Contributed Paper at the
34th Annual Conference of the
Australian Agricultural Economics Society,
University of Queensland, Brisbane, Australia,
13-15 February, 1990

THE NEW ZEALAND PASTORAL SECTOR SUPPLY RESPONSES

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ABSTRACT

An econometric model of the pastoral sector of New Zealand was used to study the supply response effects of the assistance provided during the 1979-1984 period. A dynamic simulation approach was used to evaluate the nature of enterprise mix and stock numbers in the absence of such assistance and any resulting opportunity cost of resource misallocation due to foregone income opportunities. The structural characteristics of the model with respect to the key behavioural equations in the sheep, beef and dairy industries were investigated to see whether there were any significant changes during or due to the assistance build up.

Results suggest that the enterprise mix at present vis a vis sheep, beef and dairy activities would have been considerably different, if there had been no assistance, and this would have enabled better returns from larger beef and dairy industries. There has thus been a double cost of the assistance due to the payments and more recently of the production foregone due to the switching between enterprises to sheep from beef and dairy. There was no evidence of a significant structural change in the pastoral sector during the assistance period even though behavioural responses to the incentive structure was evident. The supply response was found to be consistent throughout the slow growth period of 1960-78, the assistance build up of 1979-1984 and the post liberalisation period since 1984.

Based on the dynamic multipliers estimated from the model for the impact period, the medium term and the long run, it is apparent that the impact of removal of assistance will take at least 5-7 years to work its way through, and in some cases up to 12 years. The estimated model, which represented a significant improvement over past efforts in the quality of data used and specification, particularly in capturing the linkages between the beef and dairy cattle industries, was found to be quite stable based on historical (base) simulation results. In addition to policy analysis, the model has been found useful in outlook work as well, and is quite responsive to price, including exchange rate effects, cost and weather scenarios.

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* The views expressed in this paper are those of the authors and do not necessarily reflect the official view of the New Zealand Ministry of Agriculture and Fisheries. The typing assistance of Frances Roche and comments from colleagues are very much appreciated.

NEW ZEALAND PASTORAL SECTOR SUPPLY RESPONSES

1 INTRODUCTION

Objectives

The general objective of this study is to address the issue of supply response by the New Zealand pastoral sector to changes in the domestic production environment. The specific task of this paper was to investigate the effects of the assistance, and its subsequent removal, on the structural characteristics of the pastoral sector. This is achieved by estimating supply response parameters of the main pastoral outputs; lamb, mutton, wool, beef and milkfat. The study has been undertaken with the assistance of an econometric model representing the main activities of the pastoral sector in New Zealand. These include sheep, beef and dairy farming, and the important interactions among them.

Background

The pastoral sector accounts for more than 65% of the value of agricultural production and over 85% of the value of agricultural based exports. It is of critical importance to the New Zealand economy. In the past decade, the sector experienced fluctuating world prices together with a period of high levels of assistance. This was followed by a major cutback in all forms of direct and indirect subsidies, which has led to pastoral farmers again being fully exposed to international price movements. These developments, along with changes in input prices and climatic conditions, have led to some significant livestock supply responses within the sector.

Past studies which have modelled pastoral sector supply response in New Zealand include Laing and Zwart (1983a) and Shaw (1986). The Laing and Zwart model and the subsequent update (Grundy, Lattimore and Zwart, 1988), have been used in applications to evaluate the effects of the removal of the SMP (Supplementary Minimum Prices) scheme (Laing and Zwart, 1983b; Johnson, 1986; Griffith and Grundy 1988). These have provided some understanding of the nature of supply response during the assistance period. But due to the shortcomings in the quality of data, including the period of coverage which was only

up to 1981 or 1985, and some aspects of their model specification, particularly in the cattle sector where the beef and dairy sector interactions are represented, the findings of above studies require reappraisal. This study has used an extended data base (updated to 1988), has improved the specification and makes available a better tool to analyse the effects of removing all output assistance.

The rest of this paper is presented according to the following outline. A brief background to the pastoral sector of New Zealand is provided. This is followed by a concise description of the conceptual framework of the pastoral model. Pertinent changes in model specification and the quality of data used which are improvements over past efforts of supply response measurements are highlighted. A summary of model results are then reported. These include tests of the stability of model parameters and the dynamic multipliers computed from the simulations. Also given are the results of dynamic simulations for the level of output and inventory in the different pastoral sectors under a scenario of no output assistance to these activities. The final section discusses the policy implications of these results in terms of resource misallocation and the true cost of the assistance provided to the pastoral sector.

2 PASTORAL SECTOR IN NEW ZEALAND

In this section we cover some of the important historical developments during the sample period (1962-1988), including changes in overseas markets and in domestic agricultural assistance policy. The corresponding developments in livestock inventories and production (together termed supply here), are then reported.

Changes in Causal Factors

A number of factors have influenced the unit returns for pastoral commodities. Dominant of these has been fluctuations in world market prices. Among developments in the international markets, the accession of UK into the European Community (EC) in the early 1970s, and the expansion of the US, Middle East and third world markets for meat, wool and dairy products during the 1980s, have been major influences on the levels

of pastoral sector prices. Processing margins and the returns to hides and skins have also been important. Details of the relative importance of factors is given in Reynolds and Moore (1990).

The seasonal effects of climate on pasture availability through soil moisture conditions showed significant variation during certain years over this period. Adverse weather resulting in soil moisture deficit, was quite pronounced during the drought years of 1964, 1973, 1978, 1983 and more recently in 1988 and 1989.

Level of Output Assistance

The output prices for the pastoral activities were very significantly influenced by domestic assistance policies that were put into effect for the different products at various periods of time (table 1). This assistance included not only SMPs, but also the Government support and the payment of debts in the industry stabilisation accounts for meat and dairy. Most output assistance to sheep farming was provided during the 1982-86 period. This is evidenced by between 25 - 118¢ per kg of total price subsidies provided for lamb, between 10 - 80¢ for mutton, and between 4 - 53¢ for wool. The beef sector received relatively less assistance, between 1 - 16¢, with most of this being delivered in 1982 and 1983. The dairy industry also received between 7 - 30¢ of output assistance during this period, but was assisted mainly in the preceding years between 1975-80. Output assistance for all commodities was more or less completely withdrawn by 1987.

Changes in Pastoral Activity

Over the three decades of the 1960s to the 1980s, the pastoral sector in general experienced three distinctly different types of production environments and thus underwent marked changes in the nature and scope of the level of production and the size of livestock numbers in the different classes (Table 2). These three phases included a long slow growth period, followed by a period of stable total livestock numbers but major changes in the mix of the different types of livestock, and finally a period of decline over the most recent five years.

TABLE 1: NATURE OF OUTPUT ASSISTANCE[1] TO PASTORAL PRODUCTS

June Years	Lamb			Mutton			Wool			Beef			Milkfat		
	Mkt Price	Assist Level	Farm Price	Mkt Price	Assist Level	Farm Price	Mkt Price	Assist Level	Farm Price	Mkt Price	Assist Level	Farm Price	Mkt Price	Assist Level	Farm Price
1965-69	41.4	0	41.4	17.0	0	17.0	66.9	0	66.9	36.5	0	36.5	72.1	5	77.1
1970-74	51.5	1	52.5	29.7	0	29.7	109.6	1	110.6	55.5	0	61.3	113.4	8	121.4
1975-79	80.5	3	83.5	40.6	-1	39.6	172.6	1	173.6	59.3	2	61.3	133.2	19	152.2
1980	113.9	4	117.9	54.7	3	57.7	265.1	0	265.1	112.8	-1	111.8	163	45	208
1981	118.6	5	123.6	61.0	2	63.0	247.7	0	247.7	105.6	7	112.6	261	-1	260
1982	137.4	27	164.4	44.7	10	54.7	279.0	41	312.1	118.0	16	134.0	279	21	300
1983	73.7	94	167.7	48.6	17	65.6	267.0	53	312.3	137.4	13	150.4	330	30	360
1984	56.0	118	176.0	65.6	10	75.6	297.0	23	318.0	159.1	3	162.1	343	7	350
1985	108.2	83	191.2	11.8	80	91.8	373.4	4	377.4	215.4	1	216.4	388	8	396
1986	52.1	56	108.1	6.7	29	35.7	343.8	0	343.8	152.4	4	156.4	390	8	398
1987	158.0	7	165.0	56.4	2	58.4	416.7	0	416.7	157.8	3	160.8	345	10	355
1988	123.4	1	124.4	55.1	1	56.1	453.3	0	453.3	151.3	2	153.3	401	6	407
1989	160.9	1	161.9	49.3	1	50.3	516.0	0	516.0	216.1	1	217.1	571	5	576

Sources: Policy Services MAFCorp, New Zealand Meat Producers Board, Wool Board and the Dairy Board.

1 Includes both SMP payments and subsidies arising from write-off of Industry Stabilisation Account debts - apportioned to year in which it was incurred.

During the 1960's and for the most part of the 1970s, the sheep sector grew at a slow but steady rate except for a period of slump in the mid 70s. But since 1979, the sheep sector expanded quite significantly to reach peak levels of over 70 million in 1982 and 1983. This increase corresponded to the time when the range of assistance provided to sheep farming in the form of supplementary minimum prices, input and interest subsidies and tax concessions was the highest. Following policy changes most of these assistance measures were eliminated by 1986 and the sheep numbers have since declined to be about 61 million at present in the liberalised 'more market' environment (Table 2).

TABLE 2: NATURE OF CHANGES IN NEW ZEALAND PASTORAL ACTIVITIES (1965 - 1989)

I INVENTORY OF LIVESTOCK	1965	1970	1975 (Yr. ending June)	1980	1985	1989
a Total Sheep (millions)	54.1	60.6	55.6	68.8	67.9	61.2
b Beef Cattle ('000' head)	3,627.6	5,048.0	6,237.7	5,141.9	4,595.0	4,475.0
c Dairy Cattle ('000' head)	3,173.3	3,729.3	3,014.0	2,972.1	3,327.5	3,247.0
d Deer & Goats ('000' head)	Neg.	Neg.	Neg.	157.0	746.8	2,359.6(E)
e Total (Mil.) Stock Units (incl.Deer & Goats)	80.13	94.10	99.10	104.62	104.13	99.82
II PRODUCTION ('000' TONNES)						
a Lamb	300.0	359.0	331.3	383.4	498.1	387.4
b Mutton	171.4	200.3	163.3	167.1	213.0	162.8
c Wool	283.0	328.0	294.1	356.5	373.0	320.4
d Beef	268.0	402.0	493.2	479.6	494.7	538.2
e Milkfat	282.0	275.0	273.3	318.0	362.0	377.0

Sources: New Zealand Agricultural Statistics and the Information Network for Official Statistics (INFOS), Dept. of Statistics, New Zealand.

The beef sector is the other component in the sheep/beef farming system which is predominant in New Zealand pastoral agriculture. Beef cattle number peak levels were recorded during the mid 1970s with total over 6 million, following a steady and rapid growth during the period 1965-1975. Since then, with the growth of the sheep sector, beef cattle numbers dropped to well below the 5 million level during the early 1980s. There was some recovery in beef numbers during the latter part of the 80s, at the same time as when sheep numbers started to show a downturn.

The dairy sector has seen relatively less fluctuation in its size with around 3 million total dairy cattle for the most part of the 1970s and the early part of 1960s and 80s as well. During the late 1960s, the dairy sector grew to almost 4 million head and in recent years has again seen some growth above the 3 million level (Table 2).

Among the recent developments in the pastoral sector, the tremendous growth during the last 6-8 years in both deer and goat numbers found in New Zealand rank quite high. This growth was the result of several contributory factors, including market developments for venison, velvet and goat fibres, taxation incentives in the mid 1980s and the availability of feral stock for breeding purposes. It is estimated that the number of deer and goats farmed in New Zealand has reached almost 2.5 million at present from only about 150,000 at the beginning of the decade (Table 2).

Alongside the above developments in the inventory of different classes of livestock have been the associated changes in the outputs of the sheep, beef and dairy sectors of New Zealand pastoral agriculture. While lamb production rose dramatically from 300,000 tonnes in 1960 to almost 500,000 tonnes in 1985, mutton production also increased significantly by over 50,000 tonnes (Table 2). Wool production grew by almost 100,000 tonnes during this 20 year period. But since 1985, all three outputs from the sheep sector have diminished considerably in their importance, following corresponding changes in sheep numbers.

Beef output however, grew from about 400,000 tonnes in the early 1970s to almost 500,000 tonnes in the mid 70s and then fell back in the late 1970s. During the mid to late 1980 period, beef production recovered again to be around the 500,000 tonne level. Dairy milkfat production however, has grown steadily during

the entire period from below 200,000 tonnes in the 1960s to around 380,000 tonnes at present in 1989 (Table 2). Increases in milkfat per cow seem to have been more important than trends in numbers.

3 PASTORAL SUPPLY RESPONSE MODEL

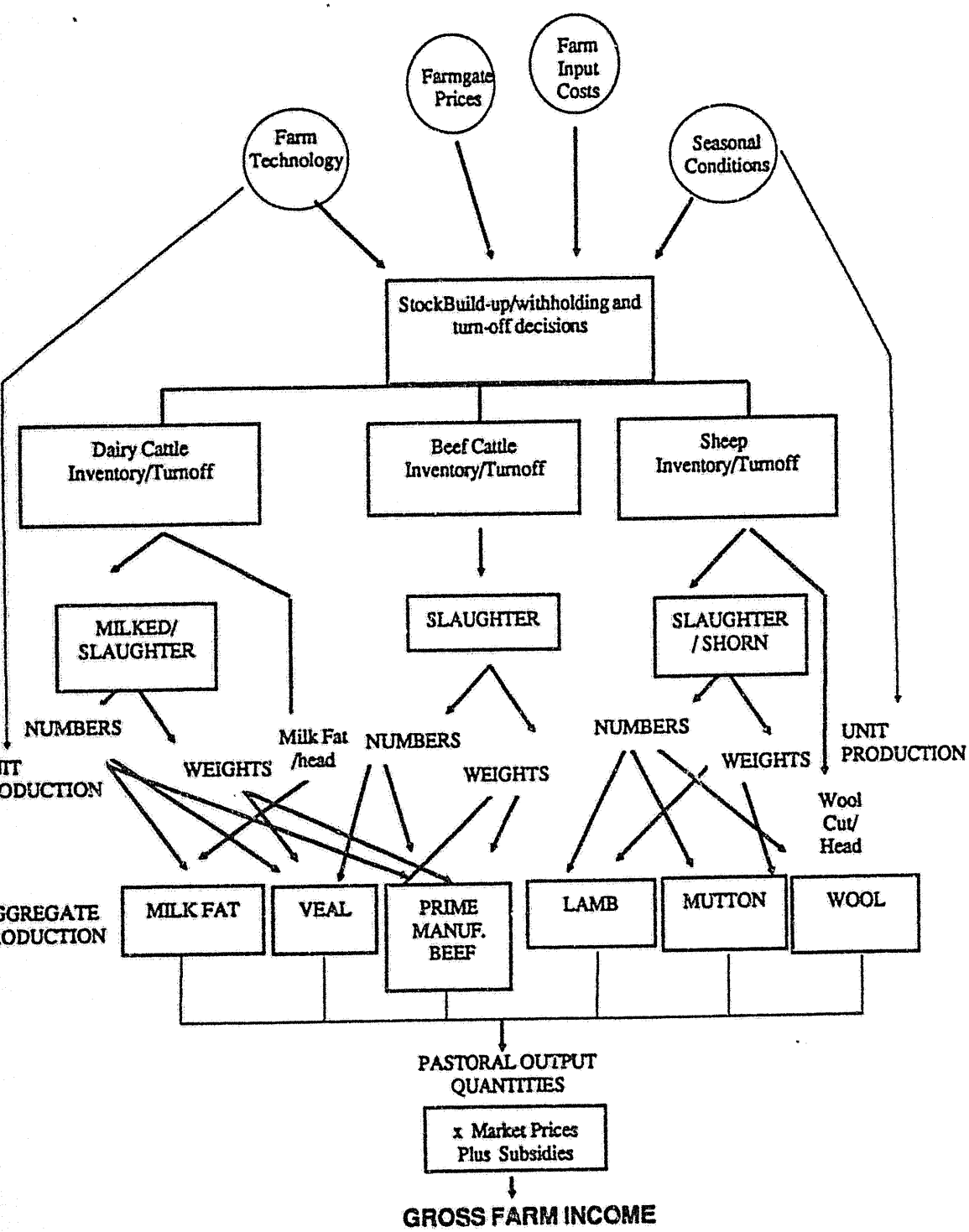
Conceptual Model

The model focuses on capturing the changes in the inventories and the level of aggregate production of the major pastoral outputs. The hypotheses to be tested is that world commodity prices, exchange and inflation rates and assistance policies together influence the returns and costs faced by farmers. These in turn determine farmer responses of output and inventory decisions which are also the function of opening farm capital stock, including livestock and available feed, along with farm technology and climatic factors. The overall conceptual framework of this model is provided as a flow diagram in figure 1 and is similar to the theoretical construct developed by Reutlinger (1966) and Jarvis (1974).

In the application of the theory of capital and investment to livestock supply studies (Jarvis, 1974), the livestock are viewed as capital goods and the producers as portfolio managers. Output in future periods can be increased only by increasing the size of the breeding flock or herd and/or withholding stock or delaying stock turn-off decisions. These decisions include, for example, number of cows milked, sheep shorn, animals reared and slaughtered, and those retained for later production. The inventory of breeding stock are the determining factors of next periods' birth of lambs and calves, which in turn determine lamb and veal production in the same period and beef, mutton, wool and milk fat production in subsequent periods. Here the time periods are years ending June 30.

Unit productivity includes factors such as stock weaned per animal mated, milkfat per cow milked, wool cut per sheep, and slaughter weight per animal. Unit productivity, and stock adjustment decisions determine farm production quantities. When multiplied by farmgate prices, (inclusive of any output assistance) a gross measure of farm income is derived. The available technology and weather conditions will influence both inventory decisions and unit productivities.

Figure 1: Supply and Investment Decisions on Pastoral Farms



Producers' decisions need to be first considered with respect to the enterprise mix of sheep, beef and dairy. Supply responses can then be further disaggregated by outputs of prime and manufacturing beef (from the beef and/or dairy sectors); veal and milk fat (from the dairy sector); and the joint products of lamb, mutton and wool (from the sheep sector). Thus, a multi-output characteristic is exhibited by both the sheep and dairy sectors in New Zealand and a multi-period sequential decision making is involved in all the three sectors modelled. This requires a block recursive structure and a dynamic simulation framework to capture the inter-relationships between the time periods and also the sectoral outputs.

The responses observed are the results of producers adjusting production decisions within given biological constraints, and in response to variable prices and weather. The output responses observed may not always follow the intuitive expectations. When prices rise, farmers may withhold stock from slaughter in order to build inventories (and hence future production) leading to an observed fall in output in the shortrun. This negative short-run supply response for livestock is a rational and characteristic outcome of farmers' decision making.

Improvements in Data and Model Specification

This theoretical and conceptual framework was adopted in the 'New Zealand pastoral supply model', (SriRamaratnam and Reynolds, 1989). The livestock response model was developed to enable medium-term forecasting and quantative analysis of the aggregate impact of prices, weather and possible government policies. In particular, it has been used to answer questions with respect to the effects of the economic liberalisation programme upon the agricultural sector. By applying the inventory closures inherent in the conceptual model to the available data sources, a significantly richer data base than used in earlier New Zealand livestock models (Laing and Zwart, 1983; Shaw, 1986) has been derived. In particular, slaughter data for each major age and sex category of each of sheep, dairy and beef livestock are elicited.

A major advance has been the delineating and constraining of separate measures of flows and transfers within the flocks and herds of New Zealand. First, the residual of the lamb drop which is promoted to the adult flock in year t+1 is derived directly. The proxy for this used until now have been ewes and male

hoggets on hand at 30 June, and these have shown significant differences. Secondly, the transfers from the dairy herd to beef production are derived directly for each category and found to be greater than earlier estimates. Finally, within the cattle herds, the demographic variables for cattle aged between 1 and 2 and over 2 years are differentiated for the first time. This advance will enable analysis of the break down of slaughter by type and give basis to understanding trends in the mix and level of output. Further analysis which involves a split of total beef to manufacturing and prime beef production is made possible.

A model has been developed and operationalised on a micro computer, within which it is possible to analyse and project aggregate livestock producer responses to changes in prices, costs and seasons. The price variables used in the model have been updated and refined to better reflect actual farmgate returns. Improved MAF estimates of the impacts of assistance on output have been utilised. Moreover, disaggregated indices of farm costs (by type of enterprise) and of seasonal conditions are made use of. On the basis of the conceptual model and the data available or derived, equations were estimated to explain inventory, turn-off, build-up, transfers and per unit production trends. By applying the derived statistics corrected for the implied breakdown, greatly improved fits on the turn-off behavioural equations are achieved (see Appendix tables B1-B3).The results presented represent work on model development and refinements carried out so far and are a potential advancement of earlier work by other studies on livestock numbers and production.

Model Results - Dynamic Multipliers

The model has been found to be stable, as seen from base simulations and model validation results reported elsewhere (SriRamaratnam and Reynolds, 1990) and the dynamic multipliers discussed in this paper. A list of important model variables (Appendix table A) and the behavioural equations, including the production identities and reported in the Appendix (tables B1-B3). The model is run on a large microcomputer and a

Table 2: Dynamic Multipliers[1] of Pastoral Supply Response

Impact on		Following a 10% increase in Farmgate Prices: Lamb	Mutton	Wool	Beef	Milkfat	Costs of Prod'n	Soil Moisture Stress Days
A.	**Lamb Production**							
	Impact	0.35	-0.40	-	-0.46	-	0.44	-0.13
	Interim	0.96	-	0.19	-0.72	-	-0.19	-0.67
	Final	0.16	-	0.14	-0.10	-	-0.17	-0.61
	Mutton Production							
	Impact	-1.67	-1.69	-1.26	-	-	0.99	1.20
	Interim	0.11	-0.11	0.07	-	-	-0.06	-0.20
	Final	0.05	0.001	0.04	-	-	-0.07	-0.001
	Wool Production							
	Impact	-	-0.28	0.30	-	-	-0.02	-0.58
	Interim	0.25	-0.23	0.16	-	-	-0.12	-0.37
	Final	0.11	-0.003	0.10	-	-	-0.12	-0.42
	Sheep Numbers							
	Impact	0.085	0.019	0.136	-0.03	-	-0.14	-0.49
	Interim	0.120	0.006	0.106	-0.07	-	-0.12	-0.44
	Final	0.110	0.003	0.097	-0.07	-	-0.12	-0.42
B.	**Beef Production**							
	Impact	1.49	0	-2.29	-2.10	-0.10	1.59	0.16
	Interim	-1.25	0	0	3.20	2.16	-0.68	-0.67
	Final	-0.004	0	0	0	0.22	-0.001	-0.01
	Beef Cattle Numbers							
	Impact	-0.67	0	0	0.19	1.29	-1.19	-0.36
	Interim	-0.37	0	0	0.35	0.15	-0.78	-0.11
	Final	0.001	0	0	0.007	0.12	0.003	-0.004
C.	**Milkfat Production**							
	Impact	-0.49	-	-	-	1.45	-1.90	-0.34
	Interim	-	-	-	-	0.10	-0.08	-0.01
	Final	-	-	-	-	0.05	-	-0.001
	Dairy Cattle Numbers							
	Impact	-	-	-	0.05	-0.02	-0.004	-0.02
	Interim	-	-	-	-0.09	0.09	-0.008	-0.02
	Final	-	-	-	-0.08	0.06	0.006	-0.002

1 A dynamic multipiler gives the impact of a designated once-off shock (a 10% rise in some product price, production cost or days of soil moisture stress) on some outcome (e.g. livestock numbers or production). The 'impact' multiplier records the response in the year in which the shock incurred, while the 'interim' multiplier records the outcome after the shock has worked its way through the system for three years. The 'final' multiplier records the outcome after the shock has stabilised - that is, long term effect.

Source: SriRamaratnam and Reynolds (1990)

more detailed discussion of the model specification was reported in an earlier paper (SriRamaratnam and The model has also been used for pastoral output projections in the medium term based on price, cost and seasonality assumptions made by within and outside sources.

The dynamic aspects of producer responses are particularly important for forecasting and policy analysis. A convenient way to summarise these model characteristics is through dynamic multipliers. They have been calculated by shocking the historical data with an isolated, one season's increase in a causal factor (ie prices, costs or weather), and observing the simulated impact on key response variables in the model (ie livestock numbers, turn-off and output), both in that season and following ones. As a set, dynamic multipliers summarise how producers have responded in the historical period, and this gives a basis from which we can forecast future responses to given prices, costs and weather.

An illustration of the interpretation of these multipliers can be seen in the example of responses of beef cattle numbers and production, (see table 3,B.) Following a 10% rise in beef prices, slaughter of cattle is reduced by (2.1%) to build up cattle numbers by 0.19% after 1 year and 0.35% after 3 years. In the medium term, the impact of increased inventory is reflected in a 3.2% increase in the slaughter of cattle and hence beef production.

It can also be seen from the multipliers tabulated that:

* Beef production may also be increased in the short run (1.5%) in response to a 10% lamb price increase, but then reduces in the medium term reflecting the switch over to greater lamb production;

* a high responsiveness to lamb and wool price increases by beef production and numbers in the short to medium term, and little in the long term;

* a 10% rise in milkfat prices increases beef cattle numbers (1.3%) in the short run and beef production (by +2.16%) in the medium term;

* a rise of 10% in costs of production and days of soil moisture stress increases slaughter in the year that costs increase, and this then gives rise to a reduction in cattle numbers and production in later years;

* a high responsiveness by mutton production to changes in lamb, mutton and wool prices in the short run;

* rise in input costs increases lamb and mutton production in the short run as slaughterings increase, but milkfat production is significantly reduced (-1.9%). In all cases, the medium and longterm effects are small;

* increasing days of soil moisture stress impacts positively on output by increasing slaughter but negatively through lower output per animal. Thus the overall impact of adverse weather has mixed effects on output levels in the short run depending if lower slaughter weights, wool cut per sheep or milk per cow is sufficient to offset the increase in slaughter. Lamb, wool and milkfat output falls because the unit productivity fall-off is more pronounced, whereas mutton and beef output rises since the increase in slaughter is more significant than the sheep and cattle slaughter weight reductions.

* each of sheep, beef and dairy cattle numbers decline in adverse seasons eg when days of soil moisture stress increase. However, the impact on dairy numbers is relatively small.

A significant finding from the study of aggregate producer responses is that the responsiveness to price changes was as predicted by the theoretical and conceptual model, but was estimated to be low. In many cases (eg the response to mutton price changes) the response was found not to be significant. Moreover, the model's response parameters and the multipliers estimated were lower than those obtained in a study of the Australian sheep industry using a similar model (Dewbre et al, 1985).

The explanation for this appears to be that New Zealand livestock producers have (in aggregate) limited ability to switch into cropping or horticulture enterprises in comparison to their Australian counterparts in

the wheat-sheep belt. This then explains why the total of all livestock carried has been relatively stable and why the changes in livestock enterprise mix have been comparatively much greater (as shown in earlier sections). In New Zealand, the choice is basically between alternate livestock enterprises and the farmers' decisions on mix depends on the longer term profitability of various combinations of sheep, beef or dairy enterprises. Climatic changes, costs, and capital investment trends will determine the level of total livestock carried.

4 IMPACT OF OUTPUT ASSISTANCE ON PASTORAL ACTIVITIES

The supply response model of New Zealand pastoral agriculture outlined so far in this paper, was utilised to study the effects of a scenario of no output assistance to the pastoral activities during the 1980s. The structural characteristics of the model, with respect to the key behavioural equations in the sheep, beef and dairy industries, were also investigated to analyse the impact of assistance. A dynamic simulation approach was used to evaluate the nature of enterprise mix and stock numbers which would have been realised in the absence of such assistance.

Did Producer Behaviour Change?

It was necessary to study whether there was a structural change (ie a change in producer behaviour) associated with either the introduction or the removal of the price supports paid to farmers in the early 1980s. It was found that the model's estimated response parameters remained stable. The hypothesis that there had been a change in the response parameters during the period of assistance (1979-1984) was rejected.

The conclusions that can be drawn are that changes to farmgate prices and seasonal conditions facing the New Zealand livestock sector can and have adequately explained producers' aggregate supply responses. Producers' behaviour before and since liberalisation has not changed, it was only the environment faced which changed. The output and livestock inventory changes observed can be explained as rational and consistent responses to prices, given the seasonal conditions and costs prevailing over the period.

Such a finding is not surprising given the size of actual changes in farmgate prices. Because much of the assistance was offset by lower world prices and increasing on-shore margins, the output prices farmers were reacting to had not risen significantly. Moreover, any rises which did occur were countered by increasing farm input costs. Against this background, livestock numbers were unlikely to expand beyond the 1982 peak. The decline in the ye · to June 1983 was associated with the 1983 drought. Better prices during 1984/85 as a result of higher world prices, the 20% devaluation, and continued subsidies provided the incentive to increase output. Upon removal of the subsidies, farmers have run down the flock but have maintained high output levels in the transition due to the slaughter of capital stock.

Simulation of a No Assistance to Output Scenario

The nature of output assistance to lamb, mutton, wool, beef, and milkfat was illustrated in figure 1 by contrasting the level of price offered by the market in relation to what was paid to the farmers during the 1980s. The pastoral supply response was modelled using the farmgate prices in the base analysis. The market prices with no output assistance were utilised to simulate the effects of this scenario as an application of the model. The results are presented below and compared to the results of other studies while their implications are discussed in section 5.

Past studies have examined the effects of the removal of assistance to the pastoral sector (Laing & Zwart 1983b; Johnson 1986; Griffith and Grundy, 1988). But as pointed out previously, these studies were undertaken with models estimated using data up to 1981, or 1985 with no changes in original model specification, while assistance was provided to the pastoral activities well into 1986. They also concentrated on the assistance provided through the SMPs (Supplementary Minimum Prices) only, whereas the total output assistance delivered during this period included subsidies to stabilisation accounts as well. These studies were also applications of the Laing and Zwart model (1983b) which also included the Farm Income and Investment as well as the Export Market sub-models, in addition to the pastoral Livestock Inventory and Production System which alone is used in this study.

TABLE 4: COMPARISON OF THE EFFECTS OF PASTORAL OUTPUT ASSISTANCE ON INVENTORY AND OUTPUT MIX

I	INVENTORY (Millions)	1980	1981	1982	1983	1984	1985	1986	1987	1988
(a)	Sheep Assist	66.9	67.4	69.6	68.5	67.9	66.5	65.3	63.8	62.4
	No Assist	66.9	67.0	66.4	64.9	65.0	64.0	63.9	63.1	60.7
(b)	Beef Cattle Assist	5.12	5.08	4.78	4.31	4.32	4.40	4.75	4.70	4.81
	No Assist	5.04	5.06	4.66	4.50	4.70	5.05	5.05	4.90	5.02
(c)	Dairy Cattle Assist	2.97	2.98	3.05	3.09	3.14	3.21	3.25	3.25	3.26
	No Assist	2.98	3.02	3.04	3.06	3.12	3.19	3.23	3.23	3.26
(d)	Total Stock Units Assist	102.5	102.6	103.7	100.6	100.6	99.9	100.8	99.2	98.5
	No assist	102.2	102.4	100.4	98.1	99.6	100.8	100.9	99.3	98.0
II	OUTPUTS ('000's TONNES)									
(a)	Lamb Assist	401.7	435.7	432.6	461.0	455.3	464.6	413.9	413.4	409.6
	No Assist	402.2	435.1	435.8	421.8	397.7	407.4	399.2	400.0	390.8
(b)	Mutton Assist	168.9	190.5	186.9	193.9	189.1	196.0	150.6	175.3	175.6
	No Assist	169.4	190.4	180.9	196.8	200.3	182.2	136.9	169.0	173.6
(c)	Wool Assist	318.8	324.9	313.9	306.1	305.6	320.6	308.5	310.1	302.7
	No Assist	319.1	323.3	303.4	294.8	296.8	302.7	302.3	306.7	294.5
(d)	Beef Assist	451.3	512.2	506.1	527.2	418.3	484.7	420.2	518.7	528.3
	No Assist	450.3	470.8	488.2	522.6	376.5	469.4	495.5	560.3	616.7
(e)	Milkfat Assist	314.0	310.0	316.2	320.1	354.4	364.0	367.5	349.2	366.6
	No Assist	310.0	312.0	315.6	316.6	365.3	371.2	375.2	351.3	379.1

The Inventory and output levels reported for 'Assist" are base run results, while the 'No Assist" results are from the corresponding simulation.

Due to their timing in 1983 and 1986 respectively, these studies by Laing and Zwart and Johnson, hence could not incorporate the actual level of total output assistance provided to the different pastoral activities. This has been possible in this paper, in order to compare the impacts of with and without assistance scenarios. In the absence of the knowledge of actual payments to the farmers since 1982 and 1985, the subsequent levels of assistance were held by the above studies, at the level prevailing in 1982 and 1985 respectively. But it is quite evident now that most of the output assistance to the pastoral outputs was provided between 1982 and 1986, particularly in the case of lamb and mutton. The results from the application of the pastoral model used in this paper using data up to 1988, are therefore, comparisons with base historical simulations, while those results from past studies were comparisons of essentially two or more forecast simulations outside the sample period.

The inventory and output mix in the pastoral sector without output assistance (No Assist) was simulated using the model and is compared to the actual levels (historical data) under assistance provided (Assist) during the 1980-1988 period (Table 4). Results show that sheep numbers which approached 70 million under assistance, would not have been higher than 67 million without it. Throughout the 1980-1988 period, sheep numbers would have been between 1/2 - 3-1/2 million lower without the output assistance provided for sheep farming. In 1988, sheep numbers would have been about 2 million fewer at around 61 million.

Beef cattle numbers would have been somewhat lower during the early 1980s with no output assistance, but since 1983 would have been between 190,000 (ie, in 1983) to 650,000 (ie, in 1985) greater if there had been no output assistance during the mid 1980's when sheep farming was subsidised. In 1988, the beef numbers would have been more than 200,000 greater with no assistance, at over 5 million. Fewer beef cattle during the early 1980's with no pastoral assistance is the result of some assistance provided for beef during this period (ie, 1981-1983), before sheep production begun to be heavily assisted in both absolute and relative terms.

Dairy numbers in the absence of price distortions are estimated as likely to have been marginally higher during the early 1980s and then since 1982 would have been slightly lower until 1988, when the two

scenarios result in almost equal numbers. The dairy sector received appreciable levels of assistance during 1982 and 1983, but most of it was from programmes besides the SMP scheme.

Total stock units (table 3) would have been lower under no assistance during most years of the 1980s with the difference ranging between about quarter of a million to almost 3.5 million in 1983. Total stock units would not have reached anywhere near 104 million as it did in 1982 without output assistance and in 1988 the level of total stock units would have been about 0.5 million fewer than the 98.5 million realised with assistance. In 1983, the total stock units would have been very close to the current level of about 98.0 million with no assistance. During 1985-1987 total stock units would have been actually higher under no assistance.

As regards output, lamb production would have been between 0-5 thousand tonnes greater during 1980-1982 with no assistance but since 1983 would have been substantially lower (table 4). From 1983 to 1985, lamb production would have been progressively lower in each year and almost 60,000 tonnes less in 1985. Since 1986, production would have been between 15-20 thousand tonnes less in each year. Mutton production also would have been lower with no output assistance in most years but not depressed to the same level as lamb production. The difference in mutton production was between 2-15 thousand tonnes, with the greatest reduction being in 1985 when mutton output with assistance was 196 thousand tonnes (table 4). Wool production also would have been between 5-20 thousand tonnes less in most years. Output assistance to wool was provided mainly during 1982-84. In 1988, wool production would have been about 8 thousand tonnes less.

Beef production would have been between 1-18 thousand tonnes less from 1980-85 with no output assistance, corresponding to the lower beef cattle numbers during 1980-82 and the subsequent build up of stock to 1985. But since 1986, with market prospects improving for beef, beef production would have been between 40-90 thousand tonnes greater in each year (table 4). Dairy milkfat production would have been greater with no output assistance since 1984, but the amount of difference is much smaller than for beef. It would have been between 2-15 thousand tonnes higher in each year during this period in the absence of pastoral output assistance.

Higher beef output and dairy production in recent years have been the foregone income opportunities for the New Zealand pastoral sector due to the assistance provided, particularly for sheep farming during the 1982-86 period. Higher lamb, mutton and wool production resulting from a higher level of sheep farming activity during the assistance period did not compensate for above past losses as well as losses in the future due to the misallocation of resources in the pastoral sector.

5 SUMMARY AND IMPLICATIONS OF MODEL RESULTS

The pastoral Supply Response Model used in this study has been developed over the past year. The objective was to better represent the main New Zealand pastoral activities within an econometric framework, and thus provide a tool to study the effects of past and potential future policy on agriculture. In this paper, the pastoral model which uses improved data updated to 1988, and model specification reflecting this advancement, was employed to investigate the full impact of pastoral output assistance during the early part of 1980s. Past studies have been unable to do this well due to either their ex-ante nature, shortcomings of data and model specification, and/or the failure to consider total output assistance, not just SMPs alone.

While the provision of output assistance did not change farmers' response patterns, what it did do was to lead to some switching between enterprises. Farmers were faced with higher sheepmeat prices (relative to beef and dairy prices) than would have been the case in the absence of output assistance. Farmers would have been expected to respond by increasing overall livestock numbers, and particularly sheep at the expense of beef or dairy cattle. The test which was conducted with the model showed that, in the absence of any output assistance (farmers facing market as opposed to assisted farmgate prices); total livestock numbers would have fallen only marginally while, the mix of cattle numbers would have risen at the expense of sheep numbers. Consequently, during the late 1980s, the output of beef and veal would have been higher. This is significant because over this period, beef prices have been much more favourable than sheepmeat prices. Thus, the opportunity cost of the assistance was the value of this production foregone because of the pattern of output assistance adopted.

The results of dynamic simulations comparing the effects of output assistance, suggest that, sheep numbers on the average would have been about 2.5% fewer and lamb production about 5% less for the 1980-88 period, in the absence of assistance. Mutton production would have been only about 1% lower and wool production almost 2.5% less on the average.

Beef cattle numbers nevertheless, would have been about 4% higher and beef production around 2% more during the whole period, but almost 14% greater during the last few years. Dairy cattle numbers on the average would have been almost the same, but dairy milkfat production would have been more than 2% higher in the absence of assistance mainly due to greater milkfat yield. Total livestock units, excluding deer and goats, however, would have been about 1.5% lower in the absence of output assistance.

Overall implications of the results suggest that the nature of enterprise mix, stock numbers and the level of production among the major pastoral activities in New Zealand would have been considerably different if there had been no output assistance through Government policy measures. The opportunity cost of income foregone due to the lower production of higher valued beef and dairy milkfat output during the period (1980-88) imply that the cost of resource misallocation arising from Government policy, which favoured sheep meats production has been quite high. This is so in spite of the higher lamb, mutton and wool production during the assistance phase. The true market value for these products during this period has been quite low in most years, compared to beef and milkfat. Even the higher total stock units of about 1-2% achieved due to pastoral assistance, cannot be sufficient economic grounds for such assistance as the resulting pattern of resource allocation was out of line with the market realisation and it has also led to a double cost of assistance.

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APPENDIX TABLE A: LIST OF VARIABLES IN THE PASTORAL SUPPLY RESPONSE MODEL

SHEEP SECTOR

I ENDOGENOUS (From Behavioural Equations)

(a)	KE	-	Breeding Ewes ('000's)
(b)	LM	-	Lambs Marked ('000's)
(c)	TOL	-	Lamb Turnoff ('000's)
(d)	DL	-	Lamb Deaths ('000's)
(e)	TOAS	-	Adult Sheep Turnoff ('000's)
(f)	DS	-	Adult Sheep Deaths ('000's)
(g)	SHW	-	Sheep Wintered (Millions)
(h)	SWL	-	Slaughter Weight of Lambs (kg)
(i)	SWAS	-	Slaughter Weight of Adult Sheep (kg)
(j)	FWL	-	Fleece Weight of Wool (kg)

II ENDOGENOUS (From Identities)

(a)	KS	-	Total Sheep ('000's) = KAS + KEWH
(b)	KAS	-	Adult Sheep ('000's)
(c)	KOS	-	Other Sheep ('000's) = KAS - KE
(d)	KEWH	-	Ewe & Wether Hoggets ('000's)

III EXOGENOUS

(a)	LES	-	Live Exports of Sheep ('000's)
(b)	LEL	-	Live Exports of Lambs ('000's)
(c)	WS	-	Weather Index for Sheep (No of days of moisture stress/year)
(d)	PPIS	-	Prices paid Index Sheep (1981=100)
(e)	PL	-	Farm gate price of Lamb (cts/kg)
(f)	PM	-	Farm gate price of Mutton (cts/kg)
(g)	PW	-	Farm gate price of wool (cts/kg)

BEEF SECTOR

(a)	KCHPB	-	Cows and Heifers put to the Bull ('000's)
(b)	CVWB	-	Beef Calves Weaned ('000's)
(c)	KYHB	-	Young Beef Heifers <1 year ('000's)
(d)	KYSB	-	Young Steers and Bulls < 1 year ('000's)
(e)	SLV	-	Vealer/yearling slaughter ('000's)
(f)	SWV	-	Slaughter wt of Vealers (kg)
(g)	SWAC	-	Slaughter wt of Adult Cattle (kg)
(h)	SLHT	-	Heifers (1-2 yrs) Slaughter ('000's)
(i)	SLST	-	Steers (1-2 yrs) Slaughter ('000's)
(j)	SLCT	-	Cows (>2yrs) Slaughter ('000's)
(k)	SLBT	-	Bulls and Steers (>2 yrs) Slaughter ('000's)

(a)	KCB	-	Beef Cows >2yrs ('000's)
(b)	KHB	-	Beef Heifers 1-2 yrs ('000's)
(c)	KSB	-	Beef Bulls & Steers >2yrs ('000's)
(d)	KISB	-	Beef Immature Bulls & Steers 1-2 yrs ('000's)

(a)	DCB	-	Death of Beef Cows ('000's)
(b)	DHB	-	Death of Beef Heifers ('000's)
(c)	DSB	-	Deaths of Beef Bulls & Steers ('000's)
(d)	DISB	-	Deaths of Immature B&S ('000's)
(e)	DCVB	-	Death of Beef Calves ('000's)
(f)	LEB	-	Live Exports of Beef Cattle ('000's)
(g)	WB	-	Weather Index for Beef (No. of days)
(h)	PPIB	-	Prices Paid Index Beef (1981=100)
(i)	PPB	-	Farm gate price of Prime Beef (cts/kg)
(j)	PMB	-	Farm gate price of Manufacturing beef (cts/kg)

DAIRY SECTOR

(a)	KCHMD	-	Cows and Heifers in Calf and/or Milk ('000's)
(b)	CVBD	-	Dairy Calves Born ('000's)
(c)	KYHD	-	Young Dairy Heifers <1 year ('000's)
(d)	KYBD	-	Young Dairy Bulls <1 year ('000's)
(e)	SLCV	-	Bobby Calf Slaughter ('000's)
(f)	SWCV	-	Slaughter wt of Bobby Calf (kg)
(g)	MPCOW	-	Milkfat per cow (kg)
(h)	TCDB	-	Transfer of Cows (>2 yrs) from Dairy to Beef
(i)	TBDB	-	Transfer of Bulls (>2 yrs) from Dairy to Beef
(j)	THDB	-	Transfer of Heifers (2 yrs)
(k)	TIBDB	-	Transfer of I.Bulls (2 yrs)

(a)	KCD	-	Dairy Cows >2yrs ('000's)
(b)	KHD	-	Dairy Heifers 1-2 yrs ('000's)
(c)	KBD	-	Dairy Bulls >2yrs ('000's)
(d)	KIBD	-	Dairy I. Bulls 1-2 yrs ('000's)

(a)	DCD	-	Death of Dairy Cows ('000's)
(b)	DHD	-	Death of Dairy Heifers ('000's)
(c)	DBD	-	Death of Dairy Bulls ('000's)
(d)	DIBD	-	Death of I. Dairy Bulls ('000's)
(e)	DCVD	-	Death of Dairy Calves ('000's)
(f)	BCVRD	-	Dairy Calf Retentions for Beef ('000's)
(g)	LED	-	Live Exports of Dairy Cattle ('000's)
(h)	WD	-	Weather Index for Dairy (No of days)
(i)	PPID	-	Price Paid Index Dairy (1981=100)
(j)	PD	-	Farm gate price of milk fat (cts/kg)
(k)	PBCV	-	Average Pool price of Bobby Calves ($/hd)

APPENDIX TABLE B1: SHEEP SECTOR BEHAVIOURAL EQUATIONS (1962-1988)

												R^2	F	DW
(A)	INVENTORY ADJUSTMENTS													
(i)	BREEDING EWES KE =	-9236.4 (-4.03*)	+	0.8367 KS (24.62***)	-	45.14 WS (2.37*)	+	842.1 RAPLWPP (1.48)				0.960	208.9***	1.51
(ii)	LAMBS MARKED LM =	2960.4 (1.44)	+	0.993 KEL (27.5***)	-	81.57 WSL (-5.209***)	+	1147.7 APLPP (1.31)	-	2108.4 APPBPP (-2.88**)		0.976	266.9***	2.38
(B)	TURN OFF/SLAUGHTER													
III	LAMB TURNOFF TOL =	-8403.9 (-2.45**)	+	0.8481 LM (16.4***)	+	28.24 WS (1.28)	+	965.8 APLPP (0.530)	-	2835.8 APMPP (-1.408*)		0.945	112.8***	1.48
IV	LAMB DEATHS DL =	-33.7 (-0.199)	+	0.0359 LM (9.488***)	+	0.665 WSL (0.362)						0.774	45.4***	2.50
V	ADULT SHEEP TURNOFF TOAS =	7313.8 (2.49**)	+	0.0643 KASL (1.83*)	+	46.109 WS (3.080***)	-	701.10 APWPP (-2.01**)	-	776.2 APLMPP (-1.92*)		0.570	9.59**	1.99
VI	DEATH OF SHEEP DS =	-33.3 (-0.12)	+	0.0558 KASL (9.819***)	+	9.103 WS (3.072***)	+	4.451 WSL (1.557*)	-	190.87 APMPP (1.389*)		0.854	39.2***	1.42
VII	SHEEP WINTERED SHW =	3.57 (1.21)	+	0.0015 KASL (24.2***)	-	0.0118 WSL (-0.545)	+	0.620 RPWPPL (1.57*)				0.968	265.3***	2.05
(C)	PER UNIT PRODUCTION													
VIII	SLAUGHTER WEIGHT OF LAMBS SWL =	16.68 (17.5***)	-	0.0169 WS (-2.939***)	-	0.357 APLPP (-1.404*)	-	0.028 T62 (-2.952**)				0.436	7.7**	2.29
IX	SLAUGHTER WEIGHT OF SHEEP SWAS =	36.0 (15.0***)	-	0.0569 WS (3.054***)	+	0.6294 APWPP (1.916*)	-	0.178 T62 (-6.822***)				0.768	29.7***	1.41
X	FLEECE WEIGHT OF WOOL FWL =	5.23 (35.2***)	-	0.0081 WS (-3.776***)	-	0.0093 WSL (-4.426***)	+	0.081 APWPP (1.76*)	-	0.301 APMPP (-2.51**)		0.633	12.2***	2.59
XI	SLIPE WOOL PER HEAD SLWLH =	1.020 (8.11***)	-	0.0028 WS (-1.737*)	-	0.0022 WSL (-1.357*)	-	0.0723 APWPP (-2.103**)	+	0.388 APLPP - 0.021 D86 (5.00***) (-0.203)		0.535	6.9**	1.43
(D)	CLOSURE REQUIREMENT FOR SHEEP CRS =	534.4 (1.78)	+	4.823 SLPF (2.32)	+	1550.3 SD86 (1.89)	-	3516.7 SDLIS (-4.28)				0.498	9.6**	2.09

SHEEP SECTOR PRODUCTION IDENTITIES

LAMB PRODUCTION QL	=	(LAMB TURNOFF TOL	-	LIVE LAMB EXPORT) LEL	*	LAMB SLAUGHTER WEIGHT SWL
MUTTON PRODUCTION QM	=	(ADULT SHEEP TURNOFF TOAS	-	LIVE SHEEP EXPORTS) LES	*	SHEEP SLAUGHTER WEIGHT SWAS
SHORN WOOL PRODUCTION QSWL	=	SHEEP WINTERED SHW			*	FLEECE WEIGHT OF WOOL FWL
SLIPE WOOL PRODUCTION QSLWL	=	(SLAUGHTER OF LAMB SLL	+	ADULT SHEEP) SLAS	*	SLIPE WOOL PER HEAD SLWLH
TOTAL WOOL PRODUCTION QTWL	=	(SHORN WOOL QSWL	+	SLIPE WOOL) QSLWL	+	WOOL ON SKINS QWLSK

Values in parentheses are t-statistics, with the astreisks (*) representing the level of significance at the 10% (*), 5% (**) and 1% (***) level. The same applies to the F statistics.

APPENDIX TABLE B2: DAIRY SECTOR BEHAVIOURAL EQUATIONS (1973-1988)

												R^2	F	DW
(A)	INVENTORY ADJUSTMENTS													
I	COWS AND HEIFERS IN CALF AND/OR MILK KCHMD	=	663.5 (2.14**)	+	0.6736 (5.89***)	KCHTDL +	60.69 (1.078)	RPDPP -	125.1 (-1.604*)	APLPP		0.862	32.3***	1.92
II	DAIRY CALVES BORN CVBD	=	555.4 (1.85**)	+	0.5128 (4.538***)	KCHTDL +	4.9645 (0.117***)	RPDPP +	1.223 (2.975***)	APMB -	0.346 (-0.319) WDL	0.830	19.3***	1.46
III	YOUNG DAIRY HEIFERS KYHD	=	-209.7 (-2.78**)	+	0.302 (8.95***)	CVBD -	0.319 (-1.02)	WD +	54.2 (4.399***)	APPBPP		0.849	29.1***	2.16
IV	YOUNG DAIRY BULLS KYBD	=	37.8 (11.1***)	+	0.4937 (0.492)	RPDPP +	0.0221 (2.584**)	APMB				0.333	4.8**	1.46
(B)	TURN OFF/SLAUGHTER													
V	BOBBY CALF SLAUGHTER SLCV	=	3307.0 (8.02***)	-	1.015 (-5.52***)	CVBD +	2.204 (1.305*)	WD -	272.1 (-3.404**)	APMBPP		0.693	12.3***	1.46
(C)	PER UNIT PRODUCTION													
VI	SLAUGHTER WT OF BOBBY CALF SWCV	=	31.9 (3.4***)	+	0.0378 (1.416*)	WDL -	3.095 (-2.558**)	D80 -	0.172 (-1.375*)	T72		0.821	23.9***	2.75
VII	MILK FAT PER COW MPCOW	=	-253.3 (-2.1**)	-	0.2028 (-1.856**)	WD +	0.0621 (1.398*)	PD -	0.4535 (-2.665**)	PPID +	5.187 T72 (3.049***)	0.822	18.3***	2.14
(D)	TRANSFER OF CATTLE FROM DAIRY TO BEEF USE													
VII	IMMATURE BULLS TIBDB	=	-42.8 (-6.7***)	+	1.77 (1.96***)	KYBDL +	0.659 (1.09)	RPPBPP				0.906	73.6***	1.85
IX	BULLS TBDB	=	-9.12 (-2.39**)	+	1.57 (4.27***)	KIBDL +	2.815 (1.62*)	RPMBPP				0.593	12.0**	1.89
X	HEIFERS THDB	=	-109.8 (-1.54*)	+	0.225 (1.695*)	KYHDL +	14.25 (1.16)	RPDPP				0.439	2.0*	1.68
XI	COWS TCDB	=	-117.9 (-0.60)	+	0.882 (1.943**)	KHDL +	80.31 (0.512)	RPPBPD				0.452	2.2*	1.45

DAIRY SECTOR PRODUCTION IDENTITIES

TOTAL MILK FAT PRODUCTION QML	=	COWS AND HEIFERS IN CALF AND/OR MILK KCHMD	*	MILK FAT PER COW MPCOW
BOBBY VEAL PRODUCTION QBV	=	BOBBY CALF SLAUGHTER SLCV	*	SLAUGHTER WT OF BOBBY CALF SWCV

Values in parentheses are t-statistics, with the astreisk (*) representing the level of significance at the 10% (*), 5% (**) and 1% (***) level. The same applies to the F statistics.

APPENDIX TABLE B3: BEEF SECTOR BEHAVIOURAL EQUATIONS (1973-1988)

																				R^2	F	DW
(A)	**INVENTORY ADJUSTMENT**																					
I	**COWS AND HEIFERS PUT TO THE BULL**																					
	KCHPB	=	-65.9 (-0.38)	+	0.689 (11.023***)	KCHEL	-	2.256 (-1.00)	WB	+	257.5 (3.179***)	APPBPP							0.907	49.7***	1.49
II	**BEEF CALVES WEANED**																					
	CVWB	=	38.7 (0.76)	+	0.8025 (33.44***)	KCHPBL	-	1.753 (-2.738**)	WBL	+	35.37 (1.506*)	APPBPP							0.988	411.3***	1.57
III	**YOUNG BEEF HEIFERS RATIO**																					
	KYHCB	=	0.430 (9.89***)	+	0.00003 (1.173)	CVWB	-	0.0001 (-3.724***)	BCVRD	+	0.0003 (2.367**)	PPIB							0.689	12.1***	2.96
(B)	**PER UNIT PRODUCTION**																					
V	**SLAUGHTER WT OF VEALERS**																					
	SWV	=	-751.2 (-3.25**)	-	0.138 (-0.67)	WBL	-	0.939 (3.284**)	PPIB	+	11.95 (3.72**)	T72							0.534	6.7***	1.38
VI	**SLAUGHTER WT OF ADULT CATTLE**																					
	SWAC	=	247.7 (18.14***)	-	21.65 (-1.62*)	SLYOT	-	0.399 (-1.971**)	WB	+	225.9 (3.78***)	RPMBPW							0.515	5.0**	2.93
										-	146.8 (-3.55***)	RPPBPD									
(C)	**TURN OFF/SLAUGHTER**																					
VII	**VEALER/YEARLING SLAUGHTER**																					
	SLV	=	106.5 (3.08***)	+	0.139 (0.762)	WB	-	0.318 (-4.03***)	APPB	-	0.002 (-0.70)	SLPV	-	30.64 (-3.42)	D80				0.949	70.5***	1.39
VIII	**SLAUGHTER NUMBERS OF ADULT CATTLE : SLAC = SLHT + SLST + SLCT + SLBT**																					
(i)	**HEIFERS**						SLAUGHTER POOL															
	SLHT	=	-794.7 (-2.43**)	+	0.134 (0.34***)	SLPH	+	23.7 (1.23)	APPBPP	-	242.4 (-2.38**)	APLPP							0.434	4.8*	1.63
(ii)	**STEERS**																					
	SLST	=	225.5 (0.73)	+	0.272 (1.93*)	SLPS	+	100.9 (1.79*)	APPBPP	-	227.3 (-2.81**)	APLPP							0.633	13.5**	1.48
(iii)	**COWS**																					
	SLCT	=	-1414.6 (-1.312*)	+	0.813 (2.968***)	SLPC	-	0.759 (-0.280)	APMB	-	176.2 (-1.96*)	RPDPP	+	4.51 (2.71**) + 2.342 (0.983)	APL WB				0.770	11.1***	2.14

APPENDIX TABLE B3: CONT'D

(iv) BULLS

SLBT	=	-706.9 (-2.18**)	+	1.003 (4.979***)	SLPB	+	52.6 (1.49)	APMBPP +	3.21 (1.34)	WB	0.607	8.7***	1.80

BEEF OUTPUT/PRODUCTION IDENTITIES

YEARLING VEAL PRODUCTION QYV	=	VEALER/YEARLING SLAUGHTER SLV	*	SLAUGHTER WT OF VEALERS SWV
TOTAL VEAL PRODUCTION QTV	=	BOBBY VEAL PRODUCTION QBV	+	YEARLING VEAL PRODUCTION QYV
TOTAL BEEF PRODUCTION QB	=	SLAUGHTER OF ADULT CATTLE SLAC	*	SLAUGHTER WTS OF ADULT CATTLE SWAC

Values in parentheses are t-statistics, with the astreisks (*) representing the level of significance at the 10% (*), 5% (**) and 1% (***) level. The same applies to the F statistics.