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THE PROMOTION OF WOOL AND SYNTHETIC FIBRE BLENDS: SOME ALTERNATIVE STRATEGIES FOR THE WOOL INDUSTRY†

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This paper discusses from the wool industry's point of view its optimal level of expenditure on wool promotion and its optimal policy in promoting wool blends. The relevance of the Dorfman-Steiner and Nerlove-Waugh theorems relating to advertising is questioned. Mathematical conditions for the optimal allocation of promotional funds between pure wool and wool blends are outlined and game theory is used to consider whether the wool industry should leave the promotion of wool blends to makers of man-made fibres.

1 INTRODUCTION

Optimal methods of promoting wool, optimal levels of expenditure on wool promotion, and the policy which the industry should follow in promoting fibre mixtures containing a proportion of wool have been debated by the wool industry for a number of years. These issues are summarised in Chapter 8 of the IAC *Draft Report on Financing of Rural Products* [4]. All of these issues are important but in this paper I intend principally to look at some theoretical implications for the wool industry of the promotion of wool mixtures. I shall also consider the relevance of the Dorfman-Steiner theorem [2] and the Nerlove-Waugh theorem [9] for determining optimal promotion levels in the wool industry. Theoretical confusion exists on both these aspects and unless the theoretical position is clarified unwise policy decisions may be made. The wool industry promotes wool mixtures to a limited extent. The International Wool Secretariat (I.W.S.) has for some time given technical advice to textile producers using wool in their blends. In 1971, the I.W.S. introduced Woolblendmark to identify wool-rich blends and to provide a symbol to promote these. Woolblendmark is available to

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textile producers for wool-rich blends (those containing 60 per cent or more wool), for selected products only and subject to the maintenance of general quality standards by the user [5]. In particular Woolblendmark is only made available for the promotion of a blended product when the I.W.S. is convinced that the promotion of the product will result in a net increase in the demand for wool and not simply displace an equivalent amount of wool already used. In some countries, for instance, Woolblendmark is not available for men's suits because this may reduce sales of wool in this end use. Despite the increased promotion of wool blends by the I.W.S., the bulk of its promotional effort (possibly 90 per cent of its promotional expenditure) is aimed at pure wool. While this policy may prove to be rational, the basis for it needs to be carefully examined.

At the general marketing level, an emphasis on pure new wool in consumer advertising may be held to be rational because this does not blur the image or identification of the product. A simple, clear identification is likely to make product promotion more effective [7]. Furthermore, wool blends may benefit by a "trickle-down" effect. For example, if a consumer cannot afford to buy pure wool or has some reservations about it, his preference for wool blends may be increased by an advertising campaign in favour of pure wool.

Again the view has been expressed by some leaders in the wool industry that it may be unnecessary to promote wool mixtures because these will be promoted by manufacturers and processors of man-made fibres. Because mixtures have superior characteristics for some purposes [6] or are initially more acceptable to consumers, manufacturers of synthetic fibres may promote these in order to increase their sales of synthetics. The reliance which the wool industry can place on this factor is considered later.

In this paper, I shall first consider the relevance for the wool industry of the Dorfman-Steiner and Nerlove-Waugh theorems. The question of altering consumers' preferences for blends is then briefly discussed and followed by a general examination of the problem of maximizing wool sales when the wool industry's promotional budget can be distributed between effort on promoting pure wool and effort on promoting wool-blends. The extent to which competition between manufacturers and processors of man-made fibres can be relied upon in promoting wool blends is discussed and the scope for the wool industry to co-operate with manufacturers and processors of man-made fibres in promoting wool blends is considered.

2 RELEVANCE OF DORFMAN-STEINER AND NERLOVE-WAUGH THEOREMS TO WOOL PROMOTION

The Dorfman-Steiner theorem asserts that under monopoly conditions, a firm's optimal ratio of advertising expenditure to sales revenue (that is, its profit-maximising degree of advertising intensity) is equal to the ratio of the advertising elasticity of demand for the firm's product to the (absolute) price elasticity of demand for its product [2]. Thus, the more elastic is the demand for a firm's product, the lower, other things equal, is its optimal advertising intensity. The theorem also implies that if a firm's advertising elasticity of demand is constant, the optimal intensity of advertising by the firm rises linearly with the Lerner measure of its degree of monopoly. The Lerner measure of the degree of monopoly is equal to the difference between the price of a product and its marginal cost of production divided by its price.

Apart from any other limitation which it has (for example, it does not take account of the cumulative effect of advertising) the Dorfman-Steiner theorem is not applicable to co-operative or collective promotion of the products of most agricultural industries. This is because most rural industries do not operate as a tight profit-maximising cartel and in many instances, as in the wool industry, the supplies of producers are not controlled. This suggests that theorems developed by Nerlove and Waugh [9] to cover co-operative advertising when supply is not controlled are likely to be more applicable to the wool industry. Nerlove and Waugh consider the optimal advertising intensity for an industry consisting of a large number of firms which aims to maximise its quasi-rent, when supply and other market conditions are not controlled.

They broadly conclude that an industry's optimal ratio of advertising expenditure to sales rises (1) with the inelasticity of the supply of its product, (2) with the elasticity of demand for its product with respect to advertising and (3) with falls in the own price elasticity of demand for its product, as each one of these factors varies and other things are held constant.

Relating this theorem to developments in the wool industry, it might be held that as a result of the growth of substitutes for wool the own price elasticity of demand for wool has increased [3]. Hence, on the basis of the Nerlove-Waugh theorem, and supposing other things unaltered, this suggests that the *optimal* ratio of advertising to sales revenue in the wool industry should be declining. But in the wool industry and in the fibre market generally other things have not remained unaltered. New qualities have been imparted to some woollen garments, e.g., machine washability, permanent pleating, and consumers are not always aware of the quality of wool blends. In consequence, the possibilities for promoting wool and wool blends may have increased. The elasticity of quantity sold with respect to advertising expenditure may have risen.

But apart from this, the theoretical basis of the Nerlove-Waugh theorem can be questioned for it assumes that advertising horizontally displaces a Marshallian demand curve, a curve for which the quantity of the product is measured on the X-axis. By contrast if vertical displacement of the demand curve (by a constant) occurs as a result of increased advertising, different conclusions from those of Nerlove and Waugh follow. For example, increases in the own price elasticity of demand for a product raise the industry's optimal *level* of advertising expenditure whereas this level falls in the Nerlove-Waugh case.

This point is important because the Nerlove-Waugh theorem is being used for policy advice on the mistaken view that the profitability of promoting an industry's product *necessarily* falls, other things equal, as the demand for the industry's product becomes more elastic. The Industries Assistance Commission in its *Draft Report on Financing Promotion of Rural Products* [4] considers the theorem to be important for policy purposes. It is, therefore, worthwhile illustrating the dangers posed by the theorem. This can be done by reference to Figure 1.

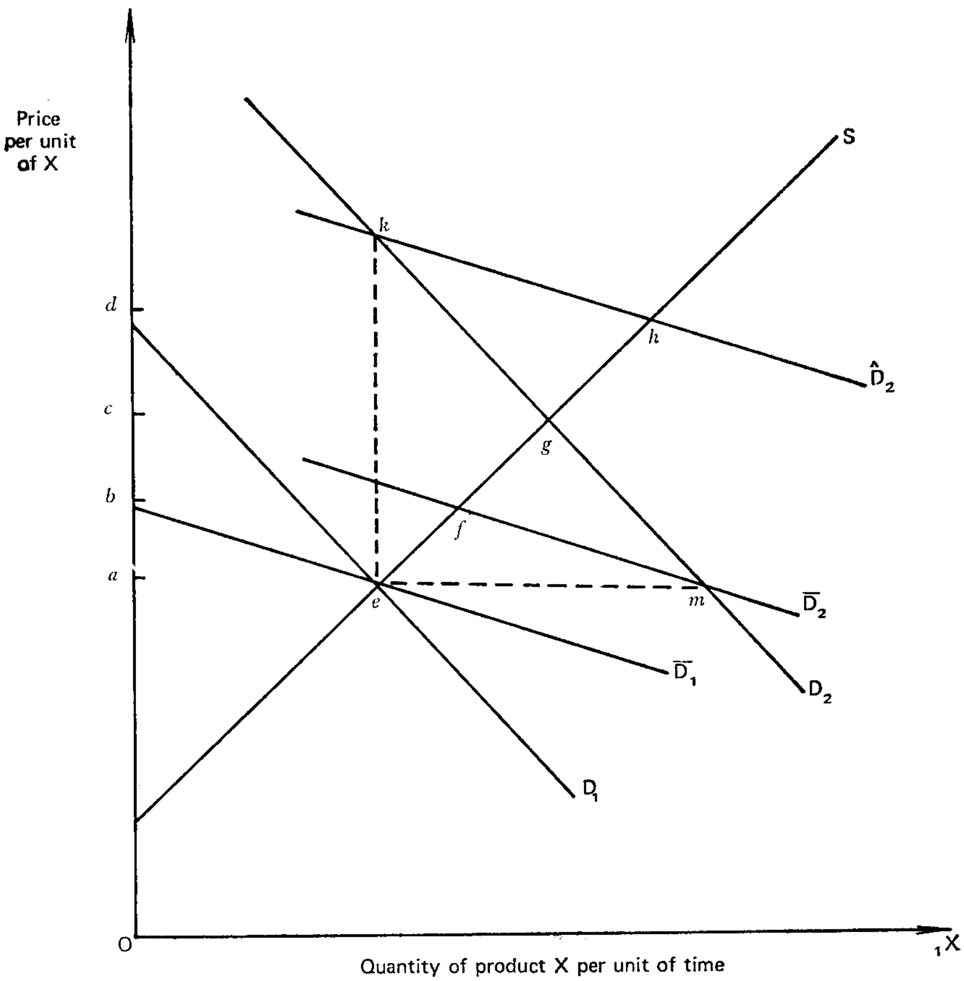
In Figure 1 market situations for an industry possessing normal supply and demand curves are illustrated and the industry is assumed to be initially in equilibrium at *e*. Assume that a promotion campaign is under consideration for the competitive industry the effect of which is expected to be to shift the industry demand curve upwards. The effect of the campaign on the industry's quasi-rents will depend, as Nerlove and Waugh suggest, on the elasticity of demand for the industry's product.

Assume that as measured at point *e* the industry demand curve is the relatively inelastic curve D_1 and that the industry's promotion campaign is expected to move this demand curve up to D_2 so that it is parallel to D_1. The campaign will then increase quasi-rents in the industry by an amount equivalent to the area of quadrilateral *aegc*.

This gain can be compared with the gains for an "equivalent" shift in the demand curve when the initial demand curve is more elastic as measured at *e*. Let the initial (more) elastic demand curve be indicated by $\bar{D}_1$. The result depends upon how the equivalent shift is defined. If an equivalent horizontal shift, equivalent to the distance *em*, is considered and assumed to be achieved with an unchanged level of advertising expenditure, the demand curve moves up to $\bar{D}_2$ and quasi-rents in the industry rise by an amount equivalent to the area of quadrilateral *aefb* an area less than in the more inelastic case in which the gains are equivalent to the area of the quadrilateral *aegc*. This is the type of shift which Nerlove and Waugh consider and in this case advertising relative to existing sales becomes less profitable as demand becomes more elastic. On the other hand, if the equivalent shift to that occurring in the inelastic case is taken to be the vertical distance *ek*, the opposite conclusion follows. In Figure 1 the industry demand curve is shown as shifting from $\bar{D}_1$ to $\hat{D}_2$ and quasi-rents are increased by an amount equivalent to the area of quadrilateral *aehd*. Promotion is much more profitable in the elastic case than in the inelastic case for which quasi-rents rise by the equivalent of the area of the quadrilateral *aegc*. Under these conditions, promotion becomes more profitable and optimal advertising intensities rise as the demand for the industry's product becomes more elastic. This result accords with Donaldson's apparent view [1] that product promotion may be more profitable for a rural industry facing an elastic demand for its product.

Clearly, the result does depend upon the nature of the shift in the demand curve, and so generalizations based upon the Nerlove-Waugh theorem are liable to be misleading. If the elasticity of demand for wool has declined, as some writers suggest that it has as a result of increased competition from synthetics, then depending upon the circumstances,

FIGURE 1



this can provide a case for higher advertising intensities in the wool industry rather than smaller intensities as the Nerlove-Waugh advertising theorem suggests. Insufficient empirical evidence is available at present to decide this issue, but we must not be misled by theory.

The above points and those made by Parish in an earlier paper [10] suggest that the Nerlove-Waugh theorem cannot and should not be mechanically applied to decisions about promotion in the wool industry and other rural industries. Wool blends open up complicated promotion options not covered by Nerlove and Waugh in their single product model.

3 MAXIMIZING WOOL SALES BY PROMOTING BLENDS

There are undoubtedly circumstances in which the development of a preference for wool blends by consumers is in the interest of the wool industry, and circumstances in which it pays the wool industry to promote wool blends. This can be illustrated.

Assume that the wool industry aims to maximize the quantity of wool, W, which it sells for a given outlay on promotion (the available supply of wool being nominally assumed to be in perfectly elastic supply). In doing this, the industry has an option of allocating promotional outlay between $i = 1, \ldots, n$ wool blends each of which contains the fraction ω_i of wool. One of these "blends" may correspond to pure wool ($\omega = 1$).

Stated mathematically the problem for the industry is to maximize

$$W = \sum_{i=1}^{n} \omega_i y_i \text{ (where } 0 < \omega_i \leqslant 1) \tag{1}$$

subject to

$$F(y_1, y_2, \ldots, y_n) = 0 \tag{2}$$

where y_i is the quantity sold of the i^{th} blend and F represents the promotion frontier for blends given the "fixed" total promotional outlay of the wool industry. Assuming F to be concave, to be suitably differentiable and ruling out corner solutions, total wool sales, W, will be maximized when the promotional budget is allocated between blends to ensure that

$$\omega_i + \lambda F_i = 0, \quad (i = 1, \ldots, n) \tag{3}$$

$$F = 0, \tag{4}$$

where λ is a Lagrange multiplier. Taking any blend, say the n^{th}, the optimal allocation occurs when

$$\frac{F_i}{F_n} = \frac{\omega_i}{\omega_n} \quad (i = 1, \ldots, n - 1). \tag{5}$$

The left hand side of this expression represents the marginal trade-off between sales of the i^{th} and the n^{th} blend, given the promotion constraint, and the right hand side represents the relative wool content of the two blends. The condition implies that the sales trade-off between any two blends must be equal to their relative wool content if promotional outlay is to be optimally allocated. The marginal equalities in (5) hold for all those blends it is worthwhile for the wool industry to promote, and the result implies that it can be optimal to jointly promote a range of pure wool and selected blends.

Equation (5) also implies that in equilibrium

$$\frac{F_i}{\omega_i} = \frac{F_n}{\omega_n}, \quad (i = 1, \ldots, n - 1) \tag{6}$$

the marginal wool sales from increasing the sales of blend i is equal to the marginal wool sales forgone as a result of the sales forgone of blend n, i and n being any two different blends.

The necessity of this condition being satisfied, given the above conditions, is easily illustrated if we assume two blends, 1 and 2. Let θ_1 represent the increase in the sales of blend one, y_1, which can be achieved by altering promotion in favour of blend one so that sales of blend two decline by one unit. Then, wool sales increase, remain constant or decline for increased promotion of blend one accordingly as

$$\omega_1\theta_1 \gtreqless \omega_2 \text{ or as } \theta_1 \gtreqless \frac{\omega_2}{\omega_1}. \tag{7}$$

For instance, let us suppose that blend one contains 0.5 units wool and blend two contains 0.8 units of wool. Then a transfer of promotion from blend two to blend one requires that more than 1.6 *additional* units of blend one be sold for each unit of blend two *forgone* if total wool sales are to rise. However, when both sides of expression (7) reach equality, it is impossible to increase wool sales by reapportioning the promotion budget between blends.

It is not difficult to illustrate these conclusions diagrammatically for the case of two alternative blends (one of which may be the "blend" pure wool). In this case, total wool sales by weight are given by

$$W = \omega_1 y_1 + \omega_2 y_2 \tag{8}$$

which is to be maximized subject to the sales possibility frontier

$$F(y_1, y_2) = 0. \tag{9}$$

If the sales possibility frontier for a given promotional budget is concave and differentiable (and corner solutions are excluded), this maximum occurs for

$$\frac{dy_2}{dy_1} = -\frac{\omega_1}{\omega_2}. \tag{10}$$

In Figure 2, the curve *ABC* represents a possible form of the sales trade-off frontier, *F*, between the blends. The lines marked W_1, W_2, W_3 and W_4 are iso-wool quantity lines. All combinations of the sales of blends along the line W_1 result in the same volume of wool sales, W_1. This line is obtained by rearranging

$$W_1 = \omega_1 y_1 + \omega_2 y_2 \tag{11}$$

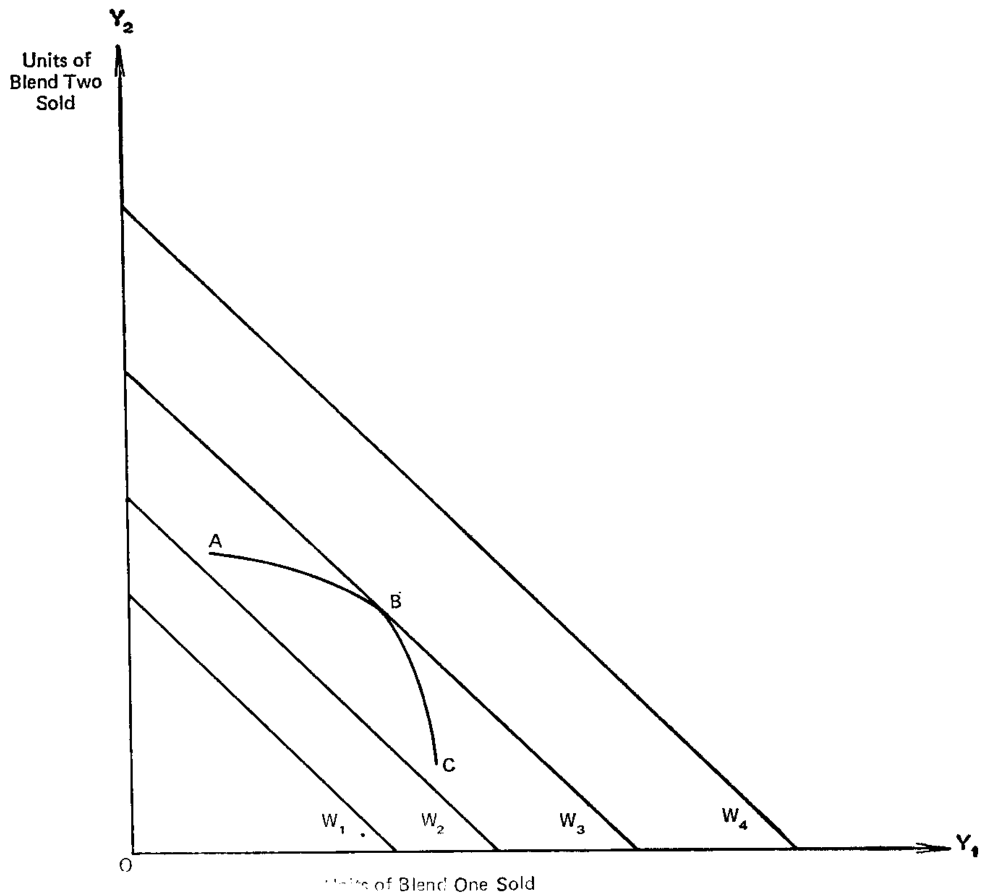
to give

$$y_2 = \frac{W_1}{\omega_1} - \frac{\omega_1}{\omega_2} y_1 \tag{12}$$

which has a slope of $-\frac{\omega_1}{\omega_2}$. The other iso-wool quantity lines may be obtained in the same manner and all have a slope of $-\frac{\omega_1}{\omega_2}$, equal to the ratio of the proportionate wool content of the blends.

In the case illustrated in Figure 2, the optimal attainable sale of wool blends corresponds to the combination at *B*. Any other attainable combination is on a lower iso-wool quantity line. At *B* the slope of the sales trade-off frontier, $\frac{dy_2}{dy_1}$, equals the slope of an iso-wool quantity line, $-\frac{\omega_1}{\omega_2}$, and thus the condition stated in (10) is satisfied.

FIGURE 2



As a particular example, consider the alternative of promoting pure wool ($\omega_1 = 1$) or a blend ($0 < \omega_2 < 1$). As long as the increase in the sales of the blended units relative to the pure wool units forgone exceeds the reciprocal of the wool content of the blended units (that is, $\left(\frac{1}{\omega_2}\right)$, wool sales are increased by allocating more funds to promoting the blend. If for instance $\omega_2 = 0.5$, the expansion in the sale of blended units must exceed twice any loss in the sale of pure wool units, if wool sales are to increase the trade-off.

The above analysis rules out corner-point solutions. But sometimes it does not pay the wool industry to promote some blends at all. In terms of Figure 2, the slope of the relevant curves may be such that the optimum is achieved at end-points A or C of the sales trade-off curve. Nevertheless, if maximum wool sales are required and if F is concave and differentiable, then from the Kuhn-Tucker theorem, the marginal equalities stated in (5) must hold for all those blends which it is worthwhile for the wool industry to promote.

In the event that the sales possibility frontier is strictly convex rather than concave (i.e., sales of any and every blend increase at a growing rate with increased promotion of the blend), the optimal strategy for the wool industry is to promote one selected blend which might be, but need not be pure wool. Looking at the overall picture, any promotional body aiming to maximize the quasi-rents of wool growers must, in relation to its expenditure on promotion, push the demand curve for wool as far to the right as is possible. Its promotional strategy must ensure that relative to its expenditure on promotion, the demand for wool is maximized at every price level. As the above theory indicates, this may require the body to promote selected blends. But other actions may also be called for. For instance, the promotional body may need to inform consumers and textile producers of new developments in the treatment of wool. Given that promotion is efficient in the sense that it maximizes demand for wool for a given outlay on promotion, or minimizes the promotional cost of achieving a specific level of demand for wool, the industry's quasi-rents are maximized by expanding expenditure on promotion until the additional costs involved are just equal to the marginal increase in quasi-rents which are achieved. In a purely competitive world, such as that envisaged in the Nerlove-Waugh model [9], it is theoretically easy to determine the optimal level of promotional expenditure for an industry. But the purely competitive assumption may be inapplicable to the wool industry.

Other fibres are not in pure competition with wool. For instance, man-made fibres are not because the man-made fibre industry is oligopolistic in most countries and dominated by a few multi-nationals. Promotional effort in the wool industry may be matched and cancelled out to some extent by countervailing promotion by manufacturers of man-made fibres. This needs to be taken into account in determining an optimal promotion strategy for the wool industry. Countervailing expenditure on promotion tends to lower the optimal level of promotion for the wool industry.

4 THE PROMOTION OF BLENDS BY COMPETITION BETWEEN MANUFACTURERS OF MAN-MADE FIBRES AND TEXTILE PRODUCERS

I shall argue that the wool industry is unlikely to maximize wool sales and its returns if it relies passively on man-made fibre and textile producers to promote wool blends. Unfortunately, some members of the wool industry believe that it is optimal to leave the promotion of blends entirely to manufacturers of man-made fibres.

Manufacturers of man-made fibres may promote wool blends. If consumers prefer wool blends to pure synthetics and if commodities made from these blends can be marketed at a competitive price, free competition should *if present*, ensure that wool blends are produced and promoted by textile producers, including those producers with interests in the sale of synthetic fibres. Every maker of man-made fibres has an incentive to increase his market share of man-made fibres and his profit by satisfying consumer demands. This can lead each to promote blends as a competitive strategy. As a result, makers of man-made fibres may experience reduced sales of synthetics and lower profits.

Makers of man-made fibres face a dilemma of the prisoner's type [8, p. 95] which is readily illustrated by a duopoly example. Suppose two makers of man-made fibres each of which has the alternative of promoting pure synthetic yarn or a blended yarn containing only some of his synthetic fibre. A producer of man-made fibres may promote a blend by providing suitable advertising subsidies to textile processors who use or make the blend, and by providing these processors with technical advice, samples and so on. Where the synthetic fibre producer owns textile processing plants or firms, as is common in the United Kingdom, a decision can be taken for these plants or firms to produce and promote the blend.

Imagine that there are two makers of man-made fibres and that the pattern of their payoffs for alternative strategies are as indicated in Table 1. The arithmetical figures given for the payoffs are purely for illustrative purposes and the mathematical structure of the problem can be generalized [8] to show circumstances in which action on the basis of individual self-interest conflicts with the collective interest of a group. The entry (70,20) for example indicates that if maker 2 promotes a blended yarn and maker 1 promotes only a pure synthetic yarn, maker 2's payoff is 70 and maker 1's payoff is 20. Whatever strategy is adopted by his opponent, it always pays the other competitor, acting in his own self-interest, to promote a blended yarn. Consequently each is driven by his own self-interest to promote a blended yarn and they do not maximize their collective gains. By promoting a blended yarn each producer of synthetics obtains 40 whereas by promoting only a pure synthetic yarn each could have obtained 50. While the competitive self-interest of the duopolists may lead each to promote a blended yarn, the duopolists have an incentive to collude and promote only pure synthetic yarn. In the absence of competition, one would expect the promotion of pure synthetic yarn to be the joint strategy of the producers, to the detriment of wool. The outcome depends to some extent on the strength of competition between producers of synthetics.

TABLE 1

	Maker 1's Strategies	
	Promote Pure Synthetic	Promote Blended Yarn
Maker 2's Strategies		
Promote Pure Synthetic	(50, 50)	(20, 70)
Promote Blended Yarn	(70, 20)	(40, 40)

Now that a number of important patents on man-made fibres has lapsed, the number of makers of man-made fibres has risen and trade barriers have been reduced, e.g., for countries within the EEC, competition between makers of man-made fibres has possibly increased. Hence, the production and promotion of blended yarns may increase. The wool industry may find that it is no longer faced by a strong coalition of manufacturers of man-made fibres as might have been so in the past. Competition, however, does not ensure production of blends and their promotion unless consumers prefer blends in comparison to pure synthetics. When the production of synthetic fibres is competitive and consumers do not display a marked preference for blends, no producer of synthetic fibres has an incentive to alter that preference. But if preferences are altered, say by the wool industry convincing customers of the advantage of adding wool to synthetic fibres, competition between makers of man-made fibres and textile producers will, if present, lead to their production and promotion of blended products. Secondary promotion of wool blends by the wool industry can lead to primary promotion of these by makers of man-made fibres.

When a new synthetic fibre is being introduced consumer preferences may be such that acceptability of the new fibre is only gained by using it in mixtures with other fibres. Once acceptability of the new fibre is established the proportion of natural fibre used in blends may be reduced by the maker of the new synthetic. Generally the wool industry has no interest in establishing new fibres, except in cases where they are complementary to wool. But once a fibre becomes established the industry has an interest in the proportion of wool used in any blend containing the fibre and may be able to influence this by convincing consumers or textile processors of the advantage of maintaining the wool content of any blend. The industry may be able to promote wool successfully in this way while pointing out that the optimal proportion of wool may vary for different end-uses [5] and that wool-rich blends and pure wool are not appropriate for some end-uses.

Within the above context of collusion or non-collusion between manufacturers of synthetics, there is little scope for the wool industry to co-operate with makers of synthetics in promoting wool-blends. Furthermore, it would be a folly for the wool industry to abandon the promotion of blends to the man-made fibre industry because of the potential for changes in the proportions of various fibres in the blends. The consequences of such a move would be under-representation of the advantages of using wool in blends and the likely denial to the wool industry of a partial free-ride. This partial free-ride may be obtained if the wool industry convinces textile processors and the consumers of the advantages of maintaining wool content in a blend and if fibre producers compete to satisfy the preferences of buyers. However, the possible reactions of manufacturers of synthetics must be taken into account. Even if manufacturers form only a loose coalition, they may react to a rise in the wool industry's expenditure on the promotion of selected wool blends by increasing their own expenditure on the promotion of synthetics. Nevertheless, after taking account of this possible reaction, the wool industry may gain by expanding its promotion of selected blends.

To conclude: It is probably profitable for the wool industry to promote a range of selected wool blends, limiting its promotional support in certain circumstances as with Woolblendmark, despite the existence of a "trickle-down" effect from the promotion of pure wool. Furthermore, it would seem to be unwise for the wool industry to rely solely on manufacturers of man-made fibres and textile producers to promote wool blends. The success which the wool industry is likely to achieve by promoting blends will depend partly on the state of competition between manufacturers of man-made fibres and between producers of textiles. As demonstrated in this paper, the wool industry may be able to improve its own gains by taking advantage of such competition as exists. While oligopolistic competition from manufacturers of man-made fibres and organizations representing other fibres needs to be reckoned with by the wool industry, it is probably less true now than it used to be that manufacturers of man-made fibres are in collusion. Nevertheless game-like models continue to be more relevant to analysing the wool industry's promotional strategies than the purely competitive model of advertising developed by Nerlove and Waugh.

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