COTTON RESEARCH AND PROMOTION PROGRAM: ECONOMIC EFFFECTIVENESS STUDY

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ABSTRACT

This study of the effectiveness of the cotton checkoff program is the fourth commissioned by the Cotton Board since such evaluations became a requirement for all mandatory commodity checkoff programs under the 1996 Farm Bill. A discussion of the model used and the analytical results is preceded by a background discussion of U.S. and global cotton and textile markets, an overview of the cotton checkoff program, and a brief primer on the economics of cotton advertising and promotion. The report concludes that the cotton checkoff program clearly has enhanced cotton demand, augmented U.S. cotton yields and production over time, generated a positive return to both cotton producers and importers, reduced the dependence of cotton producers on government farm programs, and benefited taxpayers.

Key words: cotton checkoff program, cotton, man-made fibers, textiles, producer and importer assessments, econometric simulation model, benefit-cost analysis.

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COTTON RESEARCH AND PROMOTION PROGRAM: ECONOMIC EFFECTIVENESS STUDY

EXECUTIVE SUMMARY

This study of the effectiveness of the cotton checkoff program is the fourth commissioned by the Cotton Board since such evaluations became a requirement for all mandatory commodity checkoff programs under the 1996 Farm Bill. The cotton checkoff program was established under the Cotton Research and Promotion Act (CRPA) of 1966 in an effort to arrest the erosion of consumer demand for cotton "with the view of eventually reducing or eliminating the need for limiting marketings and supporting the price of cotton". The legislative intent of the CRPA and subsequent legislation, including the Cotton Research and Promotion Amendments Act (CRPAA) of 1990 was two-fold: (1) to authorize and enable the establishment of an effective and coordinated program of cotton research and promotion and (2) to reduce the dependence of cotton producers on government farm programs. 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 cotton research and promotion activities. The CRPAA of 1990 required cotton textile and apparel product importers 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? Has the program reduced the dependence of producers on government support programs? This report examines these general questions with a particular focus on empirically measuring:

- The effects of the cotton checkoff program on the demand for raw cotton (mill level) and the demand for cotton fiber textile products (retail level);
- The spillover effects of the cotton checkoff program on man-made fiber markets;
- The economic effects of the agricultural research programs funded with cotton checkoff dollars;
- The overall return on investment from the cotton checkoff program to U.S. cotton producers and importers of cotton fiber textile products; and
- The implications of the cotton checkoff program for government cotton program costs.

Under the cotton checkoff program as authorized by Congress, a checkoff assessment of one dollar per bale sold plus a fractional percentage of the value of the bale (five-tenths of one percent) is collected by first handlers on domestically produced (raw) cotton, imported (raw) cotton, and the cotton content of imported textile and apparel products. In nominal terms, expenditures from cotton checkoff collections have grown substantially over the years to over $77 million in 2009/10. The checkoff funds are used to finance activities at both the retail and wholesale (mill) levels of cotton markets in four general categories of expenditure: (1) marketing (retail-level), (2) textile research or non-agricultural research (mil-level), (3) agricultural research, and (4) administration. Currently, marketing activities account for 63% of checkoff expenditures while textile research accounts for about 16% and agricultural research 15%. The remaining 6% goes to pay administrative costs.

To measure the impact of cotton checkoff expenditures on demand as well as the returns to those who pay the checkoff assessments, the World Fiber Model developed at Texas Tech University is used in this study to conduct a simulation analysis of the cotton checkoff program. The analysis focuses specifically on determining: (1) the effects of cotton promotion on the U.S. and world cotton and cotton fiber textile markets and the associated spillover effects on man-made fiber markets, (2) the returns to domestic cotton producers and cotton importers from their investments in the checkoff program, and (3) the effects of the program in potentially reducing the dependence of producers on government support programs.

First, the relationships between checkoff expenditures and the demand for cotton at the retail and wholesale (mill) levels is statistically determined and incorporated into the Texas Tech model. Then, the model is used to simulate two basic scenarios: (1) a baseline "With Promotion Expenditures" scenario in which both retail-level and mill-level cotton checkoff promotion expenditures are set to their actual historical levels and (2) a counterfactual "Without Promotion Expenditures" scenario in which those expenditures are set to zero over the history of the program. A comparison of the results of the two scenarios in terms of their effects on the levels of production, prices, consumption, mill use, trade, etc. in U.S. and world cotton and fiber markets provides a direct measures of the market effects of the promotion activities of the Cotton Board over time. Because no market forces other than cotton checkoff promotion expenditures in the Texas Tech model is allowed to change as the two simulation scenarios are conducted, this process effectively isolates the impacts of retail-level and the mill-level cotton checkoff advertising and promotion expenditures on domestic and world fiber market quantities and prices.

The simulated markets effects of promotion are reported for two time periods: (1) crop years (August/July) 1986/87 through 2009/10, referred to as the "full" or "entire" period of analysis and (2) crop years (August/July) 2005/06 through 2009/10, referred to as the "most recent five-year" or "last five-year" period of analysis, corresponding to the five-year period since the last checkoff evaluation study was conducted. Note that the analysis conducted here does <u>not</u> include the period since August 2010 when cotton prices began a rapid climb.

The main conclusion of the analysis is that the cotton checkoff program clearly has been worth the cost to both producers and importers as well as to taxpayers. Major findings over the full period of analysis include:

- U.S. cotton producers earned an average of $4.20 from every cotton checkoff dollar spent on promotion over the period of 1986/87-2009/10. U.S. cotton importers earned a higher average after-tax return of $10.70 per checkoff dollar over the same period.
- The U.S. taxpayer was a primary beneficiary of the cotton checkoff program over the same period. Over the last two decades, the deficiency, counter-cyclical payments, and marketing loan programs in place for much of the period meant that the higher cotton prices generated by the cotton checkoff program lead to farm program cost savings of about $203.5 million per year, an annual average savings of about 11%.

- The checkoff program reduced the dependence of cotton producers on government farm programs over same period. About one-half of the farm-level benefits of the cotton checkoff program served to enhance cotton producer profitability and one-half served to reduce their dependence on government farm programs.
- The cotton checkoff program affects the entire world fiber market. Over the 1986/87-2009/10 period, the checkoff program tended to increase U.S. and foreign cotton production and mill use, U.S. CFT consumption and imports, and cotton and CFT prices while reducing U.S. cotton exports.
- The cotton checkoff program has enhanced U.S. cotton yields and production over time but with a lag of between ten and twelve years depending on the production region.

The conclusions suggest a number of implications for management of the cotton checkoff program. First, although acting as an effective means of reducing cotton producer dependence on cotton farm programs during periods when government price and income support programs are in operation, the cotton checkoff program nevertheless offers little direct net benefit to cotton producers during those periods. The highest returns to producers occur in years when cotton prices are above target and loan rates. During those periods, increases in cotton prices resulting from cotton checkoff programs allow the benefits of cotton checkoff program to flow directly to producers rather than serving primarily to reduce cotton farm program costs.

Second, the high return to checkoff promotion expenditures over the period of analysis suggests that the program functions well to increase the net benefit to producers in years when farm prices exceed farm program support levels. Although an increase in the level of promotion expenditures would likely lead to a lower return in high price years due to the diminishing effectiveness of increases in promotion expenditures, a substantial increase in revenues could likely be achieved while still maintaining a reasonable BCR during those periods.

Third, the price-supporting feature of cotton promotion implies that importers benefit from promotion programs even in years when farm programs prevent farmers from doing so to the same extent. 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.

Fourth, other fiber industries benefit from the cotton checkoff program through the positive price effects on cotton fiber products which lead consumers to substitute away from those products to those made with competing fibers.

Finally, increasing the share of checkoff funding invested in agricultural research could effectively enhance the returns to producers from cotton checkoff expenditures. With cotton farm programs in place, research expenditures that successfully enhance production by raising yields and expanding area would effectively raise total farm revenues since any consequent downward pressure on prices would be compensated for by government farm program payments. A consistent, growing program of cotton checkoff investment in production research would generate a growing flow of returns to producers over time with little implication for producer revenues from any corresponding negative effects on farm prices – at least during years of government cotton programs similar to those in place over most of the last few decades.

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COTTON RESEARCH AND PROMOTION PROGRAM: ECONOMIC EFFECTIVENESS STUDY

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. In defense of the cotton industry, the federal government operated price support programs and implemented a number of regulations "with the objective of adjusting supply to demand in the interest of benefiting producers and all others concerned with the production and handling of cotton as well as the general economy of the country" (PL 89-502, 80 Stat. 279, Sec. 2, July 13, 1966). By the mid-1960s, however, cotton surpluses were mounting and existing cotton policies were largely ineffective at dealing with them (Stults et al., 1989). By the end of the 1965/66 crop year, cotton stocks had peaked at nearly 17 million bales which exceeded total use that year by 4.5 million bales. The following year, Congress passed the Cotton Research and Promotion Act (CRPA) of 1966 (7 USC 2101 et seq.) in an effort to arrest the erosion of consumer demand for cotton "with the view of eventually reducing or eliminating the need for limiting marketings and supporting the price of cotton".

In passing the CRPA, Congress was concerned about the growing cost of federal cotton programs and reasoned that the inroads into the textile fiber market made by synthetic fibers were due, for the most part, to research and promotion conducted primarily by large chemical firms. Consequently, the legislative intent of the CRPA and subsequent legislation, including the Cotton Research and Promotion Amendments Act (CRPAA) of 1990 (PL 101-624, 104 Stat. 3909, November 28, 1990), was two-fold: (1) to authorize and enable the establishment of an effective and coordinated program of cotton research and promotion and (2) to reduce the dependence of cotton producers on government farm programs. The 1966 Act 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 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. As a consequence, up to one-third of the assessments collected were refunded during that period. The CRPAA of 1990 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.

The existence of the CRPAA has raised several important questions for stakeholders and policy makers. 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? Has the program reduced the dependence of producers on government support programs? Has the program had a significant impact on lowering the costs of federal cotton support programs? This report examines these general questions with a particular focus on empirically measuring:

- The effects of the cotton checkoff program on the demand for raw cotton (mill level) and the demand for cotton fiber textile products (retail level);
- The spillover effects of the cotton checkoff program on man-made fiber markets;
- The effects of the agricultural research programs funded with cotton checkoff dollars;
- The overall return on investment associated with the cotton checkoff program principally to U.S. cotton producers and importers of cotton fiber textile products; and
- The implications of the cotton checkoff program for government cotton program costs.

In addressing these questions, the initial focus of this study is on the effects of the cotton checkoff program on cotton demand and the resulting impacts on world fiber prices and markets over the period of 1986/87-2009/10. Additionally, we consider the impacts of the checkoff program on the most recent five-year period from 2005/06 to 2009/10. Required every five years for all commodity checkoff programs under the 1996 Farm Bill, this study of the effectiveness of the cotton checkoff program is the fourth study commissioned by the Cotton Board since that time. The three previous evaluations include the "1996 Report" by Capps et al., the "2001 Report" by Murray et al., and the "2006 Report" by Capps and Williams.

This analysis of the cotton checkoff program is conducted using a multi-equation, 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 then used to conduct a benefit-cost analysis of the program at the producer and importer levels. The specific effects of the agricultural research program expenditures on the regional U.S. production of cotton are also analyzed. In this report, a discussion of the model used and the analytical results is preceded by a background discussion of U.S. and global cotton and textile markets, an overview of the cotton checkoff program, and a brief primer on the economics of cotton advertising and promotion. The report ends with a summary of the major conclusions and implications for management of the cotton checkoff program.

U.S. AND WORLD COTTON MARKETS

Currently, the nominal U.S. Gross Domestic Product (GDP) is almost $15 trillion, about 4.6% of which is contributed by the agricultural sector and related industries (USDAa and USDAc). Cotton production adds roughly $6 billion per year to the U.S. economy, accounting for 4% to 5% of the total value added to the U.S. economy from all crop production (Census Bureau, 2011). The farming, ginning, processing, warehousing, merchandising, and domestic milling segments of the U.S. cotton industry account for over 21,000 U.S. businesses and provide over 191,000 U.S. jobs (National Cotton Council, 2011).

Clearly the cotton and cotton textile industry is a critical component of the overall U.S. economy. In particular, U.S. consumers purchase cotton textiles in over 90 major product classifications in three broad categories: (1) home furnishings; (2) apparel; and (3) industrial products. Apparel is the predominant category, followed by home furnishings and industrial products (National Cotton Council, 2011).

Economic Structure of the U.S. Cotton Industry

The U.S. cotton industry is composed of two interdependent sectors: (1) the raw cotton sector and (2) the cotton textile sector. The raw cotton sector includes the supply (production and ginning) and demand (milling and exporting) of raw cotton fiber. The cotton textile sector includes the supply (milling, manufacturing, and importing) and demand (consumers) for cotton textiles. Note that the milling industry represents the demand side of the cotton sector but the supply side of the cotton textile sector. The cotton textile supply chain is exhibited in Figure 1.

U.S. and World Cotton Production

About 98% of the cotton produced in the U.S. is upland cotton. The remainder is extra-long staple (ELS) cotton or American Pima cotton, generally grown in the western part of the Cotton Belt. Since 1965, the U.S. cotton (upland and pima) area planted has ranged from a low of 7.9 million acres (during the 1983 PIK program) to a high of 16.9 million acres and averaged 12.6 million acres (Table 1). The variability in plantings over the 1965 to 2009 period largely reflects marketing and policy influences. Since 2006, the trend in planted acreage has been downward.

U.S. harvested cotton acreage follows a similar pattern, as influenced by weather and abandonment. Over the same period, cotton yields ranged from a low of 404 lb/acre in 1980 to a high of 879 lb/acre in 2007 with an average of 601 lb/acre. U.S. cotton yield, also influenced significantly by weather, has exhibited an upward trend in recent years from adoption of improved varieties and boll weevil eradication. U.S. cotton production over the 1965 to 2009 period ranged from 3.7 billion lb to 11.4 billion lb and averaged nearly 7.0 billion lb. Farm prices for cotton also varied widely between 1965 and 2009 from 21.8¢/lb to 76.5¢/lb and averaged 51.7¢/lb. Cotton farm receipts ranged from roughly $954 million to $6.8 billion and averaged nearly $4.0 billion.

Although roughly 80 countries produce cotton, India and China are currently the major competitors with the United States in the production of cotton. Together the three countries produce about 60% of the cotton in the world. The four other major foreign producers of cotton include the Former Soviet Union, Brazil, Turkey, and Pakistan (Table 2). Between 2005 and 2009, these four regions plus China and India accounted for 85% of total foreign cotton production. During that same period, India accounted for the largest share (31%) of total foreign cotton area harvested followed by China, (21%), Pakistan (11%), and the former Soviet Union (9%). Nevertheless, relatively higher yields over the same time period made China the largest foreign cotton producer (36% of total foreign production) followed by India (23%), Pakistan (10%), and the former Soviet Union (9%) (Table 2).

U.S. Cotton Trade

The U.S. has accounted for an average of 38% of global trade in raw cotton since 2001, which is up from an average 23% share over the 1981-2000 period (Table 3). The United States is the leading world exporter of raw cotton, and hence exports represent a major source of revenue for U.S. producers. Except for 1995, 1996, and 1998, U.S. imports of raw cotton were almost nonexistent. Even in those three years, U.S. imports of raw cotton were only a fraction of the level of exports and an even smaller fraction of the level of domestic cotton supply. Between 1965 and 1984, Pakistan, China, Turkey, Brazil, Sudan, and Egypt were the major non-U.S. exporters of cotton (Table 3). Since the mid-1980s, however, Uzbekistan and African countries have emerged as the leading foreign cotton export competitors for the United States. At times over the last twenty years, Pakistan, India, and China have played major roles in world cotton export markets. Since 2005, Australia, Brazil, and India have emerged as dominant export competitors along with Uzbekistan and French West Africa. The most consistent foreign cotton importing nations since the mid-1980s have been the EU-27, Russia, Japan, Indonesia, South Korea, Thailand, Taiwan, and China (Table 4). Imports of raw cotton by the EU-27, Russia, and Japan have declined steadily over time while imports of raw cotton by Indonesia, Thailand, Pakistan, and China have risen dramatically.

Cotton Milling and Textile Manufacturing

Cotton bales are shipped from gins and warehouses located throughout the U.S. Cotton Belt. The majority are shipped to foreign mills, with the remainder shipped to domestic U.S. mills (Figure 1). The remaining U.S. domestic cotton textile mills are concentrated in four states: (1) Alabama; (2) Georgia; (3) North Carolina; and (4) South Carolina. U.S. cotton mills largely have adopted a business plan of spinning cotton into yarn that is then exported.

U.S. mill use of cotton increased slowly from about 3.0 billion lb in the early 1980s to a little over 5.0 billion lb in the late 1990s and has since trended down sharply (Capps and Williams, 2006). For example, U.S. domestic mill use declined from 4.7 billion pounds in 2000 to 1.6 billion pounds in 2009, or about 3.3 million bales (Table 5). Rapidly growing U.S. imports of cotton fiber textile (processed cotton) products from foreign mills drastically reduced the domestic mill share of total U.S. cotton consumption (expressed in raw cotton fiber equivalents) from a fifteen year average (1986-2000) of 63% to just 18% in 2009.

Cotton Fiber Textile Trade

U.S. trade in processed cotton has followed quite a different pattern from that of U.S. trade in raw cotton. Beginning in the late 1980s, U.S. cotton textile exports began to increase rapidly reaching a peak at 2.3 billion lb in 2000, stabilized around 2.2 billion lb, and then more recently have declined to 1.5 billion lb in 2009 (Table 5). U.S. cotton textile exports, however, have not kept pace with the influx of cotton textile imports. Imports have captured a large and growing share of U.S. cotton consumption, from 30%-35% in the 1960s to over 80% by 2009 (Table 5).

The growth in net imports is due largely to strong growth in the U.S. demand for processed cotton products and the reduction in U.S. and world trade barriers primarily as a result of the

Agreement on Textiles and Clothing (ATC) signed in 1994 as part of the Uruguay Round of the General Agreements on Tariffs and Trade (GATT) negotiations. U.S. consumption of processed cotton products has more than doubled since the mid-1980s (Table 5). Almost 75% of the imports consist of apparel while less than 20% are fabric and other textile products (USDAc).

As barriers to world cotton and textile trade have declined, developing countries, where wages are much lower than those in the United States, have gained a competitive edge in global cotton fiber product markets. Apparel manufacturing is more labor intensive than textile processing. This growing competitive advantage has determined, in large part, the changing global pattern of cotton and textile production and manufacturing. In recent years, that pattern has included U.S. raw cotton production and exports to developing countries, milling and manufacturing in foreign countries, and then importation of the cotton textile goods back into the domestic U.S. market. The global pattern of trade also has included fabric construction in the United States, cutting and assembling in other countries, and then U.S. importation of the final cotton textile products. Unfortunately, reliable public and private estimates of how much apparel made of U.S.-produced cotton is imported back into the U.S. are not available.

U.S. Processed Cotton and Man-Made Fiber Demand[1]

Total domestic processed cotton fiber product consumption, defined as U.S. cotton mill use plus net imports of processed cotton (expressed on a raw cotton fiber equivalent basis), realized a dramatic increase from nearly 5.0 billion lb in 1986 to 9.9 billion lb in 2004 (Capps and Williams, 2006). On a per capita basis, total domestic consumption of processed cotton rose from 20.7 lb to a peak of 36.4 lb in 2005. Since 2005, per capita U.S. domestic consumption of cotton has trended downward to 29 lb in 2009 (Table 5). The more recent decline may be attributed partly to the recession that began in 2008. Per capita consumption of U.S. mill output of processed cotton rose from 13.9 lb to 19.9 lb between 1986 and 1997 and then afterwards declined precipitously to 5.2 lb in 2009 primarily due to the surge in processed cotton imports in recent years. Between 1986 and 1996, per capita consumption of imported processed cotton products increased by 47% from 6.8 lb to 10.0 lb and then jumped from 23.8 lb to 28.1 lb over the 2005 to 2009 period (Table 5).

U.S. per capita consumption of man-made fibers, including rayon (cellulosic fiber) and polyester (non-cellulosic fiber), has averaged 1.5 to 2 times higher than that of cotton since at least the mid-1980s (Table 6). Since the mid-1980s, the annual U.S. per capita consumption of man-made fibers has increased from around 40-42 lb to about 50 lb in 2005 before leveling off and declining to about 38 lb in 2009 (Table 6). Polyester is the dominant man-made fiber in terms of domestic consumption.

Like U.S. mill use of cotton, U.S. mill use of man-made fibers also has dropped in recent years while imports have risen. Mill use of man-made fibers rose from 8.7 billion lb in 1986 to 11.1 billion lb in 1997 and then dropped to 6.6 billion lb by 2009 (Table 6). Imports of man-made fibers, on the other hand, have increased steadily. The domestic mill share of total U.S. man-

[1] Because wool accounted for only 1% to 2% of total fiber consumption during this period, the focus of this analysis centers on man-made fiber and cotton fiber.

made fiber consumption declined from nearly 90% in the mid-1980s to about 57% in 2009 while the net import share jumped from 10% to 43% over the same period.

Of course, cotton is only one of a number of natural and manmade fibers used in the production of textile products. Competition between different fibers can be measured by both production and usage data. On the production side, cotton accounted for over 40% of total world fiber production between 1980 and 2001 (Table 7). However, cotton has lost market share steadily to synthetic fibers in every year since 1995. Over that period, non-cellulosic synthetic fibers (principally polyester) have commanded an increasingly larger share of world fiber production than cotton.

Cotton and Man-Made Fiber Prices[2]

Among the various potential determinants of the demand for any commodity, price is usually one of if not the most important. Although consumption of all fibers is measured in pounds, a pound of cotton does not provide the same amount of textiles as a pound of other fibers, such as celluslosic or non-cellulosic man-made fibers. Consequently, comparing the per pound prices of various fibers can provide a misleading view of their relative market values. Thus, the U.S. Department of Agriculture (USDA) developed a method for adjusting the pounds of fiber used in manufacturing textiles so that the quantity of cotton needed to provide the same quantity of textiles could be estimated (Donald, Lowenstein, and Simon 1963). This adjustment of fiber consumption, known as "cotton equivalent" pounds, represents the quantity of cotton that would be needed to replace a pound of other fibers as raw material for textile production. USDA publishes estimates of domestic fiber consumption in cotton equivalent pounds. The prices of fibers are correspondingly converted to raw fiber equivalent prices. The cotton price is divided by 0.90 and the rayon and polyester prices are divided by 0.96. Rayon represents the class of cellulosic man-made fibers (rayon and acetate) while polyester represents the class of non-cellulosic man-made fibers (polyester; acrylic; polypropylene; and nylon).

To calculate the appropriate mill price for cotton to compare with those of competing fibers between 1991 and 2006, an adjustment must be made to account for user marketing certificates. The Upland Cotton User Marketing Certificate program, also known as "Step 2," began in the fall of 1991 as an incentive for American produced cotton to be domestically consumed or exported (USDAb). Payments under the program were made in cash or certificates to domestic users based on documented raw cotton consumption and to exporters based on documented export shipments at a payment rate equal to the difference between the U.S.-Northern Europe price and the Northern Europe price during the fourth week of the period, minus 1.25¢/lb (the threshold) (USDAe). Available on a weekly basis, the payment was based on a comparison of the Northern Europe (Liverpool) current price (NE) to the five-day average of the lowest U.S. current quote (USNE). Initially, the user certificate value (CV) was calculated as: CV = (USNE – NE) – 1.25.

[2] In this section, the prices of reference for the various fibers are in raw fiber equivalents. The reference prices are: cotton - Strict Low Middling (SLM) 1 1/16" at Group B mill points, net weight; rayon - 1.5 and 3.0 denier, regular staple at f.o.b. producing plants; polyester - 1.5 denier, regular staple at f.o.b. producing plants.

The 2002 Farm Act suspended the application of the 1.25¢/lb threshold until August 1, 2006. Consequently, Step 2 payment calculations for the 2002-05 marketing years were based on the difference between the USNE and the NE prices. If CV was less than zero in any week, then the certificate value for that week was zero. Also, the subsidy was paid as long as the adjusted world price (AWP) was less than 130% of the cotton loan rate. So, for a payment to occur, the certificate value (CV) had to be positive and the AWP also had to be less than 130% of the loan rate. On February 8, 2006, the President signed legislation repealing the Step 2 Program as of August 1, 2006. The repeal terminated export subsidies and import substitution subsidies cited by the World Trade Organization (WTO) in the findings of a dispute settlement panel. Thus, to calculate the "effective mill price" of cotton after 1991 until the termination of the Step 2 program, the certificate value (CV) must be subtracted from the nominal mill price of cotton[3].

The nominal mill price of cotton (raw fiber-equivalent basis) generally increased from the 1960s through the 1990s, hitting an average annual all-time high of 100.8¢/lb in 1995 (Figure 2). The record high price was short lived, however, as the cotton mill price fell to a low of 45.6¢/lb in 2002 and then recovered to 67.0¢/lb in 2008. The nominal raw fiber-equivalent mill price of polyester followed a similar pattern over the years, generally increasing from 48¢/lb in 1975 to highs in the early to mid-1990s. Polyester prices declined from the mid-1990s to 2001, but have increased recently in 2008 and 2009.

The nominal farm price of cotton followed a much slower but still generally upward trend until the mid-1990s, hitting a high of 76.5¢/lb in 1995. By 2001, however, the farm price of cotton had dropped to 32¢/lb, the lowest level since the early 1970s (Figure 2). However, between July 2010 and January 2011, the monthly average farm and spot prices of cotton increased 20% and 89% respectively (Figure 15). Over the same period, the nominal A index followed a similar pattern, reaching a near record high of 98.1¢/lb in 1995 and then dropping to a low of 45.4¢/lb in 2002 before recovering modestly (Figure 2).

Adjusting the nominal prices for inflation, however, reveals that in relative terms, the prices of cotton and man-made fiber followed a clear downward since at least the mid-1970s (Figure 3). Figures 2 and 3 show clearly that cotton and competing fiber prices have been highly correlated over time.

Government Intervention in U.S. Cotton Markets

Government intervention in U.S. cotton and textile markets has been the norm rather than the exception since at least the 1930s. The primary objective of the intervention over the years has been to support cotton producer income through the use of a variety of policy tools, primarily cotton price and income support programs and demand enhancement programs.

[3] In 1997/98, the Step 2 program ran out of money and was not operative.

U.S. Cotton Price and Income Support Policy

Beginning with the Agricultural Adjustment Act of 1933, the government has attempted to support cotton farm income by restricting output, supporting domestic market prices and making payments of various types to cotton producers. Supply reduction has been achieved through various programs designed to reduce acreage in production, such as acreage allotments, set-asides, and acreage reduction programs, as well as long-term land retirement programs like the Soil Bank in the 1950s and the Conservation Reserve Program created in 1985. The combined effect of these programs has been to support farm prices over the years, including the price of cotton.

The principal price support feature of U.S. farm policy has been the nonrecourse (NR) marketing assistance loan program operated by the Commodity Credit Corporation (CCC) since 1938. Through the CCC, cotton farmers can request loans on the bales of cotton they have harvested and ginned at the announced loan rate. If market prices rise sufficiently above the loan rate during the term of the loan, cotton farmers normally sell their crop and repay their loans plus any interest, fees and charges. If market prices drop below the loan rate, however, producers can default on their loans and transfer ownership of their cotton (pledged as collateral) to the CCC as full settlement of their loans, without penalty except for certain warehouse charges such as compression. The commodity loan program acts to support price at the established loan rate by removing supply from the market and into government inventories until the market price rises to the level of the loan rate. The NR loan rate for cotton rose from 38.9¢/lb in the mid-1970s to a high of 57.3¢/lb in 1985. Since that time, however, the cotton NR loan rate has varied only slightly from a high of 55.0¢/lb in 1985 to a low of 50.0¢/lb in 1994. The current cotton NR loan rate is 52.0¢/lb. As exhibited in Table 1, in most years, farm prices of cotton were above the loan rate.

Beginning with direct payments under the Food and Agriculture Act of 1965 and then deficiency payments under the Agriculture and Consumer Protection Act of 1973, income support to U.S. producers of many commodities, including cotton, became a central feature of U.S. farm policy. Until the passage of the Federal Agricultural Improvement and Reform (FAIR) Act of 1996, producers received deficiency payments based on a payment rate equal to the difference between a set target price and the existing national average market price or the non-recourse loan rate, whichever was higher. The total payment to each farmer was calculated as the product of the payment rate, the farm's eligible payment acreage, and the farm's established program payment yield. Producers could only take part in the non-recourse loan program or receive deficiency payments if they set aside a portion of their acreage to reduce production.

The Food Security Act of 1985 added marketing loan provisions to the income support features of U.S. farm policy for cotton and a few other commodities. The marketing loan program allows cotton producers to sell their crop in the market and repay their loans at less than the loan rate and receive a marketing loan gain (or loan deficiency payment, as applicable) equal to the difference between the loan rate and the “adjusted world price” (AWP, which is the marketing loan repayment rate) whenever the AWP is below the loan rate. The AWP is the prevailing world price for upland cotton, adjusted to account for U.S. quality and location.

To mitigate potential negative impacts of the price support programs on exports and the domestic textile industry and to further support cotton farm income, the Food, Agriculture, Conservation, and Trade Act (FACTA) of 1990 implemented a three-step "competitiveness" program for cotton. Step 1 of the program allowed the Secretary of Agriculture to lower the cotton loan repayment rate when the AWP falls below 115% of the upland cotton loan rate and the weekly average U.S.-Northern Europe price quotation exceeds the Northern Europe price quotation. Step 2 provided for payments to U.S. mills and exporters in user marketing certificates or cash when the A index, the world price of cotton, exceeded the Northern European cotton price by more than 1.25¢/lb for four consecutive weeks. As indicated earlier, the Step 2 provision underwent several modifications through the years and was ultimately repealed effective August 1, 2006. Step 3 permitted special import quotas for upland cotton to enable domestic mills to import foreign cotton when the weekly average U.S.-Northern Europe price quotation (adjusted for any certificate value in effect, unless U.S. supplies are extremely tight) exceeds the Northern Europe price quotation by more than 1.25¢/lb for four consecutive weeks.

Recent Changes in U.S. Cotton Policy

With the passage of the FAIR Act in 1996, acreage reduction programs were eliminated and a schedule of agricultural marketing transition assistance (AMTA) payments was established. Cotton farmers were offered declining payments, known as production flexibility contract (PFC) payments, based on historical acreage and yields. Total planting flexibility enabled cotton producers who had participated in previous commodity programs to shift production to other crops such as corn or soybeans without sacrificing program benefits. Total planting flexibility also permitted farmers to shift production to cotton from other crops. The FAIR Act also continued the three-step "competitiveness" program that was initiated under the 1990 farm bill. In 1998, Congress added *ad hoc* marketing loss assistance (MLA) payments to the PFCs. Continuation of the CRP allowed the Cotton Belt to continue active participation in acreage reduction to control soil erosion.

The Farm Security and Rural Investment Act of 2002 replaced PFC payments with direct payments (DPs) and added new counter-cyclical payments (CCPs) for cotton and other covered crops for 2002 through 2007 (Westcott, Young, and Price 2002). Like PFC payments, DPs were decoupled (not tied to current production or price). CCPs, on the other hand, were only partially decoupled payments. Farmers had nearly complete flexibility in what to plant to their base so that CCPs were essentially decoupled from production decisions. However, the actual payment received could be affected by the current market price so that the CCPs were not decoupled from prices. Owners of farms were given a one-time opportunity to select a method for determining base acreage for both DPs and CCPs based on historic production. The payment acreage was set at 85% of base acreage. Payment yields for DPs remained at the levels specified by the 1996 Farm Act. For CCPs, farmers could update their payment yields at the time they initially enrolled.

DPs were made available to eligible landowners and producers of upland cotton who enter into an annual agreement. The amount of the DP was equal to the product of the payment rate, payment acres, and payment yield. The payment rate for upland cotton was set at 6.67¢/lb for crop years 2002 through 2007. CCPs were available to contract holders when a program crop's target price was greater than the effective price. The target price for upland cotton for the crop years 2002 through 2007 specified in the 2002 Farm Act was 72.4¢/lb. Consequently, the effective price of upland cotton received by producers was the sum of the DP (6.67¢/lb) and the higher of the national average farm price for the marketing year or the national loan rate (52.0¢/lb). The minimum effective upland cotton price was 58.67¢/lb, calculated as the sum of the direct payment (6.67¢/lb) and the loan rate (52.0¢/lb). The maximum payment rate for upland cotton was 13.73¢/lb, calculated as the target price (72.4¢/lb) minus the minimum effective price (58.67¢/lb). The payment amount equaled the product of the payment rate, payment acres, and the counter-cyclical payment yield.

The 2002 Farm Bill extended nonrecourse commodity loans with marketing loan provisions but eliminated the requirement that producers must enter into an agreement for DPs in order to be eligible for loan program benefits. All current upland cotton production was eligible. Farmers could receive government marketing loan assistance payments either through marketing loan gains (MLG) for those producers who receive CCC nonrecourse loans or loan deficiency payments (LDP). Cotton producers with CCC loans could receive an MLG because the marketing loan provisions allowed them to repay their loans at a rate less than the loan rate. The difference between the loan rate and the repayment rate is the MLG. Alternatively, producers who do not place their cotton crop under loan could receive an LDP when the AWP is below the national loan rate of 52¢/lb. The difference between the AWP and the loan rate is the LDP. In addition to the price and income support provisions of the 2002 Farm Act, cotton producers could also benefit from crop and revenue insurance programs to guard against diverse weather, insect manifestations, and other natural perils. Payments from the USDA to cotton farmers covered a portion of the contract premiums for the insurance policies.

The Food, Conservation, and Energy Act of 2008 maintained much of the 2002 Farm Bill Provisions, with some key modifications, while adding several policy innovations (USDA-ERS, 2008). The 2002 provisions for marketing assistance loans and loan deficiency payments, direct and countercyclical payments were largely retained in the 2008 bill. Compared to prior legislation, the 2008 bill reduced the storage reimbursement payment rates for cotton stored in the loan program. The 2008 legislation authorized slightly lower target price for countercyclical payment rate calculation.

The 2008 legislation authorized a new program called the Average Crop Revenue Election, or ACRE, program. ACRE was designed as an optional alternative to receiving counter-cyclical payments. Producers of program crops can irrevocably (through 2013) elect to participate in the ACRE program for all covered commodities and peanut acreage on a given farm. For ACRE participants, direct payments are reduced by 20% and marketing assistance loan rates are reduced by 30% on enrolled farms. Participants are then eligible for state-based revenue coverage equaling 90% of the product of a five-year average State yield and a two-year average guarantee price. The actual calculations and trigger conditions of ACRE payments are complex. There appears to have been relatively little interest in the ACRE program among cotton growers. However, the high cotton prices of 2010 and possibly for 2011 have resulted in minimal to zero LDP and CCP payment rates, raised the likely ACRE price guarantee, and may thus create potential interest in the ACRE program in the latter years of the 2008 Farm Bill.

The other new program in the 2008 Farm Bill involves disaster assistance. The legislation authorized an umbrella program called the Supplemental Agricultural Disaster Assistance (or SADA) program in an attempt to replace *ad hoc* disaster bills. One of the elements of SADA that potentially impacts cotton growers is the Supplemental Revenue Assistance, or SURE program. The SURE program can be viewed as a whole farm revenue insurance program, and it resembles the ACRE program in its complexity (Anderson, 2011). Coverage under the SURE program is linked to the crop or revenue insurance coverage choices made by participants. At least minimal crop insurance coverage for all crops on a given farm is require to be eligible for the SURE program, and higher levels of crop insurance coverage directly increase the calculated SURE guarantee. Despite the complications, the SURE program has seen some application among cotton growers during 2010.

Clearly, U.S. farm policy has been an important driver in U.S. cotton markets. For cotton, the most significant agricultural policy changes were: (1) the 1985 Farm Bill (creation of the marketing loan); (2) the 1990 Farm Bill (establishing 3-step competitiveness provisions); and (3) the 1996 Farm Bill (allowing flexibility which pushed acreage to corn in the mid-1990s and since 2007). Government outlays to U.S. cotton farmers totaled roughly $43.7 billion between the federal fiscal years of 1986 through 2009, averaging about $1.8 billion per year (Table 8). Payments to cotton farmers hit a low of $217 million in 1995/96 just before the 1996 Farm Bill was passed and then hit an all-time high of $3.937 billion in 2001/02. Given the relatively high market prices for cotton currently, there will likely be minimal CCC outlays for the 2010 and 2011 U.S. cotton crops.

U.S. Cotton Policy and the WTO Cotton Decision

In March 2005, a WTO appellate panel ruled against the United States in a dispute settlement case brought by Brazil against certain aspects of the U.S. cotton program (Schnepf, 2010). In compliance with the "prohibited subsidy" portion of the WTO ruling, the Bush Administration proposed statutory changes to Congress in July of 2005, including elimination of the Step 2 cotton program, removal of a 1% cap on fees charged under the GSM-102 export credit guarantee program, and termination of the GSM-103 export credit guarantee program. Congress complied with a portion of the Administration's proposal by including a provision in the Deficit Reduction Act of 2005 (February 2006) that called for the elimination of Step 2 on August 1, 2006. Schnepf (2010) documents the lengthy and drawn out process that now has Brazil poised to levy retaliatory countermeasures under the WTO given the U.S. maintenance of price and income support programs for cotton.

Textile and Apparel Trade Agreements

The government also has intervened in U.S. textile markets by restricting imports of textiles and apparel in an effort to protect the U.S. cotton industry. The intervention has historically taken the form of textile and apparel trade agreements to limit imports through tariffs and quotas. Prior to the 1970s, a trade agreement, referred to as the Long Term Agreement Regarding International Trade in Cotton Textiles (LTA), was in effect. This agreement specifically allowed the U.S. to limit the growth of cotton textile imports to 5% per year (Dickerson 1999). No restrictions on man-made fiber trade were imposed during the years 1964 to 1971. Following an influx of man-made fiber textile imports in the early 1970s, however, the U.S. joined the Multi-Fiber Arrangement (MFA) in 1973. Under the MFA, import quotas were established by participating countries and implemented on a country- and product-specific basis when textile and clothing exports posed a threat of "market disruption" (MacDonald and Vollrath 2005). The MFA was renewed in 1977, 1981, and 1986 with minimal changes in provisions.

The MFA and its predecessor agreements influenced world textile and clothing trade patterns for nearly 50 years (MacDonald and Vollrath 2005). The Agreement on Textiles and Clothing (ATC) negotiated as part of the Uruguay Round of the General Agreements on Tariffs and Trade (GATT) negotiations and signed in 1994 specified that the MFA was to be phased out by the end of 2004. The ATC established a schedule for eliminating quotas initially established under the MFA and for accelerating the annual growth rates in import quantities under the quota system. Under the ATC, textile and clothing tariffs also were lowered, highlighting the need to bring all trade policies applied to the sector into alignment with World Trade Organization (WTO) rules.

OVERVIEW OF THE COTTON CHECKOFF PROGRAM

Like many other major U.S. agricultural commodity industries, the U.S. cotton industry operates a government-established program to expand demand and enhance productive efficiency through collective action by stakeholders in the cotton industry. The term "checkoff" refers to the collection of assessments and comes from the concept of checking off the appropriate box on a form, like a tax return, to authorize a contribution for a specific purpose, such as the public financing of election campaigns, or, as in this case, the financing of promotion and research activities in support of the cotton industry.

The Cotton Research and Promotion Act (CRPA) of 1966 (7 USC 2101 et seq.) established the cotton checkoff program and authorized the newly established Cotton Board to collect assessments from cotton producers to support "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 2105). From 1967 to 1991, all domestic cotton producers were required to pay a checkoff assessment. However, the 1966 Act allowed producers who were not in favor of supporting the program to request a refund. Over the period 1967 to 1991, up to one-third of the assessments collected were refunded.

In November of 1990, Congress enacted the Cotton Research and Promotion Amendments Act (CRPAA) of 1990 (7 U.S.C. 2101 note) which contained two provisions amending funding procedures of the CRPA: (1) all cotton marketed in the United States, whether from domestic or foreign production, was to share in the cost of the research and promotion program and (2) the right of cotton producers to demand a refund of assessments was terminated. The CRPAA was approved by producers and importers voting in a referendum held in July 1991. Since that time, all imported cotton, and not just the cotton produced in the United States, has been subject to the assessment of a fee as set out in the CRPAA. The assessment on imports is collected by the U.S. Customs Service and remitted to the Cotton Board through the Agricultural Marketing Service (AMS) on a monthly basis.

For each bale of cotton sold, a checkoff assessment of one dollar plus a fractional percentage of the value of the bale (five-tenths of one percent) is 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 all but one year since 1999/98 from a high of 0.644¢/lb in 1980/81 (Table 9). The importer assessment began in August of 1992 and has since varied from a low of 0.359¢/lb in 2007/08 to a high of 0.581¢/lb in 1997/98 (Table 10). Before implementation of the mandatory checkoff program in 1992, about 65% of the cotton assessments collected was available for funding cotton checkoff activities (Table 11). The remaining 35% was refunded on average each year. A comparison of the producer and importer assessments demonstrates that they are not equal. The importer assessment exceeded the producer assessment on a per pound basis in every year from 1992 through 2000 except for 1994 and 1995. Since 2001, however, the annual producer assessment has been greater than the importer assessment.

By eliminating refunds and requiring importers to pay a checkoff assessment, the 1990 amendments to the CRPA contributed to a substantial increase in annual cotton checkoff expenditures from $28.6 million in 1991/92, the year before implementation of the mandatory program, to roughly $77.2 million in 2009/10 (Table 11 and Figure 4). On an inflation-adjusted basis (2009 dollars), checkoff expenditures initially doubled from just over $40 million in 1991 to over $80 million in 1996. Since that time, real checkoff expenditures have hovered between about $70 million and $80 million.

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, however, 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 (CCI) is responsible for cotton export promotion activities.

CI uses its checkoff assessment allocation to finance promotional activities at both the retail and wholesale (mill) levels of cotton markets in four general categories of expenditure: (1) marketing; (2) textile research (non-agricultural research); (3) agricultural research; and (4) administration. Marketing expenditures are primarily for retail-level advertising and promotion activities including 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.

Textile or non-agricultural research expenditures are primarily for promotion activities at the mill-level including activities to expand the demand for cotton by U.S. mills as well as foreign textile mills in both processing and fashion fabrics. Although focused primarily on the development of new cotton products, mill-level promotion activities also include technical support to mills, apparel manufacturers, and retailers to find ways of reducing their costs and increasing their operating efficiencies.

Agricultural research expenditures finance projects intended primarily to enhance cotton yields and/or reduce cotton production costs such as genetic improvements to enhance cotton yield and quality, improving cotton's resistance to temperature extremes and to insects and diseases, advances in biotechnology, reduced dependence on pesticides, and profitable conservation tillage practices.

Since the mid-1990s, the share of CI expenditures allocated to marketing activities has declined slightly from near 70% to 63% in recent years (Table 11 and Figure 5). Over the same period, the share allocated to textile research has declined from a high of 23% to 16%. On the other hand, allocations of expenditures to agricultural research have increased substantially from about 4% in 1986/87 to 15% in 2009/10. Administrative costs have accounted for an average 5.7% of total expenditures since 1986/87 and 5.5% since 2005/06.

Like many other commodity checkoff programs, the cotton checkoff program is federally authorized. Consequently, the Secretary of Agriculture and the AMS have oversight responsibilities. Recommended program plans and budgets of the Cotton Board must be approved by the Secretary before they become operational. The responsibilities of AMS include: (1) developing regulations to implement the checkoff program, in consultation with the cotton industry and (2) ensuring compliance with the authorizing legislation. AMS regulations specify allowable activities, such as the type of promotion or research activities, the level and collection of assessments, the composition of the Cotton Board, and the types of allowable expenditures. AMS reviews the budgets and projects of the Cotton Board to prevent any prohibited activities such as lobbying. Although not responsible for conducting evaluations of the program, the AMS reviews the independent evaluation of the effectiveness of the program required at least once every five years by the 1996 Farm Bill. The Cotton Board reimburses AMS for its oversight costs.

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 advertising and promotion activities. 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 markets. A further complication for cotton promotion is that the U.S. government has intervened in cotton markets over time in a variety of ways including price and income support programs, cotton textile import restrictions, and cotton export subsidies. These interventions have affected cotton and cotton textile prices and quantities in both the U.S. and global cotton and CFT markets.

Graphical Analysis of the Effects of Cotton Advertising and Promotion

The largest portion of cotton checkoff funds are spent on promoting retail cotton fiber textile (CFT) consumption. If retail promotion activities effectively shift out the U.S. CFT demand as intended, then Figure 6 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 Figure 6 represents raw cotton markets while the bottom row represents CFT markets. The first column of graphs represents U.S. markets while the last column represents all other countries (the "rest-of-the-world" or ROW). The middle column represents world markets.

The United States is depicted in Figure 6 (top left graph) 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 on the top row of Figure 6). In contrast, the ROW is depicted as a net cotton importing region (top right graph of Figure 6). Not considering the effects of U.S. farm policy for now, 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 in Figure 6). In turn, the world price level determines the quantities of cotton demanded and supplied in all countries, including the United States.

In CFT markets, the U.S. is an importing country while the ROW is a net exporting region as depicted in the bottom row of graphs in Figure 6. The interaction of the U.S. CFT import demand and the ROW CFT export supply (middle graph of the bottom row of Figure 6) 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. For the cotton miller, the price of cotton represents the price of the input while the CFT price represents the price of the output. If the price of cotton (P_c^w in Figure 6) 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 in Figure 6) 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 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[4].

[4] Note that the vertical nature of the CFT supply curve here is a graphical device intended to illustrate the technical relationship between CFT supply and mill demand. As a technical function of mill demand, the supply of CFTs changes as the mill demand for cotton changes in response to changes in the prices of both cotton and CFTs as well as other economic forces.

Consequently, an increase in the U.S. CFT demand as a result of retail-level checkoff program expenditures (represented by the rightward shift of the CFT retail demand curve in the bottom left graph of Figure 6) results in a rightward shift of the U.S. CFT import demand (middle bottom graph in Figure 6) and a consequent increase in the CFT market price (the higher horizontal price line in the bottom row of Figure 6)[5]. The increase in the CFT price, however, signals an increase in cotton mill demand in all countries (top left and top right graphs of Figure 6) 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 also increases, limiting the expansion of cotton mill demand in all countries. The effect on U.S. cotton exports, however, is unclear (middle top graph of Figure 6). 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 as well.

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 of Figure 6), however, the U.S. excess demand for CFTs shifts left to some extent while the ROW export supply shifts to the right to some extent (bottom middle graph of Figure 6). 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 depicted in the top left graph of Figure 7. 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 in the top right graph of Figure 7).

In the United States, 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 in the top middle graph of Figure 7). 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 of Figure 7). The reduced availability of U.S. cotton for export and the increased ROW mill demand for cotton combine to boost the price of cotton in both the U.S. and ROW markets. The implications for U.S. exports of cotton, however, are unclear (top middle graph of Figure 7). 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.

[5] For expositional purposes only, this figure 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 is, however, included in the empirical analysis of the checkoff program discussed later.

In CFT markets, increased U.S. and foreign cotton processing results in additional CFT production (the rightward shifts of the CFT supply curves in the bottom left and right graphs of Figure 7) and, therefore, a reduced U.S. demand for imported CFTs along with an increased ROW CFT supply for export (the leftward shift of the U.S. import demand and rightward shift of the ROW export supply in the bottom middle graph of Figure 7). 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.

The Complications of U.S. Cotton Farm Policy

The effects of the cotton checkoff program on the U.S. cotton and CFT markets over the years as depicted in Figures 6 and 7 have been complicated by U.S. farm policy. In the decade preceding the 1996 Farm Bill, 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 also was in place for cotton although the cotton market price was generally above the loan rate in most years.

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 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 Figures 6 and 7, 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 increases in the cotton market price achieved through cotton promotion most likely reduced government payments to cotton producers since farm prices were below the target price. While 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 (the FAIR Act) 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 Figures 6 and 7 with limited effects from government intervention although the cotton marketing loan program was left in place. 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 (CCPs) in the 2002 Farm Bill which 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 (the Adjusted World Price or AWP) is below the loan rate[6]. Because the market price has been below the loan rate in most years under the 2002 and 2008 Farm Bills and well below the target price in all years, the checkoff program has functioned since the expiration of the 1996 Farm Bill much as it did prior to its implementation to reduce both the dependence of farmers on government farm programs and the cost of the cotton program to taxpayers rather than to increase the profits of cotton producers.

Spillover Effects of Cotton Promotion

A commodity checkoff program such as the one for cotton can have unintended effects on related markets – the so-called spillover effects of checkoff promotion. These spillover effects can take both *direct* and *indirect* routes from cotton promotion to MMF markets (and back to cotton markets). The *direct* spillover effects result from the impact of the cotton promotion directly on MMF demand while the *indirect* effects flow from the cotton promotion to MMF markets through price response. For example, successful retail-level cotton promotion might have a negative *direct* effect on MMF demand by persuading man-made fiber textile (MMFT) consumers to reduce their purchases of apparel, floor coverings, and home furnishings made of man-made fibers. The result would be greater CFT consumption than the initial shift in CFT demand that promotion might generate. At the same time, however, any positive effect of the promotion on cotton fiber textile (CFT) demand would also be expected to raise CFT prices and encourage the *indirect* spillover effect of encouraging some substitution of the now more expensive CFTs with MMFTs which would tend to offset to some extent the *direct* effects.

On the other hand, retail-level cotton promotion could just as well have a *direct* positive effect on MMFT demand if the promotion simply persuaded consumers to purchase more apparel, floor coverings and textile home furnishings of any type of fiber and not necessarily just cotton. In this case, the increase in MMFT demand could erode the initial effect of the promotion on CFT demand. The *indirect* spillover effect of a higher CFT price would then add to the *direct* substitution of consumers away from CFTs. Thus, retail-level CFT promotion could result in higher or lower MMFT demand depending on the nature and strength of the spillover effects

[6] A more detailed explanation of U.S. cotton policy since the 2002 Farm Bill is provided in the appendix to Welch et al. (2008).

which would also have consequence for the extent of the promotion effect on the initial impact on CFT demand.

Of course, the spillover effects from MMFT markets to CFT markets would feed back to affect imports and prices at the retail level of the supply chain as well as farm prices and production up the supply chain. Also, cotton promotion at the mill-level creates similar spillover effects from cotton markets to MMF markets. Again, the implications for both markets depend on the nature and strength of the *direct* and *indirect* spillover effects. And, as with the retail-level promotion, the spillover effects create consequences for prices and quantities all along the supply chains for both cotton and man-made fibers.

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, Brown, and Fairchild, 1989). Because advertising generates differential levels and rates of buyer response and may prompt repeat purchases, the effects of advertising may persist beyond the period of initial impact. This carryover effect has been reported to last from one month to two years depending on the commodity and type of promotion activity (Jensen et al., 1992). The effects of advertising do not persist forever, however. Adecay in the effects normally occurs after some period of time. Research shows that the promotion message will be forgotten by potential users without continuous exposure to the message (Zielske, 1959).

METHODOLOGY

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. At the same time, the interactions in and among markets as complicated by farm policy, trade policy, and a host of other forces impacting the market becomes quite intractable for graphical analysis. This section describes the methodology used to test hypotheses relating to the direction of the impacts of the cotton checkoff program as represented by the preceding graphical analysis as well as a measurement of the magnitude of the effects of the program. After presenting the model and data used in the empirical analysis, the results of econometrically estimating the parameters of the model are discussed with a primary focus on several key equations in the model for this analysis. The results of validating the model for use in analyzing the effects of the cotton checkoff program then are discussed.

The Texas Tech University World Fiber Model

To test the hypotheses relating to the direction of the impacts of 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 is conducted with 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 Cotton Incorporated and, hence, is referred to here as the Modified World Fiber Model (MWFM). The WFM has been used for a wide range of analyses and received extensive peer review, including most recently Pan, Hudson, and Ethridge (2010), Welch et al. (2008); Chaudhary et al. (2008); MacDonald et al. (2008); Pan et al. (2008, 2007a, 2007b, 2006, and 2005); Li, Mohanty, and Pan (2005); and Ramirez et al. (2004). An extensive technical description and documentation of the WFM is available in Pan et al. (2004).

Two of the three previous studies of the cotton checkoff program (Capps et al., 1997 and Murray et al., 2001) both relied on less comprehensive, quasi-reduced form econometric models for their analyses of the performance of the program. Capps et al. (1997) covered the period of 1991-1995 while Murray focused on the period of 1996-2000. A more recent analysis by Capps and Williams (2006) covered a more extensive time period (1986/87-2004/05) and used an earlier version of the Texas Tech WFM model, a more formal and structurally comprehensive model than used by the two previous studies. Their analysis and the supporting econometric simulation model made extensive and fundamentally important advances in the methodology for analyzing the cotton checkoff program, providing the most accurate, reliable, and defensible measurement of the impacts and returns from the cotton checkoff program to date. This study updates the Capps and Williams (2006) analysis and extends the analytical period through 2009/10. The updated Texas Tech World Fiber Model, as again modified for this study (MWFM), replicates the structure of world cotton and CFT markets as depicted in Figures 6 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 while 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 Modified World Fiber Model used in this analysis takes into account world markets and prices of not only cotton (top half of Figure 8) but also wool and man-made fibers (synthetics, primarily polyester, and cellulosics, primarily rayon) (bottom half of Figure 8) and their interactions. Consequently, the model is capable of capturing *spillover effects*, that is, the impacts on the man-made fiber industry induced by the promotion 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 United States, 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 are not available, prices are used rather than expected return. For major players such as the United States, China and India, the parameters of the respective cotton production equations are econometrically 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 (Figure 9). The Southwest is further subdivided into irrigated and dry land areas of production. Cotton producers located in the irrigated areas of the Southwest may 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.

Man-made fiber production for both synthetics and cellulosics is derived through the estimation of capacity and utilization behavioral equations for each country (Figure 10). Emphasis in the model is placed on cotton and man-made fibers (primarily synthetics). As indicated earlier in this report, these fibers collectively account for more than 95% of total world fiber utilization. Synthetic fiber accounts for roughly 88% of the man-made fiber production in the world.

Mill use, both for cotton and man-made fiber, is a function of the textile price in the downstream retail market, prices of raw cotton and man-made fiber from the upstream market (mills), and the textile (non-agricultural research) expenditures of the Cotton Board in each 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 man-made fibers 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 U.S. model also includes representations of the cotton fiber textile market and the man-made fiber textile market (Figure 11). The U.S. demands for cotton and man-made fiber textiles are calculated as the respective sums of the net imports of cotton and man-made fiber textiles plus mill use of cotton and man-made fiber 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 man-made fiber textile prices (proxies for retail cotton textile and man-made fiber textile prices), which 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, man-made fiber, cotton fiber textiles, and man-made fiber textiles 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 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 man-made fibers 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.

A stylized model specification for a representative country in the MWFM is presented in Table 12. The model specifies per capita consumption of a given fiber (cotton or man-made) as a function of cotton and man-made fiber prices, per capita income, retail-level cotton checkoff promotion expenditures, and other shift variables. On the supply side, cotton acreage generally is specified as a function of own and competing crop expected net returns or prices, while cotton yield is dependent on cotton price and a time trend to capture technological change. For man-made fibers, capacity and utilization are modeled separately to estimate production and generally specified as functions of man-made fiber and crude oil prices over a lag period of five years. Finally, export and import equations are specified as functions of domestic and international prices. For import equations, international prices are calculated by converting world price into domestic currency equivalent after adding appropriate tariffs. Similarly, for export equations, international prices are calculated by converting representative world prices into domestic currency equivalents.

Data

Two general types of data are required for the analysis undertaken in this study: (1) data pertaining to supply, demand, trade, prices, etc and (2) marketing and promotion expenditures and non-agricultural research expenditures by the Cotton Board. The data sources are compiled from the St. Louis Federal Reserve Bank, the Food and Agricultural Policy Institute (FAPRI), the Foreign Agricultural Service (FAS), the FAO World Fiber Consumption Survey, *Fiber Organon* (published by the American Fiber Manufacturers Association), the Cotton Board, Cotton Incorporated, the National Cotton Council, the U.S. Department of Agriculture, and direct contact with various research organizations and institutes in various countries. In general, the structural parameters of this multi-equation model are statistically generated using 34 annual data observations covering 1976/77 through 2009/10, the common time period and frequency across all endogenous and predetermined variables. Data associated with the promotion and non-agricultural research expenditures of the cotton checkoff program only go back to 1976/77. Consequently, this period in time is the starting point for this analysis.

Model Parameter Estimation

This section reports the empirical results of the econometric estimation of the parameters of the Texas Tech Modified World Fiber Model (MWFM) with an emphasis on four key U.S. demand equations which are the focus of the marketing and promotion activities as well as the non-agricultural research activities of the Cotton Board. The parameters of the MMFM were estimated using Ordinary Least Squares (OLS) with annual data for 1976/77 to 2009/10. Two (2SLS) or three-stage least squares (3SLS) procedures sometimes are used in the estimation of simultaneous systems. In this case, however, the large size of the model and the availability of a limited number of annual observations resulted in a greater number of predetermined variables than the number of observations. Also, 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. Additionally, data for some variables over the 1976/77 to 2009/10 time period were not available for some behavioral equations, further necessitating the use of OLS to statistically estimate the parameters of the behavioral equations in the model.

For all cotton producing regions, cotton acreage is highly inelastic with respect to price in the short-run as expected, with elasticities ranging from 0.09 in the U.S. Delta region to 0.57 in Brazil (Table 13). The long-run price elasticity of cotton acreage in each region is higher than their short-run counterparts as expected, varying from 0.13 in the U.S. Delta to 1.60 in Brazil. Also, the demand for cotton at the mill level is found to be price inelastic as expected. The own-price elasticities for cotton at the mill level range from -0.02 in the U.S. to -0.64 in Egypt. The U.S. mill demand price elasticity is found to be much smaller than the elasticities reported by both Capps et al. (1997) and Murray et al (2001) (-0.17 and -0.40, respectively, as opposed to -0.02) and smaller than that reported by Lowenstein (1952), Waugh (1964), Wohlgenant (1986), Ding and Kinnucan (1996), and Shui, Behgin, and Wohlgenant (1993). The U.S. mill demand own-price elasticity, however, is found to be more in line with the elasticity of -0.08 reported by Capps and Williams (2006). The inconsistency of statistically estimated cotton mill demand elasticities has been noted by cotton industry analysts for many years (Anderson, 2009).

In all regions except the United States, the cross-price elasticities for polyester in the respective cotton mill demand equations are positive and smaller in magnitude than the corresponding own-price elasticities for cotton. The implication is that polyester and cotton are substitutes in foreign cotton mill use. The cross-price elasticity for polyester in the U.S. cotton mill demand equation, however, is negative and larger in magnitude than the own-price elasticity for cotton implying that cotton and polyester are complements at the cotton mill level of the U.S. cotton industry. Although different from the results for foreign countries in the MWFM, the finding that cotton and polyester are complements in cotton mill use in the United States is consistent with the conclusions of a number of other studies, including Capps et al. (1997), Ding and Kinnucan (1996), Murray et al. (2001), and Capps and Williams (2006). Murray et al. (2001) found the elasticity of cotton mill demand with respect to polyester price to be -0.13, lower than the estimate of -0.41 found in this study. Ding and Kinnucan (1996) reported a relatively high short-run polyester price elasticity of cotton mill demand of -0.27 and an even higher long-run cross-price elasticity of -0.85. Capps et al. (1997) found the polyester cross-price elasticity to be -0.55. Capps and Williams (2006) determined the elasticity to be -0.26.

For U.S. man-made fiber mill demand, the own-price elasticity is found to be -0.30 while the cross-price elasticity is determined to be 0.14 (Table 13). This set of findings is different than the own-price elasticity of -0.20 and the cotton cross-price elasticity of -0.08 reported by Capps and Williams (2006).

At the retail level of fiber markets, the demands for textiles across all countries in the model, including the United States, are found to be inelastic with respect to both the prices of textiles and income (Table 13). In the U.S., the own-price elasticities of cotton fiber textile demand and man-made fiber textile demand are found to be -0.65 and -0.25, respectively. In foreign countries, data limitations restricted the estimation of parameters to the demand for *all* textiles. The own-price elasticities for all textiles in those countries are found to range from -0.02 for the EU-25 to -0.51 for Mexico. The income elasticities are found to range in magnitude from 0.03 in South Korea to 0.58 and 0.94 in Mexico and the U.S., respectively. The U.S. demand for man-made fiber textiles is found to be slightly more income inelastic (0.62) than cotton fiber textiles (0.94). Given that the income elasticities of textiles are positive and less than unity in magnitude across all countries, the implication is that consumers in most countries consider textile goods to be necessities rather than luxury goods.

The price elasticities of the foreign supplies of cotton fiber textiles and of man-made fiber textiles are important in determining the extent of the price and quantity responses in the model to any checkoff-induced increases in the retail and mill-level demands for cotton. The share of U.S. cotton fiber textile consumption accounted for by imports is 80% currently, and the domestically produced share is approximately 20%. The import share of U.S. man-made fiber textile consumption at present is roughly 43%. The domestically-produced share is about 57%. Most of the cotton fiber imported by the U.S. is in the form of apparel or intermediate products. Some of those cotton product imports may be manufactured with the raw cotton exported by the U.S. to foreign countries. The U.S. also exports some cotton textile products but most are relatively unprocessed and often return to U.S. markets in a more finished form. Thus, how effective the cotton checkoff program is at raising cotton and cotton textile prices and generating increased profits at the farm level depends critically on how textile imports respond to any price changes induced by the program. In the model, the import supply elasticity for cotton fiber textiles is found to be 0.47 in the short-run and 0.93 in the long-run (Table 13). Thus, a 10% increase in the price of cotton fiber textiles translates into a 4.7% increase in the import supply of cotton fiber textiles in the short-run and a 9.3% increase in the long-run. These findings are similar to those reported by Capps and Williams (2006). Murray et al. (2001) found the long-run import supply elasticity for cotton fiber textiles to be between 4.2 and 7.1. The lower import supply elasticity found in this study reflects in large part the effects of nearly 50 years of U.S. restrictions on imports of cotton fiber textiles under the Multi-Fiber Agreement on the price responsiveness of those imports. Those restrictions, however, have been phased out in recent years.

For the U.S. import supply of man-made fiber textiles, the price elasticity is found to be 0.53 in the short-run and 1.07 in the long-run. No previously published estimates of U.S man-made fiber textile import supply are available except for Capps and Williams (2006). They reported the short-run elasticity to be 0.52 and the long-run elasticity to be 13.4. Consequently, the short-run elasticities are comparable, but the long-run elasticities are widely different. The elasticity estimates indicate that a 10% increase in the man-made fiber textile price translates into a 5.3% increase in the man-made fiber textile import supply in the short-run and a 10.7% increase in the long-run. Because man-made fibers have faced fewer U.S. import restrictions than has been the case for cotton textiles, the import supply of man-made fiber textiles is found to be more sensitive to changes in its price than is the case for the import supply of cotton fiber textiles.

Four Key Demand Equations in the Texas Tech MWFM

The direct effects of the cotton checkoff program in the model are reflected in the four equations in the Texas Tech MWFM relating to the retail demands for cotton fiber textiles and for man-made fiber textiles and to the mill demands for cotton and for man-made fibers. These equations are treated as a seemingly unrelated regression (SUR) system, taking into account cross-equation correlations of the error or disturbance terms in order to achieve gains in statistical efficiency. The demand equations pertaining to net domestic consumption of cotton and man-made fiber as well as domestic mill use of cotton account for 99% of the variability in the corresponding endogenous variables indicating that these representations provide excellent fits of the data. The demand equation pertaining to domestic mill use of man-made fiber accounts for 87% of the variability in this endogenous variable. Also, the signs and magnitudes of the statistically estimated parameters in each demand equation are consistent with *a priori* expectations as indicated for key variables in the model by their partial elasticities (Table 13).

The statistically estimated coefficients and p-values associated with these four demand equations are provided in Table 14. Given the sample size in this analysis, the significance level chosen for this analysis is 0.10. Consequently, the estimated coefficients of the structural parameters are deemed to be statistically different from zero if their corresponding p-values are less than 0.10 for two-tailed tests and less than 0.20 for one-tailed tests. The accompanying definitions of the variable names used in Table 14 are provided in Table 15.

U.S. Cotton Fiber Textile Demand and Man-Made Fiber Textile Demand Equations

The first set of U.S. demand equations in the model represent consumer demand at the retail end of the cotton and man-made fiber marketing chains, which include the apparel market, the home furnishings market, and others. Graphically, the net domestic consumption of cotton and man-made fiber over the period 1976 to 2009 is exhibited in Figure 12. Note the upward trend in net domestic consumption of cotton and man-made fiber from 1976 to 2005. Since 2006, net domestic consumption of cotton and man-made fiber has declined monotonically. About two-thirds of the cotton checkoff funds are used for marketing and promotion activities in an attempt to shift out the retail demand for cotton fiber textiles (see Table 11). These two equations provide the econometric evidence of the effectiveness of the use of marketing and promotion activities in achieving the goal of shifting out cotton fiber textile demand as well as evidence of the direct spillover effects of those expenditures on the demand for man-made fiber textile goods.

Equations (1) and (2) in Table 14 provide the SUR parameter estimates for the U.S. cotton fiber textile demand equation and the U.S. man-made fiber textile demand equation, respectively. The associated goodness-of-fit statistics (R^2) are 0.995 and 0.993, respectively. In other words, these two equations explain nearly all of the variability in the consumption of cotton fiber textiles and man-made fiber textiles over the period of analysis (1976/77 to 2009/10). Neither the Durbin-Watson (DW) statistics nor the Ljung-Box Q-statistics indicate the presence of serial correlation of residuals in either of these structural equations.

The econometric analysis indicates that the statistically significant drivers of cotton fiber textile consumption include the real (inflation-adjusted) cotton textile fiber price, real disposable personal income, the year-to-year change in unemployment rate, a one-year lag in energy prices, real cotton checkoff marketing and promotion expenditures, and qualitative variables related to agricultural and trade policy (equation (1) in Table 14). The own-price and income elasticities of demand for cotton fiber textiles are found to be -0.65 and 0.94, respectively (see Table 13). Both are higher than reported previously in the 2006 report by Capps and Williams (-0.41 and 0.87, respectively). The elasticity with respect to lagged real energy prices is -0.32. Note that with larger (smaller) changes in the unemployment rate, the net domestic consumption of cotton textiles falls (rises). In the previous report by Capps and Williams (2006), lagged real energy prices and the change in unemployment rate were not considered as possible drivers of net domestic consumption of cotton textiles. These variables are included in this analysis along with real disposable personal income to obtain impacts of macroeconomic factors on the net domestic consumption of cotton textiles.

For man-made fiber textile consumption, the econometric analysis indicates that the statistically significant drivers are the inflation-adjusted man-made textile fiber prices, real disposable personal income, the year-to-year change in unemployment rate, housing starts, and qualitative variables related to agricultural and trade policy (equation (2) in Table 14). The change in unemployment rate, housing starts, and real disposable personal income represent the impacts of macroeconomic factors on the net domestic consumption of man-made fibers. More than half of net domestic consumption of man-made fibers is in floor coverings and industrial markets. Housing starts is a key indicator of the market for floor coverings. The own-price elasticity of demand for man-made fiber textiles is found to be -0.25, similar to the elasticity of -0.24 reported by Capps and Williams (2006). The income elasticity of demand for man-made fiber textiles is found to be 0.62, slightly higher than the value of 0.56 reported by Capps and Williams (2006). The elasticity with respect to housing starts is found to be 0.23 indicating a positive relationship between housing starts and changes in man-made fiber textile consumption. Similar to cotton textile fiber consumption, changes in year-to-year unemployment rates are inversely related to man-made fiber consumption. Neither housing starts nor the changes in unemployment rates were considered in previous analyses of the demand for man-made fiber textile consumption.

The carryover effects associated with all advertising and promotion programs, as discussed by Clarke (1976), Lee and Brown (1992), Forker and Ward (1998), and others, are accounted for in this analysis through the use of a polynomial distributed lag (PDL) procedure, a lag formulation commonly used in the analysis of advertising effectiveness. Previous analyses of the cotton checkoff program by Murray et al. (2001) and by Capps and Williams (2006) used the PDL procedure. The attractive features of the PDL include: (1) a flexible representation of the lag structure allowing for the possibility of humped-shaped or monotonically declining lag weight distributions and (2) a parsimonious representation of the lag structure (Simon and Arndt,1980). Another previous analysis of the effectiveness of the cotton checkoff program by Capps et al. (1997), however, used a polynomial inverse lag (PIL) structure (Mitchell and Speaker (1986)) rather than the PDL to capture the carryover effects. In contrast to the PDL model, the PIL does not require specifying the lag length, and, thus, is conceptually an infinite lag. In principle, then, the use of the PIL lag formulation imposes the assumption on the model that advertising/promotion expenditures in one period have infinitely long impacts over time on consumption.

The PDL formulation was adopted in this study in order to allow for testing for lag length, that is, the pattern and time period over which marketing promotion expenditures influence demand. The search for the polynomial degree and lag length for each advertising variable involves a series of nested OLS regressions. Second, third, and fourth degree polynomials with lags up to 10 years were considered in each case. Based on the Akaike Information Criteria (AIC) and the Schwarz Information Criterion (SIC) statistics for selecting lag length, the optimal lag length for retail-level (marketing) promotion expenditures in both equations is two years while the degree of the polynomial is two with the PDL beginning with the current level of expenditures. This finding is consistent with Capps et al (1997), Capps and Williams (2006), and Ding and Kinnucan (1996). Also, based on the AIC and SIC statistics, both head and tail endpoint restrictions are employed in the analysis.

The short-run advertising elasticity for cotton fiber textiles is found to be 0.03 while the cumulative (long-run) advertising elasticity is found to be 0.11 (see Table 13). These results are consistent with the marketing and promotion elasticities of demand reported by most other studies of generic advertising programs which have tended to range between 0.01 and 0.25 in both the short-run and the long-run (Williams and Nichols, 1998). The results imply that cotton checkoff expenditures have effectively shifted out the demand for cotton fiber textiles over time. Capps et al. (1997) reported an elasticity of cotton checkoff program expenditures of 0.06 in the short-run and 0.10 in the long-run. Murray et al (2001), however, reported a much smaller cotton promotion elasticity of 0.02. Capps and Williams (2006) reported a cotton promotion elasticity of 0.05 in the short-run and 0.17 in the long-run. Because any lagged effects of marketing and promotion expenditures were assumed away in the Murray et al. study, the short-run and cumulative impacts of marketing and promotion expenditures were the same in that study. Neither the assumption on lagged effects nor the promotion elasticity reported by Murray et al. is in agreement with the existing literature for cotton promotion. Ding and Kinnucan (1996) reported a long-run advertising elasticity for cotton of 0.07. Solomon and Kinnucan (1993) found the advertising elasticity for cotton for the export market to be 0.12. Dewbre, Richardson, and Beare (1987) reported an advertising elasticity of 0.09 for Australian wool promotion in the United States.

Berndt (1990) argued that models based on quarterly and annual data tend to overestimate the cumulative effects of advertising and promotion. However, our estimates of the impact of marketing and promotion activities perhaps are a reflection of the increase in the level of funds that occurred as a result of the amended Act of 1992. Recall from Table 11 that the level of cotton checkoff funding rose from roughly $29 million in 1991/92 to about $77 million in 2009/10. On average, two-thirds of that funding is allocated to marketing and promotion activities over this period. Consequently, this scale effect in the level of funding for marketing and promotion of cotton may also account for the magnitude of the cumulative estimate of the advertising elasticity.

Another possibility for the relatively large estimate of the long-run advertising elasticity may be due to the relatively higher level of cotton promotion intensity over time (that is, the level of cotton promotion expenditures compared to cotton farm cash receipts) than normally has been the case for other checkoff commodities. As shown in Table 16, between 1977/78 and 1992/93, the ratio of cotton checkoff expenditures to total cotton farm cash receipts (the intensity of the cotton checkoff program) increased from 0.3% to 1%, a more than 3-fold increase. In 2001/02, however, the ratio doubled to about 2% before dropping to 1.1% to 1.6% from 2002/03-2007/08. In 2008/09 and in 2009/10, the ratio was 2.4% and 2.1% respectively. For most checkoff program commodities, annual program expenditures as a percent of producer cash receipts have averaged less than 1% over time. For the soybean checkoff program, for example, program expenditures for research and promotion ranged from only 0.05% to 0.48% of soybean farm cash receipts over the history of the program since 1970/71 (Williams, Capps and Bessler, 2009). Also, the advertising intensity for the Florida Department of Citrus annual orange juice advertising program dropped from over 3% in the late 1960s to less than 1% in more recent years (Capps, Bessler, and Williams, 2004). With a cotton checkoff advertising intensity that is notably higher than that of other checkoff programs, the overall impact of the cotton checkoff program may be expected to be greater in both a practical and a statistical sense in its effects on production, demand, prices, and exports than might be the case for other checkoff program commodities.

In addition to the generic cotton promotion expenditures from checkoff dollars collected by the Cotton Board, private industries also spent funds to promote their own particular brands of cotton fiber textiles and man-made fiber textiles. These brand advertising expenditures might be expected to have an impact on the demand for cotton fiber textiles and man-made fiber textiles as well. Data for such expenditures by private companies are proprietary and not readily available, and thus, were excluded from this analysis. Statistical theory suggests that omitted variables may result in biased structural parameter estimates, although the direction of the bias is not clear. However, in the cotton and man-made fiber textile demand equations of the Texas Tech MWFM, no serial correlation pattern is evident in the residuals, based on the Durbin-Watson statistics and the Ljung-Box statistics indicating the absence of any systematic omitted variable bias associated with the structural parameter estimates of the demand functions for both types of fiber textiles.

None of the previous three studies of the cotton checkoff program (Murray et al., 2001; Capps et al., 1997; and Capps and Williams, 2006) included the effects of brand promotion expenditures related to man-made fiber textiles due to the unavailability of data. For branded cotton fiber textile promotion, however, Murray et al. (2001) obtained data from Levi Strauss to serve as a proxy for branded promotional expenditures for cotton fiber textiles. Importantly, the inclusion of these data in the Murray et al. (2001) analysis revealed no statistically significant impact of the branded advertising variable on the structural parameter estimate associated with generic cotton checkoff marketing and promotion expenditures. Capps, Bessler, and Williams (2004) also found that brand advertising expenditures were statistically insignificant in influencing the level of orange juice demand. Insignificant branded advertising and promotion effects, at least from a statistical point of view, are not surprising. Generic advertising and promotion expenditures are designed to increase the demand for a particular commodity while corresponding branded expenditures associated with a given manufacturer are designed primarily to increase the market share for that manufacturer. In other words, generic marketing and promotion expenditures are designed to grow market demand for the product while branded marketing and promotion expenditures are designed to grow the market share associated with that particular brand but not necessarily the overall market demand for the product.

The impact of cotton checkoff program marketing and promotion expenditures on man-made fiber textile consumption is found to be positive (equation (2) in Table 14), a result that is inconsistent with expectations and earlier theoretical arguments. However, the positive relationship found is not statistically different from zero. In other words, the direct effect of the marketing and promotion activities of the Cotton Board on the domestic demand for man-made fiber textiles is negligible and statistically not distinguishable from zero. Based on the statistically insignificant coefficient for the impact of cotton checkoff promotion activities found for man-made fiber demand, the short-run and long-run cross-advertising elasticities of man-made fiber textile consumption with respect to marketing expenditures for cotton are calculated to be 0.003 and 0.009 (see Table 13). These respective elasticities are smaller than those previously reported by Capps and Williams (2006) (0.01 and 0.02, respectively). The important implication of this result is that there is no statistically discernible direct spillover effect of cotton checkoff program expenditures on the U.S. demand for man-made fiber textiles.

<u>U.S. Cotton Mill Use and U.S. Man-Made Fiber Mill Use Equations</u>

The second set of key demand equations represents the demands by U.S. mills for raw cotton and for raw man-made fibers (Equations (3) and (4) in Table 14). Graphically, the mill use of cotton and man-made fiber over the period 1980 to 2009 is presented in Figure 13. Mill use of these fiber products has declined since 2000. Each year, roughly 15% to 20% of cotton checkoff funds are spent on mill-level (textile or non-agricultural research) promotion activities in attempt to stimulate the mill use of raw cotton (see Table 11). The statistical analysis associated with these two equations provides an empirical assessment of the effectiveness of cotton checkoff funded activities in attempting to directly stimulate U.S. mill demand for raw cotton and of the spillover effects on the demand by U.S. mills for raw man-made fibers. Note that the parameters of separate demand functions at the retail and at the mill levels of the marketing channel are statistically estimated. This model feature is unique to the literature (except for Capps and Williams (2006)) in dealing with the evaluation of the cotton checkoff promotion and research activities.

Equations (3) and (4) in Table 14 are the U.S. cotton mill use and U.S. man-made fiber use equations in the MWFM, respectively. The goodness-of-fit statistics associated with the cotton mill demand and man-made fiber mill demand equations are 0.994 and 0.870, respectively. In other words, these two equations account for most of the variation in the consumption of cotton and man-made fiber at the mill level over the period of analysis (1976/77 to 2009/10). Neither the Durbin-Watson (DW) statistics nor the Ljung-Box Q-statistics indicate the presence of serial correlation of residuals in either of these structural equations. Also, all the estimated coefficients are statistically significant and agree in sign with economic theory.

The statistical results for equation (3) (cotton mill demand) indicate that the statistically significant drivers of cotton consumption at the mill level include real (inflation-adjusted) cotton textile fiber prices, real prices of cotton paid by domestic mills, real prices of polyester paid by domestic mills, cotton mill use in the previous year, real mill-level (textile or non-agricultural research) promotion expenditures financed by cotton checkoff dollars, and qualitative variables related to agricultural and trade policy.

The cotton fiber textile price represents the per unit value of the output from cotton mills. Thus, the mill demand for raw cotton should increase with an increase in the output price. The positive and statistically significant sign for the cotton textile price in equation (3) provides statistical evidence that the U.S. mill demand for cotton is responsive to changes in the price of cotton fiber textiles. The estimated coefficient of the cotton fiber textile price implies that a 10% increase in the price of cotton fiber textiles translates into a 2.4% increase in mill use of cotton (see Table 13). Capps and Williams (2006) reported an output price elasticity of cotton mill demand of 0.41.

Based on the statistically estimated coefficient of the raw cotton price reported in equation (3) of Table 14, the own-price elasticity of cotton mill demand is found to be -0.02, implying that U.S. mill demand for raw cotton is much less responsive to changes in the market price of raw cotton (the input price) than to the cotton fiber textile price (output price) (see Table 13). The own-price elasticity of cotton mill demand found in this study is much smaller than the elasticity of -0.17 reported by Capps et al. (1997), the elasticity of -0.08 reported by Capps and Williams (2006), and also smaller than those reported in several other studies as discussed earlier.

Given the dominance of polyester over other synthetic fabrics in man-made fiber markets, the real price of polyester is used in the mill demand specifications for cotton and man-made fibers to represent the per unit cost of man-made fiber (the man-made fiber input price) at the mill level. Given the high degree of correlation among synthetic fiber prices, using just the polyester price to represent man-made fibers helps avoid potential collinearity problems in the mill demand equations. In the U.S. cotton mill use equation (equation (3) in Table 14), the polyester cross-price elasticity is found to be -0.42, which is larger in absolute value than the own-price elasticity (see Table 13). The implication is that, in the United States, cotton and polyester are complements at the mill level. Although the opposite was found to be the case for foreign cotton mill demand, the finding that cotton and man-made fibers are complements in U.S. mill use is consistent with the findings of previous studies. The polyester cross-price elasticity reported here is also within the range of the estimates reported by previous studies. For example, Murray et al (2001) report the polyester cross-price elasticity of cotton mill demand to be -0.13 while Ding and Kinnucan (1996) reported a short-run polyester cross-price elasticity of -0.27 and a long-run cross-price elasticity of -0.85. Capps et al. (1997) reported a polyester cross-price elasticity estimate for cotton mill demand of -0.55, and Capps and Williams (2006) reported the cross-price elasticity for cotton mill demand with respect to polyester to be -0.26.

The U.S. textile industry at the mill level typically is characterized by lags between orders and deliveries. Stennis, Pinar, and Allen (1983) indicate that forward ordering is prevalent in this industry. Distributors and retailers often contract for cotton fiber twelve months or more prior to delivery. Consequently, to account for these dynamics, various lag lengths on prices were tested in the empirical specification for mill demand. Forward contracting, at least historically, has been an integral part of the cotton and textile industry such that the price observed today influences consumption in the future. Textile manufacturers, for example, make future decisions based on today's prices. Using the AIC and the SIC, the optimal lag length on prices was found to be zero in all cases so that all prices in the mill demand equations are contemporaneous. This finding differs from those of Wohlgenant (1986); Shui, Beghin, and Wohlgenant (1993); and Ding and Kinnucan (1996) who considered a lag length of 12 months. Because our analysis employs more current data, the justification for our finding is the improvements in the efficiency of ordering and deliveries that have occurred over the last 25 years.

As with the retail demand for cotton fiber textiles, the PDL formulation is used to account for the carryover effects of mill-level (textile or non-agricultural research) promotion expenditures on cotton mill demand in equation (3) (Table 14). The results indicate that the short-run elasticity of non-agricultural research expenditures with respect to cotton mill use is 0.02 and that the cumulative (long-run) elasticity is 0.06 (see Table 13). These elasticities are smaller than those previously reported by Capps and Williams (2006) (0.03 and 0.09). As well, unlike the findings of Capps and Williams (2006), there is no delay in the impact of mill-level promotion activities on cotton mill demand. Thus, the cumulative effect of a 10% change in mill-level promotion of raw cotton in a given year is sustained over two years, giving rise to a 0.6% change in domestic mill use of cotton. These results are similar to those of Capps et al. (1997) who report a short-run elasticity associated with mill-level promotion expenditures of 0.08 and the long-run elasticity of 0.13 after a nine-month delay. Murray et al. (2001) also found a statistically positive and significant relationship between non-agricultural research expenditures and cotton mill use. They reported a cumulative elasticity in the range of 0.31 to 0.35 which is not only well above the elasticity reported in this study but also exceedingly high relative to those reported previously in the literature for cotton and for other commodities.

In the U.S. man-made fiber mill demand equation (equation (4) in Table 14), based on the reported coefficients for the real polyester price and the market price of cotton, the own-price elasticity and the raw cotton cross-price elasticity of the U.S. mill demand for man-made fibers are -0.30 and 0.14, respectively (see Table 13). These results are different from the own-price elasticity of -0.20 and the cross-price elasticity of -0.08 previously reported by Capps and Williams (2006). The results provide evidence of the substitutability of cotton and man-made fibers at the mill level and identify a potential *indirect* avenue for spillover effects from cotton checkoff program activities. The elasticity of the man-made textile price (output price) associated with mill consumption is positive (0.03) albeit not statistically different from zero. This result is not in accord with the findings of Capps and Williams (2006) who reported the output price elasticity to be 0.20.

The results for equation (4) in Table 14, also suggest that mill-level (textile or non-agricultural research) promotion activities associated with the cotton checkoff program are positively related to the mill demand for man-made fibers with no delay between expenditures and effect as in the case of cotton mill demand. The results indicate that the short-run elasticity of mill-level promotion expenditures with respect to man-made fiber mill use is 0.01 and that the cumulative (long-run) elasticity is 0.05 (see Table 13). Thus, the contemporaneous effect of a 10% change in mill-level promotion expenditures for cotton gives rise to a 0.1% change in U.S. man-made fiber mill demand. Sustained over a period of two years, the cumulative effect of a 10% change in non-agricultural research expenditures for cotton is a 0.5% change in U.S. man-made fiber mill demand. This *direct* spillover effect, however, is not statistically different from zero. The implication is that the cotton checkoff program expenditures have little, if any, *direct* impact on mill demand for man-made fibers which is the same conclusion reached for the retail demand for man-made fibers.

Summary Comments on the Texas Tech MWFM and the Demand Equation Estimation Results

The structure of the Texas Tech Modified World Fiber Model (MWFM) and the parameters estimated for the model equations represent the key assumptions of the methodology for determining the net benefits associated with the cotton checkoff program for cotton producers and cotton importers. The modifications to the Texas Tech model correspond to the incorporation of the promotion and non-agricultural research expenditures. We use a linear model with a square root transformation on the expenditure variables to capture diminishing marginal returns. Even though both domestic producers and importers pay assessments to fund the checkoff program, the net benefits associated with the programmatic activities of Cotton Incorporated may be quite different for each group. Using the MWFM, producer and importer net benefits are separated and government savings as a result of the cotton checkoff program are captured. The key structural parameters that allow a calculation of the benefit-cost ratios as well as government savings are precisely those associated with the cotton checkoff marketing and promotion expenditures and non-agricultural research expenditures, and the price elasticities of demand at the retail and mill levels of the marketing channel.

Importantly, several statistical results are keys to understanding the conclusions of the simulation analysis of the effectiveness of the cotton checkoff program in the next section. First, note that the demand for cotton fiber textiles at the retail level and the demand for cotton at the mill level in the model are positively and significantly affected by the cotton checkoff expenditures. Perhaps more important is that the long-run elasticity associated with retail-level (marketing) promotion expenditures (0.11) exceeds the long-run elasticity associated with mill-level (textile or non-agricultural research) promotion expenditures (0.06). Thus, all other factors held constant, equal *percentage* changes in retail-level and mill-level promotion expenditures lead to a greater *percentage* change in cotton fiber textile consumption than in mill demand for raw cotton. Second, the cotton checkoff program has no statistically significant impact on either the demand for man-made fiber textiles or the mill demand for man-made fibers. Finally, the only statistically significant spillover effect of the cotton checkoff program on the markets for man-made fibers is through mill level prices as a result of the interrelationship between cotton and man-made fibers in mill use. In the man-made fiber mill level relationship, cotton and man-made fiber are substitutes. That is, higher cotton prices lead to a greater mill level use of man-made fiber. In the cotton mill use relationship, cotton and man-made fibers act as complements. That is, higher man-made fiber prices lead to a reduction in mill level use of cotton.

Model Validation

Validation of the MWFM consisted of a check on the dynamic, within-sample (ex-post) simulation statistics over the period of 1986/87-2009/10. 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 (Appendix Table 1). Most of the Theil inequality coefficients are close to zero, indicating excellent model performance. As well, the bias and variance proportions are close to zero, indicative of the ability of the model to not only replicate the observed values of endogenous variables over time on average but also to replicate their variability.

SIMULATION ANALYSIS OF THE IMPACTS AND RETURNS FROM THE COTTON CHECKOFF PROGRAM

The cotton checkoff elasticities presented and discussed in the previous section of this report provide measurements of the relationship between cotton checkoff expenditures and the U.S. demands for cotton, cotton fiber textiles, man-made fiber, and man-made fiber textiles. While instructive, the expenditure elasticities fall far short of providing a complete understanding of either the market effects of the expenditures or the returns they generate to those who pay the assessments for at least two reasons. First, the expenditure elasticities are *static* impact measures and tend to overestimate the effect of an increase in expenditures on quantity demanded. Thus, the expenditure elasticities indicate how demand changes given a change in checkoff expenditures, holding constant all other factors. That is, the assumption underlying the calculation of the cotton checkoff expenditure elasticities is that a change in expenditures that affects demand does not affect prices, imports, supply, or any other market quantities. Undoubtedly, however, if demand shifts as a result of checkoff expenditures, then price will change unless supply is perfectly elastic which, in turn, will change the levels of imports, supply, and many other market variables, including the quantity demanded of the good itself.

A look at Figure 14 serves to help illustrate the problem with using an elasticity as the measure of the demand impact of checkoff expenditures. For expositional purposes only, this figure, like Figure 6, does not show the small leftward shift of the supply curve that occurs as a result of the checkoff assessment on cotton producers. Again, this leftward "tax" effect of the checkoff is included in the empirical analysis discussed later. In Figure 14, assume, for example, that a 10% increase in checkoff expenditures shifts demand from D_0 to D_1. If price (P_0) does not change, then the demand for the commodity increases from Q_0 to Q_2. If the *expenditure elasticity* (as statistically estimated through the process described in the previous section) is 0.05 and promotion expenditures increase by 10%, then the increase in Q from Q_0 to Q_2 (the quantity consumed) would be on the order of 0.5% (calculated as the percent change in Q (0.5%) divided by the percent change in expenditures (10%)). But this assumes that price remains at P_0 and does not change even when the demand is increasing from the promotional activities. Normally, one would expect that price would increase somewhat (such as from P_0 to P_1 in Figure 14) when promotion successfully shifts out demand unless supply is perfectly elastic (which is not the case in U.S. cotton markets). Because price does tend to increase, the actual increase in demand as a result of promotion can be much smaller (such as from Q_0 to Q_1 in Figure 14) than the expenditure elasticity leads us to believe might happen because of the assumption that price does not change. And, if price changes when the demand changes, then imports, and supply, and many other market variables are likely to change as well.

A second reason that expenditure elasticities are insufficient measures of checkoff program impact is that they provide measures only of the effect of the program expenditures on demand. The primary objective of the cotton checkoff program, however, is not simply to increase the demand for cotton but rather to enhance the profitability of growing cotton for domestic producers. The expenditure elasticities presented and discussed earlier in this report suggest that the cotton checkoff program has had a positive and statistically significant impact on the demand for cotton and cotton fiber textiles. The relevant question for those who pay for the program, however, is whether or not the increase in demand and any consequent increase in their revenues have been sufficient to cover their assessment costs.

To provide a more accurate measure of the impact of cotton checkoff expenditures on demand as well as a measure of the returns to those who pay the checkoff assessments, the Texas Tech University Modified World Fiber Model (MWFM) was used in this study to conduct a simulation analysis of the cotton checkoff program. The analysis focuses specifically on answering the questions posed in the introduction to this report: (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? (2) Have the net benefits of the program to domestic cotton producers and cotton importers been greater the costs of the promotion? (3) Has the program reduced the dependence of producers on government support programs? To answer these questions, two basic scenarios were simulated with the MWFM: (1) a baseline "With Promotion Expenditures" scenario in which both retail-level and mill-level cotton checkoff promotion expenditures were set to their actual historical levels and (2) a counterfactual "Without Promotion Expenditures" scenario 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, trade, etc.) over the 1986/87 to 2009/10 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 Promotion Expenditures" 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, improved cotton varieties, etc.

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 Promotion Expenditures" 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 Promotion Expenditures" scenario from their baseline solution values in the "With Promotion Expenditures" 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 Texas Tech MWFM is allowed to change as the two simulation scenarios are conducted, this process effectively isolates the impacts of retail-level and the mill-level cotton checkoff advertising and promotion expenditures on the respective endogenous variables in the model.

The markets effects of promotion are reported for two time periods: (1) crop years (August/July) 1986/87 through 2009/10, referred to as the "full" or "entire" period of analysis and (2) crop years (August/July) 2005/06 through 2009/10, referred to as the "most recent five-year" or "last five-year" period of analysis, corresponding to the five-year period since the last checkoff evaluation study was conducted. Note that because the last full crop year that could be included in the analysis was 2009/10, the last five year period included in the model ended in July of 2010. Consequently, the analysis conducted here does not include the period since August 2010 when cotton prices began a rapid climb. Between July 2010 and January 2011, the monthly average farm and spot prices of cotton increased 20% and 89%, respectively (see Figure 15).

In graphical terms, the overall simulated effects of the cotton checkoff program are equivalent to the combination of the changes in quantities and prices demonstrated in Figures 6 and 7 which illustrate the separate cotton and cotton fiber textile market effects of the retail-level (marketing) and the mill-level (textile or non-agricultural research) promotion expenditures by the Cotton Board. Those combined effects, however, are complicated in the simulation analysis by the effects of U.S. cotton farm policy over time, simultaneous interactions with other world fiber markets, and the spillover effects of promotional activities on man-made fiber and textile markets. Obviously, the final effects of the cotton checkoff program on cotton and fiber textile markets and prices and on the returns to cotton producers and importers will depend on the nature and strength of the relationships and interactions among the many market variables as captured by the Texas Tech MWFM.

Effects of the Cotton Checkoff Program on U.S. and World Fiber Markets[7]

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 1986/87-2009/10 (Table 17). On the supply side of the U.S. cotton market, the cotton checkoff program boosted annual cotton production by about 3% on average over the entire period, somewhat larger than

[7] To better comprehend the simulation effects discussed here, the reader is encouraged first to review the graphical analysis presented earlier in this report associated with Figures 6 and 7.

the 2% average annual increase in the last five-year period of the analysis[8]. Note that the increase in U.S. cotton production as a result of the checkoff program was not uniformly distributed across the Cotton Belt. The largest average annual impacts on cotton production over the entire period from 1986/87 to 2009/10 were in the Southeast and West regions where production increased by 62 million lb (4%) and 60 million lb (4.5%), respectively. The average annual impacts of the cotton checkoff program on production over the same period in the Delta, the irrigated Southwest, and the dryland Southwest regions were more modest at 25 million lb (1%), 37 million lb (3%), and 39 million lb (3.5%), respectively.

The average annual mill use of cotton in the United States was 581 million lb higher in the 1986/87-2009/10 period of analysis and about the same over the last five year period (570 million lb) as a result of the cotton checkoff program than would otherwise have been the case (Table 17). Overall, the average annual domestic cotton mill use rose by about 15% over the entire period. Because the cotton research and promotion program induced a larger increase in U.S. cotton mill demand than in U.S. cotton production, cotton was diverted from exports to domestic markets. On average in each year over the 1986/87-2009/10 period of analysis, the checkoff program diverted about 345 million lb of cotton from exports to domestic mills, slightly less than the 385 million lb diverted on average in each year during the most recent five year period of the analysis. The farm price of cotton averaged about 5.4¢/lb higher in each year from 1986/87 to 2009/10 as a result of the checkoff program, somewhat less than the annual average increase of 6.6¢/lb during the most recent five-year period of analysis. The average annual changes in the prices paid by domestic mills for cotton and the world cotton price (A-index) were similar to those of U.S. farm prices.

In foreign cotton producing and milling countries, the cotton checkoff program boosted cotton mill demand by an annual average of 1% over the entire period of the analysis. The consequent higher world cotton price (A-index) stimulated a foreign production response of 2% on average in each year over that period (Table 17). The average annual increase in foreign production over the entire period of the analysis (752.5 million lb) was more than sufficient to meet the increase in foreign mill demand (430 million lb) and still allow an increase in exports to importing countries (374 million lb) to fill the void left by the decline in U.S exports.

The simulation results also indicate that, due to the promotion activities of the Cotton Board, U.S. consumption of cotton fiber textiles was higher by 853 million lb (10%) on average in each year over the entire period of analysis, slightly less than the average annual increase achieved in the last five-year period of analysis of 916 million lb (9%). Over the same 24-year period of analysis, the cotton textile fiber (CFT) price index increased on net by an annual average of about 2%, indicating that the increase in the retail CFT demand induced by the retail-level (marketing) checkoff expenditures was slightly larger than the combined increase in U.S. and foreign supply of CFTs induced by the mill-level (textile or non-agricultural research) expenditures of the program. Because the induced increase in U.S. CFT demand was greater than the induced increase in U.S. CFT supplies, the cotton checkoff program also boosted U.S. CFT imports on average each year over the entire period of analysis by 6%.

[8] Recall that the "most recent five-year period" of the analysis includes crop years (August/July) 2005/06 through 2009/10 but does not include the months since the end of the 2009/10 crop year when cotton prices began a rapid climb. See the previous section for a discussion of the time periods included in this analysis.

In the U.S. MMF market, the cotton checkoff program resulted in a small average annual increase in mill demand (2%) and a smaller average annual increase in MMF production over the entire period of analysis leading to a small increase in MMF prices, including the price of polyester (Table 17). Recall that the previous section of this report concluded that the direct effect of the cotton checkoff program on man-made fiber mill demand has been positive but quite small. In other words, there has been only a small *direct* effect of the cotton checkoff program on the demand for man-made fiber at the mill level. There is also a small *indirect* substitution effect of the cotton checkoff program on man-made fiber markets through price linkages between the two markets, which tend to work together to boost MMF mill demand given that the mill price of cotton increases as a result of the program. The consequence is a 2% increase in MMF mill demand over the 24-year period of analysis but a smaller 0.5% increase in the most recent five-year period of analysis. The price of polyester realizes only a small average annual increase of 2.7% over the entire period of analysis and a smaller 1.1% over the most recent five-year period of analysis.

In the MMF textile market, the cotton checkoff program had a small average annual effect on consumption, net imports, and the retail price of MMF textiles (Table 17). Recall that the *direct* effects of the cotton checkoff program on the demand for man-made fiber textile products were found to have been small and positive but statistically insignificant. Over the entire period of analysis, the cotton checkoff program increased MMF textile consumption by an annual average of only 1.2%. The slightly larger average annual increase in domestic MMF mill use as discussed above, however, leads to slightly lower average annual MMFT prices (-0.2%) and net imports (-0.1%) over the entire period of analysis. The smaller positive average annual impact of the checkoff program on MMF mill use in the most recent five-year period of analysis allows some import increase to meet the small checkoff-induced increase in MMFT consumption.

In summary, the key impacts of the cotton checkoff program on world cotton and cotton fiber textile markets <u>on average in each year</u> over the entire 1986/87 to 2009/10 period according to the simulation analysis were the following (Table 17):

- A 3% increase in U.S. cotton production with much of the increase taking place in western and southeastern states;
- A 2% increase in foreign cotton production;
- Increases in U.S. and foreign cotton mill use of about 15% and 1%, respectively;
- An 8% decline in U.S. cotton exports offset to a large degree by an increase in foreign cotton exports of nearly 4%;
- An increase in the annual average prices of cotton, including the U.S. farm price (10%), the U.S. mill price (9%), and the world price of cotton measured by the A-index (10%);
- A 10% increase in cotton fiber textile consumption along with higher imports of cotton fiber textiles from foreign mills of about 6% resulting in a larger share of the U.S. consumption of cotton fiber textiles being supplied by foreign rather than domestic mills; and
- A small increase in the price of cotton fiber textiles of about 2%.

In U.S. man-made fiber and man-made fiber textile markets, the key impacts of the cotton checkoff program <u>on average in each year</u> over the entire simulation period (the spillover effects) included the following (Table 17):

- A small positive impact on the U.S. production of synthetics and cellulosics (0.7% and 3.7%, respectively);
- A small increase in U.S. man-made fiber mill use of about 2%;
- An increase in the polyester price of about 3%;
- A small increase (1%) in the U.S. consumption of man-made fiber textiles;
- A small net decline (-0.2%) in net imports of man-made fiber textiles; and
- A marginal net decline (-0.1%) in the price of man-made fiber textiles.

A graphical analysis of the domestic and global impacts of the Cotton Research and Promotion Program over the 1986/87 to 2009/10 period as well as the 2005/06 to 2009/10 period is given in Figures 16 and 17. The average annual bale impacts of the checkoff program are given in Figure 18. The graphical depictions serve to summarize the impacts of the checkoff program over the two respective periods.

Benefit-Cost Analysis of the Cotton Checkoff Program

While 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 the question of stakeholder returns from a commodity checkoff program 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. For example, 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) $$R_t = (P_{ct}^{w} Q_{ct}^{w} - C_{ct}^{w} Q_{ct}^{w}) - (P_{ct}^{wo} Q_{ct}^{wo} - C_{ct}^{wo} Q_{ct}^{wo}),$$

where P_c is the effective 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) $$PBCR = \frac{\sum_{t=1}^{T} R_t}{\sum_{t=1}^{T} E_t},$$

where E is the cotton checkoff promotion expenditures. The producer checkoff assessments in each year are usually netted out of the additional profit generated (R_t) to arrive at 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) $$N_t = (P_{cft}^{w} Q_{cft}^{w} - P_{cft}^{wo} Q_{cft}^{wo}) + (P_{mft}^{w} Q_{mft}^{w} - P_{mft}^{wo} Q_{mft}^{wo}),$$

where P is retail price, Q is quantity sold, the subscripts cft and mft indicate cotton fiber textiles and man-made fiber textiles, respectively, and the superscripts w and wo again indicate "with" and "without" the cotton checkoff promotion expenditures. Since 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 (π) and multiplying by N from equation (3):

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

The IBCR is then calculated as additional net profits earned by importers (less the importer checkoff assessment) 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 entire 24 years of the analysis (1986/87-2009/10) the combination of increased acreage and enhanced per pound returns to producers as a result of the cotton checkoff program generated additional total revenue (net of added costs of production) to producers of $4.5 billion, roughly $187.4 million per year or about 4.0% of the total cotton farm receipts received by producers over that period (Table 18). Over the same period, the higher prices of cotton induced by the cotton checkoff program reduced government cotton farm program costs by about $4.9 billion, an average of about $203.5 million per year. In essence, the cotton checkoff program not only increased revenues to cotton producers over the year but also worked to reduce the dependence of farmers on government payments.

Over the entire period of analysis, just over 52% of the total revenues added by the cotton checkoff program accrued to producers while nearly 48% accrued to the government as farm program cost savings (Table 18). The share of the total revenue to producers was higher than the farm program cost savings over that period for at least two reasons. First, the farm price was above the support price in a number of years so that all revenues accrued to producers in those years. Also, the 1996 FAIR Act eliminated deficiency payments so that production decisions became more responsive to changes in market conditions. As a consequence, during the period that the 1996 Farm Bill was in force, the price increases generated by the cotton checkoff program benefited producers primarily with little contribution to reducing farm program costs.

The situation during the most recent five-year period of analysis was quite different with the cotton checkoff program adding only about $24 million to farm revenues (an annual average of $4.8 million) and reducing government cotton farm costs by $1.8 billion (an annual average of about $360 million). During this time period, only about 12% of the checkoff-generated revenues accrued to farmers with the rest helping to reduce farm program costs. With the return of target prices in the 2002 Farm Bill, the implementation of the counter-cyclical payment program, the adjusted world price below the loan rate in all but one year, and the farm price below the target price in all years, a much larger share of the benefits of the cotton checkoff program generated farm program cost savings during the most recent five-year period than during the 1996 Farm Bill years. Capps and Williams (2006) reported a similar finding for the pre-1996 Farm Bill years when similar farm policy conditions existed.

Using the added net farm revenues as a result of the cotton checkoff program as the producer "benefit" of the program, the calculated (undiscounted) producer NBCR over the entire period of analysis was 4.2 or 2.4 on a discounted basis (accounting for the time value of money) (Table 18). The government cost savings per dollar of cotton promotion expenditure over the same period was 4.6 or 2.6 when discounted to present value. In other words, because much of the cotton checkoff program benefits accrued to the government as farm program cost savings over time, the checkoff program not only increased producer net revenues by an average of $4.2 per dollar spent on promotion over the 1986/87-2009/10 period of analysis but also resulted in an average of $4.6 more dollars of their net revenues per dollar spent on promotion coming from the market rather than from the government. Thus, about half of the farm-level benefits of the cotton checkoff program served to enhance cotton producer profitability and half served to reduce their dependence on government farm programs.

Given the more extensive intervention of the government in cotton markets in recent years than at various times over the full period of analysis, the low return to producers (NBCR) of 0.8 (0.7 on a discounted basis) during the last five years of analysis is not surprising. The farm program cost savings during that period was correspondingly higher at 5.8. The implication is that on average in each year over the last five years, most of the benefits of cotton checkoff program served to reduce the dependence of cotton producers on government farm programs.

Capps et al. (1997) reported a similar undiscounted NBCR for the cotton checkoff program of about -0.7 in the early years of the program and 3.2-3.5 in the later years of their analysis. Murray et al. (2001) reported an undiscounted NBCR in the range of 3.2-6.0. In the most recent previous analysis of the cotton checkoff program, Capps and Williams (2006) reported an undiscounted producer NBCR of 0.6 for the 1986/87-1991/92 period and a higher 9.2 during the 1992/93-2004/05 period during which the 1996 Farm Bill allowed a much larger share of the farm-level benefits to enhance producer profits than to reduce their dependence on farm programs.

Cotton Importer BCR Analysis

Importers began paying the cotton checkoff assessment in July of 1992 with the implementation of the Cotton Research and Promotion Amendments Act of 1990. Since that time, the revenue effects of the cotton check-off program have accrued to importers from two sources: (1) changes in sales of cotton fiber textiles (CFTs) and (2) changes in sales of man-made fiber textiles MMFTs). Recall from the earlier discussion that the cotton checkoff program has both direct and indirect spillover effects on both the volume and value of MMFT sales.

In the case of CFTs, the cotton checkoff program increased both the price and quantity consumed (see Table 17) resulting in 12% more revenues in CFT sales since 1992 than would have been the case without the promotion program (Table 19). In the case of MMFTs, the cotton checkoff program had a positive effect on MMFT consumption with little effect on the price of MMFTs resulting in 1.5% more sales of MMFTs since 1992 than would have been the case without the promotion program (Table 19). Note that the calculated importer BCR captures the man-made fiber market spillover effects associated with the checkoff program activities of Cotton Incorporated.

The total increase in revenue to importers from sales of both cotton fiber textiles and man-made fiber textiles amounted to about $272.5 billion or an average of $15.1 billion per year since importers began paying the cotton checkoff assessment (Table 19). According to the financial data of major apparel and home furnishings retailers, the average industry pre-tax profits to sales ratio ranged from a low of 0.8% to a high of 8.6% since 1994 for an average of 6.1% (Table 20). Applying the annual pre-tax profits sales ratios to the annual increases in CFT and MMFT sales generated by the cotton checkoff program yields a cumulative increase in profits by the U.S. retail textile sales industry of about $19.5 billion. Consequently, the undiscounted benefit to the retail textile industry in terms of additional pre-tax profits as a result of the cotton checkoff program over the 1992/93 to 2009/10 period was $17.3 per dollar spent by the Cotton Board on cotton and cotton fiber textile promotion activities (Table 19). Applying an assumed 37% tax rate to the added importer pre-tax profits suggests that the added after-tax profits of imports over the 1992/93-2009/10 period was around $12.5 billion which gives an after-tax importer BCR of 10.7 over that period. The discounted pre- and after-tax BCRs over the same period were 10.9 and 6.8, respectively.

The undiscounted importer (pre-tax) BCR estimate in this study is smaller than reported by Capps and Williams in the previous 5-year study (19.5) but larger than those reported in earlier studies. Capps et al. (1997) and Murray et al. (2001) reported undiscounted importer (pre-tax) BCRs of between 3.63 and 5.59 and between 1.90 and 3.40, respectively. Those two previous studies, however, failed to capture spillover effects from the man-made fiber industry associated with the program and, therefore, underestimated the retail benefits of the cotton checkoff program. If only the specific effects of the cotton checkoff program on cotton and cotton fiber textiles are considered, then the added pre-tax profit to importers from the program would be somewhat less at $16.6 billion and would yield a somewhat lower (pre-tax) importer BCR of about 15.6. Differences in time periods and model structure also account for differences in the calculation of importer BCRs. Neither the Capps et al. (1997) nor the Murray et al. (2001) studies included separate demand equations for cotton at the mill level and for cotton fiber textiles at the retail level.

Economic Effects of the Cotton Checkoff Agricultural Research Program

The analysis thus far centers attention primarily on ascertaining the impacts of cotton checkoff-funded marketing and promotion expenditures and non-agricultural (textile) research expenditures on various segments of the cotton industry, both domestic and foreign. This section of the report provides an analysis of the economic relationship between checkoff expenditures on cotton research and the U.S. cotton supply. Capps and Williams (2006) was the only previous study of the cotton checkoff program to consider the effects of investing funds in agricultural research. This section of the report expands on their work in this area.

As discussed earlier, marketing and promotion expenditures are intended to shift out the retail demand for cotton fiber textile products while non-agricultural research expenditures are intended to shift out the textile mill demand for raw cotton. In contrast, checkoff expenditures in support of agricultural research are intended to shift out the supply of U.S. cotton by increasing production efficiency and/or reducing production costs. Typically, agricultural research expenditures that reduce production costs would be expected to lead to an expansion in the acreage dedicated to cotton production. On the other hand, agricultural research expenditures that increase production efficiency would be expected to increase production yields, that is, the output per acre in production. Since production is the product of acreage and yield, successful agricultural research of either type would tend to increase output. Emphasis is placed on harvested acreage over planted acreage to get a better handle on production.

The effects of investments in research on the market supply of a commodity like cotton, however, are often not immediate, measurable, or direct. Research investments may fund either basic, long-term types of research or more applied, short-term types of research. Because the lag between research activities, particularly basic research, and the commercialization of new technologies available for adoption by cotton producers may be quite lengthy, the full market impacts and any benefits of checkoff-funded research to cotton producers may not be felt for a long time following the research investment.

Also, research investments may not always result in measurable market impacts. For example, basic or applied research that provides knowledge about what does *not* work in increasing yields or reducing costs has value but is not measurable in terms of market impacts. At the same time, applied research often is related to or depends on previous investments in basic research. Consequently, investments in basic research may have only indirect market effects to the extent that the results of that research lead to more applied research to develop new technologies and processes for adoption by producers. For these and other reasons, accurate quantification of the effectiveness of cotton checkoff agricultural research expenditures over the years on cotton production is difficult at best. An added complication is the difficulty of obtaining the necessary data over a sufficiently long enough period of time to be able to statistically identify the relationship between research and production.

Cotton checkoff expenditures on agricultural research have grown in absolute amount and as a share of total cotton checkoff expenditures over the years. From about $1.5 million in the mid-1980s (4.5% of total expenditures), agricultural research expenditures increased to nearly $4.6 million in 2009/10 (15% of total expenditures). Checkoff dollars, however, represent a small portion of the total investment in cotton production research in this country. Much of the research investment is made by private firms like Monsanto and others and publicly funded research organizations like the agricultural experiment stations at landgrant universities and the Agricultural Research Service of the U.S. Department of Agriculture. In general, most basic, long-term types of research are funded by public and private firm investments. Checkoff dollars are normally invested in more applied, short-term types of research. As a consequence, the relationship between cotton checkoff investments in research and cotton production may be more straightforward and amenable to statistical measurement than might be the case for cotton research funded by other groups.

Major contributions to both the theory and measurement of the returns to producers from investments in agricultural research have been made by a variety of researchers (see, for example, Schultz (1953); Griliches (1958); Evenson (1967); Peterson (1967); Fox (1985); Pardey and Craig (1989); Chavas and Cox (1992); and Williams, Shumway, and Love (2002)). A number of commodities have been analyzed, including corn, poultry, rice, rapeseed, wheat, wool, and soybeans. The reality is that little research is available on the returns and supply effects of either public or private investments in cotton research.

Data and Methodology

The first step in the analysis of the cotton supply effects of cotton checkoff investments in agricultural research is to gather annual data pertaining to harvested acreage and yields for various cotton production regions: (1) the West (Arizona, California, and New Mexico); (2) the Irrigated Southwest (Kansas, Oklahoma, and Texas); (3) the Dryland Southwest (Kansas, Oklahoma, and Texas); (4) the Southeast (Alabama, Florida, Georgia, North Carolina, South Carolina, and Virginia); and (5) the Delta (Arkansas, Louisiana, Mississippi, Missouri, and Tennessee). The aggregate of these regions is the so-called "Cotton Belt." The U.S. cotton planting season typically occurs from February to June, depending on the region.

Over the period of 1977/78 to 2009/10, average harvested acreage was the highest in the Delta at 3.24 million acres followed by the Dryland Southwest at 3.16 million acres and the lowest in the West at 1.32 million acres followed by the Southeast at 1.86 million acres, and the Irrigated Southwest at 2.00 million acres (Figure 19). Over that same period, the West achieved the highest average yields at 1,160 lb/acre followed at a distance by the Delta at 718 lb/acre, the Southeast at 623 lb/acre, the Irrigated Southwest at 614lb/acre, and finally the Dryland Southwest at 368 lb/acre (Figure 20).

Although annual data on harvested acreage and yield are available back to 1962/63 for the various production regions, data on agricultural research expenditures from Cotton Incorporated

(CI) are only available back to 1977/78. Thus, the maximum time period available for this analysis covers only the 33 crop years between 1977/78 and 2009/10. Over that time period, nominal agricultural research expenditures have grown from less than $1.0 million per year to nearly $11.5 million (see Table 11). Since 1992/93, nominal agricultural research expenditures have averaged about $7.4 million and accounted for about 12% of cotton checkoff expenditures.

The economic relationship between cotton checkoff-funded agricultural research expenditures and cotton harvested acreage and yield is measured using regression analysis. Separate single-equation models are specified corresponding to the harvested acreage and the yields of cotton in each of the five production regions. Agricultural research expenditures finance projects intended primarily to enhance cotton yields and/or reduce cotton production costs such as genetic improvements to enhance cotton yield and quality, improving cotton's resistance to temperature extremes and to insects and diseases, advances in biotechnology, reduced dependence on pesticides, and profitable conservation tillage practices. Agricultural research expenditures that reduce production costs would be expected to give rise to expanding acreage dedicated to cotton production.

As with the retail demand for cotton fiber textile and the mill demand for cotton, a polynomial distributed lag (PDL) formulation is used to account for the potential carryover effects of agricultural research expenditures on harvested acreage and on yields across the five production regions. In each region, the logarithm of harvested acreage in the current period is specified to be a function of several variables: (1) the logarithm of the real price of cotton paid by mills in the previous year, (2) a one-year lag of the logarithm of harvested acreage, (3) agricultural policies corresponding to the 1985, 1990, 1996, and 2002 Farm Bills, and (4) a PDL formulation of the logarithm of real agricultural research expenditures. For yield in each region, the logarithm of yield in the current period is specified to be a function of: (1) weather effects, with the use of El-Niño and La-Niña as proxy variables, (2) a one-year lag of the logarithm of yield, and (3) a PDL formulation of the logarithm of real agricultural research expenditures. A second degree polynomial distributed lag with endpoint constraints was used for the acreage and yield equations in each of the five production regions. Lag lengths of up to 12 years were considered with the optimal lag lengths chosen based on statistical criteria, namely the Schwarz Information Criterion (SIC) and the Akaike Information Criterion (AIC).

Similar to Mitchell (2009), weather effects are proxied through the occurrences of the El-Niño/La-Niña phenomenon. El-Niño and La-Niña are two extreme phases of the El-Niño/Southern Oscillation (ENSO) climate cycle. El-Niño occurs when there is an irregular warming of subsurface temperatures from Peru to Ecuador to the Pacific. Over the period 1962 to 2010, past El-Niño occurrences were recorded in 1965/66, 1969/70, 1972/73, 1976/77, 1982/83, 1986/87, 1991/92, 1994/95, 1997/98, 2002/03, 2006/07, and 2009/10 (Stormfax, 2011).

The effects of El-Niño give rise to more rain across the Southern part of the United Sates. La-Niña represents a cooling of subsurface temperatures. Episodes of La-Niña were recorded in 1964/65, 1970/71, 1973/74, 1975/76, 1988/89, 1995/96, 1998/99, 2000/01, 2006/07, 2007/08, and 2009/10 (Stormfax, 2011). La-Niña leads to warmer conditions and less rain across the southern part of the United States. Consequently, for years in which La-Niña occurred, owing to more drought conditions, cotton yields are expected to be lower in all production regions. For years in which El-Niño occurred, cotton yields are expected to be higher, particularly for the Southwest Dryland regions.

In conjunction with the work of Mitchell (2009), the agricultural policy variables correspond to the implementation of the 1985, 1990, 1996, and 2002 farm bills. The 1985 Farm Bill solidified the role of farm program payments in supporting cotton prices as well as incomes of producers and likely reinforced non-market incentives to produce cotton. The 1990 Farm Bill continued the basic orientation of the Food Security Act of 1985. The 1990 Farm Bill also instituted the Conservation Reserve Program (CRP), which took out some highly erodible cotton land. Further, the Acreage Reduction Program (ARP) was instituted with a maximum of 25% reduction in cotton acreage. The 1996 Farm Bill allowed producers almost total flexibility in their planting decisions and eliminated acreage reduction programs. Finally, the 2002 Farm Bill reinstituted some of the risk buffering aspects of the 1985 Farm Bill. Operationally, each of the farm bills corresponds to a set of indicator variables, zero if the particular legislation is not in effect, and one if in effect. These agricultural policy variables are expected to be positively associated with harvested acreage in the respective production regions of the United States.

Empirical Results

The econometric analyses associated with the impacts of agricultural research expenditures on yields and harvested acreages are exhibited in Tables 21 and 22. Definitions of the variables in those two tables are provided in Table 23. For the yield equations, the goodness-of-fit statistics (adjusted R^2) range from 0.325 (Southeast region) to 0.541 (Delta region). Yield in the previous year affects the current yield in the Delta region, the Southeast region, and the Southwest Irrigated region. For these regions, inertia or stickiness exists in yields. Weather conditions, particularly the effects of La-Niña, negatively impact yields. The effects of La-Niña reduce yields in the Delta region by 8.43%, in the Southeast region by 9.82%, in the Southwest Dryland region, by 13.88%, in the Southwest Irrigated region by 12.65%, and in the West region by 13.69%. All of these reductions in yields attributed to La Niña are significantly different from zero. The West region is negatively affected by the effects of El Niño. Yields in the West region are lower by 9.17% due to El Niño. All other production regions are not significantly affected by El Niño.

For the equations pertaining to harvested acres of cotton, the goodness-of-fit statistics are much higher in comparison to the yield equations. The adjusted R^2 values vary from 0.613 (Southwest Dryland region) to 0.941 (Southeast region). The real price of cotton paid by mills in the previous year is a significant driver of harvested acres in the Southeast region and the Southwest Dryland region. Cotton acreage in the previous year is a significant determinant of harvested acres in the Delta region, the Southeast region, the Southwest Dryland region, and the West region. Agricultural policy, in particular through the Farm Bills enacted in 1985, 1990, 1996, and 2002, is a key factor associated with harvested acres of cotton in all production regions. The Farm Bill legislation is positively associated with harvested acreage in all production regions except for the Southwest Irrigated region.

Agricultural research expenditures are found to positively and significantly affect yields in each of the five production regions. In addition, agricultural research expenditures are found to positively and significantly affect harvested acreage in the Delta region and in the Southeast region. No discernible effect on harvested acreage is evident for the Southwest Dry, Southwest Irrigated, or West regions. The cumulative or long-run elasticities on yields as well as the length of time to reach the cumulative effect by production region are exhibited in Table 24. The long-run percentage changes in yields due to a 1% change in real agricultural research expenditures are found to vary among regions from 0.09 in the West to 0.17 in the Irrigated Southwest. The length of time to reach this cumulative effect varies from ten to twelve years across the respective production regions. The conclusion from this analysis is that that agricultural research expenditures funded with cotton checkoff dollars have effectively enhanced cotton yields and, thus, cotton production over the years. The amount of time required to reach this cumulative impact, however, has been between ten and twelve years, depending on the production region. The short-run checkoff expenditure elasticities are quite small, ranging from 0.0033 in the Southeast region to 0.0088 in the Southwest Dryland region. Hence, the contemporaneous impact of changes in agricultural research expenditures from the checkoff program on cotton yields is almost negligible.

The cumulative or long-run elasticities on harvested acres as well as the length of time to reach the cumulative effect by production region are exhibited in Table 25. Changes in agricultural research expenditures from the cotton check-off program positively and significantly impact harvested acres of cotton in the Delta region and in the Southeast region. The long-run percentage changes in harvested acres due to a 1% change in inflation-adjusted agricultural research expenditures from the check-off program are 0.3186 for the Delta region and 0.3405 in the Southeast region. The length of time to reach this cumulative effect for the Delta region is ten years while for one Southeast region the length of time is seven years. The long-run elasticities on harvested acres attributed to inflation-adjusted agricultural research expenditures are 0.2270 for the West region, 0.0623 for the Southwest Irrigated region, and -0.1268 for the Southwest Dryland region. However, none of the respective elasticities for these three regions is significantly different from zero. The length of time necessary to reach these cumulative effects varies from six years (Southwest Dryland region), ten years (West region), and twelve years (Southwest Irrigated region).

Capps and Williams (2006) report similar results of the impacts of changes in real agricultural research expenditures on cotton yields. The long-run elasticities reported in this study compared to those reported in the previous study by Williams and Capps (2006) were respectively: 0.07 and 0.09 for the West region; 0.18 and 0.17 for the Southwest Irrigated region; 0.08 and 0.10 for the Southeast region; and 0.11 and 0.14 for the Delta region. A non-similar finding associated with yields is for the Southwest Dryland region. Capps and Williams (2006) also report a shorter length of time from six years to ten years to reach the cumulative effects on yields instead of ten years to twelve years.

Capps and Williams (2006) also report that changes in real agricultural research expenditures had no discernable effect on harvested acreage of cotton. The current results indicate that this finding is still true for the West region, the Southwest Irrigated region, and the Southwest Dryland region. However, harvested areas in the Southeast region and the Delta region now are shown to be positively impacted by inflation-adjusted agricultural research expenditures.

There is a limitation to the analysis concerning agricultural research expenditures. No direct link exists to the MWFM because the sample size available for the econometric analysis would have been reduced appreciably due to the long lags indigenous to the yield and harvested acreage equations. Consequently, without this formal link, we are not able to ascertain the net impacts of agricultural research expenditures on supply while simultaneously considering the impacts of promotion and non-agricultural research on cotton textile demand and mill demand.

CONCLUSIONS AND IMPLICATIONS

The main conclusion of this study is that the cotton checkoff program clearly has been worth the cost to both producers and importers as well as to taxpayers. Major findings of this study include the following:

- *U.S. cotton producers earned an average of $4.2 ($2.4 on a discounted basis) from every cotton checkoff dollar spent on promotion over the period of 1986/87-2009/10. U.S. cotton importers earned a higher average after-tax return of $10.7 per checkoff dollar ($6.8 discounted) over the same period.* The higher return to importers is the result of: (1) the spillover effects of cotton checkoff programs at retail to MMFT markets, (2) the operation of government farm programs that resulted in a large share of the farm-level benefits of the checkoff program serving to reduce government farm program costs rather than to increase producer revenues, and (3) the higher retail per unit price paid to importers for fiber textiles than received by producers for cotton.
- *The U.S. taxpayer was a primary beneficiary of the cotton checkoff program over the same period*. Over the last two decades, the deficiency, counter-cyclical payments, and marketing loan programs in place for much of the period meant that the higher cotton prices generated by the cotton checkoff program lead to farm program cost savings of about $203.5 million per year, an annual average savings of about 11%.
- *The checkoff program reduced the dependence of cotton producers on government farm programs over same period.* Because much of the cotton checkoff program benefits accrued to taxpayers as farm program cost savings over time, the checkoff program not only increased producer net revenues but also reduced their dependence on farm programs. Over the period of 1986/87-2009/10, the program resulted in an average of 4.6 more dollars in cotton producers' net revenues per dollar of cotton checkoff expenditures coming from the market rather than from the government. Thus, about half of the farm-level benefits of the cotton checkoff program served to enhance cotton producer profitability and half served to reduce their dependence on government farm programs.
- *The cotton checkoff program affects the entire world fiber market.* Over the 1986/87-2009/10 period, the checkoff program tended to increase U.S. and foreign cotton production and mill use, U.S. CFT consumption and imports, and cotton and CFT prices while reducing U.S. cotton exports. The program also increased U.S. MMF production and mill use, the U.S. polyester price, and U.S. MMFT consumption while reducing U.S. net imports of MMFT and U.S. MMFT prices.
- *The cotton checkoff program has significantly enhanced U.S. cotton yields and production over time.* The lag between cotton checkoff investment in production research and the impact on yields and production are between ten and twelve years depending on the

production region. The long-run percentage changes in yields due to a 1% change in real agricultural research expenditures are found to vary among regions from 0.09 in the West to 0.17 in the Irrigated Southwest. In addition, agricultural research expenditures have significantly raised harvested acreage in the Delta region and in the Southeast region.

These conclusions suggest a number of implications for management of the cotton checkoff program. First, although acting as an effective means of reducing cotton producer dependence on cotton farm programs, the cotton checkoff program offers less net benefit to cotton producers than otherwise would be possible during periods when government price and income support programs are in operation. In many years, the deficiency, counter-cyclical payment, and marketing loan features of U.S. cotton farm program set target and often loan prices well above market prices and, thus, guaranteed payments to farmers despite the level of the farm price. Consequently, a large share of the increased revenues generated by the cotton checkoff program over the 1986/87-2009/10 period served to reduce farm program costs rather than increase cotton profits in many years resulting in $4.60 less in benefits to producers for every dollar spent on promotion than would have been the case in the absence of the farm programs.

Second, the high PBCR to checkoff promotion expenditures over the period of analysis (4.2) suggests that the program functions well to increase the net benefit to producers in years of less government intervention or when farm prices exceed farm program support levels. Although an increase in the level of promotion expenditures would likely lead to a lower PBCR in high price and/or low government intervention years, a substantial increase in revenues could likely be achieved while still maintaining a reasonable BCR during those periods.

Third, the price-supporting feature of cotton promotion implies that importers benefit from promotion programs even in years when farm programs prevent farmers from doing so to the same extent. 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.

Fourth, while the execution of cotton promotion programs successfully avoids any statistically significant 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. Despite the small measured decline in man-made fiber textile prices as a result of the cotton checkoff program, the demand for man-made fibers has been sufficiently higher in each year as a result of the program. Consequently, man-made fiber sales revenues have been higher due to the checkoff program.

Finally, increasing the share of checkoff funding invested in agricultural research could effectively enhance the returns to producers from cotton checkoff expenditures. Research expenditures were found to have a statistically significant effect on yields in all production regions of the United States as well as harvested acreage in selected regions. With cotton farm programs in place, research expenditures that successfully enhance production by raising yields and expanding area would effectively raise total farm revenues since any consequent downward pressure on prices would be compensated for by government farm program payments. The only downside is that research investments take a long time to generate significant effects on production – up to 10 or 12 years according to the results reported here. However, a consistent, growing program of cotton checkoff investment in production research would generate a growing flow of returns to producers over time with little implication for producer revenues from any corresponding negative effects on farm prices – at least during years of government cotton programs similar to those in place over most of the last few decades.

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TABLES

Table 1: U.S. Cotton Acreage, Yields, Production, Nominal Farm Price, and Nominal Farm Receipts, 1965-2009

Crop Year	Planted Acres	Harvested Acres	Yield	Production	Farm Price	Loan Rate	Farm Receipts[1]
	1,000 acres	1,000 acres	lbs/acre	million lbs	---------------- ¢/lb	-----------	million $
1965	14,152	13,613	527	7,174	29.4	29.0	$2,109
1966	10,349	9,553	480	4,585	21.8	21.0	$1,000
1967	9,450	7,997	447	3,575	26.7	20.25	$954
1968	10,913	10,159	516	5,242	23.1	20.25	$1,211
1969	11,883	11,051	434	4,796	22.0	20.25	$1,055
1970	11,945	11,155	438	4,886	22.0	20.25	$1,075
1971	12,355	11,471	438	5,024	28.2	19.5	$1,417
1972	14,001	12,984	507	6,583	27.3	19.5	$1,797
1973	12,480	11,970	520	6,224	44.6	19.5	$2,776
1974	13,679	12,547	442	5,546	42.9	25.3	$2,379
1975	9,478	8,796	453	3,985	51.3	34.3	$2,044
1976	11,636	10,914	465	5,075	64.1	37.2	$3,253
1977	13,680	13,275	520	6,903	52.3	42.6	$3,610
1978	13,375	12,400	420	5,208	58.4	48.0	$3,041
1979	13,978	12,831	547	7,019	62.5	50.2	$4,387
1980	14,534	13,215	404	5,339	74.7	48.0	$3,988
1981	14,330	13,841	542	7,502	54.3	52.5	$4,073
1982	11,345	9,734	590	5,743	59.6	57.1	$3,423
1983	7,926	7,348	508	3,733	66.6	55.0	$2,486
1984	11,145	10,379	600	6,227	58.9	55.0	$3,668
1985	10,685	10,229	630	6,444	56.3	57.3	$3,628
1986	10,045	8,468	552	4,674	52.4	55.0	$2,449
1987	10,397	10,030	706	7,081	64.3	52.3	$4,553
1988	12,515	11,948	619	7,396	56.6	51.8	$4,186
1989	10,587	9,538	614	5,856	66.2	50.0	$3,877
1990	12,348	11,732	634	7,438	68.2	50.3	$5,073
1991	14,052	12,960	652	8,450	58.1	50.8	$4,909
1992	13,240	11,123	700	7,786	54.9	52.4	$4,275
1993	13,438	12,783	606	7,746	58.4	52.4	$4,524
1994	13,720	13,322	708	9,432	72.0	50.0	$6,791
1995	16,931	16,007	537	8,596	76.5	51.9	$6,576
1996	14,653	12,888	705	9,086	70.5	51.9	$6,406
1997	13,898	13,406	673	9,022	66.2	51.9	$5,973
1998	13,393	10,684	625	6,678	61.7	51.9	$4,120
1999	14,874	13,425	607	8,149	46.8	51.9	$3,814
2000	15,517	13,053	632	8,249	51.6	51.9	$4,257
2001	15,769	13,828	705	9,749	32.0	51.9	$3,120
2002	13,958	12,417	665	8,257	45.7	52.0	$3,774
2003	13,480	12,003	730	8,762	63.2	52.0	$5,538
2004	13,659	13,057	855	11,164	43.1	52.0	$4,812
2005	14,245	13,803	831	11,467	49.7	52.0	$5,963
2006	15,274	12,732	814	10,362	48.4	52.0	$5,388
2007	10,827	10,489	879	9,219	61.3	52.0	$5,651
2008	9,471	7,569	813	6,151	49.1	52.0	$3,199
2009	9,150	7,529	777	5,850	62.8	52.0	$3,674

Source: USDAc [1] Excludes government payments

Table 2: Harvested Acres, Yields, and Production of Cotton in Selected Countries, 1970-2009

Year Beginning August 1	Former Soviet Union			Brazil			Turkey			China			India			Pakistan		
	Area	Yield	Prdctn	Area	Yield	Prdctn	Area	Yield	Prdctn	Area	Yield	Prdctn	Area	Yield	Prdctn	Area	Yield	Prdctn
	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales
1970	2.746	854	10,770	2.469	241	2,733	0.526	759	1,835	4.997	458	10,500	7.605	127	4,423	1.748	311	2,500
1971	2.770	847	10,780	2.590	263	3,123	0.688	760	2,400	4.923	429	9,700	7.800	162	5,787	1.957	362	3,249
1972	2.735	877	11,020	2.307	282	2,990	0.761	714	2,495	4.896	400	9,000	7.679	147	5,167	2.010	336	3,100
1973	2.742	876	11,030	2.287	234	2,459	0.678	756	2,355	4.942	515	11,700	7.574	143	4,958	1.845	343	2,909
1974	2.879	924	12,220	2.216	241	2,448	0.838	716	2,755	5.013	491	11,300	7.562	159	5,505	2.031	300	2,802
1975	2.924	865	11,610	1.815	220	1,837	0.670	717	2,205	4.955	479	10,900	7.350	154	5,192	1.851	267	2,269
1976	2.950	886	12,010	1.990	297	2,710	0.581	819	2,185	4.929	420	9,500	6.885	147	4,646	1.865	224	1,921
1977	2.992	907	12,470	2.015	243	2,246	0.778	739	2,640	4.845	422	9,400	7.866	156	5,645	1.843	300	2,539
1978	3.038	853	11,907	1.965	277	2,499	0.653	728	2,182	4.867	445	9,950	8.119	166	6,192	1.902	244	2,132
1979	3.090	904	12,833	1.975	290	2,627	0.612	778	2,186	4.512	487	10,100	8.127	168	6,262	2.023	368	3,417
1980	3.147	858	12,401	2.015	295	2,728	0.673	743	2,296	4.920	549	12,400	7.823	169	6,071	2.108	339	3,280
1981	3.168	758	11,032	2.070	328	3,123	0.654	746	2,241	5.185	571	13,600	8.057	177	6,559	2.215	338	3,434
1982	3.188	725	10,619	2.113	277	2,691	0.595	822	2,246	5.828	616	16,500	7.871	187	6,755	2.263	364	3,782
1983	3.192	680	9,976	1.960	344	3,096	0.614	850	2,398	6.077	763	21,300	7.721	173	6,122	2.221	223	2,271
1984	3.347	776	11,928	2.420	400	4,446	0.743	781	2,664	6.923	903	28,700	7.382	247	8,360	2.236	451	4,630
1985	3.316	839	12,777	2.290	346	3,642	0.660	785	2,379	5.140	805	19,000	7.533	261	9,021	2.366	514	5,587
1986	3.475	765	12,217	2.130	297	2,907	0.589	880	2,380	4.306	824	16,300	6.948	227	7,254	2.505	527	6,062
1987	3.527	709	11,491	2.156	401	3,968	0.586	916	2,465	4.844	876	19,500	6.471	240	7,140	2.568	572	6,744
1988	3.432	805	12,686	2.367	300	3,258	0.737	882	2,985	5.535	751	19,100	7.343	244	8,214	2.508	569	6,551
1989	3.338	796	12,203	1.900	350	3,058	0.725	851	2,835	5.203	728	17,400	7.331	313	10,541	2.599	560	6,687
1990	3.171	818	11,910	1.977	363	3,293	0.641	1,021	3,007	5.588	807	20,700	7.440	267	9,135	2.662	615	7,522
1991	3.010	800	11,065	1.969	339	3,064	0.599	937	2,578	6.539	869	26,100	7.661	264	9,291	2.836	768	10,000
1992	2.888	690	9,146	1.485	283	1,929	0.637	901	2,635	6.835	659	20,700	7.543	311	10,775	2.836	543	7,073
1993	2.903	703	9,378	1.085	445	2,219	0.568	1,060	2,766	5.000	749	17,200	7.440	287	9,800	2.805	488	6,282
1994	2.707	706	8,778	1.220	440	2,467	0.582	1,080	2,886	5.530	784	19,900	7.861	309	11,148	2.650	514	6,250

Continued on next page

Table 2: (continued)

Year Beginning August 1	Former Soviet Union			Brazil			Turkey			China			India			Pakistan		
	Area	Yield	Prdctn	Area	Yield	Prdctn	Area	Yield	Prdctn	Area	Yield	Prdctn	Area	Yield	Prdctn	Area	Yield	Prdctn
	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales	million hectares	kg/ha	1000 480 lb bales
1995	2.564	701	8,260	1.130	363	1,884	0.757	1,125	3,911	5.422	879	21,900	9.063	318	13,250	2.998	601	8,272
1996	2.535	566	6,588	0.695	440	1,405	0.743	1,055	3,600	4.722	890	19,300	9.122	332	13,918	3.149	506	7,319
1997	2.503	618	7,108	0.765	538	1,890	0.722	1,101	3,651	4.491	1,023	21,100	8.904	302	12,337	2.960	528	7,175
1998	2.527	569	6,600	0.685	760	2,391	0.757	1,110	3,860	4.459	1,011	20,700	9.287	302	12,883	2.923	511	6,863
1999	2.495	637	7,300	0.752	931	3,216	0.719	1,100	3,634	3.726	1,028	17,600	8.791	302	12,180	2.983	641	8,776
2000	2.417	573	6,365	0.853	1,101	4,312	0.654	1,198	3,600	4.058	1,089	20,300	8.576	278	10,931	2.928	623	8,379
2001	2.523	637	7,380	0.748	1,024	3,519	0.693	1,249	3,975	4.820	1,102	24,400	8.730	307	12,300	3.116	579	8,286
2002	2.443	612	6,865	0.735	1,152	3,890	0.700	1,300	4,179	4.500	1,219	25,200	7.667	301	10,600	2.794	621	7,972
2003	2.446	596	6,700	1.100	1,191	6,015	0.710	1,257	4,100	5.300	978	23,800	7.630	399	14,000	2.989	571	7,845
2004	2.551	685	8,030	1.172	1,096	5,900	0.700	1,291	4,150	5.900	1,118	30,300	8.786	471	19,000	3.192	760	11,138
2005	2.637	691	8,370	0.850	1,204	4,700	0.600	1,288	3,550	5.350	1,156	28,400	8.873	467	19,050	3.101	692	9,850
2006	2.616	682	8,190	1.094	1,393	7,000	0.630	1,313	3,800	5.950	1,299	35,500	9.166	518	21,800	3.250	643	9,600
2007	2.595	688	8,125	1.077	1,488	7,360	0.520	1,298	3,100	6.200	1,299	37,000	9.439	554	24,000	3.000	624	8,600
2008	2.494	618	7,075	0.843	1,415	5,480	0.340	1,236	1,930	6.050	1,321	36,700	9.406	523	22,600	2.900	653	8,700
2009	2.186	597	5,990	0.836	1,393	5,350	0.280	1,361	1,750	5.300	1,315	32,000	10.260	492	23,200	3.000	697	9,600

Source: USDAb.

Table 3: Major Foreign Exporters of Cotton, 1965-2009

Year	Uzbekistan	Africa	Australia	Pakistan	Paraguay	India	China	Turkey	Sudan	Brazil	Mexico	Egypt	Other Foreign Sources	Total Foreign Sources	U.S.	World	Foreign Share of World Exports	U.S. Share of World Exports
	----------	----------	----------	----------	----------	----------	----------	----------	1000 480 lb bales	----------	----------	----------	----------	----------	----------	----------	%	%
1965	0	372	0	492	39	155	0	959	570	937	2,127	1,575	6,674	13,900	3,035	17,000	81.8	17.9
1966	0	446	0	558	23	198	0	1,093	682	1,014	1,518	1,428	6,540	13,500	4,832	18,300	73.8	26.4
1967	0	527	1	887	22	191	0	1,083	794	836	1,327	1,171	6,461	13,300	4,361	17,600	75.6	24.8
1968	0	633	19	606	28	160	100	993	848	1,765	1,641	1,087	6,320	14,200	2,825	17,000	83.5	16.6
1969	0	670	66	393	53	169	100	1,186	1,081	1,933	1,266	1,463	6,520	14,900	2,878	17,700	84.2	16.3
1970	0	535	19	473	28	139	100	1,124	1,049	1,011	802	1,397	13,023	19,700	3,897	23,600	83.5	16.5
1971	0	637	15	1,151	17	166	100	1,539	990	1,409	944	1,366	13,066	21,400	3,385	24,800	86.3	13.6
1972	0	647	100	822	72	198	100	1,489	1,090	1,333	940	1,387	14,322	22,500	5,311	27,800	80.9	19.1
1973	0	590	14	196	74	182	100	1,000	729	661	767	1,199	14,588	20,100	6,123	26,200	76.7	23.4
1974	0	611	44	1,060	83	89	200	583	568	269	891	878	15,124	20,400	3,926	24,300	84.0	16.2
1975	0	771	69	418	151	294	250	2,163	1,097	356	536	775	15,820	22,700	3,311	26,000	87.3	12.7
1976	0	794	24	65	195	35	200	580	607	54	542	606	16,098	19,800	4,784	24,600	80.5	19.4
1977	0	684	48	471	292	11	100	1,218	689	192	597	686	16,012	21,000	5,484	26,400	79.5	20.8
1978	0	808	109	246	392	195	15	962	814	141	963	690	15,765	21,100	6,180	27,300	77.3	22.6
1979	0	803	279	1,177	302	399	12	617	805	0	913	876	15,217	21,400	9,229	30,700	69.7	30.1
1980	0	849	243	1,489	325	527	6	1,028	426	42	818	749	13,798	20,300	5,926	26,300	77.2	22.5
1981	0	766	371	1,096	600	339	0	956	269	138	756	898	13,011	19,200	6,567	25,800	74.4	25.5
1982	0	933	617	1,272	339	500	75	654	640	1,021	395	920	12,934	20,300	5,207	25,500	79.6	20.4
1983	0	932	374	377	367	299	760	499	1,004	80	475	780	12,553	18,500	6,786	25,300	73.1	26.8
1984	0	1,070	690	1,260	551	151	944	684	590	354	575	560	13,571	21,000	6,215	27,200	77.2	22.8
1985	0	1,541	1,138	3,146	575	336	2,799	322	499	358	380	837	14,169	26,100	1,960	28,100	92.9	7.0
1986	0	1,533	1,180	2,870	319	1,018	3,169	510	820	303	220	586	14,172	26,700	6,684	33,400	79.9	20.0
1987	6,284	1,749	818	2,358	726	19	2,322	197	725	597	375	436	6,894	23,500	6,582	30,100	78.1	21.9
1988	7,006	1,982	1,319	3,780	1,006	149	1,636	666	775	464	561	294	7,662	27,300	6,148	33,500	81.5	18.4
1989	6,810	2,115	1,319	1,371	919	1,077	865	205	750	661	212	211	7,185	23,700	7,694	31,400	75.5	24.5

Continued on next page

Table 3: (Continued)

Year	Uzbekistan	Africa	Australia	Pakistan	Paraguay	India	China	Turkey	Sudan	Brazil	Mexico	Egypt	Other Foreign Sources	Total Foreign Sources	U.S.	World	Foreign Share of World Exports	U.S. Share of World Exports
	1000 480 lb bales																%	%
1990	5,393	2,055	1,372	1,357	896	708	928	753	400	716	223	90	6,909	21,800	7,793	29,600	73.6	26.3
1991	5,200	2,247	2,111	2,059	818	303	602	289	400	133	248	90	7,100	21,600	6,646	28,200	76.6	23.6
1992	5,500	2,048	1,730	1,175	597	990	684	269	200	110	25	85	6,887	20,300	5,201	25,500	79.6	20.4
1993	5,800	2,026	1,689	318	505	369	749	500	200	5	34	525	7,080	19,800	6,862	26,700	74.2	25.7
1994	5,006	2,682	1,359	148	597	104	183	9	350	152	185	307	7,718	18,800	9,402	28,200	66.7	33.3
1995	4,524	2,798	1,463	1,433	519	567	20	266	425	101	221	87	7,276	19,700	7,675	27,400	71.9	28.0
1996	4,550	3,308	2,383	119	200	1,187	10	207	362	0	349	211	7,114	20,000	6,865	26,800	74.6	25.6
1997	4,570	3,617	2,712	380	290	312	25	100	344	0	204	322	6,324	19,200	7,500	26,700	71.9	28.1
1998	3,812	3,596	3,040	10	250	195	676	394	247	23	103	450	6,404	19,200	4,298	23,500	81.7	18.3
1999	4,200	3,736	3,211	415	325	70	1,692	207	185	12	134	455	5,758	20,400	6,750	27,100	75.3	24.9
2000	3,450	3,261	3,903	582	258	94	442	127	159	315	80	300	6,529	19,500	6,740	26,300	74.1	25.6
2001	3,500	3,551	3,130	180	225	60	342	133	289	674	90	490	5,436	18,100	11,000	29,100	62.2	37.8
2002	3,400	3,781	2,655	231	225	56	751	313	377	489	64	825	5,433	18,600	11,900	30,300	61.4	39.3
2003	3,100	4,436	2,157	170	451	700	173	357	412	964	114	325	6,041	19,400	13,758	33,300	58.3	41.3
2004	3,950	4,131	1,998	558	297	660	30	152	284	1,557	135	660	6,188	20,600	14,436	35,000	58.9	41.2
2005	4,800	4,451	2,884	288	289	3,675	36	216	340	1,972	249	435	7,565	27,200	17,673	44,900	60.6	39.4
2006	4,500	3,861	2,129	217	239	4,875	88	303	261	1,300	175	370	6,182	24,500	12,959	37,500	65.3	34.6
2007	4,200	2,661	1,219	269	80	7,500	62	370	197	2,231	220	619	5,772	25,400	13,634	39,000	65.1	35.0
2008	3,000	2,146	1,201	357	55	2,360	84	136	160	2,739	175	100	4,287	16,800	13,261	30,100	55.8	44.1
2009	3,800	2,266	2,115	700	35	6,550	23	150	140	1,990	75	325	5,331	23,500	12,037	35,600	66.0	33.8

Source: USDAc

Table 4: Major Foreign Importers of Cotton, 1965-2009

Year	EU-27	Russia	Japan	Indonesia	South Korea	Thailand	Taiwan	India	Pakistan	China	Major Foreign Importers
	----------	----------	----------	----------	----------	----------	1000 480 lb bales	----------	----------	----------	----------
1965	7,026	0	3,078	0	327	105	305	457	7	500	11,805
1966	6,971	0	3,556	160	362	105	357	649	10	500	12,670
1967	6,648	0	3,499	62	404	129	471	644	4	300	12,161
1968	6,714	0	3,131	107	450	78	464	377	4	300	11,625
1969	6,500	0	3,448	160	470	135	507	721	0	400	12,341
1970	6,503	0	3,669	180	557	212	735	693	6	500	13,055
1971	6,520	0	3,555	230	523	230	584	642	7	700	12,991
1972	7,046	0	3,883	279	484	299	657	400	4	2,000	15,052
1973	6,358	0	3,728	250	788	389	911	119	2	1,800	14,345
1974	6,030	0	3,228	157	722	262	652	113	1	700	11,865
1975	6,396	0	3,220	351	1,013	389	1,024	96	0	900	13,389
1976	6,058	0	3,037	287	909	409	801	447	2	650	12,600
1977	6,161	0	3,150	394	1,312	329	1,052	398	1	1,600	14,397
1978	6,043	0	3,382	404	1,363	457	855	44	4	2,125	14,677
1979	6,577	0	3,336	474	1,627	376	1,248	2	4	4,100	17,744
1980	5,910	0	3,207	490	1,527	402	965	0	5	3,550	16,056
1981	6,072	0	3,504	490	1,496	243	1,135	36	5	2,199	15,180
1982	6,351	0	3,137	492	1,562	397	1,044	3	4	1,085	14,075
1983	6,155	0	3,338	603	1,602	558	1,171	0	240	664	14,331
1984	6,432	0	3,125	538	1,601	614	1,294	0	9	85	13,698
1985	6,418	0	3,054	808	1,682	703	1,534	0	6	1	14,206
1986	7,092	0	3,688	919	1,901	1,290	2,357	0	3	16	17,266
1987	7,571	5,395	3,431	882	1,957	872	1,608	107	4	86	21,913
1988	6,988	5,827	3,491	1,112	2,145	1,252	1,781	171	5	1,448	24,220
1989	6,616	5,878	3,165	1,292	2,040	1,207	1,301	15	17	1,873	23,404
1990	5,580	5,290	2,949	1,490	2,052	1,624	1,479	0	2	2,205	22,671
1991	6,098	3,900	2,705	1,873	1,801	1,641	1,484	214	20	1,630	21,366
1992	6,580	2,650	2,228	1,989	1,711	1,522	1,264	102	24	242	18,312
1993	6,673	3,000	1,993	2,039	1,689	1,613	1,236	222	350	808	19,623
1994	6,395	2,159	1,650	2,075	1,747	1,440	1,114	442	696	4,060	21,778

Continued on next page

Table 4: (Continued)

Year	EU-27	Russia	Japan	Indonesia	South Korea	Thailand	Taiwan	India	Pakistan	China	Major Foreign Importers
	--1000 480 lb bales--										
1995	6,216	1,100	1,514	2,139	1,661	1,545	1,380	85	122	2,908	18,670
1996	6,231	1,000	1,342	2,147	1,504	1,414	1,300	15	279	3,491	18,723
1997	6,021	1,225	1,341	1,910	1,322	1,236	1,209	145	120	1,725	16,254
1998	5,073	850	1,263	2,323	1,472	1,207	1,375	508	925	332	15,328
1999	5,077	1,600	1,280	2,076	1,525	1,696	1,438	1,600	475	117	16,884
2000	4,973	1,650	1,138	2,650	1,421	1,573	1,040	1,567	470	230	16,712
2001	4,656	1,800	1,063	2,356	1,616	1,882	1,531	2,388	865	449	18,606
2002	4,131	1,650	1,013	2,228	1,492	1,945	1,219	1,216	872	3,127	18,893
2003	3,287	1,475	778	2,150	1,274	1,678	1,011	800	1,805	8,832	23,090
2004	3,181	1,450	815	2,200	1,343	2,282	1,337	1,038	1,756	6,385	21,787
2005	2,426	1,375	651	2,200	1,011	1,892	1,133	400	1,615	19,284	31,987
2006	2,092	1,325	610	2,200	1,068	1,905	1,160	465	2,305	10,588	23,718
2007	1,639	1,125	581	2,300	975	1,928	964	600	3,907	11,530	25,549
2008	1,013	725	430	2,000	988	1,602	787	800	1,917	6,996	17,258
2009	974	600	304	2,100	1,010	1,806	1,016	600	1,400	10,903	20,713

Source: USDAc

Table 5: U.S. Processed Cotton Consumption, Total and Per Capita, 2000-2009[1]

Year	Mill Use of Raw Cotton	Imports of Processed Cotton	Exports of Processed Cotton	Net Imports of Processed Cotton	Total U.S. Cotton Consumption	Domestic Mill Share of U.S. Consumption	Net Import Share of U.S. Consumptio	Mill Use Per Capita	Net Imports Per Capita	Total U.S. Consumption Per Capita
	---------- million lbs ----------					%	%	---------- lb ----------		
2000	4,747.0	7,301.5	2,339.2	4,962.3	9,709.3	48.9	51.1	16.8	17.6	34.4
2001	3,848.4	7,226.0	2,026.6	5,199.4	9,047.8	42.5	57.5	13.5	18.2	31.7
2002	3,693.8	8,131.8	2,086.5	6,045.3	9,739.1	37.9	62.1	12.8	21.0	33.8
2003	3,227.5	8,738.0	2,196.9	6,541.1	9,768.6	33.0	67.0	11.1	22.5	33.6
2004	3,130.8	9,012.2	2,226.3	6,785.9	9,916.7	31.6	68.4	10.7	23.1	33.8
2005	3,035.3	9,947.7	2,211.5	7,736.2	10,771.5	28.2	71.8	10.2	26.1	36.4
2006	2,619.4	10,374.0	2,136.9	8,237.1	10,856.5	24.1	75.9	8.8	27.5	36.3
2007	2,315.3	10,385.8	1,893.5	8,492.3	10,807.6	21.4	78.6	7.7	28.1	35.8
2008	2,067.4	9,829.1	1,843.7	7,985.4	10,052.8	20.6	79.4	6.6	26.2	33.0
2009	1,585.1	8,820.8	1,498.2	7,322.6	8,907.7	17.8	82.2	5.2	23.8	29.0

[1] The trade and consumption data are expressed in raw cotton fiber equivalents.
Source: USDAc

Table 6: U.S. Man-Made Fiber (MMF) Consumption, Total and Per Capita, 2000-2009[1]

Year	Mill Use of MMF	Imports of Processed MMF	Exports of Processed MMF	Net Imports of Processed MMF	Total U.S. MMF Consumption	Domestic Mill Share of U.S. Consumption	Net Import Share of U.S. Consumption	Mill Use Per Capita	Net Imports Per Capita	Total U.S. Consumption Per Capita
	million lbs					%	%	lb		
2000	11,144.3	4,907.6	2,479.0	2,428.6	13,572.9	82.1	17.9	39.5	8.6	48.1
2001	10,040.6	4,946.4	2,372.8	2,573.6	12,614.2	79.6	20.4	35.2	9.0	44.2
2002	10,402.8	5,594.5	2,275.5	3,319.0	13,721.8	75.8	24.2	36.1	11.5	47.6
2003	10,082.3	6,102.1	2,154.9	3,947.2	14,029.5	71.9	28.1	34.7	13.6	48.2
2004	10,256.9	6,554.7	2,372.0	4,182.7	14,439.6	71.0	29.0	34.9	14.3	49.2
2005	10,196.6	7,082.5	2,374.2	4,708.3	14,904.9	68.4	31.6	34.4	15.9	50.3
2006	9,441.2	7,300.9	2,108.8	5,192.1	14,633.3	64.5	35.5	31.6	17.4	48.9
2007	9,047.2	7,361.6	1,812.0	5,549.6	14,596.8	62.0	38.0	30.0	18.4	48.3
2008	7,933.6	6,844.0	1,765.9	5,078.1	13,011.7	61.0	39.0	26.0	16.7	42.7
2009	6,607.7	6,403.8	1,374.6	5,029.2	11,636.9	56.8	43.2	21.5	16.4	37.9

[1] The trade and consumption data are expressed in raw cotton fiber equivalents.
Source: USDA b and Meyer (2006).

Table 7: World Textile Fiber Production, 1980-2009

Year	Rayon and Acetate Production	Rayon and Acetate Share	Non-cellulosic Fibers Production	Non-cellulosic Fibers Share	Cotton Production	Cotton Share	Wool Production	Wool Share	Silk Production	Silk Share	Flax Production	Flax Share	Hemp Production	Hemp Share	World Total Fiber Production
	million lbs.	%	million lbs.	%	million lbs.	%	million lbs.	%	million lbs.	%	million lbs.	%	million lbs.	%	million lbs.
1980	7,147	10.59	23,095	34.22	31,427	46.57	3,732	5.53	123	0.18	1,389	2.06	569	0.84	67,482
1981	7,064	10.52	23,869	35.54	30,474	45.38	3,781	5.63	126	0.19	1,347	2.01	492	0.73	67,153
1982	6,493	9.74	22,368	33.57	31,993	48.01	3,765	5.65	121	0.18	1,437	2.16	459	0.69	66,636
1983	6,457	9.42	24,418	35.64	31,560	46.06	3,821	5.58	121	0.18	1,733	2.53	406	0.59	68,516
1984	6,605	8.14	26,023	32.08	42,552	52.45	3,869	4.77	123	0.15	1,512	1.86	443	0.55	81,127
1985	6,462	8.22	27,533	35.00	38,541	49.00	3,849	4.89	150	0.19	1,642	2.09	481	0.61	78,658
1986	6,304	8.42	28,499	38.06	33,880	45.24	3,975	5.31	139	0.19	1,605	2.14	485	0.65	74,887
1987	6,229	7.58	30,293	36.85	38,891	47.31	4,079	4.96	139	0.17	2,108	2.56	474	0.58	82,213
1988	6,385	7.47	31,784	37.16	40,514	47.37	4,202	4.91	141	0.16	2,039	2.38	465	0.54	85,530
1989	6,488	7.72	32,512	38.68	38,280	45.54	4,431	5.27	146	0.17	1,799	2.14	397	0.47	84,053
1990	6,079	6.97	32,838	37.67	41,808	47.96	4,359	5.00	146	0.17	1,570	1.80	364	0.42	87,164
1991	5,365	5.91	33,678	37.12	45,636	50.29	3,931	4.33	148	0.16	1,541	1.70	439	0.48	90,738
1992	5,130	5.95	35,629	41.31	39,650	45.97	3,783	4.39	148	0.17	1,484	1.72	432	0.50	86,256
1993	5,171	6.12	36,566	43.31	37,234	44.10	3,682	4.36	150	0.18	1,369	1.62	260	0.31	84,432
1994	5,087	5.60	39,549	43.51	41,229	45.35	3,419	3.76	152	0.17	1,261	1.39	209	0.23	90,906
1995	5,371	5.58	40,513	42.06	45,059	46.77	3,430	3.56	203	0.21	1,631	1.69	125	0.13	96,332
1996	5,004	5.18	43,574	45.06	43,256	44.73	3,291	3.40	183	0.19	1,241	1.28	145	0.15	96,694
1997	5,102	4.95	49,374	47.89	44,294	42.96	3,150	3.06	174	0.17	863	0.84	140	0.14	103,097
1998	4,909	4.82	51,266	50.34	41,326	40.58	3,080	3.02	212	0.21	884	0.87	162	0.16	101,839
1999	4,573	4.35	53,980	51.31	42,222	40.14	3,042	2.89	214	0.20	1,052	1.00	112	0.11	105,195
2000	4,884	4.45	57,802	52.63	42,767	38.94	2,961	2.70	245	0.22	1,063	0.97	99	0.09	109,821
2001	4,591	4.01	57,855	50.53	47,377	41.38	2,903	2.54	293	0.26	1,370	1.20	116	0.10	114,505
2002	4,684	4.07	61,764	53.68	43,668	37.95	2,795	2.43	311	0.27	1,711	1.49	137	0.12	115,070
2003	4,971	4.10	64,962	53.61	46,432	38.32	2,714	2.24	298	0.25	1,674	1.38	128	0.11	121,179
2004	5,450	3.94	69,342	50.07	58,353	42.13	2,690	1.94	322	0.23	2,196	1.59	146	0.11	138,499
2005	5,475	3.89	73,879	52.53	55,888	39.74	2,690	1.91	344	0.24	2,200	1.56	169	0.12	140,645
2006	5,809	3.96	77,735	52.98	58,470	39.85	2,709	1.85	353	0.24	1,416	0.97	242	0.16	146,734
2007	6,424	4.20	84,662	55.36	57,448	37.57	2,692	1.76	376	0.25	1,165	0.76	162	0.11	152,929
2008	5,610	3.93	81,620	57.13	51,409	35.98	2,626	1.84	326	0.23	1,130	0.79	147	0.10	142,868
2009	6,090	4.28	83,452	58.61	48,741	34.23	2,565	1.80	311	0.22	1,083	0.76	154	0.11	142,396

Source: USDA

Table 8: Government Payments Made to U.S. Cotton Farmers, 1986/87-2009/10

Crop Year	Government Outlays to Cotton Farmers
	million $
1986/87	1,385.5
1987/88	953.5
1988/89	1,336.6
1989/90	825.9
1990/91	452.5
1991/92	939.7
1992/93	1,626.2
1993/94	1,719.3
1994/95	370.2
1995/96	217.0
1996/97	759.0
1997/98	1,163.0
1998/99	1,947.0
1999/00	3,432.0
2000/01	2,149.0
2001/02	3,937.0
2002/03	3,075.0
2003/04	2,551.0
2004/05	2,229.2
2005/06	3,696.3
2006/07	2,979.8
2007/08	2,541.5
2008/09	1,614.6
2009/10	2,270.1

Source: USDAd, Baffes (2005) through 2002/03, and EWG (2011)

Table 9: Estimated Annual Assessment of U.S. Cotton Producers, 1976/77-2009/10

Crop Year	Average Farm Price[1]	Loan Rate	Maximum of Farm Price or Loan Rate	Calculation of Assessment Rate	Average Assessment Per RB[2]	Average Assessment Per Pound
	¢/lb	¢/lb	¢/lb		$/RB	$/lb
1976/77	63.8	38.9	63.8	$1 per RB + .006 x value	$2.92	$0.00585
1977/78	52.1	44.6	52.1	$1 per RB + .006 x value	$2.60	$0.00520
1978/79	58.1	48.0	58.1	$1 per RB + .006 x value	$2.73	$0.00545
1979/80	62.3	50.2	62.3	$1 per RB + .006 x value	$2.86	$0.00573
1980/81	74.4	48.0	74.4	$1 per RB + .006 x value	$3.22	$0.00644
1981/82	54.0	52.5	54.0	$1 per RB + .006 x value	$2.69	$0.00538
1982/83	59.5	57.1	59.5	$1 per RB + .006 x value	$2.80	$0.00559
1983/84	65.3	55.0	65.3	$1 per RB + .006 x value	$2.99	$0.00598
1984/85	58.7	55.0	58.7	$1 per RB + .006 x value	$2.77	$0.00554
1985/86	56.8	57.3	57.3	$1 per RB + .006 x value	$2.72	$0.00544
1986/87	51.5	55.0	55.0	$1 per RB + .006 x value	$2.65	$0.00530
1987/88	63.7	52.3	63.7	$1 per RB + .006 x value	$2.85	$0.00570
1988/89	55.6	51.8	55.6	$1 per RB + .006 x value	$2.68	$0.00535
1989/90	63.6	50.0	63.6	$1 per RB + .006 x value	$2.91	$0.00581
1990/91	67.1	50.3	67.1	$1 per RB + .006 x value	$3.02	$0.00604
1991/92	56.8	50.8	56.8	$1 per RB + .006 x value	$2.71	$0.00542
1992/93[3]	53.7	52.4	53.7	$1 per RB + .0055 x value	$2.48	$0.00496
1993/94	58.1	52.4	58.1	$1 per RB + .005 x value	$2.50	$0.00500
1994/95	72.0	50.0	72.0	$1 per RB + .005 x value	$2.86	$0.00573
1995/96	75.4	51.9	75.4	$1 per RB + .005 x value	$2.89	$0.00578
1996/97	69.3	51.9	69.3	$1 per RB + .005 x value	$2.73	$0.00546
1997/98	65.2	51.9	65.2	$1 per RB + .005 x value	$2.65	$0.00529
1998/99	60.2	51.9	60.2	$1 per RB + .005 x value	$2.48	$0.00496
1999/00	45.0	51.9	51.9	$1 per RB + .005 x value	$2.30	$0.00460
2000/01	49.8	51.9	51.9	$1 per RB + .005 x value	$2.30	$0.00460
2001/02	29.8	51.9	51.9	$1 per RB + .005 x value	$2.30	$0.00460
2002/03	44.5	52.0	52.0	$1 per RB + .005 x value	$2.30	$0.00460
2003/04	61.8	52.0	61.8	$1 per RB + .005 x value	$2.55	$0.00498
2004/05	41.6	52.0	52.0	$1 per RB + .005 x value	$2.30	$0.00460
2005/06	47.7	52.0	52.0	$1 per RB + .005 x value	$2.30	$0.00460
2006/07	46.5	52.0	52.0	$1 per RB + .005 x value	$2.30	$0.00460
2007/08	59.3	52.0	59.3	$1 per RB + .005 x value	$2.48	$0.00460
2008/09	47.8	52.0	52.0	$1 per RB + .005 x value	$2.30	$0.00460
2009/10	62.9	52.0	62.9	$1 per RB + .005 x value	$2.57	$0.00460

[1] Upland cotton.
[2] RB = Running Bale which generally weighs 500 lb.
[3] Assessment changed in August 1992. Average calendar year assumed to be average of .006 and .005.
Source: Constructed from information from various sources, including National Cotton Council and USDAa.

Table 10: Estimated Annual Assessment of U.S. Cotton Importers, 1992/93-2009/10

Calendar Year	Total Importer Assessment	Volume Assessed	Assessment per Pound
	$	1000 lb	$/lb
1992[1]	4,346,256	845,575	0.00514
1993	14,319,289	2,806,380	0.00510
1994	13,833,760	2,987,981	0.00463
1995	14,934,106	3,028,836	0.00493
1996	18,735,007	3,338,497	0.00561
1997	19,299,015	3,322,875	0.00581
1998	20,855,888	3,798,294	0.00549
1999	23,441,363	4,434,036	0.00529
2000	22,536,343	4,762,643	0.00473
2001	22,211,764	4,980,039	0.00446
2002	24,234,799	5,799,761	0.00418
2003	24,157,639	6,315,593	0.00383
2004	24,720,900	6,592,529	0.00375
2005	26,979,855	7,194,943	0.00375
2006	29,224,894	8,186,293	0.00375
2007	30,347,149	8,447,271	0.00359
2008	28,090,666	7,787,284	0.00361
2009	29,751,136	6,968,027	0.00427

[1] Importer assessment began in August 1992.
Source: Worsham, 2011

Table 11: Cotton Incorporated Annual Marketing and Research Expenditures[1], 1986/97-2009/10

Calendar Year	Expenditures					Share of Total CI Expenditures				Assessments		Share of CI Expenditures	
	Marketing	Textile Research	Agricultural Research	Administrative	Total	Marketing	Textile Research	Ag. Research	Admin.	Imports	Producer[2]	Imports	Producer
	$					%				$		%	
1986	12,157,924	3,924,016	807,938	1,465,898	18,355,776	66.2	21.4	4.4	8.0	NA	24,755,664	NA	0.0
1987	11,610,134	4,166,364	855,385	1,777,437	18,409,320	63.1	22.6	4.6	9.7	NA	40,383,360	NA	0.0
1988	14,784,245	4,507,161	1,091,429	1,758,128	22,140,963	66.8	20.4	4.9	7.9	NA	39,575,448	NA	0.0
1989	15,474,691	4,205,688	1,026,656	1,696,965	22,404,000	69.1	18.8	4.6	7.6	NA	34,012,205	NA	0.0
1990	17,888,468	5,708,869	1,174,591	1,778,072	26,550,000	67.4	21.5	4.4	6.7	NA	44,952,096	NA	0.0
1991	18,887,491	6,574,114	1,219,089	1,872,051	28,552,745	66.1	23.0	4.3	6.6	NA	45,824,582	NA	0.0
1992	28,031,978	8,536,696	3,559,076	2,086,473	42,214,223	66.4	20.2	8.4	4.9	4,346,256	38,611,814	10.1	.9
1993	29,481,154	9,179,814	4,037,752	2,130,284	44,829,004	65.8	20.5	9.0	4.8	14,319,289	38,721,600	27.0	.0
1994	30,709,947	9,977,975	4,399,945	2,290,980	47,378,847	64.8	21.1	9.3	4.8	13,833,760	54,078,365	20.4	.6
1995	35,757,359	10,866,604	5,503,535	2,245,353	54,372,851	65.8	20.0	10.1	4.1	14,934,106	49,661,760	23.1	.9
1996	42,360,691	9,746,135	6,501,893	2,270,865	60,879,584	69.6	16.0	10.7	3.7	18,735,007	49,643,194	27.4	.6
1997	41,683,949	10,086,715	6,777,091	2,729,671	61,277,426	68.0	16.5	11.1	4.5	19,299,015	47,719,186	28.8	.2
1998	42,640,979	9,131,940	6,750,132	2,812,962	61,336,013	69.5	14.9	11.0	4.6	20,855,888	33,135,974	38.6	.4
1999	39,154,136	9,062,859	6,538,030	2,967,687	57,722,712	67.8	15.7	11.3	5.1	23,441,363	37,465,344	38.5	.5
2000	40,277,315	9,242,313	6,691,148	3,092,212	59,302,988	67.9	15.6	11.3	5.2	22,536,343	37,951,104	37.3	.7
2001	42,117,341	9,759,805	7,061,347	3,147,837	62,086,330	67.8	15.7	11.4	5.1	22,211,764	45,795,316	32.7	.3
2002	41,191,178	10,216,087	7,071,020	3,168,988	61,647,273	66.8	16.6	11.5	5.1	24,234,799	38,183,100	38.8	.2
2003	40,347,871	9,510,292	8,070,376	3,276,592	61,205,131	65.9	15.5	13.2	5.4	24,157,639	44,080,594	35.4	.6
2004	43,977,405	10,416,252	8,378,760	3,216,127	65,988,544	66.6	15.8	12.7	4.9	24,720,900	53,471,689	31.6	.4
2005	47,999,000	12,251,000	8,602,000	3,594,000	72,446,000	66.3	16.9	11.9	5.0	26,979,855	55,397,588	32.8	.2
2006	46,479,000	11,151,000	9,567,000	3,747,000	70,944,000	65.5	15.7	13.5	5.3	29,224,894	49,014,099	37.4	.6
2007	50,707,000	12,263,000	10,381,000	4,264,000	77,615,000	65.3	15.8	13.4	5.5	30,347,149	44,624,763	40.5	.5
2008	48,239,000	12,768,000	11,068,000	4,351,000	76,426,000	63.1	16.7	14.5	5.7	28,090,666	31,102,175	47.5	.5
2009	48,713,000	12,448,000	11,492,000	4,588,000	77,241,000	63.1	16.1	14.9	5.9	29,751,136	29,507,942	50.2	.8

[1] Nominal dollars.
[2] Crop year. Years prior to 2000 estimated based on national production levels and per pound assessment rate (see Table 2).
NA = Not applicable because importer assessments began in 1992.
Source: Worsham, 2011

Table 12: General Specifications of Key Behavioral Equations Related to Cotton in the Texas Tech Modified World Fiber Model[1]

Variable	Behavioral Equation
Per capita fiber textile consumption	$C_f^i = C_f^i(P_f^c, P_f^q, N, E_f, Z_f^i)$
Raw fiber mill use	$D_m^i = D_m^i(P_f^i, P_r^i, E_m, Z_m)$
Cotton acreage	$A_c = A_c(P_{c,t-1}, A_{c,t-1}, Z_c)$
Cotton yield	$Y_c = Y_c(P_{c,t-1}, R, Z_Y)$
Cotton supply	$S_c = Y_c * A_c$
Man-made fiber supply	$S_q = S_q(\sum_{k=1}^{5} P_{q,t-k}, \sum_{k=1}^{5} P_{o,t-k}, Z_q)$
Cotton imports	$I_c = I_c(P_c / P_c^w(1+T), Z_I)$
Cotton exports	$X_c = X_c(P_c / P_c^w(1-V), Z_x)$
Cotton price linkage	$P_c = P_c(P_c^w)$
Man-made fiber price linkage	$P_q = P_q(P_q^w)$

[1] The capital letters C, D, A, S, I, X, P, N, E, Y, R, T, V, and Z represent per capita consumption, demand, acreage, supply, imports, exports, price, per capita income, checkoff expenditures, yield, time trend, tariff rate, export subsidy rate, and other shift factors, respectively. The small letters used as subscripts are defined as follows: f= fiber textiles, i = cotton (c) and man-made fibers (q) , m = mill, r = raw fiber, o=oil, and w = world. All variables are assumed to be subscripted with t for the current time period unless otherwise indicated.

Table 13: Key Partial Elasticities for Selected Variables in the Texas Tech World Fiber Model

	Price Elasticities							Checkoff Expenditure Elasticities			
	Raw Fibers			Textiles				Marketing		Non-Ag Research	
	Cotton		Man-made	All	Cotton	Man-made	Income	Short-	Long-	Short-	Long-
Variable	Short-run	Long-run	Fibers[a]	Textiles	Fiber	Fiber	Elasticities	run	run	run	run
COTTON AND MAN-MADE FIBERS SUPPLY AND DEMAND ELASTICITIES											
Cotton Acreage											
United States											
Delta	0.09	0.13									
South East	0.30	0.45									
Southwest Irrigated	0.27	0.31									
Southwest Dryland	0.36	0.42									
West	0.13	0.43									
China											
Xinjinag	0.16	1.03									
Yangtze River	0.18	0.76									
Yellow river	0.21	0.96									
Other	0.30	0.96									
India											
North	0.23	0.62									
Central	0.23	0.72									
South	0.20	0.52									
Brazil	0.57	1.60									
Egypt	0.25	0.58									
Australia	0.56	1.24									
Uzbekistan	0.11	0.16									
Pakistan	0.13	0.32									
Mexico	0.44	0.92									
Kazakhstan	0.15	0.20									
Tajikistan	0.12	0.18									
Turkmenistan	0.13	b									
Chad	0.06	b									
Mali	0.06	b									
Benin	0.08	b									
Burkina Faso	0.07	b									
Cotton Mill Use											
United States	-0.02		-0.41		0.24					0.02	0.06
China	-0.46		0.16								
India	-0.29		0.10								
Pakistan	-0.38		0.18								
Taiwan	-0.15		0.05								
South Korea	-0.16		0.04								
Japan	-0.05		0.01								
Mexico	-0.27		0.10								
Egypt	-0.64		0.14								
Australia	-0.13		NA								
Bangladesh	-0.31		NA								
EU-25	-0.19		0.08								
Brazil	-0.25		0.12								
Vietnam	-0.33		NA								
Man-Made Fiber Mill Use											
United States	0.14		-0.30			0.03				0.01[c]	0.05[c]

Table 13: Continued

	Price Elasticities							Checkoff Expenditure Elasticities			
	Raw Fibers			Textiles				Marketing		Non-Ag Research	
	Cotton		Man-made	All	Cotton	Man-made	Income	Short-	Long-	Short-	Long-
Variable	Short-run	Long-run	Fibers[a]	Textiles	Fiber	Fiber	Elasticities	run	run	run	run
COTTON FIBER TEXTILE AND MAN-MADE FIBERS TEXTILE SUPPLY AND DEMAND ELASTICITIES											
Textile Fiber Consumption											
United States (Cotton)					-0.65		0.94	0.03	0.11		
United States (Man-made)						-0.25	0.62	0.003[c]	0.009[c]		
China				-0.27			0.56				
India				-0.35			0.40				
Pakistan				-0.37			0.41				
Taiwan				-0.12			0.02				
South Korea				-0.09			0.03				
Japan				-0.09			0.16				
Egypt				-0.17			0.51				
EU-25				-0.02			0.12				
Mexico				-0.51			0.58				
Brazil				-0.21			0.53				
Australia				-0.06			0.23				
U.S. Fiber Textile Import Supply											
Cotton					0.47[d] 0.93[e]						
Man-made fiber						0.53[d] 1.07[e]					

[a] Polyester. [b] Not statistically different from the short-run elasticity. [c] Not statistically different from zero. [d] Short-run price elasticity. [e] Long-run price elasticity.

Table 14: Four Key U.S. Demand Equations in the Texas Tech World Fiber Model[a]

(1) TCFCUS_CI =

4286.189 – 46.15637*RCTFPIUS + 0.927146*RDPI – 447.1276*CH_UNEMPRATE
[0.0000] [0.0000] [0.0000] [0.0000]

– 21.51885*RCPIE$_{t-1}$ – 1474.795*D1984 – 617.1571*D2003 – 859.691*D2004 – 480.7158*D2001
[0.0000] [0.0000] [0.0000] [0.0000] [0.0005]

– 625.629*D1988 – 728.7371*D1985 + 506.7525*D1992 + 471.2838*D1991 – 480.4957*D1983
[0.0000] [0.0000] [0.0001] [0.0009] [0.0007]

+ 2.954436*SQRT(RMEXP$_t$) + 3.939248*SQRT(RMEXP$_{t-1}$) + 2.954436*SQRT(RMEXP$_{t-2}$)
[0.0000] [0.0000] [0.0000]

Adj. R^2 = 0.995 DW = 2.32

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(2) MMFCUS_CI =

3914.001 – 33.49281*RMMFPIUS + 1.043982*RDPI – 939.9225*D2001 – 850.2991*D2008
[0.0002] [0.0002] [0.0000] [0.0000] [0.0000]

– 1520.036*D2009 + 665.7344*D1983 + 644.2302*D1997 – 435.3229*D2006 + 1.59071*HOUST
[0.0000] [0.0000] [0.0000] [0.0000] [0.0000]

+ 237.3808*D1987 – 286.4979*D1995 – 57.72201*CH_UNEMPRATE + 0.40929*SQRT(RMEXP$_t$)
[0.0015] [0.0003] [0.0456] [0.6247]

+ 0.54572*SQRT(RMEXP$_{t-1}$) + 0.40929*SQRT(RMEXP$_{t-2}$) + 1.096428*AR(1) – 0.775299*AR(2)
[0.6247] [0.6247] [0.0000] [0.0000]

Adj. R^2 = 0.993 DW = 2.23

CTMILLUSE_CI =

1295.839 – 1.070307*RUSMILL_COT_P + 10.69734*RCTFPIUS – 24.02382*RBERRYEPOLYP_CI
[0.0000] [0.6248] [0.0014] [0.0000]

– 613.3022*D2001 – 469.7914*D1988 + .769167*CTMILLUSE_CI$_{t-1}$ – 192.0779*DMYTRADE
[0.0000] [0.0000] [0.0000] [0.0000]

+ 473.8486*D1989 – 433.12*D1998 – 409.4167*D1999 + 293.601*D2005 – 296.7199*D1982
[0.0000] [0.0000] [0.0000] [0.0000] [0.0000]

– 255.2462*D1997 – 386.7952*D2009 – 165.6094*D1985 + 1.720797*SQRT(RNAEXP$_t$)
[0.0000] [0.0000] [0.0093] [0.0072]

+ 2.294396*SQRT(RNAEXP$_{t-1}$) + 1.720797*SQRT(RNAEXP$_{t-2}$)
[0.0072] [0.0072]

Adj. R^2 = 0.994 DW = 2.27

MMFMILLUSE_CI =

5870.594 + 25.70541*RUSMILL_COT_P + 4.234447*RMMFPIUS
[0.1004] [0.0390] [0.8991]

– 51.49306*RBERRYEPOLYP_CI + .383562*MMFMILLUSE_CI$_{t-1}$ – 1583.25*D2008
[0.0002] [0.0115] [0.0001]

–2561.611*D2009 – 606.1355*D8283 – 790.102*D1991 + 3.65907*SQRT(RNAEXP$_t$)
[0.0000] [0.0737] [0.0302] [0.3516]

+ 4.87876*SQRT(RNAEXP$_{t-1}$) + 3.65907*SQRT(RNAEXP$_{t-2}$)
[0.3516] [0.3516]

Adj. R^2 = 0.870 DW = 2.26

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[a] See definition of variable names in Table 15. Two-sided p-values associated with the corresponding estimated coefficients are reported in brackets.

Table 15: Definitions of Variables in the Four Key Demand Equations in Texas Tech World Fiber Model

Variable		Description
AR(1)	=	Coefficient in the autoregressive process (AR) of order 1 for the residuals, e(t)+AR(1)*e(t-1)
AR(2)	=	Coefficient in the autoregressive process (AR) of order 2 for the residuals, e(t)*AR(1)*e(t-1)+AR(2)*e(t-2)
BERRYEPOLYP	=	Nominal price of polyester in the U.S. ¢/lb.
CH_UNEMPRATE	=	Year-to-year change in the U.S. unemployment rate
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_CI	=	Mill level consumption of cotton fiber (million lb)
D200x	=	Dummy variable = 1 for year 200x; 0 otherwise
DMYTRADE	=	Defined as a trade variable; 0 if year ≤ 1997; 1 for year = 1998; 2 for year = 1999; 3 for year =2000; 4 for year = 2001; 5 for year = 2002; 6 for year ≥ 2003.
Dxx	=	Dummy variable = 1 for year 19xx; 0 otherwise
HOUST	=	U.S. housing starts
MEXPND	=	Nominal advertising and promotion expenditures (million $)
MMFCUS_CI	=	Total man-made fiber textile consumption (million lb)
MMFMILLUSE_CI	=	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 $)
RBERRYEPOLYP	=	Real price of polyester (BERRYEPOLYP*100/CPIU)
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 $)
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 $) (NAEXPND*100/CPIU)
RUSMILL_COT_P	=	Real price of cotton paid by domestic mills
TCFCUS_CI	=	Total cotton fiber textile consumption (million lb)
USMILL_COT_P	=	Nominal price of cotton paid by domestic mills ($/lb)
WTOLIB	=	Dummy variable 1 for years 1998 and beyond; 0 otherwise

Table 16: Cotton Checkoff Program Expenditure Intensity, 1986/87-2009/10

Crop Year	Farm Receipts[a]	Nominal Expenditures by Cotton Incorporated	Program Expenditure Intensity[b]
	million $	million $	%
1986/87	2,449	18.4	0.7
1987/88	4,553	18.4	0.4
1988/89	4,186	22.1	0.5
1989/90	3,877	22.4	0.6
1990/91	5,073	26.6	0.5
1991/92	4,909	28.6	0.6
1992/93	4,275	42.2	1.0
1993/94	4,524	44.8	1.0
1994/95	6,791	47.4	0.7
1995/96	6,576	54.4	0.8
1996/97	6,406	60.9	1.0
1997/98	5,973	61.3	1.0
1998/99	4,120	61.3	1.5
1999/00	3,814	57.7	1.5
2000/01	4,257	59.3	1.4
2001/02	3,120	62.1	2.0
2002/03	3,774	61.6	1.6
2003/04	5,538	61.2	1.1
2004/05	4,812	66.0	1.4
2005/06	5,963	72.4	1.2
2006/07	5,388	70.9	1.3
2007/08	5,651	77.6	1.4
2008/09	3,199	76.4	2.4
2009/10	3,674	77.2	2.1

[a] Excluding government payments
[b] Ratio of program expenditures to farm receipts.
Sources: USDAc and Worsham, 2011.

Table 17: Selected Effects of Cotton Checkoff Promotion Expenditures on U.S. and World Cotton and Man-Made Fiber Markets, 1986/87-2009/10

	2005/06-2009/10		All Years of Expenditures (1986/87-2009/10)	
U.S. Cotton Market	average annual change	average annual % change	average annual change	average annual % change
Cotton Production (million lbs)				
Delta	13.9	0.5	25.4	1.0
Southeast	17.2	2.0	62.3	4.1
Southwest irrigated	27.2	1.4	36.8	2.7
Southwest dryland	28.2	2.3	38.8	3.5
West	74.4	11.3	60.0	4.5
Total production	40.9	2.2	229.6	2.8
Mill Use (million lbs)	569.8	26.5	581.0	14.9
Exports (million lbs)	-385.0	-5.7	-344.8	-7.6
Prices (cents/lb)				
Farm price	6.6	12.6	5.4	9.6
Effective Price Paid by Mills	6.7	12.3	5.5	9.2
Foreign Cotton Markets				
Production (million lbs)	1490.2	3.0	752.5	2.1
Mill Use (million lbs)	969.2	1.7	430.2	1.0
Exports (million lbs)	763.5	6.9	374.3	3.5
World Price (A-index) (Cents/lb)	8.7	13.1	6.5	9.8
U.S. Cotton Fiber Textile Market				
Consumption (million lbs)	915.7	8.6	853.4	10.1
Net Imports (milion lbs)	345.9	4.3	272.4	6.0
Cotton Fiber Textile Price Index		2.3		1.8
U.S. Man-made Fiber Market[a]				
Production (million lbs)				
Synthetic	247.9	1.3	138.7	0.7
Cellulosic	32.3	23.7	23.6	3.7
Mill Use (million lbs)	34.4	0.5	145.9	2.0
Polyester Price (cents/lb)	0.7	1.1	2.2	2.7
U.S. Man-made Fiber Textile Market[a]				
Consumption (million lbs)	87.5	0.7	140.7	1.2
Net Imports (million lbs)	53.1	1.1	-5.1	-0.2
Man-made Fiber Textile Price Index		-0.1		-0.1

[a] 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 due to lengthy price lags in MMF production equations.

Table 18: Producer Benefit-Cost Analysis, 1986/87-2009/10

	2005/06-2009/10		All Years of Expenditures 1986/87-2009/10	
	Cumulative	Annual Average	Cumulative	Annual Average
Added Net Revenues to Cotton Producers ($ million)[1]	256.4	51.3	4,497.5	187.4
Historical Cotton Producer Revenues ($ million)	23,875.0	4,775.0	112,902.0	4,704.3
Ratio of Added Net Revenues to Historical Revenues	1.1%		4.0%	
Farm Program Cost Savings ($ million)	1,801.7	360.3	4,884.7	203.5
Historical Cotton Farm Program Cost ($million)	13,102.3	2,620.5	44,170.9	1,840.5
Ratio of Cost Savings to Total Cotton Program Costs	13.8%		11.1%	
Ratio of Cost Savings to Total Cotton Producer Revenue	7.5%		4.3%	
Total Added Revenue (Producers + Government) ($ million)	2,058.1	411.6	9,382.3	390.9
Producer Share	12.5%		47.9%	
Government Cost Saving Share	87.5%		52.1%	
Total Cotton Checkoff Expenditures[2] ($ million)	309.2	61.8	1,065.1	44.4
Net Benefit-Cost Ratios ($ Added Net Revenue/$ Spent)				
Producer Net BCR (Added Net Revenue/$ Spent)	0.8		4.2	
Government Net BCR (Cost Savings/$ Spent)	5.8		4.6	
Total Net BCR (Producers and Government)	6.7		8.8	
Discounted Benefit-Cost Ratios ($ Added NR/$ Spent)[3]				
Producer Discounted BCR (Added NR/$ Spent)	0.7		2.4	
Government Discounted BCR (Cost Savings/$ Spent)	5.0		2.6	
Total Discounted BCR (Producers and Government)	5.8		4.4	

[1] Added cost of production and producer checkoff assessment have been subtracted from added net revenue of producers.
[2] Marketing and non-agricultural research expenditures plus associated administrative expenditures.
[3] Added revenues discounted by the Treasury bill rate in each year.

Table 19: Importer Benefit-Cost Analysis, 1992/93-2009/10

	2005/06-2009/10		All Years of Expenditures (1992/93-2009/10)	
	Cumulative	**Annual Average**	**Cumulative**	**Annual Average**
	---------- $ million ----------		---------- $ million ----------	
Added Sales Revenue to Importers				
Cotton Fiber Textile Products	72,581.8	14,516.4	272,521.4	15,140.1
Man-Made Fiber Textile Products	11,507.3	2,301.5	50,642.1	2,813.5
Total	84,089.0	16,817.8	323,163.5	17,953.5
Added Importer Pre-Tax Profit[1]	4,861.4	972.3	19,484.3	1,082.5
Added Importer After-Tax Profit[1]	3,062.7	612.5	12,496.6	694.3
Total Cotton Checkoff Expenditures[2] **($ million)**	309.2	61.8	1,065.1	59.2
Importer Pre-Tax BCR[3] **($ profit/$ spent)**	14.7		17.3	
Importer After-Tax BCR[3] **($ profit/$ spent)**	8.9		10.7	
Discounted Importer Pre-Tax BCR[3,4] **($ profit/$ spent)**	12.8		10.9	
Discounted Importer After-Tax BCR[3,4] **($ profit/$ spent)**	7.7		6.8	
Added Sales Revenue as a Percent of Historical Retail Textile Product Sales Revenue				
Cotton Fiber Textile Products	10.6%		12.1%	
Man-Made Fiber Textile Products	1.2%		1.5%	
Total	5.1%		5.8%	

[1] Added sales revenues multiplied by the estimated before or after tax profits (as appropriate) as a percent of sales in each year. Before-tax profit ratio based on data in Table 20. An assumed 37% tax rate was applied to the pre-tax profit to obtain the added after-tax profits (Worsham, 2011).
[2] Marketing and non-agricultural research expenditures plus corresponding share of administrative costs.
[3] Importer assessment has been subtracted from added profit.
[4] Present value of added profit calculated assuming a 5% cost of capital in each year.

Table 20: Financial Data of Major Apparel and Home Furnishings Retailers, 1994-2009

Major Soft-Goods Retailers	Estimated Before Tax Profits as a Percent of Sales by Calendar Year																
	1994	1995	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average
	-- % --																
Federated Dept. Stores	4.0	1.3	2.9	6.1	7.3	7.6											*4.9*
Kohl's Dept. Store	7.6	8.4	7.2	7.7	8.6	9.2	-9.8	10.7	11.3	9.2	10.0	10.0	11.4	10.6	8.7	9.2	*8.1*
Dillard's	7.1	4.4	5.9	6.0	2.7	3.2	-0.2	1.4	2.7	0.2	2.5	1.8	3.3	0.8	-5.4	1.4	*2.3*
May Dept. Stores	10.6	10.6	10.3	10.1	10.4	11.0	9.7	8.1	6.1	4.6							*9.2*
TJX Companies	3.7	2.4	5.5	7.1	8.9	9.7	-9.0	8.2	7.8	8.0	7.2	6.3	7.2	6.7	7.6	9.6	*6.1*
Limited Brands	10.2	15.0	7.8	4.4	25.3	8.5	-8.1	9.7	9.9	13.1	11.9	9.9	10.3	11.1	5.0	7.5	*9.5*
Abercrombie & Fitch	8.3	10.1	12.5	15.4	20.9	23.9	21.1	20.3	19.8	19.6	17.5	19.7	20.3	20.2	12.7	4.1	*16.6*
Nordstrom's	8.6	6.6	5.6	6.3	6.7	6.5	-1.2	3.6	3.3	6.1	9.1	11.5	12.9	13.3	7.6	8.1	*7.2*
The Gap	14.2	13.3	14.2	13.1	14.6	15.3	-10.0	1.7	5.5	10.6	11.5	11.2	7.9	8.9	10.9	12.8	*9.7*
Sears	3.1	4.9	5.5	5.1	4.6	5.9											*4.9*
J.C. Penney	8.1	5.3	3.8	3.0	3.1	1.5	0.0	0.6	1.8	3.1	5.5	7.7	9.0	8.7	4.9	2.3	*4.3*
Target Stores	3.4	2.1	3.1	4.8	5.0	5.7	-5.6	5.6	6.1	6.1	6.5	7.3	7.6	7.3	5.4	5.9	*4.8*
Wal-Mart	5.1	4.6	4.6	4.6	5.3	5.4	5.3	4.9	5.2	5.5	5.6	5.5	5.4	5.3	5.2	5.4	*5.2*
K-mart	0.5	-2.1	1.0	1.1	2.2	2.7	-1.0	-7.5	-9.5	2.3							*-1.0*
Saks, Inc.	4.3	-0.3	3.7	3.9	1.1	4.9	1.8	-7.7	-2.6	2.4	6.3	-7.5	-50.6	11.7	-7.7	-13.1	*-3.1*
Ross Stores	4.9	5.1	8.0	9.8	10.1	10.0	9.2	10.3	18.2	11.0	8.1	16.6	12.7	7.3	8.6	10.8	*10.0*
Linens 'N' Things	6.6	0.2	3.7	5.1	5.6	6.5	6.7	2.7	5.1	5.1							*4.7*
Bed, Bath & Beyond	11.6	11.1	11.1	11.4	11.6	11.5	7.2	7.5	8.2	8.9	9.8	9.9	9.0	8.0	5.9	7.7	*9.4*
Sears Holding Corporation							-3.1	0.4	1.9	1.8	1.3	1.6	-1.4	2.3	-5.6	-3.9	*-0.5*
Macy's							0.6	5.0	6.8	7.1	7.1	9.1	5.4	5.0	-19.8	2.2	*2.8*
Annual Average	*6.8*	*5.7*	*6.5*	*6.9*	*8.6*	*8.3*	*0.8*	*4.7*	*6.0*	*6.9*	*8.0*	*8.0*	*4.7*	*8.5*	*2.9*	*4.7*	***6.1***

Source: Worsham, 2010

Table 21: Econometric Analysis Associated with the Impacts of Agricultural Research Expenditures on Yields in Various Production Regions of the United States

$LOG(Delta\ Yield)_t$	=	$2.786907 + 0.038667*EL\_NINO_t - 0.088066*LA\_NINA_t + 0.428302*LOG(Delta\ Yield)_{t-1}$ [0.0127] [0.4171] [0.0486] [0.0331]
		$+ 0.00446*LOG(RAGRESEXP)_t + 0.00818*LOG(RAGRESEXP)_{t-1}$ [0.0069] [0.0069]
		$+ 0.01116*LOG(RAGRESEXP)_{t-2} + 0.01339*LOG(RAGRESEXP)_{t-3}$ [0.0069] [0.0069]
		$+ 0.01488*LOG(RAGRESEXP)_{t-4} + 0.01562*LOG(RAGRESEXP)_{t-5}$ [0.0069] [0.0069]
		$+ 0.01562*LOG(RAGRESEXP)_{t-6} + 0.01488*LOG(RAGRESEXP)_{t-7}$ [0.0069] [0.0069]
		$+ 0.01339*LOG(RAGRESEXP)_{t-8} + 0.01116*LOG(RAGRESEXP)_{t-9}$ [0.0069] [0.0069]
		$+ 0.00818*LOG(RAGRESEXP)_{t-10} + 0.00446*LOG(RAGRESEXP)_{t-11} - 0.565184*AR(1)$ [0.0069] [0.0069] [0.0352]
		Adj $R^2 = 0.541$ DW = 2.19
$LOG(Southeast\ Yield)_t$	=	$4.049150 + 0.046521*EL\_NINO_t - 0.103416*LA\_NINA_t + 0.265600*LOG(Southeast\ Yield)_{t-1}$ [0.0072] [0.3842] [0.0317] [0.2648]
		$+ 0.00325*LOG(RAGRESEXP)_t + 0.00596*LOG(RAGRESEXP)_{t-1}$ [0.0229] [0.0229]
		$+ 0.00813*LOG(RAGRESEXP)_{t-2} + 0.00976*LOG(RAGRESEXP)_{t-3}$ [0.0229] [0.0229]
		$+ 0.01084*LOG(RAGRESEXP)_{t-4} + 0.01138*LOG(RAGRESEXP)_{t-5}$ [0.0229] [0.0229]
		$+ 0.01138*LOG(RAGRESEXP)_{t-6} + 0.01084*LOG(RAGRESEXP)_{t-7}$ [0.0229] [0.0229]
		$+ 0.00976*LOG(RAGRESEXP)_{t-8} + 0.00813*LOG(RAGRESEXP)_{t-9}$ [0.0229] [0.0229]
		$+ 0.00596*LOG(RAGRESEXP)_{t-10} + 0.00325*LOG(RAGRESEXP)_{t-11} - 0.616518*AR(1)$ [0.0229] [0.0229] [0.0161]
		Adj $R^2 = 0.325$ DW = 2.07
$LOG(Southwest\ Dry\ Yield)_t$	=	$3.693100 - 0.032404*EL\_NINO_t - 0.149390*LA\_NINA_t + 0.00879*LOG(RAGRESEXP)_t$ [0.0000] [0.7158] [0.1090] [0.0010]
		$+ 0.01624*LOG(RAGRESEXP)_{t-1} + 0.02232*LOG(RAGRESEXP)_{t-2}$ [0.0010] [0.0010]
		$+ 0.02706*LOG(RAGRESEXP)_{t-3} + 0.03044*LOG(RAGRESEXP)_{t-4}$ [0.0010] [0.0010]
		$+ 0.03247*LOG(RAGRESEXP)_{t-5} + 0.03315*LOG(RAGRESEXP)_{t-6}$ [0.0010] [0.0010]
		$+ 0.03247*LOG(RAGRESEXP)_{t-7} + 0.03044*LOG(RAGRESEXP)_{t-8}$ [0.0010] [0.0010]
		$+ 0.02706*LOG(RAGRESEXP)_{t-9} + 0.02232*LOG(RAGRESEXP)_{t-10}$ [0.0010] [0.0010]
		$+ 0.01624*LOG(RAGRESEXP)_{t-11} + 0.00879*LOG(RAGRESEXP)_{t-12}$ [0.0010] [0.0010]
		Adj $R^2 = 0.412$ DW = 2.12

Table 21: Continued

LOG(Southwest IRR Yield)$_t$	=	3.270935 – 0.072466*EL_NINO$_t$ – 0.135240*LA_NINA$_t$
		[0.0031] [0.2679] [0.0441]
		+ 0.319371*LOG(Southwest IRR Yield)$_{t-1}$ + 0.00639*LOG(RAGRESEXP)$_t$
		[0.1034] [0.0219]
		+ 0.01162*LOG(RAGRESEXP)$_{t-1}$ + 0.01569*LOG(RAGRESEXP)$_{t-2}$
		[0.0219] [0.0219]
		+ 0.01859*LOG(RAGRESEXP)$_{t-3}$ + 0.02034*LOG(RAGRESEXP)$_{t-4}$
		[0.0219] [0.0219]
		+ 0.02092*LOG(RAGRESEXP)$_{t-5}$ + 0.02034*LOG(RAGRESEXP)$_{t-6}$
		[0.0219] [0.0219]
		+ 0.01859*LOG(RAGRESEXP)$_{t-7}$ + 0.01569*LOG(RAGRESEXP)$_{t-8}$
		[0.0219] [0.0219]
		+ 0.01162*LOG(RAGRESEXP)$_{t-9}$ + 0.00639*LOG(RAGRESEXP)$_{t-10}$
		[0.0219] [0.0219]
		Adj R^2 = 0.505 DW = 2.02
LOG(West Yield)$_t$	=	6.502915 – 0.096225*EL_NINO$_t$ – 0.147219*LA_NINA$_t$
		[0.0000] [0.0233] [0.0009]
		+ 0.00360*LOG(RAGRESEXP)$_t$ + 0.00655*LOG(RAGRESEXP)$_{t-1}$
		[0.0015] [0.0015]
		+ 0.00884*LOG(RAGRESEXP)$_{t-2}$ + 0.01047*LOG(RAGRESEXP)$_{t-3}$
		[0.0015] [0.0015]
		+ 01145*LOG(RAGRESEXP)$_{t-4}$ + 0.01178*LOG(RAGRESEXP)$_{t-5}$
		[0.0015] [0.0015]
		+ 0.01145*LOG(RAGRESEXP)$_{t-6}$ + 0.01047*LOG(RAGRESEXP)$_{t-7}$
		[0.0015] [0.0015]
		+ 0.00884*LOG(RAGRESEXP)$_{t-8}$ + 0.00655*LOG(RAGRESEXP)$_{t-9}$
		[0.0015] [0.0015]
		+ 0.00360*LOG(RAGRESEXP)$_{t-10}$ – 0.366678*AR(1)
		[0.0015] [0.1534]
		Adj R^2 = 0.453 DW = 1.70

See Table 23 for variable definitions. Two-sided p-values associated with the corresponding estimated coefficients are reported in brackets.

Table 22: Econometric Analysis Associated with the Impacts of Agricultural Research Expenditures on Harvested Acres in Various Production Regions of the United States

LOG(DELTA HA)$_t$	=	2.108530 + 0.357931*LOG(DELTA HA)$_{t-1}$ + 0.812557*FARM_BILL_1985
		[0.3970] [0.0901] [0.0011]
		+ 1.101422*FARM_BILL_1990 + 0.783921*FARM_BILL_1996
		[0.0002] [0.0001]
		+ 0.576891*FARM_BILL_2002 + 0.084184*LOG(RCTMPUS)$_{t-1}$
		[0.0008] [0.6131]
		+ 0.01225*LOG(RAGRESEXP)$_t$ + 0.02228*LOG(RAGRESEXP)$_{t-1}$
		[0.0959] [0.0959]
		+ 0.03008*LOG(RAGRESEXP)$_{t-2}$ + 0.03565*LOG(RAGRESEXP)$_{t-3}$
		[0.0959] [0.0959]
		+ 0.03899*LOG(RAGRESEXP)$_{t-4}$ + 0.04010*LOG(RAGRESEXP)$_{t-5}$
		[0.0959] [0.0959]
		+ 0.03899*LOG(RAGRESEXP)$_{t-6}$ + 0.03565*LOG(RAGRESEXP)$_{t-7}$
		[0.0959] [0.0959]
		+ 0.03008*LOG(RAGRESEXP)$_{t-8}$ + 0.02228*LOG(RAGRESEXP)$_{t-9}$
		[0.0959] [0.0959]
		+ 0.01225*LOG(RAGRESEXP)$_{t-10}$
		[0.0959]
		Adj R^2 = 0.823 DW = 2.33
LOG(Southeast HA)$_t$	=	-0.226159 + 0.689735*LOG(Southeast HA)$_{t-1}$ + 0.068889*FARM_BILL_1985
		[0.8499] [0.0001] [0.6734]
		+ 0.512622*FARM_BILL_1990 + 0.229615*FARM_BILL_1996
		[0.0238] [0.1954]
		+ 0.152646*FARM_BILL_2002 + 0.244867*LOG(RCTMPUS)$_{t-1}$
		[0.2885] [0.1541]
		+ 0.02270*LOG(RAGRESEXP)$_t$ + 0.03972*LOG(RAGRESEXP)$_{t-1}$
		[0.0457] [0.0457]
		+ 0.05107*LOG(RAGRESEXP)$_{t-2}$ + 0.05675*LOG(RAGRESEXP)$_{t-3}$
		[0.0457] [0.0457]
		+ 0.05675*LOG(RAGRESEXP)$_{t-4}$ + 0.05107*LOG(RAGRESEXP)$_{t-5}$
		[0.0457] [0.0457]
		+ 0.03972*LOG(RAGRESEXP)$_{t-6}$ + 0.02270*LOG(RAGRESEXP)$_{t-7}$
		[0.0457] [0.0457]
		Adj R^2 = 0.941 DW = 2.05
LOG(Southwest Dry HA)$_t$	=	12.85457 – 0.484965*LOG(Southwest Dry HA)$_{t-1}$ + 0.371832*FARM_BILL_1985
		[0.0000] [0.0104] [0.0780]
		+ 0.541720*FARM_BILL_1990 + 0.319548*FARM_BILL_1996
		[0.0172] [0.0200]
		+ 0.864507*FARM_BILL_2002 + 0.615457*LOG(RCTMPUS)$_{t-1}$
		[0.0000] [0.0062]
		– 0.01056*LOG(RAGRESEXP)$_t$ – 0.01811*LOG(RAGRESEXP)$_{t-1}$
		[0.5036] [0.5036]
		– 0.02264*LOG(RAGRESEXP)$_{t-2}$ – 0.02415*LOG(RAGRESEXP)$_{t-3}$
		[0.5036] [0.5036]
		– 0.02264*LOG(RAGRESEXP)$_{t-4}$ – 0.01811*LOG(RAGRESEXP)$_{t-5}$
		[0.5036] [0.5036]
		– 0.01056*LOG(RAGRESEXP)$_{t-6}$
		[0.5036]
		Adj R^2 = 0.613 DW = 2.11

Table 22: Continued

LOG(Southwest IRR HA)$_t$	=	6.744463 + 0.062573*LOG(Southwest IRR HA)$_{t-1}$ – 0.368692*FARM_BILL_1985
		[0.0000] [0.6756] [0.0138]
		– 0.014280*FARM_BILL_1996 – 0.051685*FARM_BILL_2002 + 0.025151*LOG(RCTMPUS)$_{t-1}$
		[0.8448] [0.5717] [0.8923]
		– 0.910059*D1992 + 0.00178*LOG(RAGRESEXP)$_t$ + 0.00329*LOG(RAGRESEXP)$_{t-1}$
		[0.0000] [0.6355] [0.6355]
		+ 0.00452*LOG(RAGRESEXP)$_{t-2}$ + 0.00548*LOG(RAGRESEXP)$_{t-3}$
		[0.6355] [0.6355]
		+ 0.00616*LOG(RAGRESEXP)$_{t-4}$ + 0.00657*LOG(RAGRESEXP)$_{t-5}$
		[0.6355] [0.6355]
		+ 0.00671*LOG(RAGRESEXP)$_{t-6}$ + 0.00657*LOG(RAGRESEXP)$_{t-7}$
		[0.6355] [0.6355]
		+ 0.00616*LOG(RAGRESEXP)$_{t-8}$ + 0.00548*LOG(RAGRESEXP)$_{t-9}$
		[0.6355] [0.6355]
		+ 0.00452*LOG(RAGRESEXP)$_{t-10}$ + 0.00329*LOG(RAGRESEXP)$_{t-11}$
		[0.6355] [0.6355]
		+ 0.00178*LOG(RAGRESEXP)$_{t-12}$
		[0.6355]
		Adj R^2 = 0.745 DW = 2.15
LOG(West HA)$_t$	=	– 0.173507 + 0.716848*LOG(West HA)$_{t-1}$ + 0.787917*FARM_BILL_1985
		[0.9585] [0.0160] [0.0372]
		+ 0.848793*FARM_BILL_1990 + 0.565148*FARM_BILL_1996
		[0.0274] [0.0719]
		+ 0.358294*FARM_BILL_2002 + 0.241377*LOG(RCTMPUS)$_{t-1}$
		[0.1561] [0.2827]
		+ 0.00873*LOG(RAGRESEXP)$_t$ + 0.01587*LOG(RAGRESEXP)$_{t-1}$
		[0.4074] [0.4074]
		+ 0.02143*LOG(RAGRESEXP)$_{t-2}$ + 0.02540*LOG(RAGRESEXP)$_{t-3}$
		[0.4074] [0.4074]
		+ 0.02778*LOG(RAGRESEXP)$_{t-4}$ + 0.02857*LOG(RAGRESEXP)$_{t-5}$
		[0.4074] [0.4074]
		+ 0.02778*LOG(RAGRESEXP)$_{t-6}$ + 0.02540*LOG(RAGRESEXP)$_{t-7}$
		[0.4074] [0.4074]
		+ 0.020143*LOG(RAGRESEXP)$_{t-8}$ + 0.01587*LOG(RAGRESEXP)$_{t-9}$
		[0.4074] [0.4074]
		+ 0.00873*LOG(RAGRESEXP)$_{t-10}$
		[0.4074]
		Adj R^2 = 0.922 DW = 1.78

See Table 23 for variable definitions. Two-sided p-values associated with the corresponding estimated coefficients are reported in brackets.

Table 23: Definitions of Variables in the Yield Equations and in the Harvested Acreage Equations for the Various Production Regions of the United States

Variable		Description
Delta $Yield_t$	=	cotton yield in the Delta region in pounds per acre in time period t
Southeast $Yield_t$	=	cotton yield in the Southeast region in pounds per acre in time period t
Southwest Dryland $Yield_t$	=	cotton yield in the Southwest Dryland region in pounds per acre in time period t
Southwest Irrigated $Yield_t$	=	cotton yield in the Southwest Irrigated region in pounds per acre in time period t
West $Yield_t$	=	cotton yield in the West region in pounds per acre in time period t
El Niño	=	1 with the occurrence of El Niño, 0 otherwise
La Niña	=	1 with the occurrence of La Niña, 0 otherwise
Delta HA_t	=	harvested acres of cotton in the Delta region in time period t
Southeast HA_t	=	harvested acres of cotton in the Southeast region in time period t
Southwest Dryland HA_t	=	harvested acres of cotton in the Southwest Dryland region in time period t
Southwest Irrigated HA_t	=	harvested acres of cotton in the Southwest Irrigated region in time period t
West HA_t	=	harvested acres of cotton in the West region in time period t
Farm_Bill_1985	=	1 for years 1985, 1986, 1987, 1988, and 1989; 0 otherwise
Farm_Bill_1990	=	1 for years 1990, 1991, 1992, 1993, 1994, and 1995; 0 otherwise
Farm_Bill_1996	=	1 for years 1996, 1997, 1998, 1999, 2000, and 2001; 0 otherwise
Farm_Bill_2002	=	1 for years 2002, 2003, 2004, 2005, 2006, and 2007; 0 otherwise
$RCTMPUS_{t-1}$	=	Inflation-adjusted price of cotton paid by mills in the previous year
D1992	=	1 if year = 1992; 0 otherwise
$RAGRESEXP_t$	=	Inflation-adjusted agricultural research expenditures associated with the cotton checkoff program in time period t

Table 24: Effects of Cotton Checkoff Agricultural Research Expenditures on Cotton Yields, 1977/78-2009/10

Production Regions	Average Yield	Short-run Elasticity[a]	Long-Run Elasticity[a]	Length of Time for Cumulative Effect
	(lb/acre)			
West	1,160	0.0036	0.0936	10 years
Southwest				
- Irrigated	604	0.0064	0.1662	10 years
- Dryland	368	0.0088	0.3078	12 years
Southeast	623	0.0033	0.0987	11 years
Delta	718	0.0045	0.1354	11 years

[a] Percentage change in yields due to a 1% change in cotton checkoff agricultural research expenditures.

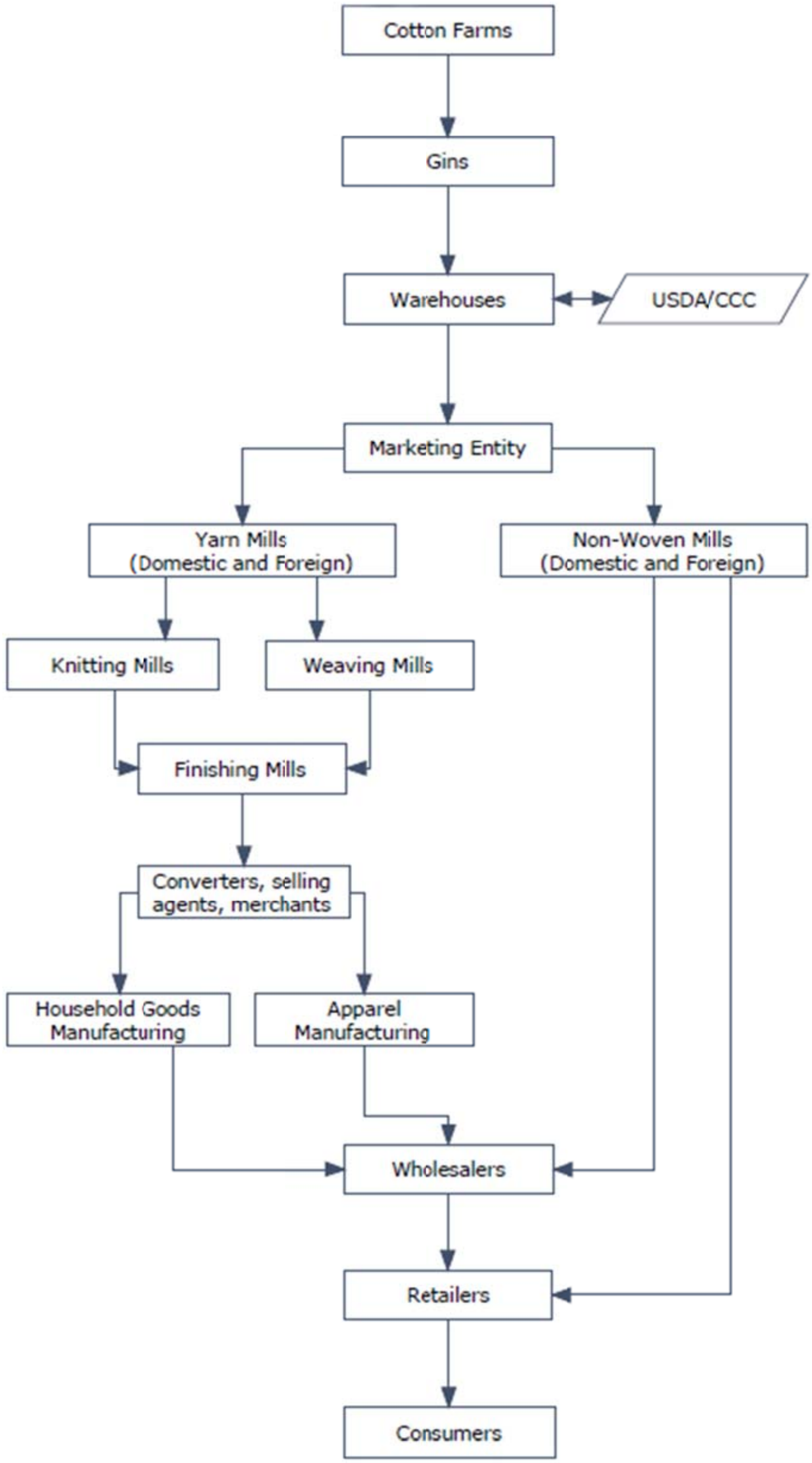
Table 25: Effects of Cotton Checkoff Agricultural Research Expenditures on Harvested Acres of Cotton, 1977/78-2009/10

Production Regions	Average Harvested Acres	Short-run Elasticity[a]	Long-Run Elasticity[a]	Length of Time for Cumulative Effect
	(thousands)			
West	1,320	0.0087[b]	0.2270[b]	10 years
Southwest				
- Irrigated	1,999	0.0018[b]	0.0623[b]	12 years
- Dryland	3,157	-0.0106[b]	-0.1268[b]	6 years
Southeast	1,863	0.0227	0.3405	7 years
Delta	3,241	0.0123	0.3186	10 years

[a] Percentage change in harvested due to a 1% change in cotton checkoff agricultural research expenditures.
[b] Not statistically different from zero.

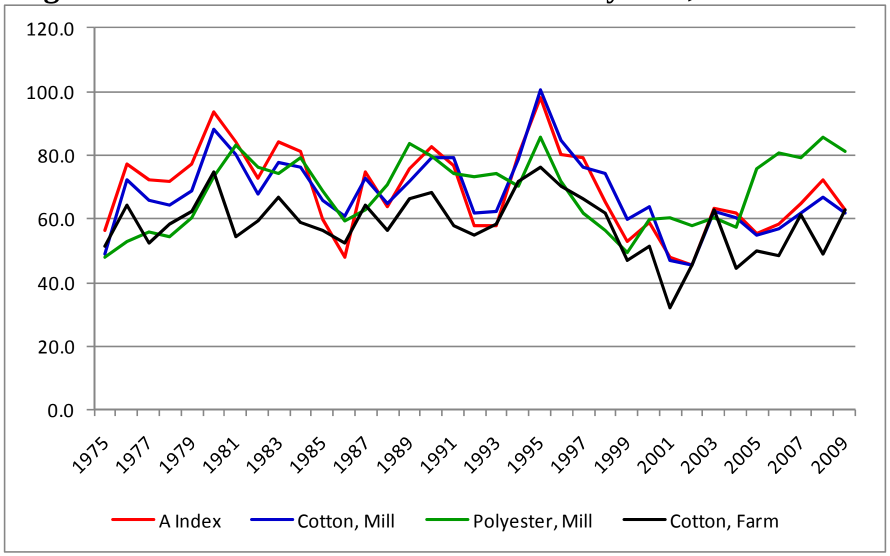
FIGURES

Figure 1: Cotton Textile Supply Chain



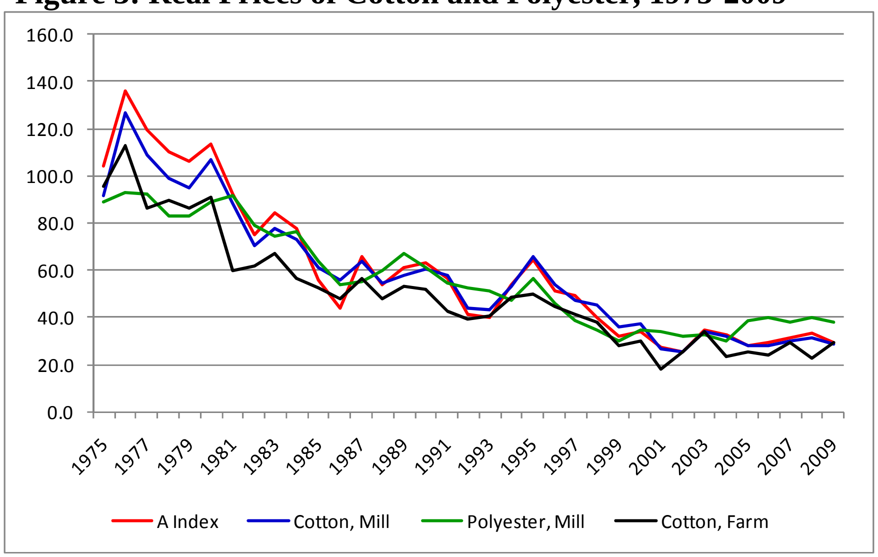
Cotton Incorporated (2010).

Figure 2: Nominal Prices of Cotton and Polyester, 1975-2009



[a] Mill prices are raw-fiber equivalent.
Source: USDAc.

Figure 3: Real Prices of Cotton and Polyester, 1975-2009



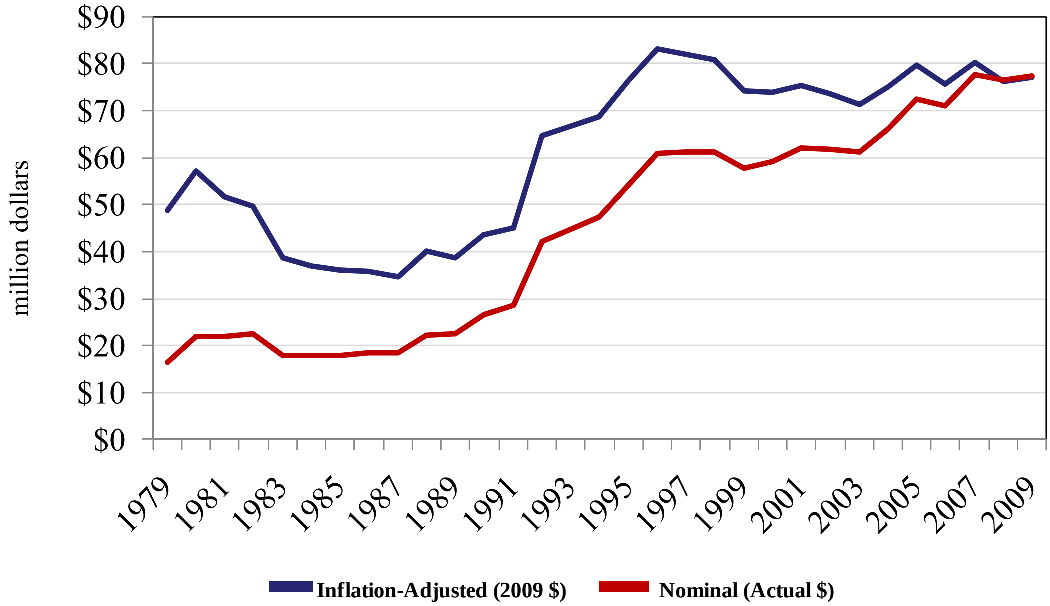
[a] Mill prices are raw-fiber equivalent. Prices are deflated by the CPI (U.S. city average) (1982-84=100)

Fiber Prices

	A Index Cot Price	US Mill Deliv Cot P	U.S. Poly. Price			Real A Index	Real US Mill Deliv	Real USA Poly	
	A Index	Cotton, Mill	Polyester, Mill	Cotton, Farm		A Index	Cotton, Mill	Polyester, Mill	Cotton, Farm
1975	56.2	49.2	48.0	51.3	1975	104.4	91.4	89.2	95.3
1976	77.5	72.2	53.0	64.1	1976	136.1	126.8	93.1	112.6
1977	72.3	65.8	55.8	52.3	1977	119.3	108.6	92.1	86.3
1978	72.0	64.3	54.3	58.4	1978	110.4	98.6	83.2	89.5
1979	77.2	69.0	60.5	62.5	1979	106.4	95.0	83.4	86.1
1980	93.5	88.0	73.1	74.7	1980	113.5	106.8	88.8	90.7
1981	84.2	80.4	83.3	54.3	1981	92.6	88.4	91.6	59.7
1982	72.6	68.0	76.5	59.6	1982	75.2	70.4	79.2	61.7
1983	84.0	77.7	74.2	66.6	1983	84.4	78.0	74.5	66.9
1984	81.0	76.1	79.3	58.9	1984	77.9	73.2	76.3	56.7
1985	59.9	65.8	69.0	56.3	1985	55.7	61.2	64.1	52.3
1986	48.0	61.0	59.3	52.4	1986	43.8	55.6	54.1	47.8
1987	74.7	72.7	63.0	64.3	1987	65.7	64.0	55.4	56.6
1988	63.6	64.9	70.9	56.6	1988	53.8	54.9	60.0	47.9
1989	75.9	72.0	83.5	66.2	1989	61.2	58.1	67.4	53.4
1990	82.7	79.3	80.0	68.2	1990	63.3	60.7	61.2	52.2
1991	76.8	79.1	74.4	58.1	1991	56.4	58.1	54.7	42.7
1992	57.9	61.9	73.5	54.9	1992	41.3	44.1	52.4	39.1
1993	58.1	62.4	74.4	58.4	1993	40.2	43.2	51.5	40.4
1994	80.0	78.7	70.2	72.0	1994	54.0	53.1	47.4	48.6
1995	98.1	100.8	85.7	76.5	1995	64.4	66.1	56.2	50.2
1996	80.4	84.9	71.8	70.5	1996	51.3	54.1	45.8	44.9
1997	79.2	76.3	62.0	66.2	1997	49.3	47.5	38.7	41.2
1998	65.3	74.2	56.5	61.7	1998	40.1	45.5	34.7	37.9
1999	53.1	60.0	49.7	46.8	1999	31.9	36.0	29.8	28.1
2000	59.1	64.1	59.9	51.6	2000	34.3	37.2	34.8	30.0
2001	48.0	47.1	60.5	32.0	2001	27.1	26.6	34.2	18.1
2002	45.4	45.6	58.1	45.7	2002	25.3	25.3	32.3	25.4
2003	63.4	62.5	60.1	63.0	2003	34.5	34.0	32.7	34.2
2004	62.0	60.4	57.3	44.7	2004	32.8	32.0	30.3	23.7
2005	55.2	54.8	75.8	49.7	2005	28.3	28.0	38.8	25.5
2006	58.6	56.7	80.5	48.4	2006	29.1	28.1	39.9	24.0
2007	64.6	62.0	79.1	61.3	2007	31.2	29.9	38.2	29.6
2008	72.2	67.0	85.7	49.1	2008	33.5	31.1	39.8	22.8
2009	62.8	62.0	81.0	62.8	2009	29.2	28.9	37.8	29.3

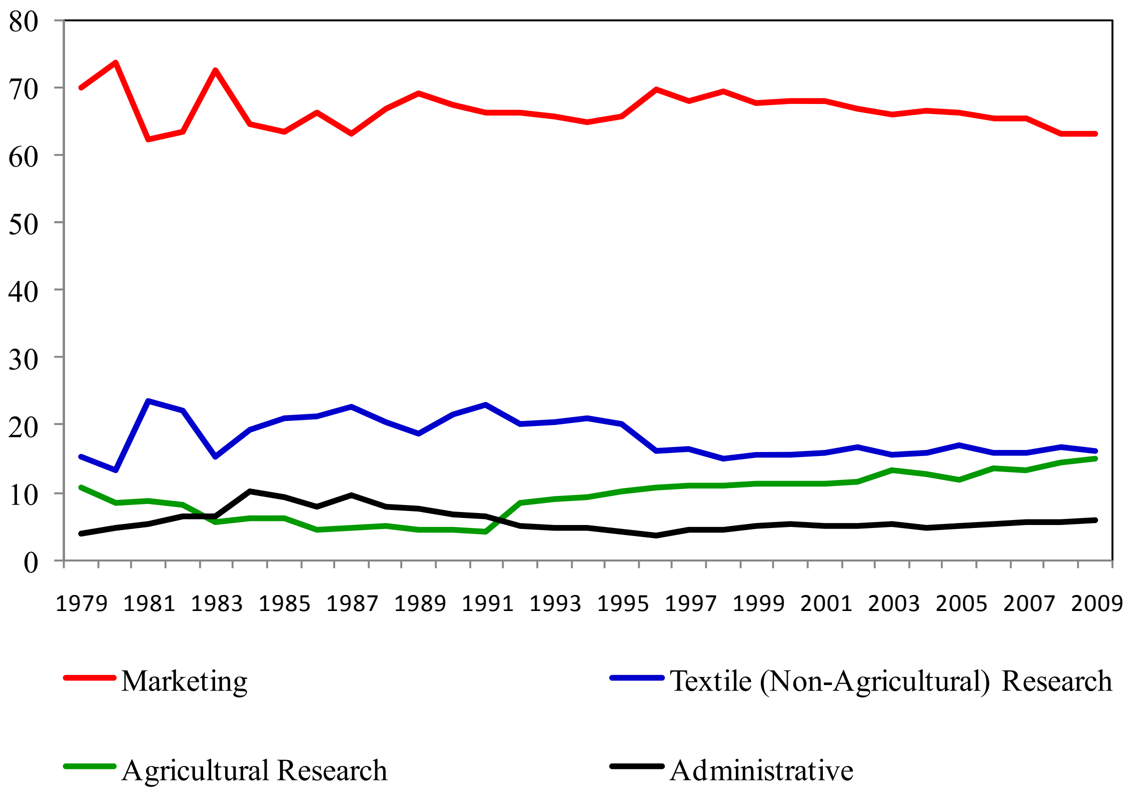
Nominal Cotton Price from USDA Appendix Table 1
Real Cotton Price = Nominal Price/CPI-U Total * 100

Figure 4: Annual Nominal and Annual Inflation-Adjusted Cotton Incorporated Expenditures, 1979-2009



Source: Worsham, 2011.

Figure 5: Annual Shares of Cotton Incorporated Expenditures, 1979-2009



Source: Worsham, 2011.

Figure 6: Global Cotton and Cotton Fiber Textile Market Effects of Retail-Level Cotton Checkoff Promotion

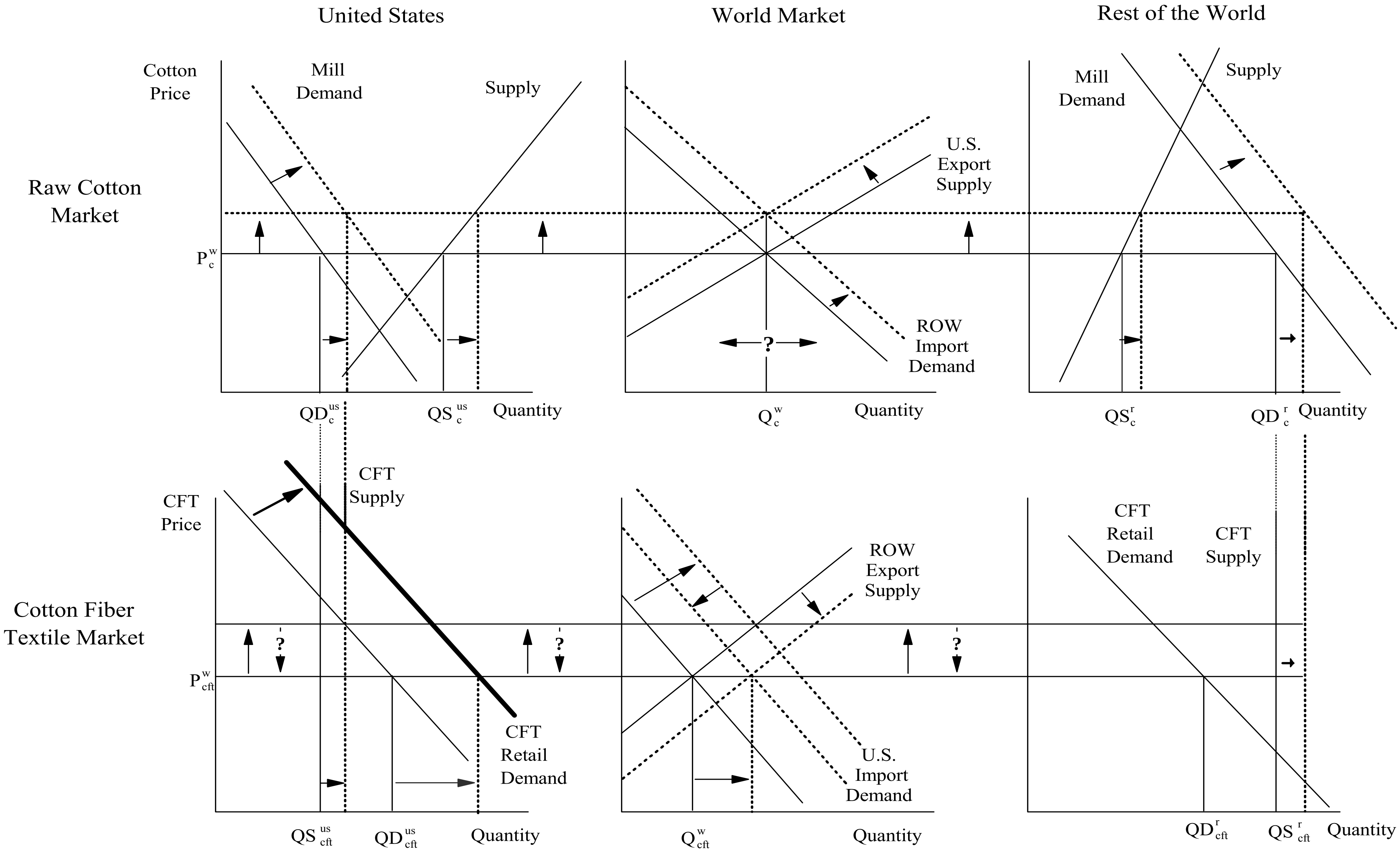


Figure 7: Global Cotton and Cotton Fiber Textile Market Effects of Mill-Level Cotton Checkoff Promotion

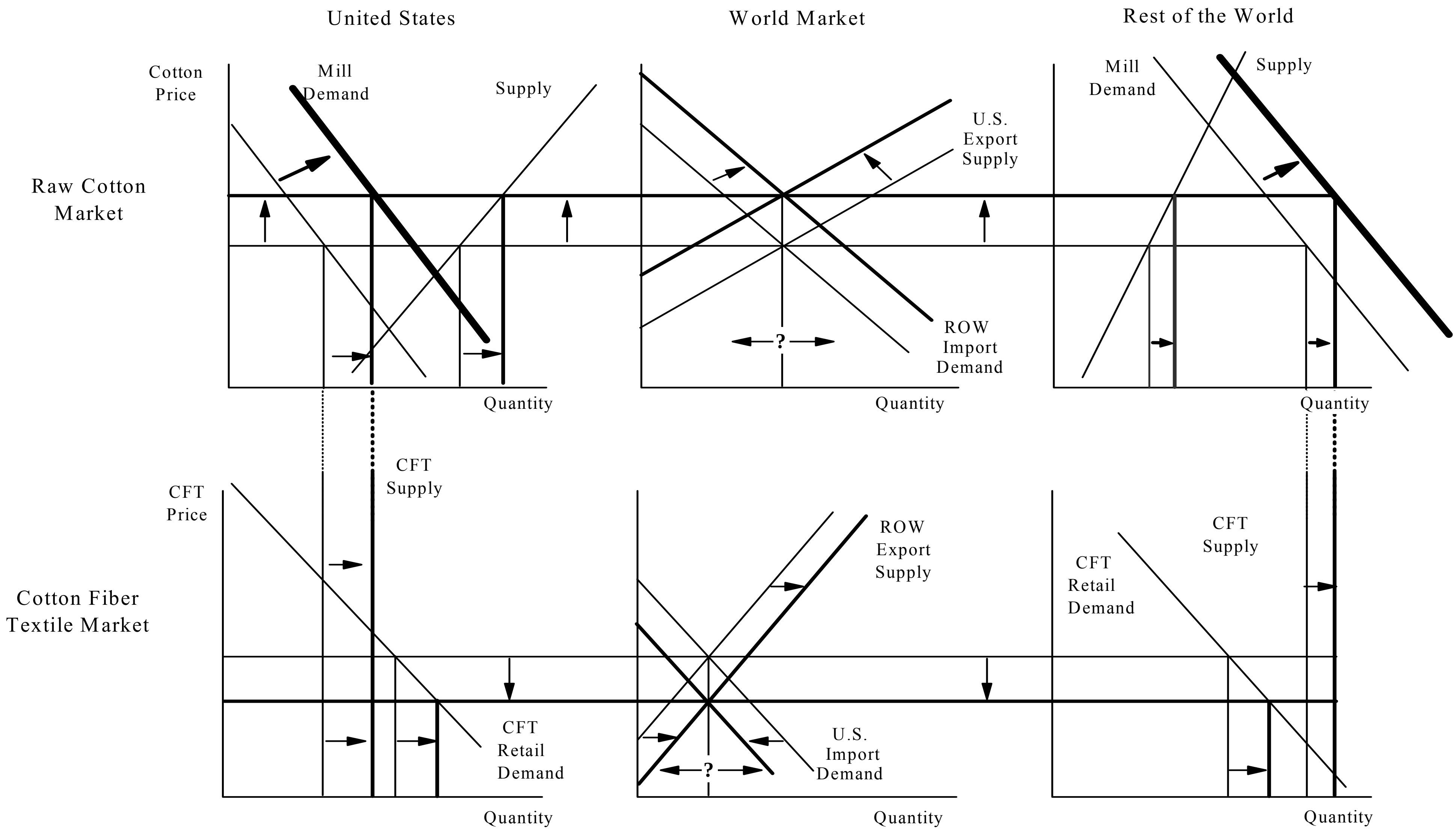


Figure 8: Representative Country Model in the Texas Tech World Fiber Model

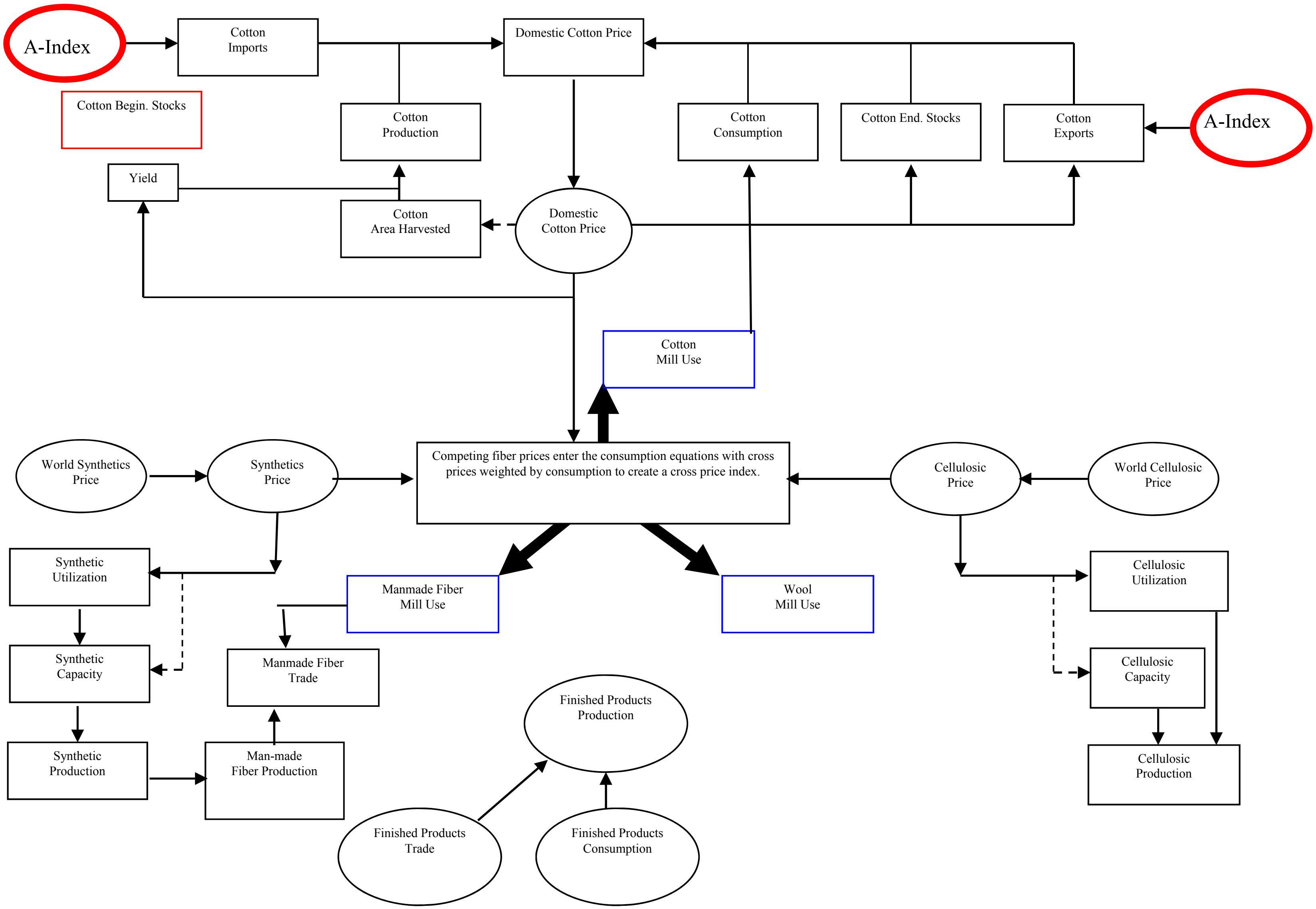


Figure 9: Schematic Representation of U.S. Cotton Supply Model in the Texas Tech World Fiber Model

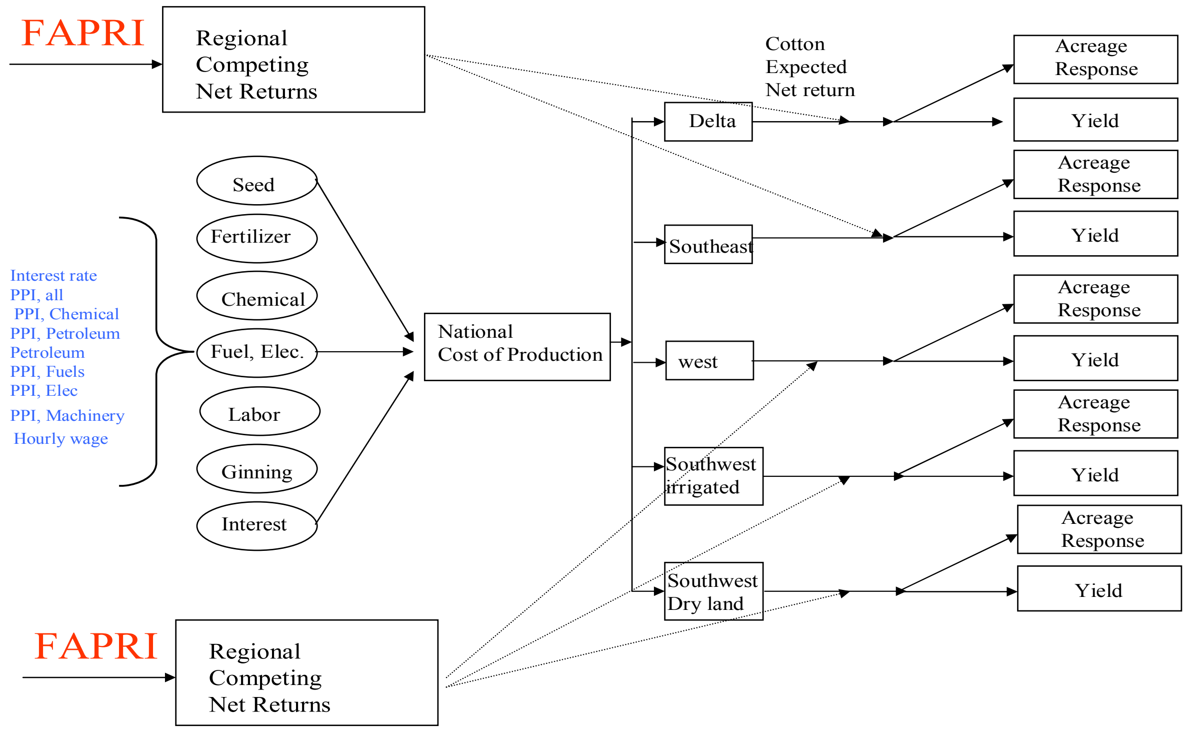


Figure 10: Schematic Representation of the Man-made Fiber Model in the Texas Tech World Fiber Model

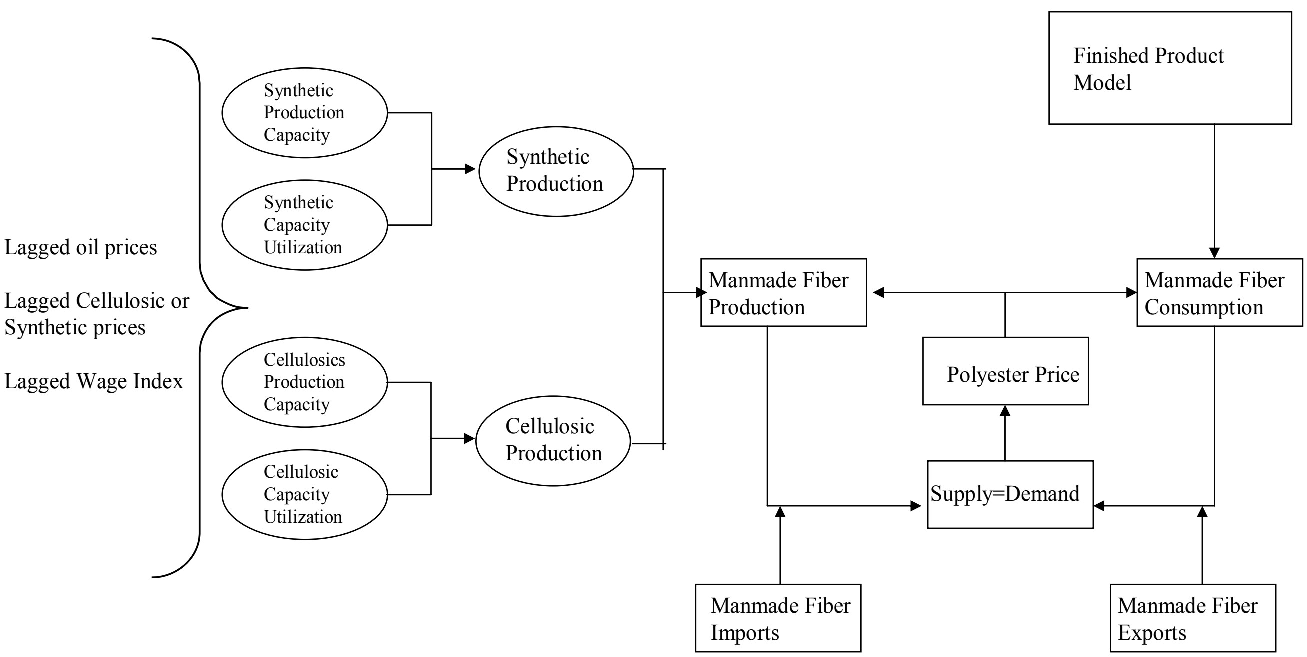


Figure 11: U.S. Cotton and Non-Cotton Textile Models in the Texas Tech World Fiber Model

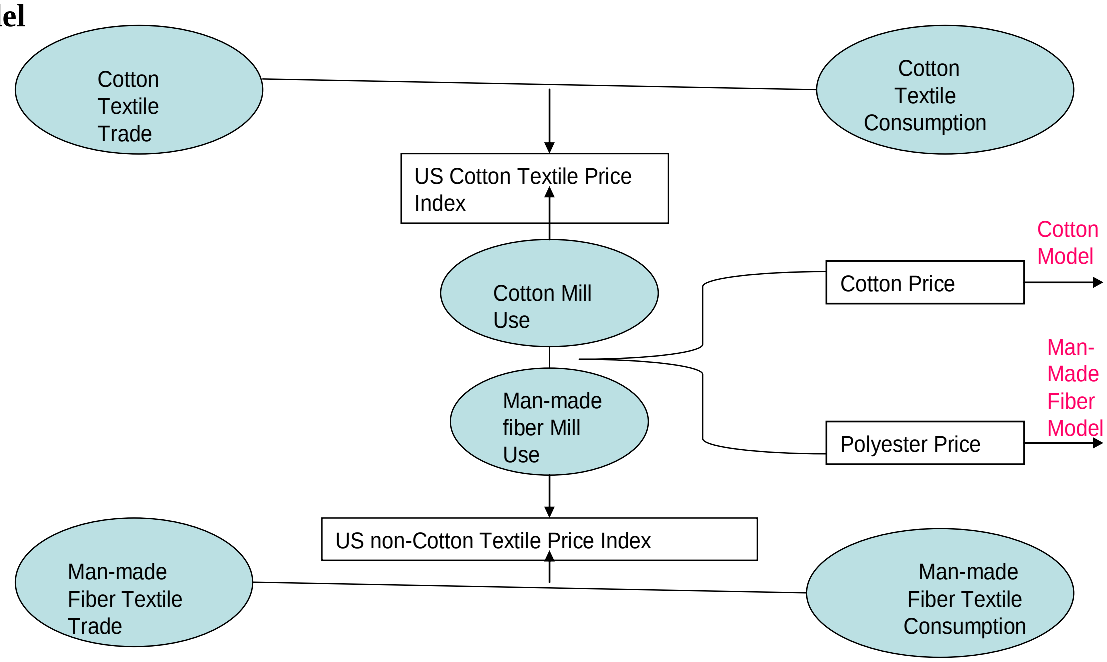


Figure 12: Net Domestic Consumption of Cotton and Man-Made Fiber, 1976-2009

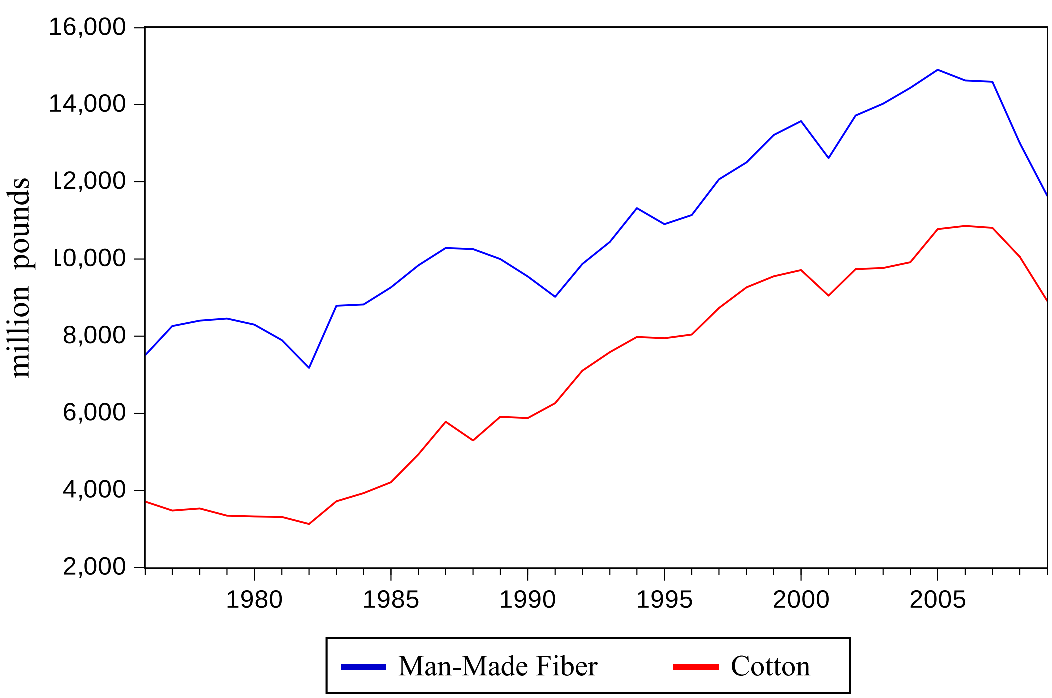


Figure 13: Mill Use of Cotton and Man-Made Fiber, 1980-2009

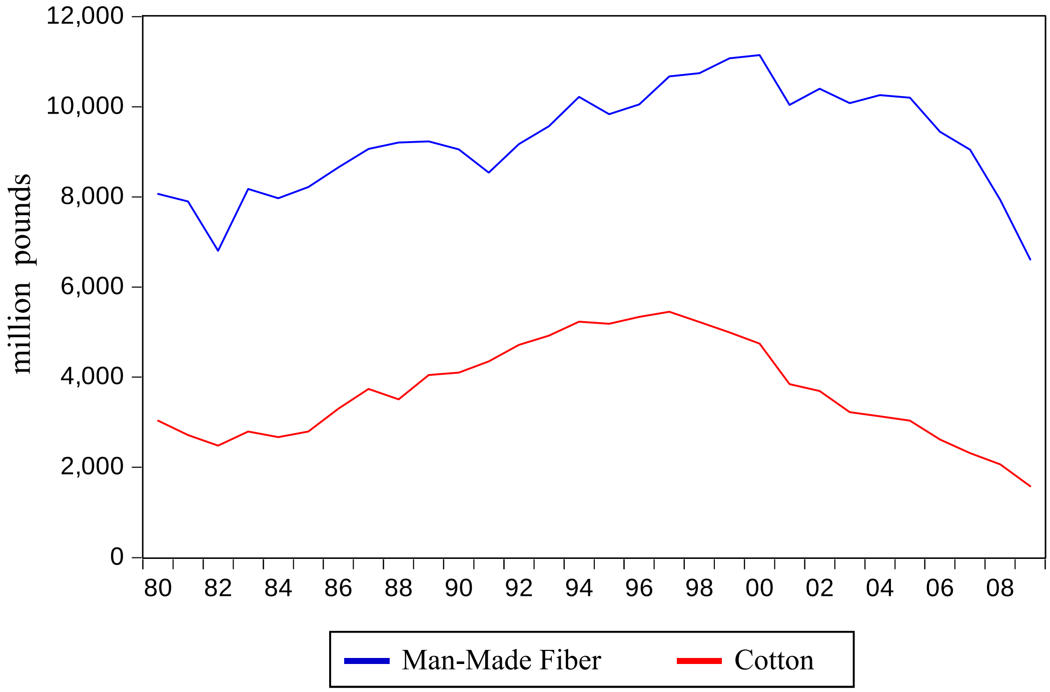
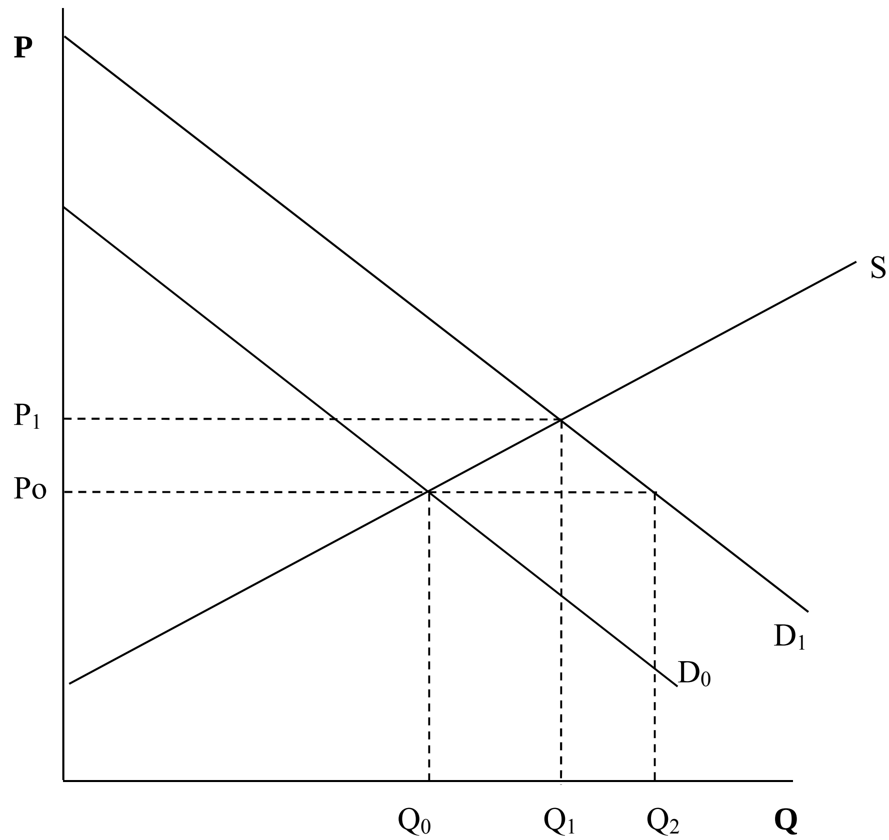


Figure 14: Market Effects of a Rightward Shift in the Market Demand Function from Advertising and Promotion Programs[a]



[a] For expositional purposes only, this figure, like Figure 6, does not show the small leftward shift of the supply curve that occurs as a result of the checkoff assessment on cotton producers. Again, this leftward "tax" effect of the checkoff is included in the empirical analysis discussed later.

Figure 15: Season Average Upland Cotton Farm and Spot Prices, 1970/71 - 2009/10 and Monthly August 2010 - January 2011

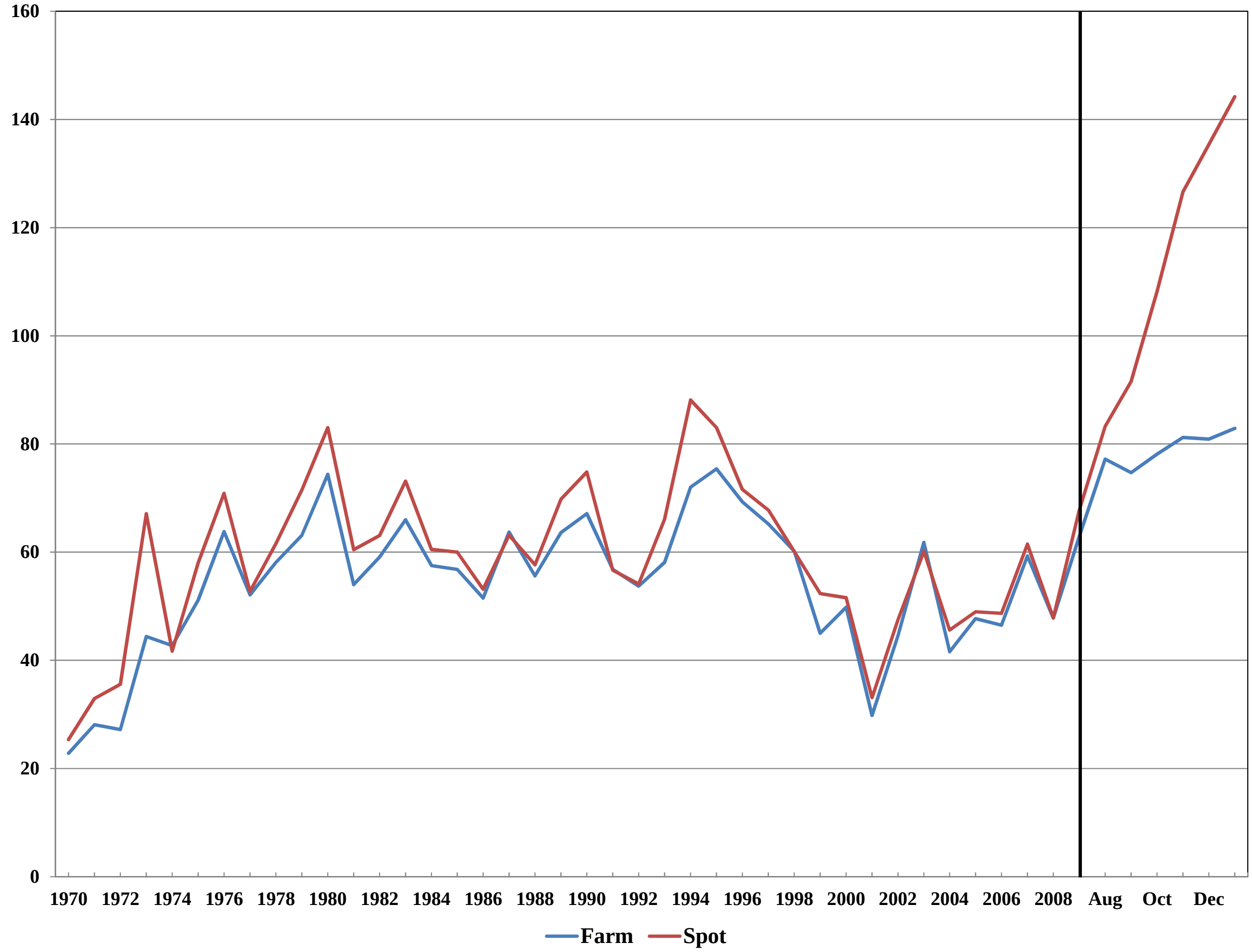


Figure 16: Domestic Impacts of Program

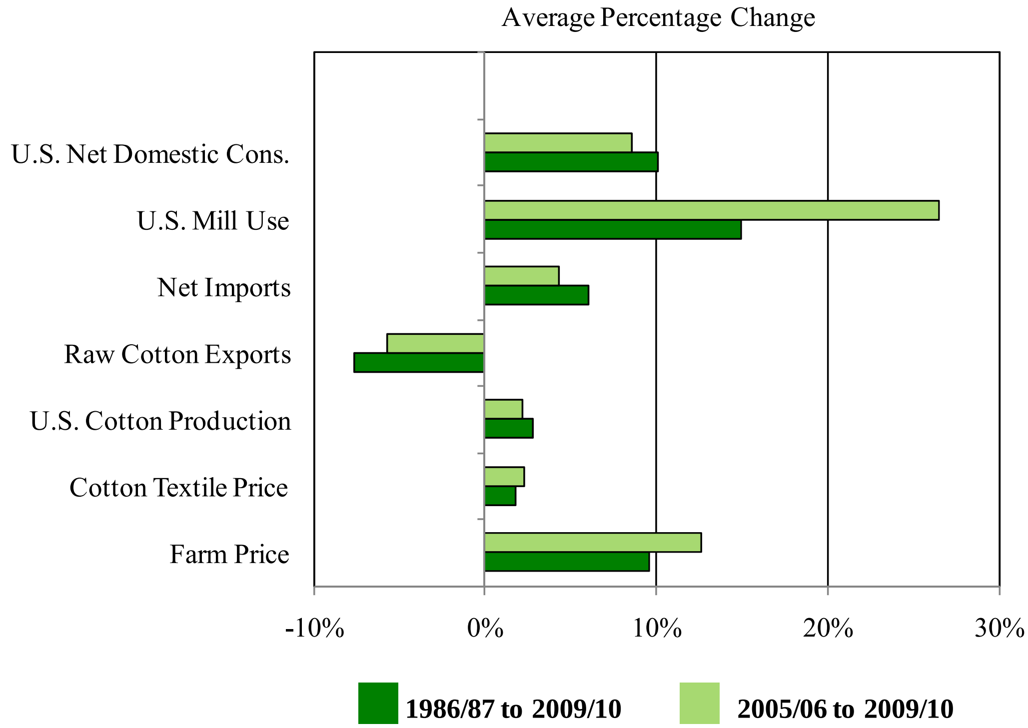


Figure 17: Global Impacts of Program

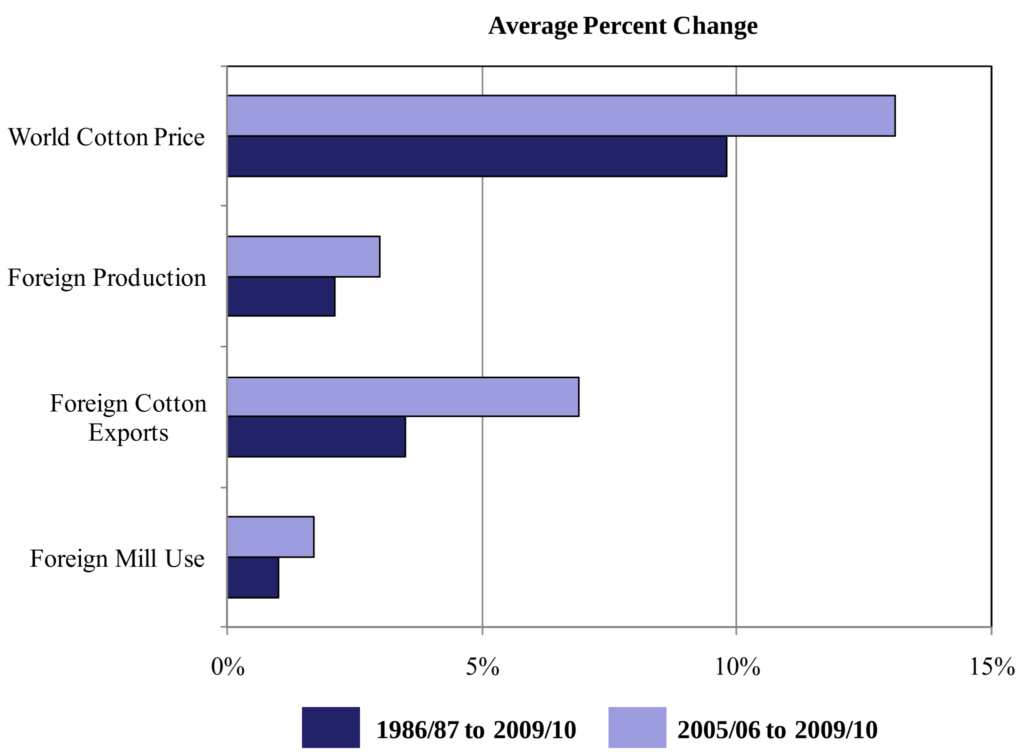


Figure 18: Average Annual Bale Impacts of Program

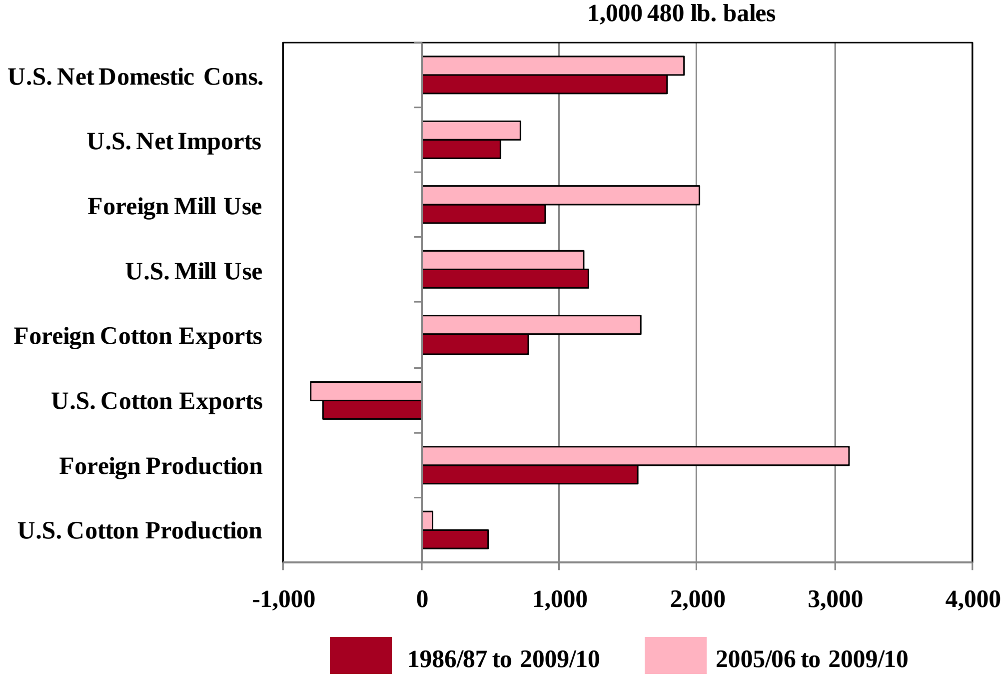


Figure 19: U.S. Cotton Yields by Region, 1977/78-2009/10[a]
lb/acre

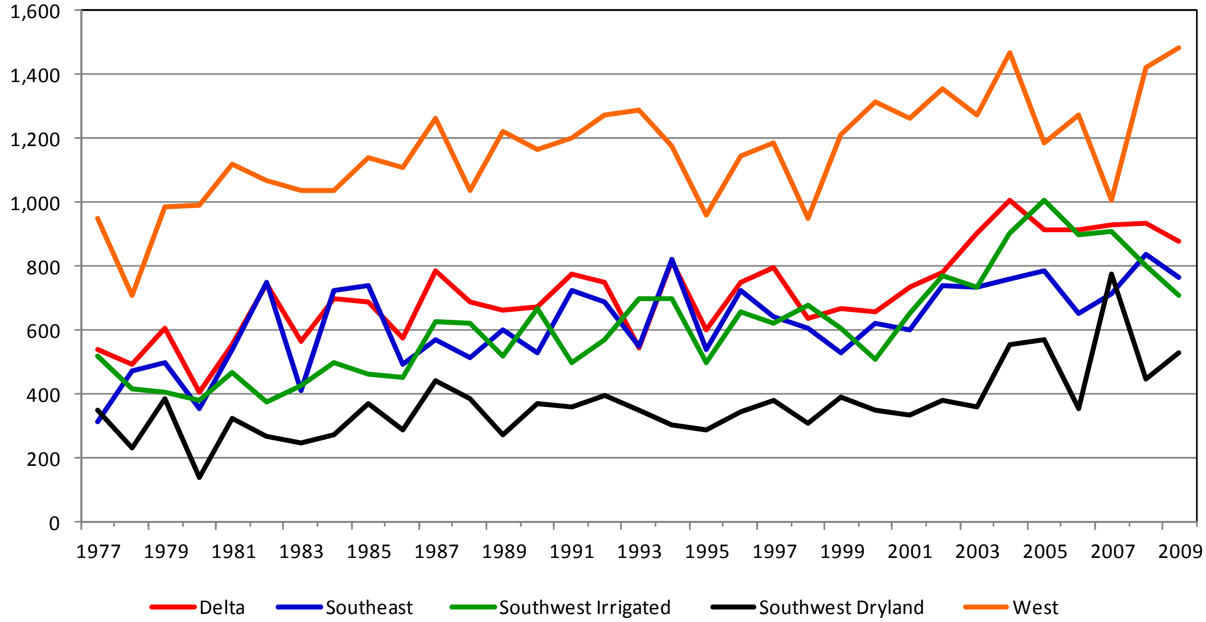
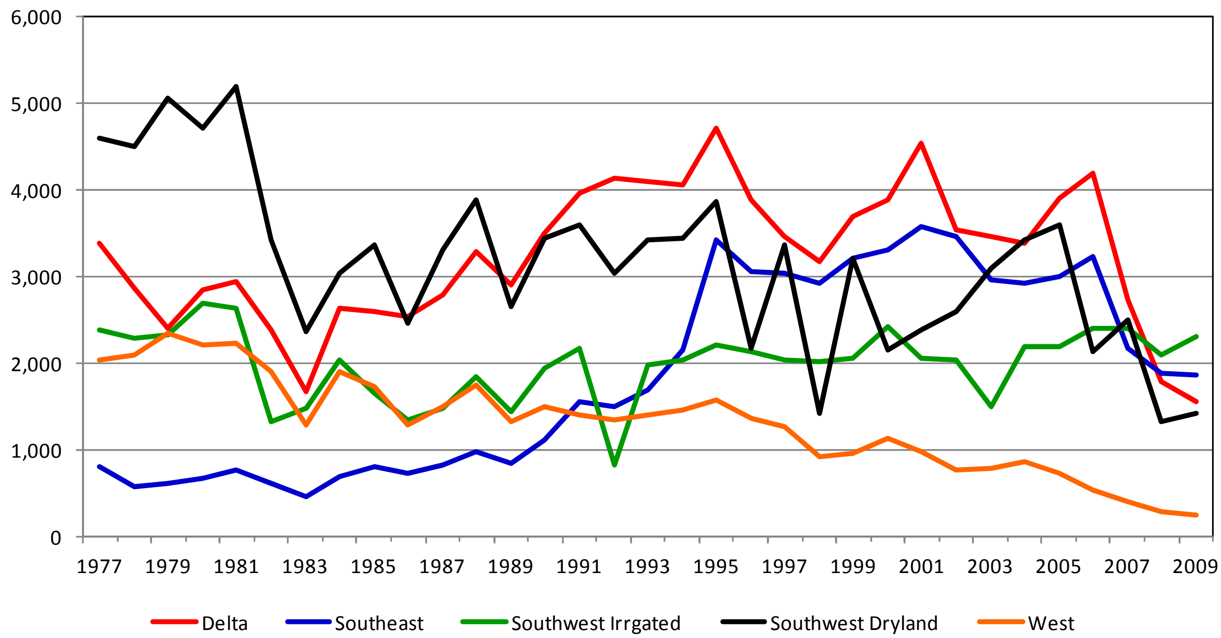


Figure 20: U.S. Harvested Acres of Cotton by Region, 1977/78-2009/10[a]
1,000 acres



[a] Delta: Arkansas, Louisiana, Mississippi, Missouri, and Tennessee; Southeast: Alabama, Florida, Georgia, North Carolina, South Carolina, and Virginia; Southwest Dry: Texas, Kansas, and Oklahoma; Southwest Irrigated: Texas, Kansas, and Oklahoma; West: California, Arizona, and New Mexico.

APPENDIX
Appendix Table 1: Model Validation Statistics for Selected Key Model Variables

		Bias	Reg	Dist	Inequality Coefficient	
Variable	Explanation	UM	UR	UD	U1	U2
CTAHAUs	Cotton A-index	0.077	0.230	0.693	0.075	0.572
CTPPRIAg	Argentina Production	0.084	0.160	0.756	0.100	0.827
CTUMAg	Argentina Mill Use	0.061	0.340	0.599	0.249	0.646
CTEXTAg	Argentina Export	0.081	0.190	0.729	0.100	0.985
CTIMTAg	Argentina Import	0.260	0.010	0.730	0.180	0.385
CTCESAg	Argentina Ending Stock	0.081	0.190	0.729	0.100	0.631
CTPPRAu	Australia Production	0.590	0.400	0.010	0.069	0.364
CTUMIAu	Australia Mill Use	0.061	0.120	0.819	0.256	0.605
CTCESAu	Australia Ending Stock	0.081	0.020	0.899	0.062	0.839
CTEXTAu	Australia Export	0.061	0.390	0.549	0.067	0.337
CTPPRBr	Brazil Production	0.062	0.210	0.728	0.157	0.361
CTUMBr	Brazil Mill Use	0.086	0.060	0.854	0.085	0.158
CTEXTCBr	Brazil Export	0.077	0.200	0.723	0.043	0.147
CTIMTBr	Brazil Import	0.010	0.010	0.980	0.211	0.394
CTCESBr	Brazil Ending stock	0.360	0.010	0.630	0.136	0.250
CTPPRBG	Bangladesh Production	0.460	0.053	0.487	0.054	0.201
CTCESBG	Bangladesh Ending Stock	0.083	0.000	0.917	0.291	0.766
CTUMIBG	Bangladesh Mill Use	0.071	0.220	0.709	0.279	0.700
CTIMTBG	Bangladesh Import	0.061	0.350	0.589	0.288	0.716
CTPPRBn	Benn Production	0.000	0.092	0.908	0.031	0.628
CTCESBn	Benn Ending Stock	0.083	0.170	0.747	0.092	0.408
CTEXTBn	Benn Export	0.100	0.086	0.814	0.277	0.622
CTPPRBk	Burkina Faso Production	0.150	0.230	0.620	0.172	0.365
CTCESBk	Burkina Faso Ending Stock	0.086	0.040	0.874	0.095	0.117
CTEXTBk	Burkina Faso Export	0.230	0.150	0.620	0.168	0.361
CTPPRCd	Chad Production	0.080	0.170	0.750	0.091	0.102
CTCESCd	Chad Ending Stock	0.084	0.050	0.866	0.066	0.802
CTEXTCd	Chad Export	0.084	0.130	0.786	0.093	0.104
CTPPRCt	Cote d'ivoire Production	0.260	0.069	0.671	0.035	0.848
CTCESCt	Cote d'ivoire Ending Stock	0.069	0.010	0.921	0.065	0.810
CTUMICt	Cote d'ivoire Mill Use	0.089	0.100	0.811	0.079	0.137
CTEXTCt	Cote d'ivoire Export	0.460	0.051	0.489	0.039	0.107
CTUMCa	Canada Mill Use	0.040	0.400	0.560	0.275	0.532
CTCESCa	Canada Ending stock	0.072	0.020	0.908	0.076	0.113
CTIMTca	Canada Import	0.020	0.300	0.680	0.299	0.563
CTPPRICn	China Production	0.330	0.110	0.560	0.134	0.248
CTIMTCn	China Import	0.540	0.300	0.160	0.087	0.111

Appendix Table 1: (continued)

Variable	Explanation	Bias UM	Reg UR	Dist UD	Inequality Coefficient U1	U2
CTUMCn	China Mill Use	0.470	0.410	0.120	0.280	0.466
CTCESCn	China Ending Stock	0.095	0.010	0.895	0.040	0.571
CTPPREG	Egypt Production	0.066	0.330	0.604	0.073	0.466
CTEXTEG	Egypt Export	0.073	0.270	0.657	0.087	1.121
CTUMIEG	Egypt mill Use	0.070	0.290	0.640	0.066	0.988
CTCESEG	Egypt Ending Stock	0.080	0.160	0.760	0.080	0.129
CTIMTEg	Egypt Import	0.510	0.330	0.160	0.277	0.446
CTPPREu	EU Production	0.320	0.240	0.440	0.104	0.193
CTIMTEu	EU Import	0.068	0.300	0.632	0.186	0.422
CTUMIEu	EU Mill Use	0.086	0.000	0.914	0.103	0.190
CTCESEu	EU Ending Stock	0.083	0.130	0.787	0.043	0.702
CTEXTEu	EU Export	0.079	0.180	0.741	0.039	0.123
CTPPRID	Indonesia Production	0.590	0.410	0.000	0.078	0.622
CTCESID	Indonesia Ending Stock	0.093	0.060	0.847	0.035	0.528
CTUMIID	Indonesia Mill Use	0.099	0.010	0.891	0.278	0.435
CTIMTID	Indonesia Import	0.099	0.000	0.901	0.035	0.523
CTPPRIN	India Production	0.000	0.066	0.934	0.109	0.214
CTCESIN	India Ending Stock	0.064	0.270	0.666	0.053	0.749
CTUMIIN	India Mill Use	0.082	0.160	0.758	0.061	0.813
CTIMTIN	India Import	0.150	0.250	0.600	0.221	0.385
CTEXTIN	India Export	0.094	0.040	0.866	0.066	0.334
CTUMJp	Japan mill Use	0.099	0.000	0.901	0.032	0.919
CTCESJp	Japan Ending Stock	0.380	0.061	0.559	0.041	0.130
CTIMTJp	Japan Import	0.098	0.010	0.892	0.032	0.932
CTPPRKz	Kazakhstan Production	0.010	0.077	0.913	0.201	0.417
CTCESKz	Kazakhstan Ending Stock	0.087	0.010	0.903	0.056	0.733
CTUMIKz	Kazakhstan mill Use	0.590	0.410	0.000	0.094	0.302
CTEXTKz	Kazakhstan Export	0.190	0.051	0.759	0.244	0.557
CTPPRILa	Other American Production	0.071	0.280	0.649	0.071	0.427
CTUMLa	Other American Mill Use	0.410	0.480	0.110	0.108	0.232
CTEXTCLa	Other American Export	0.060	0.400	0.540	0.088	0.115
CTIMTLa	Other American Import	0.092	0.070	0.838	0.296	0.465
CTCESLa	Other American Ending Stock	0.060	0.060	0.880	0.112	0.230
CTPPRMl	Mali Production	0.400	0.250	0.350	0.032	0.520
CTCESMl	Mali Ending Stock	0.084	0.000	0.916	0.057	0.748
CTEXTMl	Mali Export	0.430	0.390	0.180	0.031	0.495
CTCESMS	Malaysia Ending Stock	0.260	0.420	0.320	0.229	0.397
CTUMIMS	Malaysia mill Use	0.079	0.210	0.711	0.093	0.345
CTIMTMS	Malaysia Import	0.080	0.200	0.720	0.094	0.340
CTPPRIMx	Mexican Production	0.093	0.020	0.887	0.036	0.108

Appendix Table 1: (continued)

Variable	Explanation	Bias UM	Reg UR	Dist UD	Inequality Coefficient U1	U2
CTUMMx	Mexican Mill Use	0.110	0.470	0.420	0.039	0.077
CTEXTMx	Mexican Export	0.082	0.180	0.738	0.075	0.558
CTIMTMx	Mexican Import	0.080	0.075	0.845	0.148	0.307
CTCESMx	Mexican Ending Stock	0.070	0.040	0.890	0.035	0.536
CTPPRNr	Nigeria Production	0.063	0.360	0.577	0.282	0.752
CTCESNr	Nigeria Ending Stock	0.079	0.200	0.721	0.084	0.135
CTUMINr	Nigeria Mill Use	0.098	0.000	0.902	0.038	0.548
CTEXTNr	Nigeria Export	0.088	0.120	0.792	0.066	0.388
CTPPROa	Other Asia Production	0.061	0.390	0.549	0.095	0.656
CTIMTOa	Other Asia Import	0.066	0.340	0.594	0.085	0.102
CTUMIOa	Other Asia Mill Use	0.083	0.160	0.757	0.053	0.748
CTCESOa	Other Asian Ending Stock	0.067	0.330	0.603	0.081	0.195
CTEXTOa	Other Asian Export	0.077	0.230	0.693	0.087	0.112
CTIMTOe	Other Europe Import	0.083	0.160	0.757	0.038	0.113
CTUMIOe	Other Europe Mill Use	0.084	0.140	0.776	0.036	0.103
CTCESOe	Other Europe Ending Stock	0.088	0.000	0.912	0.195	0.343
CTPPROf	Other African Production	0.060	0.380	0.560	0.045	0.146
CTEXTOf	Other African Export	0.420	0.440	0.140	0.035	0.931
CTUMIOf	Other African Mill Use	0.160	0.066	0.774	0.052	0.101
CTCESOf	Other African Ending Stock	0.082	0.160	0.758	0.090	0.144
CTIMTOf	Other African Import	0.084	0.160	0.756	0.097	0.424
CTPPRPK	Pakistan Production	0.190	0.071	0.739	0.186	0.351
CTUMIPK	Pakistan Mill Use	0.066	0.320	0.614	0.174	0.413
CTIMTPK	Pakistan Import	0.570	0.420	0.010	0.072	0.463
CTEXTPK	Pakistan Export	0.090	0.090	0.820	0.065	0.342
CTCESPK	Pakistan Ending Stock	0.061	0.320	0.619	0.265	0.679
CTUMRu	Russia Mill Use	0.092	0.020	0.888	0.192	0.464
CTCESRu	Russia Ending Stock	0.091	0.020	0.889	0.048	0.665
CTIMTRu	Russia Import	0.090	0.030	0.880	0.193	0.466
CTUMKR	South Korea Mill Use	0.210	0.072	0.718	0.131	0.255
CTCESKR	South Korea Ending Stock	0.470	0.030	0.500	0.119	0.221
CTIMTKR	South Korea import	0.190	0.065	0.745	0.135	0.261
CTPPRITk	Turkey Production	0.310	0.050	0.640	0.162	0.352
CTUMTk	Turkey Mill Use	0.066	0.260	0.674	0.166	0.387
CTEXTTk	Turkey Export	0.073	0.030	0.897	0.289	0.737
CTIMTTk	Turkey Import	0.079	0.110	0.811	0.194	0.472
CTCESTk	Turkey Ending Stock	0.088	0.100	0.812	0.045	0.623
CTUMTw	Taiwan mill Use	0.470	0.050	0.480	0.254	0.631
CTCESTw	Taiwan Ending Stock	0.520	0.380	0.100	0.031	0.813
CTIMTTw	Taiwan Import	0.550	0.380	0.070	0.255	0.644

Appendix Table 1: (continued)

		Bias	Reg	Dist	Inequality Coefficient	
Variable	Explanation	UM	UR	UD	U1	U2
CTPPRTj	Tajikistan Production	0.020	0.077	0.903	0.201	0.393
CTCESTj	Tajikistan Ending Stock	0.071	0.150	0.779	0.042	0.610
CTUMITj	Tajikistan Mill Use	0.092	0.060	0.848	0.048	0.651
CTEXTTj	Tajikistan Export	0.010	0.080	0.910	0.193	0.398
CTPPRTu	Turkmenistan Production	0.086	0.120	0.794	0.252	0.669
CTCESTu	Turkmenistan Ending Stock	0.520	0.220	0.260	0.210	0.360
CTUMITu	Turkmenistan Mill Use	0.280	0.071	0.649	0.173	0.320
CTEXTTu	Turkmenistan Export	0.080	0.170	0.750	0.039	0.125
CTPPRIUz	Uzbekistan Production	0.086	0.130	0.784	0.079	0.108
CTUMUz	Uzbekistan mill Use	0.076	0.110	0.814	0.171	0.297
CTEXTUz	Uzbekistan Export	0.080	0.190	0.730	0.085	0.130
CTCESUz	Uzbekistan Ending Stock	0.089	0.080	0.831	0.097	0.128
CTEXTUs	US Export	0.074	0.250	0.676	0.054	0.224
USSSPC	U.S. Polyester Price	0.071	0.290	0.639	0.045	0.160
MMMDUs	U.S. Man-made fiber mill use	0.083	0.070	0.847	0.055	0.105
CTMPPUs	U.S. Cotton Market Price	0.074	0.250	0.676	0.076	0.608
CTFMPUs	U.S. Cotton Farm Price	0.075	0.250	0.675	0.075	0.586
CTCESUs	U.S. Cotton Ending Stock	0.076	0.200	0.724	0.089	0.161
CTPDUd	U.S. Delta Cotton Production	0.170	0.370	0.460	0.183	0.392
CTPDUse	U.S. Southeast Cotton Production	0.490	0.490	0.020	0.038	0.110
CTPDUswi	U.S. Southwest Irrigated Cotton Production	0.062	0.360	0.578	0.043	0.144
CTPUswd	U.S. Southwest Dry land Production	0.073	0.180	0.747	0.042	0.132
CTPDUw	U.S. West Production	0.068	0.300	0.632	0.052	0.183
CTPPRUs	U.S. Total Production	0.060	0.370	0.570	0.035	0.998
CTUMIUs	U.S. Cotton Mill Use	0.078	0.220	0.702	0.077	0.169
CTFPIUS	U.S. Cotton Textile Price Index	0.070	0.290	0.640	0.255	0.666
TCFCUs	U.S. Domestic Consumption	0.078	0.210	0.712	0.293	0.470
CFNMUs	U.S. Net import	0.590	0.140	0.270	0.045	0.093
MFNTUs	U.S. Net import	0.570	0.130	0.300	0.051	0.099
TMFCUs	U.S. Domestic Consumption	0.095	0.010	0.895	0.048	0.093
MFFPIUS	U.S. Man-made Fiber Price Index	0.390	0.052	0.558	0.084	0.179
CTPPRVN	Vietnam Production	0.061	0.390	0.549	0.079	0.614
CTCESVN	Vietnam Ending Stock	0.360	0.062	0.578	0.059	0.877
CTUMIVN	Vietnam Mill Use	0.070	0.190	0.740	0.031	0.806
CTIMTVN	Vietnam import	0.270	0.068	0.662	0.033	0.773
CTPPRZb	Zimbabwe Production	0.540	0.410	0.050	0.247	0.620
CTCESZb	Zimbabwe Ending Stock	0.080	0.180	0.740	0.087	0.127
CTUMIZb	Zimbabwe Mill Use	0.098	0.000	0.902	0.058	0.742
CTEXTZb	Zimbabwe Export	0.079	0.190	0.731	0.037	0.114