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PROFITABILITY OF INCREMENTAL EXPENDITURE ON FIBRE PROMOTION

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In this paper the impact of changes in wool promotion expenditure and changes in expenditure on the promotion of competing fibres are examined using an equilibrium displacement model. The emphasis is on examining impacts on producer profits net of promotion expenditure and on benefit-cost ratios measuring changes in producer surplus relative to changes in promotion expenditure. It was found, for example, that incremental expenditure on apparel wool promotion on the domestic market is unprofitable but incremental expenditure on promotion of apparel wool on the export market is generally profitable. Further, it was found that increased promotion of cotton and man-made fibres on the export market, with promotion of apparel wool unchanged, would reduce profits to apparel wool producers. Finally, a case is made for improved data availability in order to allow more comprehensive *ex-ante* and *ex-post* evaluations of promotion programs, thereby increasing the intensity of scrutiny of promotion programs to a level more in line with that for investment in rural research and development.

> 'Clever promotion is in large part art. The logic behind a successful promotion is seldom obvious unless someone imagines the promotion. Economists are neither inclined by talent or training to do so.'
>
> *McLaren 1996*

Introduction

Australian wool producers contribute significant funds through specific taxes for research, development and promotion activities. Relatively little is spent on research and development compared with promotion. For example, in 1994/95 the Australian Wool Research and Promotion Organisation (AWRAP) spent around $27m on wool research but contributed almost $97m towards trying to increase the world demand for wool and a further $3m on promoting wool on the domestic market (AWRAP 1995; International Wool Secretariat (IWS) 1994, pers. comm.).

The level of the total tax contribution for promotion has fallen dramatically from the boom years of the late 1980s. For example, tax receipts for wool promotion were $203m in 1989/90 compared with only $113m in 1994/95. The IWS promotion budget (which contained contributions from major wool producing countries and an Australian

Government contribution until 1993/94) has fallen from $293m in 1990/91 to only around $130m in 1996/97 (IWS 1994, pers. comm.; Carson 1996). The IWS have suggested that another $70m is required to build market share (Carson 1996) but, as evidenced by debate in the rural press, wool producers are divided on whether the extra promotion funds would be effective in enhancing farm gate returns.

In this paper the impacts of changes in wool promotion expenditure and changes in expenditure on the promotion of competing fibres are examined. The emphasis is on examining impacts on producer profits, taking into account cross-commodity impacts. Procedures developed recently by Piggott, Piggott and Wright (1995) are used. There is frequent cross-referencing to that paper in order to avoid duplication. Using existing methods, an important empirical issue is investigated: the profitability of incremental promotion expenditure in fibre markets. The study is warranted by the recent calls for increased expenditure on wool promotion and media debate about its effectiveness. While economists may not excel at developing clever promotion programs (McLaren 1996), by understanding the basic economic relationships in the wool market they can provide evidence on whether the additional funds being requested should be provided.

The format of the paper is as follows. A review of some previous wool promotion studies is presented in the next section. A structural market model appropriate for examining the impacts of promotion is presented in the third section. Data requirements and data sources are presented in the fourth section of the paper. In the next three sections results are presented in three different forms: general equilibrium elasticities, benefit-cost ratios and examples of some simulations, respectively. Limitations are then discussed followed by conclusions and suggestions for further research.

Some Previous Studies on Wool Promotion

The effectiveness of wool promotion has been an issue for Australian economists for over 30 years. Previous studies on the theoretical aspects of promotion effectiveness include attempts to define criteria for successful promotion (Parish 1963; De Boer 1977), how promotion of non-branded agricultural products should be financed (Industries Assistance Commission (IAC) 1976; De Boer 1977), and procedures for evaluating the success of promotion campaigns (Quilkey 1986). While these studies were concerned with promotion of agricultural products in general, many of the issues raised were incorporated into a continuing debate on wool promotion effectiveness.

Donaldson (1962) reviewed the factors which may determine the success of wool promotion, and indicated the nature of the information necessary to enable an evaluation of the returns from promotion. He concluded that (p.12) 'Until empirical studies indicate the nature of the relationships between advertising and the demand for wool in different situations it is not possible to say whether the advertising of wool is effective ...'. There was a lapse in attention to wool promotion in the professional literature until Tisdell (1976) provided a critique of the IAC's (1976) sanctioning of the Nerlove-Waugh theorem as a useful rule for calculating optimal levels of wool promotion expenditure. An extended debate then ensued on this and related matters (Lewis and Bereza 1977; Tisdell 1977a; Schrimper 1977; Tisdell 1977b; Lewis 1979, 1981). The debate did not reach agreement on '... a workable decision calculus on wool promotion' (Tisdell 1977a, p. 99), but the need for such a decision tool was recognised, and further theoretical work has been prompted (Goddard, Griffith and Quilkey 1992). Further, the debate raised the crucial requirement for data on underlying supply and demand elasticities, the relationship between domestic and export markets for wool, and the links with related markets, such as cotton and synthetic fibres, for the development of models of wool promotion effectiveness.

Some 25 years elapsed between Donaldson's call for empirical research and the first published estimate of the promotion elasticity of demand for wool (Bureau of Agricultural Economics (BAE) 1987). Data used in that study included IWS promotion expenditure figures for the United States and records of wool apparel purchases obtained from household surveys conducted in the United States. The results indicated that wool promotion expenditure by the IWS significantly increased the demand for apparel wool in the United States. The short-run elasticity of demand with respect to changes in wool promotion expenditure was estimated to be 0.07 and the corresponding long-run elasticity was calculated to be 0.09. The estimated promotion elasticities from this and two subsequent analyses are presented in Table 1.

Conboy (1992) estimated linear equations representing the demand for wool in France, Germany, Italy, Japan, the United Kingdom, the United States and the Rest-of-world, the world supply of greasy wool, the world sheep inventory and world wool stocks. Promotion elasticities for each country or region considered were also estimated. The effectiveness of wool promotion was calculated using simulation. The results of the analysis indicated that IWS-funded promotion expenditure was effective in terms of increasing consumer expenditure on woollen goods and increasing returns to producers. It was concluded that increased promotion expenditure would benefit Australian wool producers.

Griffith and Goddard (1993) analysed the impact of IWS wool promotion on the demand for wool in France, Germany, Italy, Japan, the United Kingdom, the United States and the Rest-of-world (excluding China and Eastern Europe). Demand equations for each of these regions were estimated using standard econometric techniques and annual data from 1976-89. The results from this study showed that promotion had a positive impact in France and the United States, and

TABLE 1
Wool Promotion[a] Elasticities from Previous Studies

Study	Country	Form of Promotion Variable	Elasticity
BAE 1987	United States	Promotion expenditure	0.07 to 0.09
Conboy 1992[b]	France	Promotion	0.159
	France[c]	Quantity * promotion	0.159
	France[c]	Quantity * promotion	0.491
	Germany	Promotion	–0.025
	Germany[c]	Price * promotion	0.018
	Germany[c]	Price * promotion	–0.016
	Italy	Promotion	0.37
	Italy[c]	Price * promotion	0.113
	Italy[c]	Price * promotion	0.357
	Japan	Promotion	–0.003
	Japan	Price * promotion	–0.003
	United Kingdom[c]	Promotion	0.067
	United Kingdom[c]	Promotion	0.478
	United Kingdom	Price * promotion	0.002
	United States	Promotion	–0.001
	United States[c]	Price * promotion	–0.035
	United States[c]	Price * promotion	–0.044
Griffith and Goddard 1993[b]	France	Inverse of promotion	0.208
	Germany	Inverse of promotion * time	0.157
	Italy	Inverse of promotion	0.148
	Japan	Quantity/promotion	0.216
	United Kingdom	Promotion * time	0.21
	United States	Quantity/promotion	0.23
	Rest of world	Inverse of promotion	–0.005

Notes: a Referred to as advertising in these studies.
b The promotion variable was lagged one time period in these studies.
c Refers to alternate specifications of other variables in these equations.

the authors concluded that increasing promotion expenditure there would be beneficial. In Italy and the United Kingdom, promotion was found to have a statistically significant effect on demand but the results were considered to be 'unrobust' which placed some doubt on the benefit of increasing promotion expenditure in these countries. Finally, in Japan, Germany and the Rest-of-world, the value of any wool promotion expenditure was queried because the promotional responses were found to be statistically insignificant. However, on the basis of simulation results, it was concluded that the optimal level of wool promotion expenditure was higher than the actual level for that time period in all areas except for the Rest-of-world.

A Structural Model

The methods used in this paper are described fully in Piggott *et al.* (1995). In brief, a structural market model representing demand and supply functions for wool and competing fibres is developed. Wool is disaggregated into apparel and non-apparel types. Promotion expenditure variables are included as demand shifters. Equilibrium displacement modelling (EDM) procedures (see Piggott 1992) are then used to examine the impacts of incremental changes in promotion expenditures on variables of interest. The benefits of incremental wool promotion to wool producers in the form of increased producer surplus, with and without incremental promotion expenditure on competing fibres, are also compared with the incremental promotion expenditure in the form of benefit-cost ratios. Values of elasticities needed to quantify effects are assumed values based on previous studies where possible.

The structural model is based on a number of important characteristics of the fibre market. In Australia, around 97 per cent of wool is for apparel uses. Because of its fineness and long staple length, about 85 per cent of Australia's total wool clip is suitable for the worsted process, which produces woven textiles such as suits. The remaining 12 per cent of apparel wool, which is coarser, is used in the woollen process to produce yarn for knitwear (Mullen and Alston 1990). Non-apparel wool is used for furnishing fabrics and carpets. While substitution between apparel and non-apparel wool is possible, it is limited. In this model, non-apparel wool essentially refers to carpet wool which is not exported from Australia. As such, apparel and non-apparel wool are considered to be marginally related in demand on the domestic market but not related on the export market. Cotton and man-made fibres are substitutes for apparel and non-apparel wool in the textile industry and are therefore considered to be related in demand, both domestically and on the export market.

Wool and cotton exports account for about 98 per cent and 93 per cent of total wool and cotton production, respectively, and it is assumed here that around 9 per cent of man-made fibres produced in Australia are also exported. Despite the existence of the Multi-Fibre Agreement, Australia's domestic fibre market at the raw fibre level is not shielded from international market forces. Therefore, the domestic and export markets for wool, cotton and man-made fibres cannot be separated and, once allowance has been made for quality differences and transport costs, a single price exists for each product irrespective of the market in which it is sold.

It is assumed that, on both the domestic and international markets, the demand for apparel wool is affected by its own promotion and the promotion of cotton and man-made fibres, but not by non-apparel wool promotion. Similarly, the demand for non-apparel wool is assumed to be influenced by its own promotion, the promotion of cotton and man-made fibres, but not by the promotion of apparel wool. While Australian producers fund apparel wool on the domestic and world markets, the promotion of carpet wool is largely funded by the New Zealand Wool Board. The demands for cotton and man-made fibres, however, are assumed to be affected by their own promotion as well as the promotion of apparel and non-apparel wool. It is also thought that the relative fibre prices of all the competing fibres would have an impact on the production decisions and therefore on the fibre inputs used by international textile manufacturers.

Promotion of cotton in Australia is the responsibility of the Australian Cotton Foundation Limited (ACF). For the three years ending 1993/94, cotton promotion was reduced because of the drought (ACF 1994, pers. comm.). From 1966 until the early 1990s, international cotton promotion was undertaken by the International Institute for Cotton, an inter-governmental international association of cotton producing countries, which concentrated its efforts on Japan and Western Europe. The Institute is no longer operational. The other major international cotton promotional body is Cotton Incorporated in the United States. This organisation was formed in 1971 and is supported by cotton growers. The largest share of Cotton Incorporated's spending has been on promotion in the United States market but some promotional activities have also been undertaken in Asia and Europe.

Research and promotional activities by the man-made fibres industry are undertaken by the manufacturers and are believed to be significantly greater than for either wool or cotton. For example, it was estimated that Dupont alone spent about AU$120m in consumer promotion in 1992 and approximately AU$6.5m on the promotion of new micro fibres (Cotton Incorporated 1992).

With regard to supply, apparel and non-apparel wool are considered to be substitutable at the margin but neither wool type is assumed to be substitutable with cotton or man-made fibres. Therefore, while the relative prices of apparel and non-apparel wool may influence the production decisions of a wool producer, it is assumed that the price of cotton and man-made fibres will not affect the amount of wool being produced. Similarly, the supply of cotton and the supply of man-made fibres are expected to be a function of their own price but not a function of the price of competing fibres.

These considerations led to the following structural model specification:

(1a) $D_a^d = D_a^d(P_a, P_n, P_c, P_m, A_a^d, A_c^d, A_m^d, Z_1)$

(domestic demand—apparel wool)

(1b) $D_a^e = D_a^e(P_a, P_c, P_m, A_a^e, A_c^e, A_m^e, Z_2)$

(export demand—apparel wool)

(1c) $D_n^d = D_n^d(P_a, P_n, P_c, P_m, A_n^d, A_c^d, A_m^d, Z_3)$

(domestic demand—non-apparel wool)

(1d) $D_c^d = D_c^d(P_a, P_n, P_c, P_m, A_a^d, A_n^d, A_{c,}^d, A_m^d, Z_4)$

(domestic demand—cotton)

(1e) $D_c^e = D_c^e(P_a, P_n, P_c, P_m, A_a^e, A_n^e, A_c^e, A_m^e, Z_5)$

(export demand—cotton)

(1f) $D_m^d = D_m^d(P_a, P_n, P_c, P_m, A_a^d, A_n^d, A_c^d, A_m^d, Z_6)$

(domestic demand—man-made fibres)

(1g) $D_m^e = D_m^e(P_a, P_n, P_c, P_m, A_a^e, A_n^e, A_c^e, A_m^e, Z_7)$

(export demand—man-made fibres)

(1h) $S_a = S_a(P_a, P_n, Z_8)$

(supply—apparel wool)

(1i) $S_n = S_n(P_a, P_n, Z_9)$

(supply—non-apparel wool)

(1j) $S_c = S_c(P_c, Z_{10})$

(supply—cotton)

(1k) $S_m = S_m(P_m, Z_{11})$

(supply—man-made fibres)

(1l) $D_a^d + D_a^e - S_a \equiv 0$

(market clearance—apparel wool)

(1m) $D_n^d - S_n \equiv 0$

(market clearance—non-apparel wool)

(1n) $D_c^d + D_c^e - S_c \equiv 0$

(market clearance—cotton)

(1o) $D_m^d + D_m^e - S_m \equiv 0$

(market clearance—man-made fibres)

where D, S, P and A are the quantity demanded, quantity supplied, fibre price and promotion expenditure, respectively. Other exogenous variables affecting individual fibre demand and supply are captured in the Z_i $(i = 1,...,11)$ vectors. The subscripts, a, n, c and m relate to apparel wool, non-apparel wool, cotton, and man-made fibres, while the superscripts, d and e refer to the domestic and export markets, respectively. The model is intended to be representative of the farm level in the case of wool and cotton and 'factory door' in the case of man-made fibres. It is static with all lagged or carryover effects assumed to be captured in a three-year adjustment period (i.e. the demand and supply functions pertain to three-year time intervals).

Following Piggott *et al.* (1995), the behavioural equations are substituted into the identities and the identities are totally differentiated. Further manipulation leads to the derivation of a matrix of general equilibrium price elasticities resulting from incremental promotion expenditure (equation 7 in Piggott *et al.* 1995) and these elasticities are used to derive general equilibrium elasticities for quantities traded, revenue, producer surplus and profits net of incremental promotion expenditure. These elasticities (see Piggott *et al.* 1995, Table 4) show the percentage change in endogenous variables following a one per cent change in a promotion variable allowing all cross-commodity effects to occur. Expressions for the effects of simultaneous changes in two or more promotion variables on endogenous variables can be obtained as functions of two or more general equilibrium elasticities (see, in particular, equations 12, 13 and 15 in Piggott *et al.* 1995).

Data

All data used in this model were for the financial years 1991/1992 to 1993/94, with the exception of data published by the United States Government or United States companies which relate to the calendar years 1991 to 1993.

The Marshallian price elasticities for domestic demand for each of the fibres were based on estimated elasticities provided in a wide range of studies (Dewbre, Corra and Passmore 1983; Dewbre, Vlastuin and Ridley 1986; BAE 1987; Simmons and Ridley 1987; Harris 1988; Mues and Simmons 1988; Ball, Beare and Harris 1989; Mullen, Alston and Wohlgenant 1989; Connolly 1990; Coleman and Thigpen 1991; Conboy 1992; Connolly 1992; Griffith and Goddard 1993). Where estimates were not available (for example, the cross-price elasticity of demand for Australian wool with respect to the price of Australian cotton) the elasticities were extrapolated from other elasticities using theoretical restrictions.

The relevant elasticities for the export markets are the excess-demand elasticities for Australian fibre exports in the rest of the world. Following Alston, Norton and Pardey (1995), these elasticities were calculated using the following formulae:

$$\eta_i^e = \frac{Q_{Ri}^s}{Q_{Ai}^e} * \varepsilon_{Ri} + \frac{Q_{Ri}^c}{Q_{Ai}^e} * \eta_{Ri} \quad (2)$$

where η_i^e is the excess-demand elasticity for Australian fibre in the rest of the world, Q_{Ri}^s and Q_{Ri}^c are the supply and consumption of that fibre in the rest of the world, Q_{Ai}^e is the quantity of fibre exported from Australia to the rest of the world, and ε_{Ri} and η_{Ri} are, respectively, the fibre supply and demand elasticities in the rest of the world. World supply and consumption data for each of the fibres were either obtained directly from the *Commodity Statistical Bulletin 1995* (Australian Bureau of Agricultural and Resource Economics (ABARE) 1995), the *Cotton and Wool Situation and Outlook Report* (United States Department of Agriculture (USDA) 1994), or were derived from information contained in these publications. Data on Australian fibre exports and the fibre supply and demand elasticities in the rest of the world were obtained from the sources stated above.

The price elasticities of supply of wool, cotton and man-made fibres are believed to be positive, consistent with the three year time period, as producers would be able to adjust to price changes. Moreover, the supply of man-made fibres is expected to be more responsive to price changes because production is not affected by biological lags. The base Marshallian price elasticities are presented in Table 2.

There is much uncertainty regarding the magnitude of partial promotion elasticities. While promotion elasticities for the demand for wool and cotton in various regions have been estimated in a number of recent studies, no empirical work has been done on estimating the impact of fibre promotion on the demand for man-made fibres. In this analysis, promotion elasticities for wool, cotton and man-made fibres have been based on the promotion elasticities for wool estimated by the BAE (1987), Conboy (1992), Griffith and Goddard (1993) and the promotion elasticities for cotton estimated by Solomon and Kinnucan (1993). It is also assumed that negative cross-commodity impacts of promotion would exist. (However, the demand for apparel wool is not expected to be affected by the promotion of non-apparel wool, and visa-versa. Accordingly, the respective cross-promotion elasticities for these two fibres have been set at zero.) Given that a three-year time horizon underlies this analysis, the promotion elasticities used in this study and the existence of negative cross-

TABLE 2: *Base Marshallian Elasticity Matrix*

Dependent variable	Elasticity with respect to: Apparel wool price	Non-apparel wool price	Cotton price	Man-made fibre price	Domestic apparel wool promotion	Domestic non-apparel wool promotion	Domestic cotton promotion	Domestic man-made fibre promotion	Export apparel wool promotion	Export non-apparel wool promotion	Export cotton promotion	Export man-made fibre promotion
Domestic apparel wool demand	–0.80	0.05	0.20	0.30	0.20	0.00	–0.025	–0.05	0.00	0.00	0.00	0.00
Export apparel wool demand	–3.40	0.00	1.30	1.60	0.00	0.00	0.00	0.00	0.20	0.00	–0.05	–0.10
Domestic non-apparel wool demand	0.10	–0.80	0.20	0.30	0.00	0.10	–0.025	–0.10	0.00	0.00	0.00	0.00
Domestic cotton demand	0.05	0.02	–0.20	0.10	–0.05	–0.05	0.10	–0.10	0.00	0.00	0.00	0.00
Export cotton demand	25.00	10.00	–86.00	50.00	0.00	0.00	0.00	0.00	–0.05	–0.05	0.10	–0.15
Domestic man-made fibre demand	0.05	0.15	0.10	–0.40	–0.05	–0.10	–0.05	0.20	0.00	0.00	0.00	0.00
Export man-made fibre demand	350.00	1000.00	657.00	–2008.00	0.00	0.00	0.00	0.00	–0.10	–0.05	–0.05	0.20
Apparel wool supply	1.40	–0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-apparel wool supply	–0.10	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cotton supply	0.00	0.00	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Man-made fibre supply	0.00	0.00	0.00	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Sources: Dewbre, Corra and Passmore 1983; Dewbre, Vlastuin and Ridley 1986; BAE 1987; Simmons and Ridley 1987; Harris 1988; Mues and Simmons 1988; Ball, Beare and Harris1989; Mullen, Alston and Wohlgenant 1989; Connolly 1990; Coleman and Thigpen 1991; Conboy 1992; Connolly 1992; Griffith and Goddard 1993; Solomon and Kinnucan 1993, and authors' judgement.

promotion effects seem reasonable. The base promotion elasticities are also presented in Table 2.

While the EDM abstracts from any policy interventions in domestic or export markets, many of the elasticities used were estimated over time periods when interventions were in place. As Lewis (1979) has noted, there have been interactions between wool promotion activities and intervention programs (e.g., pressures for wool promotion funds to be used to get rid of over-represented wools accumulated by buffer-stock programs). Sensitivity analysis can be used to estimate the possible effects of past policy interventions on underlying producer or consumer responses.

The base prices, quantities and revenues are presented in Table 3. Production, consumption and export data for wool and cotton were obtained from the *Commodity Statistical Bulletin 1995*, or estimated from information contained in this publication. A break-up of apparel and non-apparel Australian wool production, consumption and export data was calculated from total wool data. The unit export value of apparel wool and cotton, the average auction price for greasy wool in New Zealand (which was used as a proxy for the price of non-apparel wool) and the price of polyester in the United States (converted from USc/lb to A$/t and used as a proxy for the world price of man-made fibres) were also obtained from the *Commodity Statistical Bulletin 1995*. Australian consumption of man-made fibres for 1990 was obtained from Coleman and Thigpen (1991). Estimates of Australian production and exports of man-made fibres for the three years ending 1993/94 were derived from this figure and from information contained in Button (1992).

TABLE 3

Base Quantities, Prices and Revenues for the Years 1991/92-1993/94

Commodity	Quantity kt	Unit value $/t	Total revenue $m
Domestic apparel wool	6.9	3830	26.5
Export apparel wool	2704.0	3830	10356.0
Domestic non-apparel wool	27.4	2476	67.8
Domestic cotton	87.7	2003	175.6
Export cotton	1214.6	2003	2432.5
Domestic man-made fibres	700.0	2235	1564.5
Export man-made fibres	70.0	2235	156.4

Sources: Coleman and Thigpen 1991; Button 1992; USDA 1994; ABARE 1994a, b; ABARE 1995.

The base promotion expenditure data are presented in Table 4. Promotion expenditure data for apparel and non-apparel wool were obtained from the IWS (1994, pers. comm.). An estimate of domestic cotton promotion expenditure was provided by the ACF (1994, pers. comm.). International cotton promotion expenditure data were obtained from the *Annual Reports* of Cotton Incorporated (1993). Information contained in these annual reports, in *Cotton Research and Promotion Booster Program* (Cotton Incorporated 1992), and in *Wool: Structuring for Global Realities* (Wool Industry Review Committee 1993) was used to estimate total global promotion expenditure on man-made fibres. For example, the base promotion data were estimated based on the belief that manufacturers of man-made fibres generally out-spend the wool industry on research and promotion by three to one (Wool Industry Review Committee 1993). Cotton Incorporated (1992) also stated that synthetic fibre manufacturers spend considerably more money on marketing and promotion than cotton producer organisations. For example, in 1992 Cotton Incorporated spent around $30m while Dupont alone spent almost $90m. Domestic promotion expenditure on man-made fibres was assumed to be around one per cent of revenue from domestic sales of man-made fibres.

Some of the numbers used in analyses such as this are unknown or unknowable; judgements are required. The analysis which follows can be repeated using alternative judgements about key parameters and magnitudes.

TABLE 4
Base Australian Promotion Expenditure: Amounts by Type of Promotion for the Years 1991/92-1993/94

Commodity	**Apparel wool $m**	**Non-apparel wool $m**	**Cotton $m**	**Man-made fibres $m**
Domestic apparel wool	5.9			
Export apparel wool	410.1			
Domestic non-apparel wool		3.5		
Export non-apparel wool[a]		48.2		
Domestic cotton[b]			0.5	
Export cotton[a]			76.1	
Domestic man-made fibres[b]				15.0
Export man-made fibres[ab]				1500.0

Notes: a Australian producers do not contribute to export promotion expenditure for these commodities; b These figures are estimates.
Sources: Cotton Incorporated 1992, 1993; Wool Industry Review Committee 1993; ACF 1994, pers. comm.; IWS 1994, pers. comm.

General Equilibrium Promotion Elasticities

The estimated general equilibrium elasticities are presented in Table 5. Consider, for example, the figures in the fifth column which are the general equilibrium elasticities associated with a one per cent increase in expenditure on apparel wool promotion on the export market. Such an increase would cause a 0.061 per cent increase in the price of apparel wool, a 0.083 per cent increase in the quantity of apparel wool traded, a 0.144 per cent increase in revenue for apparel wool producers, a 0.166 per cent increase in producer surplus accruing to apparel wool producers and a 0.062 per cent increase in their profits net of the incremental promotion expenditure.

The signs of the general equilibrium elasticities depend on a complex pattern of cross-commodity price and promotional relationships. For example, increased promotional expenditure on apparel wool will, as a 'first-round' affect, cause the demand for apparel wool to shift right and the price of apparel wool to increase. As a 'second-round' effect, the demand for a substitute (e.g. cotton) can be expected to shift rightward (because the price of apparel wool is now at a higher level) causing the price of cotton to increase. This effect will lead to further adjustments in the apparel wool market. All of this is complicated further through cross-price relationships in supply and the fact that wool is sold domestically and internationally.

Kinnucan (1996) has shown that the 'own' price effects of incremental promotion expenditure can be zero or negative in the presence of cross-commodity effects of the type assumed in this paper. This also holds when the commodity concerned is sold on multiple markets. Consider a two-commodity example where both commodities are sold in two markets, the two commodities are substitutes in demand in each market as well as substitutes in supply and incremental promotion expenditure on commodity 1 has a positive (negative) effect on the demand for commodity 1(2). It can be demonstrated that an increment of promotion expenditure on commodity 1 in market 1 will have a zero effect on the price of commodity 1 (i.e., zero 'own' price effect) if:

$$(3) \qquad \frac{\tilde{\beta}^1_{11}}{\tilde{\beta}^1_{21}} = \left(\frac{\rho_2}{\rho_1}\right)\left(\frac{\rho_1\tilde{\eta}^1_{12} + (1-\rho_1)\tilde{\eta}^2_{12} + \tilde{\varepsilon}_{12}}{\rho_2\tilde{\eta}^1_{22} + (1-\rho_2)\tilde{\eta}^2_{22} + \tilde{\varepsilon}_{22}}\right)$$

or

$$(4) \qquad \frac{\tilde{\beta}^1_{11}}{\tilde{\beta}^1_{21}} = \left(\frac{\rho_2}{\rho_1}\right)\left(\frac{\tilde{\eta}^*_{12} + \tilde{\varepsilon}_{12}}{\tilde{\eta}^*_{22} + \tilde{\varepsilon}_{22}}\right)$$

where $\tilde{\eta}_{ij}$ = absolute value of the elasticity of demand for commodity i with respect to price of commodity j; $\tilde{\varepsilon}_{ij}$= absolute value of the

TABLE 5: *Base General Equilibrium Promotion Elasticities*

Dependent variable	Promotion variable							
	Domestic apparel wool	**Domestic non-apparel wool**	**Domestic cotton**	**Domestic man-made fibres**	**Export apparel wool**	**Export non-apparel wool**	**Export cotton**	**Export man-made fibres**
	A_a^d	A_n^d	A_c^d	A_m^d	A_a^e	A_n^e	A_c^e	A_m^e
Price								
Apparel wool	0.000	0.033	–0.009	–0.033	0.061	0.000	–0.015	–0.032
Non–apparel wool	0.000	0.066	–0.017	–0.066	0.014	0.000	–0.003	–0.008
Cotton	0.000	0.047	–0.012	–0.047	0.035	–0.001	–0.007	–0.021
Man-made fibres	0.000	0.053	–0.014	–0.052	0.029	–0.001	–0.006	–0.016
Quantity								
Apparel wool	0.000	0.033	–0.009	–0.033	0.083	–0.001	–0.020	–0.043
Non-apparel wool	0.000	0.076	–0.019	–0.076	0.011	0.000	–0.002	–0.006
Cotton	–0.001	0.071	–0.018	–0.070	0.052	–0.002	–0.010	–0.031
Man-made fibres	–0.001	0.096	–0.025	–0.094	0.051	–0.001	–0.011	–0.029
Revenue								
Apparel wool	0.000	0.067	–0.017	–0.066	0.144	–0.001	–0.034	–0.076
Non-apparel wool	0.000	0.142	–0.036	–0.141	0.024	0.000	–0.005	–0.014
Cotton	–0.001	0.118	–0.031	–0.117	0.087	–0.003	–0.017	–0.052
Man-made fibres	–0.001	0.149	–0.039	–0.146	0.080	–0.002	–0.018	–0.045

Producer Surplus								
Apparel wool	0.000	0.067	–0.018	–0.066	0.166	–0.001	–0.039	–0.087
Non-apparel wool	0.000	0.152	–0.038	–0.151	0.021	0.000	–0.005	–0.012
Cotton	–0.001	0.142	–0.037	–0.140	0.104	–0.003	–0.021	–0.063
Man-made fibres	–0.002	0.191	–0.050	–0.188	0.103	–0.002	–0.023	–0.058
Net Profit								
Apparel wool	–0.002	0.067	–0.018	–0.066	0.062	–0.001	–0.039	–0.087
Non-apparel wool	0.000	0.032	–0.038	–0.151	0.021	0.000	–0.005	–0.012
Cotton	–0.001	0.142	–0.037	–0.140	0.104	–0.003	–0.021	–0.063
Man-made fibres	–0.002	0.191	–0.050	–0.227	0.103	–0.002	–0.023	–0.058

elasticity of supply of commodity i with respect to price of commodity j; $\tilde{\beta}_{ij}$ = absolute value of the elasticity of demand for commodity i with respect to promotion expenditure on commodity j; ρ_i = proportion of commodity i sold on market 1; subscripts 1,2 denote commodities 1 and 2 respectively; the * superscript denotes aggregate demand; and superscripts 1,2 denote markets 1 and 2, respectively. Note that $\tilde{\eta}^*_{ij}$ is the quantity-weighted average of $\tilde{\eta}^1_{ij}$ and $\tilde{\eta}^2_{ij}$. If the left-hand-side of (3) or (4) is greater (less) than the right-hand-side then the 'own' price effect will be positive (negative).

Several of the general equilibrium price elasticities in Table 5 are extremely small and, in the case of apparel wool promotion on the domestic market, all the general equilibrium price elasticities are zero while, in the case of non-apparel wool promotion on the export market, the elasticities for apparel and non-apparel wool prices are zero (corrected to three decimal places). In some cases, the 'own' price effects from incremental promotion expenditure are negative (domestic cotton promotion, domestic man-made fibre promotion, export cotton promotion and export man-made fibre promotion).

The general equilibrium price elasticities are used to compute the general equilibrium quantity elasticities (see Piggott *et al.* 1995, equations 8-11) which are, in turn, used to compute general equilibrium elasticities for producer surplus (Piggott *et al.* 1995, equation 17). The zero values for several general equilibrium price elasticities and negative values for some 'own' price effects therefore filter through to zero or negative 'own' quantity and 'own' producer surplus effects. If the 'own' producer surplus effect from incremental promotion is zero or negative, the 'own' profit effect will be negative.

The values of the general equilibrium elasticities are sensitive, of course, to the assumed base Marshallian elasticities. For example, it was found that a doubling of the assumed values for all own- and cross-promotion elasticities resulted in the own-profit elasticity for incremental promotion of apparel wool on the export market changing from 0.062 to 0.249. Generally, however, the signs of general equilibrium profit elasticities (both own-profit and cross-profit) were robust to this change. Piggott *et al.* (1995) show that the general equilibrium elasticities depend upon the magnitude of the assumed percentage change in promotion expenditure. However, most of the general equilibrium elasticities shown in Table 5 are unchanged (at three decimal places) if 10 per cent increases in promotion expenditure are assumed and, for those that do change, the change is negligible. For example, assuming a 10 per cent increase in promotion expenditure on apparel wool in the export market rather than a one per cent change, caused the own-profit elasticity to increase from 0.062 to 0.063. For reasons of space a detailed sensitivity analysis is not reported in this paper. Sufficient information is provided in this paper and in Piggott *et al.*

(1995) to enable the model to be used to generate results for alternative parameter values.

Benefit-Cost Ratios

The profitability of incremental promotion expenditure can also be expressed in terms of benefit-cost ratios having the increase in producer surplus in the numerator and the increase in promotion expenditure in the denominator. The values of the numerator and denominator are calculated by applying the percentage changes from the matrix of general equilibrium elasticities to base values for producer surplus and promotion expenditure.

Selected benefit-cost ratios are reported in Table 6. An example of the calculations involved is given in the Appendix. The diagonal elements in Table 6 are benefit-cost ratios associated with a one per cent increase in the promotion expenditure indicated by the row and column heading, assuming all other forms of promotion expenditure remain constant. For example, if there is a one per cent increase in apparel wool promotion on the export market with all other forms of promotion expenditure remaining constant, there is a 1.498 dollar increase in producer surplus accruing to apparel wool producers for each additional one-dollar outlay on promotion. On the other hand, the producer surplus accruing to apparel wool producers is diminished by 0.211 dollars for each additional one-dollar outlay on domestic apparel wool promotion expenditure, assuming no change in other forms of promotion expenditure.

TABLE 6
Benefit-Cost Ratios[a]

Promotion variable	Promotion variable				
	A_a^d	A_n^d	A_c^d	A_m^d	A_a^e
A_a^d	–0.211	41.687	–11.258	–41.477	1.474
A_n^d	1.224	1.226	0.916	0.003	1.396
A_c^d	–65.624	182.816	–63.841	–307.860	117.636
A_m^e	–6.045	0.093	–7.591	–5.995	–2.715
A_a^e	1.474	2.102	1.339	0.904	1.498

Note: [a] The diagonal elements are benefit-cost ratios associated with a one per cent increase in the promotion expenditure indicated in the row and column heading, assuming all other forms of promotion expenditure remain constant. The off-diagonal elements are benefit-cost ratios associated with simultaneous one per cent increases in the promotion expenditures indicated by the row and column headings assuming all other forms of promotion expenditure remain constant, with the benefits and costs being those applying to the producers of the commodity corresponding to the row heading.

The off-diagonal elements in Table 6 are benefit-cost ratios associated with simultaneous one per cent increases in the promotion expenditures indicated by the row and column headings, assuming all other forms of promotion expenditure remain constant, with the benefits and costs being those applying to the producers of the commodity corresponding to the row heading. For example, if there is a simultaneous one per cent increase in domestic apparel wool and domestic cotton promotion expenditure, the producer surplus accruing to apparel wool producers declines by 11.258 dollars for each additional one-dollar outlay on apparel wool promotion. On the other hand, if there is a simultaneous one per cent increase in both domestic and export apparel wool promotion, the producer surplus accruing to apparel wool producers increases by 1.474 dollars for each additional one-dollar outlay on promotion expenditure.

The results of only five types of incremental promotion expenditure are presented in Table 6: domestic promotion of apparel wool, non-apparel wool, cotton and man-made fibres and promotion of apparel wool on the export market. Moreover, only increments in two types of promotion at any one time are analysed. Nevertheless, the results shown in the table demonstrate the types of outcomes possible when cross-commodity impacts and multiple markets are considered. In particular, there are several negative ratios in Table 6 and some of those which are positive are also less than one. Such ratios indicate unprofitable incremental promotion expenditure. For example, increased domestic promotion of apparel wool is only profitable for apparel wool producers if it is accompanied by increased promotion of non-apparel wool on the domestic market or increased promotion of apparel wool on the export market. On the other hand, promotion of apparel wool on the export market is always profitable for apparel wool producers except for the case where it is accompanied by increased promotion of man-made fibres on the domestic market. Moreover, increased promotion of apparel wool on the export market is more profitable for apparel wool producers if accompanied by a simultaneous increase in the promotion of non-apparel wool on the domestic market. Increased domestic cotton promotion is only profitable for cotton producers when accompanied by increased promotion of non-apparel wool on the domestic market or increased promotion of apparel wool on the export market.

The relatively much larger (in absolute value) benefit-cost ratios in the row for domestic cotton promotion are a result of the fact that the base ratio of cotton producer surplus to cotton promotion expenditure (1,738.7) is very large relative to that for the other fibres (e.g., 8.9 in the case of apparel wool). Hence, even if the percentage change in producer surplus following a one per cent increase in domestic cotton promotion (either alone or simultaneously with increased promotion expenditure on another fibre) is much less than one per cent, the benefit-cost ratio associated with the incremental promotion expenditure can be large in absolute value.

Simulations

Piggott *et al.* (1995) demonstrate how some interesting questions can be answered using the general equilibrium elasticities reported in Table 5. One can simulate the effects of, say, changes in promotion expenditure on commodity k assuming promotion expenditure on other commodities either remains constant or is increased. For example, a five per cent increase in promotion expenditure for cotton and man-made fibres on the export market with promotion of apparel wool remaining constant will result in a 0.71 per cent fall in profits to producers of apparel wool. Alternatively, if promotion expenditure for apparel wool, cotton and man-made fibres were all to increase by five per cent, then profits to apparel wool producers would decrease by 0.41 per cent. One can also simulate 'catch-up' promotion; that is, use the information in Table 5 to determine how much additional promotion expenditure on commodity k is necessary in order to preserve profits for producers of commodity k at existing levels in the face of increased promotion expenditure on commodity j.

Limitations

As with any analytical tool, EDM has weaknesses. These are discussed in various publications, including Piggott (1992) and Piggott *et al.* (1995). Other assumptions involved in the present analysis, such as linear supply curves having own-price elasticities exceeding unity and which shift in parallel fashion, are discussed in Piggott *et al.* (1995).

Data limitations need to be taken into account when assessing the results of this study. EDM requires the use of a base set of own- and cross-price elasticities of demand and supply and own- and cross-promotion elasticities. While the assumed parameter values in this study were based on elasticities derived from previous econometric studies, information on some elasticities was extremely limited, particularly with regard to own-promotion elasticities for non-apparel wool and man-made fibres, and cross-promotion elasticities for all fibres. Information on the base price, quantity and promotion data for man-made fibres was also extremely limited.

Data limitations required the authors to use highly-aggregated measures of promotion (e.g., export promotion of apparel wool). In practice there are various types of promotion used for each of the fibres included in this study and, in principal, one would expect them to vary in their effectiveness. Hopefully, however, the choices of 'aggregate' promotion elasticities reflect the effectiveness of the various forms of promotion.

Conclusions and Further Research

Promotion is an important marketing tool in world fibre markets. Australia is an important player in the world wool market and contributes large sums to wool promotion, much more than is contributed to research and development. Recently there have been calls for increases in expenditure on wool promotion.

It has been shown in this paper that the profitability of incremental expenditure on promotion of fibres depends on complex interactions among many parameters. When relationships between commodities in demand and supply are allowed, then several forms of incremental promotion expenditure are unprofitable based on the parameter values assumed in this study. This includes promotion of apparel wool within Australia, although incremental promotion expenditure on apparel wool in export markets appears to be profitable.

The returns from alternative uses of levy dollars, in particular, the returns from research and development, are also difficult to measure and highly uncertain, although many studies have suggested that the returns are high (see, for example, Scobie, Mullen and Alston 1991). A major concern is that evaluation of the profitability of incremental promotion expenditure seems to be given relatively little attention compared with incremental expenditure on research and development, even though expenditure of levy dollars on promotion far exceeds expenditure of levy dollars on research and development. Little is known about the *ex-ante* evaluation process for promotion campaigns, although *ex-ante* and *ex-post* evaluations of promotion campaigns, like any other investment decision, are important management tools. On the other hand, expenditures on research and development projects tend to be subject to a careful review process as scientists compete for a limited volume of funds. Wohlgenant (1993) demonstrates that farmers should not be indifferent between alternative types of expenditures of levy dollars.

The informational needs for evaluating incremental promotion expenditure include, as a priority, continuously updated estimates of Marshallian demand and supply elasticities.

In this paper attention has not been given to the vertical distribution of benefits and costs from incremental promotion expenditure. This would be an obvious extension to the present analysis, as would 'endogenising' promotion expenditure by incorporating a tax variable in the supply functions within the structural model. Another avenue for research might be an investigation of the relationship between promotion and other exogenous variables in the demand equations.

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Appendix

As shown by Piggott *et al.* (1995), the change in producer surplus following an increment of promotion expenditure is positively related to the proportionate change in equilibrium quantity traded which, in turn, can be shown to be a sum of products of Marshallian supply (or demand) elasticities and general equilibrium price elasticities (see their equations 8, 17, 18 and 19). These relationships can be used to explain the benefit-cost ratios appearing in Table 6. Consider, for example, the ratio of 2.102 which corresponds to simultaneous one per cent increases in apparel wool promotion on the export market and non-apparel wool on the domestic market. The proportionate change in the equilibrium quantity of apparel wool resulting from these changes is 0.0012 and can be disaggregated into four components: (a) the Marshallian own-price elasticity of supply of apparel wool times the general equilibrium elasticity of apparel wool price with respect to a one per cent change in apparel wool promotion on the export market (0.0856); (b) the Marshallian cross-price elasticity of supply of apparel wool with respect to the price of non-apparel wool times the general equilibrium elasticity of non-apparel wool price with respect to a one per cent change in apparel wool promotion on the export market (-0.0028); (c) the Marshallian own-price elasticity of supply of apparel wool times the general equilibrium elasticity of apparel wool price with respect to a one per cent change in non-apparel wool promotion on the domestic market (0.0465); and (d) the Marshallian cross-price elasticity of supply of apparel wool with respect to the price of non-apparel wool times the general equilibrium elasticity of non-apparel wool price with respect to a one per cent change in non-apparel wool promotion on the domestic market (-0.0132).

The proportionate change in the equilibrium quantity of apparel wool results in a proportionate change of 0.0023 in apparel wool producers' surplus which translates into a dollar value of $8.6186 million. The one per cent increase in apparel wool promotion on the export market translates into a dollar value of $ 4.1006 million. Hence, the benefit-cost ratio is 8.6186/4.1006 or 2.102.