ECONOMIC RELATIONSHIPS WITHIN

THE JAPANESE FEED AND LIVESTOCK SECTOR

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PREFACE

This report is based upon work carried out by Masaru Kagatsume over the period 1980 to 1982 while he worked as a graduate fellow in the AERU. Dr Zwart of the Department of Agricultural Economics and Marketing at the College has been involved with the Unit's research programme into Japanese Agricultural Policy and the inter-relationships between Japan and New Zealand. This research programme has been financially supported by the Japan Advisory Committee.

The present report describes an attempt to measure in quantitative terms the impacts of differing Japanese policies concerning the balance of imported final products and imported feedstuffs.

Other publications emanating from this research programme include Discussion Papers No's 41, 47 and 57, all of which discuss Japanese food policy and implications for New Zealand.

P D Chudleigh
Director

SUMMARY

In analysing New Zealand's problems of access to Japanese markets for livestock products, there has been considerable discussion about alternative import policies. Attempts to analyse alternative Japanese policies, which could improve welfare for Japanese producers and consumers, while at the same time increasing access for New Zealand products, have been dependent on understanding the interactions which exist within the Japanese livestock sectors. The aim of this study is to provide estimates of some of the quantitative information which is necessary to analyse these problems.

The study develops a twenty-three equation econometric model which measures the interactions between the supply and demand for beef and dairy products, and the associated impacts on the feed grain sector in Japan. The production and consumption of livestock products is seen to be influenced to a marked extent by policy variables which are under control of the Japanese Government, or quasi governmental institutions. These variables influence both the price and level of imports of beef and dairy products, and are seen to play a major role in these markets. As might be expected, the short-run implications of changes in the policy variables are often relatively small, but longer responses appear to be more diverse and complex.

The model clearly demonstrates the implications of following a policy which attempts to increase domestic prices. It is shown that for both beef and dairy products, a policy of increasing price support in an attempt to increase producer incomes, would cause production to expand and prices to fall. The long-run outcome of such changes is shown to be an increase in stocks and the termination of imports.

Policies which liberalise the imports of products were shown to have beneficial impacts for New Zealand exports, but these effects appear to differ between the products. In general, the results showed that with liberalisation New Zealand's share of the import market would increase relative to Australia's, but it must be remembered that in some cases New Zealand's share of the market is substantially lower than that of Australia, the major competitor for New Zealand's livestock products. In the case of beef imports, and to a lesser extent dairy imports, the model has identified the trade-offs which exist in Japan between the imports of finished products and livestock feeds. These trade-offs are important in any analysis of food security for self-sufficiency in Japan.

CHAPTER 1

INTRODUCTION

In recent years there has been considerable discussion about the effects of Japanese agricultural policy on the agricultural trade between Japan and Australia and New Zealand. This discussion has suggested that Japan's current policy of protecting livestock producers has led to a reduction in agricultural trade, and in the welfare of consumers within Japan. Alternative policies which would guarantee the same level of income for agricultural producers, and yet increase consumer welfare, have been suggested in the past (Anderson (1982), Hayami (1979), Kagatsume (1980) and Kitson (1979)). Alternative policies in general involve a trade-off, between domestic consumption and self-sufficiency in agricultural products, or between imports of feed-grains and finished products. The changes which have been suggested are sometimes dramatic and it is difficult to estimate the actual trade-offs that are involved.

The aim of this study is to aid in quantitative evaluation of alternative proposals for the agricultural trade between Japan and New Zealand. The report deals specifically with the development of an econometric model of the Japanese feed and livestock sectors.

Because the Japanese beef and dairy sectors are highly dependent on imported feed grains, it is important to consider the trade-offs between imports of meat and dairy products from New Zealand and imports of livestock feeds from the United States. Self-sufficiency and food security are stated objectives of Japanese agricultural policies, and yet the high level of dependence on imported feed stuffs means that Japan is vulnerable to changing conditions in international feed grain markets. In this situation, it has been argued that Japan should adopt a more flexible importing policy which has a reasonable balance between the import of final products and inputs such as feed. The mathematical model developed in this study is an attempt to measure the trade-offs which exist between these sectors.

Chapter 2 of the paper provides a brief outline of the general structure of these sectors and later chapters discuss in more detail the methodology used in the development of the econometric model and the derivation of policy multipliers. The final part of the paper presents and discusses the multipliers which describe the dynamic impacts of changes in major policy variables in Japan. Such variables include the guaranteed prices and import quotas which are fixed by policy making authorities in Japan.

CHAPTER 2

THE ECONOMETRIC MODEL

2.1 Introduction

The model developed in this study can be divided into three general components; the dairy and beef models are self-contained simultaneous equation models of the supply and demand for dairy products and beef products respectively, and the feed grain component of the model essentially captures the derived demand for feed from both of the above sectors. In the present version of the model, the supply and demand for other meat products such as poultry and pork and fish are presumed to be predetermined. Each of these major sectors of the model are broken into sub-models which represent major product types within the industry concerned. The dairy sector model is disaggregated into a raw milk or drinking milk sub-sector and a more general milk products sub-sector. The beef sector model is also made up of two major components; the wagyu beef sub-sector, and the dairy beef sub-sector. The role of the dairy sector in providing beef calves for the beef sector is an important cross-linkage between the two major product types in the model. A schematic outline of the overall model is shown in Figure 1.

The feed grain sector is linked to the livestock sectors by the demand for feed from the total number of cattle in Japan. The demand for feed is made up of two major components, the demand for unprocessed feed and the demand for processed or compound feeds. Although an aggregate relationship is included, no attempt is made in the model to explain domestic feed grain production in any detail. An equation is included however, to explain imports of feed grains.

The following sections briefly outline the structure and major components of these sectors. No attempt is made to provide a comprehensive background discussion of the sectors. Further information can be found in review articles by Longworth (1976), and BAE (1981).

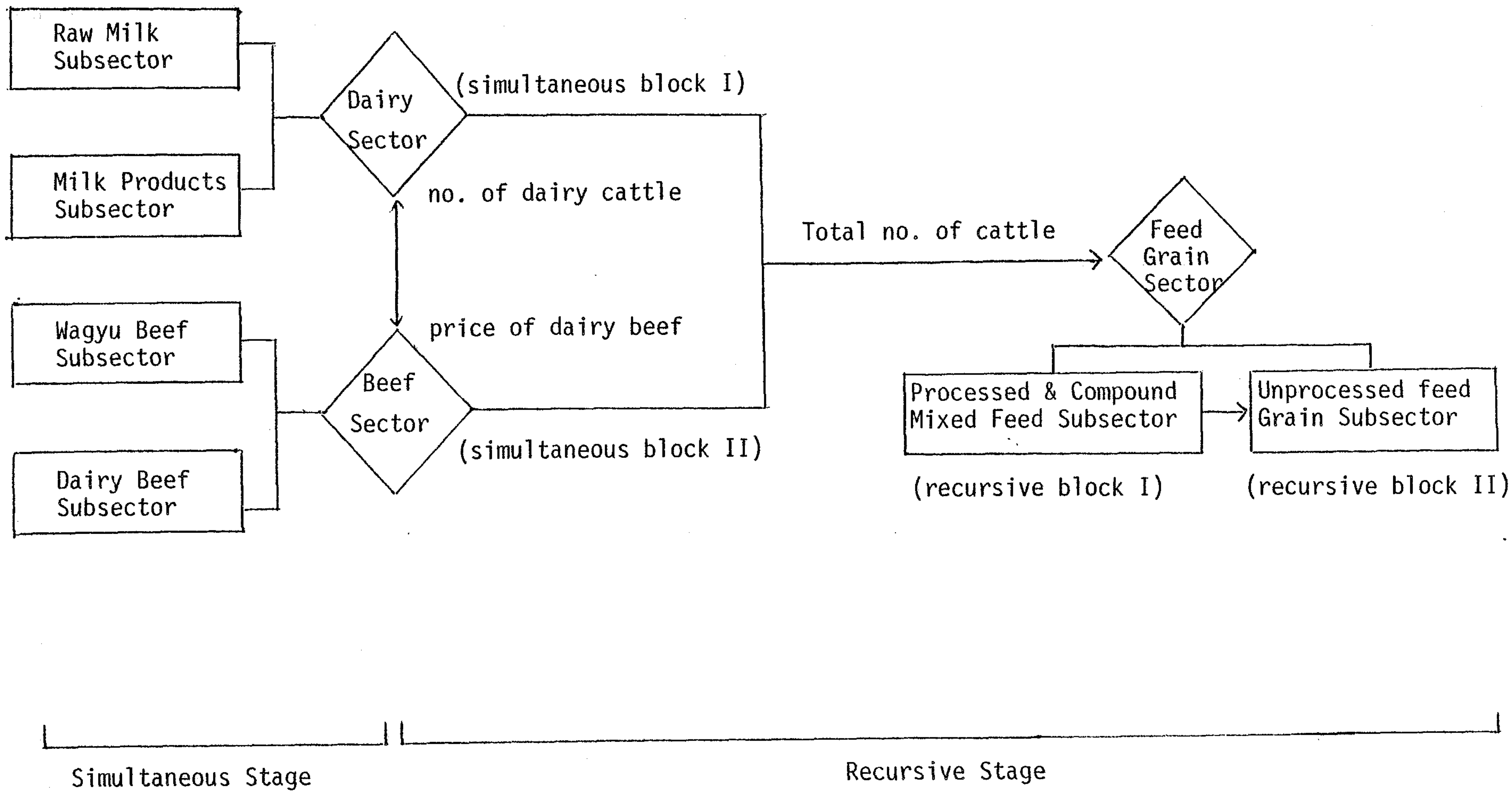
2.2 The Dairy Sector

The Japanese dairy sector has grown considerably in the last twenty years as changing tastes in Japan have led to increased consumption of milk and other dairy products. Although rice is still the mainstay of Japanese agricultural production, livestock products now make up approximately 25 per cent of gross agricultural output. While dairy production only makes up about six per cent of gross agricultural output, production has expanded rapidly and there have been considerable adjustments in the structure of dairy farming. Over the last twenty years there has been a strong tendency for the number of dairy farms to be reduced and for the size of individual dairy farms to increase. At the same time total milk production per cow has increased by approximately 30 per cent.

Demand for milk and milk products in Japan is relatively low by world standards and has increased at a slower rate than milk production in the last decade. Of the 65 million tonnes of milk produced in Japan per year approximately 60 per cent is consumed as drinking milk and the remaining 40 per cent is used in some form of processing. A full range of processed products are produced in Japan and in the last few years the production of butter and milk powders has reached a level that has led to an accumulation of stocks.

FIGURE 1

OUTLINE OF THE MAJOR SECTORS IN THE OVERALL MODEL



Although a wide range of dairy products was imported in the past, the only major imported product at the present time is cheese. Cheddar cheese is imported from Australia, New Zealand and other world markets to be used in the production of processed cheese within Japan.

The import of dairy products to stabilise supply, and other stabilisation activities in the domestic market are under the control of the Livestock Industry Promotion Corporation (LIPC). The LIPC is a semi-governmental institution, established in 1961, with the responsibility of stabilising domestic prices of major livestock products both by intervention in the domestic market, and by controlling imports. Although prices for drinking milk in Japan are determined competitively, they are high by world standards, because of the natural protection which is afforded the fresh product. Milk for processing, however, must compete with imported product and is presently subsidised by the LIPC at a level somewhat lower than the raw milk price. This deficiency payment has a substantial impact on producers' returns, although the payment of the guaranteed price is limited to a fixed quantity. Thus the guaranteed price (GP) and the liquid quota (LMQ) are both major policy instruments which influence the level of dairy production in Japan.

The LIPC also controls the price level for designated dairy products (which includes butter and skim milk powders) by controlling imports and domestic stocks. An indicative price is fixed each year for each of these products; domestic storage is adjusted in order to maintain this price in the market. Imports of designated products are controlled through the issuing of import quotas by the LIPC. Over the last few years, imports of butter and skim milk powder have dropped virtually to zero because of the quota mechanism. Imports of cheese are handled through an alternative system which does not involve tenders but does impose a tariff, the level of which is related to the importer's use of the domestic product. Thus the indicative stabilisation price (BSP), the level of milk product imports (IMMP) and the level of dairy product stocks are the major policy variables which influence dairy product prices and consumption in Japan.

Figure 2 presents a schematic outline of the structure of the dairy sector and the major policy instruments. The major links with the other sectors in the model are through the demand for feed and through the impact that the number of dairy cows has on calves which can be used for beef production.

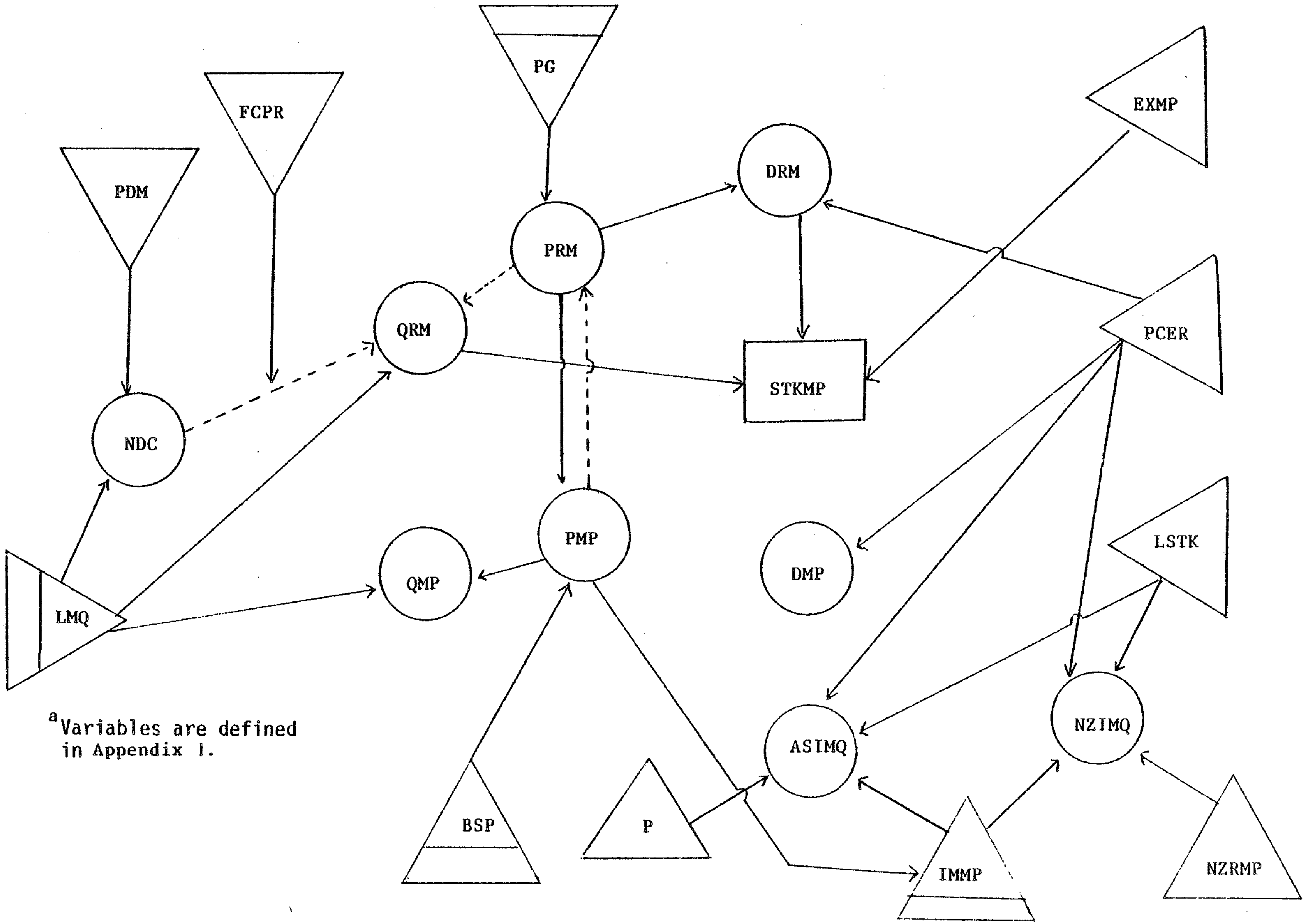
2.3 The Beef Sector

As mentioned in the previous section, the beef industry in Japan is broken into two major components. Wagyu beef is the traditional beef in Japan and provides approximately 35 per cent of Japan's beef production in any year. The remainder of beef production is split between dairy steers and dairy cows. Beef production has not grown as fast as dairy production in the last five years, but beef consumption has been increasing at a faster rate than dairy consumption. Beef consumption in Japan however, is still considerably less than in most other countries in the world, partly because prices are substantially higher.

The Japanese beef industry is protected largely by the operations of the Livestock Industry Promotion Corporation, who are responsible for controlling both the stability of domestic prices and the level of beef imports. As in the dairy sector, imports of beef are controlled by a tendering system. Quotas are fixed for a particular period and tenders are offered by the major exporting

FIGURE 2

SCHEMATIC OUTLINE OF THE MAJOR RELATIONSHIPS IN THE DAIRY SECTOR[a]



[a]Variables are defined in Appendix 1.

countries, which include Australia, the United States and New Zealand. Imported beef is usually sold by the LIPC in such a manner that domestic prices will be stabilised. Price stabilisation bands for both wagyu and dairy beef are set by the LIPC, who use the resale of imported beef and also domestic stocks in an attempt to maintain market prices within these bands. In this general framework, the major policy instruments which the government uses to affect the beef market include the total import quota (BIMPQ) and the beef stabilisation price (BPSTB). Figure 3 presents a schematic outline of the beef industry, showing the major endogenous variables which include the total number of cattle, the production of wagyu and dairy beef, the prices of these products and total beef consumption.

Within the total model imports from Australia and New Zealand are determined by a simple market share model. The import quota is assumed to be an exogenous policy variable, but the share of the import market among Australia, New Zealand and other exporters is assumed to be determined by the relative prices of these imports.

The beef sector has an obvious linkage with the dairy sector through the number of dairy cows which are available to produce beef calves. The linkage with the feed grain sector is through the demand from all cattle for both processed and unprocessed feed.

2.4 The Feed Grain Sector

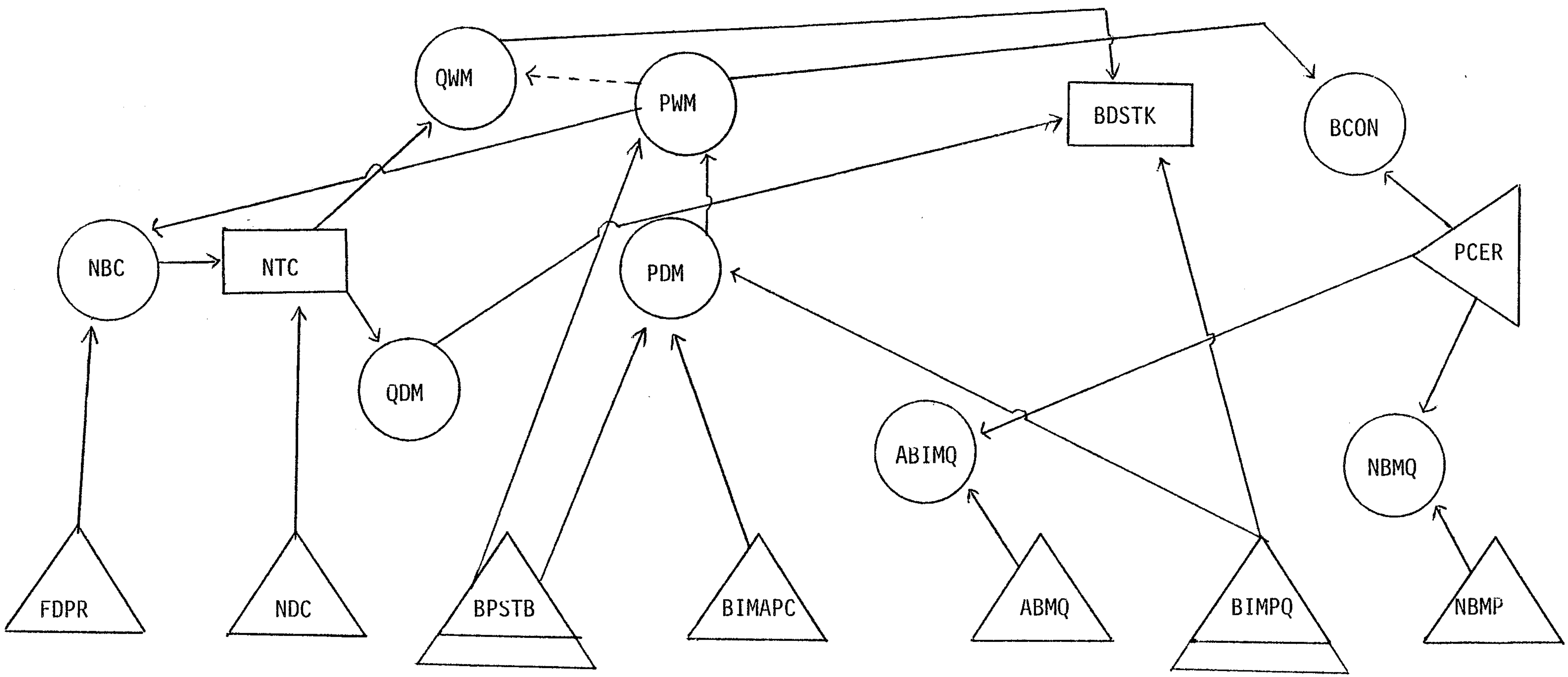
Japan is highly dependent on imported feeds for its livestock sector. The self-sufficiency level for cereal feeds has dropped significantly from around 20 per cent in the early 1970's to less than 10 per cent in 1980. A similar situation exists for soya beans and other protein feeds. These feed imports come largely from North America and Australia and are purchased on the highly competitive world feed markets. Price uncertainty in these markets has often meant that Japanese producers have been faced with highly variable input costs. Domestically produced feed is mainly in the form of roughage for both dairy and beef cattle and is largely made up of rice and barley straw, and some green feed crops.

Imports of feed grains are relatively unaffected by import policies. In Figure 4 it is shown that the endogenous variables in the feed grain sector are the level of imports and domestically produced feed, the amount of feed which is mixed and compounded, and total feed consumption. The exogenous variables in the feed grain sector are the cost of imported feed and the closely related domestic feed costs.

This section has briefly described the major components and characteristics of the livestock and feed industries in Japan. Figures 2, 3 and 4 summarise the relationships which are assumed to exist in the market, and the arrows shown in the diagrams depict the major lines of causality. Each of the endogenous variables is represented by an equation in the econometric model, which is developed in the next Chapter. The econometric model describes the consumption, production, price, trade and stocks of milk, milk products, beef and feed grains. Each of these endogenous variables is influenced by the major policy variables which have been described above. As the objective of the model is to look at general policy issues, the model has been aggregated in many respects. For example, there are many grades of beef, but in the final model there are only two categories; wagyu beef, which represents the high quality feed-lot beef, and dairy beef which represents all other lower quality beef products and which is readily substituted by imported beef.

FIGURE 3

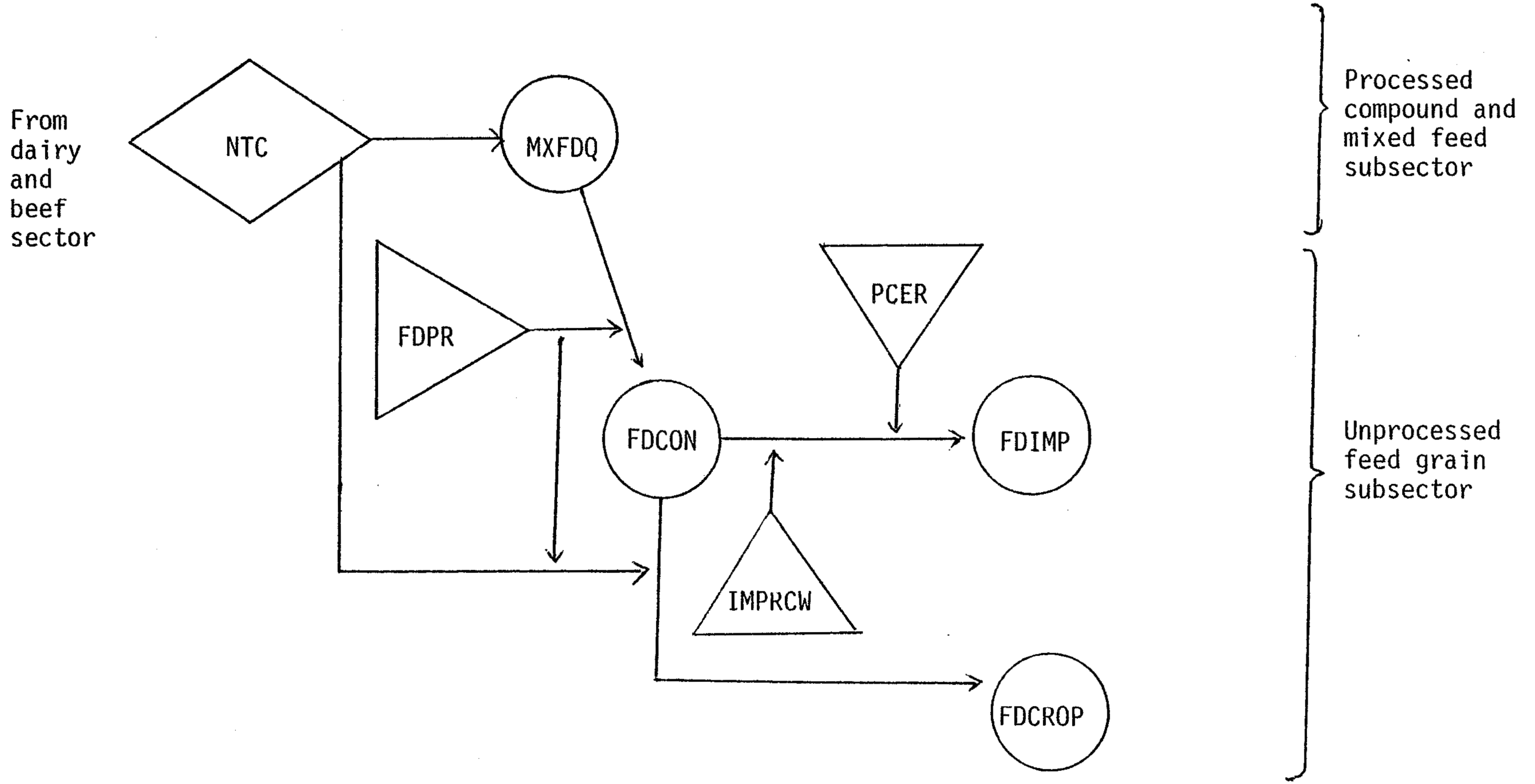
SCHEMATIC OUTLINE OF THE RELATIONSHIPS IN THE BEEF SECTOR [a]



[a] Variables defined in Appendix 1.

FIGURE 4

RELATIONSHIPS IN THE FEED GRAIN SECTOR[a]



[a] Variables defined in Appendix 1.

This is a reasonable degree of aggregation as these products have very different demand characteristics and are also produced in different situations. It has also been necessary to aggregate the wide range of dairy products which are both produced and consumed in Japan. To do this all dairy products have been aggregated in terms of their milk equivalent content. This is a more critical form of aggregation and it does produce some complications in interpreting the final results.

Because the focus of this analysis is on policy linkages, details of the specifications for individual equations are not discussed in any depth. The specifications used however, would generally conform to that expected in an econometric model of agricultural production and trade (Labys, 1973). The discussion of estimates presented in the following chapter however, does outline some of the individual variables and the reason for their inclusion.

CHAPTER 3

THE ESTIMATED STRUCTURAL MODEL

3.1 Introduction

In this chapter the estimated equations for the overall model are presented. The relationships which are reported are the preferred estimates. Criteria for selection of individual equations involved a subjective weighting of the consistency of signs and the magnitude of the estimated parameters in relation to a priori reasoning, previous studies, statistical significance of the estimates, and the explanatory power of the estimated equations. Annual data from the period 1960 through to 1979 were used to estimate the parameters of the stochastic equations. Equations with two or more current endogenous variables were estimated using two stage least squares (TSLS) and other equations were estimated using ordinary least squares (OLS). In the application of two stage least squares, problems were encountered with the sample size. In this case the number of pre-determined variables used in the first stage of the two stage estimation exceeds the number of sample observations. Initial estimates of these relationships were made using instrumental variables to overcome the problem. Because the results were not significantly different from OLS results however, the results presented below are those from the ordinary least squares estimates.

The variables used in the individual equations are defined in Appendix 1.

3.2 Estimated Equations for the Raw Milk Subsector

As noted in Chapter 2.2 the raw milk sub-sector accounts for the milk which is consumed in liquid form. Table 2 presents the estimated equations and the associated coefficients of determination and Durbin-Watson statistics. The significance of the estimated parameters are shown as t statistics in parentheses under each parameter.

It can be seen from Table 1 that the demand for raw milk can be expressed as a simple dynamic function of the change in milk prices and the level of real personal consumption expenditure.

The production of raw milk is primarily a function of the lagged price and the number of dairy cows, but is also influenced by the amount of milk which is eligible for the deficiency payment, and the price of feed-grain.

Although the price of raw milk is determined in a competitive market in Japan, it is influenced by the guaranteed price for milk used in processing. The negative relationship between the price of raw milk and the demand for raw milk for other uses is somewhat more difficult to explain. It is possible that this relationship is caused by the fact that the lack of demand for raw milk has meant that prices have dropped at the same time as milk is channelled into other uses, such as the production of milk beverages. The importance of the lagged price of milk products is expected, and reflects the influence of the processing milk sector in determining the raw product price to producers.

TABLE I

ESTIMATED EQUATIONS OF THE RAW MILK SUBSECTOR[a]

Demand for Raw Milk

(1) $$DRM = 144.971 + \underset{(9.18)}{0.983051} * DRM1 - \underset{(-1.99)}{3.00634} * \Delta PRM + \underset{(0.26)}{1.01416} * PCER$$

$R^2 = 0.99$ D.W. = 1.71

Production of Raw Milk

(2) $$QRM = 2126.63 + \underset{(3.25)}{4.98886} * PRM1 + \underset{(4.28)}{1.72884} * NDC + \underset{(1.76)}{0.171078} * LMQ$$

$$- \underset{(-2.16)}{71.9169} * FDPR + \underset{(0.46)}{0.10319} * QMP1$$

$R^2 = 0.99$ D.W. = 1.94

Price of Raw Milk

(3) $$PRM = 47.3368 - \underset{(-2.196)}{0.227139} * DOTH + \underset{(1.49)}{0.195461} * PG + \underset{(7.52)}{0.822635} * PMP1$$

$R^2 = 0.98$ D.W. = 2.06

No. of Dairy Cows

(4) $$NDC = 491.145 + \underset{(7.42)}{0717959} * NDC1 + \underset{(0.49)}{0.339459} * PRDM + \underset{(1.98)}{1.55944} * DOTH$$

$$+ \underset{(0.97)}{0.0421802} * LMQ - \underset{(-1.80)}{17.6993} * FDPR$$

$R^2 = 0.99$ D.W. = 1.15

Returns from Dairy Cattle

$$PRDM = 0.9746083 * PRM + 0.0253916 * PDM$$

[a] Variables are defined in Appendix 1. The presence of a numeral as the last character of a variable name signifies a lagged variable. (i.e. DRM1 is DRM lagged one period).

The equation explaining the number of dairy cows is an important equation for the overall model, as it also has implications for the production of beef. It can be seen that the number of dairy cows is relatively slow to adjust, but there is a weak positive relationship with the returns received from dairy cows as well as the size of the deficiency payment. As expected, the number of dairy cows is also a negative function of the price of mixed feed. The relationship between the demand for other milk and the number of dairy cows is somewhat difficult to explain, but it is most likely associated with the strong growth in the demand for other milk products. For example, at the same time as there has been strong growth in dairy cow numbers, there has been an increasing trend towards the production of other products which utilise raw milk. The variable which represents the returns from dairy cattle (PRDM) is simply a weighted average of the price of raw milk and the price of beef from dairy cattle. This variable reflects the joint product nature of dairy production in Japan and the fact that some dairy cattle are kept solely for beef production. The weights, which are presented in Table 1, are derived from the proportion of dairy cattle which are used solely for milk production and the proportion of dairy cattle which are used solely for beef production.

In general, the results for the raw milk subsector explain a high degree of the variation in the endogenous variables. The signs of the relationships are consistent with a priori expectations, although the significance of the lagged dependent variables in many of the equations suggests that the variables are relatively stable and adjustments are slow to take place.

3.3 Estimated Equations for the Milk Product Subsector

Table 2 presents the estimated relationships for the milk products subsector.

The demand function for milk products is similar in form to that for raw milk. There is still a positive income relationship but the price of milk products is less significant than the price variable in the demand for raw milk relationship. The lack of significance of this variable could be due to the fact that the milk products are highly aggregated and cover a wide range of price levels.

The quantity of milk products produced in the previous period explains the variation in the amount of milk which is used for the manufacture of milk products but, as would be expected, this level of production is also influenced by the price of the milk products, and the amount of milk which is covered by the deficiency payment. The production of milk products increased as the quantity of milk eligible for the deficiency payment increases.

As would be expected, the price for milk products is closely related to the price of raw milk. This is a part of the simultaneous relationship between the guaranteed price, the price of milk products, and the raw milk price. Another price which enters the relationship, is the milk product stabilisation price (BSP) which is the indicative stabilisation price announced by the LIPC. The price of milk products is also influenced by the demand for local milk products (measured as the difference between the demand for milk products and the imports of milk products). It can be seen that either an increase in the demand for milk products or a reduction in the imports of milk products will cause the price of these products to increase.

Equations 8 and 9 in Table 2 describe the level of imports of milk products from Australia and New Zealand. In general, it can be seen that these equations are a function of the total import quota for milk products and the stocks held

TABLE 2

ESTIMATED EQUATIONS OF THE MILK PRODUCTS SUBSECTOR[a]

Demand for Milk Products

$$(5)\quad DMP = \underset{}{317.384} + \underset{(4.50)}{0.783463} * DMP1 - \underset{(-0.74)}{1.11678} * PMP + \underset{(0.99)}{6.6306} * PCER$$

$$R^2 = 0.98 \quad D.W. = 1.95$$

Quantity of Milk Products Produced

$$(6)\quad QMP = 279.496 + \underset{(4.26)}{0.710368} * QMP1 + \underset{(1.07)}{1.07450} * PMP + \underset{(1.27)}{0.136964} * LMQ$$

$$R^2 = 0.95 \quad D.W. = 0.91$$

Price of Milk Products

$$(7)\quad PMP = 7.54866 + \underset{(0.0068)}{0.000415098} * PMP1 + \underset{(16.20)}{0.951083} * PRM + \underset{(0.074)}{0.000203386} * BSP + \underset{(0.69)}{0.00112657} * (DMP - IMMP)$$

$$R^2 = 0.99 \quad D.W. = 1.91$$

Imports of Milk Products from New Zealand

$$(8)\quad NZIMQ = -49.0186 + \underset{(0.60)}{0.12306} * NZIMQ + \underset{(3.82)}{0.362523} * IMMP - \underset{(0.38)}{0.0701803} * LSTK + \underset{(0.61)}{1.5338} * PCER - \underset{(-0.80)}{1.85986} * NZRMP$$

$$R^2 = 0.86 \quad D.W. = 1.47$$

Imports of Milk Products from Australia

$$(9)\quad ASIMQ = -45.3349 + \underset{(0.54)}{0.112255} * ASIMQ + \underset{(3.37)}{0.210697} * IMMP - \underset{(-2.82)}{0.320772} * LSTK + \underset{(2.70)}{6.85752} * PCER - \underset{(-3.041)}{3.95324} * ASDMP$$

$$R^2 = 0.91 \quad D.W. = 1.64$$

Stock of Milk Products

$$(10)\quad STKMP = \underbrace{QRM - DRM - DOTH}_{QMP} + IMMP - DMP - EXMP$$

[a] Variables defined in Appendix 1.

by the LIPC. The two equations have a similar specification except that each equation is a negative function of the price of imports in that particular country. These relationships are significant, and reflect the competitive allocation of the import quota for milk products between Australia and New Zealand. Thus, while the quota quantity may be fixed, the allocation between Australia and New Zealand depends on price. The final equation in the milk product subsector is an identity which describes the change in stocks held by the LIPC residual of supply and demand.

In summary, it can be seen that the milk product subsector is generally a flow-on from the raw milk subsector, and incorporates the competitive imports of these products from Australia and New Zealand. Despite the level of aggregation in dealing with milk products, the fit for the individual equations is good. As in the raw milk subsector, the relative significance of the lagged dependent variables suggests that the rate of adjustment in both the demand and the production of milk products is somewhat slow. This is possibly a reflection of the policy control which is imposed on the livestock sector in Japan, and the protection from instability which this has afforded.

3.4 Estimated Equations for the Beef Sector

As discussed in the previous chapter the production of beef in Japan can be broken into the two categories of wagyu beef and dairy beef. In this model, however, the beef consumption function is an aggregate of the two forms of beef. In Table 3 a summary of the estimated equations for the beef sector is given. The dynamic form of the aggregate beef consumption function is seen to be a negative function of the price of beef and a positive function of consumption expenditures. In this case the price variable is made up of a weighted average of the price of wagyu beef and the price of dairy beef, which reflects the relative proportion of these two meats in total beef consumption. Although the price variable is relatively insignificant, the expenditure variable has a major effect on beef consumption which reflects the luxury attitude towards beef consumption in Japan.

Separate production equations are estimated for dairy and wagyu beef. The production function for wagyu beef follows the form of a conventional production function with total production being a positive function of the lagged price and a positive function of the total number of cattle. Price has relatively little effect, as the number of cattle is included as an independent variable in this equation and is the major factor affecting production in the short run. In a model of this type the longer run effects operate through the cattle number relationship. As might be expected, the feed price has a negative effect on the level of production as does the total beef import quota; this reflects the competition from imported beef and its associated price effects. The negative, although insignificant coefficient on TIME presumably reflects this slight trend towards decreasing wagyu beef production in Japan during this period.

The equation explaining the production of dairy beef in Japan has almost exactly the same specification as that for wagyu beef, except that there is no negative time trend in production. Once again, the total number of cattle, the feed price, and the beef import quota are seen to be the most significant variables.

While there are similarities in the production functions for the two types of beef, the price formation relationships show considerable differences. As would be expected, the price of wagyu beef (Equation 14) is influenced by

TABLE 3

ESTIMATED EQUATIONS OF THE BEEF SECTOR [a]

Beef Consumption

$$(11)\quad BFCON = -23.9557 + \underset{(3.58)}{0.668373} * BFCON1 - \underset{(-0.63)}{0.0291235} * (\tfrac{1}{3}*PWM + \tfrac{2}{3}*PDM) + \underset{(2.63)}{2.60181} * PCER$$

$R^2 = 0.96$ D.W. = 1.37

Production of Wagyu Beef

$$(12)\quad QWM = -136.998 + \underset{(4.8)}{0.584502} * QWM1 + \underset{(0.22)}{0.00343803} * PWM1 + \underset{(6.49445)}{0.0901691} * (NBC + NDC) - \underset{(-1.20905)}{3.1701} * FDPR - \underset{(-0.882826)}{2.43709} * TIME - \underset{(-5.04)}{0.489195} * BIMPQ$$

$R^2 = 0.89$ D.W. = 2.18

Production of Dairy Beef

$$(13)\quad QDM = -29.3078 + \underset{(3.20)}{0.675005} * QDM1 + \underset{(0.93)}{0.0289546} * PDM1 + \underset{(1.60)}{0.0423148} * (NBC + NDC) - \underset{(1.50595)}{4.09238} * FDPR - \underset{(-1.33657)}{0.241774} * BIMPQ$$

$R^2 = 0.95$ D.W. = 1.86

Price of Wagyu Beef

$$(14)\quad PWM = \underset{(-1.78)}{-167.399} - \underset{(-0.096)}{0.0284611} * PWM1 + \underset{(2.14)}{0.209965} * BPSTB + \underset{(3.51)}{56.9664} * TIME + \underset{(2.01)}{0.620125} * PDM1$$

$R^2 = 0.98$ D.W. = 1.8

Price of Dairy Beef

$$(15)\quad PDM = -351.302 + \underset{(0.91)}{0.142068} * PDM1 + \underset{(5.22)}{0.537432} * BPSTB + \underset{(4.37)}{1.53674} * BIMAPC + \underset{(1.92)}{0.785785} * (BFCON - BIMPQ)$$

$R^2 = 0.96$ D.W. = 1.76

TABLE 3 CONTINUED

Number of Beef Cattle

(16) NBC = 461.289 + 0.840605 * NBC1 + 0.215479 * PWM - 5.48026 * FDPR
(6.24) (1.11) (-0.19)

- 22.1934 * TIME
(-0.59)

$R^2 = 0.83$ D.W. = 0.86

Imports of Beef from New Zealand

(17) NBMQ = 2.22322 - 0.414643 * NBMQ1 + 0.040221 * BIMPQ - 0.0407322
(-1.2) (3.21) (-1.30)

* NBMP + 0.286785 * PCER + 0.00967931 * BFCON1 - 0.0235798
(1.81) (0.63) (-1.46)

* QBM1 - 0.949606 * TIME
(-1.80)

$R^2 = 0.81$ D.W. = 1.69

Imports of Beef from Australia

(18) ABIMQ = -9.12937 - 0.0409757 * ABIMQ1 + 0.568485 * BIMPQ - 0.0131342
(-1.57) (28.89) (-0.64)

* ABMP + 0.536142 * PCER - 1.75941 * TIME
(2.46) (-2.15)

$R^2 = 0.99$ D.W. = 2.48

Stocks of Beef

(19) BDSTK = QBM + BIMPQ - BFCON - BFEX

[a] Variables defined in Appendix 1.

the stabilisation prices which are announced by the LIPC. It should be noted that the price used in this equation is in fact the average of the ceiling and floor price, which reflects the general level of prices which the LIPC is attempting to maintain. Because wagyu beef makes up a smaller proportion of total beef production, it is dominated by dairy beef consumption and is influenced by the price of dairy meat from the previous period. The time trend is somewhat more difficult to explain, but is probably due to the increasing scarcity of very high quality wagyu beef and changing tastes.

While the dairy beef price is also influenced by the stabilisation price, there is an additional influence from imported beef products. This is reflected in the average import beef price (BIMAPC) and a variable which measures the demand for local beef products. As was the case for milk products, this latter variable is a positive function of beef consumption and a negative function of beef imports.

The equation explaining the number of beef cattle accounts for the herd of wagyu beef cows that are currently in Japan. As would be expected, this function is positively related to the price of wagyu beef and negatively related to the feed price. The negative coefficient on the time variable reflects the trend towards the decrease in numbers of wagyu beef cattle in Japan during the estimating period. While this equation has a relatively high degree of explanation, the level of serial correlation present in the final equation is a cause for some concern.

Equations 17 and 18 describe the level of imports of beef from Australia and New Zealand. As for milk products, these two equations have the same basic specification in each case, except for the inclusion of the import price of the respective country. Other variables in these equations include the total level of beef imports into Japan and a measure of disposable or real income. While it might be expected that the total level of beef imports would be sufficient to explain changes in the import levels from Australia and New Zealand, it must be realised that there are also substantial imports from other countries such as the United States. In this case it is reasonable to expect that as factors such as incomes change in Japan there may be changing market shares among the different sources of imports, due to the differing qualities and characteristics of the imports from different countries. A similar effect would be noticed in the "TIME" variables which are included in each of these equations. In the case of imports of beef from New Zealand it was also shown that imports were a positive function of the previous year's beef consumption, and a negative function of the previous year's beef production in Japan. Although these latter effects are only marginally significant, it can be seen that a negative relationship associated with beef production in Japan is larger than the positive effect associated with increased consumption. If these relationships can be interpreted <u>ceteris paribus</u>, they reflect the declining competitiveness of the New Zealand type of beef on the Japanese market as production and consumption grows.

The final relationship in the beef sector model is an identity which explains the changing level of beef stocks, the majority of which are held by the LIPC.

3.5 Estimated Equations for the Feed Grain Sector

The major objective in modelling the feed grain sector is an attempt to measure the effect of changes in the livestock sector on the consumption and subsequently the import of feed grains. Table 4 shows the estimated equations for the major relationships in the sector. Equation 20 explains

TABLE 4

ESTIMATED EQUATIONS OF THE FEED GRAIN SECTORS [a]

Production of Mixed Feed

(20) MXFDQ = -609.171 + 0.971278 * MXFDQ1 + 0.557513 * (NDC + NBC)
(21.36) (0.68)

R^2 = 0.98 D.W. = 1.47

Consumption of Feed Grain

(21) FDCON = 546.929 + 0.981216 * MXFDQ + 0.00964062 * FDCON1
(109.11) (1.45)

- 18.8683 * FDPR
(-3.96)

R^2 = 0.99 D.W. = 1.88

Imports of Feed

(22) FDIMP = 11022.0 - 31.5772 * IMPRCW + 0.315955 * FDCON + 8.3152 * PCER
(-1.31) (1.33) (0.77)

R^2 = 0.85 D.W. = 1.04

Production of Feed Crops

(23) FDCROP = -10377.8 + 1.58848 * FDCON + 2.80789 * (NDC + NBC)
(5.81) (1.62)

+ 119.712 * FDPR
(0.33)

R^2 = 0.98 D.W. = 1.37

[a] Variables defined in Appendix 1.

the level of production of mixed and compound feed in Japan. This is a relatively simple function of the total number of cattle in Japan, including both dairy and beef cattle. The importance of the lagged dependent variable suggests that production of mixed feed is relatively slow to adjust over time. The feed consumption equation is seen to be primarily a function of the level of mixed feed production, but is also influenced by the price of feed grain. An alternative form of this model would use a reduced form equation in which Equation 20 is substituted into Equation 21, and thus the total consumption of feed grain would depend on the total number of cattle as well as feed prices. The formulation used in this model allows more flexibility in that it identifies further important variables.

The level of imports of feed grain is estimated to be a negative function of the import price for feed grain and a positive function of the total level of feed consumption in Japan. Although the final estimated version of the equation included a positive relationship with real income, this is a relatively insignificant relationship which is probably related to the total trend in the level of imports of feed.

The final equation in the feed grain sector explains local production of feed crops in Japan. As might be expected this variable is closely related to the consumption of feed grains and also to the total number of cattle on hand in any year. There is also a positive although insignificant relationship between the total price of feed and the production of feed crops, which are substitutes for purchased feed.

In general the equations estimated for the feed grain sector explain a high proportion of the variation in these variables. These relationships are important for overall policy analysis as they measure the derived demand for total feed, and also for imports of feed, to satisfy the requirements of the livestock sector.

3.6 Summary

The econometric model outlined in this Chapter consists of twenty-three linear equations and identities. As has already been noted, the model is a somewhat aggregated summary of the relationships which exist in the livestock and feed sectors in Japan. The estimated relationships have shown the strong dependencies between the sectors and also the importance of dynamic relationships both within and between individual sectors. In order that these relationships might be studied more closely, it is essential to look at the model as a complete entity, rather than a set of twenty-three individual relationships. To this end, the following chapter develops a generalised theoretical framework for the analysis of the estimated model. The framework will be used in later sections to validate the model and also to derive policy response multipliers.

CHAPTER 4

FRAMEWORK FOR MODEL ANALYSIS

4.1 Introduction

This chapter presents a brief summary of a theoretical framework used to analyse a linear simultaneous equation system and to derive policy response multipliers. Although much of the material presented in this chapter can be found in Intrilligator (1978) and Johnston (1963) it is presented here in a consistent fashion to aid in the understanding and presentation of the estimated model. For readers who are primarily concerned with the policy implications of the model results, this chapter of the paper is less important, and they may wish to proceed directly to the section on model validation and policy conclusions

4.2 The Structural Form

The linear equations which have been presented in the previous chapter can be represented in matrix algebra form by the following dynamic equation:

$$AY(t) = BY(t-1) + CZ(t) + V(t) \qquad (1)$$

where A and B are n x n matrices

C is an n x m matrix

Y is the column vector of n endogenous variables

Z is the column vector of m exogenous variables, and

V is the column vector of n disturbance terms.

In the estimated model n (the number of endogenous variables) equals 23, and m (the nubmer of exogenous variables) equals 19.

In order to investigate the performance of the equation system, it is necessary to solve the simultaneous equation system. In doing so, there are two stages of solution. The first is to solve for the endogenous variables as a function of all the predetermined variables and exogenous variables in the system. The second is to solve the endogenous variables in the system as a function of the exogenous variables only. The former is called the reduced form of the equation system, and the latter is called the final form of the system.

4.3 The Reduced Form

The reduced form is derived by premultiplying the inverse matrix of the coefficient matrix A in the structural form (Eq. 1) to both sides of the equation system, i.e.

$$\begin{aligned} Y(t) &= A^{-1} B Y(t-1) + A^{-1} C Z(t) + A^{-1} U(t) \qquad (2) \\ &= \pi_1 Yt-1 + \pi_2 Z(t) + V(t) \end{aligned}$$

This manner of presenting a model will be used for deriving the dynamic multipliers and also in certain types of simulation (e.g. The ...

coefficient matrix π_2 in Equation 2 is also the short run impact multiplier matrix and can be used directly to measure the impact of the immediate impacts of a change in any of the exogenous variables).

4.4 The Final Form

In order to investigate the dynamic properties of the equations system, a final form relationship can be derived. To do this it is necessary to solve the first order difference equation of the reduced form (Eq. 2). Following the usual procedure for solving difference equation systems with fixed coefficients, the following equation can be derived:

$$Y(t) = (I - \pi_1)^{-1} \pi_2 Z(t) + (G_{ii}) (\lambda_1^t, \lambda_2^t, \ldots, \lambda_n^t) \quad i = 1 \ldots n \qquad (3)$$

$$= Y^*(t) + y(t)$$

where the λ_i ($i = 1, \ldots, n$) are the characteristic roots of the coefficient matrix π_1 of the lagged endogenous variables, and (G_{ii}) ($i = 1 \ldots n$) is the matrix of the arbitrary constants which are determined by the initial conditions. This equation is known as the final form. The first term in the right hand side of the final form equation (3), shows the long run equilibrium or stationary values, $Y^*(t)$, of the endogenous variables corresponding to a given set of the exogenous variables, $Z^*(t)$.

The second term in the right hand side of the final form equation, $y(t)$, shows the systematic fluctuation of the endogenous variables around their long run equilibrium. In the terminology of difference equations, the final form equation (3) is known as the general solution. The second term in the equation is the homogenous part of the solution and consists of the linear combination of the eigen values (characteristic roots) of the lagged endogenous variable coefficient matrix (π_1) in the reduced form with the exponent t. The first term in the equation corresponds to the "non homogenous part of the solution", and is the coefficient matrix for $Z(t)$ (i.e. $(I - \pi_1)^{-1}\pi_2$). The coefficients are identical to the long run multiplier matrix which will be discussed in the following section.

It can be shown that the systematic movement of the endogenous variables around their long run equilibrium value depends upon the magnitude and sign of the dominant eigen value. If the absolute value of the dominant eigen value is less than one, then the system has stability and if it is a positive real value, then the system will converge monotonically towards equilibrium. If it is a negative real value, then it converges towards the equilibrium in an oscillating manner. If the absolute value of the dominant eigen value is larger than one in either of the above cases, then it diverges from the long run equilibrium. If it is a complex number, then it shows cyclical convergence to the equilibrium. The absolute value of the number shows the amplitude of the cyclical movement, and the periodicity of the cyclical movement can be derived using the real part and the imaginary part of this complex number.[1]

4.5 Dynamic Multipliers

In the preceding discussion, two kinds of multipliers (short run impact multiplier and long run multiplier) have already been referred to. In this section a more systematic explanation of these multipliers will be presented.

[1] If the complex number can be represented as a+bi then the periodicity of the cycle is equal to $2\pi / \tan^{-1}(\frac{b}{a})$.

If the reduced form equation (2) is lagged one period:

$$Y(t-1) = \pi_1 Y(t-2) = \pi_2 Z(t-1) + V(t-1) \qquad (4)$$

and substituting into the reduced form equation (2), the following statement can be derived:

$$Y(t) = \pi_1 \{\pi_1 Y(t-2) + \pi_2 Z(t-1) \quad + \pi_2 Z(t) + V(t)$$

$$= \pi_1^2 Y(t-2) + \pi_1 \pi_2 Z(t-1) + \tau_2 Z(t) + \pi_2 V(t-1) + V(t) \qquad (5)$$

By continually substituting for the lagged variables this procedure can be repeated s times such that;

$$Y(t) = \pi_1^{s+1} Y(t-s-1) + \sum_{\tau=0}^{s} \pi_1^{\tau} \pi_2 Z(t-\tau) + \sum_{\tau=0}^{s} \pi_1 V(t-\tau) \qquad (6)$$

where: τ is the iteration number.

The stability conditions are essential to this analysis as long run multipliers will be relevant only as long as the model is stable. The stability condition means that the absolute value of the dominant eigen values must be less than one. This implies that the matrix π^{s+1} approaches a null matrix as s increases to infinity, i.e.

$$\lim_{s \to \infty} \pi_1^{s+1} = 0$$

In this situation Equation (6) is simplified to the following:

$$Y(t) = \sum_{\tau=0}^{\infty} \pi_2 Z(t-\tau) + \sum_{\tau=0}^{\infty} \pi_1 V(t-\tau) \qquad (7)$$

Definitions of the various multipliers can be obtained from successive components of the exact part of this equation (i.e. π_2, $\pi_1\pi_2$, $\pi_1^2\pi_2$, ... $\pi_1^{\tau}\pi_2$). These matrices describe the effect of changes in exogenous variables on the endogenous variables in the same or successive periods, and are known as the delayed multipliers. The multipliers are generally broken into the following major categories.

Short run static multipliers

The short run static multipliers measure the influence that a one unit change in an exogenous variable (Z) will have on the endogenous variables (Y) within the same period assuming all other predetermined variables are held constant. By taking the partial derivative of Y_t with respect to Z_t in the final form equation (7) where $\tau = 0$, the matrix of impact multipliers is

$$\pi^{M} = \left. \frac{\partial Y(t)}{\partial Z(t)} \right|_{\tau=0} = \frac{\partial}{\partial Z(t)} (\pi_1^{0} \pi_2 Z(t)) = \pi_2$$

Long run static multipliers

The long run static multiplier (also known as the equilibrium or stationary multiplier), shows the impact of a sustained unit change in an exogenous variable on the endogenous variables after a long period of time. It describes the change in an endogenous variable between two stationary states, and can be derived by taking the partial derivative of the final form with respect to the fixed variables, Z(t), which represent a sustained change in some exogenous variable.

$$\frac{\partial Y(t)}{\partial \overline{Z(t)}} = \frac{\partial}{\partial \bar{Z}} \left(\sum_{\tau=0}^{\infty} \pi_1^{\tau} \pi_2 \bar{Z} \right) = (I - \pi_1)^{-1} \pi_2$$

where: $\overline{Z(t)} = \bar{Z}$

These multipliers equal the sum of the delay multipliers up to an infinite period lag ($\tau=\infty$).

Delay dynamic multipliers

The delay multiplier describes the impact of an impulse change or the effects of a one period change in an exogenous variable on the current and future values of the endogenous variables. Since the exogenous variable returns to its original level, its effects on the endogenous variables would decline as time increases, depending on the strength of the feedback and assuming the system to be stable. It can be derived by taking the partial derivative of Equation (7) with respect to $Z(t-\tau)$;

$$\frac{\partial Y(t)}{\partial Z(t-\tau)} = \frac{\partial}{\partial Z(t-\tau)} \left(\sum_{\tau=0}^{\infty} \pi_1^{\tau} \pi_2 \, Z(t-\tau) \right) = \pi_1^{\tau} \pi_2$$

Cumulative dynamic multipliers

The cumulative multiplier describes the effects of a one unit change in the exogenous variable (which is maintained over τ periods) on the current and future values of an endogenous variable. In the evolutionary expansion of the final form of the model, the coefficient of the exogenous variable can be written as follows:

$$\sum_{\tau=0}^{\infty} \pi_1^{\tau} \pi_2 \, Z(t-\tau) \qquad (8)$$

Since the value of the exogenous variables remains constant over the τ periods, Equation (8) becomes

$$(I = \pi_1 + \pi_1^2 + \ldots \pi_1^{\tau}) \; \overline{Z(t)} = \sum_{\tau=0}^{\infty} \pi_1^{\tau} \pi_2 \, \overline{Z(t)}$$

The cumulative dynamic multiplier can be derived by taking the partial derivative of Y(t) with respect to Z(t):

$$\frac{\partial Y(t)}{\partial \overline{Z(t)}} = (I + \pi_1 + \pi_2 + \ldots \pi_1^{\tau}) \pi_2$$

This equals the sum of the delay multiplier over the τ periods.

Each of these types of multiplier can be used to provide information about the manner in which the system responds to changes in specific exogenous variables.

An alternative, more general form of analysis shows how the model responds in a situation where more than one exogenous variable is changing at any one time.

4.6 Simulation Analysis

In simulation analysis the values of the endogenous variables (Y(t)) are estimated for specific values of Y(t-1), Z(t) and U(t) or V(t). The simulated values of the endogenous variables can be used both in forecasting and policy analysis, as well as in general validation procedures. The alternative types of simulation and their applications are briefly discussed in this section.

There are three basic types of simulation associated with model analysis: partial, total, and final. In a partial simulation, actual data for the exogenous and policy variables Z(t), the lagged endogenous variables Y(t-1) and the endogenous variables appearing on the right hand side of each equation, are utilised to obtain a set of partial predictions for each of the endogenous variables Y(t). A total simulation places greater dependence on the model's ability to generate the endogenous variables, and only actual data for the exogenous variables Z(t), and the lagged endogenous variables Y(t-1), are required. In the final simulation, values of the lagged endogenous variables Y(t-1) as well as the current values of Y(t) are generated from the model, and only actual data for the exogenous variables Z(t) are needed. The latter method of solution is that most often associated with policy simulation analysis where it is necessary to measure the effects that changes in a policy variable will have on the endogenous variables over time.

Simulation of a commodity model can follow directly from its estimated reduced form:

$$Y(t) = \pi_1 * Y(t-1) + \pi_2 * Z(t) + V(t)$$

To obtain a sequential set of values for the endogenous variabls requires solving the simultaneous equations using the actual or predicted values of all lagged endogenous variables and the exogenous variables. The sequential values of Y(t) are obtained through iterating over each of the n endogenous variables and for each time period.

Policy simulation analysis is normally performed by manipulating the values of the exogenous or policy controllable variables Z(t) and observing the resulting changes in Y(t). The disturbances U_t or V_t may be suppressed, or generated following a random or autoregressive process to provide a stochastic simulation. The analysis may be carried out over the sample period which has been used to estimate the model parameters, or over some post-sample period. In the former case, the goal might be to explain how a commodity market would have behaved if other policies had been followed, while in the latter case, the goal becomes one of determining the future impact of such policies. Simulation analysis can also produce forecasts of key market variables based on conditional predictions of the exogenous variables.

The reduced form simulation could be applied to almost any appropriate commodity model. However, the reduced form solution procedure becomes difficult when nonlinearities exist in variables or coefficients, or when equations are dynamic and contain lagged endogenous variables. In this case an alternative model solution procedure known as the Gauss-Seidel procedure can be used to solve the structural form of the econometric model. This procedure is briefly outlined below.

Given that the general structural form of econometric model can be written as follows:

$$Y(t) = (I-A)*Y(t) + B*Y(T-1) + C*Z(t),$$

and given a set of starting estimates (o) for the endogenous variables on the right side of the equation, and values for the exogenous variables, each equation can be solved to obtain a set of estimates for the dependent variables;

$$Y(t)^{(1)} = (I-A)*Y(t)^{(0)} + B*Y(t-1)^{(0)} + C*Z(t)$$

These estimates on the left side of each equation can then be used to obtain a second estimate (2).

$$Y(t)^{(2)} = (I-A)*Y(t)^{(1)} + B*Y(t-1)^{(1)} + C*Z(t)$$

This procedure can be continued for up to r iterations. The consecutive estimates of Y(t) will converge on a particular value such that;

$$Y(t)^{(r)} = (I-A)*Y(t)^{(r-1)} + B*Y(t-1)^{(r-1)} + Z*Z(t)$$

where: $$\left| \frac{Y(t)^{(r)} - Y(t)^{(r-1)}}{Y(t)^{(r-1)}} \right| \leq L$$

The value of L is selected as a critical percentage so that at convergence the final estimated value does not differ from the previously estimated value by more than L (for example, L = 0.1 or 0.01). When the convergence criterion is not met, the estimates are placed on the right hand side of each equation and the procedure is continued. It should be noted that the critical value applies to each variable and to each equation until the full set of equations is solved for a particular period.

Once the stationary values of the variables Y(t) are attained they can be used as the lagged endogenous variables Y(t-1) in the right hand side and simulation advances to the subsequent time period (t+1). Whilst this procedure involves many iterations which consist of evaluating equations, it is ideally suited to computerisation and can easily handle non-linear equation systems and complex lag structures.

The reduced form simulation procedure was used in this study to provide simulations which were used to validate the estimated model. Although the alternative types of simulation were used to test the validity of the model under alternative situations, a standard set of validation tests was used to evaluate each of these simulations.

4.7 Validation Criteria

The objective in any validation exercise is to show how closely the model-generated endogenous variables (Y(t)) approximate the actual data (A(t)).

As parametric tests to measure the forecast error between actual and estimated values or simulated observations, single point criteria have traditionally been applied. These include the mean absolute percentage error (MAPE):

$$\text{MAPE} = \frac{1}{n} \sum_{t=1}^{n} \frac{(A(t) - Y(t))}{A(t)} \times 100,$$

and the root mean square error (RMSE);

$$\text{RMSE} = \sqrt{\frac{1}{n} \Sigma \, (A(t) - Y(t))^2}$$

where A(t) = actual observation values and Y(t) = forecast or estimated values. Similarly the Theil inequality coefficient, U, which is essentially a standardisation of the RMSE can also provide information as to sources of error. Depending on the desired standardisation, there are three types of U coefficient;

$$U_0 = \frac{\sqrt{\frac{1}{T} \sum_{t=1}^{T} (Y(t) - A(t))^2}}{\sqrt{\frac{1}{T} \sum_{t=1}^{T} Y_t^2} + \sqrt{\frac{1}{T} \sum_{t=1}^{T} A_t^2}}$$

$$U_1 = \frac{\sqrt{\frac{1}{T} \sum_{t=1} \{(Y(t) - A(t-1)) - (A(t) - A(t-1))\}^2}}{\sqrt{\frac{1}{T} \sum_{t=1}^{T} (Y(t) - Y(t-1))^2} + \sqrt{\frac{1}{T} \sum_{t=1}^{T} (A(t) - A(t-1))^2}}$$

$$U_2 = \frac{\sqrt{\frac{1}{T} \sum_{t=1}^{T} \{(Y(t) - Y(t-1) - (A(t) - A(t-1))\}^2}}{\sqrt{\frac{1}{T} \sum_{t=1}^{T} \{A(t) - A(t-1)\}^2}}$$

The coefficients U_0 and U_1 range from zero to one, but U_2 ranges from zero to infinity. In all cases the smaller the value of U is the better the goodness of fit. It is obvious that in a situation where Y(t) = A(t) then the numerator in all of these measures will tend to zero.

A non-parametric test, the Turning Point Errors Test is also useful as a measure of goodness-of-fit. The test measures how well actual turning points are simulated during the historical period, under the assumption that the ability of a model to predict turning points is a test of the validity of a model. The measure has four possible outcomes; a turning point will actually exist and the model will either predict or not predict it. Alternatively, no turning point exists and the model will either predict or not predict one. These four possibilities are illustrated in the following diagram;

		Predicted	
		Turning Point	No turning point
Actual	Turning Point	f_{11}	f_{12}
	No turning point	f_{21}	f_{22}

Each cell represents the frequency of each alternative. Perfect turning point forecasting implies $f_{12} = f_{21} = 0$; that is, there are no turning point errors. Expressing these errors in proportional terms provides a measure of turning point errors which can be identified as follows.

The total turning point error (TPE) can be defined as,

$$TPE = \frac{f_{12} + f_{21}}{f_{11} + f_{12} + f_{21} + f_{22}}$$

A measure of error due to turning points missed (TPME) is,

$$TPME = \frac{f_{12}}{f_{11} + f_{12}}$$

A measure of error due to falsely predicted turning points (TPFE) is,

$$TPFE = \frac{f_{21}}{f_{21} + f_{22}}$$

Each of these measures ranges between zero and one; small values indicate satisfactory turning point simulation.

The difficulty with each of the measures outlined above is that, although they do allow comparisons to be made between the goodness-of-fit for individual variables, they do not provide a rigorous statistical test. This implies that they cannot be used to make probabalistic,or concise statements about the overall validity of a particular model. These measures must be used carefully to identify the overall value of a model, but more importantly they can be used to identify weaknesses which may exist in the specification or estimation of a particular model.

CHAPTER 5

SYSTEMATIC REPRESENTATION OF THE ESTIMATED RESULTS

5.1 Derivation of the Estimated Structural Form

As outlined in the preceding chapter, the general structural form of the econometric model can be written as follows:

$$A*Y(t) = B*Y(t-1) + C*Z(t).$$

Using the estimated results of the structural equations, the coefficient matrices A, B and C of the model are presented in Tables 5, 6 and 7.

As the first 19 equations in the model, which make up the dairy sector and beef sector, form the simultaneous block, the first 19 rows (or columns) of the coefficient matrix (A) have non-zero elements both above and below the diagonal.

The last four equations in the model, which correspond to the feed grain sector, form the recursive block, and the last four rows (or columns) of the coefficient matrix (A) have non-zero elements only below the diagonal line.

The B matrix (Table 6) which has the same dimensions as the A matrix contains the coefficients which are associated with the lagged endogenous variables in the model. The C matrix (Table 7) has 22 rows which correspond to each of the equations in the model and 23 columns which correspond to the exogeneous and policy variables in the model.

5.2 Derivation of the Estimated Reduced Form

Given the estimated structural form, and pre-multiplying the inverse matrix of (A) from the left hand side, the general reduced form can be written as follows:

$$Y(t) = A^{-1} B*Y(t-1) + A^{-1} C*Z(t)$$

$$= \pi_1*Y(t-1) + \pi_2*Z(t)$$

Using the estimated results of the structural form the coefficient matrices π_1 and π_2 in the model are derived and presented in Tables 9 and 10.

Table 8 presents the inverse matrix of A and the coefficient matrices π_1 and π_2 are presented in Tables 9 and 10 respectively. As has already been noted, Table 10 measures the impact of the exogenous variables on each of the endogenous variables and corresponds to the short-run impact multipliers.

5.3 Derivation of the Estimated Final Form

As the general reduced form becomes the first-order difference equations system, it is possible to derive the final form by solving this equation system for the endogenous variables. The non-homogenous part of the solution is solved by substituting $Y(t) = \bar{Y}$ into the reduced form and the resultant equation system is: $\bar{Y} = (I-\pi_1)^{-1}\pi_2*Z(t)$. Coefficients are presented in Table 11. For the homogenous part of the solution, by substituting

$Y(t) = \lambda^t$ into the reduced form it is possible to derive the characteristic equations and solve them for the characteristic roots:

$$Y(t) = (I-\pi_1)^{-1} \pi_2 * Z(t) + m_{g1} \lambda_1^t \ldots m_{gn} \lambda_n^t \qquad g = 1 \ldots n,$$

or in matrix form;

$$Y(t) = (I - \pi_1)^{-1} \pi_2 * Z(t) + (m_{ij}) \begin{pmatrix} \lambda_1^t \\ \lambda_2^t \\ \vdots \\ \lambda_n^t \end{pmatrix} \qquad i,j = 1 \ldots n.$$

The estimated characteristic roots (λ) of the coefficient matrix π_1, in the reduced form of the model are shown in Table 12. The elements of the matrix m are arbitrary constants which are determined by the initial conditions for each of the variables.

5.4 Stability Test

Among the characteristic roots of π , the most dominant eigen value has a maximum absolute value $\lambda_5 = .98305$. This is a positive real number which is less than one, which implies that the Japanese livestock-feed grain market possessed, in 1960-79, stability of the type that following any transitory disturbance, the endogenous variables would converge monotonically to their equilibrium or stationary values. This convergence, however, would occur at a relatively slow rate because the dominant characteristic root is close to one.

It should be noted that λ_7, λ_{19} and λ_{23} have latent roots with negative values and absolute values less than one, which show an oscillatory convergence to the equilibrium value (i.e. dampened oscillation). However, these roots have much smaller absolute values than λ_5.

In addition to these, the eigen values λ_{14} and λ_{15}, are complex numbers with an absolute value of less than one, which would suggest cyclical convergence to the equilibrium value as time passes. The periodicity and amplitude of their cyclical movement are computed to be $\tau = 177$ (i.e. frequency = 0.00564 cycle/year) and $A_0 = 0.782$ respectively. The absolute value of these complex roots are slightly smaller than the dominant root λ_9 and hence these cyclical variations would be dominated by the monotonic variation shown by λ_9 and will not appear in the apparent total movement. Moreover, this cyclical component shows a periodicity which is too long to be observed. This is presumably due to the fact that this model uses only linear relationships and has a maximum lag of only one period.

As stated above, all the estimated characteristic roots have an absolute value which is less than one. Hence, it can be considered that the whole system of the Japanese livestock feed grain sector is stable during the sample period. At the same time, it has shown that it takes a long time to return to the equilibrium state and almost always exists in the disequilbrium (non steady) state.

These results about model stability should, however, be carefully interpreted. The results are dependent on the choice of the set of exogenous variables and given an alternative set of exogenous variables, the model could turn out to be unstable. What has been shown is merely that under the selected set of exogenous variables and model structure, these markets were shown to be stable.

During the sample period for the estimation of this model there were unusual circumstances such as the oil shock in 1973 and the food crisis in 1974-75. These unusual events almost certainly affected the stability of the market. Thus, in order to derive more reasonable estimates of the stability during this period, it would be necessary to include dummy variables to exclude the effect of the extraordinary movements from the system as a whole. However, because of the desire to restrict the total number of variables in the model, this procedure was not followed, and this has almost certainly had an effect on the stability measures derived.

TABLE 5

Matrix of Endogenous Variable Coefficients

Note: The rows in Tables 5-11 correspond to endogenous variables as defined in the columns of the A matrix. A further definition is presented in Table 1.

COFFICIENT MATRIX OF ENDOGENOUS VARIABLES (A)

DRM	QRM	PRM	NDC	DMP	QMP	PMP	NZIMQ	ASIMQ	STKMP	BFCON	QWM	QDI	PWM	PDM	NEC	WBMQ	ABIMQ	BDSTK	MXFDQ	FDCON	FDIMP	FDCHOP
1.0000	0.0000	3.0063	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	1.0000	0.0000	-1.7288	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	-0.3308	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0086	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	1.1168	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	-1.0745	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	-0.9511	0.0000	-0.0011	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0000	-1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0097	0.0194	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	-0.0902	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	-0.0902	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	-0.0423	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	-0.0423	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.7858	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2155	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	-1.0000	-1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	-0.5575	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.5575	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.9612	1.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.1122	1.0000	0.0000
0.0000	0.0000	0.0000	-2.8079	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-2.8079	0.0000	0.0000	0.0000	0.0000	-1.5885	0.0000	1.0000

TABLE 6

Matrix of Lagged Endogenous Variable Coefficients (B)

COEFFICIENT MATRIX OF THE LAGGED ENDOGENOUS VARIABLES (B)

DRM	GRM	PRM	NDC	DMP	QMP	PMP	MZIMQ	ASIMQ	STKMP	EFCON	CWM	QDM	PWM	PDM	NEC	NEMQ	ABIMQ	EDSTK	MXFDQ	FDCOK	FDIMP	FDCKOP
0.9831	0.0000	3.0063	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	4.9889	0.0000	0.0000	0.1032	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8226	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.7180	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.7835	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.7104	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1231	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1123	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6684	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5845	0.0000	0.0034	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6750	0.0000	0.0290	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0285	0.6201	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8466	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0097	-0.0236	-0.0236	0.0000	0.0000	0.0000	-0.4146	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0410	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5713	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0096	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.7076	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE 7

Matrix of Exogenous Variable Coefficients (C)

COEFFICIENT MATRIX OF THE EXOGENOUS VARIABLES (C)

CONST	PCER	PO	LHQ	DOTH	LSTK	PSP	WZRHP	EXHP	ASLHP	LPSTL	BIPAPC	FDPR	NBHP	ABHP	TIME	IMPRCW	EFEX	IMHP	BIHPC
144.9710	1.0142	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2126.6299	0.0000	0.0000	0.1711	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-71.9169	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
47.3368	0.0000	0.1955	0.0000	-0.2271	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
491.1450	0.0000	0.0000	0.0422	1.5594	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-17.6993	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
317.3840	6.6306	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
279.4960	0.0000	0.0000	0.1370	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
7.5487	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0011	0.0000
-49.0186	1.5338	0.0000	0.0000	0.0000	-0.0702	0.0000	-1.8599	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3625	0.0000
-45.3349	6.8575	0.0000	0.0000	0.0000	-0.3208	0.0000	0.0000	0.0000	-3.9532	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2107	0.0000
0.0000	0.0000	0.0000	0.0000	-1.0000	0.0000	0.0000	0.0000	-1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
-23.9557	2.6018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-136.9980	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-3.1701	0.0000	0.0000	-2.4371	0.0000	0.0000	0.0000	-0.4892
-29.3078	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-4.0924	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2418
-167.3990	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2100	0.0000	0.0000	0.0000	0.0000	56.9664	0.0000	0.0000	0.0000	0.0000
-351.3020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5374	1.5367	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.7858
461.2890	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-5.4803	0.0000	0.0000	-22.1934	0.0000	0.0000	0.0000	0.0000
2.2232	0.2868	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0407	0.0000	-0.9496	0.0000	0.0000	0.0000	0.0462
-9.1294	0.5361	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0131	-1.7594	0.0000	0.0000	0.0000	0.5665
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-1.0000	0.0000	1.0000
-609.1710	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
546.9290	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-18.8683	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2947.8799	10.2698	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-7.2422	0.0000	0.0000	0.0000
10377.7998	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	119.7120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

TABLE 8

Inverse Matrix (A^{-1})

INVERSE MATRIX OF A

1.0000	0.0000	-3.0063	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	1.0000	0.5720	1.7288	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0115	0.0000	0.0000	-0.0001	0.0147	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.3308	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0067	0.0000	0.0000	-0.0001	0.0085	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	-1.0608	0.0000	0.9987	0.0000	-1.1154	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	1.0207	0.0000	0.0012	1.0000	1.0731	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.9499	0.0000	0.0011	0.0000	0.9987	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-1.0000	1.0000	4.6391	1.7288	-0.9987	0.0000	1.1154	0.0000	0.0000	1.0000	0.0115	0.0000	0.0000	-0.0001	0.0147	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9850	0.0000	0.0000	-0.0096	-0.0191	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0298	0.0902	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006	1.0000	0.0000	0.0194	0.0008	0.0902	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0140	0.0423	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	1.0000	0.0091	0.0004	0.0423	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.7740	0.0000	0.0000	-0.0075	0.9850	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2155	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0438	0.1325	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.9841	1.0000	1.0000	0.0381	0.0202	0.1325	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.1844	0.5575	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0037	0.0000	0.0000	0.1201	0.0047	0.5575	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.1810	0.5470	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0036	0.0000	0.0000	0.1178	0.0046	0.5470	0.0000	0.0000	0.0000	0.9812	1.0000	0.0000	0.0000
0.0000	0.0000	0.0203	0.0614	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	0.0132	0.0005	0.0614	0.0000	0.0000	0.0000	0.1100	0.1122	1.0000	0.0000
0.0000	0.0000	1.2164	3.6769	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0245	0.0000	0.0000	0.7920	0.0312	3.6769	0.0000	0.0000	0.0000	1.5586	1.5885	0.0000	1.0000

TABLE 9

Reduced Form Lagged Endogenous Variable Coefficients (A^{-1} B)

COEFFICIENT MATRIX OF THE LAGGED ENDOGENOUS VARIABLES (REDUCED FORM ; P1=INV(A)*B)

DRM	QRM	PRM	WDC	DMP	QMP	PMP	NZIMQ	ASIMQ	STKMP	WFCON	GWM	QDM	PWM	PDM	WBC	WBMQ	ABIMQ	BDSTK	MXFDQ	FDCON	FDIMP	FDCHCF
0.9831	0.0000	3.0063	0.0000	0.0000	0.0000	-2.4731	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	4.9889	1.2412	0.0000	0.1032	0.4705	0.0000	0.0000	0.0000	0.0077	0.0000	0.0000	0.0000	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.8226	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.7180	0.0000	0.0000	0.2722	0.0000	0.0000	0.0000	0.0045	0.0000	0.0000	0.0000	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.7825	0.0000	-0.8731	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0009	0.7104	0.8401	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0009	0.0000	0.7818	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	-0.0000	0.0000	0.0000	0.1231	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1123	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-0.9831	0.0000	1.9825	1.2412	-0.7825	0.1032	3.8168	0.0000	0.0000	0.0000	0.0077	0.0000	0.0000	0.0000	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6583	0.0000	0.0000	0.0003	-0.0086	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0647	0.0000	0.0000	0.0245	0.0000	0.0000	0.0000	0.0004	0.5845	0.0000	0.0029	0.0122	0.0758	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0304	0.0000	0.0000	0.0115	0.0000	0.0000	0.0000	0.0002	0.0000	0.6750	-0.0003	0.0347	0.0356	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0285	0.6201	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5173	0.0000	0.0000	0.0002	0.1353	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0061	0.1336	0.8406	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0097	-0.0236	-0.0236	0.0000	0.0000	0.0000	-0.4146	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0410	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0951	0.0000	0.0000	0.0361	0.0000	0.0000	0.0000	-0.6577	0.5845	0.6750	0.0024	0.0555	0.1114	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.4003	0.0000	0.0000	0.1517	0.0000	0.0000	0.0000	0.0025	0.0000	0.0000	-0.0038	0.0751	0.4686	0.0000	0.0000	0.0000	0.9713	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.3928	0.0000	0.0000	0.1489	0.0000	0.0000	0.0000	0.0024	0.0000	0.0000	-0.0034	0.0737	0.4598	0.0000	0.0000	0.0000	0.9530	0.0096	0.0000	0.0000
0.0000	0.0000	0.0000	0.0440	0.0000	0.0000	0.0167	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	-0.0008	0.0083	0.0516	0.0000	0.0000	0.0000	0.1069	0.0011	0.7076	0.0000
0.0000	0.0000	0.0000	2.6398	0.0000	0.0000	1.0007	0.0000	0.0000	0.0000	0.0164	0.0000	0.0000	-0.0225	0.4956	3.0908	0.0000	0.0000	0.0000	1.5139	0.0153	0.0000	0.0000

TABLE 10

Reduced Form Exogenous Variable Coefficients - Short-run Multipliers (A^{-1} C)

COEFFICIENT MATRIX OF THE EXOGENOUS VARIABLES (REDUCED FORM ; P2=INV(A)*C)

*****SHORT-RUN-IMPACT-MULTIPLIER*****DELAYED MULTIPLIER=CUMULATIVE MULTIPLIER II. LAG=0*****

CONST	PCER	PG	LHQ	DOTH	LSTK	HSP	NZHMP	EXMP	ASCHP	EPSTL	BIHAPC	FDFR	NBMP	ABMP	TIME	IMPRCW	FFEX	IMPP	BIMFC
2.6603	1.0142	-0.5876	0.0000	0.6629	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2997.4023	0.0300	0.1118	0.2440	2.5661	0.0000	0.0000	0.0000	0.0000	0.0000	0.0079	0.0226	-102.5162	0.0000	0.0000	-0.0064	0.0000	0.0000	0.0000	-0.0115
47.3368	0.0000	0.1955	0.0000	-0.2271	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
503.6743	0.0174	0.0647	0.0422	1.4843	0.0000	0.0000	0.0000	0.0000	0.0000	0.0045	0.0130	-17.6993	0.0000	0.0000	-0.0037	0.0000	0.0000	0.0000	-0.0067
258.3500	6.6223	-0.2073	0.0000	0.2410	0.0000	-0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013	0.0000
336.2951	0.0080	0.1995	0.1370	-0.2318	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0012	0.0000
52.8610	0.0075	0.1857	0.0000	-0.2158	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0011	0.0000
-49.0186	1.5338	0.0000	0.0000	0.0000	-0.0702	0.0000	-1.8599	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3625	0.0000
-45.3349	6.8575	0.0000	0.0000	0.0000	-0.3208	0.0000	0.0000	0.0000	-3.9532	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2107	0.0000
2736.3921	-7.6064	0.9068	0.2440	0.6423	0.0000	0.0002	0.0000	-1.0000	0.0000	0.0079	0.0226	-102.5162	0.0000	0.0000	-0.0064	0.0000	0.0000	0.9987	-0.0115
-15.2768	2.5627	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0123	-0.0294	0.0000	0.0000	0.0000	-0.5447	0.0000	0.0000	0.0000	0.0150
-53.2407	0.0016	0.0056	0.0038	0.1338	0.0000	0.0000	0.0000	0.0000	0.0000	0.0045	0.0012	-5.2602	0.0000	0.0000	-3.3317	0.0000	0.0000	0.0000	-0.4898
9.9981	0.0007	0.0027	0.0018	0.0628	0.0000	0.0000	0.0000	0.0000	0.0000	0.0021	0.0006	-5.0732	0.0000	0.0000	-0.4198	0.0000	0.0000	0.0000	-0.2421
-167.3990	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2100	0.0000	0.0000	0.0000	0.0000	56.9664	0.0000	0.0000	0.0000	0.0000
-363.3063	2.0137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5278	1.5136	0.0000	0.0000	0.0000	-0.4260	0.0000	0.0000	0.0000	-0.7740
425.2180	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0452	0.0000	-5.4803	0.0000	0.0000	-9.9183	0.0000	0.0000	0.0000	0.0000
2.2232	0.2868	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0407	0.0000	-0.9496	0.0000	0.0000	0.0000	0.0402
-9.1294	0.5361	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0131	-1.7594	0.0000	0.0000	0.0000	0.5665
-27.9657	-2.5604	0.0086	0.0056	0.1966	0.0000	0.0000	0.0000	0.0000	0.0000	0.0189	0.0311	-10.3334	0.0000	0.0000	-3.2069	0.0000	-1.0000	0.0000	0.2531
-91.3015	0.0097	0.0361	0.0235	0.8275	0.0000	0.0000	0.0000	0.0000	0.0000	0.0278	0.0073	-12.9229	0.0000	0.0000	-5.5317	0.0000	0.0000	0.0000	-0.0037
457.3427	0.0095	0.0354	0.0231	0.8120	0.0000	0.0000	0.0000	0.0000	0.0000	0.0272	0.0071	-31.5485	0.0000	0.0000	-5.4278	0.0000	0.0000	0.0000	-0.0036
2999.1721	10.2709	0.0040	0.0026	0.0911	0.0000	0.0000	0.0000	0.0000	0.0000	0.0031	0.0008	-3.5383	0.0000	0.0000	-0.6687	-7.2422	0.0000	0.0000	-0.0004
-7043.0928	0.0638	0.2378	0.1551	5.4575	0.0000	0.0000	0.0000	0.0000	0.0000	0.1831	0.0480	4.5122	0.0000	0.0000	-36.4818	0.0000	0.0000	0.0000	-0.0245

TABLE 11

Long Run Multipliers

LONG-RUN MULTIPLIER

CONST	PCER	PG	LHQ	DOTH	LSTK	BSP	NZBMP	EXMP	ASDMP	EPSTB	BIMAPC	FDPR	NBMP	ABMP	TIME	IMPRCW	BFEX	IMMP	BIMPC
8553.3555	59.8360	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
7042.2925	1.3070	6.5028	0.4784	2.0022	0.0000	0.0056	0.0000	0.0000	0.0000	0.0307	0.0884	-180.4062	0.0000	0.0000	-0.0728	0.0000	0.0000	-0.0311	-0.0452
247.3598	0.1272	0.8813	0.0000	-1.0241	0.0000	0.0008	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	-0.0042	0.0000
2018.0927	0.3545	1.0337	0.1496	4.3276	0.0000	0.0009	0.0000	0.0000	0.0000	0.0177	0.0512	-62.7543	0.0000	0.0000	-0.0424	0.0000	0.0000	-0.0049	-0.0262
211.6996	29.8234	-4.2996	0.0000	4.9965	0.0000	-0.0047	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0009	0.0000	0.0000	-0.0006	0.0000	0.0000	0.0261	0.0000
1867.0552	0.5738	3.0928	0.4729	-3.5941	0.0000	0.0034	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006	0.0000	0.0000	0.0004	0.0000	0.0000	-0.0187	0.0000
243.1483	0.1547	0.8337	0.0000	-0.9688	0.0000	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0000	0.0001	0.0000	0.0000	-0.0051	0.0000
-55.8973	1.7490	0.0000	0.0000	0.0000	-0.0800	0.0000	-2.1209	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4134	0.0000
-51.0675	7.7247	0.0000	0.0000	0.0000	-0.3613	0.0000	0.0000	0.0000	-4.4531	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2373	0.0000
-1722.7646	-88.3524	10.8024	0.4784	-3.9942	0.0000	0.0103	0.0000	-1.0000	0.0000	0.0307	0.0884	-180.4075	0.0000	0.0000	-0.0723	0.0000	0.0000	0.9429	-0.0452
-33.9056	7.3338	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0502	-0.1276	0.0000	0.0000	0.0000	-1.5157	0.0000	0.0000	0.0000	0.0652
607.0508	1.2987	0.2243	0.0325	0.9392	0.0000	0.0002	0.0000	0.0000	0.0000	0.1710	0.3156	-28.7095	0.0000	0.0000	-19.6350	0.0000	0.0000	-0.0011	-1.3388
434.7315	1.3575	0.1346	0.0195	0.5635	0.0000	0.0001	0.0000	0.0000	0.0000	0.1516	0.3335	-25.2394	0.0000	0.0000	-8.6558	0.0000	0.0000	-0.0006	-0.9145
-428.3896	4.0501	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5541	1.0096	0.0000	0.0000	0.0000	54.5529	0.0000	0.0000	0.0000	-0.5162
-440.5289	6.7170	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5864	1.6744	0.0000	0.0000	0.0000	-1.3882	0.0000	0.0000	0.0000	-0.8562
2314.8792	5.4752	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.7491	1.3648	-34.3817	0.0000	0.0000	-65.4876	0.0000	0.0000	0.0000	-0.6979
-16.0252	0.2086	-0.0060	-0.0009	-0.0250	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0057	-0.0117	0.8992	-0.0288	0.0000	-0.2101	0.0000	0.0000	0.0000	0.6664
-8.7700	0.5150	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0126	-1.6902	0.0000	0.0000	0.0000	0.5461
1075.6885	-4.6776	0.3589	0.0519	1.5027	0.0000	0.0003	0.0000	0.0000	0.0000	0.3726	0.7768	-53.9489	0.0000	0.0000	-26.7751	0.0000	-1.0000	-0.0017	-1.3185
62896.7031	113.1593	20.0656	2.9029	84.0065	0.0000	0.0171	0.0000	0.0000	0.0000	14.8852	27.4850	-1885.4744	0.0000	0.0000	-1271.9818	0.0000	0.0000	-0.0946	-14.0540
62868.2656	112.1146	19.8803	2.8761	83.2309	0.0000	0.0169	0.0000	0.0000	0.0000	14.7478	27.2313	-1887.1189	0.0000	0.0000	-1260.2384	0.0000	0.0000	-0.0937	-13.9242
34194.3789	78.1227	7.6251	1.1031	31.9231	0.0000	0.0065	0.0000	0.0000	0.0000	5.6565	10.4445	-723.8015	0.0000	0.0000	-483.3624	-24.7675	0.0000	-0.0360	-5.3406
01653.6875	194.4611	34.4821	4.9886	144.3627	0.0000	0.0294	0.0000	0.0000	0.0000	25.5798	47.2322	-3150.6855	0.0000	0.0000	-2185.8645	0.0000	0.0000	-0.1626	-24.1514

TABLE 12

ESTIMATED CHARACTERISTIC ROOTS

(λ)			
1	0.0		
2	0.708		
3	0.0		
4	.710		
5	.983		
6	0.0		
7	-.415		
8	0.0		
9	0.0		
10	.585		
11	.675		
12	.971		
13	.718		
14	.782	+	.028 I
15	.782	-	.028 I
16	.010		
17	.650		
18	.144		
19	-.028		
20	.841		
21	.123		
22	.112		
23	-.041		

CHAPTER 6

VALIDATION OF THE MODEL

6.1 Introduction

The previous chapter summarised the estimated coefficients and response parameters of the overall econometric model. Before considering the economic implications of the responses which are implied by the estimated model, it is important to consider the overall validity of the model. By using the model to simulate over the estimation period, it is possible to get an idea of how well the model explains the changes that have taken place. Although these tests would be more meaningful if the model were used to simulate conditions in the future, or some period outside of the estimation period, the lack of such data precludes the possibility of such a test. It is also relatively less important in a situation where the major aim of developing the model is to understand the response relationships within the sectors rather than to provide forecasts.

While it may not be possible to make concise statements about the validity of a particular model, the validation exercise is valuable in identifying weaker parts in the structure of a particular model. To aid in identifying these problems the validation exercise is broken into three major parts or tests. The partial test is essentially a measure of the ability of the individual equations to explain the variation in the endogenous variables. No account is taken of previously generated endogenous variables or the simultaneous interaction which exists between equations. The test criteria are thus equivalent to those which would be derived from the original estimating equations.

The total test takes account of the interaction between endogenous variables in the simulation for any one period. It does, however, assume that all lagged endogenous variables are known with certainty. This test provides a measure of the ability of the overall model to account for the simultaneous reactions within the sectors of the model. The final test is carried out by simulating the model simultaneously using only model-generated values of lagged endogenous variables. This test comes the closest to approximating a true forecast situation, as the only information provided is the level of exogenous variables and initial values for lagged endogenous variables.

It can be seen that the three tests provide a progression of increasingly difficult criteria which must be met to establish the validity of the model. By breaking the test into these individual components it is easier to identify the major source of any difficulties in the overall model.

6.2 The Partial Test

The results of the partial test are summarised in Table 13. As stated above, the results simply reflect the accuracy of the original estimating equation, except for the identities which can be seen to have a perfect explanation. It can be seen from the R square (R^2) measure that all of the equations have an excellent fit with the minimum R^2 of .8 and a Theil U_0 of .11. In general, the mean absolute percentage errors for the individual equations are relatively low, but problems do arise with some variables. These are caused mainly by either exceptional individual observations, as in

TABLE 13

SUMMARY OF VALIDATION RESULTS - PARTIAL TEST

	R Square	Theil Coefficients U_0	U_1	U_2	MAPE	Turning Point Tests TPE	TPME	TPFE
DRM	.9967	.0095	.1598	.4073	2.0033	0.0000	.0000	.0000
QRM	.9963	.0090	.1417	.3959	1.5980	.0000	.0000	.0000
PRM	.9762	.0319	.3409	.8856	4.9626	.4211	.5000	.8750
NDC	.9915	.0107	.2058	.4242	1.6207	.1053	.5000	.5000
DMP	.9831	.0169	.2813	.8012	3.4022	.1053	.5000	.5000
QMP	.9452	.0330	.4386	.7012	6.2746	.3158	.7500	.7500
PMP	.9982	.0081	.0823	.2340	1.6206	.2105	.0000	.6667
NZIMQ	.8640	.1075	.2950	.6672	73.9269	.3684	.2857	.5000
ASIMQ	.9126	.0854	.2270	.6025	100.3767	.1579	.0000	.2500
STKMP	1.0000	.0000	.0000	.0000	0.0000	.0000	.0000	.0000
BFCON	.9615	.0383	.3986	.8100	7.3975	.3158	.4000	.5714
QWM	.8911	.0292	.1712	.4936	4.8298	.2632	.3750	.2857
QDM	.9489	.0635	.4047	.9528	13.7380	.2632	.3750	.2857
PWM	.9782	.0385	.3004	.7696	9.9635	.0526	.0000	.2000
PDM	.9575	.0451	.2638	.6802	9.9856	.3158	.3750	.3750
NBC	.8337	.0256	.5678	.7966	3.7525	.4211	.7143	.6000
NBMQ	.8028	.1115	.1867	.4691	32.0370	.3158	.3077	.1818
ABIMQ	.9980	.0155	.0331	.1057	9.0116	.1053	.1667	.1667
BDSTK	1.0000	.0000	.0000	.0000	0.0003	.0000	.0000	.0000
MXFDQ	.9863	.0240	.3102	.6919	4.4908	.2105	1.0000	1.0000
FDCON	1.0000	.0006	.0065	.0179	0.1215	.0000	.0000	0.0000
FDIMP	.8951	.0603	.5121	1.0388	8.0376	.1053	.5000	.5000
FDCROP	.9805	.0276	.3219	.8221	5.3923	.1053	.5000	.5000

the equation for the imports of milk products from Australia, or it is caused by the relatively low absolute value of some variables. The turning point error tests show that most of the equations have a probability of a turning point error of less than .3. However, some individual equations have relatively high turning point errors. This is especially true for the equation which explains the number of beef cattle (NBC) and the equation which explains the price of raw milk (PRM). As many of the equations in the model have large coefficients on the lagged dependent variables, which imply a slow rate of adjustment to changing exogenous variables, it is to be expected that the model might miss some of the short run changes in the actual data.

6.3 The Total Test

The results presented in Table 14 show that in general the degree of explanation does not fall when the simultaneous relationships are incorporated in the simulation. The major exceptions to this are the variables which explain the stocks of milk products and beef products. In the model these variables are explained by identities which are essentially residuals from other variables such as consumption, production and imports, in which case it is not surprising that these variables are subject to considerably more variability than the other variables. In effect, they account for residual variability in the other variables which go to make up the identity. The other variable whose explanation has decreased significantly is the production of wagyu beef (QWM). The major cause of this error is probably that the estimated equation depends largely on the endogenous variables which explain the number of beef cows and the number of dairy cows. Thus, any errors in the estimation of these variables would be passed on to the production equation.

In general, the calculated mean absolute percentage errors (MAPE) are relatively low except for variables which have low means, such as the stock variables. The turning point error test shows that the ability of the model to predict turning point has deteriorated from the partial test. This would be expected as errors from endogenous variables are passed on to other endogenous variables. Apart from the stock variables, however, the only equations which show turning point errors of greater than 50 per cent are the relationship explaining the number of beef cattle (NBC) and the relationship explaining the price of milk products, both of which have a turning point error of 52 per cent.

6.4 The Final Test

As has been discussed previously, the final test is the most rigorous test of an econometric model at it includes a test of the dynamic relationships which have been estimated. The results presented in Table 15 show that the ability of the model to explain the historical events have not deteriorated considerably when model-generated lagged endogenous variables are incorporated in the simulation. Apart from the stock variables, there are only three other variables whose R^2 has fallen below 80 per cent. These relationships include the quantity of wagyu meat produced (QWM), the number of beef cattle (NBC) and the New Zealand share of the imports into Japan (NBMQ). As would be expected, the Theil U and MAPE measures have deteriorated somewhat with the dynamic simulation, but there are individual case where the MAPE have improved.

TABLE 14

SUMMARY OF VALIDATION RESULTS - TOTAL TEST

	R Square	Theil Coefficients U_0	U_1	U_2	MAPE	Turning Point Tests TPE	TPME	TPFE
DRM	.9961	.0111	.1755	.4661	2.2272	0.0000	0.0000	.0000
QRM	.9887	.0212	.4185	.4679	4.2417	0.0000	0.0000	.0000
PRM	.9762	.0319	.3409	.8856	4.9626	.4211	.5000	.8750
NDC	.9915	.0108	.2084	.4334	1.6742	.1053	.5000	.5000
DMP	.9820	.0178	.2856	.8083	3.5650	.1053	.5000	.5000
QMP	.9510	.0316	.4433	.6824	5.9852	.3158	.7500	.7500
PMP	.9493	.0541	.6746	.9449	6.4277	.5263	1.0000	1.0000
NZIMQ	.8640	.1075	.2950	.6672	73.9269	.3684	.2857	.5000
ASIMQ	.9126	.0854	.2270	.6025	100.3767	.1579	0.0000	.2500
STKMP	.8579	.2011	.2227	.4867	384.5098	.4737	.4000	.4545
BFCON	.9586	.0398	.4052	.8059	7.6323	.3158	.4000	.5714
QWM	.4303	.0786	.5461	.8457	12.4260	.3684	.5000	.4286
QDM	.9368	.0728	.4930	1.0318	16.1475	.2632	.3750	.2857
PWM	.9782	.0385	.3004	.7696	9.9635	.0526	.0000	.2000
PDM	.9486	.0506	.3011	.7400	11.3748	.4211	.6250	.5000
NBC	.8310	.0265	.5772	.7870	4.1583	.5263	.7143	.7143
NBMQ	.8028	.1115	.1867	.4691	32.0370	.3158	.3077	.1818
ABIMQ	.9980	.0155	.0331	.1057	9.0116	.1053	.1667	.1667
BDSTK	.1365	.9187	.9082	10.3444	72494.3720	.6316	.7000	.6250
MXFDQ	.9862	.0242	.3199	.6873	4.6404	.2105	1.0000	1.0000
FDCON	.9670	.0525	.7745	.8946	10.8915	.1053	.5000	.5000
FDIMP	.8951	.0616	.5482	1.0409	8.7407	.1053	.5000	.5000
FDCROP	.9739	.0783	.9164	.9703	16.8438	.1579	.5000	.6667

TABLE 15

SUMMARY OF VALIDATION RESULTS - FINAL TEST

	R Square	Theil Coefficients			MAPE	Turning Point Tests		
		U_0	U_1	U_2		TPE	TPME	TPFE
DRM	.9893	.0404	.4338	.3738	5.8549	0.0000	0.0000	.0000
QRM	.9885	.0291	.6326	.3923	5.0688	0.0000	0.0000	.0000
PRM	.9725	.0894	.7444	.6725	11.4509	.3158	1.0000	1.0000
NDC	.9864	.0156	.2928	.4317	2.5116	.2105	1.0000	1.0000
DMP	.9750	.0271	.3648	.5752	4.7201	.1053	1.0000	.0000
QMP	.9017	.0477	.5391	.7654	8.4379	.2105	1.0000	.0000
PMP	.9699	.1086	.8346	.7525	14.3460	.3158	1.0000	1.0000
NZIMQ	.8569	.1105	.2978	.6593	75.1265	.3684	.2857	.5000
ASIMQ	.9101	.0866	.2272	.5697	105.0024	.1579	.0000	.2500
STKMP	.3940	.6024	.5029	.4246	157.8717	.4211	.4000	.4000
BFCON	.9313	.0546	.4360	.7922	11.3527	.2105	.8000	.0000
QWM	.0092	.1746	.6368	.8362	25.1798	.3684	.6250	.4000
QDM	.9091	.1244	.5895	.8067	19.7643	.2632	.6250	.0000
PWM	.9760	.0406	.3225	.7617	9.6180	.2632	.7500	.6667
PDM	.9432	.0529	.3109	.7157	11.5676	.4211	.6250	.5000
NBC	.5511	.0488	.6191	.8904	8.4564	.3158	.8571	.0000
NBMQ	.6416	.1835	.3286	.5392	46.5913	.4211	.3077	.3077
ABIMQ	.9980	.0157	.0335	.1084	8.8923	.1053	.1667	.1667
BDSTK	.1452	.9629	.9360	9.3173	23602.7839	.5263	.5000	.5000
MXFDQ	.9817	.0373	.4438	.5707	7.7581	.1053	1.0000	.0000
FDCON	.9805	.0577	.7183	.5774	9.0672	.1053	1.0000	.0000
FDIMP	.8400	.0781	.5291	.8656	12.7133	.1053	1.0000	.0000
FDCROP	.9920	.0906	.8884	.6309	17.7981	.1579	1.0000	1.0000

The general measure of turning point errors also shows some improvement in comparison with the total test. Of the 23 endogenous variables, eight have a lower percentage of turning point errors in the final test, and only five have a higher percentage of turning point errors. This suggests that the dynamics incorporated in the model are a reasonable representation of the market structure. Some of these results can be explained by the aggregate time path of the endogenous variables. Many variables in the model have a strong time trend with relatively few turning points. In a situation where the simulation model uses estimated lagged endogenous variables, the model is most likely to recreate these strong time trends. The fact that there are relatively few turning points can be seen in Figures 5 to 11 presented in Appendix II. These graphs give an indication of the general ability of the model to simulate past conditions for some of the major variables in the final test. The selected variables are considered to represent some of the major ones in each sector.

In general, the graphs show the strong time trends which exist in some of the variables in the beef and cattle market. The relatively stable trends in the predicted variables reflect the stable nature and dependence on lagged values which is incorporated in the econometric model.

6.5 Summary

The validation exercise has shown that the estimated econometric model is a reasonable representation of the Japanese livestock and feed sectors. The very high degree of explanation is partly attributable to the fact that many of the variables in the model display strong time trends; the lack of ability to predict turning points is partly a reflection of the low speed of adjustment of the overall model. The lack of turning points and the possible inability of the model to anticipate the turning point is of some concern when the major objective of the model is to measure the responsiveness of the endogenous variables to policy changes. For this reason it is important that consideration be given to the validity of the multipliers which are to be derived from the estimated model. The following Chapter of this report presents the major multipliers for the model and discusses both their consistency and validity as well as their implications for policy analysis.

CHAPTER 7

MULTIPLIER AND POLICY RESPONSE

7.1 Introduction

Chapter 4 of this report described how the impact, delayed, cumulative and long-run multipliers could be derived from the reduced form and final form of the econometric model. Because of the amount of information involved, a complete set of these multipliers is not given. However, Table 10 in Chapter 5 presents a complete set of impact multipliers for each of the 22 exogenous variables and 23 endogenous variables. Similarly, Table 11 presents a complete matrix of the long-run multipliers for the same variables. The multipliers presented in Table 10 and Table 11 are in absolute form, which means that the size of the multipliers must be considered in relation to the units and the size of the variables concerned. For policy analysis it is often more relevant to convert this information to percentages and thus present the multiplier in terms of elasticities.

This chapter considers in more detail the elasticities with respect to the seven major exogenous variables in the model. Most of these variables are policy variables which are under the control of the Japanese Government or quasi-government institutions. These include guarantee prices and quotas for both beef and dairy products as well as the import quotas for both of these products. The major non-policy variables considered are personal consumption expenditures, which reflect trends that are likely to continue in the Japanese economy, and the import price of feed, which has in the past been a major cause of instability for the Japanese livestock industries. In Tables 16 and 17 the short and long-run elasticities for each of these variables are presented.

7.2 Response to Income Changes

The variable PCER measures disposable income in Japan. As might be expected, the major influence of income changes is through the demand for raw milk, milk products and beef. The influence on demand leads to price increases which in turn have an impact on production in later periods. The lagged effect of these responses is evident in the relative size of the long and short-run elasticities. The response in the demand function shows that demand for both raw milk and beef is elastic, with income elasticities of approximately 1.5 in both cases. The demand for milk products is somewhat lower with an elasticity of .77. The apparently large effect that changes in income have on stocks of both beef and milk products comes through changes in consumption, which have a direct influence on the level of stocks. These elasticities appear somewhat more important than they are in absolute terms as the levels of stocks are usually relatively low.

It is interesting to note the impact that income changes have on imports of both dairy products and beef from New Zealand. In the short-run, income changes appear to have substantial impacts on imports of these products, especially beef. These short-run effects have already been discussed and are presumably caused by preferences for products from New Zealand in relation to products from other countries. The long-run elasticities, however, are somewhat different. For dairy products it can be seen that there is a negative impact in the long run. For beef the long-run elasticity is somewhat less than in the long run although still positive. These diminishing

TABLE 16

SHORT-RUN IMPACT ELASTICITIES FOR THE MAJOR EXOGENOUS AND POLICY VARIABLES

	PCER	PG	LMQ	BSP	BPSTB	FDPR	IMMP	BIMPQ
DRM	.0265	-.0103	-	-	-	-	-	-
QRM	.0004	.0011	.0579	-	.0006	-0.0471	-	-.0002
PRM	-	.0838	-	-	-	-	-	-
NDC	.0007	.0018	.0273	-	.0010	-0.0221	-	-0.0003
DMP	.1710	.0036	-	-.0001	-	-	.0006	-
QMP	.0003	.0053	.0850	.0001	-	-	-.0009	-
PMP	.0046	.0763	-	.0012	-	-	-.0128	-
NZIMQ	.2679	-	-	-	-	-	1.1720	-
ASIMQ	1.4251	-	-	-	-	-	.8103	-
STKMP	-1.6265	.1297	3.0376	.0005	.0088	-0.6647	3.9522	-0.0002
BFCON	.5218	-	-	-	-.0131	-	-	.0029
QWM	.0007	.0017	.0267	-	.0106	-0.0716	-	-.2096
QDM	.0004	.0010	.0155	-	.0061	-0.0854	-	-.1281
PWM	-	-	-	-	.0684	-	-	-
PDM	.1696	-	-	-	.2327	-	-	-.0621
NBC	-	-	-	-	.0077	.0054	-	-
NBMQ	5.2771	-	-	-	-	-	-	.7052
ABIMQ	.9799	-	-	-	-	-	-	.9900
BDSTK	-37.3180	.0836	1.2764	-	1.4405	-4.5530	-	3.5151
MXFDQ	.0000	.0001	.0018	-	.0007	-0.0019	-	-0.0000
FDCON	.0005	.0001	.0017	-	.0007	-0.0046	-	-0.0000
FDIMP	.0607	.0000	.0002	-	.0001	-0.0006	-	-0.0000
FDCROP	.0002	.0004	.0068	-	.0007	0.0004	-	-0.0001

TABLE 17

LONG-RUN ELASTICITIES FOR THE MAJOR

EXOGENOUS AND POLICY VARIABLES

	PCER	PG	LMQ	BSP	BDSTB	FDPR	IMMP	BIMPQ
DRM	1.5642	-	-	-	-	-	-	-
QRM	.0198	.0655	.1135	.0008	.0024	-0.0828	-0.0087	-0.0006
PRM	.0815	.3778	-	.0045	-	-	-0.0493	-
NDC	.0146	.0286	.0966	.0003	.0038	-0.0785	-0.0037	-0.0010
DMP	.7702	.0743	-	-0.0011	-	-	0.0124	-
QMP	.0227	.0819	.2933	.0013	-	-	-0.0137	-
PMP	.0950	.3424	-	.0053	-	-	-0.0574	-
NZIMQ	-.3056	-	-	-	-	-	1.3365	-
ASIMQ	-1.6053	-	-	-	-	-	0.9128	-
STKMP	-18.8926	1.5455	1.6027	.0208	.0343	-1.1697	3.7310	-0.0092
BFCON	1.4932	-	-	-	-.0695	-	-	0.0126
QWM	.5832	.0674	.2284	.0008	.4020	-0.3909	-0.0040	-0.5728
QDM	.7538	.0500	.1694	.0005	.4406	-0.4250	-0.0065	-0.4838
PWM	.2521	-	-	-	.1806	-	-	-0.0306
PDM	.5657	-	-	-	.2559	-	-	-0.0687
NBC	.1787	-	-	-	.1280	-0.0340	-	-0.0217
NBMQ	3.8391	-0.0736	-0.2508	.0017	-.5510	0.5017	0.0102	1.1643
ABIMQ	.9414	-	-	-	-	-	-	.9510
BDSTK	-68.1773	3.5002	11.8576	.0425	28.4417	-23.8416	-0.4558	-18.3098
MXFDQ	.5510	.0654	.2214	.0008	.3778	-	-0.0085	-0.0652
FDCON	.5436	.0645	.2184	.0008	.3743	-	-0.0084	-0.0643
FDIMP	.4621	.0302	.1022	.0004	.1751	-0.0619	-0.0039	-0.0301
FDCROP	.5486	.0651	.2205	.0008	.3777	-	-0.0085	-0.0649

responses are most likely caused by the increase in domestic production which occurs with a lag following increases in domestic market prices. This response serves as a demonstration of the responsive nature of production of these products in Japan, and is a reasonable reflection of past events.

7.3 Response to Changes in the Guaranteed Price for Milk Products

The guaranteed price for milk products (PG) is the government determined price which is paid for purchases of milk for manufacturing from farmers in Japan. As might be expected, this variable has a positive effect on the production of milk in Japan because of the close linkage between this price, the price for raw milk, and the price for milk products. The increased number of dairy cows leads to increased production of both wagyu and dairy meat, although it does not appear to have a direct effect on the price of these products. The increased production which would be associated with an increase in the guaranteed price also leads to an increase in the level of stocks of both milk products and beef. This reflects the stabilising influence of these stocks. As would be expected, a change in a policy variable which leads to increased production, would also lead to increased imports and use of feed products, especially in the long-run. While the elasticities for this response appear to be relatively low in absolute terms, the multiplier shows that an increase of one yen per kilogram in the guaranteed price leads to an increase of 7.6 thousand tonnes in imports of feed grains.

7.4 Response to Changes in the Maximum Quantity Eligible for Deficiency Payments

The variable LMQ measures the total quantity of milk which is eligible to receive the guaranteed price for processing milk. With a complex policy variable such as this, it is somewhat difficult to outline a-priori expectations of the responses. It is generally assumed that this variable has the effect of controlling the production of milk by reducing returns to producers. The results from the model however, indicate that this variable has little impact on price, but it does influence quantities produced in these markets. An increase in this allocation leads to increases in dairy cows, production of raw milk, and the production of milk products. This increased production, however, leads to increases in stocks of milk products, as well as stocks of beef products following increases in beef production. In a similar manner to the guaranteed price, this variable does not appear to have any influence on the imports of dairy products from New Zealand, but it does have a negative effect on the imports of New Zealand beef. This relationship is due to the fact that any policy instrument which increases beef production in Japan decreases the demand for imports from New Zealand which are directly competitive with Japanese dairy beef.

7.5 Response to Changes in the Stabilisation Price for Milk Products

It is difficult to put a specific interpretation on these elasticities because the variable used in the model (BSP) is a weighted average of the stabilisation price for the various milk products. The stabilisation prices are the price levels which the LIPC attempts to maintain through its market intervention operations. It appears from the results, that this variable has relatively little impact on the markets other than a short-run negative effect on consumption of milk products and a positive impact on the price of milk products. These relatively small short-run effects lead to more wide-ranging long-run effects, including increases in returns to farmers, in dairy production, in beef production, and hence in the demand for imported feed. These elasticities show the well established effects of government control of market prices. Attempts to legislate increases in market prices usually lead to decreases in consumption, but even larger increases in production, and hence substantial increases in stocks. Although the model does not suggest that such a change would have an effect on imports of milk products from countries such as New Zealand, this would undoubtedly be the situation if the changes were sufficiently large and sustained.

7.6 Response to Changes in the Beef Stabilisation Price

The beef stabilisation price operates in a similar manner to the dairy product stabilisation price and provides a basic guideline for the market intervention operations of the LIPC. As would be expected, such a price change leads to an increase in the associated market prices, which leads to both decreases in consumption and increases in production. Thus, as consumption decreases there is surplus production which inevitably leads to increased stocks.

7.7 Response to Changes in Feed Price

The variable (FDPR) is not a policy variable, and is exogenous to the model because it is largely determined by the price of imported feed products. As would be expected, increases in feed prices have a negative influence on the number of both beef and dairy cattle, as well as the long-run production of beef and dairy products. The decrease in production of beef leads to a run down of domestic stock and in increase in imports of beef. Many of these changes take some time to occur, so the short-run response is somewhat less than the long-run response. Although the elasticities are not large, these effects do underline the vulnerability of the Japanese production system to fluctuations in imported feed prices.

7.8 Response to Changes in the Imports of Milk Products

The policy variable (IMMP) measures the quantity of imports of milk products which are largely under the control of the LIPC. The quantity tendered for import is viewed to be a major restriction on imports of products from New Zealand and Australia. The short-run impact of an increase in the quantity of imports is somewhat limited, but as the short-run effects work through the model, the longer term effects on the Japanese livestock sector become more obvious. In the short-term an increase in imports leads to a reduction in the price of milk products which causes an increase in consumption and a reduction in domestic production of milk products. The increased imports also lead to an increase in the stocks of milk products. The elasticity for this increase in stocks appears to be quite large, and in absolute terms the multiplier shows that a one tonne increase in imports leads to a .998 tonne increase in domestic stocks. While this increase in stocks would appear to negate the benefits of increased imports, it must be remembered that the products imported could be considerably different from those in stock. The response in the imports from Australia and New Zealand show that with a one per cent increase in import quota, New Zealand receives a proportionately larger share of this increase than Australia. In absolute terms, for every tonne increase in imports, imports from New Zealand increase .36 tonnes with .21 tonnes from Australia. The remainder is presumably made up of imports from other countries.

In the long term the change in the quantity of imports has a more diverse effect. The reduction in the price for milk products leads to a reduction in the overall price which farmers receive for milk. This leads to an eventual reduction in dairy production with a very small reduction in beef production. The reduction in dairy production, however, does lead to a saving in terms of imports of feed. The absolute results suggest that for each tonne increase in imports of dairy products, there would be a .03 tonne reduction in feed imports. It would be expected that this coefficient would be substantially larger, but it must be remembered that the observations used in estimating the model cover a relatively small range of import levels. This relationship can be seen in the way in which increased imports in the model lead to increased stocks of dairy products. While these responses may be valid for small fluctuations in import quotas, they would not be relevant for any substantial increase in imports. In such a situation stocks would not be allowed to accumulate and production would be reduced along with a reduction in feed imports. It is unfortunate that the model cannot pick up these wider range responses, but the estimates of the model are limited by the data available and the aggregate nature of the model.

7.9 Response to Changes in the Beef Import Quota

Beef imports are controlled by a system similar to that used for dairy product imports and are also under the control of the LIPC. The response to increases in the beef import quota to some extent parallels the response to increases in dairy imports. In the short run, an increase of one percent in the import quota leads to an increase of 0.99 per cent in imports from Australia. In absolute terms, however, New Zealand's share is still small. For each tonne increase in imports New Zealand would have a share of .04 tonnes and Australia .57 tonnes. The increased imports do not have an effect on the price of dairy meat. This result reflects the facts that the imported meat is substituted for the dairy beef rather than wagyu beef. The reduction in price leads to an immediate reduction in production and a subsequent increase in stocks. The response of stocks, however, does not appear to be as large as it is in the case of milk products. For each tonne increase in beef imports, there is an increase in beef stocks of .25 tonnes.

The long-run impact of a sustained increase in imports is somewhat different to the short-term response. The first point to note is that New Zealand's share of the increased imports increases relative to that of Australia. Although it is still low in absolute terms, for each one per cent increase in beef imports, New Zealand's share would increase by 1.16 per cent. In the long term the increase in beef consumption is even larger than it is in the short term, as the price of wagyu beef falls. It is also interesting to note the long-term response in beef stocks. The model results suggest that in the long term the level of stocks falls as imports increase. This response is presumably caused by the large increase in domestic consumption in relation to the reductions in production both of which are caused by the price falls. As would be expected the decrease in both beef and dairy cattle numbers leads to a reduction in feed imports. In this case the long-term results are more sensible than for the dairy sector. The absolute multipliers suggest that for every tonne increase in beef imports, there is a reduction of 5.3 tonnes of imports of feed, as well as a substantial reduction in the domestic production of feed.

7.10 Summary

The discussion of the multipliers in the previous section has shown that most of the responses contained within the econometric model are not difficult to understand and are generally consistent with a-priori expectations. The results show that the policy variables and major exogenous variables exert considerable influence on the quantities produced and consumed, and on prices in the livestock market in Japan. The dynamic implications of the multipliers are also seen to be important in that the responses vary considerably over time. As would be expected the short-run responses are generally seen among closely related variables, while the longer-run responses are much more diverse and complex.

From New Zealand's point of view, the results show that exports of New Zealand's agricultural products would benefit from a liberalisation of the import policy on both milk products and beef. The market-share relationships show that with liberalisation New Zealand's share of the import market would increase relative to Australia's. It must be remembered however, that New Zealand's share of the beef market is presently substantially lower than that of Australia. In the case of beef imports, and to a lesser extent dairy imports, the model has shown the trade-off which exists between imports of finished products and livestock feeds. These trade-offs are important in any analysis of food security or self-sufficiency for Japan.

The model also clearly demonstrates the implications of a policy which attempts to increase domestic prices. It was shown that for both beef and dairy products, a policy of increasing price support in an attempt to increase producer incomes, would cause production to expand and prices to fall. The long-run outcome of such a change would be an increase in stocks of these products and of course the termination of imports. Recent events in the dairy industry in Japan would appear to have followed this path, as increasing local production has led to a reduction in imports of traditional dairy products.

A more detailed analysis of agricultural policy options for Japan would require the development of variables which measure the welfare of producers and consumers in Japan, as well as a method of accounting for the Government cost of the actual policy. This type of analysis is beyond the scope of the present study, but the multipliers and policy response measures derived in this study do provide the basis for such a study.

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A P P E N D I C E S

APPENDIX I

Definitions of Variables Used in the Model

(a) (Endogenous Variables)

(Name)			(Unit)
DRM	=	demand for raw milk	('000 tonne)
QRM	=	production of raw milk	('000 tonne)
PRM	=	price of raw milk	(yen/l)
NDC	=	number of dairy cattle	('000 head)
DMP	=	demand of milk product	('000 tonne)
QMP	=	production of milk product	('000 tonne)
PMP	=	price of milk product	(yen/l)
NZIMQ	=	import of milk product from New Zealand	('000 tonne)
ASIMQ	=	import of milk product from Australia	('000 tonne)
STKMP	=	stock of milk product	('000 tonne)
BFCON	=	consumption of beef	('000 tonne)
QWM	=	production of wagyu beef	('000 tonne)
QDM	=	production of dairy cattle meat	('000 tonne)
PWM	=	price of wagyu beef	(yen/kg)
PDM	=	price of dairy cattle meat	(yen/kg)
NBC	=	number of beef cattle	('000 head)
NBMQ	=	import of beef from New Zealand	('000 tonne)
ABIMQ	=	import of beef from Australia	('000 tonne)
BDSTK	=	stock of beef	('000 tonne)
MXFDQ	=	production of mixed feed	('000 tonne)
FDCON	=	consumption of feed grain	('000 tonne)
FDIMP	=	import of feed grain	('000 tonne)
FDCROP	=	production of feed grain	('000 tonne)
NTC	=	number of total cattle (NDC + NBC)	('000 head)
QBM	=	total beef production (QWM + QDM)	('000 tonne)

(b) (Exogenous Variables)

(Name)			(Unit)
PCER	=	income level (personal consumption expenditure)	(Index)
PG	=	government price for processing milk	(yen/kg)
LMQ	=	maximum quantity eligible for deficiency payment	('000 tonne)
DOTH	=	disposition of raw milk for other use	('000 tonne)
LSTK	=	stock of milk product by LIPC	('000 tonne)
BSP	=	milk product stabilisation price	(yen/kg)
MP	=	import price	(yen/kg)
NZRMP	=	import price of New Zealand milk product	(ratio)
EXMP	=	export of milk product	('000 tonne)
ASDMP	=	import price of Australian milk product	(yen/kg)
BPSTB	=	beef stabilisation price	(yen/kg)
BIMAPC	=	average import price of beef	(yen/kg)
GBSTK	=	government stock of beef	('000 tonne)
FDPR	=	feed price/output price ratio	(Index)
NBMP	=	import price of beef from New Zealand	(yen/kg)
ABMP	=	import price of beef from Australia	(yen/kg)
TIME	=	time trend	
IMPRCW	=	import price of feed grain/wholesale price	(Index)
BFEX	=	export of beef	('000 tonne)
IMMP	=	import of milk products	('000 tonne)
BIMPQ	=	import of beef	('000 tonne)

Note: BPSTB is derived by taking average of ceiling price and floor price with respect to the wagyu beef and the other meat.

APPENDIX II

Validation of Selected Variables

Fig.1 Demand for Raw Milk (DRM)

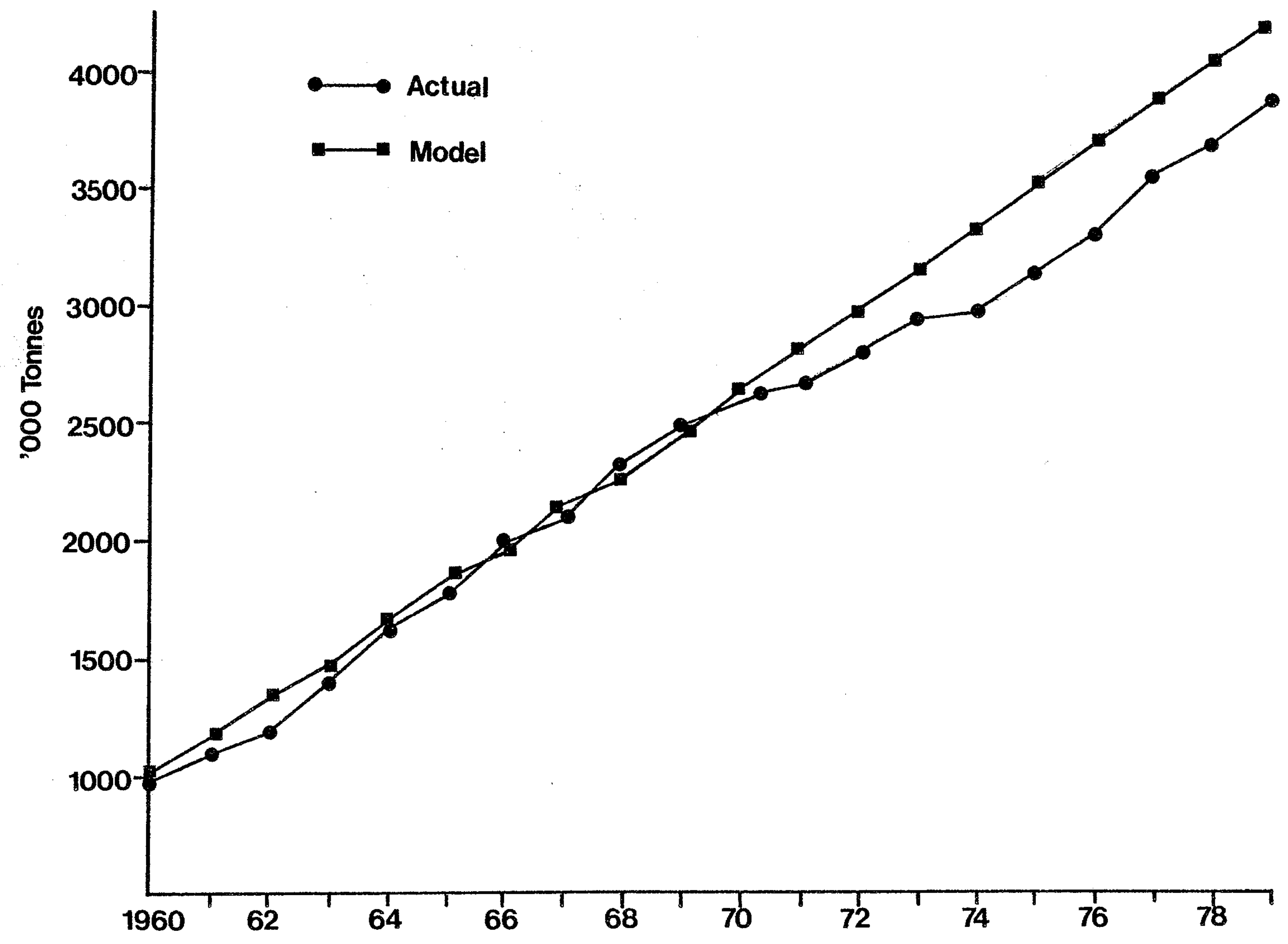


Fig. 2 Number of Dairy Cattle (NDC)

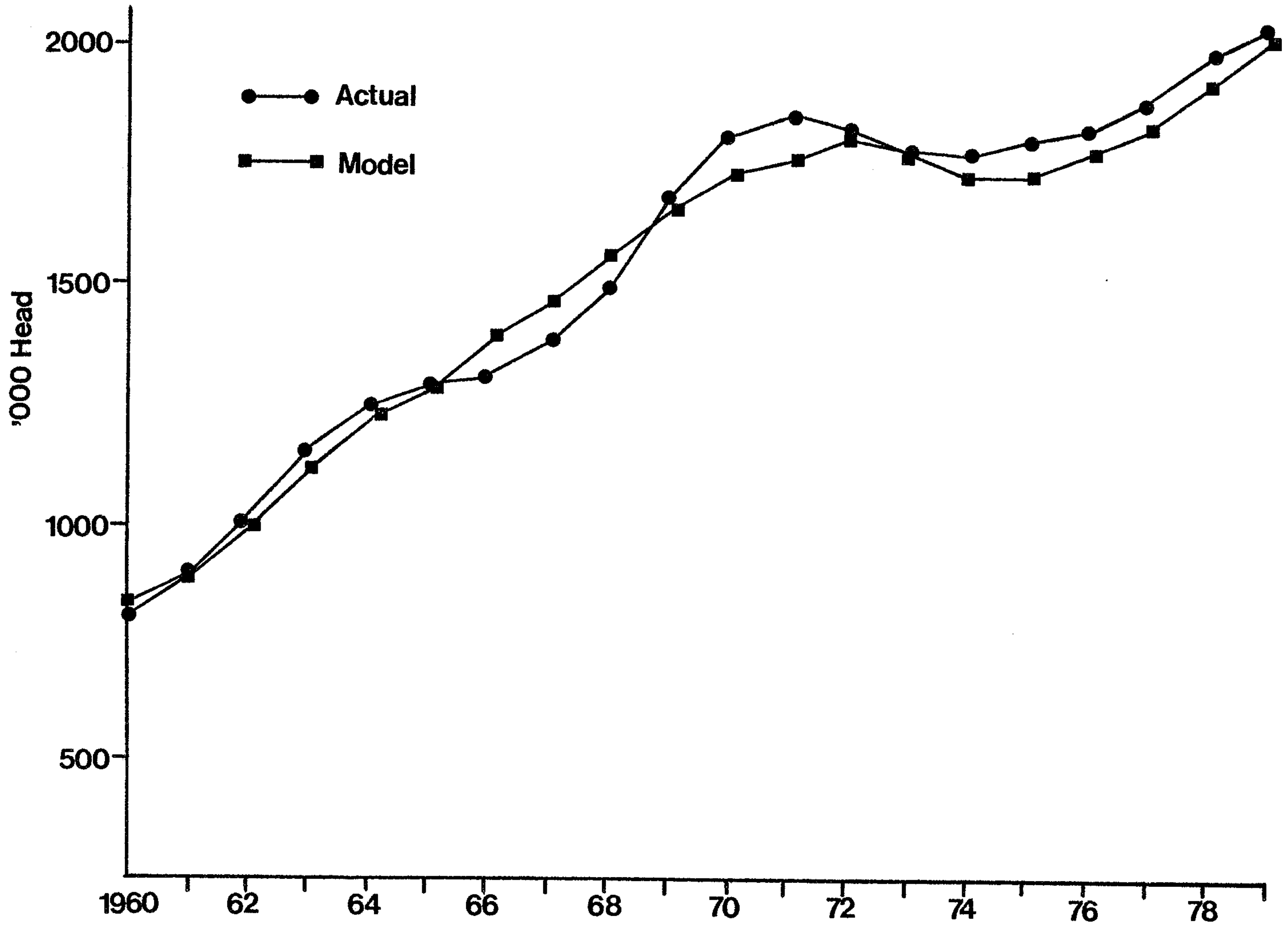
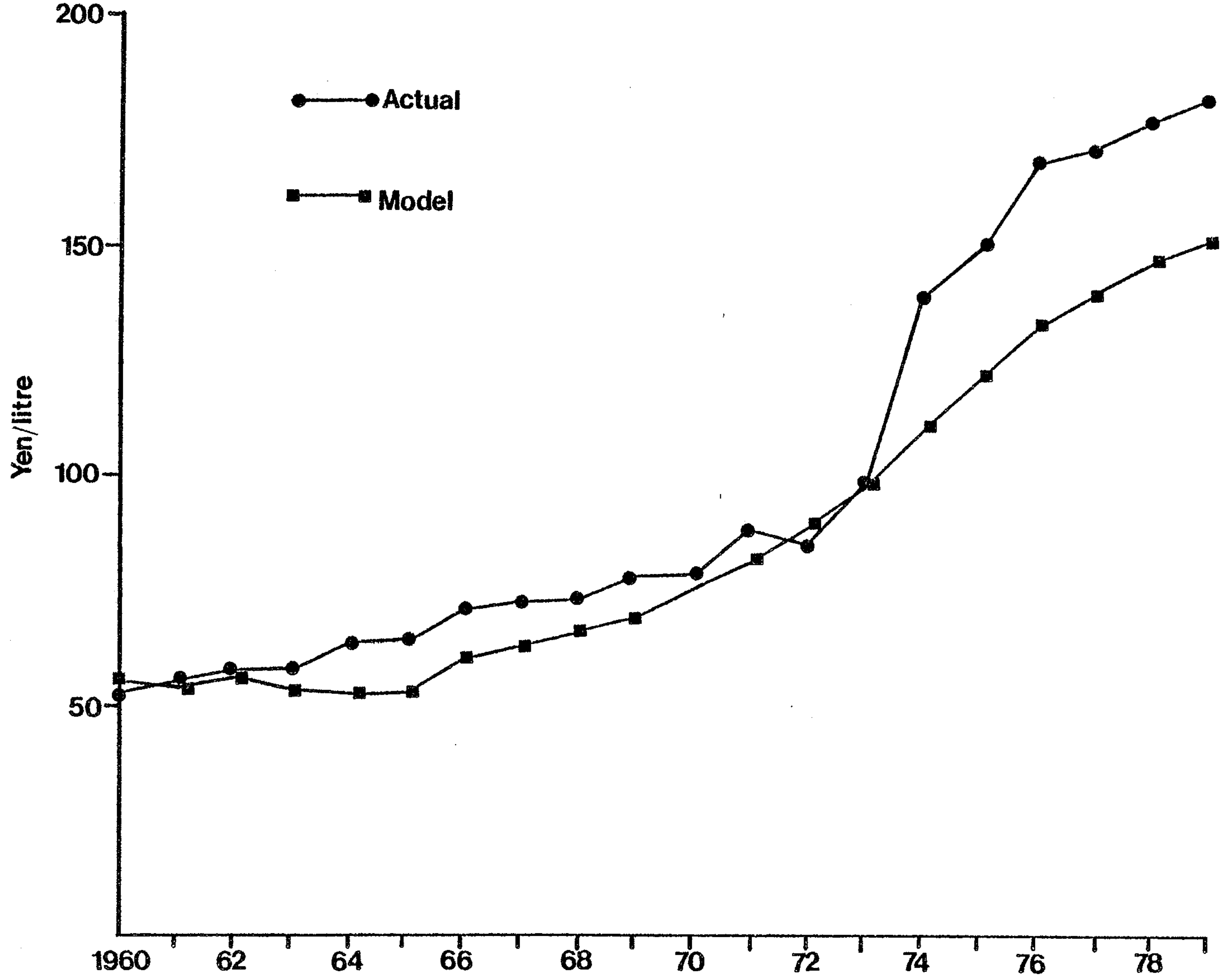


Fig.3 Price of Raw Milk (PRM)



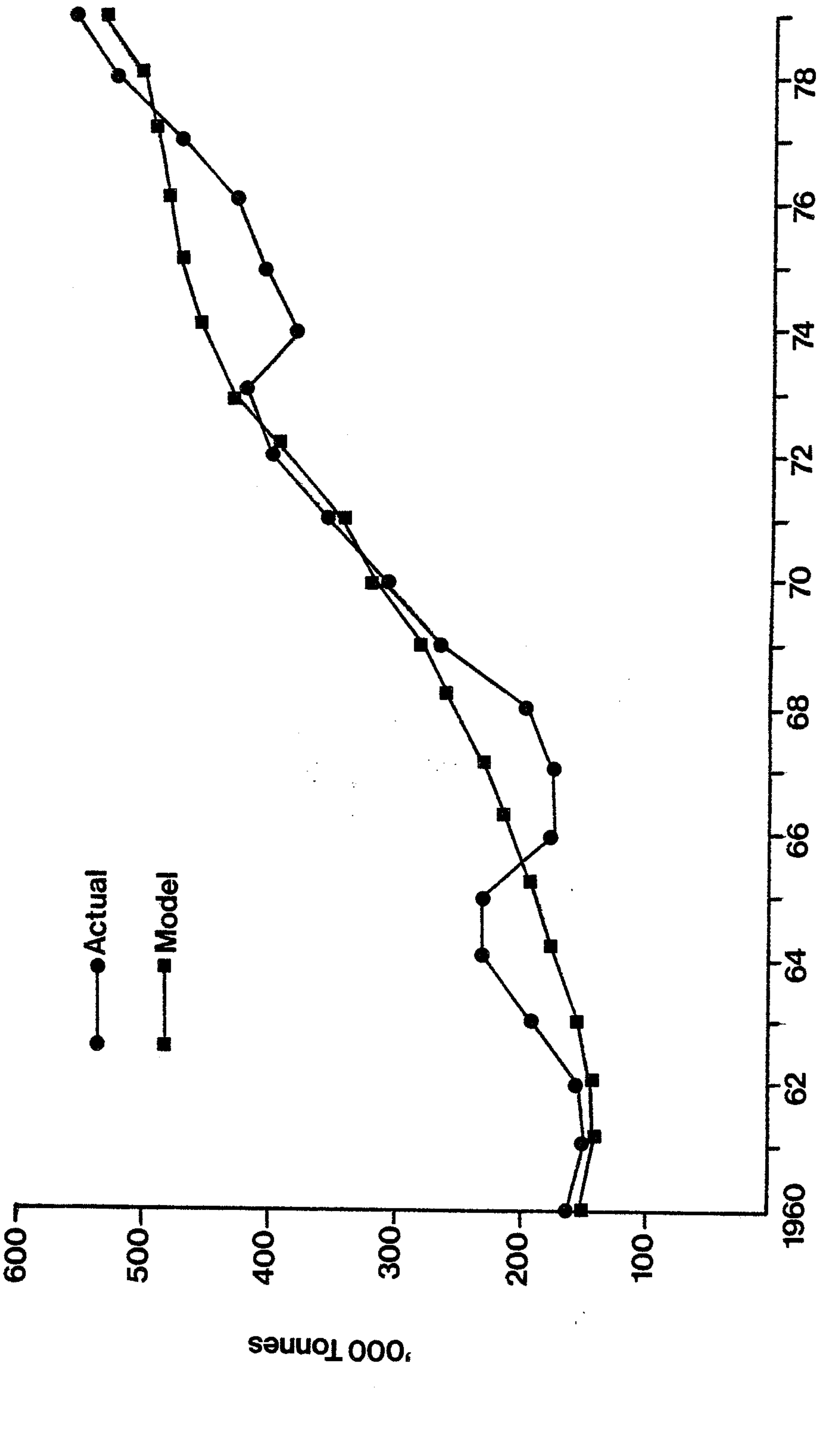


Fig.4 Consumption of Beef (BFCON)

Fig.5 Price of Wagyu Beef (PWM)

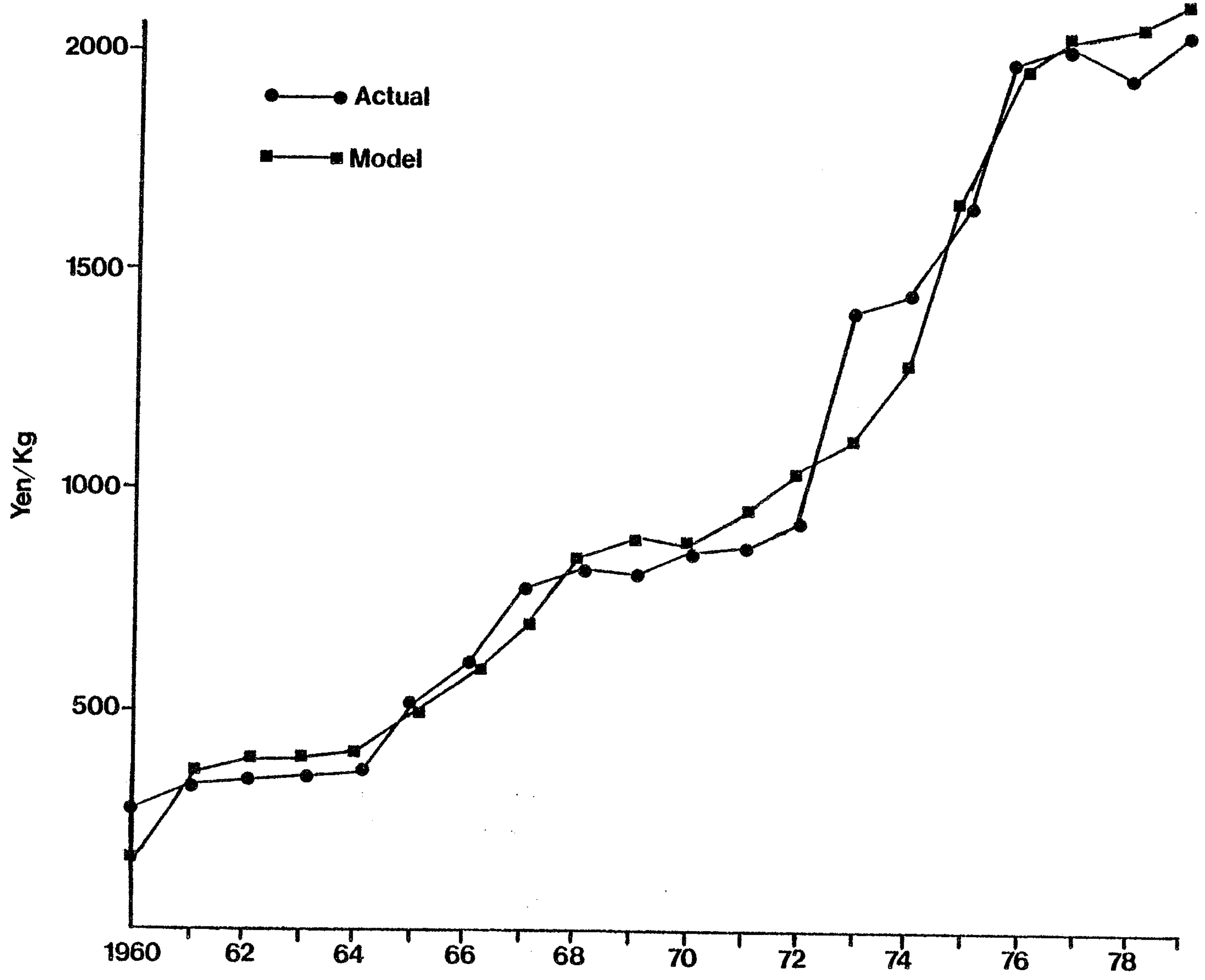


Fig.6 Number of Beef Cattle (NBC)

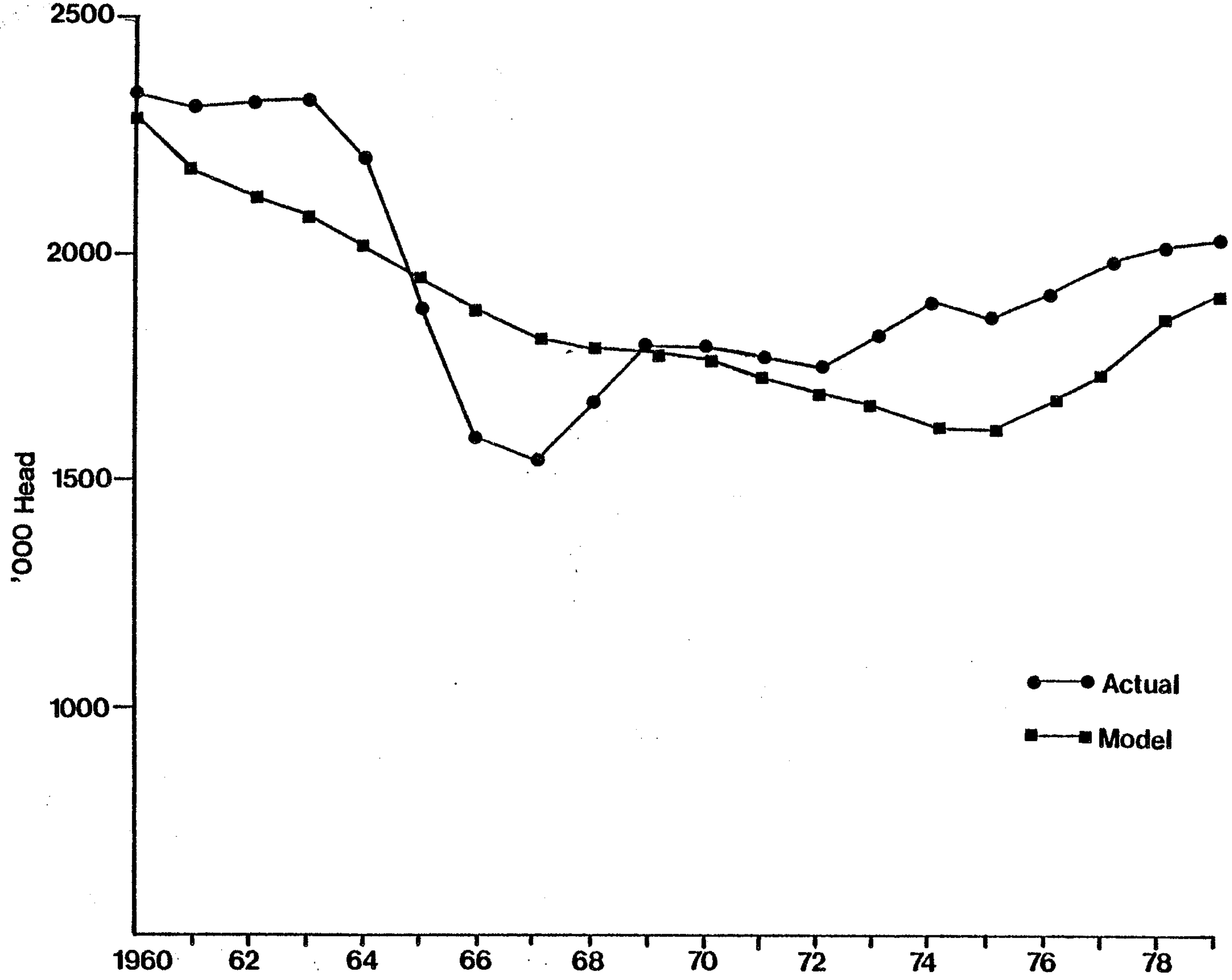
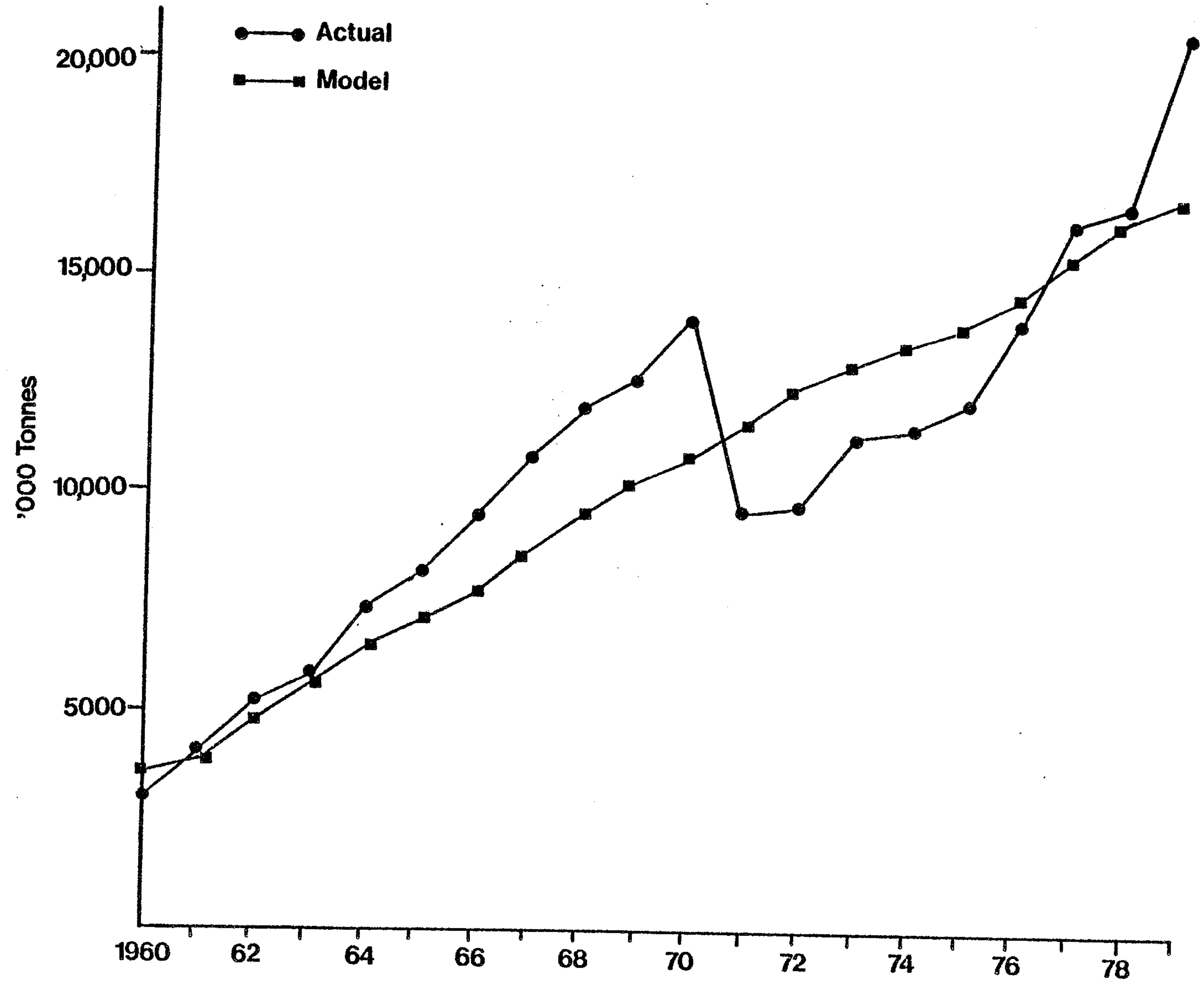


Fig. 7 Imports of Feedgrain (FDIMP)



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