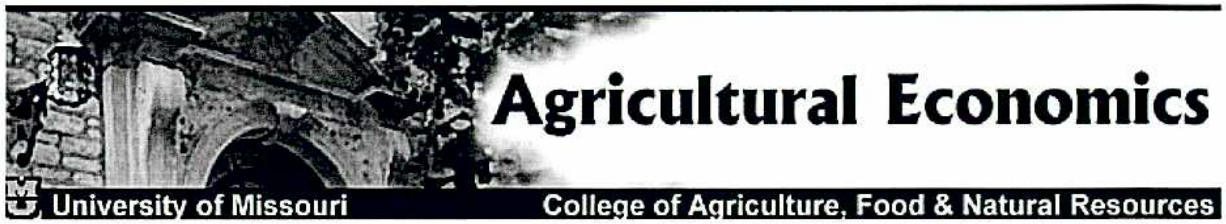

Chinese Synthetic Fiber Capacity and its Impacts on Natural Fiber Markets

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Chinese Synthetic Fiber Capacity and its Impact on Natural Fiber Markets

Seth Meyer and William H. Meyers[1]

Abstract

Chinese synthetic fiber capacity is more than 100 times larger than it was just 30 years ago. It represents more capacity than exists in the United States and Western Europe combined and continues to expand each year to serve the growing Chinese textile industry. Historically, the Chinese government has provided support to the synthetic fiber industry and encouraged its expansion. At the same time, petroleum consumption in China continues to expand, and China is now the second largest petroleum consumer in the world. As a byproduct of petroleum distillation, the feeder materials for synthetic fiber production are readily available in the marketplace. In the presence of inter-fiber competition, the large amount of synthetic production capacity may have consequences for world cotton consumption and prices. With changes in Chinese government support to the synthetic fiber industry or other changes in the demand for synthetic capacity, there is the potential for indirect consequences on cotton fiber markets.

Using a structural econometric model of inter-fiber competition, such impacts are investigated. Man-made fiber production is handled in a unique fashion, with capacity and utilization rates estimated separately to determine production. Models of man-made fiber markets in China, Japan, and Taiwan as well as the United States will help to more fully represent the market for man-made fibers. The world cotton market is covered with country level models for all countries of primary importance in the natural fibers markets with the remainder of the world broken up into regional blocks. The model includes relevant input prices at the mill level to reflect inter-fiber competition, and therefore contains the most important factors determining cotton production, prices and trade. To simulate a reduction of subsidization provided to the synthetic fiber industry by the Chinese government, changes in Chinese synthetic capacity are imposed to determine the impact on world cotton markets.

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Chinese Synthetic Fiber Capacity and its Impact on Natural Fiber Markets

Chinese synthetic fiber capacity is more than 100 times larger than it was just three decades ago, and today China is the world's largest single producer and consumer of both synthetic and cotton fibers. Historically the Chinese government has supported cotton production both for national security reasons, to cloth the world's largest standing army, and as an input to their textile industry, seen as a tool for industrialization and a strong foreign currency earner. While cotton acreage in China has varied from year to year, it has not seen sustained gains or losses in acreage for much of the last 30 years. Yields over the same period have risen substantially, from 408 lbs. an acre in the 1970/71 crop year to 1050 lbs. an acre in the 2002/03 crop year. These yields, competitive with the world's other large cotton producers, raised raw cotton production by 13 million bales over the same period. Significant liberalization has occurred in the Chinese cotton markets with market forces determining internal prices. Although quota fill rates may mislead one to think import restrictions have little impact, the implementation of such quotas follows the letter, but perhaps not the spirit, of the law and the trade barriers remain somewhat less than perfectly transparent. Not withstanding such considerations, the cotton industry has made substantial moves toward a more market-oriented structure, and burdensome government stocks of cotton have largely been eliminated. The amount of land available for future cotton production has come into question as urban encroachment, production of specialized fruit and vegetable crops, and regional issues of water availability constrain China's ability to sustain or increase cotton area to meet its burgeoning textile fiber demand. Mill use is expected to outpace production by an average of 5 million bales a year from 2004/05 to 2013/14 (FAPRI).

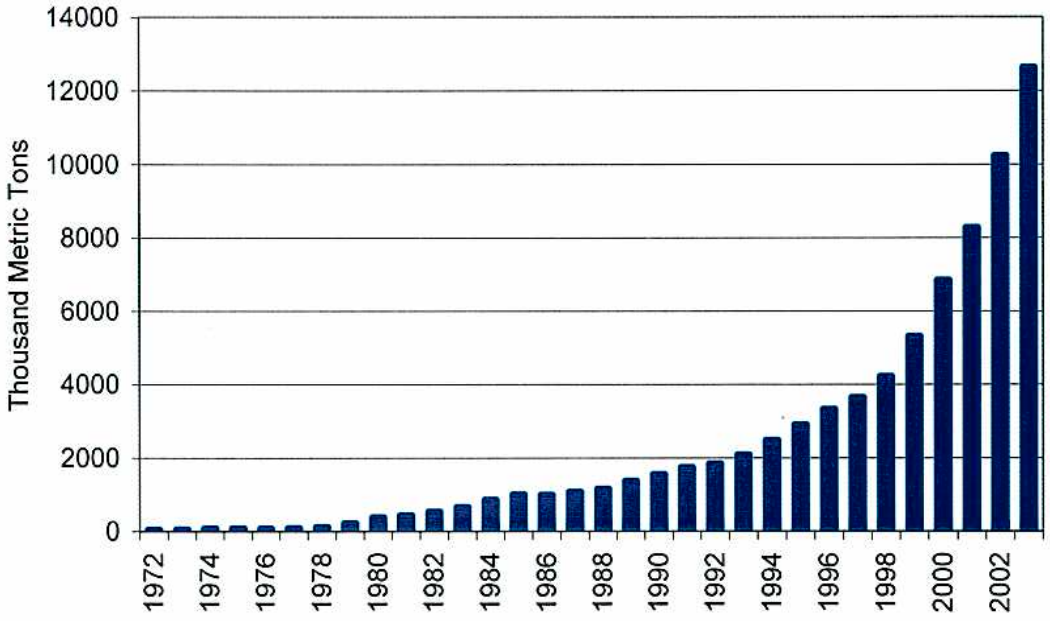

Figure 1. Chinese synthetic capacity

Since the 1980s, the government has encouraged and subsidized the production of synthetic fibers as a way to supply its textile and industrial sectors and provide an alternative to natural fiber production in a country whose population exceeds one billion. Beginning from a very low level in the 1970s, growth in Chinese synthetic fiber capacity has increased exponentially (Figure 1) and today it represents nearly one third of world synthetic fiber capacity.

Subsidization of the Chinese synthetic fiber industry has generally been indirect. Energy costs for many industries were heavily subsidized when a substantial portion of the current capacity was being constructed. In 1990, oil subsidy rates were 55% and coal subsidy rates were 37%. Oil subsidy rates have fallen significantly, while those for coal remained near 30% from 1995-1996. Total energy subsidization fell from 42% to 20% over the same period (World Bank). Additionally, import tariffs and less transparent rules and procedures on synthetic fibers reduced foreign competition. Trade barriers are estimated to include tariff rates of 7% and non-tariff barriers equaling 15% in tariff equivalents (Yansheng, Zhongxin and Shuguang). Yansheng, Zhongxin and Shuguang's study suggested that liberalization of these trade barriers would reduce domestic production by 10%. In 1997 the Chinese government also began a program to encourage the replacement of obsolete spinning machinery by providing a subsidy of Rmb 3 million ($360,000) and interest free loans of Rmb 2 million ($240,000) per 10,000 spindles removed from production (CIRFS). Lax intellectual property law enforcement and state ownership likely aid in keeping some non-competitive capacity in operation.

Even with the elimination of such indirect subsidization, Chinese synthetic capacity can be expected to expand robustly as textile goods production expands. Labor costs are low and the domestic milling industry is likely to continue to grow as incomes rise and the Agreement on Textiles and Clothing transitional period expires and textiles move to the general rules of the Global Agreement on Tariffs and Trade. How that textile industry is fed remains a key issue. As China, and potentially India and Pakistan, begins to dominate world trade in textile goods and milling in many other locations declines fiber production in those regions must seek other markets. To estimate the impact that subsidization of the man-made fiber industry in China has on world fiber prices, structural econometric models were used to simulate the impacts of a reduction in Chinese synthetic capacity on synthetic and cotton fiber prices.

Econometric Structural Model

The modeling systems employed to investigate the influence of Chinese synthetic capacity on world and U.S. cotton prices are the current Food and Agricultural Policy Research Institute's U.S. crops model and a modified version of the world fiber and textile model (Meyer). U.S. supply equations have been removed from the world fiber and textile model and linkages made to the U.S. crops model in the same procedure used in the FAPRI baseline process. The models consist of single equation estimation using ordinary least squares in a variety of functional forms. The models are linked together and solve simultaneously across multiple regions, countries, and sub-country areas and for multiple fiber prices (Figure 2). Cotton mill use for the United States is also segmented into product categories and includes production, consumption, and trade of each category by fiber type. Product price indices within the United States are also endogenous.

The world fiber and textile model includes supply and demand for cotton for all countries or regions of the world. It covers synthetic fibers as well as cellulosic fibers for the United States, China, Japan, and Taiwan, as well as wool and textile goods in the United States. In the case of man-made fibers, the remainder of the world is simulated with trade equations.

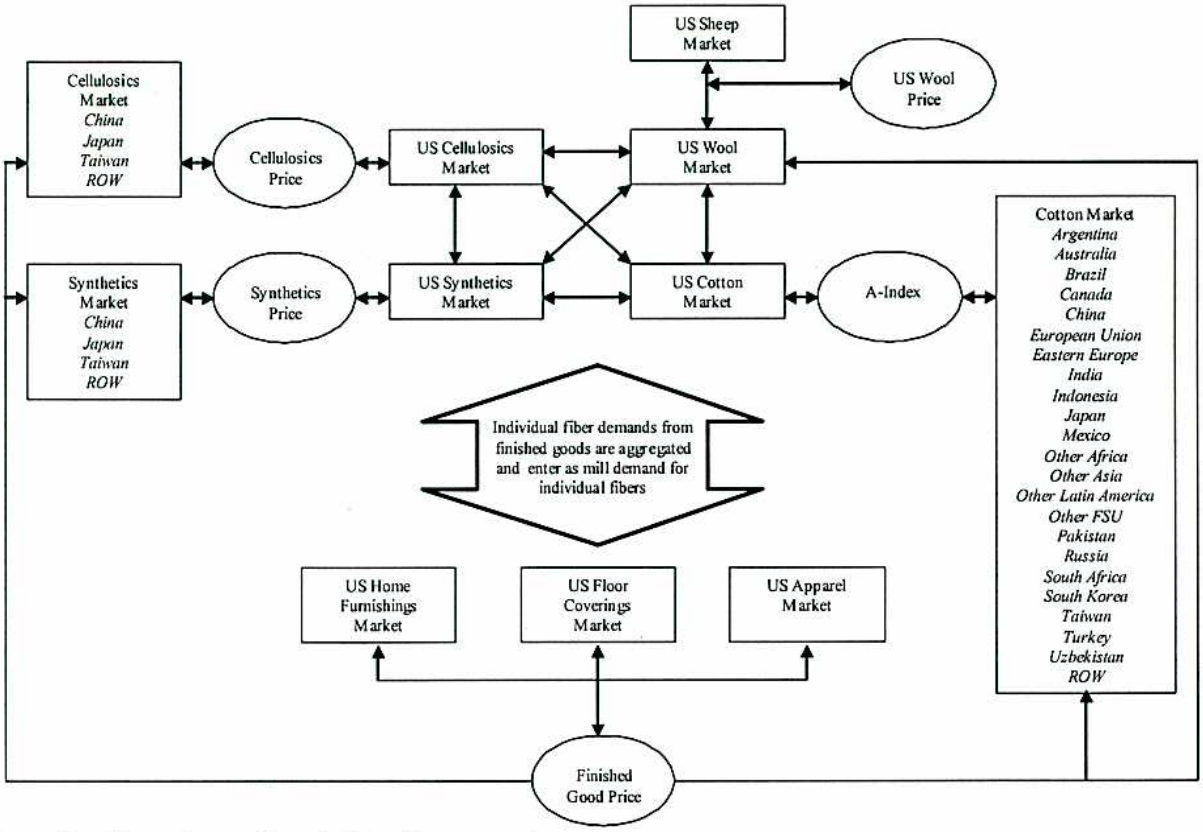

Figure 2. Overview of modeling framework

Man-Made Fiber Model

Man-made fiber production is broken into equations estimating capacity and equations estimating the utilization of existing capacity. The modeling of cellulosic and synthetic fibers is similar throughout. Capacity is fixed in the current period, as the construction of additional capacity is not instantaneous and investment decisions occur over several years. Input and output prices are broken into near-term and long-term effects. In the near term, elasticities are smaller and the period mostly reflects disinvestment and minor capacity change while the long term effects reflect investment decisions on the construction of new facilities. Capacity equations are some derivative of the following generalized form.

$$
\begin{aligned}
&Capacity = \alpha \\
&+\beta_1\left(\left[OW_{t-1}+OW_{t-2}\right]/2\right)+\beta_2\left(\left[OW_{t-3}+OW_{t-4}+OW_{t-5}+OW_{t-6}+OW_{t-7}\right]/5\right) \\
&+\beta_3\left(\left[FP_{t-1}+FP_{t-2}\right]/2\right)+\beta_4\left(\left[FP_{t-3}+FP_{t-4}+FP_{t-5}+FP_{t-6}+FP_{t-7}\right]/5\right) \\
&+\beta_5\left(\left[IR_{t-1}+IR_{t-2}\right]/2\right)+\beta_6\left(\left[IR_{t-3}+IR_{t-4}+IR_{t-5}+IR_{t-6}+IR_{t-7}\right]/5\right),
\end{aligned} \tag{1}
$$

where: $|\beta|_1 \le |\beta_2|$, $|\beta_3| \le |\beta_4|$, $|\beta_5| \le |\beta_6|$, OW is an oil and wage price index, FP is the fiber price (either synthetics or cellulosics), and IR is a representative interest rate.

Equations determining the percentage of available capacity employed share a similar structure across countries and for all man-made fibers. The equations employ a logistic specification modeling the decision to employ the next productive capacity unit. The specification bounds utilization rates to be between zero and one and suggests a U-shaped average variable cost curve. The input and output prices are divided by the average input and output prices of recent history. Such a specification implies a long-term natural utilization rate, i.e., a constant minimization point on the average variable cost curve. Utilization rates adjust in the current period and are determined by current prices and costs relative to those observed in recent history. The generalized specification follows the form of:

$$
\begin{aligned}
\log\left(\frac{\%Utilization}{100\%-\%Utilization}\right) &= \alpha+\beta_1\left(\frac{OW_t}{\left[OW_{t-1}+OW_{t-2}+OW_{t-3}+OW_{t-4}+OW_{t-5}\right]/5}\right) \\
&+\beta_2\left(\frac{FP_t}{\left[FP_{t-1}+FP_{t-2}+FP_{t-3}+FP_{t-4}+FP_{t-5}\right]/5}\right).
\end{aligned} \tag{2}
$$

With a starting point of *A* in Figure 3, if we hypothesize a sustained increase in output prices in the production process in isolation, in the period in which the shock initially takes place utilization of existing capacity responds and production moves outward along AVC_1 to point B. As capacity adjusts to the new higher price level as seen in equation (1), the average variable cost curve shifts outward from AVC_1 to AVC_2, while the production moves back to the minimum point C on the new average variable cost curve AVC_2. The long-term result of the positive sustained output price shock on the supply equations is a return to minimization of average variable costs on the new AVC_2 curve and the utilization rate returns to the level it maintained before the shock. With increased capacity, this adjustment translates into greater production. All of the synthetic and cellulosic fiber capacity and utilization equations within the model operate in a similar fashion.

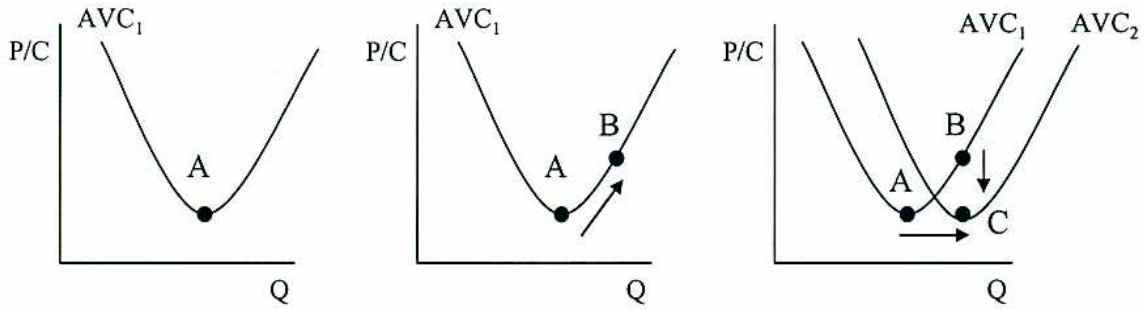

Figure 3. Dynamics of man-made capacity and utilization equations

The model structure for the Chinese fiber sector can be seen in Figure 4. Price linkages between the U.S. synthetics price and domestic synthetics price are used for Japan and Taiwan, whereas China has an independent internal price linked through trade for cotton and synthetic fibers. Cross-price effects enter demand equations for all fibers in China, Taiwan, and Japan in the form of a current period consumption-weighted index of substitutable fiber prices. Data in the man-made fibers model are available on a calendar year basis, while data for cotton are available on a crop year basis beginning August 1 and ending July 31. Steps are taken to synchronize supplies and prices between the two time periods.

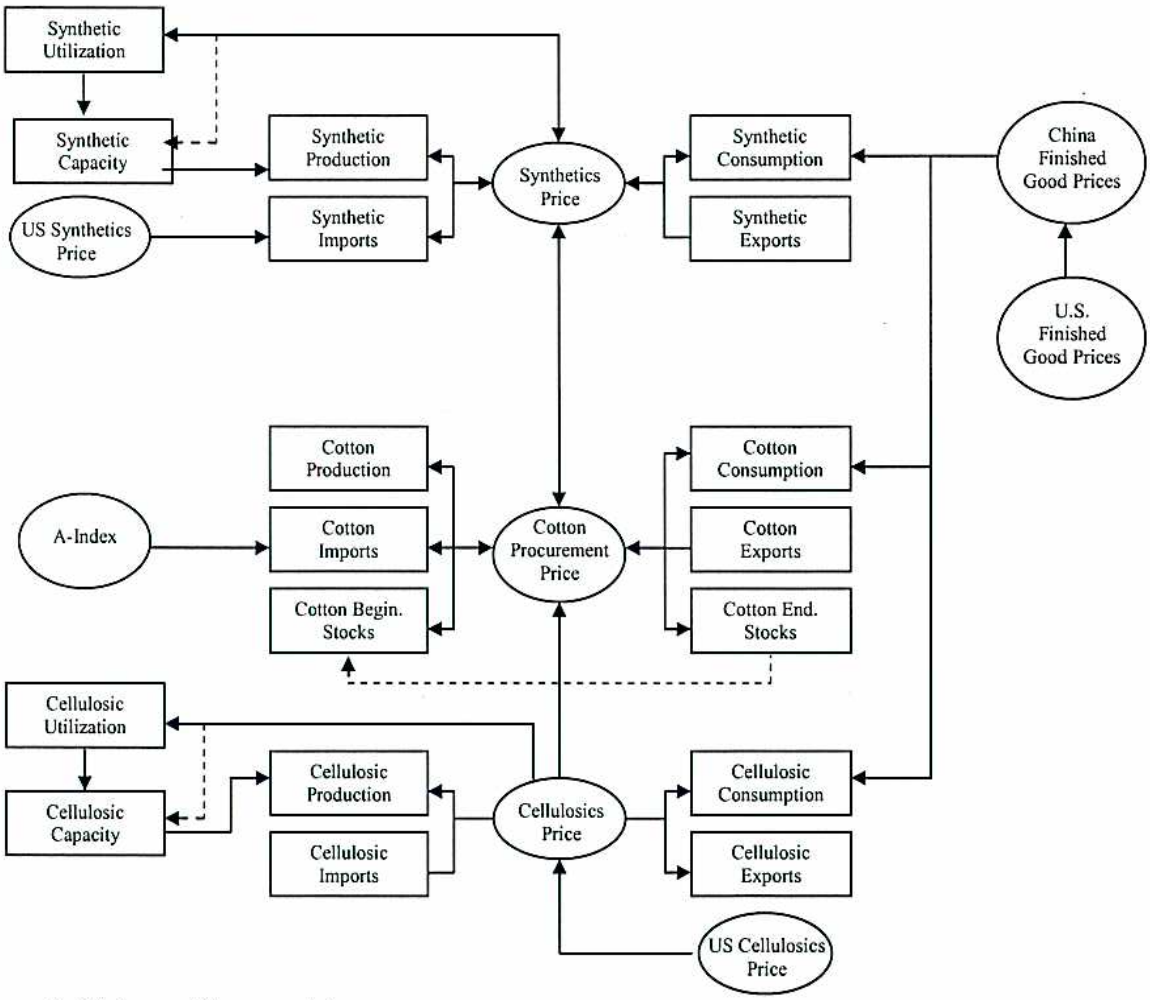

Figure 4. Chinese fiber model

World Cotton Model

The world cotton model for areas outside the United States, China, Taiwan, and Japan covers only cotton market equations and is similar in structure to historical FAPRI cotton models, with the noted exception of the inclusion of a dynamically solved synthetics cross-price variable in the mill use equations for most countries and regions. The model closes on the A-Index price, solving for the price that balances trade between the 24 countries/regions of the world (Figure 5). The United States, China, and Australia have internal prices while the remainder of the countries and regions are specified with exchange-rate-adjusted price linkages to the A-Index price. The specifications of the individual country's or region's cotton market generally share the same structure, solving for area harvested, production, imports, exports, mill use, and ending stocks. Country level market closure is adapted to local market conditions. Depending upon whether the country is an importing or exporting country, one of the trade flows may be exogenized and the variable left to be solved in the identity may vary from market to market as prevailing forces suggest.

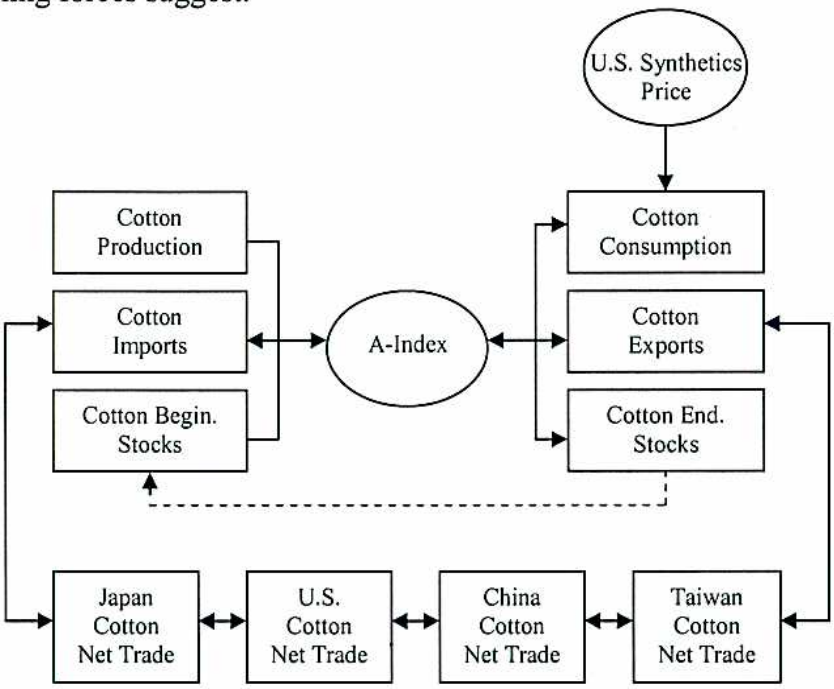

Figure 5. World cotton model

United States Crops Model

The United States crops model employed is the same model used for the baseline process at FAPRI at the University of Missouri and this scenario employed the model structure as it stood for the 2004 January baseline. The model has substantial extensions in the area of fiber demand and textile trade that are generally not utilized in scenario analysis that does not directly involve analysis of the cotton sector. The U.S. crop model covers acreage, supply, and utilization for the 10 primary field crops and includes relevant policy parameters. International linkages that are normally solved through the simultaneous solution of international crops and

oilseeds models are simulated through reduced form equations that replicate their behavior in responding to changes in U.S. prices and trade. While cotton is the primary crop of interest, including competition for acreage in the United States is important to obtain a realistic U.S. response. Acreage decisions in the United States are based on relative returns, which include government payments, and not market price alone. The general structure of the cotton portion of the U.S. crops model can be seen in Figure 6.

Analyses of scenarios not involving the cotton sector use a simple, single cotton mill use equation. For baseline purposes and for the purpose of this scenario, U.S. mill use is determined by a complex U.S. fiber and textile goods model where fibers and trade in finished goods compete. In Figure 6, cotton mill use represents a number of inter-fiber competition and textile market equations.

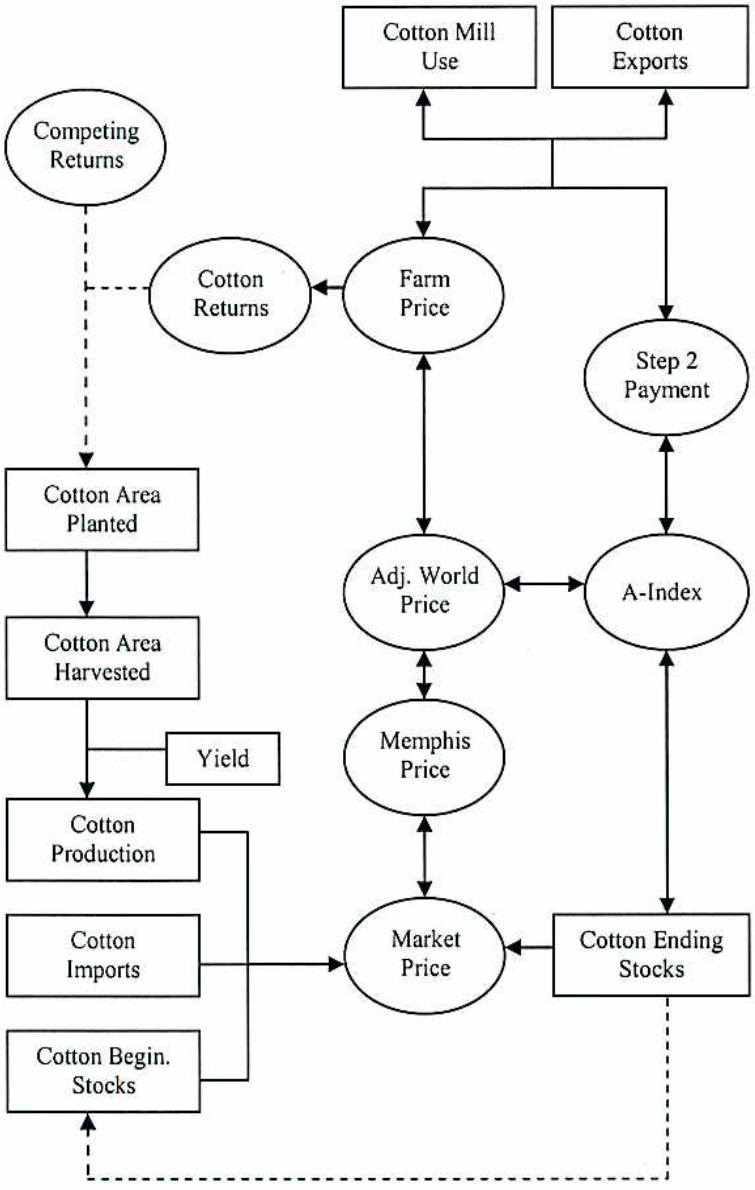

Figure 6. Cotton system in the U.S. crops model

United States Inter-Fiber Competition and Textiles Model

The U.S. model of inter-fiber competition and textiles was developed to incorporate the increasing importance of synthetic fibers in cotton markets and to provide a more detailed analysis of the milling industry in the United States. The model divides U.S. mill use into fiber type (cotton, synthetic, cellulosic, and wool) and separates textile goods production by fiber type for textile product categories (apparel, home furnishings, floor coverings, industrial/other, and semi-manufactured goods) that may be traded or used in the production of other non-textile goods (Figure 7). Production, consumption, and trade in each finished product category closes on a different textile goods price index. The fiber share in each product category is determined by equations that are a function of the lag of shares and relative prices of each fiber and a current period consumption-weighted index of competing fiber prices or the fibers thought to be the most readily substitutable in that product category. Textile goods price indices are not available by fiber type. One index covers all apparel and no separate index is available for cotton versus synthetic apparel; therefore, content decisions are made at the mill level and through trade in finished goods.

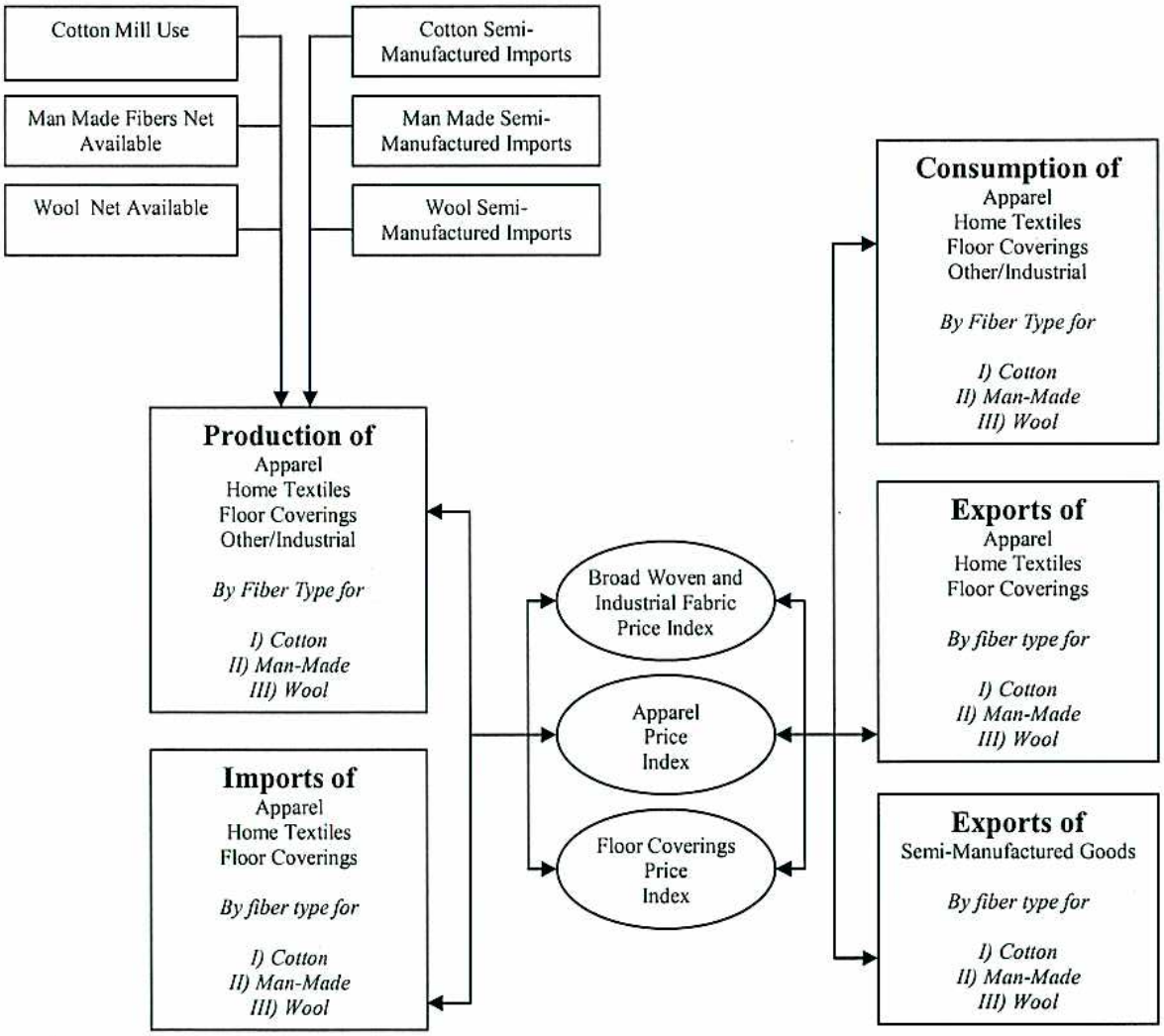

Figure 7. U.S. textile good model

Due to data limitations, complete foreign textile goods models cannot be constructed. Other methods must be employed to ensure consistency in world cotton demand as changes occur in U.S. trade in cotton content finished textile goods. U.S. finished textile goods prices are also used to determine finished goods trade and have influence on cotton consumption by our major textile trading partners in the absence of the ability to construct full world-wide textile models.

Model Elasticities

Raw fiber elasticities for the model are described in Tables 1 and 2. Symmetry is not imposed and cotton fibers appear to be more own-price elastic than do synthetic fibers. Elasticities for cellulosic and wool fibers have some unexpected cross-price signs as well as large own-price elasticities for cellulosics in China and Taiwan. The small market share and the dynamically weighted cross-price may distort the elasticity results.

Table 1. Asian fiber demand elasticities

	Price Shocked		
	Cotton	Synthetics	Cellulosics
China			
Cotton	-0.46	0.06	0.00
Synthetics	0.17	-0.21	-0.01
Cellulosics	0.38	0.20	-4.80
Japan			
Cotton	-0.67	0.34	0.04
Synthetics	0.12	-0.18	0.02
Cellulosics	0.00	0.00	-0.65
Taiwan			
Cotton	-0.78	0.66	-0.07
Synthetics	0.16	-0.54	-0.02
Cellulosics	0.10	0.30	-4.76

Note: Weights are left dynamic, which may distort the results for the minor fiber cellulosics.

The additional dynamics in the specification of the U.S. mill use equations, where fiber content for a particular category of finished goods is determined by fiber share equations with large lag dependents, impose differing short-run and long-run elasticities within the model. As expected, long-run elasticities are greater than short-run elasticities and natural fibers are the most elastic in the long run. Again, symmetry is not imposed and some cross-price elasticities for minor fibers have unexpected signs. The other elasticities in the updated model may vary from the model elasticities presented in the original documentation of the world fiber and textile model (Meyer).

Table 2. U.S. own and cross-price elasticities of raw fiber demand at the mill level

	Cotton	Synthetics	Cellulosics	Wool
One period				
Cotton	-0.256	0.031	0.006	0.001
Synthetics	0.026	-0.170	0.013	0.002
Cellulosics	0.026	0.511	-0.744	0.002
Wool	0.008	0.278	0.029	-0.727
Long Run				
Cotton	-1.164	0.709	0.130	0.028
Synthetics	0.423	-0.466	-0.040	-0.008
Cellulosics	0.423	0.194	-0.794	-0.008
Wool	0.071	0.363	0.038	-0.901

Reduction in Chinese Synthetic Capacity Scenario

Using the January 2004 FAPRI baseline as a starting point, model modifications were made and a new baseline was constructed All variables were lined up to historical data available as of January 2004 and a forecast, solving for all endogenous variables including synthetic fiber capacity in China, was estimated through the 2013/14 crop year. The solution represents the baseline forecast with which the scenario will be directly compared. The model was modified, making Chinese synthetic capacity exogenous and then reducing by a sustained 10% in 2004 through the end of the baseline period as seen in Figure 8. While exact impacts of an elimination of the subsidies on Chinese synthetic fiber production are not known, the 10% capacity reduction is used to gauge the sensitivity of natural fiber markets to changes in Chinese synthetic capacity. Although capacity is now exogenized, Chinese synthetic utilization remains endogenous and responsive to current prices.

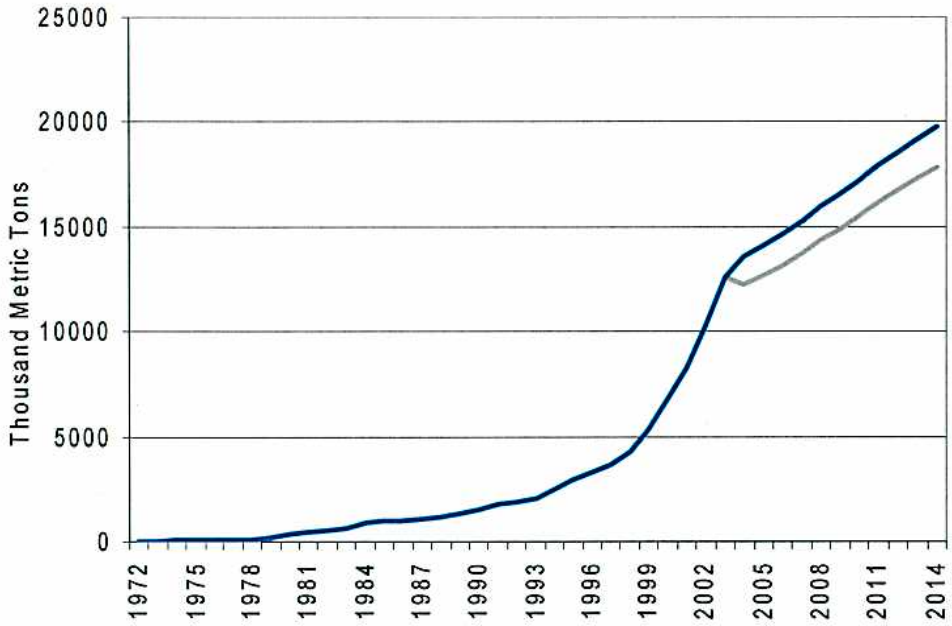

Figure 8. Chinese synthetic capacity change

Table 3. Percentage changes for Chinese fiber supply and utilization

Cotton	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
Area harvested	0.00	0.68	0.77	0.78	0.78	0.78	0.78	0.75	0.72	0.68	0.66
Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Production	0.00	0.68	0.77	0.78	0.78	0.78	0.78	0.75	0.72	0.68	0.66
Beginning stocks	0.00	-3.03	-1.99	-1.27	-0.63	-0.24	-0.11	0.21	0.55	0.87	1.09
Imports	1.17	2.86	3.27	3.17	2.95	2.77	2.89	2.97	2.97	2.84	2.75
Total supply	0.21	0.40	0.62	0.79	0.89	0.93	0.97	1.02	1.07	1.09	1.10
Mill use	0.95	0.99	1.07	1.13	1.17	1.19	1.16	1.14	1.12	1.10	1.08
Ending stocks	-3.03	-1.99	-1.27	-0.63	-0.24	-0.11	0.21	0.55	0.87	1.09	1.22
Domestic use	0.21	0.40	0.62	0.79	0.89	0.93	0.97	1.02	1.07	1.09	1.10
Exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Synthetics	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Utilization	2.58	1.76	1.10	0.58	0.18	0.00	0.00	0.00	0.00	0.00	0.00
Capacity	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
Production	-7.68	-8.42	-9.01	-9.48	-9.84	-10.00	-10.00	-10.00	-10.00	-10.00	-10.00
Imports	20.20	19.49	19.77	19.70	19.25	18.45	17.71	17.63	17.41	17.11	16.77
Exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apparent consumption	-3.29	-4.06	-4.53	-4.90	-5.18	-5.41	-5.44	-5.50	-5.55	-5.63	-5.70

Table 4. Absolute changes for Chinese fiber supply and utilization

Cotton	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
						(thousand acres)					
Area harvested	0	89	95	97	98	98	100	96	92	88	86
						(lbs/acre)					
Yield	0	0	0	0	0	0	0	0	0	0	0
						(thousand 480 lbs bales)					
Production	0	187	201	206	209	210	214	206	199	191	187
Beginning stocks	0	-206	-158	-98	-50	-20	-9	18	48	77	96
Imports	78	179	208	218	213	205	212	219	221	218	212
Total supply	78	160	251	326	373	396	417	443	468	486	495
Mill use	283	318	350	376	392	405	399	395	392	391	388
Ending stocks	-206	-158	-98	-50	-20	-9	18	48	77	96	107
Domestic use	78	160	251	326	373	396	417	443	468	486	495
Exports	0	0	0	0	0	0	0	0	0	0	0
Synthetics	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Utilization	0.023	0.017	0.010	0.005	0.002	0.000	0.000	0.000	0.000	0.000	0.000
Capacity	-6235	-6483	-6718	-7009	-7309	-7598	-7903	-8227	-8528	-8805	-9074
Production	-4317	-5142	-5662	-6164	-6598	-6895	-7104	-7366	-7609	-7823	-8040
Imports	2133	2219	2309	2401	2480	2467	2499	2553	2589	2597	2601
Exports	0	0	0	0	0	0	0	0	0	0	0
Apparent consumption	-2184	-2923	-3353	-3763	-4119	-4428	-4605	-4813	-5019	-5226	-5439

Changes to Chinese fiber supply and utilization are illustrated in Tables 3 and 4. While Chinese capacity is fixed, utilization responds to the increase in synthetic fiber prices. Production in the 2003/04 crop year is fixed, as the crop has already been harvested in both hemispheres. The only fiber response available in the first period is through increased utilization of existing man-made fiber capacity. Chinese cotton demand increases in the first year are met through imports and stock adjustments. In subsequent years, Chinese area rises modestly above

the baseline levels and most of the increased demand is met by increased imports. Stocks, reduced in early periods to meet increased demand, rise above baseline levels toward the end of the projection period as cotton mill use rises and pipeline stock levels are higher.

The increases in fiber prices can be seen in Tables 5 and 6. In response to the reduction in Chinese synthetic fiber capacity and the resulting contraction in supplies, the synthetic proxy price represented by a U.S. average price for 1.5 denier polyester staple used for cotton blending (USDA), rises by 5% over baseline levels. The cotton A-index price, the average of the five lowest CIF Northern Europe cotton price quotes, rises nearly 3% in the first period when supplies are fixed. As acreage expands and synthetic fiber capacity builds outside of China, the A-index ends 1.74% above baseline prices. United States cotton farm prices rise by 1.2% above baseline prices by the end of the projection period.

Table 5. Fiber price percentage changes

Cotton	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
Cotlook A index	2.92	2.24	2.10	2.13	2.34	2.63	2.34	2.05	1.81	1.74	1.74
U.S. farm price	1.24	0.97	0.99	1.09	1.70	2.62	2.80	2.46	1.85	1.38	1.20
Synthetics	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Price	5.28	5.50	5.81	6.15	6.42	6.63	6.14	5.70	5.39	5.27	5.14

Note: The "A" index is the average of the five lowest CIF Northern European quotes. The synthetics price is represented by the 1.5 denier polyester staple used for blending with cotton (USDA).

Table 6. Fiber price absolute changes

Cotton	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
						(Dollars per pound)					
Cotlook A index	0.021	0.015	0.014	0.014	0.015	0.017	0.015	0.013	0.012	0.012	0.012
U.S. farm price	0.008	0.006	0.006	0.006	0.010	0.015	0.016	0.014	0.011	0.008	0.007
Synthetics	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Price	0.031	0.032	0.035	0.037	0.038	0.040	0.038	0.036	0.035	0.035	0.035

Note: The "A" index is the average of the five lowest CIF Northern European quotes. The synthetics price is represented by the 1.5 denier polyester staple used for blending with cotton (USDA).

World production of cotton rises after the 2003/04 crop year by an average of 1 million bales per year over the baseline projection, as seen in Tables 7 and 8. Acreage rises by more than 800,000 acres world-wide. Cotton mill use also rises above baseline levels by just over 1 million bales, a near 1% increase in cotton consumption. Trade is 350,000 bales larger at the end of the scenario and stocks are nearly 250,000 bales higher than baseline levels on the increased production numbers.

Table 7. Percentage changes for world cotton supply and utilization

Cotton	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
Area harvested	0.00	1.02	1.03	1.06	0.96	0.94	1.05	1.06	1.04	1.00	0.94
Yield	0.00	-0.02	-0.01	-0.01	-0.01	-0.06	-0.06	-0.04	0.00	0.00	-0.01
Production	0.00	1.00	1.01	1.04	0.96	0.88	0.99	1.02	1.04	1.00	0.93
Beginning stocks	0.00	-1.54	-0.60	-0.14	0.13	0.08	-0.14	-0.05	0.16	0.41	0.56
Imports	0.18	0.74	0.87	0.96	0.91	0.78	0.78	0.83	0.91	0.95	0.94
Total supply	0.04	0.46	0.66	0.78	0.77	0.69	0.70	0.75	0.82	0.86	0.85
Mill use	0.51	0.74	0.87	0.96	0.98	0.97	0.95	0.94	0.94	0.94	0.92
Ending stocks	-1.54	-0.60	-0.14	0.13	0.08	-0.14	-0.05	0.16	0.41	0.56	0.59
Domestic use	0.00	0.39	0.60	0.73	0.74	0.66	0.67	0.72	0.79	0.83	0.83
Exports	0.18	0.75	0.88	0.97	0.91	0.79	0.79	0.83	0.92	0.96	0.94

Table 8. Absolute changes for world cotton supply and utilization

Cotton	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
						(thousand acres)					
Area harvested	0	886	887	914	833	809	903	913	898	872	827
						(lbs/acre)					
Yield	0	0	0	0	0	0	0	0	0	0	0
						(thousand 480 lbs bales)					
Production	0	1024	1044	1086	1005	930	1048	1093	1123	1092	1036
Beginning stocks	0	-496	-209	-50	49	33	-58	-19	64	168	231
Imports	58	234	285	324	313	275	277	297	330	350	349
Total supply	58	763	1120	1360	1367	1239	1268	1370	1517	1610	1616
Mill use	496	738	885	987	1021	1021	1009	1009	1019	1029	1020
Ending stocks	-496	-209	-50	49	33	-58	-19	64	168	231	248
Domestic use	0	529	834	1036	1054	963	990	1073	1187	1260	1268
Exports	58	234	285	324	313	276	278	297	330	349	349

Table 9. Percentage changes for United States fiber supply and utilization

Cotton	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
Area harvested	0.00	0.77	0.57	0.56	-0.29	-0.84	-0.55	-0.08	0.38	0.77	0.76
Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Production	0.00	0.76	0.57	0.56	-0.11	-0.83	-0.54	-0.02	0.56	0.82	0.75
Beginning stocks	0.00	-2.57	-1.60	-1.49	-1.59	-3.00	-5.15	-5.70	-5.14	-3.83	-2.67
Imports	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total supply	0.00	0.13	0.12	0.12	-0.43	-1.32	-1.61	-1.35	-0.75	-0.22	0.02
Mill use	-0.63	-0.35	-0.07	0.18	0.26	0.19	0.27	0.44	0.67	0.91	1.12
Ending stocks	-2.57	-1.60	-1.49	-1.59	-3.00	-5.15	-5.70	-5.14	-3.83	-2.67	-2.20
Domestic use	-1.41	-0.89	-0.72	-0.65	-1.31	-2.47	-2.76	-2.41	-1.62	-0.90	-0.56
Exports	1.12	1.03	0.88	0.82	0.36	-0.32	-0.63	-0.49	-0.09	0.28	0.42

Synthetics	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Utilization	2.88	2.50	2.08	1.58	1.03	0.43	0.02	-0.28	-0.42	-0.41	-0.36
Capacity	0.00	0.34	0.69	1.06	1.58	2.01	2.47	2.92	3.25	3.27	3.24
Production	2.88	2.85	2.78	2.66	2.62	2.45	2.49	2.64	2.81	2.84	2.87
Imports	-24.32	-28.04	-30.77	-31.29	-33.67	-34.69	-37.44	-37.66	-39.22	-38.81	-39.05
Exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apparent consumption	-0.79	-0.94	-1.07	-1.19	-1.29	-1.36	-1.29%	-1.22	-1.17	-1.16	-1.15

Table 10. Absolute changes for United States fiber supply and utilization

Cotton	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
						(thousand acres)					
Area harvested	0	98	70	68	-35	-101	-66	-9	44	89	88
						(lbs/acre)					
Yield	0	0	0	0	1	0	0	0	1	0	0
						(thousand 480 lbs bales)					
Production	0	138	100	98	-18	-145	-94	-4	96	140	130
Beginning stocks	0	-108	-72	-72	-79	-153	-270	-300	-264	-188	-126
Imports	0	0	0	0	0	0	0	0	0	0	0
Total supply	0	30	28	26	-97	-298	-364	-304	-168	-48	4
Mill use	-40	-20	-4	10	14	10	14	21	32	42	50
Ending stocks	-108	-72	-72	-79	-153	-270	-300	-264	-188	-126	-100
Domestic use	-148	-92	-75	-69	-139	-260	-286	-242	-157	-84	-51
Exports	148	123	103	95	42	-39	-78	-62	-11	36	54

Synthetics	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Utilization	0	0	0	0	0	0	0	0	0	0	0
Capacity	0	184	372	577	870	1117	1379	1626	1810	1830	1834
Production	1230	1209	1190	1149	1149	1083	1116	1186	1272	1294	1314
Imports	-1602	-1640	-1683	-1703	-1752	-1720	-1726	-1765	-1830	-1849	-1871
Exports	0	0	0	0	0	0	0	0	0	0	0
Apparent consumption	-371	-431	-493	-554	-604	-637	-610	-579	-558	-556	-557

Conclusion

Synthetic fiber prices rise by 5.1% above baseline prices while world cotton prices rise by 1.7% and U.S. domestic cotton farm prices rise by 1.2%. Those changes represent $0.035 per pound for synthetic fiber, $0.012 per pound for world cotton and $0.007 per pound for the U.S. cotton farm price. There is a 0.8% increase in the Chinese cotton procurement price, less than the world price change as Chinese cotton prices are already above world prices. On a per pound basis the changes appear modest. However, when valuing the 2003/04 production of 92.34 million bales at world prices, a change of $0.012 per pound equates to $0.5 billion in increased gross returns to the world's cotton farmers. A $0.007 change in the U.S. farm price, at 2003/04 yield levels, adds $5.08 per acre in market returns to U.S. cotton farmers. In looking at U.S. fiber market changes as illustrated in Tables 9 and 10, it can be seen that acreage actually falls below baseline levels for crop years 2007/08 through 2010/11. Acreage specifications within the U.S. crops model depend not on market prices but on net returns, which include government payments. Loan deficiency payments and countercyclical payments decline as market prices rise and there is a narrow range where gross returns fall as market prices rise, as illustrated in Figure 9.

Given the impacts generated from a hypothetical decrease in Chinese synthetic capacity, it is clear that understanding and properly modeling man-made fiber production capacity is relevant in policy modeling for natural fibers both within China and around the world. The sensitivity of natural fiber markets to changes in synthetics fiber capacity is not limited to policy changes, which supports the importance of efforts to include man-made fibers in most cotton analysis. Modeling the subsidization policies for man-made fibers for China and other large producers is the next logical step in determining the linkage between these policies and natural fiber prices.

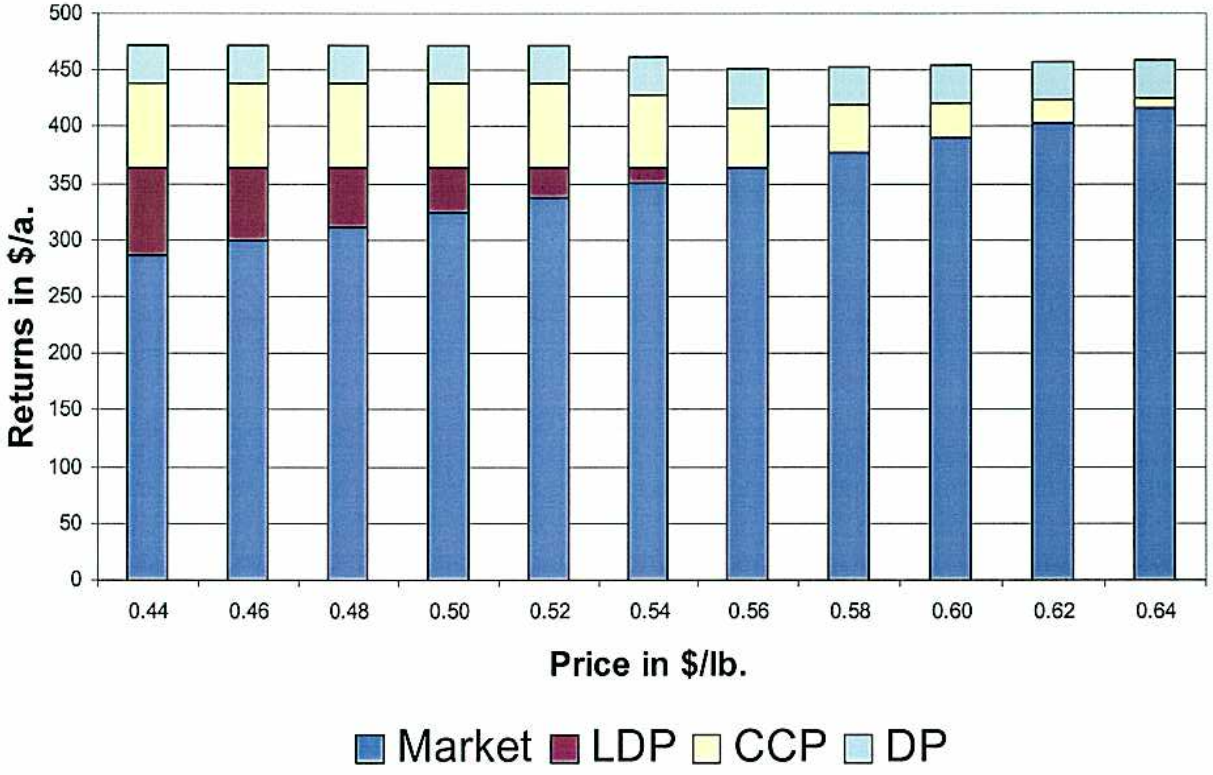

Figure 9. 2004/04 cotton gross returns when yield = 650 lbs/acre

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