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Abstract

The motivation for this study rests on two factors. First, Australian dairy farmers spend around $20 million annually on generic promotion and estimates of the returns from this expenditure are required to facilitate efficient investment decisions. Second, while the Australian dairy industry is currently highly regulated despite a substantial reduction in assistance over the past decade, manufacturing milk subsidies are to be eliminated by 2000 and market milk regulations are being reviewed. The profit potential of promotion may vary with the degree of regulation, so past estimates of the returns from promotion may not hold in the competitive environment of the future. Hence, the aim of this study is to examine the effects of government intervention on the profitability for dairy farmers of incremental changes in generic dairy promotion expenditure using a perfectly competitive market as a reference point. Competitive market price and quantity outcomes for the Australian dairy industry are estimated. The impacts of increments in dairy product and competing product generic promotion expenditures on dairy farmers' profits are assessed using equilibrium displacement modelling. Finally, graphical procedures are used to examine the effects of dairy industry regulation on the profitability of dairy promotion.

Key Words: generic promotion, dairy, equilibrium displacement modelling

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1. Introduction

The Australian Dairy Corporation (ADC) is responsible for the generic promotion of Australian dairy products. In 1994/95, the ADC spent $13.74 million on domestic dairy promotion and a further $5.75 million on promoting dairy products in key export markets. The proportion of total ADC promotion funds spent on promotion in export markets has increased substantially in recent years, reaching 29.5 per cent in 1994/95 (ADC 1996a). Each year decisions have to be made regarding the type of promotion and the distribution of promotion funds between the domestic and international markets. Estimates of potential returns from these alternative promotion expenditures are required to facilitate efficient investment decisions.

Returns to promotion and the distribution of these returns among market participants depends on how promotion is financed, the market structure for the commodity and the existence and type of government intervention (Alston et al 1994). An equilibrium displacement modelling (EDM) approach has been used to assess the benefits of incremental promotion expenditure for meat and fibres in Australia (Piggott et al 1995; Hill et al 1996). In both these cases, promotion expenditure was financed by producer levies and the markets for the commodities were relatively free from government intervention. While generic promotion of dairy products is also funded by producer levies, the market for dairy products is highly regulated. The impact that government policies have on dairy prices and quantities is expected to influence the level of potential benefits from dairy promotion expenditure.

The main objective of this study is to examine the effects of government intervention on the level of profits to dairy farmers from incremental changes in generic dairy promotion expenditure using a perfectly competitive market as a reference point. The cross-commodity impacts of generic promotion of dairy substitutes are taken into account using EDM once simulated competitive quantity and price outcomes have been

determined. Then, the effects of the government-induced price distortions on the benefits of promotion are evaluated. The emphasis is on generic promotion and brand promotion is ignored.

The format of the paper is as follows. A description of the Australian dairy industry is presented in the next section. A review of previous studies on dairy promotion is given in Section 3. In Section 4, the competitive price and quantity outcomes for raw milk are calculated following the procedure set out in Freebairn (1992a). Assuming a free-market situation, a model of the dairy industry is then developed in Section 5. Data to implement the model, including the competitive dairy price and quantity estimates and 'best-bet' estimates of the crucial parameters, are presented in Section 6. The general equilibrium promotion elasticities are presented in Section 7. In Section 8, some of the literature on the influence of market distortions on the level and distribution of gains from research or promotion is reviewed, and the impact on returns to dairy promotion in a regulated market is examined graphically. Conclusions are presented in the final section.

2. The Australian Dairy Industry

2.1 Introduction

The Australian dairy industry consists of two distinct, but interrelated, sectors: the market or fresh milk sector and the manufacturing milk sector. In 1994/95, around 22.5 per cent of the total milk production of 8206 ML was consumed as liquid milk (Australian Bureau of Agricultural Economics (ABARE) 1996). The remainder was used for manufacturing purposes.

In 1994/95, 498.4 kt of Australian manufactured dairy products were exported, accounting for around $1291.2 million. In addition, 64.8 ML of fresh milk, valued at $51.8 million, were exported (ABARE 1996). Based on export and domestic production and consumption figures for 1994/95, it is estimated that around 29.6 per cent of total milk production was used to produce manufactured dairy products for the domestic market, while the remaining 47.9 per cent was used in exported manufactured dairy products.

Despite the fact that a large proportion of domestic dairy production is exported, Australia remains a small exporter in terms of world market share. In 1995, for example, Australian exports of whole milk powder, skim milk powder, butter and cheese accounted for only 10 per cent of the total world trade in these products (ADC 1996b). Therefore, it could be expected that Australian dairy exporters are predominantly price-takers on the world market. The Industry Commission (IC) (1991), however, believed that the effects of national and international dairy policies may increase the market power of Australian dairy exporters resulting in a less-than-perfectly elastic export demand curve. Nevertheless, the IC still held the view that, despite the market distortions, the export demand curve would be highly elastic (-20).

2.2 Regulations in the Australian Dairy Industry

Despite a reduction in government assistance since 1986/87 and the introduction of new dairy support arrangements on 1 July 1995, the Australian dairy industry is still highly regulated relative to most other Australian rural industries. The production and, in some states, the processing and distribution of market milk is regulated by state government statutory authorities. The price of market milk is also set by some individual state authorities based on the production, processing and distribution costs at all stages of the marketing chain, the consumer price index and, sometimes, the market price of competing products (ABARE 1991). In general, state market milk regulations are aimed at maintaining a market milk premium, the difference between the regulated price for market milk and the price for manufacturing milk at the farm level. This is achieved by restricting the supply of market milk within the individual states and by preventing manufacturing milk produced in one state from being sold as market milk in another state. Some states are currently reviewing the regulation of their market milk sectors.

Government regulation of milk for manufacturing purposes is applied at the Federal level. The marketing arrangements which were contained in the Dairy Produce Act (commonly referred to as the 'Kerin Plan') operated from 1 July 1986 until 1 July 1995. The central feature of these marketing arrangements was a levy that applied to all milk produced and subsequently used to subsidise exports of manufactured dairy products. In effect, the Kerin Plan was 'a tax/subsidy home price scheme which supports the price for export products explicitly, and supports prices for domestic manufactured milk prices and market

milk implicitly' (Wilcox 1988, in Geurts and Jonker 1995, p. 16). One aim of the Kerin Plan was to progressively lower the domestic support price so that the price of domestic product equalled the import parity price, thus encouraging a more efficient and competitive export-orientated industry.

New dairy support arrangements were introduced in Australia on 1 July 1995 in line with GATT commitments. Under these arrangements it was expected that consumers would pay the same price for dairy products as under the old arrangements and dairy processors would receive the same margin. However, the new farmgate price for manufacturing milk would be lower than under the old scheme since the new price would reflect prevailing market conditions. Nevertheless, dairy farmers should be no worse off because a subsidy would be paid to the farmer directly, rather than indirectly in the form of a higher price for manufactured milk, and manufacturing milk producers would no longer be required to pay the all-milk levy. The direct subsidy payment for manufacturing milk would be financed from the domestic manufacturing milk levy, which would be paid by manufacturers, and the levy on market milk production which would be paid by dairy farmers. Subsidies paid to the dairy industry are to be gradually reduced to zero by 30 June 2000 (ABARE 1995). Thus, within a few years, the Australian dairy manufacturing sector will be operating in a relatively competitive market environment. Economic relationships in the dairy industry, including those between promotion and price and quantity impacts, measured in the past regulated environment are unlikely to hold in the competitive environment of the future.

3. Some Previous Dairy Promotion Studies

Boutonnat et al (1991) reviewed a large number of dairy promotion studies that were undertaken in various countries. In the majority of these studies, econometric techniques were used to measure the impact of generic dairy promotion on the dairy industry in each country or region but cross-commodity impacts were largely ignored. In most of the studies reviewed, the response to generic promotion of dairy products was positive, statistically significant but small. In the majority of the studies on fluid milk promotion, the promotion elasticity ranged from 0.001 to 0.059, while in most of the studies on the promotion of butter, cheese, cream and yoghurt, the elasticity of promotion ranged from 0.001 to 0.039. In a few studies no significant promotion effect was found. It is also

worth noting that, given the pervasiveness of dairy industry policies, most of these estimates were made in a regulated market setting.

More recently, and of particular interest given the objectives of this study, Suzuki et al (1994) developed a framework that incorporated the degree of market competition to evaluate the effectiveness of generic milk promotion in Japan. Within this model, changes in both milk price and milk quantity were treated endogenously, although cross-commodity impacts were not considered. The own-price elasticity of fluid milk demand was estimated to be -0.70, the expenditure elasticity was 0.32 and the long-run promotion elasticity was 0.06, which is quite large compared with the results from earlier fluid milk promotion studies.

The authors could not find any previous studies in the professional literature on the economic impact of dairy promotion in Australia.

4. Determination of Hypothetical Competitive Price and Quantity Outcomes

Freebairn (1992a) examined the economic impact of the Kerin Plan on the Australian dairy industry. A model, based on Parish (1962), was developed to estimate economic transfers and losses due to market intervention using a hypothetical competitive market as a benchmark. Linear demand and supply curves for raw milk were estimated to pass through actual 1989-90 price and quantity values for total milk production, domestic market milk sales and domestic manufacturing sales to determine the competitive market outcomes. Manufactured dairy exports were calculated as the difference between domestic production and domestic consumption. A demand elasticity for market milk at the farm level of -0.05 and a demand elasticity for manufacturing milk at the farm level of -0.2 were used. These estimates were based on previous studies of demand elasticities at the retail level for dairy products, on knowledge of the value of milk at the farm and retail levels and by assuming constant absolute processing and marketing margins. Because little information was available on the elasticity of supply of milk at the farm level, Freebairn calculated competitive outcomes using elasticities of supply of 0.5 and 1.5.

In this study, calculation of hypothetical competitive outcomes required the linear supply and demand curves to pass through the observed average price and quantity values for the three years ending June 1995[1]. A three-year 'adjustment period' was chosen to allow supply and demand quantities and prices, which are endogenous in this model, to fully adjust to changes in the exogenous variables, such as promotion expenditure. Based on the three-year adjustment period, it is believed that the elasticities would be larger in absolute terms than those used by Freebairn. The elasticities of derived demand for market milk and for manufacturing milk are assumed to be -0.12 and -0.4, respectively, and the supply elasticity is assumed to be 1.1 under the Kerin plan. These elasticities are then used in the calculation of the simulated outcomes for the Australian dairy industry under the Kerin Plan and under a free-market scenario for the three-year period ending June 1995 (Table 1).

For the competitive market situation, the equilibrium price for raw milk is estimated to be 22.35 c/L and the competitive supply of raw milk is 18 048 ML for the three years ending 1994/95. This compares with an actual milk supply of 23 612 ML for the Kerin Plan. The estimated 23.6 per cent fall in milk production is a result of the 21.4 per cent fall in prices paid to farmers in the competitive market scenario. The quantity of market and manufacturing milk demanded, however, is estimated to be higher in a free-market situation than in a regulated market because of the fall in the price paid by domestic consumers. With a reduction in quantity supplied and an increase in quantity demanded on the domestic market, the quantity of dairy products exported is estimated to be significantly less in a competitive market than under the Kerin Plan.

5. The Model

5.1 Method

[1] While new dairy arrangements were introduced on 1 July 1995, the analysis in this paper is based on the marketing arrangements operating under the Kerin Plan. Therefore, the data used in the EDM are for the period 1992/93 to 1994/95.

Piggott et al (1995) developed procedures to assess the impacts of small changes in meat promotion expenditure using EDM. These procedures were then adapted by Hill et al (1996) to determine the profit impacts of incremental fibre promotion at the farm level. In each of these cases, the procedures and formulae were specific to a perfectly competitive market situation. While, in principle, it is possible to derive a set of general functions that could represent the regulated market situation in the dairy industry, it would be extremely difficult (Holloway 1991; Alston et al 1988; Alston et al 1995). It is easier to use EDM to assess the farm-level impacts of dairy promotion following established procedures by assuming the dairy industry is perfectly competitive (as it will be in a few years). Then, once the results are obtained from the model, it is necessary to account for the current price distortions in the dairy market. This is done diagrammatically to show the differences in the changes in producer surplus due to incremental dairy promotion between a perfectly competitive market situation and a regulated market.

EDM allows the set of equations to be general in the sense that it is not necessary to specify the functional form of the equations. Assuming a perfectly competitive dairy market, the model in this study comprises equations representing the demand for, and supply of, raw milk, fruit juice, and margarine at the farm level, and soft drinks at the 'factory door'. Thus cross-commodity effects are explicitly accounted for. Raw milk is used in the model, rather than fresh milk and manufacturing milk, since raw milk is a homogeneous product and, under a free-market situation, farmers would be paid the same price for raw milk regardless of end use. Once the equations have been specified, investigation of the impacts of an incremental change in generic promotion expenditure for raw milk is relatively straight forward. Questions about the changes in returns to dairy farmers and the profitability of milk promotion can then be addressed.

5.2 The Structural Model

Under the assumption of a free market, domestic demand for raw milk is considered to be a function of the endogenous prices of raw milk, fruit juice, soft drink and margarine. It is also expected to be influenced by its own generic promotion and the generic promotion activities of the competing products, which are considered to be exogenous variables.

Cross-commodity impacts of a change in the price of dairy substitutes have been examined in only a limited number of studies and the results have been inconclusive. Milham et al (1990) examined substitution relationships in Australian beverage consumption using annual price and quantity data for milk, tea, coffee, soft drink, beer and wine. Milk, tea and coffee were not found to have significant substitution relationships with each other nor with any of the other beverages. Also, in Kullman (1983) it was stated that the California Milk Advisory Board determined that consumers considered milk to be a 'high energy' drink that was not in competition with soft drinks. In a study on Japanese milk consumption by Suzuki et al (1994), the price of soft drink was found to be a statistically insignificant variable in explaining fluid milk demand.

In contrast, when examining the effectiveness of Canadian dairy promotion on milk demand, Kinnucan (1987) found the cross-price elasticity for milk demand in response to a change in the price of cola-based soft drinks to be positive (0.51), indicating that milk and cola are substitutes. Thompson (1979) examined the response of milk sales to generic promotion and also found the cross-price elasticity of fluid milk and soft drink to be positive (0.2), while Thompson and Eiler (1975) found that the prices of alcohol, soft drink and coffee were all significant variables that impacted negatively on milk consumption. Consumption of orange juice, however, was found to be positively related to milk consumption.

While there is doubt surrounding the demand relationship between milk and fruit juice, and milk and soft drink, these products are assumed to be substitutes in this study and, therefore, are included in the domestic demand equation for raw milk. In the model developed here, the impact of changes in own- and cross-commodity generic promotion expenditure are assessed using derived competitive price and quantity outcomes for raw milk and, hence, inclusion of the price of fruit juice and the price of soft drink seems reasonable.

Under a free-market situation, Australian dairy exports were calculated to be 28.7 per cent of domestic milk production compared with 48.2 per cent under the Kerin Plan (Table 1). Australian dairy exports are almost all manufactured products such as cheese, butter and milk powders, with only a small proportion exported as fresh milk products

(ABARE 1996). Thus, the export demand for raw milk is assumed to be a function of the price of raw milk, the price of margarine and international promotion expenditure on Australian dairy products by the ADC. Fruit juice and soft drink are not considered to be related to raw milk on the export market because of the very small amount of fresh milk exported and because fresh milk from other sources would be the main substitute for Australian fresh milk.

While Australia currently imports some dairy products, particularly speciality cheeses, the quantity of imports is small compared with total Australian dairy product output. Therefore, dairy imports are excluded from the model.

Fruit juice and soft drink are assumed to be substitutes for milk and for each other and are, therefore, are considered to be related in demand on the domestic market. In addition, it is assumed that the domestic demands for fruit juice and soft drink are a function of their own generic promotion and the generic promotion activities for the competing products.

Export demand equations for fruit juice and for soft drink are not included in the analysis because the proportion of fruit juice and soft drink that is exported is small and international promotion of these products is not being considered in this study. However, there is a significant quantity of fruit juice imported into Australia (around 35 per cent of total domestic production) and so an import equation for fruit juice is included. On the other hand, imports of soft drink are insignificant and, therefore, an import equation for soft drink is not included.

Margarine is assumed to be a substitute for raw milk on the domestic market (particularly with regard to that component of raw milk that is used in the production of butter) but not to be a substitute for fruit juice or soft drink. It is also assumed that, on the domestic market, the demand for margarine is influenced by the promotion of raw milk (mainly butter promotion) by the ADC. There is no generic promotion of margarine so margarine promotion is excluded. Export and import equations for margarine have been omitted from the model because the quantities involved are insignificant.

For each of the commodities considered, supply is assumed to be a function of its own price but not of the price of any of the other commodities.

The model is, therefore, specified as follows:

$$D_r^d = D_r^d(P_r, P_j, P_s, P_m, A_r^d, A_j^d, A_s^d, Z_1) \quad \text{(domestic demand for raw milk)} \quad (1a)$$

$$D_r^e = D_r^e(P_r, P_m, A_r^e, Z_2) \quad \text{(export demand for raw milk)} \quad (1b)$$

$$D_j^d = D_j^d(P_r, P_j, P_s, A_r^d, A_j^d, A_s^d, Z_3) \quad \text{(domestic demand for fruit juice)} \quad (1c)$$

$$D_s^d = D_s^d(P_r, P_j, P_s, A_r^d, A_j^d, A_s^d, Z_4) \quad \text{(domestic demand for soft drink)} \quad (1d)$$

$$D_m^d = D_m^d(P_r, P_m, A_r^d, Z_5) \quad \text{(domestic demand for margarine)} \quad (1e)$$

$$S_r^d = S_r^d(P_r, Z_6) \quad \text{(domestic supply of raw milk)} \quad (1f)$$

$$S_j^d = S_j^d(P_j, Z_7) \quad \text{(domestic supply of fruit juice)} \quad (1g)$$

$$S_s^d = S_s^d(P_s, Z_8) \quad \text{(domestic supply of soft drinks)} \quad (1h)$$

$$S_m^d = S_m^d(P_m, Z_9) \quad \text{(domestic supply of margarine)} \quad (1i)$$

$$S_j^i = S_j^i(P_j, Z_{10}) \quad \text{(imports of fruit juice)} \quad (1j)$$

$$D_r^d + D_r^e - S_r^d = 0 \quad \text{(raw milk market clearance)} \quad (1k)$$

$$D_j^d - S_j^d - S_j^i = 0 \quad \text{(fruit juice market clearance)} \quad (1l)$$

$$D_s^d - S_s^d = 0 \quad \text{(soft drink market clearance)} \quad (1m)$$

$$D_m^d - S_m^d = 0 \quad \text{(margarine market clearance)} \quad (1n)$$

where D, S, P, and A are the quantity demanded, the quantity supplied, price and promotion expenditure, respectively. The subscripts, r, j, s and m relate to raw milk, fruit juice, soft drink and margarine, while the superscripts, d, e and i refer to the domestic, export and import markets, respectively. Other exogenous variables affecting the demand for, and supply of, these products are captured in the Z_i (i = 1,...,10) vectors.

This model is static with all lagged or carryover effects being captured in the assumed three-year adjustment period. The model is intended to be representative of the farm level in the case of raw milk, orange juice and margarine and 'factory door' in the case of soft drink.

Following the procedures developed by Piggott et al (1995), general equilibrium elasticities for a number of variables can be estimated (formulae are given in Table 2). These elasticities can be interpreted as the percentage change in the endogenous variable resulting from a one per cent change in a promotion variable, assuming all other promotion variables remain unchanged but allowing for full adjustment of all endogenous variables.

6. Data

The data requirements include base price, quantity, revenue and promotion data (where relevant) for raw milk, fruit juice, soft drink and margarine, and the proportions of each of these commodities sold on the domestic market. In addition, a base set of Marshallian price and promotion elasticities was required. All the data used in this study were based on the financial years 1992/93 to 1994/95.

The base prices, quantities and revenues for each of the commodities are given in Table 3. The assumed base production and price data for a perfectly competitive raw milk market were calculated (as described in Section 4) using data from the Australian Bureau of Agricultural and Resource Economics (ABARE) publications: the Commodity Statistical Bulletin 1994, the Commodity Statistical Bulletin 1996 and Agricultural Commodities. A breakup of manufacturing milk into milk equivalent estimates for domestic manufacturing milk and export manufacturing milk was calculated from export, production and consumption data contained in the Commodity Statistical Bulletin 1996.

Price, consumption and import data for fruit juice were calculated using data contained in the ABARE publications mentioned above. The average export price of oilseeds, obtained from the Commodity Statistical Bulletin 1996, was used as a proxy for the farm level price of margarine. Margarine quantity data were also obtained from the Commodity Statistical Bulletin 1996. The base price and quantity data for soft drinks were obtained from the Australasian Soft Drink Association (ASDA) Industry Statistical Summary 1993/94 and ASDA (personal communication, 1997).

Base promotion data for each of the commodities are presented in Table 4. International and domestic generic promotion expenditure data for dairy products were contained in the 1993/94 and 1995/96 ADC Annual Reports. Domestic generic promotion expenditure for fruit juice was estimated from information provided by the Australian Horticultural Corporation (AHC) (personal communication, 1996). This estimate is for expenditure on orange juice promotion only; the AHC does not promote any of the other fruit juices. Data on generic promotion expenditure for soft drinks were obtained from the ASDA (personal communication, 1996).

The Marshallian price and promotion elasticities are presented in Table 5. The own-price elasticity of domestic demand for raw milk was calculated from the competitive market estimates of the price elasticities for domestic market and manufacturing milk, weighted by market share. The relevant elasticity for the export market is the excess-demand elasticity for Australian dairy exports in the rest of the world. An excess-demand elasticity of -45 is used. The own- and cross-price elasticities of domestic demand for fruit juice, soft drink and margarine were based on the estimated elasticities provided in the range of studies reviewed by Boutonnat et al (1991) and from elasticities contained in Milham et al (1990). Recall that, in this study, these elasticities relate to a three-year time horizon. Elasticities that were unavailable were extrapolated from other elasticities using restrictions from economic theory.

The price elasticities for the domestic supply of raw milk, fruit juice, margarine and soft drink were all believed to be elastic because of the three-year adjustment period. The supply of imported fruit juice was expected to be the most responsive to price changes because of the relatively small proportion of fruit juice imported into Australia compared with total world production. The supply of soft drink is expected to be more elastic than the domestic supply of raw milk, fruit juice or margarine because production of soft drink is not affected by biological lags.

In this analysis, own-promotion elasticities for raw milk, fruit juice and soft drink were based on the own-promotion elasticities estimated in the various studies reviewed by Boutonnat et al (1991). Again, a three-year time horizon is assumed. The cross-promotion elasticities have largely been extrapolated from the own-promotion elasticities and it has been assumed that negative cross-promotion impacts would exist.

While the data used in this analysis are imperfect, this limitation can be at least partially offset by testing the sensitivity of the results to alternative estimates of key parameters and magnitudes.

7. General Equilibrium Promotion Elasticities

Piggott et al (1995) explain how the sign and magnitudes of general equilibrium promotion elasticities depend on a complex pattern of cross-commodity impacts. Generally speaking, however, the signs and magnitudes of the reported elasticities in Table 6 are as expected. For any one commodity, increased own-promotion of that commodity will increase its equilibrium price and quantity traded, and producers of that commodity will receive increased revenue and producer surplus. On the other hand, increased promotion of any one commodity will have a negative impact on the equilibrium prices and quantities traded of substitute products, and producers of the substitute products will experience a decrease in their revenue and producer surplus. Further, when cross-price impacts are allowed, the general equilibrium promotion elasticities are all much smaller than the corresponding Marshallian promotion elasticities shown in Table 5.

While increased own-promotion of fruit juice and soft drink results in the producers of these commodities receiving increased net profits (producer surplus net of promotion expenditure), this is not the case for domestic and export promotion of dairy products. This is because the general equilibrium elasticities for raw milk equilibrium price, equilibrium quantity and producer surplus are very small and, hence, the profit impact on dairy farmers is negative (the increase in producer surplus is less than the increase in promotion expenditure). There are several other general equilibrium elasticities which are negligible. Cross-commodity impacts of the type described earlier are part of the reason for this. That is, changes in equilibrium prices or quantities in one direction due to an initial demand shift can be more-or-less cancelled through a subsequent supply or demand shift as the market adjusts to its new equilibrium. The other reason for the negligible impact of a one per cent increment in export promotion, for example, is that an

export promotion elasticity of 0.03 implies a rightward shift in aggregate demand of approximately 100 000 litres at the existing price which is negligible in percentage terms (less than 0.001 per cent).

The effects of incremental promotion expenditure can also be expressed in terms of benefit-cost ratios which have the dollar increase in producer surplus in the numerator and the dollar increase in promotion expenditure in the denominator (see Hill et al 1996). This requires a base producer surplus figure which, following Piggott et al (1995) can be calculated for any industry as in Table 2. All values are measured at market equilibrium.

The calculated benefit-cost ratios are reported in Table 7. The ratios along the diagonal represent the return in dollars to producers of a product for a $1 increase in promotion expenditure on that product, holding all other promotion expenditures constant. The diagonal values for fruit juice and for soft drink suggest benefit-cost ratios greater than one indicating that it is profitable to increase promotion of each product on the domestic market. This accords with the positive general equilibrium profit elasticities for these products (Table 6). Conversely, the benefit-cost ratio for both domestic and export promotion of raw milk is less than one, which matches the negative general equilibrium profit elasticities for producers of these products. It is not profitable to increase raw milk promotion expenditure on the domestic or on the export market. For example, a $1 increase in domestic raw milk promotion returns only $0.21 to dairy farmers.

The off-diagonal elements represent the benefit-cost ratios when there is competitive promotion in the market. Thus a $1 increase in domestic raw milk promotion, together with a $1 increase in domestic fruit juice promotion, returns only $0.13 to dairy farmers. The domestic promotion benefit-cost ratios are all reduced in the presence of cross-promotion impacts, falling below one in a number of instances. Both domestic and export promotion of dairy products has a greater adverse effect on dairy farmers if it is accompanied by increased fruit juice and soft drink promotion on the domestic market. A simultaneous increment in domestic and export promotion of dairy products is also unprofitable.

Sensitivity analysis is restricted to determining the effects of changing three groups of parameters on the elasticity of profits with respect to a one per cent change in promotion

variables (Table 8). In relation to domestic raw milk, a doubling of all the promotion parameters causes the general equilibrium profit elasticities for raw milk to rise from -0.018 to -0.013. However, if either the domestic supply elasticities or the own-price and cross-price elasticities of domestic demand for raw milk and the competing commodities are doubled, profits to the dairy industry are reduced. For example, a doubling of all the domestic supply elasticities causes the general equilibrium profit elasticity for raw milk to fall from -0.018 to -0.037, while a doubling of the own-price and cross-price elasticities of domestic demand for raw milk and the competing commodities causes the general equilibrium profit elasticity for raw milk to fall marginally from -0.0178 to -0.0179.

8. The Impact of Market Distortions on Benefits from Dairy Promotion Expenditure

Boutonnat et al (1991) discussed the impact on returns to dairy promotion in a non-competitive market. They concluded that the market structure, and/or the degree and extent of government intervention in the market place, can affect the ability of dairy promotion to increase dairy farmer returns and profits. A summary of their findings is partially reproduced as Table 9.

Suzuki et al (1994) found that the marginal rates of return to promotion were about 25 per cent higher when an imperfect competition model was used compared with using a conventional competitive model. These results indicate that the rate of return from promotion is likely to be understated when the market place is characterised by imperfect competition if this type of competition is not captured by the model. Suzuki et al (1994, p. 302) also determined that the 'increase in milk price associated with an increase in promotion becomes larger as the market power parameter and the promotion elasticity of fluid demand become larger and as the price elasticity of fluid demand becomes smaller.' The estimated marginal rates of return actually declined over time as the Japanese milk market became more competitive.

Alston et al (1994) explored diagrammatically the interactions between market regulations and promotion effectiveness in the dairy industry of a hypothetical small open economy. While producers in this industry could never benefit from promotion if the

market was competitive, they could potentially benefit under a range of commodity programs (similar to those operating in Australia).

A number of Australian studies have examined the impact of government intervention on the returns from investment in supply-increasing or demand-increasing research (see, for example, Alston et al 1995; Freebairn 1992b; and Voon 1993). In this section the procedure used by Freebairn (1992b) to analyse research in the dairy industry is adapted to examine the impact of government intervention in the Australian dairy industry on the benefits from incremental investment in dairy promotion.

A graphical representation of the Freebairn (1992b, pp. 143-6) model under the Kerin Plan and under perfect competition is provided in Figure 1. For simplicity it is assumed that the supply and demand curves are linear and that marketing margins are a constant absolute amount. Retail prices are excluded as the aim is to examine the impact of government intervention in the dairy industry on the level of profits accruing to dairy farmers from incremental promotion. D^f and D^m represent the farm-level domestic demands for fresh and manufacturing milk, respectively, and D^d (the horizontal sum of D^f and D^m) is the aggregate derived domestic demand. The export derived demand curve for raw milk used in manufactured dairy products is represented by D^e and the total derived demand curve for Australian milk is shown as D^w. The supply curve, S, represents the supply of raw milk at the farm level.

Under perfect competition, P^e is the price dairy farmers receive for raw milk[2] . At P^e the total supply of raw milk will be equal to Q (at point A), with Q^f being consumed as fresh milk and Q^m being used to produce manufactured dairy products. Exports of manufactured dairy products in raw milk equivalent are equal to domestic production (Q) less domestic consumption ($Q^f + Q^m$).

[2] This abstracts from any seasonal or other premiums needed to secure stable quantities of market milk.

Under the Kerin Plan and state market milk regulation, the total domestic supply of raw milk, $\overline{Q}$, is determined by the weighted average pool price, $\overline{P}^{p}$. The price paid for fresh milk at the farm level, $\overline{P}^{f}$, is institutionally set above the respective free-market price and, as a result, the quantity of fresh milk consumed domestically, $\overline{Q}^{f}$, is less than the free-market quantity. The price farmers receive for manufacturing milk, $\overline{P}^{m}$, equal to the export parity price of the manufactured product plus the per unit subsidy paid on export sales (Gardner 1987, pp. 27-28), both expressed in cents per litre of farm milk, is above its free-market counterpart, while the domestic consumption of manufactured products, ($\overline{Q}^{m}$), is consequently less than consumption under a free market. Exports are substantially greater under the Kerin Plan than under perfect competition and are given by $\overline{Q} - (\overline{Q}^{m} + \overline{Q}^{f})$, so P^{e} is lower under the Kerin Plan.

This representation of the dairy industry is different from the EDM described in Section 5.2 in two main respects. First, to properly model the different policy environments as described in Section 2, the markets for fluid milk and milk used for manufactured dairy products are separated. Second, to keep the diagram relatively uncluttered, cross-commodity effects are ignored. As pointed out above, allowing for cross-commodity effects substantially reduces the impact of market shocks such as incremental promotion. However, interest here is in the relative impact between a regulated and a competitive environment and a partial-equilibrium model will show these impacts.

The effect of an incremental change in dairy promotion at the domestic retail level, under a free-market situation, is given in Figure 2[3]. From this diagram, the impact on producer revenue and profits is evident. An incremental increase in domestic dairy promotion expenditure (say a 1 per cent increase) allocated in proportion to sales of fresh and manufacturing milk is expected to result in a rightward shift in both the domestic retail demand curves for fresh milk and for manufacturing milk. With constant marketing margins, the derived demand curves at the farm level also shift, from D^{f} to $D^{f'}$ and

[3] The magnitudes of the shifts in the demand curves have been exaggerated for expositional purposes.

from D^m to $D^{m'}$, respectively. The export derived demand curve, D^e, is not affected but the total derived demand curve shifts rightward by the sum of the shifts in D^f and D^m. The new total derived demand intersects supply up and to the right of the initial equilibrium, at point B. The new farm price for raw milk is $P^{e'}$ and the new supply of raw milk is Q'. The increase in profits to all dairy farmers is equal to the area P^e A B $P^{e'}$ less the cost of funding the incremental promotion. For the base parameter values used in the EDM and a one per cent increase in promotion expenditure, the increase in producer surplus is positive (as shown in Table 6) and can be calculated to equal $516 000 for the three-year period to June 1995.

Under the Kerin Plan and state market milk regulations, the same incremental increase in dairy promotion expenditure is expected to result in the same rightward shifts in the domestic derived demand curves for fresh milk and for manufacturing milk. In a similar manner to that proposed by Freebairn (1992b, p. 153) for the effects of cost-reducing research, it is assumed that the farm price for market milk is not changed because of the promotion expenditure as it is administratively set by state milk authorities. Therefore, the new quantity demanded is $\overline{Q}^{f'}$, which generates increased revenue of area $\overline{Q}^f$ C D $\overline{Q}^{f'}$ and increased producer surplus of area E C D F, for units of fluid milk produced. For the base parameter values, this area can be calculated to equal $378 000.

Now, the pool price $\overline{P}^p$ will change because of changes in export quantities, export subsidies and the price of manufacturing milk. The pool price curve shifts up, resulting in $\overline{P}^{p'}$ and an increased output to $\overline{Q}'$. An increased quantity of manufacturing milk, $\overline{Q}^{m'}$, is sold at the higher price, $\overline{P}^{m'}$. The increase in revenue for units of manufacturing milk produced is area ($\overline{P}^{m'}$ J $\overline{Q}^{m'}$ 0) - ($\overline{P}^m$ G $\overline{Q}^m$ 0), while the increase in producer surplus is the area of new revenue minus the area $\overline{Q}^m$ H I $\overline{Q}^{m'}$. For the base parameter values, this change in surplus is calculated to be $444 000.

Clearly, the economic impact of promotion on producer surplus to dairy farmers is substantially different under a perfect competition scenario than under the regulated environment of the Australian dairy industry as existed during the period 1992/93 to

1994/95. For a one per cent increase in ADC promotion expenditure on the domestic market for the three years ending 1994/95, producer surplus increases by some $516 000, in the perfect competition case and by some $822 000 (= $378 000 + $444 000) in the regulated market case. This result is consistent with theoretical expectations as described in Table 9 and with the diagrammatic evidence provided in Figure 2. Net profit (increase in producer surplus less the incremental promotion cost of $507 000) shows an even larger difference: only $9 000 for the perfect competition case and about $315 000 for the regulated market case. When cross-commodity effects are allowed, as in Table 6, producer surplus change would be much smaller (in fact smaller than the incremental promotion cost) and a negative net profit elasticity would result. Alternatively, a benefit-cost ratio less than one would result (Table 7).

9. Conclusions

Each year the ADC has to make decisions regarding the level and distribution of promotion expenditure. In 1994/95, the ADC spent around $19.49 million dollars on promoting Australian dairy products domestically and in key export markets, with around 71 per cent being used to fund domestic promotion.

The primary aim of this paper was to examine the impact of market distortions on the level of benefits to dairy farmers from incremental changes in dairy promotion expenditure, using the perfectly competitive market as a reference point. Procedures developed by Piggott et al (1995) were used to assess impacts on prices, quantities traded, revenues and profits net of promotion expenditure, taking into account cross-commodity impacts.

Under the assumption that the dairy industry is perfectly competitive, and using the base parameters, it was determined that a one per cent increase in domestic dairy promotion expenditure would result in a 0.002 per cent increase in the price of raw milk, a 0.002 per cent increase in the quantity supplied, a 0.004 per cent increase in dairy revenue, and a 0.004 per cent increase in producer surplus, but a 0.018 per cent decrease in net profits. Similarly, a one per cent increase in dairy promotion expenditure on the export market would result in only very small increases in the price and quantity (and, hence, revenue) for raw milk and net profits to dairy farmers would fall. The increase in

producer surplus is less than the increase in promotion expenditure. Consistent with these results, benefit-cost ratios for domestic milk promotion and export milk promotion that are less than one were obtained.

As the Australian dairy industry is currently highly regulated, the impact of returns to promotion when a free-market situation does not exist were examined. Using graphical procedures, government intervention was determined to have a positive impact on the effectiveness of domestic dairy promotion expenditure in increasing producer surplus. These findings were confirmed by calculations assuming an identical increment in domestic promotion expenditure in the two cases shown in Figure 2. For the competitive market environment, the net producer surplus increase was calculated to be significantly lower than in the regulated market environment. Assessment of the impact of government intervention on the returns to international promotion was not undertaken.

Under the recent GATT agreement, regulation of the Australian manufactured milk sector will be substantially reduced over the next few years. In addition, calls are being made for deregulation of the market milk sectors. In a more competitive market environment, promotion authorities will need to carefully examine their allocation of funds. Returns to dairy farmers are likely to be much reduced in a competitive market environment, and the export returns may well be negative.

Apart from improvements in the underlying data on prices, quantities, and elasticity parameters, one way in which this research could be enhanced is to attempt to incorporate brand promotion expenditures in the model. In this market, there are substantial expenditures on the various brands of fruit juice, soft drinks and margarine as well as dairy products. These expenditures have been omitted from the current model but they are a major, if not dominant, part of total dairy market promotion and an undoubted factor in decisions made by the ADC in this market.

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Table 1 Prices and quantities for the Australian dairy industry under the Kerin Plan and under a simulated competitive market situation for the three-year period ending June 1995

Variable	Kerin Plan	Competitive market
Quantities (ML)		
Market milk	5 437	5 756
Domestic manufactured product	6 794	7 148
Exports	11 381	5 184
Total production	23 612	18 048
Derived farm level prices (c/L)		
Market milk	45.86	22.35
Manufactured milk	25.70	22.35
Weighted average price[a]	28.44	na
Export price	21.75	22.35
Elasticities		
Derived demand for market milk	- 0.10	- 0.05
Derived demand for manufacturing milk	- 0.40	- 0.33
Supply of milk	1.10	1.13
Export demand for manufacturing milk	-20.00	-45.00

a While the calculation of the weighted average price of raw milk varies between states, the dominant method used in Australia is to calculate the weighted average of the price for fresh milk, the price of domestic manufacturing milk and the price exported manufacturing milk. To simplify the analysis, this is the method used here.

na Not applicable.

Source**:** Freebairn 1992a; ABARE 1995; and authors' calculations.

Table 2 Formulae used to calculate the general equilibrium elasticities and proportional changes for any variable k

Formulae	Description
$\pi(P_k, A_i)$	general equilibrium price elasticities
$EP_k = \sum_i \pi(P_k, A_i)\, EA_i$	proportional change in price (EP_k)
$\pi(Q_k, A_i) = \varepsilon_k\, \pi(P_k, A_i)$	general equilibrium quantity elasticities
$EQ_k = \sum_i \pi(Q_k, A_i)\, EA_i$	proportional change in quantity (EQ_k)
$\pi(R_k, A_i) = \pi(P_k, A_i) + \pi(Q_k, A_i)$	general equilibrium revenue elasticities
$ER_k = \sum_i \pi(R_k, A_i)\, EA_i$	proportional change in revenue (ER_k)
$PS_k = 0.5\, P_k\, Q_k / \varepsilon_k = 0.5\, R_k / \varepsilon_k$	producer surplus
$EPS_k = 2\, EQ_k + (EQ_k)^2$	proportional change in producer surplus (EPS_k)
$\chi_k = PS_k - A_k$	producer profit
$E\chi_k = EPS_k\, (PS_k / \chi_k) - EA_k\, (A_k / \chi_k)$	proportional change in profit ($E\chi_k$)

where:

P_k = equilibrium price for commodity k
Q_k = equilibrium quantity demanded and supplied for commodity k
k = raw milk, fruit juice, soft drink, or margarine
A_i = promotion expenditure for commodity i
EA_i = the proportionate change in promotion expenditure for commodity i
R_k = the total revenue earned from commodity k
ε_k = the own-price elasticity of supply for commodity k

Source: Piggott, Piggott and Wright 1995

Table 3 Assumed base quantities, prices and revenues the three-year period ending June 1995

Commodity	Quantity	Unit value	Total revenue
	(ML)	**(c/L)**	**($M)**
Domestic raw milk[a]	12863.71	22.35	2874.59
Export raw milk[a]	5183.79	22.35	1158.40
Domestic fruit juice	720.79	19.78	142.57
Imported fruit juice	253.37	19.78	50.12
Domestic soft drink	5429.94	116.07[b]	6302.52
	('000 kt)	**($/t)**	**($M)**
Domestic margarine	309.20	344.32[c]	106.46

[a] From Table 1, competitive market.

[b] Estimate: based on turnover at the manufacturing level for 1992/93.

[c] Estimate: based on the average export price of oilseeds.

Source: ASDA 1994; ABARE 1995; ABARE 1996; and authors' calculations.

Table 4 Assumed base promotion expenditure: amounts and percentages of total by type of promotion the three-year period ending June 1995

Commodity	Value ($M)	Percentage
Domestic raw milk	38.87	77
Export raw milk	11.82	23
Domestic fruit juice[a]	1.65	100
Domestic soft drink	0.30	100

[a] Promotion expenditure on orange juice only.

Source: ADC 1996; AHC (personal communication, 1996); ASDA (personal communication, 1997) and authors' calculations.

Table 5 Base elasticity matrix

Dependent Variable	Elasticity with respect to: Raw milk price	Fruit juice price	Soft drink price	Margarine price	Domestic raw milk promotion	Domestic fruit juice promotion	Domestic soft drink promotion	Export raw milk promotion
Domestic raw milk demand	–0.13	0.06	0.05	0.01	0.04	–0.015	–0.01	0.00
Export raw milk demand	–45.00	0.00	0.00	0.005	0.00	0.00	0.00	0.03
Domestic fruit juice demand	0.15	–0.40	0.10	0.00	–0.015	0.04	–0.02	0.00
Domestic soft drink demand	0.06	0.10	–0.30	0.00	–0.01	–0.02	0.04	0.00
Domestic margarine demand	0.01	0.00	0.00	–0.20	–0.005	0.00	0.00	0.00
Raw milk supply	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Domestic fruit juice supply	0.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00
Import fruit juice supply	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
Soft drink supply	0.00	0.00	1.80	0.00	0.00	0.00	0.00	0.00
Margarine supply	0.00	0.00	0.00	1.20	0.00	0.00	0.00	0.00

Table 6 Base general equilibrium elasticities

Dependent variable	Promotion variable			
	Domestic dairy products	Domestic fruit juice	Domestic soft drink	Export dairy products
Price				
Raw milk	0.002	-0.001	0.000	0.001
Fruit juice	-0.006	0.016	-0.007	0.000
Soft drink	-0.005	-0.009	0.019	-0.010
Margarine	-0.004	0.000	0.000	0.000
Quantity				
Raw milk	0.002	-0.001	-0.001	0.001
Fruit juice	-0.007	0.017	-0.008	0.000
Soft drink	-0.009	-0.016	0.034	-0.017
Margarine	-0.004	0.000	0.000	0.000
Revenue				
Raw milk	0.004	-0.002	-0.001	0.001
Fruit juice	-0.012	0.033	-0.015	-0.001
Soft drink	-0.014	-0.025	0.052	-0.027
Margarine	-0.008	0.000	0.000	0.000
Producer Surplus				
Raw milk	0.004	-0.002	-0.001	0.001
Fruit juice	-0.013	0.034	-0.016	-0.001
Soft drink	-0.018	-0.032	0.067	-0.034
Margarine	-0.009	0.000	0.000	0.000
Net Profit				
Raw milk	-0.018	-0.002	-0.001	-0.005
Fruit juice	-0.013	0.009	-0.016	-0.001
Soft drink	-0.018	-0.032	0.067	-0.034
Margarine	-0.009	0.000	0.000	0.000

Table 7 Benefit-cost ratios[a]

	Promotion variable			
	$\mathbf{A_r^d}$	$\mathbf{A_j^d}$	$\mathbf{A_s^d}$	$\mathbf{A_r^e}$
Domestic raw milk	**0.206**	0.130	0.156	0.204
Domestic fruit juice	0.817	**1.339**	0.714	1.309
Domestic soft drink[b]	287.767	207.651	**392.367**	192.573
Export raw milk	0.204	-0.050	0.036	**0.199**

Note: **a** The diagonal elements are the benefit-cost ratios associated with a one per cent increase in own-promotion expenditure, holding all other forms of promotion constant. The off-diagonal elements are the benefit-cost ratios associated with a simultaneous one per cent increase in the promotion expenditures indicated by the row and column headings but assuming that the promotion of all other commodities does not change.

b In the case of domestic soft drink, the base ratio of soft drink producer surplus to generic soft drink promotion expenditure (5835.7) is very large compared with the base ratios for the other products (e.g. 35.2 in the case of raw milk). As a result, the benefit-cost ratios in the row for domestic soft drink are very large relative to the benefit-cost ratios for the other products.

Table 8 Sensitivity of profit[a] elasticity to a change in parameter values with respect to a one per cent increase in promotion expenditure

Commodity	Promotion variable: Domestic raw milk	Domestic fruit juice	Domestic soft drink	Export raw milk
		Base values		
Raw milk	-0.018	-0.002	-0.001	-0.005
Fruit juice	-0.013	0.009	-0.016	-0.001
Soft drink	-0.018	-0.032	0.067	-0.034
Margarine	-0.009	0.000	0.000	0.000
		Promotion elasticities doubled		
Raw milk	-0.013	-0.003	-0.002	-0.004
Fruit juice	-0.027	0.044	-0.032	-0.002
Soft drink	-0.036	-0.063	0.134	-0.069
Margarine	-0.017	0.000	0.000	0.000
		Domestic supply elasticities doubled		
Raw milk	-0.037	-0.003	-0.002	-0.011
Fruit juice	-0.020	0.001	-0.025	-0.001
Soft drink	-0.019	-0.035	0.072	-0.037
Margarine	-0.009	0.000	0.000	0.000
		Domestic demand elasticities doubled		
Raw milk	-0.018	-0.002	-0.001	-0.006
Fruit juice	-0.012	0.004	-0.013	-0.001
Soft drink	-0.016	-0.026	0.058	-0.030
Margarine	-0.007	0.000	0.000	0.000

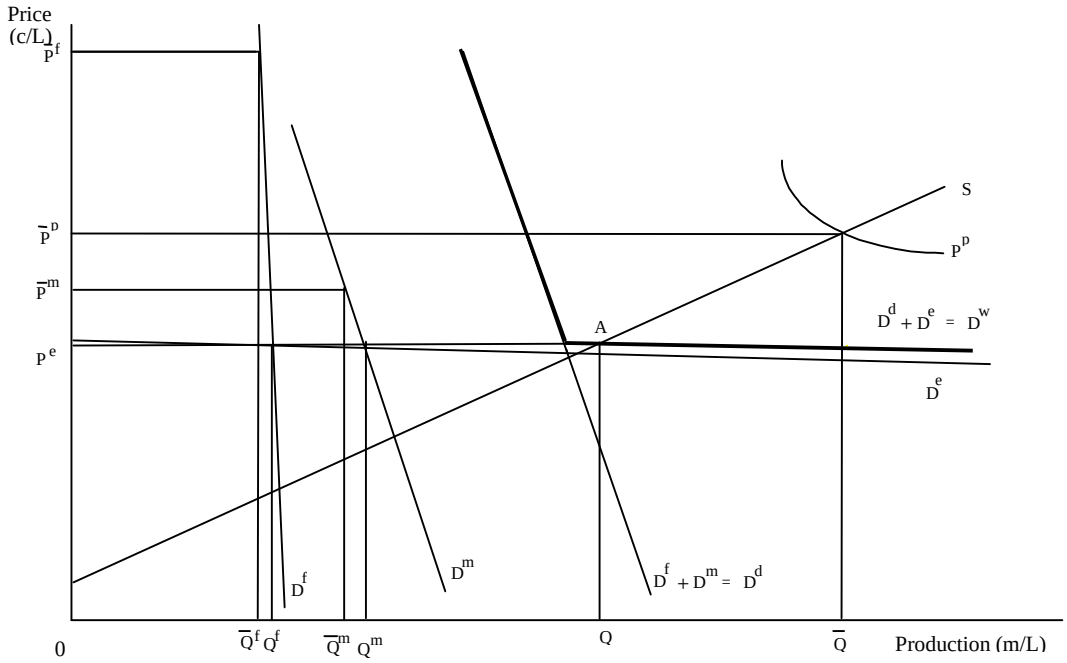
[a] Profits are net of promotion costs.

Table 9 Summary of the impacts of market structure and policy on the effectiveness of promotion expenditure

Structure/policy	Effects of promotion
Perfect competition	Increases price, quantity or both depending on the slope of the supply schedule. The resulting increase in producer surplus will be larger (1) the larger the advertising induced shift in the demand schedule and (2) the steeper the slope of the supply schedule.
Imperfect competition	Increases price, quantity, or both depending on institutional setting, degree of market power, and anticipated response of rivals. The ability to control price and/or output increases the profit potential of advertising.
Government purchase programs	Depends on the magnitude of the shift in the demand curve relative to government inventories of the surplus commodity. The demand shift has to be large enough to deplete government inventories, otherwise the advertising program will have no effect on prices, quantity, or producer surplus. If demand shifts are modest, they serve to reduce government costs but provide no direct benefit to producers.
Government deficiency payments	Similar to the purchases scheme: unless the demand shift is large enough to move the equilibrium price above the guaranteed price, advertising will have no affect on price, quantity or producer surplus. However, because advertising reduces government costs, it might confer indirect benefits.
Government production controls	Increases price and producer surplus. The effect on quantity depends on the extent to which government relaxes production controls in response to rising prices.
Government classified pricing	Depends on the mechanism used to maintain price differentials. A blend price scheme is common. Advertising the product not subject to surplus removal (e.g. fluid milk) will raise the blend price. Advertising of products subject to removals will lower government costs but have no effect on market prices or output.

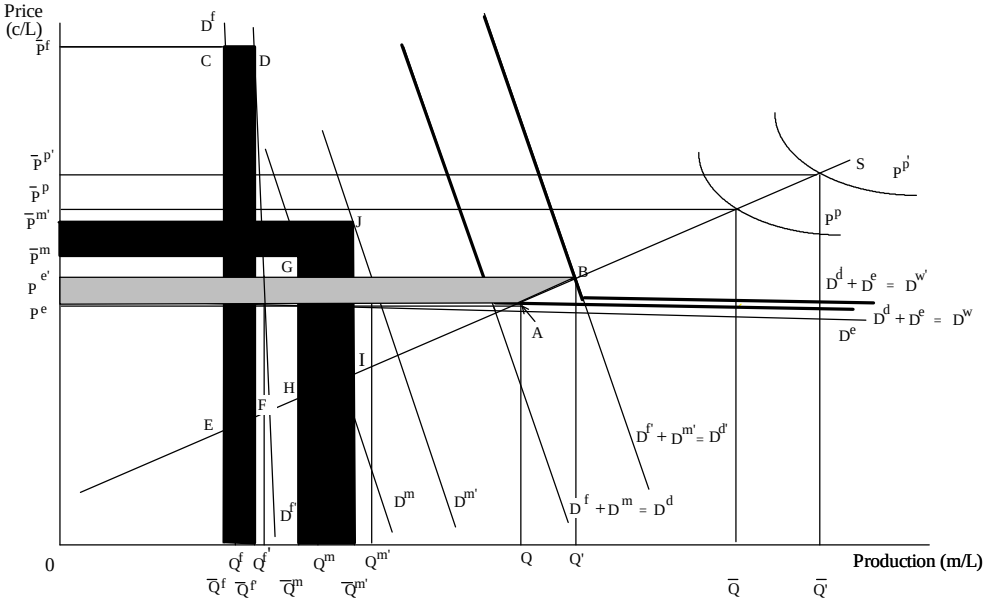
Source: Adapted from Boutonnat et al. 1991, p. 48.

Figure 1 The Australian dairy industry under farm-gate regulation and under perfect competition



Source: Adapted from Freebairn 1992, p. 145.

Figure 2 **The effects of a promotion-induced increase in the demand for both fresh milk and manufacturing milk on returns to dairy producers under the Kerin Plan and under perfect competition**



Source: Adapted from Freebairn 1992, p. 145.