPN	GDPREAL
57-58	0	0	0	0	0	26.7000	0	0
58-59	0	0	0	0	0	27.1000	0	0
59-60	0	0	0	0	0	27.6000	0	0
60-61	0	0	0	0	0	29.1000	34186.0	0
61-62	0	177.67	41.2	0		29.3000	33984.0	0
62-63	0	177.67	44.0	101.000	101.000	29.3000	33781.0	0
63-64	0	177.67	44.5	109.000	101.000	29.6000	33579.0	0
64-65	0	177.67	46.0	106.000	104.000	30.5000	33376.0	0
65-66	0	177.67	48.5	110.000	110.000	31.6000	33174.0	0
66-67	0	177.67	50.8	109.000	114.000	32.3000	32545.0	0
67-68	0	203.45	55.1	107.000	118.000	33.7000	31916.0	0
68-69	0	203.45	57.8	106.000	120.000	34.2000	31288.0	0
69-70	0	203.45	62.4	101.000	121.000	35.0000	30659.0	83305
70-71	0	203.45	67.5	98.000	126.000	36.3000	30030.0	87746
71-72	1033	203.45	75.7	106.000	133.000	38.7000	30086.0	92232
72-73	776	203.45	82.2	144.000	143.000	40.9000	30142.0	95929
73-74	817	203.45	92.4	168.000	165.000	46.000	30198.0	100168
74-75	941	219.50	108.2	148.000	215.000	53.8000	30254.0	101726
75-76	1015	219.50	136.8	155.000	251.000	61.3000	30310.0	104273
76-77	913	246.20	153.2	173.000	281.000	70.2000	30238.0	107124
77-78	702	266.80	172.9	179.000	310.000	77.1000	30166.0	108090
78-79	827	279.40	187.7	214.000	332.000	83.1000	30094.0	113366
79-80	683	353.00	201.6	249.000	365.000	91.6000	30022.0	114757
80-81	914	372.38	231.7	266.000	416.000	100.000	29950.0	118916
81-82	874	390.28	258.3	263.000	462.000	110.000	29900.0	121890
82-83	616	431.44	301.1	279.000	512.000	121.800	29860.0	119412
83-84	0	480.37	332.9	295.000	553.000	129.900		

APPENDIX III

WHOLESALERS' MARK-UP

The sholesaler's mark-up used in the calculation of the tariff equivalent of the local content scheme for blackcurrant juice was derived from data obtained in a personal communication with a major blackcurrant juice user. In the communication the average price paid for Tasmanian blackcurrant juice concentrate was given. This price, when apportioned down into a single strength equivalent, was used as the basis for the mark-up calculation.

Charley, et.al. (1980) have estimated that the yield of blackcurrant juice per kilogram of blackcurrant fruit is approximately 1.0, depending largely upon the process used. Taking this yield estimate, it is possible to calculate the input price per litre.

The wholesaler's mark-up can be expressed as:

$$M = P_0 - P_i$$

$$P_i = P_b(y)$$

Thus:

$$M = P_0 - P_b(y)$$

where
M = wholesalers' mark-up
P_o = wholesalers' price single strength juice per litre
P_i = wholesalers' input price per litre
P_b = blackcurrant price per kilogram excluding bounty paid
y = yield (litres of juice per kilogram of fruit)

Hence the wholesalers'margin is estimated as being:

$$M = 1.69 - 0.60 = 1.09 \text{ per litre}$$

Selected Bibliography

Adams, P.G., and Behrman, J.R., Econometric Models of World Agricultural Commodity Markets. Cambridge, Mass.:Ballinger Publishing Co., 1976

Akerman, G. "The Cobweb Theorem: A Reconsideration." Quarterly Journal of Economics 71 (1957):151-60.

Alston, J.M., Freebairn, J.W., and Quilkey, J.J. "A Model of Supply Response in the Australian Orange Growing Industry." Australian Journal of Agricultural Economics (December, 1980):248-67.

Anchor Foods, private correspondence, March 27, 1984.

Anderson, K. "Distributed Lags and Barley Acreage Response Analysis." Australian Journal of Agricultural Economics (August, 1974):119-32.

Askari, H., and Cummings, J.T. "Estimating Agricultural Supply Response with the Nerlove Model: A Survey." International Economic Review. 18 (June,1977):257-91.

Australian Bureau of Statistics. "Fruit, Tasmania." various issues.

Australian Bureau of Statistics. "Consumer Price Index." various issues.

Australian Bureau of Statistics. "Wages." various issues.

Australian Taxation Office. private correspondence, March 21, 1984.

Banks, E.L. and Mauldon, R.G. "Effects of Pricing Decisions of a Statutory Marketing Board." Australian Journal of Agricultural Economics. 10 (June, 1966):1-13.

Baritelle, J.L. and Price, D.W. "Supply Response and Marketing Strategies for Desiduous Crops." American Journal of Agricultural Economics. 56 (1974):245-53.

Bator, F. "The Anatomy of Market Failure." in Readings in Microeconomics, 2nd Edition, pp.518-37. Edited by W.Breit and H. Hockman. Hinsdale, Ill.: Dryden Press, 1971.

Beaumont, E. "Closer Economic Relations with New Zealand." paper presented at 1982 Symposium of the Australian Institute of Agricultural Science, Launceston, Tas., 12 November, 1982.

Blandford, D. and Currie, J.M. "Price Uncertainty--The Case for Government Intervention." Journal of Agricultural Economics. 26(1):37-50.

Blandy, R. "Does the Arbitration Commission Matter?" Economic Papers. 68 (October, 1981):32-38.

Bureau of Agricultural Economics. Quarterly Review of the Rural Economy. various editions.

Cascade Fruit Juices. private correspondence. November 14, 1983.

Campbell, K.O. "The State Marketing Board--Relic or Prototype?" Australian Journal of Agricultural Economics. 17 (1973):170-88.

Campbell, K.O. "A Wheat Policy for the Seventies." Australian Journal of Agricultural Economics. 15 (1971):51-56.

Campbell, K.O., and Fisher, B.S. Agricultural Marketing and Prices, 2nd Edition. Melbourne: Longman Cheshire, 1982.

Cassidy, H.J. Using Econometrics: A Beginner's Guide. Reston, Va.: Reston Publishing Co., 1981.

Charley, V., Tressler, D.K., and Luh, B.S. "Cherry, Berry, and other Miscellaneous Fruit Juices." in Fruit and Vegetable Juice Processing Technology, 3rd Ed. pp. 310-43. Edited by P.Nelson and D.K. Tressler. Westport, Conn.: AVI Publishing Co. 1980.

Clarke, R., Elders-IXL. Hobart. interview. September 22, 1983.

Cohen, R.L. "Further Reflections on Agricultural Marketing." Journal of Agricultural Economics. 14(4):428-37.

Colman, D. "A Review of the Arts of Supply Response Analysis." Review of Marketing and Agricultural Economics. 51 (December, 1983):201-30.

Colman, D. "A New Study of United Kingdom Cereal Supply." Journal of Agricultural Economics. 21 (1970):333-49.

CSR Ltd. private correspondence. August 14, 1984.

Edwards, G.C. "Berry Fruits: The Structure of the Tasmanian Industry." Tasmanian Journal of Agriculture. November, 1973:219-22.

Epp,D.J., and Malone,J.W. Introduction to Agricultural Economics. New York: MacMillian, 1981

Ezekiel, M. "The Cobweb Theorem." Quarterly Journal of Economics. 52(1938):255-80.

Fisher, B.S. "Rational Expectations in Agricultural Economics Research and Policy Analysis." American Journal of Agricultural Economics. 64(May, 1982):260-65.

French, B.C. and Matthews, J.L. "A Supply Response Model for Perennial Crops." American Journal of Agricultural Economics. 53 (1971):478-90.

Goodwin, T.H., and Sheffrin, S.M. "Testing the Rational Expectations Hypothesis in an Agricultural Market." Review of Economics and Statistics. 64 (1982):658-67.

Griliches, Z. "Hybrid Corn: An Exploration in the Economics of Technological Change." Econometrica. 25 (1957):501-22.

Gutter, M.M., and Low, E.M. "The British Egg Marketing Board 1957-71." Journal of Agricultural Economics. 22 (1971):247-65.

Hallum, D. "Producers' Response to Supported and Free Market Prices: A Case Study of the U.K. Egg Industry 1966-76." Journal of Agricultural Economics. 29 (1978):119-30.

Hancock, K.J. and Hughes, D.B. "Relative Wages, Institutions, and Australian Labour Markets." National Institute of Labour Studies Working Paper Series, No. 1.

Haring, J.E., Christy,S., and Humphrey, J.F. "Marketing Boards and Price Funds in Uganda, 1950-60." Journal of Agricultural Economics. 20(3):345-56.

Hausman, J.A. "Exact Consumer Surplus and Deadweight Loss." American Economic Review. 71(1981):662-76.

Hazell, P.B.R. and Scandizzo, P.L. "Market Intervention Policies When Production is Risky." American Journal of Agricultural Economics. 57(1975):247-65.

Hicks, J.R. Value and Capital, 2nd Ed. Oxford: Clarendon Press, 1946.

Hill, B.E. "Supply Response in Crop and Livestock Production." Journal of Agricultural Economics, 22(1971):287-96.

Hocking, A. "Tasmanian Marketing Authorities: Their Objectives, Potential, and Efficiency." Address to the Australian Society of Animal Production and the Australian Institute of Agricultural Science. July 22, 1982.

Holmes, M. and Rendell, J. "An Economic Survey of Blackcurrant Production 1957-1966." Department of Economics Monogram. University of Bristol, 1967.

Horticultural Market Research Unit. private correspondence, May 2, 1983.

Industries Assistance Commission. private correspondence, March 6, 1984.

Industries Assistance Commission Report No. 276. "Fruit and Fruit Products." Canberra: AGPS, 1981.

Industries Assistance Commission Report No. 304. "Orange and Tangerine Juices." Canberra: AGPS, 1982.

Intrilligator, M.D. Econometric Models, Techniques, and Applications. Englewood Cliffs, N.J.: Prentice Hall, 1978.

Jones, G.T. "The Response to the Supply of Agricultural Products in the United Kingdom, Part One." The Farm Economist 9(1961):537-58.

Jones, G.T. "The Response to the Supply of Agricultural Products in the United Kingdom, Part Two." The Farm Economist. 10(1962):1-28.

Kmenta, J. Elements of Econometrics. New York: MacMillan, 1971.

King, G.A. "Econometric Models of the Agricultural Sector." American Journal of Agricultural Economics. 57(1975):164-71.

Ladd, G.W. Review of The Dynamics of Supply: Estimation of Farmers' Response to Price by Marc Nerlove, in Journal of Farm Economics. 4(1959):452-55.

Langford, G., and Mavromatis, G. A Review of the New Zealand Blackcurrant Industry. Christchurch, N.Z.: Ministry of Agriculture and Fisheries, 1981.

Layard, P.G.R., and Walters, A.A. Microeconomics. New York. McGraw-Hill Book Co., 1978.

Lipton, H. "Potatoes: The Possible Impact of Closer Economic Relations between Australia and New Zealand." Canberra: Bureau of Agricultural Economics Occaisional Paper 68, 1982.

Livingstone, I. "Marketing Boards and Price Funds in Uganda 1950-60" Journal of Agricultural Economics.22(1971):85-94.

Maddock, R., and Carter, M. "A Child's Guide to Rational Expectations." Centre for Economic Policy Research Discussion Paper 21, 1981.

Marshall, A. Principles of Economics, 8th Edition. London: Macmillian, 1920.

Mainland, D.D. "An Analysis of Scottish Wholesale Tomato Prices." Journal of Agricultural Economics. 34(2):207-12.

McCallum, B.T. "Rational Expectations and the Natural Rate Hypothesis: Some Consistent Estimates." Econometrica. 44(1976):43-52.

Mercury. "Extracts." Hobart, Tasmania, 1972.

Morey, J.A. "The Role of the Statutory Marketing Board in the Organised Marketing of Australia's Primary Products." Sydney: Reserve Bank of Australia, 1959.

Mules, T.J. "A Supply Function for Dairy Products." Australian Journal of Agricultural Economics. 16(December, 1972):195-203.

Muth, J.F. "Rational Expectations and the Theory of Price Movements." Econometrica. 29(July, 1961):315-35.

Nerlove, M. "Adaptive Expectations and Cobweb Phenomena." Quarterly Journal of Economics. 72(1958):227-40.

Nerlove, M. The Dynamics of Supply: Estimation of Farmers' Response to Price. Baltimore: The Johns Hopkins Press, 1958.

Nerlove, M. "The Dynamics of Supply: Retrospect and Prospect." American Journal of Agricultural Economics.61(1979):874-88.

Nerlove, M. Distributed Lags and Demand Analysis for Agricultural and Other Commodities. Washington, D.C.: U.S. Government Printing Office, 1958.

Nerlove, M., Grether, D., and Carvalho, M. Analysis of Economic Time Series: A Synthesis. New York: Academic Press, 1979.

Nes, A., and Clarke, R.J. "A Computer Based Bibliography of the Blackcurrant Literature." Horticultural Research. 20(1980):83-5.

New Zealand. Consulate-General Melbourne. private communication, May 22, 1984.

New Zealand. Department of Trade and Industry. private communication, April 3, 1984.

New Zealand. Reserve Bank. Bulletin. various editions.

O'Mara, L.P. "Some Implications of Minimum Pricing: The Case of Wine Grapes in Australia." Review of Marketing and Agricultural Economics. 49(2):107-24.

Pashigian, B.P. "Rational Expectations and the Cobweb Theorem." Journal of Political Economy. 78:338-52.

Parish, R.M. "The Costs of Protecting the Dairying Industry." The Economic Record. 38(June, 1962):167-82.

Peltzman, S. "Towards a More General Theory of Regulation." Journal of Law and Economics. 19(1976):211-48.

Posner, R.A. "Theories of Economic Regulation." The Bell Journal of Economics and Management Science. 5(1974):335-58.

Quiggin, J.C., and Anderson, J.R. "Stabilisation and Risk Reduction in Australian Agriculture." Australian Journal of Agricultural Economics. 23(1979):191-206.

Rae, A.N. "An Evaluation of a New Zealand Marketing Board Supply Diversion Strategy." Australian Journal of Agricultural Economics. 22(1978):1-21.

Rae, A.N., and Carmen, H.F. "A Model of New Zealand Apple Supply Response to Technological Change." Australian Journal of Agricultural Economics. 19(1975):39-51.

Richardson, R.A. "Structural Estimates of Domestic Demand for Agricultural Products in Australia: A Review." Review of Marketing and Agricultural Economics. 43(3):71-100.

Robertson, C.A. "Supply Response to Price Under Certainty, with Reference to the United Kingdom Egg Market, 1954 to 1966." Journal of Agricultural Economics. 22(1971):143-47.

Saylor, R.G. "Alternative Measures of Supply Elasticities: The Case of Sao Paulo Coffee." American Journal of Agricultural Economics. 56(1974):98-106.

Sheffrin, S. Rational Expectations. Cambridge: Cambridge University Press, 1982.

Shonkwiler, J.S. and Emerson, R.D. "Imports and the Supply of Winter Tomatoes: An Application of Rational Expectations." American Journal of Agricultural Economics. 64(November, 1982):634-41.

Sieper, T. Rationalising Rustic Regulation. St. Leonards, N.S.W.: Centre for Independent Studies, 1982.

Stigler, G.J. "The Theory of Economic Regulation." The Bell Journal of Economics and Management Science. 2(1971):3-21.

Summerhayes, G.S. "The Australian Berry Fruit Industry." Quarterly Review of Agricultural Economics. 11(1958):44-8.

Tasmania. Department of Agriculture. Review of Berry Fruit Industry. (unpublished review). 1976.

Tasmania. Soft Fruit Industry Act, 1972.

Tasmania. Soft Fruit Industry Act, 1973.

Tasmania. Soft Fruit Industry Board. Annual Report. various issues.

Tasmania. Yearbook. Hobart: Tasmanian Government Printer, various editions.

Tomek, W.G. and Robinson, K.L. Agricultural Product Prices. Ithica, N.Y. Cornell University Press, 1972.

Varian, H. Microeconomic Analysis. Norton Publishing Co.: New York, 1978.

Veeman, M.M.D. "Marketing Boards in New Zealand," (unpublished Ph.D. dissertation, University of California--Berkeley, 1972].

Wallis, K.F. "The Econometric Implications of the Rational Expectations Hypothesis." Econometrica. 48(1980):49-73.

Warley, T.K. "The Future Role of Marketing Organisations." Journal of Agricultural Economics. 15(1964):550-67.

Willig. R.D. "Consumer Surplus Without Apology." American Economic Review. 66(1976):589-97.