An Investigation of Changes to Pricing Arrangements in the Dairy industry using a General Equilibrium Model- Simulations of Orani-f-milk

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7 February 1992

A paper presented to the 36th Annual meeting of the Australian Agricultural Economics Society, Canberra, 10-12 February 1992

* The preparation of this paper was supported financially by the Industries Commission. This paper has benefited from advice from David Luskin of the Industries Commission and Chris Phillips of the Australian Dairy Corporation although neither are implicated in any errors contained herein.

1 Introduction

This report outlines work undertaken to investigate pricing arrangements in the dairy industry. The basic tool for the work was the model **Orani-f-milk** a forecasting version of the Orani general equilibrium model of the Australian economy with disaggregated farm milk and manufacturing milk industries. The formation of the disaggregated milk industry database is described in Johnson (1991). The theory used to develop the equation system of Orani-f-milk is the same as that used for Orani and is outlined in Dixon, Parmenter, Powell and Vincent (DPSV), 1982 and Parmenter (1988).

This paper discusses the effect of long-term changes to milk pricing arrangements. The issues investigated were the effect on the macroeconomy, on industries in general and on the milk based industries in particular of,

a. Changes to Commonwealth marketing arrangements
b. Changes to state marketing arrangements.
c. A range of values for farm milk supply and household demand elasticities.

In the remainder of this section we briefly outline the structure of the Orani-f-milk model. In section 2 we outline the interpretation of the dairy marketing arrangements and the method of calculating the implicit farm milk supply and household demand elasticities in Orani-f-milk. The proposed changes are interpreted as simulations of the Orani-f-milk model in section 3 and the results of computer simulations presented and discussed in section 4. The final section contains a summary of the work and a discussion of future work.

1.1 A brief discussion of Orani-f-milk

Orani-f-milk is a computable general equilibrium model of the Australian economy. In this model the interactions of 127 domestic industries (including 16 concerned with the dairy industry) producing 129 commodities, 129 imported commodities, 151 factors of production (10 classes of labour, 127 classes of capital and 14 types of agricultural land), and 4 final demand categories are distinguished.

The interactions are represented by linear equations which describe the percentage change in endogenous variables in terms of percentage changes in the exogenous variables and model parameters. In total the equations form a simultaneous system in which there are many more variables than equations. Consequently in order to solve the model an environment must be set in which sufficient variables are exogenous so that the remaining endogenous variables can be determined.

The linear equations in Orani-f-milk have been derived from a comprehensive theory of agent behaviour - for instance consumers are presumed to maximize utility subject to a budget constraint and producers are presumed to select inputs to minimize their costs and select outputs to maximize their revenue. This theory enables the definition of five groups of equations:
(i) equations describing household and other final demands for commodities;
(ii) equations describing industry demands for primary factors and intermediate inputs;
(iii) pricing equations setting pure profits from all activities to zero;
(iv) market clearing equations for primary factors and commodities; and
(v) miscellaneous definitional equations, eg equations defining GDP, aggregate employment and the consumer price index.

The equations use data from the input-output tables of the Australian economy. The input-output tables describe the values of all commodities, both domestic and imported used by each industry, the values of primary factor inputs to each industry for the production of goods and for the building of capital, and the values of sales of each industry to all other industries and to the four categories of final demand.

Results from the Orani-f-milk model show the percentage change in endogenous variables. When the model is used in comparative static mode the simulations compare the percentage changes in the endogenous variables between a shocked situation (where the percentage change in some exogenous variables take particular values) and an unshocked situation (where the percentage changes in all exogenous variables are zero) at some time in the future. The time over which the changes occur depends on the settings of various variables. For instance in long and medium run closures we allow sufficient time for investment to change the amount of the capital stock available for use by industry. For short run situations investment may occur but there is not sufficient time for the changed capacity to be brought into use.

When the model is used in forecasting mode we calculate percentage changes in endogenous variables between a base year and some year in the future. In forecasting the exogenous variables must represent all the external influences on the economy over the period of the forecast.

In the simulations reported here we use Orani-f-milk in comparative static mode over the medium term (say 5 years). Appendix 1 discusses how the Orani-f-milk model is adapted for comparative static mode.

2 Methodology

2.1 Interpretation of the dairy marketing arrangements

2.1.1. Modification of the Kerin plan.

Under the Kerin plan a levy is imposed on all milk produced and used to support the export of manufactured milk products. Modifications to the scheme may be modelled by imposing a tax on milk exports and a subsidy on production of milk.

The imposition of export subsidies is modelled in Orani-f-milk[1] using an equation which defines the foreign currency price of exports and is of the form,

$$pe_{i,1} + \phi = Z4_i\,(pt4_i + p0_{i,4}) + (1\text{-}Z4_i).\text{margins terms} \qquad (2.1)$$

[1] Derivation of this and other equations from Orani-f-milk is fully described in DPSV (1982).

where pe_{i1} is the foreign currency f.o.b price of exports of good i, ϕ is the exchange rate, $pt4_i$ is the power of tax or subsidy[2] on exports, $p0_{i,4}$ is the price of good i in domestic currency and $Z4_i$ is the share of the value of exports at basic prices of exports at purchasers prices. The margins terms in equation 2.1 are likely to be very small and are ignored in the discussion in this report. The variables in equation 2.1 and in all subsequent equations in this report unless otherwise stated, are shown in lower case denoting percentage change form. Note that a tax on the domestic price of exports is positive in equation 2.1 while a subsidy is negative. We assume that the subsidy is in place in the base case. We model its reduction by imposing an export tax.[3]

The subsidy is paid by a levy on all milk production. The levy on the six farm milk industries is also applied as a commodity tax using an equation which expresses the purchasers price in terms of the basic price. The equation is,

$$p1_{i,j} = Z1_{i,j}\ (p0_i + pt1_{i,j} + pt2_{i,j}) + (1-Z1_{i,j}).\text{margins terms} \qquad (2.2)$$

where $p1_{i,j}$ is the price of good i to industry j (ie the purchasers price), $p0_i$ is the price of good i (ie the basic price) and $pt1_{i,j}$ and $pt2_{i,j}$ are the powers of taxes on the intermediate demand for commodity i from

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2 Taxes or subsidies on commodities may be imposed as a percentage of the value of demand, as quantity restrictions on the level of trade or as a specific tax on the price of the good. Tariffs are a common form of import tax which are normally imposed *ad valorem* which means as a percentage on the value of the commodity. The relationship between the different forms of commodity tax or subsidy may be illustrated as follows;
Suppose P_b is price of a traded good at basic values (ie before the imposition of margins and taxes) and P_p its price after the imposition of taxes and margins (frequently known as purchasers prices). Then if T is an *ad valorem* tax,
$P_p = P_b.(1+(T/100))$
In percentage changes this becomes
$P_p{\cdot} = P_b{\cdot} + t^*$
where t^* is known as the power of the tax and
$t^* = (D(1+(T/100)))/(1+(T/100))$.
Suppose we wish to reduce the tariff on a commodity from 30% of value to 5% of value.
$t^* = ((1+(5/100))-(1+(30/100))/(1+(30/100)) = -.1923$
The power of the tax required to lower the tariff is 19.23%.

3 Suppose we have a foreign price of $850 per tonne of butter. The domestic producer receives price support of 18% through the levy. We assume that the levy is already imposed in the database and we want to simulate the effect of its removal. The price to domestic producers is 850*1.18 equals $1000 per tonne. We wish to simulate the removal of this subsidy and return the price to domestic producers to the export price. The tax required would be 15.3% ((1-1.18)/1.18).100).

industry j. A tax on the basic price is positive while a subsidy is negative. The parameter $Z1_{i,j}$ is the share of the commodity at basic prices in the purchasers price of commodity i from source s to industry j. As with equation 2.1 the margins terms are likely to be small and are ignored in the discussion which follows.

We simulate the effect of the removing the levy by applying a producers subsidy using $pt1_{i,j}$ ($pt1_{i,j}$ will be negative). The subsidy increases the basic price of good i relative to the purchasers price[4]. The term $pt2_{i,j}$ is used for simulating the effect of changes to state pricing arrangements.

2.1.2 Reforms to state pricing arrangements

State pricing arrangements in the dairy industry operate principally through a two price scheme. A methodology for modelling a change in assistance via a two price scheme is outlined in McDougall (1989).

The two-priced scheme is implemented in two main ways in Australian states. In Victoria, South Australia and Tasmania state authorities operate a pooling arrangement while in New South Wales, Queensland and Western Australia the authorities operate a quota scheme. Both of these arrangement are modelled using commodity taxes albeit with different effects.

Pooling

For the states which pool returns to farmers from the fluid and nonfluid milk markets we use an amended interpretation of McDougall's methodology. The price of farm milk destined for the fluid milk market is artificially raised by the two-priced scheme whereas the prices of sales destined for nonfluid usage are largely determined by export prices. The two-price scheme is visualised as a subsidy on sales to fluid milk manufacturers and a tax on sales to nonfluid manufacturers. We simulate the removal of the pooling arrangements by applying a tax (equivalent to removing the subsidy) to the farmgate price of fluid milk and a subsidy

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[4] Suppose the levy is 2 cents per litre and the average pool price (farmers price) is 25 cents per litre. Using the terms used in footnote 2, T is (2/25).100 or 8%. The power of the tax required to remove this levy is ((1-0.92/0.92).100 or 8.7%.

(equivalent to removing the tax) to the farmgate price of nonfluid milk[5]. Since the two price scheme is revenue neutral to industries outside the milk sector the shocks applied to the commodity tax variables are constrained by the following relationship.

$$pt2_{i,f}.S_{i,n} = - pt2_{i,n}.S_{i,n} \quad (2.3)$$

where $pt2_{i,f}$ and $S_{i,f}$ are respectively the power of the tax on farm milk sales to the fluid milk manufacturers and the share of these sales in total farm milk sales for commodity i. $pt2_{i,n}$ and $S_{i,n}$ are the power of the tax on the sales of farm milk to the four nonfluid manufacturers (butter and associated products, cheese and associated products, ice cream and associated products, and manufactured milk products not elsewhere classified) and the share of these sales in total farm milk sales of commodity i.

Using equation 2.3 we define h_i, the percentage change in the wedge between the subsidised and unsubsidised price,

$$h_i = pt2_{i,f}/S_{i,n} = - pt2_{i,n}/S_{i,f} \quad (2.4)$$

and hence the tax shocks to the fluid and nonfluid milk prices may be calculated as $(h_i.S_{i,n})$ and $(h_i.S_{i,f})$ respectively for each state.

Under the pooling arrangements farmers receive a price which is the average of the price received from fluid and nonfluid milk weighted by their respective shares in state production. We calculate the subsidy necessary to raise the purchasers price of milk sold to the nonfluid manufacturing milk industries towards the pooled milk price. In equation 2.4 $pt2_{i,j}$ is positive for nonfluid prices.

We also calculate the tax required to reduce the purchasers price of sales of farm milk to the fluid milk industry towards the pooled price. In this case $pt2_{i,j}$ is negative in equation 2.4.

5 Wilcox and Bardsley (1990 page 7) use a similar interpretation of the effect of the two price (or blended price as they call it) scheme.

Quotas

The imposition of quotas on fluid milk is equivalent to the provision of a notional subsidy to quota holders (fluid milk producers) by government. The database implicitly contains these notional subsidies and we wish to model the effect of removing them. This is achieved by applying a tax to the purchases of the appropriate fluid milk industries (ie to the fluid milk industries in New South Wales, Queensland and Western Australia) using equation 2.4.

We retain the same equation structure for the quota states as for the pooling states and impose the tax by reinterpreting $S_{i,f}$. h_i and $S_{i,n}$ have the same meaning as for the pooling states but $S_{i,f}$ is set to zero to force $pt2_{i,n}$ to zero. As for pooling states the shocks on fluid milk prices, $pt2_{i,f}$, are positive.

The subsidy is notionally paid by government. To maintain revenue neutrality we simulate the removal of the notional government payment[6].

2.2 Sensitivity to parameter settings

2.2.1 Household demand elasticities

In the standard specification of the Orani-f model the price elasticities of household demand, ζ_j, may be deduced from an equation including household expenditure elasticities, ε_j, the average budget shares, Sh_j, and the Frisch parameter, F [7].

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6 Ideally the reduction in government spending. (demand) would be applied to the various state governments but since state governments are not identified in Orani-f-milk we apply an aggregated shock to the Australian govenment. The value of the shock to government demand is calculated as follows:
In the data base government demand is \$22685m (GDP is \$119197m). The value of the subsidy to the NSW fluid milk industry is z_{nsw}% of NSW production (\$111.5m), to the Qld fluid milk industry z_{qld}% Qld production (\$82.2m) and to the WA fluid milk industry it is z_{wa}% of WA production (\$33.4m). The total subsidy is $\$(z_{nsw}.111.5+z_{qld}.82.2+z_{wa}.33.4)$
The appropriate shock to other government outlays is;
shock = subsidy/22685 = $(z_{nsw}.111.5+z_{qld}.82.2+z_{wa}.33.4)/22685$
The values of the zs are calculated from Table 3.1. For instance in simulation C, z_{nsw} = ((37.73/(22.83*1.1))-1)*100 =0 502% The shock is 0.479% for simulation C, for D it is 0.424% and for E it is 0.376%.

7 The equation is derived by Frisch, 1959 and relates price elasticities to expenditure elasticities in the context of an additive utility specification. DPSV (1982, p195) discusses the use of this equation in Orani.

$\zeta_j = -\varepsilon_j.Sh_j(1+(\varepsilon_j/F))+(\varepsilon_j/F)$.

The expenditure elasticities ε_j are estimated from the ratio of the marginal budget share β_j to the average budget share Sh_j[8].

$\varepsilon_j = \beta_j/Sh_j$.

In the proposed simulations a range of values will be chosen for the β_j's for the ten manufactured milk products to produce the desired values of the ζ_j's, the own price elasticities of demand. The β_j's are calculated from the ζ_j's, the average budget shares Sh_j and the Frisch parameter by some manipulation of the two equations above.

$\beta_j^2.(1/Sh_j.F) + \beta_j((Sh_j.F-1)/Sh_j.F) - \zeta_j = 0$, and solve for β_j[9].

2.2.2 Farm milk supply elasticities

State farm milk supply is determined in Orani-f from a nested production system.[10] The farm supply elastic[illegible] may be deduced by solving the problem which minimises the mix of inputs subject to a given level of output. Higgs (1986, p240-254) derives the output equations. They are,

$x_j = f(.p_j, S_{fp}, S_{ff}, \sigma_j + \text{ other terms})$

where x_j is the output of commodity j, p_j is the price of commodity j, S_{fp} is the share of factor payments in the industry j's total costs (note that industry j produces only one commodity, commodity j), S_{ff} is the share of fixed factors in total factor payments and σ_j is the elasticity of substitution between primary factors. The other terms include wages, rentals rates for capital, and prices of intermediate inputs.

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8 See Tulpule and Powell (1978, p13) for the derivation of this equation.

9 Using the formula for a quadratic equation the roots to this equation are;
$\beta_j = -0.5((Sh_j.F-1) \pm Sh_j.F\sqrt{(1-1/(Sh_j.F))^2-4.\zeta_j/(Sh_j.F)})$

10 The nested system is described pictorially in Higgs (1986, p9) and in detail in DPSV (1982, p90-96)

Higgs shows that the implicit long term supply elasticities, θ_j may be calculated from the factor substitution elasticity and the two share terms using the formula,

$$\theta_j = \sigma_j.(1-S_{ff})/(S_{ff}.S_{fp})$$

The two share terms S_{fp} and S_{ff} are data so the supply elasticities depend on the factor substitution elasticities. We vary the factor substitution elasticities in a way appropriate to achieve the desired values for the supply elasticities.

3 Description of simulations

3.1 Shocks to simulate abolition of the Kerin plan

The feature of the Kerin Plan of concern here is the imposition of a levy on all domestic production to support the price of manufactured dairy products sold on export markets. The impost on production is 2 cents per litre[11] In Table 3.1 we show the percentage reduction in the farmgate price of sales to the fluid and nonfluid markets effected by removing the levy in the six states.

The farmgate price of milk sold to fluid markets in each of the six states in 1989/90 is shown in row 1 and for nonfluid markets in row 2. The benefit to export production of support payments from funds raised by the levy depends on the export price and varies from year to year. The level of market support to the ASIC milk industries in 1989/90 is shown in row 7 and averages 16%. We calculate the appropriate shocks to the power of the export tax in equation 2.1 to reduce this support by 11/16ths corresponding to new market support of 5% of the export price. The appropriate shocks to the power of the export tax for each of the export industries ($pt4_i$ in equation 2.1) is shown in row 8.

11 The IC, 1991 p3 states 'In 1988-89, the levy was set at the maximum rate of 45 cents per kilogram of milk fat or around 2 cents per litre'.

The shock to the power of the producers tax ($pt1_{i,j}$ in equation 2.2) is shown in row 5 for fluid sales and in row 6 for nonfluid sales.

3.2 Shocks to simulate abolition of state pricing arrangements.

The necessary shocks to commodity tax variables to simulate the removal of the state marketing arrangements are calculated in Table 3.2. The situation applicable to each of the six state farm milk industries is shown in columns 1 to 6 of the table. The six states are arranged in two groups corresponding to the two methods of implementing the marketing arrangements. The first three states, Victoria, South Australia and Tasmania employ pooling mechanisms and the second three states, New South Wales, Queensland and Western Australia operate quota schemes.

The first two rows of Table 3.2 show the volume of farm milk sold to fluid milk manufacturers and to nonfluid manufacturers in 1989/90. Rows 3 and 4 show the estimated average farmgate price of milk for fluid and nonfluid use. From this information in rows 5 and 6 we calculate the shares of milk sold for fluid and nonfluid usage in each state.

We consider four situations in regard to changed state marketing arrangements; where the fluid price retains the present premium of about 70% above the nonfluid price, where it commands a 20% premium above the nonfluid price, where it commands a 10% premium above the nonfluid price and where the new fluid and nonfluid prices are equalised. We calculate appropriate shocks for both pooling and quota states to bring about the latter three situations.

No shocks are required to model the first situation but we use equation 2.4 to ensure that the prices to fluid and nonfluid purchasers will be locked at the current premium for fluid milk (h_i is set at zero and consequently $pt2_{i,j}$ is also zero).

The appropriate shocks for the last three situations for the pooling states are shown in rows 7 and 8, rows 11 and 12 and rows 15 and 16. Rows 7, 11 and 15 are the shocks for the power of the tax on sales to fluid milk markets sufficient to reduce the fluid milk price to the appropriate level. Rows 8, 12 and 16 are the shocks for the power of the tax on sales to nonfluid milk markets sufficient to increase the nonfluid milk price to the appropriate level. Rows 9, 13 and 17 show the value of the wedge (h_i in equation 2.4). Rows 10, 14 and 18 concern the shocks to the quota states and will be discussed later.

In the case of rows 7 to 10 the fluid price is 20% above the nonfluid price. In the case of rows 12 to 14 the fluid price is 10% above the nonfluid price and in the case of rows 15 to 18 the fluid and nonfluid price are equalised.[12]

In New South Wales, Queensland and Western Australia farm milk returns are not pooled but quotas are applied to the production of milk for fluid markets. The effect of the quotas is to raise prices by 45% in New South Wales, 52% in Queensland and 47% in Western Australia. We calculate the shocks to the fluid milk price necessary to reduce it to a premium 20 percent above the nonfluid milk price. These shocks (to $pt2_{i,j}$ in equation 2.4) are shown in row 10. Similarly in rows 14 we show the shocks necessary to reduce the fluid price to a premium 10% above the nonfluid price and in row 18 we show the shocks required to equalise the fluid and nonfluid prices.

3.3 Household demand and Farm milk supply elasticities

In the simulations we use three different sets of values for household demand for the ten manufactured milk products and three different sets of values for farm milk supply elasticities. The three household demand

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12 The calculation of the appropriate shock is made as follows. Under the existing arrangements which are embodied in the base data, a volume of farm milk Vm is sold at price Pm_0 to non-fluid usage and another volume of farm milk Vf is sold at price Pf_0 to fluid markets in each state. We wish to calculate the taxes Tf and Tm which will cause a new fluid price Pf_1 to be some proportion, A of a new non-fluid price, Pm_1. Where prices are equalised as in a pooling situation A will be one. The volumes of fluid and non-fluid milk remain the same and total revenue is constant. Algebraically we write,
$Pf_1 = A.Pm_1$,
$Pf_1 = Pf_0.Tf$, $Pm_1 = Pm_0.Tm$
$Pf_0.Vf + Pm_0.Vm = Pf_1.Vf + Pm_1.Vm$
Therefore
$Pm_1 = (Pf_0.Vf + Pm_0.Vm)/(A.Vf + Vm)$,
$Tm = (Pf_0.Vf + Pm_0.Vm)/(A.Vf + Vm).Pm_0$, and
$Tf = (Pf_0.Vf + Pm_0.Vm)/(Vf + (Vm/A)).Pf_0$.
Using these equations and appropriate values for A we calculate the values for Tm and Tf. The shocks to the powers of the tariffs, tm and tf may be calculated using the formula,
$tm = (Tm - 1).100$ and $tf = (Tf - 1).100$

settings are referred to as high, medium and low. In the high setting the own price household demand elasticity is -0.2 for fluid milk and -0.6 for nonfluid milk products. Under the medium setting the own price household demand elasticity is -0.15 for fluid milk and -0.25 for nonfluid milk products and -0.1 for fluid milk and -0.2 for nonfluid milk products under the low setting. Table 3.3 shows the marginal budget shares corresponding to the desired own price demand elasticities for each of the state manufacturing milk industries.

The three farm milk supply settings are also designated high, medium and low. In the high setting the own price farm milk supply elasticity is 4.0 for all state farm milk industries. Under the medium setting it is 1.5 and under the low setting 0.5. As described in section 2.3 the farm milk supply elasticities for commodity j are implemented by varying the primary factor substitution elasticities for j. Table 3.4 shows the primary factor substitution elasticities corresponding to the desired farm milk supply elasticities for each of the state farm milk industries.

3.4 Proposed Orani-f-milk simulations

We use the shocks described in the sections above to undertake the simulations described in Table 3.5. The simulations include four different settings of state arrangements, a change to the Commonwealth arrangements in which the support to exported milk products is reduced from an average of about 16% to 5% and varying values for the household demand and farm milk supply elasticities.

There are five sets of rows labelled 1 to 5 in Table 3.5 corresponding to the settings of state and Commonwealth arrangements. The first column of Table 3.5 describes the assumptions used for these arrangements. The second column of Table 3.5 shows the assumption concerning the farm milk supply elasticities and columns 3 to 5 show the assumptions concerning the household demand elasticities.

Under the first set of arrangements, labelled 1, there is no change to the state arrangements from the current situation in which a premium of roughly 70% is paid for milk supplied to fluid manufacturers but the all milk levy is reduced so that support for exporters is reduced from an average of 16% to 5% of the export price. We hold the farm price of milk sold to fluid manufacturers constant so all adjustment is forced on to nonfluid farm prices. Only one simulation, labelled A22, is undertaken with these marketing arrangements and the middle values of the farm milk supply and household demand elasticities are assumed .

The second setting of marketing arrangements, labelled 2, also entails the reduction of the export support from 16% to 5% and no change to the state marketing arrangements except that in this simulation we allow both fluid and nonfluid prices to adjust. We undertake nine simulations corresponding to all nine combinations of farm milk supply and household demand elasticities. These simulations are labelled B11 through to B33.

In the third setting of marketing arrangements, labelled 3, we reduce the export support from 16% to 5% and modify the state marketing arrangements so that the premium of the price of farm milk sold to fluid manufacturers over the price of farm milk sold to nonfluid manufacturers is reduced to 20%. As for set 2 both fluid and nonfluid prices are allowed to adjust. We undertake only one simulation, C22 corresponding to the middle values of the farm milk supply and household demand elasticities.

The fourth setting is the same as the third except that we assume only a 10% premium for sales of milk to fluid manufacturers. The simulation, D22 also employs the middle values for the farm milk supply and household demand elasticities.

In the final set of simulations the price of farm milk sold to fluid and nonfluid manufacturers is equalised. Nine simulations, labelled E11 through to E33 corresponding to all nine combinations of farm milk supply and household demand elasticities are undertaken.

4. Results

There are two sets of tables containing the results of the simulations. In the first set, Tables 4.1 to 4.3, we compare the effect on industry and macroeconomic variables of changes in state and Commonwealth marketing arangemements using our best estimates for the household demand and farm supply elasticities. In the second set, Tables 4.4 and 4.5 we.show the effect of assuming different values for the household demand elasticity for fluid milk and the farm milk supply elasticity of demand for two of the sets of marketing arrangements.

The numbers reported in all tables[13] show the average annual percentage change in the value of the endogenous variable (labelled in column 1) in the absence of changes to dairy industry arrangements and its value in the presence of the proposed changes in the dairy industry arrangements. The column headings label the relevant simulation.

Tables 4.1 to 4.3 have the same format. We show macroeconomic and aggregated industry results in Table 4.1, output effects on the milk industries in Table 4.2 and the effect on the farm milk prices in Table 4.3.

4.1 Simulation environment

The simulations are carried out under an environment in which the balance of trade is fixed. We use the cpi as the numeraire. That is we select a value for the changes in the cpi (zero in these simulations) and all price and wage changes will move relative to it.

There are several key assumptions that are likely to have an important impact on the results. These are ;
•the longrun substitution elasticities between all factors is 1.28
•the export demand elasticities for milk products are high, -20
•the household demand elasticities for milk products are low, -.15 for fluid milk and -.25 for nonfluid milk products
•the change in investment is equal to the change in capital stock for each industry
•milk exports are endogenous

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[13] The results shown in all tables have been obtained from a two step procedure. This was necessary to eliminate linearisation errors which occurred as a result of very large changes in some variables. The problems arose in the equation determining exports. The method used to remedy linearisation errors is outlined in Appendix 2.

•the export price for milk products is endogenous

4.2 Discussion of macroeconomic and industry results

The effects on macro variables are generally small. This is partly because the milk industries are a very small part of the economy (in the database they make up about 1% of gross product) but also because while the changes to prices and taxes alter resource allocation they do not alter the amount of real resources in the economy much. For simulations A22 and B22 in Table 4.1 the changes in real GDP are less than 0.01%. The changes in simulations C22 to E22 are somewhat larger, up to 0.04%. The greater falls in prices (see Table 4.3) in the last three simulations increases competitiveness (row 1) but with fixed balance of trade is manifest in higher domestic living standards (wages, row 2 and consumption, row 5 increase) and increased investment (row 6). The increases in investment and consumption are considerably boosted by the fall in government expenditure since the government no longer has to raise income to subsidise the fluid milk industry in the three quota states.

In all simulations the volumes of both exports and imports (rows 7 and 8) fall by much the same amount and since the balance of trade is held constant there is little change in the terms of trade (the weighted change in the price of exports less the weighted change in the price of imports, shown in row 9).

While the macroeconomic effects are small there are some substantial industry effects. In comparison to the changes in the other industry groups the falls in farm and manufacturing milk industries are large but because they have a small weighting in the aggregated industry groups the corresponding falls in the output of agriculture and food manufacturing are still small. The large falls in milk-based exports in a fixed balance of trade environment lead to output gains for other exporters and import replacing industries such as Mining, TCF (which includes processed wool) and Transport equipment. The effects on the output of nontrading industries (Communications and transport, and Services) are minor.

For both industry and macroeconomic results the magnitude of the responses increases proportionately from simulation A22 through to E22- as the severity of the changes to the marketing arangements are increased.

4.3 Discussion of changes in Milk industry output

Table 4.2 shows the changes in output of the milk industries in each of the simulations. As in the industry group results the largest responses in the milk industries occurred in simulation E22 and the smallest in simulations A22 and B22.

In general the change in output of the six fluid milk industries was smaller in all simulations than for the other milk industries. Large changes occur in the output of the three export related milk products industries- Butter, Cheese and Milk products nec. The effects on the farm milk industries were dependent on the shares of the manufacturing milk industries in their sales pattern. For state farm milk industries like Victoria and Tasmania which sell predominantly to exporting industries like Butter, Cheese and Milk products nec there were large changes while for those state farm milk industries which sell mainly to industries dependant on consumption expenditure the responses were muted.

In Table 4.3 we present the changes in producers and purchasers prices for farm milk in each of the simulations. Producers prices (farmgate prices) of sales to fluid and nonfluid milk manufacturers are not explicitly identified in the Orani-f-milk model. Appendix 3 shows that in all simulations the difference between the purchasers price and the producers price is the value of the levy. We also calculate the change in the pooled price for Victoria, South Australia and Tasmania using the base period value shares shown in Table 3.2.

In columns labelled A22 and B22 of Tables 4.2 and 4.3 we consider changes to the Commonwealth arrangements with no change to the state arrangements. In A22 we do not allow the changes to effect the price of farm milk sold to fluid manufacturers whereas in B22 the price of farm milk to fluid manufacturers is not quarantined.

In these two simulations most of the impact of the changes falls on the three manufacturing milk industries, Butter, Cheese and Milk products nec. The loss of the export subsidies results in a diversion of supplies away from the export market leading to a small rise in the export price. The very high export demand elasticities cause the small rise in price to produce a large fall in demand. While export prices rise the price of milk to domestic markets falls but with low household demand elasticities for both fluid and nonfluid milk the fall in exports is not offset by much increase in domestic demand. The overall output of manufactured milk rises marginally because although output of farms fall the increased sales to higher value markets outweighs the fall in farm supply. Among the three export oriented manufacturing industries the Butter industry suffers large falls in output because its initial subsidies are greatest. Opposing effects influence the other two export oriented manufacturing industries Cheese and Milk products nec. The diversion of farm milk away from Butter leads to increases in the output of these industries although the smaller loss of export subsidies counteracts the increase in output.

The small rise in output in the fluid milk industries in some states and in the ice cream industry occurs because there is some small domestic demand response to lower domestic prices not offset by any reduction in exports in these industries. Output falls in those states most reliant on Butter exports, Victoria and Tasmania. South Australia gains most because it specialises in the production of Cheese, an export which benefits from the fall in demand for Butter.

Note that in all these simulations no trade is allowed between states. The effects on state farm output may be considerably modified if substitution were allowed between states.

The main effect of allowing the purchasers price to fluid milk manufacturers to change, in B22, is to drive the fluid milk price down with the nonfluid price. The output of the fluid milk industries is somewhat stronger as might be expected with lower prices.

In simulation C22 changes to the state arrangements occur in addition to those to the Commonwealth arrangements. The price of farm milk to fluid manufacturers is allowed to fall to 20% above that to nonfluid manufacturers. Because of the low demand elasticities the large falls in the price of farm milk sold to fluid manufacturers prompt much smaller increases in fluid milk output. However the deregulation prompts further falls in the output of the nonfluid manufacturing industry and hence in the output of the states producing for these markets (Victoria and Tasmania). Output also falls in the remaining pooling state, South Australia. By contrast output is virtually constant in the quota states. These results partly reflect the commodity composition of the sales and partly reflect the difference in the form of government intervention.

In the pooling states we imposed a fall in the price on the sales to fluid manufacturers (ie the removal of a subsidy) offset by an increase in the price of sales to nonfluid manufacturers (ie the removal of an tax) leading to a small increase in the export price. Since a considerable proportion of nonfluid output is sold on the highly elastic overseas market even quite a small price rise is sufficient to produce further falls in output. Export milk products (Butter, cheese and milk products nec) all suffer further falls and consequently farm output from the most export oriented states, Victoria, Tasmania and South Australia also suffer further falls.

In South Australia while the fluid milk price falls by 18 percent the nonfluid price rises by 22 percent whereas in Victoria the fluid milk price falls by 21 percent and the nonfluid price falls by 2 percent. Applying these results to the base period prices indicated in Table 3.2 shows that they are consistent with the assumptions of the simulations. They are explained as follows;

In the pooling states the general effect of removing the state marketing arrangements is to allow the farmgate price of milk sold to nonfluid manufacturers to move up towards the pooled price while the farmgate price of milk sold to fluid manufacturers moves down towards the pooled price. This effect is generally counteracted by the removal of most of the Commonwealth subsidy on export milk products which tends to drive the producers price of nonfluid milk down. The eventual outcome in each state depends on the relative shares of milk sold to fluid and nonfluid markets and on the extent to which exports are initially subsidised. In South Australia about 60 percent of farm milk goes to fluid markets and a large part of the nonfluid sales are exported as cheese, which have low initial subsidies. There is a larger savings from reduced fluid milk prices which may be diverted to nonfluid milk and the losses of export subsidies are less. The farmgate price of sales to nonfluid markets rises.

These price changes assume the current situation in which there is no arbitrage in milk prices between states (that is states maintain control of the price structure- in spite of the abolition of the two price scheme). Were unrestricted trade permitted between states then we would expect that after allowing for transport costs the South Australian nonfluid prices would fall to the level which, roughly, obtains in other states.

We use the same shocks in simulations D22 and E22 as in C22 except we vary the extent of the fall in the fluid price relative to the nonfluid price. In D22 we allow a premium of 10% for fluid milk and in E22 we allow no premium. The results are similar to those for C22 except with larger falls in the price of farm milk to fluid milk manufacturers the size of output responses are larger.

4.4 Effect of varying household demand and farm milk supply elasticities

In Table 4.4 we explore the effect of changes in household demand and farm milk supply elasticities on milk industry output for the simulations in which the subsidy on milk exports is reduced and there are no changes to the state arrangements (simulations B11 to B33 in Table 3.5). The output response of the 6 new farm milk industries, the 10 new manufacturing industries an aggregation of the farm milk and manufacturing milk industries and of all agricultural and manufactured food industries are shown.

In simulations B11, B12 and B13 the farm milk supply elasticity is decreased from high to medium to low while the household demand elasticities remain constant at the high value. In B21, B22 and B23 the farm milk supply elasticities decrease from high to medium to low while the household demand elasticities remain constant at the medium value. In B31, B32 and B33 the farm milk supply elasticities decrease from high to medium to low while the household demand elasticities remain constant at the low value.

With constant household demand the differences between the simulations in each set reflect only the responsiveness of farm supply to changes in prices. Under lower elasticities output does not respond as quickly to changes in export prices so output does not contract as much in state farm milk industries.

The comparison of simulations B11, B21 and B31 show the effect of a change in household demand elasticity from high to medium to low. In these simulations the farm milk supply elasticity remains constant at the high value. In simulations B12, B22 and B32 the household demand elasticities decrease from high to medium to low while the farm milk supply elasticities remain constant at the medium value. In simulations B13, B23 and B33 the household demand elasticities decrease from high to medium to low while the farm milk supply elasticities remain constant at the low value.

The effect of changing the household demand elasticities on the output of the milk industries is small. The largest effect is on the most consumption oriented industry, the Ice cream industry. With higher elasticities the demand for Ice cream is greater and there are greater output responses (compare B11 with B21). In general the output of all milk industries is greater with higher demand elasticities.

With higher elasticities the price of farm milk falls less to maintain the same demand so in general prices for all state milk commodities are higher (or for most states the fall in price is less).

Further sensitivities of milk industry output to farm milk supply and household demand elasticities are reported in Tables 4.5. In this table we report the sensitivities to varying elasticities for the situation in which the fluid price is allowed to fall to the nonfluid price (simulations E11 to E33 in Table 3.5). Recall from Tables 4.1 to 4.3 that this simulation produced the most drastic output response in the milk industries.

The responses to changes in farm milk supply elasticities can be seen by comparing the output for the milk industries in E11, E12 and E13 (for the situation of high household demand elasticity), in E21, E22 and E23 (for the situation of medium household demand elasticity), and in E31, E32 and E33 (or the situation of low household demand elasticity). In each of these three sets of simulation the output responses to changing farm milk supply elasticity are large. For instance in the first set, E11, E12 and E13, Victorian output increases from a fall of 12 percent under high farm milk supply elasticity to a fall of 5 percent under low farm milk supply elasticity. The results are qualitatively the same as for the set of sensitivities presented in Tables 4.4. However in these results the magnitudes are all much greater reflecting the greater magnitude of the shocks caused by the changes to the state marketing arrangements.

5 Concluding comments

The simulations described here show how the milk industries might respond to changes in state and Commonwealth marketing arrangements. The changes to the Commonwealth arrangements are the abolition of part or all of the Kerin plan (ie abolition of the all milk levy). The changes to the state arrangements are the elimination of the two price schemes in which farm sales to fluid milk manufacturers are subsidised at the expense of sales to nonfluid milk manufacturers or at the expense of other Government spending.

The results show that changes to the Commonwealth arrangements have small macroeconomic effects yet may lead to large contractions in the Victorian and Tasmanian farm milk industries and in the Butter and Milk products not elsewhere classified manufacturing industries. The key factors influencing these and other results are the highly inelastic domestic demand for milk and the highly elastic export demand for milk.

A range of plausible but still inelastic household demand elasticities were used in sensitivity analysis. In general within the range used there was not much effect on the results. However the results were sensitive to varying the farm milk supply elasticities. The output response of farmers were muted significantly when lower elasticities were assumed.

Changes to the state marketing arrangements are likely to lead to further large contractions in the Victorian and Tasmanian farm milk industries and to a contraction in the South Australian farm milk industry. All these states adopt pooling arrangements in the payments to farmers. The changes to the arrangements in quota states have little effect on the output of farmers in New South Wales and Western Australia and there is some contraction in Queensland.

The simulations described above and their results assume that the present situation of restricted interstate trade continues. However it does not seem likely that restrictions on interstate trade could continue with such large falls in the output of the Victorian and Tasmanian industeries. Note that the effect on farm incomes may be generally greater than the effect on output since in almost all circumstances prices fall as well as output. Consequently the pressure to allow interstate trade would be very great. Further work needs to be done to examine the effects of allowing interstate trade.

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Appendices

1 Adaptation of Orani-f-milk to comparative static mode

There are two dynamic relationships in Orani-f-milk, one concerned with the treatment of foreign debt and one concerned with investment. These relationships are outlined in Parmenter (1988) and are briefly reviewed here.

The handling of foreign debt

In the most common forecasting mode of Orani-f-milk, values are exogenously set for the active accumulation of net foreign debt at the start and at the end of the forecast period. For instance if we denote these variables by Q_r where r is the year then,

$$Q_{t+s} = Q_t + s\Delta Q \qquad \text{(A1.1)}$$

where t is the initial year, s is the number of years to be forecast and ΔQ is the average annual change in active accumulation of net foreign debt (as a % of GDP).

Generally in forecasting mode it is the requirement to meet some target value of ΔQ that drives the dynamic part of Orani-f-milk. The foreign debt module is connected with the main Orani module through ΔB, the balance of trade, which is a function of ΔQ and the average annual growth rate of real GDP.

In comparative static mode Q_{t+s} and Q_t are exogenous and set at zero, ΔQ is determined and ΔB is endogenous.

Investment in comparative static Orani

Section 19 of DPSV (1982) explains how the amount of capital stock at the end of a period depends on the amount at the start of the period and the change in the rate of return over the period. The expected rate of return at the end of the period is the same for all industries and is denoted ω. ie

$$\omega = rr_{0,j} - \beta(k_{1,j} - k_{0,j}) \tag{A1.2}$$

where $rr_{0,j}$ is the rate of return for industry j at the start of the period and $k_{0,j}$ and $k_{1,j}$ are the change in the capital stock at the start and the end of the period and β is a parameter which dampens the reaction of investment (β is less than one).

The level of capital stock at the end of the period is related to the level at the start, the rate of depreciation and the level of investment.

$$K_{1,j} = d_j K_{0,j} + Y_j \tag{A1.3}$$

where d_j is one minus the rate of depreciation in industry j and K and Y are the levels of capital stock and investment respectively. Assuming constant rate of depreciation this equation may be expressed in percentage change form.

$$k_{1,j} = (1-G_j)\, k_{0,j} + G_j\, y_j \tag{A1.4}$$

where G_j is the share of capital stock in the sum of capital stock plus investment and y is the percentage change in Y.

Using equations A1.2 and A1.4 and rearranging

$$y_j = A.(rr_{0,j}-\omega) + k_{0,j} \tag{A1.5}$$

where A is a $(1/\beta.G_j)$. Investment in industry j depends on the rate of return in industry j relative to the economy wide rate of return and the change in capital stock in the base period. In a short run closure of Orani the $k_{0,j}$'s would be exogenous and set to zero.

Investment in Orani-f-milk

The equations governing investment in Orani-f-milk start with equation A1.3 but with time subscripts introduced:

$K_{t+1,j} = d_j K_{t,j} + Y_{t,j},$
$K_{t+2,j} = d_j K_{t+1,j} + Y_{t+1,j},$
etc to
$K_{t+s,j} = d_j K_{t+s-1,j} + Y_{t+s-1,j},$ (A1.6)

The percentage change in K and Y, given by k and y are constant over the period so no longer require a time subscript. Thus,

$K_{t+1,j} = (1+k_j) K_{t,j}$ and (A1.7)
$Y_{t+1,j} = (1+y_j) Y_{t,j}$ (A1.8)

Using the Taylor series approximation and some algebra we derive,

$$y_j = C_j k_j + f2_j \quad \text{(A1.9)}$$

where C_j and $f2_j$ are parameters which are functions of base year capital and stocks and the length of time over which the accumulation occurs.

The form of the relationship between the rate of return and capital stock shown in equation A1.2 above is retained in Orani-f-milk but the interpretation is different. Instead of constraining the capital stock at the start of the period relative to the end of the period in each industry it is constrained relative to the change in capital stock for the economy as a whole, kT. kT is equal to $\sum W_j k_j$ where W_j is an appropriate weighting such as shares of base period capital stock.

$$\omega = rr_j - \beta(k_j - kT) \quad \text{(A1.10)}$$

The time dimension on rr is dropped since the rate of return is constant over the forecast period In this context β might be interpreted as a term to model lags in the introduction of new capital stock (it generally has a value of 5 and constrains the response in industry capital stock to changes in industry rates of return).

Using equations A1.9 and A1.10 we derive,

$$y_j = B_j(rr_j - \omega) + C_j kT + f2_j \quad \text{(A1.11)}$$

where B_j is (C_j/β). Investment in Orani-f-milk depends on the rate of return in industry j relative to that for the economy, the initial economy wide change in capital stock and an accumulation relationship which depends on the initial ratio of investment to capital, depreciation and the length of the forecast period (represented by the terms B_j and $f2_j$).

A comparitive static use of the forecasting model is achieved with respect to investment by setting appropriate values for the parameters C and f2.

We wish to simulate over the medium run[1]. We choose values of one for all Cs and set the f2s exogenously to zero. This will cause the change in investment to equal the change in capital stock.

2. Method for countering linearisation errors

The results shown in Tables 4.1 and 4.2 have required some adjustment from the results obtained from the original Orani-f-milk simulations. The adjustments have been undertaken to fix linearisation errors in the original simulations. The problems arise in the equation determining exports. In the levels this equation is;

$$Pe_j = -((X4_j)^{\gamma}).Fe_j, \quad \text{(A2.1)}$$

where Pe_j is the foreign currency export price of commodity j, $X4_j$ is the volume of exports of commodity j, γ is the export demand flexibility (the inverse of the elasticity) and Fe_j is a shift term. This is expressed in percentage change form as,

$$pe_j = -\gamma.x4_j+fe_j. \quad \text{(A2.2)}$$

[1]. In other work the values of y_j and k_j were constrained to some steady state value. Dixon, Horridge and Johnson (1990) simulated the construction and operation of a multi function polis (MFP). A time horizon of 25 years was used starting from a point in which the average growth in the capital stock (ie k_j) was 3%. Over the period the change in investment and capital stock was maintained at 3% ie y_j and k_j were set at 3. The values of C_j and $f2_j$ were determined with the following calibration. From equations 1.6 and 1.7,
$(Y/K)_t = k_{tj}+d = 3+d$
and n=25. d is as per the database. $C1_j$ and $f2_j$ are obtained by using equation 1.9.

The percentage change approximation involves an interpretation of percentage change as,

$$x4 = (X4_1 - X4_0).100/X4_0, \qquad \text{(A2.3)}$$

where the subscript 0 indicates the initial value of X4 and the subscript 1 indicates the final value. Expressing the change in a variable as a proportion of its base value is a reasonable approximation for situation where the changes are small but this interpretation of percentage change does allow for changes of greater than 100 percent. In the milk export equations γ has the value 20 so a change in pe of greater than 5 will result in a fall in X4 greater than 100 percent. For real variables this situation is unrealistic. We can solve this problem by using the following interpretation for percentage change concerning the export demand equation for milk,

$$x4 = (X4_1 - X4_0).100/X4_1. \qquad \text{(A2.4)}$$

With this interpretation X4 may not decline by more than 100 percent.

We introduce this interpretation for the export demand equation in a two-step procedure. First the simulations are conducted using the interpretation of percentage change described first (that is as the ratio of the change in a variable to its initial value). From these simulations we obtain the values of pe. We then calculate the expected value of x4 using the second definition of percentage change above. The procedure is as follows.

$$pe = (Pe_1 - Pe_0).100\ /Pe_1, \qquad \text{(A2.5)}$$

where we have omitted the j subscript for clarity.

$\therefore\ Pe_1 = 1/(1-(pe/100))$, since Pe_0 is one.
$X4_0 = (Pe_0)^{(1/\gamma)}.Fe_0 = 1$, since Fe_0 is one.

Using the definition for x4 above,

$$x4 = (X4_1 - X4_0).100/X4_1 = 100.((Pe_1)^{(1/\gamma)} - 1)/((Pe_1)^{(1/\gamma)}.$$

$$= 100.(1-(1/((100/(100-pe))^{(1/\gamma)}))). \qquad \text{(A2.6)}$$

Given pe we calculate the value for x4. We rerun the simulations with x4 exogenous and set at the levels given by the equation above for the ten milk industries.

3. Summary of price mechanisms

The following equations summarise the price mechanisms governing the modelling of milk in Orani-f-milk. First we recall equation 2.2 eliminating the margins terms (for expositional purposes). The purchasers price p1 is a function of the producers price p0 and two tax terms pt1 and pt2.

$$p1_{i,j} = Z1_{i,j}\ (p0_i + pt1_{i,j} + pt2_{i,j}) \qquad \text{(A3.1)}$$

$pt1_{i,j}$ is used to model changes to the Commonwealth arrangements and $pt2_{i,j}$ is used to model changes to the state arrangements. $pt1_{i,j}$ is always exogenous and is set at whatever value is required to reduce the average subsidy on milk product exports from 16% to 5%. $pt2_{i,j}$ is endogenous and is explained by equation 2.4,

$$pt2_{i,f} = h_i.S_{i,n}\ , \text{ and}$$

$$pt2_{i,n} = h_i.S_{i,f} \qquad \text{(A3.2)}$$

As explained in section 2.1.2 for the pooling states h_i is the percentage change in the wedge between the subsidised (the farm milk price to fluid manufacturers) and the unsubsidised price (the farm milk price to non-fluid manufacturers). $S_{i,n}$ and $S_{i,f}$ are the shares applicable to the sales of milk from industry i to nonfluid and fluid manufacturing industries respectively. Industry i is one of the three pooling state farm milk industries. The share for the sale of Victorian farm milk to the (Victorian) fluid milk manufacturing industry $S_{V,f}$ is the share of non-fluid farm milk sales in total Victorian farm milk sales.

h_i has no particular interpretation for the quota states but for the sake of consistency it is calculated in the same way as for the pooling states. $S_{q,f}$, where q stands for quota state and f stands for a sale to a fluid manufacturing industry, is as for the pooling states but $S_{q,n}$ is set at zero for the quota states. This ensures that the price of sales of milk to non-fluid manufacturers will not be directly affected by the shocks.

In simulation group A the wedge h_i is endogenous and the purchasers price of sales to fluid milk manufacturers $p1_{i,f}$ is exogenous and set to zero. This ensures no change in the farm milk price of sales to fluid manufacturers and the entire brunt of changes to the Commonwealth arrangements which are modelled in this simulation will impact on the price of milk to non-fluid manufacturers.

In simulation groups B to E the wedge h_i is exogenous and all $p1_{i,j}$'s are endogenous. h_i is determined by the required shock to induce the appropriate margin between the price of milk sold to fluid and non-fluid purchasers as described in section 3.2 and Table 3.2.

The prices to fluid and nonfluid producers $p0_{ij}$ are not defined in Orani-f-milk but their value can be interpreted from equation A3.1.

$$p0_{i,j} = p1_{i,j} - pt1_{i,j} \qquad \text{(A3.3)}$$

The pooled price to producers in Victoria, South Australia and Tasmania will be the value weighted sum of the producer prices.

Table 3.1 Calculation of shocks to simulate abolition of the Kerin plan based on 1989/90 data

		Farm milk industries						Manufacturing industries.				
		NSW	VIC	QLD	SA	WA	TAS	Fluid milk	Butter	Cheese	Ice cream	Milk pr nec
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Fluid milk farmgate price (a)	(1)	37.73	37.45	41.40	39.13	37.57	41.85					
Manufacturing milk farmgate price (a)	(2)	22.83	25.12	23.40	21.15	22.28	22.70					
Value of initial levy (b)	(3)	1.98	1.98	1.98	1.98	1.98	1.98					
Reduction in levy (11/16ths)	(4)	1.36	1.36	1.36	1.36	1.36	1.36					
Shock to power of tax to lower levy reducing market support to 5%												
fluid milk sales (c)	(5)	-3.61	-3.63	-3.29	-3.48	-3.62	-3.25					
nonfluid milk sales (c)	(6)	-5.96	-5.42	-5.82	-6.44	-6.11	-6.00					
Initial level of market support (a)	(7)							13.00	18.30	10.70	4.50	11.40
Shock to power of export tax ass[illegible]ing reduction of market support to [illegible] (d)	(8)							7.08	11.24	5.15	-0.48	5.75

(a) pers comm David Luskin, IC
(b) from IC, 1991
(c) row 4 as a percentage of row 1 and row 4 as a percentage of row 2
(d) calculated using the formula ((T1-5)/(T1+100))*100 where T1 is row 7

Table 3.2 Calculation of shocks to simulate the removal of state milk marketing arrangements, 1989/90

		Pooling states			Quota states		
		VIC (1)	SA (2)	TAS (3)	NSW (4)	QLD (5)	WA (6)
Volume o[illegible]d milk, mill ltrs (a)	(1)	449.40	150.20	47.20	536.30	315.60	164.30
Volume of milk sold to non-fluid man'ufact's, mill ltrs (a)	(2)	3337.60	205.80	295.80	342.70	313.40	102.70
Fluid milk farmgate price, cents/ltr (a)	(3)	37.45	39.13	41.85	37.73	41.40	37.57
Manufacturing milk farmgate price, cents/ltr (a)	(4)	25.12	21.15	22.70	22.83	23.40	22.28
Share of sales to Fluid milk industry, % (b)	(5)	16.72	57.45	22.73	72.12	64.05	72.96
Share of sales to non-fluid milk industry, % (b)	(6)	83.28	42.55	77.27	27.88	35.95	27.04
Situation 1: 20% premium for fluid price							
Pooling: power of tax shock to fluid price (c)	(7)	-16.79	-18.73	-29.30			
power of tax shock to non-fluid price (c)	(8)	3.37	25.29	[illegible].62			
Value of wedge-h in equation 2.4 (d)	(9)	-0.20	-0.44	[illegible].38	-0.98	-0.89	-1.07
Quota: power of tax shock to fluid price (e)	(10)				-27.39	-32.17	-28.84
Situation 2: 10% premium for Fluid price							
Pooling: power of tax shock to fluid price (c)	(11)	-22.83	-22.49	-34.31			
power of tax shock to non-fluid price (c)	(12)	4.58	30.37	10.09			
Value of wedge-h in equation 2.4 (d)	(13)	-0.27	-0.53	-0.44	-1.20	-1.05	-1.29
Quota: power of tax shock to fluid price (e)	(14)				-33.44	-37.83	-34.77
Situation 3: Equalised fluid and non-fluid price							
Pooling: power of tax shock to fluid price (c)	(15)	-29.02	-26.56	-39.46			
power of tax shock to non-fluid price (c)	(16)	5.82	35.87	11.61			
Value of wedge-h in equation 2.4 (d)	(17)	-0.35	-0.62	-0.51	-1.42	-1.21	-1.50
Quota: power of tax shock to fluid price (e)	(18)				-39.49	-43.48	-40.70

(a) pers comm, David Luskin, IC
(b) rows 5 & 6 are the shares of the product of rows 1 & 3 and 2 & 4 in the sum of the products of rows 1 & 3 and rows 2 & 4
(c) row 7,8,11,12,14 & 15 are calculated using (val(man+fluid)/ (vol(man)+(vol(fluid)/A))pr(man)-1)*100
where A is the fluid milk premium
(d) row for fluid milk tax shock divided by row for non-fluid milk share eg row 9 is row 7 divided by row 6
(e) the power of the tax is 1 less the ratio of row 4 times A to row 3 by 100 ie (1-(A.pr(man)/pr(fluid)))*100
where, as above, A is the fluid price premium.

Table 3.3: Calculation of appropriate marginal budget shares

			Fluid milk commodity						Manufactured milk commodities			
			NSW	Vic	Qld	SA	WA	Tas	Butter	Cheese	Ice crm	Milk pr nec
Consumption of												
Domestic commodity (a)	(1)		254.90	223.90	160.00	62.30	54.70	19.00	125.30	192.60	139.90	132.30
Imported commodity (a)	(2)		0.63	0.56	0.40	0.15	0.14	0.05	0.60	21.05	0.00	1.43
Average budget share (b)	(3)	Si	0.0040	0.0036	0.0025	0.0010	0.0009	0.0003	0.0020	0.0034	0.0022	0.0021
Budget share by Frisch par. (c)	(4)	Si.F	-0.0074	-0.0065	-0.0046	-0.0018	-0.0016	-0.0005	-0.0036	-0.0062	-0.0040	-0.0039
High own price household demand elasticity												
Desired own price elasticity (d)	(5)	zi	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.60	-0.60	-0.60	-0.60
Appr. marginal budget share (e)	(6)	bi	-0.0015	-0.0013	-0.0009	-0.0004	-0.0003	-0.0001	-0.0022	-0.0037	-0.0024	-0.0023
High own price household demand elasticity												
Desired own price elasticity (d)	(7)	zi	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.25	-0.25	-0.25	-0.25
Appr. marginal budget share (e)	(8)	bi	-0.0011	-0.0010	-0.0007	-0.0005	-0.0002	-0.0001	-0.0009	-0.0015	-0.0010	-0.0010
Low own price household demand elasticity												
Desired own price elasticity (d)	(9)	zi	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.20	-0.20	-0.20	-0.20
Appr. marginal budget share (e)	(10)	bi	-0.0007	-0.0006	-0.0005	-0.0002	-0.0002	-0.0001	-0.0007	-0.0012	-0.0008	-0.0008

(a) from Table 3.6 Johnson (1991)
(b) the sum of rows 1 and 2 divided by total consumption ($63132mill)
(c) row 5 multiplied by the Frisch parameter (-1.82)
(d) from section 3.3
(e) using formula bi = -0.5.((Si.F-1)+(((Si.F-1)/Si.F)^2+(4.zi/Si.F))^0.5).
where zi is defined in rows 3, 5 and 7 and Shi is row 3 and F is -1.82

Table 3.4: Calculation of appropriate primary factor substitution elasticities

			State					
			NSW	Victoria	Queensland	SA	WA	Tasmania
Total inputs of fixed factors (land) (a)	(1)		41.60	135.60	36.20	16.80	13.70	8.90
Total primary factors (a)	(2)		120.30	392.30	104.20	48.60	39.60	25.70
Total costs (a)	(3)		157.00	519.50	137.90	63.90	51.90	33.80
Share of:								
Primary factors in total costs (b)	(4)	Spf	0.77	0.76	0.76	0.76	0.76	0.76
Fixed factors in total primary factors (c)	(5)	Sff	0.35	0.35	0.35	0.35	0.35	0.35
High farm milk supply elasticity (d)	(6)	qj	3.16	3.21	3.18	3.19	3.17	3.18
Appropriate factor substitution elasticity (e)	(7)	sj	1.28	1.28	1.28	1.28	1.28	1.28
Medium farm milk supply elasticity (d)	(8)	qj	1.50	1.50	1.50	1.50	1.50	1.50
Appropriate factor substitution elasticity (e)	(9)	sj	0.61	0.60	0.60	0.60	0.61	0.60
Low farm milk supply elasticity (d)	(10)	qj	0.50	0.50	0.50	0.50	0.50	0.50
Appropriate factor substitution elasticity (e)	(11)	sj	0.20	0.20	0.20	0.20	0.20	0.20

(a) from Table 3.6 Johnson (1991)
(b) row 2 divided by row 3
(c) row 1 divided by row 2
(d) from section 3.3
(e) using formula sj = qj (Sff.Spf)/(1-Spf) where qj is defined in rows 3, 5 and 7 and Sff is row 1 and Spf is row 2

Table 3.5: Proposed Orani-f-milk simulations

	Farm milk supply elasticities	Household demand elasticities		
		high	medium	low
Commonwealth arrangements (all simulations)				
Market Support Payment (MSP) 5% of export prices				
State arrangements				
(1) New fluid milk prices 70% above nonfluid prices				
Farm price to fluid milk manufacturers constant	medium		A22	
(2) New fluid milk prices 70% above new non-fluid prices	high	B11	B21	B31
Farm price to fluid milk manufacturers adjust	medium	B12	B22	B32
	low	B13	B23	B33
(3) New fluid milk prices 20% above new non-fluid prices				
Farm price to fluid milk manufacturers adjust	medium		C22	
(4) New fluid milk prices 10% above non-fluid prices				
Farm price to fluid milk manufacturers adjust	medium		D22	
(5) New non-fluid milk prices equal to non-fluid prices	high	E11	E21	E31
Farm price to fluid milk manufacturers adjust	medium	E12	E22	E32
	low	E13	E23	E33

Table 4.1 Macroeconomic and industry results, percentage change over unshocked state

		Simulation number				
		A22	B22	C22	D22	E22
Endogenous variable						
Real devaluation	(')	0.06	0.09	0.23	0.26	0.29
Average wages	(2)	0.04	0.05	0.15	0.18	0.20
Capital stocks	(3)	0.00	0.00	0.04	0.05	0.06
Real GDP	(4)	0.01	0.01	0.03	0.03	0.04
Real consumption	(5)	0.02	0.02	0.07	0.08	0.09
Real investment	(6)	0.00	-0.02	0.20	0.22	0.25
Volume of exports	(7)	-0.06	-0.06	-0.02	-0.02	-0.02
Volume of imports	(8)	-0.03	-0.05	-0.02	-0.02	-0.02
Terms of trade	(9)	0.02	0.01	0.00	0.00	0.00
Output of;						
Agriculture and forestry	(10)	-0.13	-0.17	-0.23	-0.24	-0.26
Mining	(11)	0.11	0.15	0.38	0.43	0.47
Food	(12)	0.09	0.04	-0.04	-0.07	-0.09
TCF	(13)	0.03	0.05	0.11	0.12	0.13
Wood etc	(14)	0.01	0.02	0.09	0.10	0.11
Chemical & oil	(15)	0.02	0.03	0.10	0.11	0.13
Nonmetal	(16)	-0.02	-0.02	0.18	0.20	0.23
Metal	(17)	0.04	0.06	0.24	0.27	0.30
Transequip	(18)	0.04	0.06	0.19	0.21	0.24
Oth machinery	(19)	0.00	-0.01	0.13	0.15	0.17
Other manufacturing	(20)	0.01	0.01	0.09	0.10	0.11
Utilities	(21)	0.00	0.01	0.04	0.05	0.05
Construction	(22)	0.00	-0.01	0.19	0.22	0.24
Communications & Transport	(23)	0.00	0.00	0.05	0.06	0.06
Services	(24)	0.01	0.01	-0.07	-0.08	-0.09
Farm milk	(25)	-2.11	-2.82	-4.55	-4.97	-5.43
Manufacturing milk	(26)	0.19	-0.53	-2.54	-3.00	-3.49

Table 4.2 Milk industry output, percentage change over unshocked state

		Simulation number				
		A22	B22	C22	D22	E22
Output of industry;						
NSW farm milk	(1)	0.19	0.11	0.33	0.38	0.43
Vic farm milk	(2)	-4.14	-5.20	-7.87	-8.55	-9.26
Qld farm milk	(3)	0.30	-0.50	-0.68	-0.75	-0.82
SA farm milk	(4)	1.84	1.11	-1.65	-2.19	-2.73
WA farm milk	(5)	0.26	0.16	0.29	0.31	0.33
Tas farm milk	(6)	-0.43	-1.57	-5.30	-6.12	-6.97
Farm milk	(7)	-2.11	-2.82	-4.55	-4.97	-5.43
Agriculture and forestry	(8)	0.19	-0.17	-0.23	-0.24	-0.26
NSW fluid milk	(9)	0.04	0.21	1.43	1.71	1.98
Vic fluid milk	(10)	0.02	0.36	1.22	1.50	1.81
Qld fluid milk	(11)	0.01	0.22	1.93	2.24	2.55
SA fluid milk	(12)	0.01	0.17	1.45	1.71	1.98
WA fluid milk	(13)	0.01	0.19	1.70	2.01	2.31
Tas fluid milk	(14)	0.00	0.25	1.84	2.11	2.43
Butter	(15)	-22.31	-23.69	-25.42	-26.11	-26.90
Cheese	(16)	3.81	2.13	-4.91	-6.30	-7.70
Ice cream	(17)	0.50	0.47	0.41	0.38	0.35
Milk products nec	(18)	5.59	4.11	2.28	1.54	0.67
Manufacturing milk	(19)	0.19	-0.53	-2.54	-3.00	-3.49
Food	(20)	0.09	0.04	-0.04	-0.12	-0.09

Table 4.3 Producer and purchaser prices for farm milk, percentage change over unshocked state

		Simulation number									
		A22		B22		C22		D22		E22	
Prices of;		purch.	prod	purch.	prod	purch.	prod	purch.	prod	purch.	prod
NSW farm milk											
fluid sales	(1)	0.00	3.61	-3.19	0.42	-27.60	-23.99	-33.08	-29.47	-38.56	-34.95
nonfluid sales	(2)	-5.27	0.69	-5.32	0.64	-5.04	0.92	-4.97	0.99	-4.91	1.05
Vic farm milk											
fluid sales	(3)	0.00	3.63	-7.37	-3.74	-24.41	-20.78	-30.19	-26.56	-36.74	-33.11
nonfluid sales	(4)	-9.49	-4.07	-8.99	-3.57	-7.96	-2.54	-7.41	-1.99	-6.74	-1.32
pooled price	(5)		-2.78		-3.60		-5.59		-6.09		-6.63
Qld farm milk											
fluid sales	(6)	0.00	3.29	-3.39	-0.10	-32.34	-29.05	-37.56	-34.27	-42.69	-39.40
nonfluid sales	(7)	-5.52	0.30	-5.67	0.15	-5.71	0.11	-5.74	0.08	-5.77	0.05
SA farm milk											
fluid sales	(8)	0.00	3.48	-2.28	1.20	-21.29	-17.81	-25.15	-21.67	-29.02	-25.54
nonfluid sales	(9)	-6.71	-0.27	-4.96	1.48	15.80	22.24	20.06	26.50	24.33	30.77
pooled price	(10)		1.88		1.32		-0.77		-1.17		-1.58
WA farm milk											
fluid sales	(11)	0.00	3.62	-3.16	0.46	-29.11	-25.49	-34.44	-30.82	-39.54	-35.92
nonfluid sales	(12)	-5.34	0.77	-5.41	0.70	-5.22	0.89	-5.17	0.94	-5.14	0.97
Tas											
fluid sales	(13)	0.00	3.25	-4.19	-0.94	-33.53	-30.28	-38.35	-35.10	-43.87	-40.62
nonfluid sales	(14)	-6.76	-0.76	-6.67	-0.67	-1.68	4.32	-1.08	4.92	-0.28	5.72
pooled price	(15)		0.15		-0.73		-3.55		-4.17		-4.81

Table 4.4 Sensitivity of milk industry output to household demand and farm milk supply elasticities percentage changes over unshocked state

		Simulation number								
		B11	B12	B13	B21	B22	B23	B31	B32	B33
NSW farm milk	(1)	-0.07	0.25	0.56	-0.23	0.11	0.46	-0.30	0.05	0.42
Vic farm milk	(2)	-7.09	-5.02	-2.30	-7.36	-5.20	-2.31	-7.41	-5.24	-2.31
Qld farm milk	(3)	-0.84	-0.03	0.16	-1.04	-0.50	0.04	-1.09	-0.55	0.01
SA farm milk	(4)	0.16	1.15	1.90	0.05	1.11	1.99	0.00	1.09	2.02
WA farm milk	(5)	0.00	0.31	0.55	-0.17	0.16	0.45	-0.19	0.15	0.45
Tas farm milk	(6)	-3.31	-1.48	0.55	-3.49	-1.57	0.61	-3.51	-1.57	0.65
Farm milk	(7)	-4.04	-2.66	-0.94	-4.26	-2.82	-0.98	-4.31	-2.86	-0.99
Agriculture & for'y	(8)	-0.23	-0.15	-0.06	-0.25	-0.17	-0.07	-0.25	-0.18	-0.07
NSW fluid milk	(9)	0.28	0.27	0.19	0.22	0.21	0.16	0.14	0.14	0.11
Vic fluid milk	(10)	0.39	0.45	0.50	0.31	0.36	0.39	0.20	0.23	0.25
Qld fluid milk	(11)	0.27	0.26	0.21	0.22	0.22	0.18	0.16	0.16	0.14
SA fluid milk	(12)	0.29	0.22	-0.05	0.22	0.17	-0.05	0.15	0.12	-0.04
WA fluid milk	(13)	0.29	0.27	0.17	0.21	0.19	0.13	0.20	0.19	0.13
Tas fluid milk	(14)	0.25	0.24	0.13	0.25	0.25	0.12	0.26	0.25	0.12
Butter	(15)	-26.54	-23.48	-18.80	-26.84	-23.69	-18.77	-26.88	-23.70	-18.73
Cheese	(16)	0.10	2.17	3.97	-0.07	2.13	4.13	-0.08	2.15	4.18
Ice cream	(17)	1.09	1.17	1.20	0.41	0.47	0.50	0.31	0.37	0.40
Milk products nec	(18)	1.10	4.37	9.31	0.73	4.11	9.31	0.68	4.09	9.35
Manufacturing milk	(19)	-1.61	-0.32	1.23	-1.88	-0.53	1.13	-1.94	-0.58	1.11
Food	(20)	-0.02	0.07	0.17	-0.05	0.04	0.15	-0.05	0.04	0.14

Table 4.5 Sensitivity of milk industry output to household demand and farm milk supply elasticities
percentage change in value over unshocked state

		Simulation number								
		E11	E12	E13	E21	E22	E23	E31	E32	E33
NSW farm milk	(1)	0.49	0.96	1.50	-0.07	0.43	1.05	-0.56	-0.05	0.62
Vic farm milk	(2)	-12.12	-9.10	-4.60	-12.31	-9.26	-4.64	-12.41	-9.34	-4.65
Qld farm milk	(3)	-1.08	-0.33	0.57	-1.58	-0.82	0.17	-2.00	-1.23	-0.19
SA farm milk	(4)	-3.97	-2.48	-0.69	-4.26	-2.73	-0.81	-4.55	-2.99	-0.98
WA farm milk	(5)	0.61	1.06	1.51	-0.15	0.33	0.89	-0.17	0.32	0.91
Tas farm milk	(6)	-9.65	-6.99	-3.31	-9.69	-6.97	-3.14	-9.66	-6.90	-2.99
Farm milk	(7)	-7.15	-5.13	-2.22	-7.48	-5.43	2.41	-7.69	-5.62	-2.54
Agriculture & for'y	(8)	-0.35	-0.23	-0.07	-0.38	-0.26	-0.10	-0.39	-0.28	-0.11
NSW fluid milk	(9)	2.65	2.63	2.46	1.99	1.98	1.88	1.32	1.31	1.27
Vic fluid milk	(10)	2.18	2.31	2.46	1.71	1.81	1.93	1.08	1.14	1.21
Qld fluid milk	(11)	3.23	3.21	3.10	2.55	2.55	2.49	1.87	1.87	1.85
SA fluid milk	(12)	2.55	2.58	2.53	1.95	1.98	1.94	1.34	1.36	1.34
WA fluid milk	(13)	3.39	3.34	3.10	2.33	2.31	2.20	2.32	2.29	2.18
Tas fluid milk	(14)	2.33	2.42	2.52	2.34	2.43	2.51	2.34	2.43	2.49
Butter	(15)	-31.17	-26.77	-19.64	-31.34	-26.90	-19.61	-31.32	-26.85	-19.52
Cheese	(16)	-10.76	-7.81	-4.15	-10.73	-7.70	-3.81	-10.69	-7.59	-3.55
Ice cream	(17)	0.77	0.95	1.11	0.24	0.35	0.44	0.16	0.26	0.36
Milk products nec	(18)	-4.00	0.85	8.59	-4.20	0.67	8.54	-4.19	0.71	8.60
Manufacturing milk	(19)	-5.08	-3.19	-0.53	-5.40	-3.49	-0.73	-5.59	-3.66	-0.84
Food	(20)	-0.20	-0.06	0.12	-0.23	-0.09	0.09	-0.25	-0.28	0.08