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ECONOMICS AND MARKETING

Is the Cotton Checkoff Program Worth the Cost?

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ABSTRACT

The U.S. cotton industry operates a government-established program to enhance the profitability of U.S. cotton production through generic advertising and promotional activities intended to expand the demand for cotton. Operated by the Cotton Board, the so-called cotton checkoff program is financed by an assessment on domestic cotton sales and imports that amounted to nearly $75 million in 2007. How effective is the cotton checkoff program in expanding cotton demand? Are cotton producers and importers better off as a result of the program? That is, are the benefits to those who pay for the program greater than the costs? We analyze the answers to these questions using a modified version of the Texas Tech University World Fiber Model. We report the key average annual impacts of the checkoff program on U.S. and foreign cotton and man-made fiber and associated textile markets. Using those results we calculate the benefit-cost ratio (BCR) to producers and importers from their payments into the checkoff program. The annual return to producers averaged $5.7 in benefit per dollar of cost and $14.4 per dollar of cost to importers over the 1986/87 to 2004/05 period of analysis. The higher importer BCR reflects gains not only from additional sales of cotton fiber textiles but also from the "spillover" effects on sales of man-made fiber textiles prompted by the cotton checkoff program. The results also show that U.S. taxpayers are better off because the cotton checkoff program tends to reduce government outlays directed to cotton farmers.

Until the development of petroleum-derived synthetic fibers in the 1950s, cotton was unrivaled as the dominant fiber in clothing and home textile markets. The introduction of polyester and nylon fibers led to a sustained decline in the demand for cotton for all uses beginning in about 1960. By 1966, the decline in cotton demand had progressed to the point that Congress intervened, passing the *Cotton Research and Promotion Act* (CRPA) *of 1966* (Public Law 89-502, 80 Stat. 279, July 13, 1966) in an effort to arrest the erosion of consumer demand for cotton. In passing the CRPA, Congress reasoned that the inroads into the textile fiber market made by synthetic fibers were due, for the most part, to research and promotion conducted by primarily large chemical firms. Thus, the legislative intent of the CRPA and the subsequent *Cotton Research and Promotion Amendments Act* (CRPAA) *of 1990* (7 USC 2101-2118) was to authorize and enable the establishment of an orderly procedure for developing an effective and coordinated program of research and promotion. The CRPA specifically authorized the creation of the Cotton Board "for establishing and carrying on research and development projects and studies with respect to the production, ginning, processing, distribution, or utilization of cotton and its products, to the end that the marketing and utilization of cotton may be encouraged, expanded, improved, or made more efficient, and for the disbursement of necessary funds for such purposes" (7 USC Chapter 53, section 2105).

From its inception, the Cotton Board has assessed all domestic cotton producers a percentage of their cotton sales as allowed for under the legislation to cover the costs of its cotton research and promotion activities, known collectively as the Cotton Checkoff Program. Until passage of the CRPAA of 1990, producers were allowed to request a refund of their assessments. Up to one-third of the assessments collected were refunded during that period. The CRPAA terminated the right of producers to demand refunds and required importers of cotton textile and apparel products (primarily retailers and wholesalers who purchase foreign produced textile products for domestic sale) to pay a checkoff assessment as well.

How effective has the cotton checkoff program been in expanding cotton demand? Are cotton producers and importers better off as a result of the program? That is, have the benefits to those who have paid for the program been greater than the costs? In addressing the

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first question, the focus of this paper is on the effects of the cotton checkoff program on cotton demand and the resulting impacts on world fiber prices and markets. The analysis is conducted using a multiequation, econometric simulation model of U.S. and foreign fiber markets originally developed by the Cotton Economics Research Institute (CERI) at Texas Tech University known as the World Fiber Model (WFM).

Once the market effects of the cotton checkoff program have been empirically determined, they are used to answer the second question in a benefit-cost analysis of the program at the producer and importer levels. The discussion of the model and simulation results is preceded by an overview of the cotton checkoff program and a primer on the economics of cotton advertising and promotion. The paper ends with a summary of the major conclusions and implications for management of the cotton checkoff program.

OVERVIEW OF THE COTTON CHECKOFF PROGRAM[1]

The cotton checkoff program requires the payment of an assessment of $1 per bale plus a fractional percentage of value (five-tenths of one percent) collected by first handlers on domestically produced (raw) cotton, imported (raw) cotton, and the cotton content of imported textile and apparel products. Since 1976, the producer assessment has ranged from a low of 0.460¢/lb in 1999/2000 to 2002/03 to a high of 0.644¢/lb in 1980/81. The importer assessment began in August of 1992 and has since varied from a low of 0.383¢/lb in 2003/04 and 2004/05 to a high of 0.581¢/lb in 1997/98. Between 1986/87 and 1991/92, about 65% of the cotton assessments collected (from $18.3 million up to $28.6 million) was available for funding cotton checkoff activities. The remaining 35% was refunded on average each year. By eliminating refunds, the 1990 amendments to the CRPA contributed to a substantial increase in annual cotton checkoff collections from $42 million in 1992 to $66 million in 2004/05.

The Cotton Board collects all assessments and then contracts with producer-controlled organizations to carry out the research and promotion activities as authorized by the legislative acts. Initially, the producer-controlled organization was the Cotton Producer Institute. Since 1970, Cotton Incorporated (CI) has been tasked with carrying out all research and promotion activities except export promotion under contract with the Cotton Board. Cotton Council International is responsible for cotton export promotion activities.

CI uses its checkoff assessment allocation to finance research and promotion activities at both the retail and wholesale (mill) levels of cotton markets. In 2004/05, about 67% of the collected assessments were used to finance retail-level advertising and promotion and 16% to finance mill-level promotion activities. The remainder was spent on agricultural research activities (13%) and administration (5%). Retail-level advertising and promotion includes primarily media advertising, public relations, fashion marketing, retail tie-ins and other promotions, and global product marketing for cotton fiber textiles (CFTs), defined here as the cotton products produced by mills for retail consumption, primarily cotton apparel but also cotton floor coverings and various cotton textile home furnishings.

Mill-level promotion includes activities to expand the demand for cotton by U.S. as well as foreign textile mills in both processing and fashion fabrics. Although focused primarily on the development of new cotton products, mill-level promotional activities also include technical support to mills, apparel manufacturers, and retailers to find ways of reducing their costs and increasing their operating efficiencies. From 1986/87 to 2004/05, 15 to 20% of the CI budget has been directed to mill-level promotion.

ECONOMICS OF COTTON ADVERTISING AND PROMOTION

In economic terms, the objective of cotton promotion is to increase the demand for cotton and, thereby, increase the market price on a higher volume of sales over time. The increased price, however, sends signals to both domestic and foreign producers to increase production, which eventually leads to lower prices and reduces the benefits that otherwise might be expected from the advertising. At the same time, the promotion-induced increase in the price entices consumers to seek lower cost sources of the product such as imports or lower cost substitutes such as man-made fibers (MMFs). In the process, some benefits of promotion expenditures are lost to competing industries in foreign and domestic mar-

1. The discussion in this section is based on data provided by Cotton Incorporated (2006, Personal communication) and on the language of the CRPA of 1966 and the CRPAA of 1990. More details are provided in Capps and Williams (2006).

kets. A further complication for cotton promotion is that the U.S. government intervenes in the market to support prices and incomes, restrict imports of cotton textiles, subsidize cotton exports, and otherwise alter the normal functioning of the markets and the extent to which any benefits from advertising are transmitted to the producers and importers who pay for the advertising with their checkoff dollars.

Graphical Analysis of the Effects of Cotton Advertising and Promotion. As indicated earlier, the largest portion of cotton checkoff funds are spent on promoting retail CFT consumption. If retail promotional activities effectively shift out the U.S. CFT demand as intended, then Fig. 1 illustrates the likely world market effects of such expenditures in a simplified graphical representation of world raw cotton and CFT markets. The top row of graphs in Fig. 1 represents raw cotton markets, whereas the bottom row represents CFT markets. The first column of graphs represents U.S. markets and the last column represents all other countries (rest-of-the-world [ROW]). The middle column represents world markets.

The U.S. is depicted in Fig. 1 as an exporter of raw cotton because at most prices, the U.S. can produce more cotton than is demanded by domestic mills. The excess supply of cotton not demanded by domestic mills is available for export (the upward sloping export supply curve in the middle graph, top row, Fig. 1). In contrast, the ROW is depicted as a net cotton importing region. The interaction of the U.S. export supply and ROW import demand in world markets determines the world price (P_c^w) and quantity traded (Q_c^w) of raw cotton (middle top graph, Fig. 1). In turn, the world price level determines the quantities of cotton demanded and supplied in all countries, including the U.S.

In CFT markets, the U.S. is an importing country, whereas the ROW is a net exporting region as shown in the bottom row of graphs in Fig. 1. The interaction of the U.S. CFT import demand and the ROW CFT export supply (middle graph, bottom row, Fig. 1) determines both the world price (P_{cft}^w) and quantity traded (Q_{cft}^w) of CFTs in the world market. The markets for raw cotton and CFTs are linked through prices.

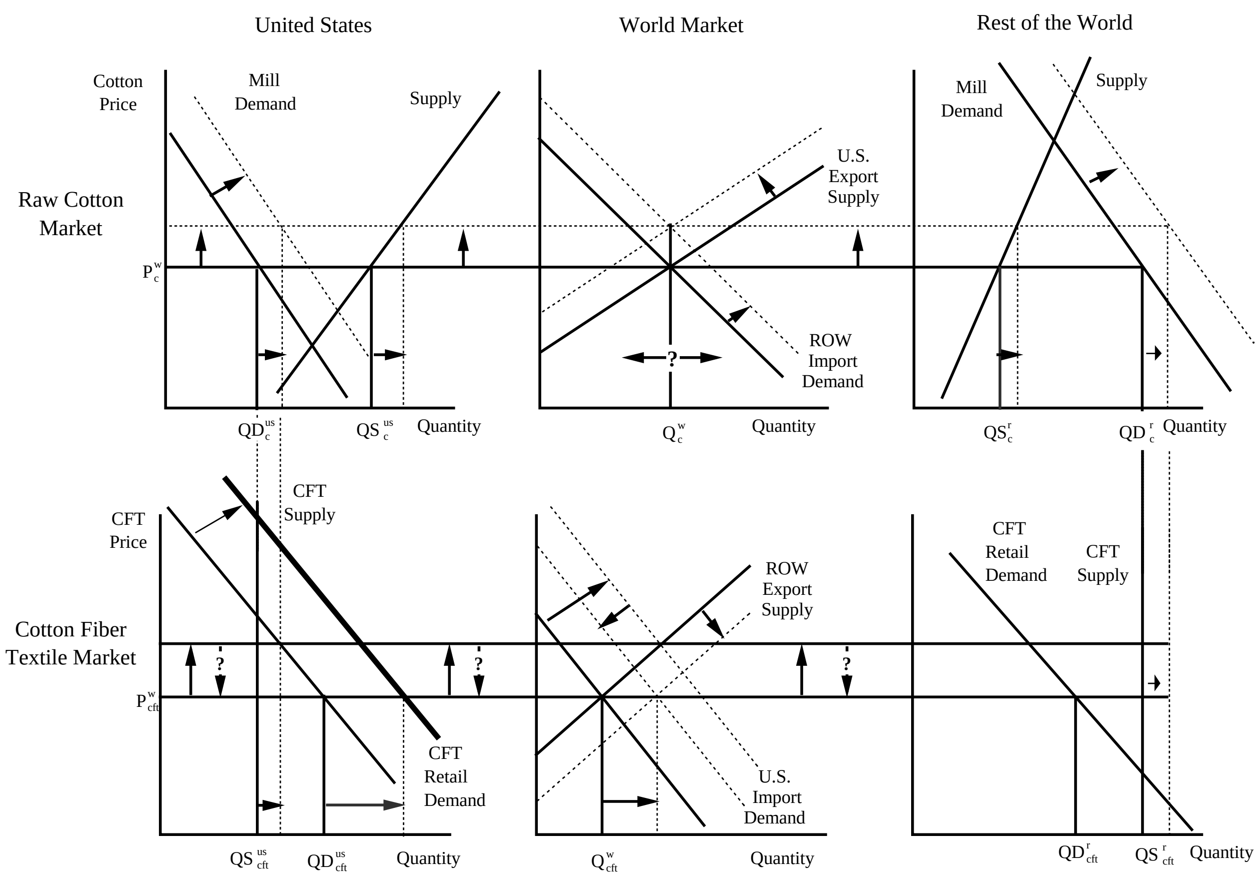

Figure 1. Effects of Retail-Level Promotion on Cotton and Cotton Fiber Textile Markets.

For the cotton miller, the price of cotton represents the price of the input, whereas the CFT price represents the price of the output. If the price of cotton (P_c^w, Fig. 1) increases, then the quantity of cotton demanded for processing and, consequently, the volume of CFT products produced both decline. On the other hand, if the CFT price (P_{cft}^w, Fig. 1) increases, the volume of cotton demanded at a given price for cotton increases, which would be depicted as a rightward shift in the cotton mill demand curve. A CFT price increase results in not only a greater volume of cotton spun or milled, but also a greater volume of CFTs supplied to the market, which would be shown as a rightward shift of the vertical CFT supply curve. Note that the vertical nature of the CFT supply curve is a graphical device to depict the fact that the quantity supplied of CFTs can only increase when its price increases if cotton mills first respond to the higher CFT price by demanding more raw cotton to produce additional CFTs. In this case, the vertical CFT curve then shifts to the right as illustrated in Fig. 1.

Consequently, an increase in the U.S. CFT demand as a result of checkoff program expenditures (represented by the rightward shift of the CFT retail demand curve in the bottom left graph, Fig. 1) results in a rightward shift of the U.S. CFT import demand (middle bottom graph, Fig. 1) and a consequent increase in the CFT market price (higher horizontal price line in the bottom row, Fig. 1)[2]. The increase in the CFT price, however, signals an increase in cotton mill demand in all countries (top left and top right graphs, Fig. 1) resulting in less U.S. cotton available for export at the same time that the foreign import demand for cotton increases. As a result, the world price of cotton increases, limiting the expansion of cotton mill demand in all countries. The effect on U.S. cotton exports, however, is unclear. If the reduction in the U.S. cotton export supply is greater (smaller) than the increase in the foreign import demand for cotton, U.S. cotton exports decline (increase) as a result of the retail promotion financed by the cotton checkoff assessments. In any case, the retail promotion expenditures clearly increase the price of cotton and appear to increase the price and U.S. imports of CFTs.

Because the increase in U.S. and foreign cotton mill demand also increases the supply of U.S. and foreign produced CFTs (rightward shifts of the CFT supplies in the bottom left and right graphs, Fig. 1), the U.S. excess demand for CFTs shifts left to some extent and the ROW export supply shifts to the right to some extent (bottom middle graph, Fig. 1). The consequence is downward pressure on the world CFT price. How far the CFT price declines following its initial increase depends on the responsiveness of mill demand in all countries to the initial promotion-induced increase in the CFT price. In theory, the supply response could be sufficient to completely counteract the initial price-enhancing effect of the retail promotion.

Not all advertising and promotion activities occur at the retail level. As discussed earlier, a substantial share of cotton checkoff funds are spent at the wholesale or mill level to develop new means of using additional cotton to produce additional CFTs. If such expenditures are effective, then their initial effect is to shift the mill demand for raw cotton to the right as shown in the top left graph of Fig. 2. Because mill-level promotion is directed at foreign as well as U.S. textile mills, the foreign mill demand also shifts out (rightward shift in the ROW mill demand, top right graph, Fig. 2).

In the U.S., greater domestic use of domestically produced cotton as a result of the mill-level promotion results in less U.S. cotton available for export (leftward shift of U.S. cotton export supply, top middle graph, Fig. 2). At the same time, the promotion-induced increase in foreign mill use of cotton shifts out the ROW import demand for U.S. cotton (top middle graph, Fig. 2). The reduced availability of U.S. cotton for export and the increased ROW mill demand for cotton boosts the price of cotton in both the U.S. and ROW markets. The implications for U.S. exports of cotton, however, are unclear. If the increase in U.S. mill demand for cotton induced by the mill-level promotion is greater than the corresponding shift in the ROW cotton mill demand, then U.S. cotton exports would tend to decline. If the reverse is the case, then mill-level promotion would lead to an increase in U.S. cotton exports.

In CFT markets, increased U.S. and foreign cotton processing results in additional CFT production (rightward shifts of the CFT supply curves, bottom left and right graphs, Fig. 2) and, therefore, a reduced U.S. demand for imported CFTs along with an increased ROW CFT supply for export (leftward shift of the U.S. import demand and rightward shift

2. For expositional purposes only, Fig. 1 does not show the small leftward shift of the U.S. cotton supply curve that occurs as a result of the checkoff assessment on cotton producers. This “tax” effect of the checkoff is included in the empirical analysis of the checkoff program discussed later.

of the ROW export supply, bottom middle graph, Fig. 2). The result is downward pressure on the world CFT price and an ambiguous impact on world CFT trade. U.S. CFT imports could increase or decrease depending on the relative magnitudes of the shifts in U.S. and ROW CFT supplies.

Complications of U.S. Cotton Farm Policy[3]. The effects of the cotton checkoff program on the U.S. cotton and CFT markets over the years as depicted in Figs. 1 and 2 have been complicated by U.S. farm policy. In the decade preceding the 1996 Farm Bill (the FAIR Act), the central feature of U.S. farm policy for many commodities, including cotton, was the deficiency payment scheme. Under U.S. farm policy during that period, U.S. cotton farmers received deficiency payments in each year equal to the difference between the established target price and the existing national average market price for cotton. A non-recourse (NR) loan program with a marketing loan feature was also in place for cotton although the cotton market price was generally above the loan rate in most years.

3. The discussion in this section is based on Welch et al. (2008) and Meyer et al. (2007).

The policy during that period worked to make the farm supply of cotton generally unresponsive to changes in the market price at levels below the target price for producers who participated in farm programs. When the market price was between the target price and the NR loan rate, producers would sell their cotton output at the market price, repay their production loans from the government at the established loan rate, and receive a payment from the government in the amount of the difference between the target price and the market price multiplied by their output. The effective price received by the producer, therefore, was the market price plus the per unit deficiency payment. Consequently, changes in the market price had little effect on the market supply and mainly affected the level of the deficiency payment (that is, the cost of the cotton program to taxpayers) and the shares of producer cotton revenues that came from market sales and from government payments. The marketing loan component of the cotton farm program allowed the market price to drop below the NR loan rate in low price years and provided for a loan deficiency payment (LDP) to producers equal to the difference

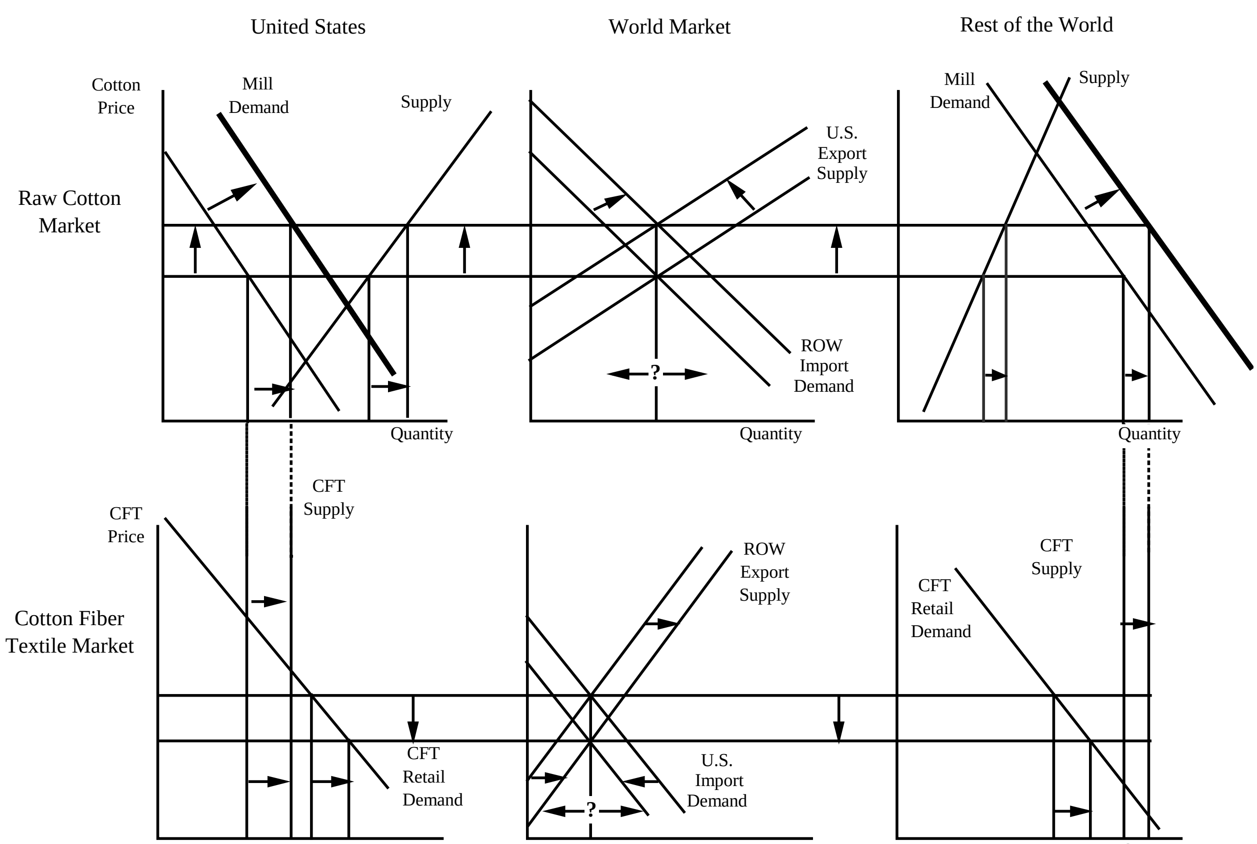

Figure 2. Effects of Mill-Level Promotion on Cotton and Cotton Fiber Textile Markets.

between the NR loan rate and the market price in addition to a deficiency payment. Thus, the effective price per unit to producers was still the target price, even in low market price years.

As depicted in Figs. 1 and 2, cotton promotion at both the retail and mill levels tends to increase the farm-level cotton market price. During the pre-1996 Farm Bill period, however, any increase in the cotton market price achieved through cotton promotion simply reduced government payments to cotton producers. Although a larger share of producer revenues consequently came from the market and less from the government, the effective price and total revenues received by cotton producers were relatively unaffected by cotton checkoff expenditures. Thus, under the pre-1996 farm policy, the cotton checkoff program primarily worked to limit government payments to cotton farmers rather than to increase their revenues. Because not all producers participated in farm programs, the cotton checkoff program likely had a small positive effect on the aggregate revenues of U.S. cotton producers during that period.

The 1996 Farm Bill eliminated target prices and the deficiency payment program in favor of decoupled direct payments to farmers so that the cotton checkoff program worked essentially as depicted in Figs. 1 and 2 with limited effects from government intervention. Then in the late 1990s, a sharp decline in world commodity prices set the stage for a return to target prices and a form of deficiency payments referred to as counter-cyclical payments in the 2002 Farm Bill and continued under the 2008 Farm Bill. In addition, the LDP provisions were continued providing an additional payment to farmers in years when the market price drops below the loan rate. Consequently, the checkoff program again works to reduce the costs of the cotton program to taxpayers rather than to increase the profits of cotton producers as was the case before the implementation of the 1996 Farm Bill.

Spillover Effects of Cotton Promotion. A commodity checkoff program like cotton can have unintended effects on related markets—the so-called spillover effects of checkoff promotion. Successful retail-level promotion of cotton would be expected to result in some shift of total textile consumption away from man-made fiber textiles (MMFT) toward CFTs. The result would be a reduction in U.S. MMFT imports and a drop in the MMFT market price with resulting negative effects on U.S. MMF mill demand in both the U.S. and foreign markets, a drop in the MMF price, and potentially some reduction in U.S. MMF imports.

Mill-level promotion of cotton has a somewhat different effect on MMF and MMFT markets. At the mill level, cotton is more likely to be a complement to MMFs than a substitute because the production of CFTs often involves the use of fiber blends. Thus, an increase in the use of cotton to produce new textile products through mill-level promotion activities results in an increase in the demand for raw MMFs, a corresponding increase in the MMF market price, an increase of U.S. MMF imports, and an increase in the quantity of MMF supplied to the market by the ROW. The consequent increase in world MMFT production leads to lower world MMFT prices and a likely increase in U.S. MMFT imports.

Sales Response to Promotion. The relationship between cotton promotion and the benefits that accrue to those who pay for the promotion is further complicated by a number of well-documented characteristics of the response of sales to advertising (see Williams and Nichols, 1998). Most importantly, there is often a lag between expenditures on advertising and promotion and the impact on sales (the "lagged effect" of advertising). Then, after some period of delay, the full effects of advertising on sales tend to play out over an extended period of time rather than all at once (the "carryover effect" of advertising) before beginning to wane (the "decay effect" of advertising). The lagged effect occurs because several exposures to a promotion message over time are usually required before an individual decides to buy (Lee et al., 1989). Because advertising generates differential levels and rates of buyer response and might prompt repeat purchases, the effects of advertising might persist beyond the period of initial impact. This carryover effect has been reported to last from 1 mo to 2 yr depending on the commodity and type of promotion activity (Jensen et al., 1992). The persistence of advertising does not last forever. A decay in the effects normally occurs after some period of time. Research shows that the promotion message will be forgotten if the potential users are not continuously exposed to it (Zielske, 1959).

MATERIALS AND METHODS

The preceding discussion provides a basic understanding of what economic theory can tell us about the potential effects of the cotton checkoff program on cotton and CFT markets as well as on competing MMF and MMFT markets. Although the graphical analysis is a powerful tool for analyzing the expected direction of the effects of the program, the analysis provides little insight into the likely magnitude of effects. To test the hypotheses relating to the direction of the impacts of the cotton promotion as represented by the preceding graphical analysis and to measure the magnitude of the effects of promotion, an empirical analysis of the cotton checkoff program was conducted with the the use of a multi-equation, econometric, simulation model of U.S. and foreign fiber markets known as the World Fiber Model (WFM. Originally developed by the Cotton Economics Research Institute (CERI) at Texas Tech University, the model was modified for this study to account for the programmatic activities of the Cotton Board and is referred to as the Modified World Fiber Model (MWFM). The major modifications to the model included the re-specification and re-estimation of the cotton and MMF mill demands and CFT and MMFT demands in both U.S. and foreign markets to include expenditure variables relating to cotton checkoff advertising and promotion. The WFM has been used for a wide range of analyses and received extensive peer review, including most recently Welch et al. (2008), Chaudhary et al. (2008), MacDonald et al. (2008), Pan et al. (2008, 2007a, 2007b, 2006, and 2005), Li et al. (2005), and Ramirez et al. (2004). An extensive technical description and documentation of the WFM are available in Pan et al. (2004).

The only two previous studies of the cotton checkoff program (Capps et al., 1997; Murray et al., 2001) relied on less comprehensive, quasi-reduced form econometric models for their analyses of the performance of the cotton checkoff program. Capps et al. (1997) covered the period of 1991 to 1995 and Murray focused on the period of 1996 to 2000. This analysis covers a more extensive time period (1986/87–2004/05) and is based on a more formal and structurally comprehensive model than used by the two previous studies. The MWFM used for this analysis replicates the structure of world cotton and CFT markets as depicted in Figs. 1 and 2 but also includes man-made and other world fiber markets.

The model functions through the simultaneous interaction of various supply, demand, trade, and price components across various commodities and regions of the world. The main components of the MWFM include: (1) U.S. and foreign cotton production; (2) U.S. and foreign MMF production; (3) U.S. and foreign cotton and MMF mill demands; (4) U.S. and foreign CFT and MMFT demands; (5) world trade and price linkages for cotton, CFT, MMF, and MMFT; (6) international price linkages and trade policy, and (7) U.S. government cotton farm policy elements. In the model, rayon represents the class of cellulosic MMFs and polyester represents the class of non-cellulosic MMFs. Besides the U.S., the model includes 34 other world regions, including 17 other cotton exporting regions (India, Brazil, Australia, Uzbekistan, Benin, Burkina Faso, Chad, Mali, Cote d'Ivoire, Nigeria, Zimbabwe, Kazakhstan, Tajikistan, Turkmenistan, Egypt, Argentina, and other Africa) and 16 importing regions (China, Bangladesh, Turkey, Vietnam, Pakistan, Taiwan, Japan, South Korea, Indonesia, Malaysia, Mexico, EU, Russia, other Asia, other America, and other Europe).

The Texas Tech University MWFM used in this analysis takes into account world markets and prices of not only cotton but also wool and MMF (synthetics, primarily polyester, and cellulosics, primarily rayon) and their interactions. Consequently, the model is capable of capturing spillover effects, that is, the impacts on the MMF industry induced by the promotional and marketing activities as well as the non-agricultural research activities of the Cotton Board.

Cotton production in all countries and regions in the model, including the U.S., is derived from behavioral equations for cotton harvested areas and yields. Generally, acreage equations are specified as a function of the expected net returns for cotton and competing crops, whereas yield is dependent on expected cotton price and time trend to account for technological change. In some countries or regions where cost of production data is not available, prices are used rather than expected return. For major players such as the U.S., China, and India, cotton production is estimated in a regional framework to capture regional differences in climate, water availability, and other natural resources that influence crop mix in different parts of the country.

The U.S. cotton supply sector in the model, for example, is divided into four production regions: (1) Delta, (2) Southeast, (3) Southwest, and (4) West. The Southwest is further subdivided into irrigated and dry-land areas of production. Cotton producers located in the irrigated areas of the Southwest might make considerably different acreage response decisions than cotton producers located in dry-land regions of the Southwest. Cotton competes for acreage with other commodities, primarily soybeans in the Delta and Southeast regions, sorghum and wheat in the Southwest, and corn and wheat in the West. Expected net returns for cotton and competing crops in the U.S. include both market returns and all government program payments such as direct payments, marketing assistance, loan deficiency payments, and counter cyclical payments. Producer cotton assessments associated with the checkoff program are treated as a cost and subtracted from the expected net returns.

MMF production for both synthetics and cellulosics is derived through the estimation of capacity and utilization behavioral equations for each country. Emphasis in the model is placed on cotton and MMF (primarily synthetics). The model representations of both cotton and MMF mill used, as modified for this analysis, are functions of the textile price in the downstream retail market, prices of raw cotton and MMF from the upstream market (mills), and the textile (non-agricultural research) expenditures of the Cotton Board in each world region as appropriate to the extent that the data are available. This structural representation of world fiber markets takes into account inter-fiber competition or complementary relationships between natural fibers and MMF in textile mill use as well as the important linkages between the raw fiber production segments of the marketing chain and the processing segments (mills) of the marketing chain in each region.

The MWFM representations of the U.S. demands for cotton and MMFT, as modified for this study, are calculated as the respective sums of the net imports of cotton and MMFT plus mill use of cotton and MMF, and are specified in the model to be functions of the textile price in the retail market, disposable personal income, and the marketing and textile (non-agricultural) research promotion activities of the Cotton Board. These components of the model solve for retail-level cotton textile and MMFT prices (proxies for retail cotton textile and MMFT prices) that also enter the respective U.S. mill demand equations as the output prices.

Finally, the MWFM also includes a series of international price and trade linkages for cotton, MMF, CFT, and MMFT to close the model. The price and trade linkages account for appropriate tariffs, quotas, tariff-rate quotas, and other border policies, as well as qualitative trade-related elements (such as the implementation of the new General Agreement on Tariffs and Trade [GATT] agreement under the World Trade Organization). In essence, the model solves for world synthetic prices as well as the world price of cotton (the A-index), which are linked to the respective domestic prices of cotton and MMF in each region. The cotton A-index and polyester prices (representative of world cotton price) are solved in the model by equalizing world exports and imports.

Data. Two general types of data were required for the analysis undertaken in this study: (1) data pertaining to cotton and other fiber and fiber textile supplies, demands, trade, prices, etc. across all countries and regions in the model, and (2) retail-level and mill-level advertising and promotion expenditures by the Cotton Board in all countries and regions of the model. The data in the first category are compiled from many publicly available sources, such as the U.S. Department of Agriculture (USDA 2006a, 2006b, and 1995-2006), the Food and Agricultural Policy Institute (FAPRI, 2006), the Food and Agriculture Organization of the United Nations (FAO, 2006), and the American Fiber Manufacturer Association (AFMA, 1989-2006) (see Pan et al., 2004 for a complete listing of data sources). The Cotton Board provided the data in the second category.

Model Parameter Estimation. The structural parameters of this multiequation model were estimated using the Ordinary Least Squares (OLS) estimator with 29 annual data observations for 1976/77 to 2004/05, the common time period and frequency across all endogenous and predetermined variables[4]. The estimated price and promotion elasticities across all countries and regions in the model are provided in Table 1. The four key equations of the Texas Tech University WFM that were re-specified and re-estimated for this analysis to account for the retail and mill-level cotton checkoff promotion expenditures (cotton and MMF retail demand equations and the cotton and MMF mill demand equations) are provided in Table 2 with variable definitions provided in Table 3.

4. Two or three-stage least squares procedures sometimes are used in the estimation of simultaneous systems. In this case, the large size of the model and the limited availability of annual observations resulted in a greater number of predetermined variables than observations. Given that the efficiency gained in parameter estimation with the use of 2SLS and 3SLS is actually consistent with a large number of data points, OLS was the estimator of choice in this analysis. Also, data for some years of the 1976/77-2004/05 time period were not available for some behavioral equations, further necessitating the use of OLS to estimate the behavioral equation parameters in the model.

Table 1. Key partial elasticities for selected variables in the MWFM.

Variable	Price Elasticities						Income Elasticities	Checkoff Expenditure Elasticities			
	Raw Fibers			Textiles				Marketing		Non-Ag Research	
	Cotton		Man-made Fibers[Z]	All Textiles	Cotton Fiber	Man-made Fibers		Short run	Long-run	Short-run	Long-run
	Short-run	Long-run									
Cotton Acreage											
United States											
Delta	0.06	0.16									
South East	0.21	4.02									
Southwest Irrigated	0.20	Y									
Southwest Dryland	0.40	Y									
West	0.27	Y									
China											
Xinjiang	0.19	1.01									
Yangtze River	0.21	0.79									
Yellow river	0.25	0.65									
Other	0.56	0.91									
India											
North	0.21	1.23									
Central	0.20	1.31									
South	0.17	0.28									
Brazil	0.16	0.45									
Egypt	0.24	0.77									
Australia	0.19	1.44									
Uzbekistan	0.13	0.17									
Pakistan	0.23	1.08									
Mexico	0.57	1.49									
Cotton Mill Use											
United States	-0.08		-0.26		0.41					0.03	0.09
China	-0.73		0.54								
India	-0.19		0.11								
Pakistan	-0.25		0.19								
Taiwan	-0.46		0.24								
South Korea	-0.51		0.31								
Japan	-0.47		0.21								
Mexico	-0.28		0.14								
Egypt	-0.36		0.12								
Man-Made Fiber Mill Use											
United States	-0.08		-0.20			0.20				0.01[X]	0.02[X]
Textile Fiber Consumption											
United States (Cotton)					-0.41		0.87	0.05	0.17		
United States (Man-made)						-0.24	0.56	0.01[X]	0.02[X]		
China				-0.25			0.74				
India				-0.05			0.57				
Pakistan				-0.53			0.64				
Taiwan				-0.03			0.09				
South Korea				-0.04			0.03				
Japan				-0.09			0.15				
Egypt				-0.38			0.52				
Turkey				-0.35			0.36				
EU-15				-0.11			0.21				
Mexico				-0.29			0.81				

[Z] Polyester.

[Y] Not statistically different from short-run elasticity.

[X] Not statistically different from zero.

[W] Short-run own price elasticity.

[V] Long-run own price elasticity.

Table 2. The four key U.S. demand equations in the MCERI model[z].

(1) TCFCUS =

Constant	*RCTFPIUS	*RDPI	*QUOTA	*DSTRUC5
6520.30	- 36.59	+ 1.04	- 361.14	- 411.91
(2074.39)	(19.83)	(0.17)	(191.74)	(176.05)
[0.005]	[0.081]	[0.000]	[0.075]	[0.030]

*RCPIE	*D2004	*$RMEXP_t$	*$RMEXP_{t-1}$	*$RMEXP_{t-2}$
- 49.79	+ 943.95	+ 17.87	+ 23.83	+ 17.87
(6.28)	(345.79)	(4.45)	(5.93)	(4.45)
[0.000]	[0.013]	[0.001]	[0.001]	[0.001]

Adj. $R^2 = 0.992$ DW = 2.00

(2) MMFCUS =

Constant	*RMMFPIUS	*RDPI	*WTOLIB	*D80	*D81
7012.19	- 33.47	+ 1.06	+ 488.02	- 1636.37	- 1578.59
(2595.13)	(20.34)	(0.22)	(318.35)	(371.99)	(361.78)
[0.0146]	[0.117]	[0.000]	[0.143]	[0.000]	[0.000]

*D899091	*D2000	*$RMEXP_t$	*$RMEXP_{t-1}$	*$RMEXP_{t-2}$
- 898.48	- 945.40	+ 2.99	+ 3.99	+ 2.99
(225.31)	(367.43)	(5.64)	(7.52)	(5.64)
[0.001]	[0.019]	[0.602]	[0.602]	[0.602]

Adj. $R^2 = 0.979$ DW = 1.90

(3) CTMILLUSE =

Constant	*RCTFPIUS	*RECMPUS	*RPOLYP	*WTOLIB
242.79	+ 21.21	- 598.62	- 17.40	- 857.54
(701.29)	(11.50)	(498.29)	(6.27)	(105.32)
[0.734]	[0.085]	[0.248]	[0.014]	[0.000]

*$CTMILLUSE_{t-1}$	*DSTRUC4	*D9495	*D99	*D2004
+ 0.83	- 4109.93	+ 365.15	+ 443.26	+ 379.09
(0.05)	(71.43)	(90.07)	(143.64)	(155.58)
[0.000]	[0.000]	[0.000]	[0.008]	[0.028]

*$RNAEXP_{t-1}$	*$RNAEXP_{t-2}$	*$RNAEXP_{t-3}$
+ 19.60	+ 26.13	+ 19.60
(13.23)	(17.65)	(13.23)
[0.159]	[0.159]	[0.159]

Adj. $R^2 = 0.990$ DW = 2.49

(4) MMFMILLUSE =

Constant	*RMMFPIUS	*RECMPUS	*RPOLYP	*WTOLIB
2359.92	+ 24.16	- 1488.48	- 31.97	- 696.85
(1730.47)	(17.97)	(939.15)	(9.31)	(128.60)
[0.193]	[0.199]	[0.134]	[0.004]	[0.000]

*$MMFMILLUSE_{t-1}$	*D82	*D2000	*$RNAEXP_{t-1}$	*$RNAEXP_{t-2}$
+ 0.83	- 1331.41	- 847.17	+ 9.24	+ 12.32
(0.10)	(325.90)	(267.05)	(18.01)	(24.02)
[0.000]	[0.001]	[0.006]	[0.616]	[0.616]

*$RNAEXP_{t-3}$	*AR(1)
+ 9.24	- 0.451
(18.01)	(0.24)
[0.616]	[0.084]

Adj. $R^2 = 0.962$ DW = 2.17

[z] **See definition of variable names in Table 3. Estimated standard errors are reported in parentheses below the corresponding coefficients. Two-sided p-values associated with the corresponding estimated coefficients are reported in brackets.**

Table 3. Definitions of variables in the four key demand equations of the MCERI model.

Variable		Description
AR(1)	=	Coefficient in the autoregressive process (AR) of order 1 for the residuals, e(t)-AR(1)*e(t-1)
CPIE	=	Consumer price index for energy, 1982-84=100
CPIU	=	Nominal CPI for all items in the U.S., 1982-84=100
CTFPIUS	=	Cotton textile fiber price index, 1991-92=100
CTMILLUSE	=	Mill level consumption of cotton fiber (million lb)
CTMPUS	=	Nominal price of cotton paid by domestic mills ($/lb)
CTSWPUS	=	Nominal price of cotton related to the two-step program
D200x	=	Dummy variable = 1 for year 200x; 0 otherwise
DSTRUC4	=	D81+D84-D89-D91
DSTRUC5	=	D85+D87+D89
Dxx	=	Dummy variable = 1 for year 19xx; 0 otherwise
MEXPND	=	Nominal advertising and promotion expenditures (million $)
MMFCUS	=	Total man-made fiber textile consumption (million lb)
MMFMILLUSE	=	Mill level consumption of man-made fiber (million lb)
MMFPIUS	=	Nominal man-made fiber textile price index, 1991-92=100
NAEXPND	=	Nominal non-agricultural research expenditures (million $)
POLYESTERPUS	=	Nominal price of polyester in the U.S., ¢/lb
RPOLYP	=	Real price of polyester (POLYESTERPUS*100/CPIU)
QUOTA	=	D2000 + D2001
RCPIE	=	Real CPI for energy (CPIE*100/CPIU)
RCTFPIUS	=	Real cotton textile fiber price index (CTFPIUS*100/CPIU)
RDPI	=	Real disposable personal income in the US (billion $)
RECMPUS	=	Real price of cotton paid by domestic mills ((CTMPUS-.85*CTSWPUS)*100/CPIU)
RMEXP	=	Real advertising and promotion expenditures (million $) (MEXPND*100/CPIU)
RMMFPIUS	=	Real man-made fiber textile price index (MMFPIUS*100/CPIU)
RNAEXP	=	Real non-agricultural research expenditures (million $) (NAEXPND*100/CPIU)
TCFCUS	=	Total cotton fiber textile consumption (million lb)
WTOLIB	=	Dummy variable 1 for years 1998 and beyond; 0 otherwise

For all regions, cotton mill demand and cotton acreage (short run) are estimated to be highly inelastic. Note that although polyester and cotton are found to be substitutes in foreign cotton milling, they are estimated to be complements in U.S. cotton milling, a finding consistent with the conclusions of a number of other studies, including Capps et al. (1997), Ding and Kinnucan (1996), and Murray et al. (2001). The retail demands for all textiles across all countries in the model, including the U.S., are found to be inelastic with respect to both prices and income (Table 1).

The lag, carryover, and decay effects associated with both U.S. mill-level and U.S. retail-level cotton advertising and promotion programs are accounted for in this analysis through the use of the polynomial distributed lag (PDL) procedure, a lag formulation commonly used in the analysis of advertising effectiveness. The attractive features of the PDL include a flexible representation of the lag structure allowing for the possibility of humped-shaped or monotonically declining lag weight distributions and a parsimonious representation of the lag structure (Simon and Arndt, 1980). The search for the polynomial degree and lag length for each advertising variable involved a series of nested OLS regressions. Second, third, and fourth degree polynomials with lags up to 10 yr were considered in each case. The Akaike Information Criteria and the Schwarz Information Criterion statistics were used for selecting lag length.

Following this procedure, the optimal lag length for the effects of Cotton Board mill-level promotion expenditures on the U.S. demands for both cotton and MMFs was 4 yr with the PDL beginning in the second year of expenditures. The estimated short-run elasticity of mill-level promotion expenditures with respect to U.S. cotton mill use is 0.03 with a cumulative (long-run) estimated elasticity of 0.09 (Table 1). This result is similar to that of Capps et al. (1997). Murray et al. (2001) reported an estimated cumulative promotion elasticity at the U.S. mill-level of 0.31 to 0.35, which is well above the estimated elasticity in this study and also relative to those reported for other commodities (see Williams and Nichols, 1998). For U.S. MMF mill demand, the effects of mill-level cotton promotion are found to be not statistically significant implying that cotton promotion has had no measurable direct impact on U.S. MMF mill demand.

The optimal lag length for the effects of retail-level promotion on the U.S. demands for both CFTs and MMFTs was 2 yr and the degree of the polynomial was two with the PDL beginning with the current level of expenditures. This finding also is consistent with Capps et al. (1997) as well as Ding and Kinnucan (1996). Both head and tail endpoint restrictions were employed in the analysis. Using the PDL formulation, the short-run advertising elasticity for U.S. CFT demand was estimated to be 0.05 with a cumulative (long-run) advertising elasticity of 0.17 (Table 1), which falls in the 0.01 to 0.25 range of short-run and long-run, retail-level promotion elasticities of demand reported by most other studies of generic advertising programs (Williams and Nichols, 1998). The results imply that cotton checkoff expenditures have effectively shifted out the U.S. demand for CFTs over time. Capps et al. (1997) reported a retail-level elasticity of cotton checkoff promotion of 0.06 in the short-run and 0.10 in the long-run. Murray et al (2001), however, reported a much smaller elasticity of 0.02. Ding and Kinnucan (1996) reported a long-run advertising elasticity of retail cotton demand of 0.07. For U.S. MMFT demand, the impact of retail-level cotton checkoff expenditures also was found to be not statistically different from zero implying no statistically discernible direct spillover effect of retail-level cotton promotion on U.S. MMFT demand.

Model Validation. Validation of the MWFM consisted of a check on the dynamic, within-sample (ex-post) simulation statistics over the period of 1986/87 to 2004/05. The dynamic simulation statistics, including the root mean-squared error as well as the mean-squared error, Theil inequality coefficients, and Theil error decomposition proportions all indicate a highly satisfactory fit of the historical, dynamic simulation solution values to observed data. Most of the Theil inequality coefficients are close to zero, indicating excellent model performance. The bias and variance proportions are close to zero, indicative of the model's ability not only to replicate the observed values of endogenous variables over time on average, but also to replicate their variability.

RESULTS AND DISCUSSION

Simulation Analysis. The simulation analysis uses the MWFM to address the two questions posed in the introduction: (1) What have been the effects of cotton promotion on the U.S. and world cotton and CFT markets and the associated spillover effects on MMF markets, and (2) Have the net benefits of the program to domestic cotton producers and cotton importers been greater than the costs of the promotion? To answer these questions, two basic scenarios were simulated with the model: (1) “With” promotion expenditures in which both retail-level and mill-level cotton checkoff promotion expenditures were set to their actual historical levels and (2) “Without” promotion expenditures in which those expenditures were set to zero over the history of the program.

First, the model was used to generate a baseline historical simulation of the various endogenous variables in the model (e.g., cotton, CFT, MMF, and MMFT production, mill-level and retail-level demand, prices, and trade) during the 1986/87 to 2004/05 period of analysis that closely replicates their actual, historical values. Because all cotton checkoff promotion expenditures were set to their actual historical values, the baseline simulation represents the With scenario. The baseline simulation accounts for all major exogenous forces affecting world fiber markets, such as advances in cotton productivity from technological developments and cultural practices, boll weevil eradication programs, and improved cotton varieties.

Next, all cotton checkoff promotion expenditures were set to zero and the model was simulated once again over the same period to generate the Without scenario results for the endogenous variables in the model. These results provide a measure of what the levels of production, prices, consumption, mill use, trade, etc. would have been in the absence of the cotton checkoff program over the period of analysis. Differences in the solution values of the endogenous variables in the Without scenario from their baseline solution values in the With scenario consequently are direct measures of the effects of the promotion activities of the Cotton Board over time.

Because no exogenous variable other than cotton checkoff promotion expenditures in the MWFM is allowed to change as the two simulation scenarios are conducted, the process just described effectively isolates the impacts of retail-level and the mill-level cotton checkoff advertising and promotion expenditures on the respective endogenous variables. The estimated cotton promotion expenditure elasticities with respect to both MMF mill demand and MMFT demand were set to zero in the simulation analysis given that they were found to be not statistically significant.

In analyzing the effects of the cotton checkoff program over the entire period of 1986/87 to 2004/05, the effects of the program were divided into two distinct periods: (1) 1986/87 to 1991/92 representing the period after implementation of the CRPA of 1966 but before the implementation of the CRPAA of 1990 and (2) 1992/93 to 2004/05 representing the period following the implementation of the CRPAA of 1990. The first period is referred to as the “voluntary” period because even though all domestic producers were required to pay the cotton checkoff assessment during that time period, they could request a refund of their payments. The second period is labeled the “mandatory” period because all cotton marketed in the U.S., whether from domestic or foreign production, during that time period was required to share in the cost of the cotton checkoff program and the right to demand a refund of the assessments was terminated. Given the increase in the magnitude of the budget available to the Cotton Board due to the CRPAA of 1990, the hypothesis is that greater market impacts of the checkoff program occurred in the mandatory period relative to the voluntary period.

Simulation Results. The simulation results demonstrate clearly that the cotton checkoff promotion program increased U.S. raw cotton production, mill use, and prices over the entire period of 1986/87 to 2004/05 (Table 4). The key average annual impacts of the cotton checkoff program on world cotton and CFT markets over the period of analysis according to the simulation results included: (1) 4% higher U.S. cotton production with much of the increase taking place in western and southeastern states; (2) 2% higher foreign cotton production; (3) higher U.S. and foreign cotton mill use by about 16% and 1%, respectively; (4) 7% lower U.S. cotton exports offset in world markets to a large degree by nearly 2% higher foreign cotton exports; (5) higher annual average prices of cotton, including the U.S. farm price (13% higher), the U.S. mill price (14% higher), and the world price of cotton measured by the A-index (2% higher); (6) 10% higher U.S. CFT use along with higher U.S. CFT imports of about 5% resulting in a larger share of the U.S. CFT consumption being supplied by foreign rather than domestic mills; and (7) 2% lower U.S. CFT price. Note that these are average annual changes and not average year-to-year changes

Despite having no direct effects on U.S. demand for MMF at the mill and retail levels, cotton promotion expenditures demonstrated important indirect effects in the simulation analysis through price linkages to cotton and CFT markets. The salient annual average spillover effects included: (1) a small negative impact on the U.S. production of synthetics and cellulosics (0.1%); (2) 3% lower U.S. MMF mill use; (3) 1.2% lower U.S. polyester price; (4) 22% higher net U.S. MMFT imports; (5) 1% lower U.S. MMFT consumption; and (6) 5% higher U.S. MMFT price (Table 4).

Benefit-Cost Analysis of the Cotton Checkoff Program. Although the simulation analysis clearly demonstrates that the cotton checkoff promotion program had measurable impacts on not only U.S. cotton markets but also the entire world fiber industry, the important question for cotton producers and importers who pay the costs of the cotton promotion programs with their checkoff assessments is whether the market effects have generated sufficiently large additional net revenues to them to justify their respective contributions to the cost of the program. The standard method to address this question is to calculate the benefit-to-cost ratio (BCR) (i.e., the average return per dollar spent on the checkoff program) for each contributing group.

The producer BCR (PBCR) is calculated as the total producer revenue added as a consequence of the cotton checkoff expenditures over time divided by the level of checkoff expenditures made to generate those additional revenues after deducting the additional production costs required to produce the additional output generated. For a given period (t), the net additional revenue received by cotton producers is calculated as:

$$(1) \quad R_t = (P_{ct}^{w} Q_{ct}^{w} - C_{ct}^{w} Q_{ct}^{w}) - (P_{ct}^{wo} Q_{ct}^{wo} - C_{ct}^{wo} Q_{ct}^{wo}),$$

Table 4. Selected simulated average annual effects of cotton promotion expenditures (retail-level and mill-level) on U.S. and foreign world fiber markets, 1986/87 to 2004/05[z].

	Voluntary Period	Mandatory Period	All Years of Expenditures	
	1986/87 – 1991/92	1992/93 – 2004/05	1986/87 – 2004/05	
U.S. Cotton Market	average annual change			ave. annual % change
Cotton Production (million lbs)				
Delta	3.4	63.1	46.0	1.7
Southeast	11.4	164.8	121.0	7.3
Southwest irrigated	6.1	21.2	35.2	2.6
Southwest dryland	3.5	21.3	16.3	1.5
West	12.8	149.5	110.4	7.5
Total production	40.8	458.7	339.3	4.0
Mill Use (million lbs)	285.7	808.7	659.3	15.8
Exports (million lbs)	-218.2	-353.3	-314.7	-7.1
Prices (cents/lb)				
Farm price	4.0	10.0	8.2	13.2
Effective Price Paid by Mills	4.3	10.8	8.9	13.5
Foreign Cotton Markets				
Production (million lbs)	193.9	1,232.3	935.7	2.3
Mill Use (million lbs)	-56.5	739.9	512.4	1.2
Exports (million lbs)	264.2	231.0	240.5	1.9
World Price (A-index) (Cents/lb)	0.0	1.9	1.4	1.8
U.S. Cotton Fiber Textile Market				
Consumption (million lbs)	428.4	1,029.9	858.0	10.2
Net Imports (million lbs)	142.6	221.1	198.7	4.6
Cotton Fiber Textile Price Index	2.7	-3.7	-1.9	-2.0
U.S. Man-made Fiber Market				
Production (million lbs)				
Synthetic	-0.8	-5.5	-4.1	-0.1
Cellulosic	-1.2	0.1	-0.2	-0.1
Mill Use (million lbs)	-118.5	-341.5	-277.8	-2.9
Polyester Price (cents/lb)	-1.4	-0.6	-0.9	-1.2
U.S. Man-made Fiber Textile Market				
Consumption (million lbs)	-8.0	-93.1	-68.8	-0.6
Net Imports (million lbs)	110.5	248.4	209.0	22.4
Man-made Fiber Textile Price Index	0.4	4.6	3.4	5.2

[Z] Includes effects of expenditures on indicated variables in each year in the given time periods in not only the corresponding years but also in the years beyond the year of expenditure.

where P_c is the price of cotton received by producers; C is production cost per unit of output; Q_c is cotton production; and w and wo indicate With and Without cotton checkoff promotion expenditures, respectively. Then, the PBCR is calculated as:

$$(2) \quad PBCR = \frac{\sum_{t=1}^{T} R_t}{\sum_{t=1}^{T} E_t},$$

where E is the cotton checkoff promotion expenditures. The expenditures in each year (E_t) can be netted out of the additional profit generated (R_t) in those years to calculate a Producer Net Profit BCR (NBCR). To account for the time value of money in calculating the PBCR, the producer net profits can also be discounted over time to present value before dividing by the total checkoff expenditures to obtain the Discounted Producer Net Profit BCR (DBCR).

The importer BCR (IBCR) is somewhat more complicated to calculate because importers earn revenues from both CFT and MMFT sales. Thus, for any given year (t), the revenue increase to importers as a result of cotton promotion (N) is calculated as:

$$(3) \quad N_t = (P^{w}_{cft}Q^{w}_{cft} - P^{wo}_{cft}Q^{wo}_{cft}) + (P^{w}_{mft}Q^{w}_{mft} - P^{wo}_{mft}Q^{wo}_{mft}),$$

where P is price, Q is quantity sold, the subscripts cft and mft indicate CFT and MMFT, respectively, and the superscripts w and wo again indicate With and Without the cotton checkoff promotion expenditures. Because the costs to importers associated with additional CFT sales are unknown, the additional net profit accruing to importers in each year (M_t) can be approximated by assuming some realistic profit ratio earned by importers on CFT and MMFT sales (p) and multiplying by N from equation (3):

$$(4) \quad M_t = \pi N_t.$$

The IBCR is then calculated as additional net profits earned by importers over time as a result of cotton promotion ($\sum_{t=1}^{T} M_t$) divided by the total cost of the promotion over time ($\sum_{t=1}^{T} E_t$). As with the NBCR, the IBCR can be discounted to present value to account for the time value of money.

Cotton Producer BCR Analysis. The simulation results indicate that over the voluntary period of the checkoff program (1986/87–1991/92) the cumulative added net revenues to producers as a result of cotton promotion amounted to $220 million, roughly $37 million per year or about 0.9% of the total cotton farm receipts received, excluding government payments (Table 5). Note that added net revenues were positive to non-participants in farm programs and negative for farm program participants during this period. Because farm program participants during that period received deficiency payments, the increase in market price had no effect on the revenue per pound of cotton they received. The primary effect on farm program participants was a change in the source of about 5% of their total revenues from the government to the market (Table 5). However, the higher cotton farm price induced by the cotton checkoff program encouraged fewer producers to participate in farm programs so that total revenues earned by participating cotton producers were actually lower as a result of cotton promotion. On the other hand, the sales of non-participants were benefited by the higher cotton farm price of cotton induced by cotton promotion.

The primary beneficiary of the cotton checkoff program during the voluntary period was the federal government. Had it not been for the cotton checkoff program, government cotton program costs would have been higher by about $221 million per year, an annual savings of about 22% (Table 5). From the perspective of cotton producers, the checkoff program during that period functioned primarily as a means of reducing their dependence on government farm programs.

During the mandatory period, however, both participants and non-participants in farm programs benefited from the boost in the cotton price and mill demand generated by cotton promotion expenditures because the 1996 FAIR Act eliminated deficiency payments during that period, forcing production decisions to become more responsive to changes in market conditions. Consequently, cotton promotion expenditures during the mandatory period had larger revenue implications for cotton producers than was the case during the voluntary period ($6.4 billion compared to $220.1 million) (Table 5). The cumulative reduction in government expenditures due to cotton promotion in the mandatory period amounted to about $6.5 billion or about $502 million per year, an annual savings of approximately 28%. Over the entire period of 1986/87 to 2004/05, the cumulative savings in government cotton program outlays totaled about $7.9 billion, an annual savings of about $413 million or approximately 27%.

Table 5. Producer benefit-cost analysis, 1986/87 to 2004/05.

	Voluntary Period 1986/87-1991/92		Mandatory Period 1992/93-2004/05		Entire Period of Analysis 1986/87-2004/05	
	Cumulative	Annual Average	Cumulative	Annual Average	Cumulative	Annual Average
Added Net Revenues to Cotton Producers ($ million)						
Non-Participants in Farm Program	251.2	41.9	321.8	24.8	573.0	30.2
Farm Program Participants	-31.1	-5.2	6,084.6	468.0	6,053.5	318.6
All Cotton Producers	220.1	36.7	6,406.4	492.8	6,626.5	348.8
Historical Cotton Producer Revenues ($ million)	25,047.2	4,174.5	63,898.8	4,915.3	88,946.1	4,681.4
Ratio of Added Net Revenues to Historical Revenues	0.9%		10.0%		7.5%	
Farm Program Cost Savings ($ million)	1,328.1	221.4	6,523.7	501.8	7,851.8	413.3
Historical Cotton Farm Program Cost ($million)	5,893.7	982.3	23,659.7	1,820.0	29,553.4	1,555.4
Ratio of Cost Savings to Total Cotton Program Costs	22.5%		27.6%		26.6%	
Ratio of Cost Savings to Total Cotton Producer Revenue	5.3%		10.2%		8.8%	
Total Added Revenue (Producers + Government) ($ million)	1,548.2	258.0	12,930.1	994.6	14,478.3	762.0
Total Cotton Check-off Expenditures[Z] ($ million)	140.3	23.4	629.3	48.4	769.6	40.5
Net Benefit-Cost Ratios ($ Added Net Revenue/$ Spent)						
Producer Net BCR (Added Net Revenue/$ Spent)[Y]	0.6		9.2		7.6	
Government Net BCR (Cost Savings/$ Spent)	9.5		10.4		10.2	
Total Net BCR (Producers and Government)[y]	10.0		19.5		17.8	
Discounted Benefit-Cost Ratios ($ Added NR/$ Spent)[X]						
Producer Discounted BCR (Added NR/$ Spent)[Y]	0.5		7.5		5.7	
Government Discounted BCR (Cost Savings/$ Spent)	7.6		7.7		6.9	
Total Discounted BCR (Producers and Government)[Y]	9.1		16.0		13.4	

[Z] **Retail-level and wholesale-level checkoff promotion expenditures.**

[Y] **Producer assessment has been subtracted from added net revenue of producers.**

[X] **Present value of added revenues/cost savings calculated using the Treasury bill rate in each year as the cost of capital.**

Using the estimated added net farm revenues as a result of the cotton checkoff program as the producer benefit of the program, the calculated (undiscounted) NBCRs during the voluntary and mandatory periods were 0.6 and 9.2, respectively, for a weighted average of 7.6 over the entire period (Table 5). That the government was the primary beneficiary of cotton checkoff programs in the earlier period is evident in the low calculated NBCR for that period. During the mandatory period of the program, however, the cotton promotion program more than paid for itself in terms of net revenues generated per dollar spent by the Cotton Board on promotion. Capps et al. (1997) reported undiscounted NBCRs of about -0.7 under the voluntary program and 3.2 to 3.5 under the mandatory program. Murray et al. (2001) reported undiscounted NBCRs for the mandatory period in the range of 3.2 to 6.0. Combining the benefits accruing to domestic producers with the reduction in government outlays generated by the cotton checkoff program, the total NBCRs for the cotton checkoff program at the farm level over both the voluntary and mandatory periods were 10.0 and 19.5, respectively, an average of 17.8 over the entire period.

Cotton Importer BCR Analysis. Importers began paying the cotton checkoff assessment in 1992 with the implementation of the CRPAA of 1990. Since that time, cotton promotion has boosted importer CFT and MMFT sales by annual averages of 9% and 5.5%, respectively, for a total of about $258 billion ($19.8 billion per year) (Table 6). According to the financial data of 18 major apparel and home furnishings retailers, the average industry pre-tax profits to sales ratio ranged from 4.2 to 6.5% between 1994 and 2003 (Cotton Incorporated, 2006, Personal communication). Applying the median profit ratio of 5% to the cumulative additional CFT and MMFT sales generated by cotton checkoff promotion expenditures according to Equation (3) yields an increase in profits to the U.S. retail textile sales industry of about $12.9 billion. Thus, the calculated IBCR over the 1992/93 to 2004/05 period was 19.5 (14.4 discounted) (Table 6). Capps et al. (1997) and Murray et al. (2001) reported lower undiscounted IBCRs of 3.63 to 5.59 and 1.90 to 3.40, respectively. Those two studies, however, failed to capture spillover effects from the MMF industry and, therefore, underestimated the retail benefits of cotton checkoff promotion.

Table 6. Importer benefit-cost analysis, 1992/93 to 2004/05.

	All Years of Expenditures (1992/93 – 2004/05)	
	Cumulative	Annual Average
	$ million	
Added Sales Revenue to Importers		
Cotton Fiber Textile Products	139,501.6	10,730.9
Man-Made Fiber Textile Products	118,060.0	9,081.5
Total	257,561.6	19,812.4
Added Importer Profit (5% of Revenue)	12,878.1	990.6
Total Cotton Check-off Expenditures[Z] ($ million)	629.3	48.4
Importer BCR[Y] ($ profit/$ spent)	19.5	
Discounted Importer BCR[Y,X] ($ profit/$ spent)	14.4	
Added Sales Revenue as a Percent of Historical Retail Textile Product Sales Revenue		
Cotton Fiber Textile Products	9.1%	
Man-Made Fiber Textile Products	5.5%	
Total	7.0%	

[Z] Retail-level and wholesale-level checkoff promotion expenditures.

[Y] Importer assessment has been subtracted from added profit.

[X] Present value of added profit calculated assuming a 5% cost of capital in each year.

Sensitivity Tests. Because the BCR calculations might be sensitive to the magnitudes of the mill-level and retail-level promotion elasticities, a sensitivity analysis was performed in which the elasticities first were reduced to one standard deviation below their original levels and then to one-half their original value. The results indicate that even if one considers the BCR estimates for the cotton checkoff program reported here to be on the high side, reducing the estimated responsiveness of cotton mill demand and cotton fiber demand to cotton checkoff promotion to some lower bound still results in a minimum positive return to cotton producers from their investment in the cotton checkoff program of about $3 per dollar spent on promotion.

CONCLUSION

The main conclusion of this study is that the cotton checkoff program has been worth the cost to importers over the years but only to producers in periods when government cotton policies have allowed cotton production to respond to market prices. Major findings of this study include the following.U.S. cotton producers earned an average of $5.6 (discounted basis) from every cotton checkoff dollar spent on promotion over the period of 1986/87 to 2004/05. U.S. cotton importers earned an even higher average return of $14.4 per checkoff dollar (discounted) over the same period. The higher return to importers is due largely to the spillover effects of cotton checkoff programs at retail to MMFT markets. The federal government was a primary beneficiary of the cotton checkoff program over the same period. The deficiency and counter-cyclical payments programs in place for much of the period forced much of the benefits of cotton promotion to accrue to the federal government in terms of farm program cost savings of about $413.3 million per year, an annual average savings of about 27%.The cotton checkoff program affects the entire world fiber market. Over the 1986/87 to 2004/05 period, the checkoff program lead to higher U.S. and foreign cotton production and mill use, U.S. CFT consumption and imports, and cotton prices, and lower U.S. cotton exports and U.S. CFT price. The program also lead to lower U.S. MMF production and mill use, U.S. MMF price, and U.S. MMFT consumption, but higher U.S. price and imports of MMFTs.

These conclusions suggest a number of implications for management of the cotton checkoff program. First, although acting as an effective cotton price support tool, the checkoff program offers little net benefit to cotton producers at a substantial cost during periods when government price and income support programs are in operation. During the voluntary period of the program, the deficiency payment feature of cotton policies set target prices well above market prices and guaranteed payments to farmers despite the level of the farm price. Consequently, cotton promotion actually reduced the profitability of cotton production during that period by returning less than $1 in benefit to producers for every dollar spent on promotion.

Second, the high average PBCR to checkoff promotion expenditures during the mandatory period suggests that without federal price and income support programs, farm level returns from the checkoff program could be increased substantially by boosting the current level of funding for cotton promotion. Although an increase in the level of promotion expenditures would likely lead to a somewhat lower PBCR given the currently low level of those expenditures, even an extraordinary expansion in promotion funding would likely have a relatively small negative effect on the returns to producers. Thus, the optimal cotton promotion strategy might be to invest checkoff funds in interest-bearing instruments during years when the farm program features income and/or price supports and then use the funds saved to promote cotton during years when such programs are eliminated.

Third, the price enhancing feature of cotton promotion implies that importers benefit from promotion programs even when farm programs prevent farmers from doing so. This phenomenon partially explains why importer returns have been larger than producer returns since importers began paying a cotton checkoff assessment in the early 1990s.

Finally, although the execution of cotton promotion programs successfully avoids any direct stimulation of competing fiber demand, other fiber industries benefit nonetheless as the positive price effects on cotton fiber products lead consumers to substitute away from CFT products to those made with competing fibers. Nearly half the additional revenues earned by importers as a result of cotton promotion have come from additional sales of MMFTs prompted by the promotion-induced increase in the CFT price.

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