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IMPACT OF CHINA'S WTO ACCESSION AND BT COTTON ADOPTION ON CHINESE AND U.S. COTTON SECTORS

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Abstract

This paper develops a framework to quantify the impact of China's World Trade Organization (WTO) accession and Bt cotton adoption on Chinese and U.S. cotton sectors. The Chinese cotton sector model has the following components: supply, demand, price linkage, and textiles output equations. The supply side of the model includes 9 regional cotton supply equations. The developed model is connected to the Food and Agricultural Policy Research Institute (FAPRI) modeling system to simulate various scenarios of China's WTO accession and BT cotton adoption. The results of China's accession without BT cotton adoption indicate that imports and domestic production of cotton in China and U.S. cotton exports increase with WTO accession. The results of BT cotton adoption without the WTO suggest a significant increase in domestic cotton production and a decrease in cotton imports and exports of U.S. cotton. The results are dominated by the WTO accession under the scenarios of both WTO accession and BT cotton adoption assumption.

Introduction

After 15 years of negotiations, China finally joined the World Trade Organization (WTO) in November of 2001. China's accession to the WTO will lead to significant changes in its domestic and trade policies. In just the last several years, China has become the second largest BT cotton producer in the world, just behind the United States. Changes in China's cotton market, trade behavior, and cotton technology have important implications for U.S. agriculture. In the last several years, the United States has become China's largest supplier of cotton, supplying 66.7 percent of imports in 1994, 67.2 percent in 1995, 41.8 percent in 1996, and 46.4 percent in 1997. China has become the world's largest buyer of U.S. cotton. In 1996, China purchased 28 percent of total U.S. cotton exports.

This study develops a framework to quantify the impact of China's WTO accession and Bt cotton adoption on the Chinese and U.S. cotton sectors. The Chinese cotton sector model has the following components: supply, demand, price linkage, and textiles output equations. The supply side of the model includes 9 regional cotton supply equations. The developed model is connected to the Food and Agricultural Policy Research Institute (FAPRI) modeling system to simulate various scenarios of China's WTO accession and BT cotton adoption.

The following section describes the policy changes implied by the WTO accession and the development of genetically engineered cotton in China. Next, the model used in the study is discussed. The fourth section of the paper presents model simulation results to evaluate China's WTO accession and Bt cotton adoption on cotton production, consumption, and trade. The paper concludes by summarizing the study's findings.

Policy Changes and the Spread of Genetically Engineered Cotton in China

The Chinese government traditionally saw cotton as a strategic commodity because of the historic importance of cotton products in fulfilling the need to clothe the world's largest population and the world's largest Army and in obtaining foreign exchange. Textile exports accounted for a very important share of total export revenues since the early 1950's. The revenue from textile exports increased more rapidly since the economic reform in 1978 and revenue increased more than 17 times in two decades. The revenue from textile exports accounted for around 25 percent of the total export revenue during 1978 to 2000. Even after the rural reform of 1978, cotton marketing remained one of the most heavily planned sectors of the economy and the Chinese government pays the high cost of managing cotton production and distribution, with 1998 expenditures estimated at RMB45 billion or US$5.4 billion (Fuell).

To reduce government losses, China began implementing domestic cotton policy which moved towards a more market-oriented approach for marketing cotton, including variable prices, marketing choices for farmers, and less government interference since 1999. However, cotton trade is still controlled strictly by the Chinese government. To limit imported cotton, the Chinese government controlled import quotas, tightened import licensing procedures, and implemented stricter foreign exchange controls.

China has reapplied to join the General Agreement on Tariffs and Trade (GATT) and its successor, the WTO since 1986. A major step toward securing China's entry into the WTO was made by signing the agreement with the United States on November 15, 1999. After 15 years of negotiations, China finally joined the WTO in November of 2001. China's inclusion in the WTO has been a significant trade issue to U.S. agriculture and is viewed as an overall benefit for U.S. farmers. China promised to cut the currently prevailing average tariff rates from 22 percent to 17.5 percent for agricultural products based on the bilateral agreement between the United States and China. For cotton, China committed to establish tariff-rate-quotas (TRQ's) starting at 743 thousand metric tons (tmt) to 894 tmt in five years. The within-quota tariff on cotton imports will decrease from 3 percent to 1 percent. The out-of-quota tariff on cotton will decline from 76 percent to 40 percent in five years. China has agreed to eliminate cotton export subsidies when it joins the WTO, benefiting U.S. agricultural products competing in third-country markets. Moreover, 67 percent of the TRQ will be reserved for non-state trading enterprises (STE) for cotton.

Demand for cotton is derived demand, which is determined by demand for textiles. China is a large exporter of textiles and apparel and exports reached $52.1 billion in 2000, up 21 percent from 1999. Textiles and apparel may benefit more than any other industry from China's accession to the WTO. Several studies analyze the impact of China's accession using computable general equilibrium (CGE) models (Wang; Ianchovichina, Martin and Fukase; Li and Zhai; RCRE) and indicate that China's trade and production of textiles and clothing will expand rapidly with accession.

Land devoted to cotton in China declined in the 1990s; with a dramatic decline in east China. There are sound economic reasons behind these changes. One of the major reasons is the significant bollworms that are costly to control. The frequency of pest outbreaks in the cotton sector has doubled over last 10 years (ERS; Huang, et al.). During the past two decades, per hectare pesticide expenditures in cotton production has risen sharply. Based on State Economic Planning Commission of China's cost of production survey data, per hectare pesticide cost reached 835 yuan in 1995 for cotton, much higher than that for rice, wheat, and corn. The rate of increase in pesticide use in cotton production rose much faster than other inputs. As a result, the share of pesticide expenditure in total material cost of production increases from 11.5 percent in 1985 to 21.7 percent in 1995 (Price Bureau of China). Per hectare pesticide costs are much higher in the major cotton producing provinces in east China. They were 1703 yuan in Hebei, 1264 yuan in Shandong, 1067 yuan in Henan, 798 yuan in Jiangsu, and 774 yuan in Anhui in 1995, which account for 46 percent, 31 percent, 36 percent, 26 percent, and 27 percent in total material cost of production in 1995 based on the same survey data.

Adoption of genetically engineered crops with traits for pest management has risen dramatically since their commercial introduction in the mid-1990's. By 1998, around 40 percent of U.S. cotton acres were planted to genetically engineered varieties (Fernandez-Cornejo and McBride). The most widely used pest management traits are herbicide tolerance and insect resistance. Insect-resistant crops containing a gene derived from the soil bacterium *Bacillus thuringiensis* (Bt) produce their own toxin to protect the entire plant from certain insects. Farmers using Bt cotton can reduce insecticide costs by discontinuing or decreasing applications of chemical insecticides targeting certain insects such as cotton bollworm. Adoption of Bt cotton significantly increased yields and net returns and significantly reduced insecticide use (Du, Fernandez-Cornejo and McBride).

Since the late 1980s, Chinese scientists have followed the lead of researchers in the United States and other countries to develop generically engineered crops with traits for pest management since the late 1980s. To battle against cotton bollworm, the Chinese government approved the commercial use of cotton varieties that were genetically engineered with a Bt gene in 1997 (Huang, et al. 2001). Varieties of Bt cotton from international companies (mostly Monsanto varieties) and domestic research institutes have been used in several provinces in China. In just a few years, the Bt cotton area has expanded to 700 thousand hectares in 2000 (Huang, et al. 2001b). Bt cotton acreages are estimated even higher up to one million hectares in 2000 by other researches (Vorman; Pray et al.) and 1.72 million hectares in 2001 by the Ministry of Agriculture of China (Cai). The data collected by Center for Chinese Agricultural Policy (CCAP) on 282 cotton farmers in 1999 shows that the adoption of Bt cotton varieties leads to a significant decrease in the use of pesticides. Per hectare pesticide use of non-Bt cotton production is more than five times higher than that of Bt cotton. The costs per pound by Bt cotton fall 20 to 33 percent than non-Bt cotton (Pray, et al.)

Econometric Model and Estimation of China's Cotton Sector

China's cotton sector is modeled in a comprehensive supply and demand framework. Major components of the cotton model include a supply sector, a demand sector, price linkage equations, and a textile output equation.

The supply of cotton is projected for each of nine cotton production regions. The regions are Xinjing, Henan, Shandong, Hubei, Jiangsu, Hebei, Anhui, Hunan, and other region. The eight provinces produced more than 90 percent of the cotton production in China in 2000. Each region has area equation, yield equation, and production equation. The cotton area (AR_i) is specified as a function of expected cotton net return ($NRCT_i$), and expected other crop net return (NRO_i).

Cotton Area Equations

Cotton area (ARit) for each region is specified as a function and cotton net return and other competing crops' net return:

$$AR_{it} = f(NRCT_{it}, NRO_{it}) \quad (1)$$

It is assumed that farmers calculate per hectare net returns to each possible crop and then choose the highest return crop subject to policy constraints. The net return calculation for cotton and other crop is endogenous to the model. It is calculated as expected gross revenue less expected input costs:

$$E(NR_{it}) = E(GR_{it}) - E(C_{it}) \quad (2)$$

Where $E(NR_i)$ is the expected return per hectare to commodity I, $E(GR_i)$ is the gross return, and $E(C_i)$ is the expected material cost. The expected gross revenue per hectare is defined as:

$$E(GR_{it}) = E(PP_{it}) * E(YD_{it}) \quad (3)$$

Where PP_i is the producer price of commodity i, and YD_i is the yield of commodity i.

Expected input costs are calculated as the sum of expected input prices multiplied by the per hectare application or use rate.

This area specification can be used easily to simulate the impact of Bt cotton adoption by imposing the cost reduction rate.

Cotton Yield Equations

Crop yield (YD_i) is projected for each of the nice production regions. The yield is specified as a time trend based on the last 20 years' yield level. It is recalculated for the simulation for the Bt adoption based on the adoption rate and assumed yield improvement by Bt cotton.

$$YD_{it} = (trend) \quad (4)$$

Cotton Production Equations

Total production of cotton , then, can be defined as the product of area harvested and yield.

$$CTPROD_{it} = AREA_{it} * YD_{it} \quad (5)$$

Total Cotton Consumption Equation

After two decades of rapid development, China has emerged as the world's largest producer of chemical fiber. Since 1977, consumption of chemical fiber has grown rapidly and has overtaken cotton. The share of cotton in total fiber consumption has declined from 83 percent in 1982 to about 40 percent (Fang, Colby, and Babcock).

Cotton demand (DC_t) is specified as a price ratio of cotton to man-made fibers ($RTPP_t$) and total yarn production ($YARN_t$):

$$DC_t = f(RTPP_t, YARN_t) \quad (6)$$

Yarn Production Equation

The yarn production is estimated as a function, a real GDP, and lagged yarn production:

$$YARN_t = f(YARN_{t-1}, GDP_t) \quad (7)$$

Cotton Ending Stock Equation

Cotton ending stock (S_t) is a function of lagged ending stock, cotton production, and domestic cotton price:

$$S_t = f(_{St-1}, CTPROD_t, PP_t) \quad (8)$$

Cotton Export Equation

Cotton export (EXPt) is a function of the world cotton price, domestic cotton price, and cotton production:

$$EXPt = f(PWt, Ppi, CTPRODt) \quad (9)$$

Cotton Import Identity

Cotton import (IMP_t) is treated as residual to close the model. The import variable is residual of total demand (consumption, ending stock, export) net of the sum of production and beginning stock:

$$IMP_t = DC_t + S_t + EXP_t - CTPROD_t - S_{t-1} \quad (10)$$

Price Transmission Equation Between China Cotton Producer Price to Reference Price

China's cotton producer price is a function of reference price, beginning stock, and lagged cotton producer price:

$$PP_t = f(REF_t, PP_{t-1}, S_{t-1}) \quad (11)$$

Cotton reference price (REF_t) is calculated based on the following equation:

$$REF_t = PW_t(1+\text{Tariff Rate})*EXCH_t \quad (12)$$

Where PW_t is the world cotton price that is the CIF Northern Europe Cotlook A index in this study, $EXCH_t$ is the exchange rate between the U.S. dollar and the Chinese yuan.

Price Transmission Equation Between Regional Cotton Producer Prices to National Cotton Price

It is assumed to have perfect transmission elasticity between regional cotton producer prices to national cotton price.

Data used for the area equation cover the period from 1981 to 1999. The data on cotton production, cotton consumption, cotton stock, cotton export, cotton import are from various issues of China Statistical Yearbook (National Bureau of Statistics of China) and USDA PSD data. The data on yarn output are from various issues of China Industrial Economic Statistical Yearbook (National Bureau of Statistics of China). The data on cotton producer price and cost of production are from various issues of China Rural Statistical Yearbook (National Bureau of Statistics of China) and various issues of China's Cost and Return of Production Statistic Materials (Price Bureau of China). World cotton price is from the FAPRI database.

All behavior equations were estimated by SAS package and estimated results are not reported here due to space limitation, but it is available upon request.

Scenario Assumptions and Simulation Results

The estimated econometric models in the above section are connected to the FAPRI model system to simulate various scenarios of the China's WTO accession and BT cotton adoption.

The FAPRI modeling system is a multi-market world agricultural model. The model is extensive in both its geographic and commodity coverage. The modeling system is organized into modules according to major commodity groupings (grains, other crops, oilseeds, livestock, and dairy) with country sub-models. The system captures important linkages between grain, cotton, oilseeds, and livestock markets. World prices are solved by equating excess supply and demand in the world market.

Based on the results of CGE studies, we assume that textile production permanently and gradually increases by 20 to 30 percent above the baseline level in five years—from 2002 to 2007 with WTO accession. After 2007, textile production is assumed to remain 20 to 30 percent above the baseline level until 2010. The adoption rate of Bt cotton is assumed to increase to 80 percent for all regions except Xinjing in four years—from 2002 to 2006 for the case of adoption scenario. It is assumed that cost of production will fall by 25 percent and yield will rise by 1 percent under Bt adoption scenario. The all scenarios simulated include:

1. With Bt Cotton adoption, but not WTO accession;
2. WTO accession with yarn production increase by 20 percent, but not Bt cotton adoption;
3. WTO accession with yarn production increase by 30 percent, but not Bt cotton adoption;
4. With Bt cotton adoption and WTO accession with yarn production increase by 20 percent;
5. With Bt cotton adoption and WTO accession with yarn production increase by 30 percent.

The simulated results with 2001 baseline (FAPRI) information are reported in Tables 2-6. The results in Table 2 show that when just Bt adoption scenario is used without the WTO accession, the domestic and world cotton prices decline roughly 0.4 percent for the Chinese domestic price and 0.48 percent for the world price by 2010. Both prices rise under all other scenarios. The prices have the highest increase, 9.47 percent for domestic cotton and 4.5 percent for world cotton, under the scenario with a 30 percent increase in textiles due to the WTO, but no Bt adoption.

Table 3 indicates that China's cotton area increases under all five scenarios. In scenario one, in which only Bt adoption is assumed, the area increases by 0.79 percent by 2010 due to the reduction in the cost of production. The cotton area has the highest increase, 2.68 percent by 2010, under the scenario with Bt adoption and 30 percent in textile output increase. Cotton yield will increase under the Bt adoption scenario, but decrease slightly due to WTO accession. The impact of Bt adoption on yield is in excess of that from WTO accession based on the results of the last two scenarios. China's cotton production increases in all scenarios ranging from 1.35 percent to 3.26 percent by 2010. The major increase in cotton production is from Hebei, Hunan, Other provinces, Hubei regions indicated in Table 4.

Driven by the expansion of the Chinese textile industry, cotton consumption in China increases significantly with all scenarios except in scenario one when only Bt cotton adoption is assumed, in which cotton consumption increases only slightly. As expected, higher domestic cotton production due to Bt adoption under scenario one results in a big decrease in China's cotton imports reaching an 8.21 percent decrease by 2010. China's WTO accession causes China's cotton imports to increase substantially: 32.59 percent for the 20 percent textile increase scenario and 44.52 percent for the 30 percent textile increase scenario. The impact of China's WTO accession on imports is significantly higher than that of Bt adoption. Consequently, the net impact of WTO accession and Bt adoption on cotton imports is positive and significant. Cotton imports will exceed the TRQ in 2004 or 2005 for the last four scenarios.

Total world cotton imports decrease by .83 percent in 2010 for the case of the Bt adoption scenario, but increase ranging from 1.55 percent to 2.25 percent for all scenarios as shown in Table 6. The United States will gain in all cases except in scenario one with only the Bt cotton adoption. Cotton exports of the United States decrease by 0.6 percent by 2010, resulting from China's Bt cotton adoption, while the United States will gain 1.44 to 2.06 percent increase in cotton exports by 2010. With both WTO accession and Bt adoption, United States cotton exports will increase by 1.22 to 1.85 percent by 2010.

Conclusions

We analyzed the impact of the accession of China to the WTO and the Bt cotton adoption on the China and U.S. cotton sectors. The results of China's accession without BT cotton adoption indicate that imports and domestic production of cotton in China and U.S. cotton exports increase with WTO accession. The results of BT cotton adoption without WTO accession suggest a significant increase in domestic cotton production and a decrease in imports and exports of U.S. cotton. The results are dominated by the WTO accession under the scenarios of both WTO accession and BT cotton adoption assumption.

Chinese cotton producers will benefit from both Bt adoption and WTO accession. Producers in the United States will lose from China's Bt adoption, but will gain significantly from China's WTO accession. The United States will still enjoy a significant net benefit from both WTO accession and Bt adoption since the impact of China's WTO accession is significantly higher than that of China's Bt adoption.

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Table 1. Trade Policy Changes for Cotton

	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Baseline Tariff Scenario	3	3	3	3	3	3	3	3	3
In-Quota Tariff Scenario	1	1	1	1	1	1	1	1	1
Out-Quota Tariff Scenario	76	67	58	49	40	40	40	40	40
Quota Level (TMT)	740	780	820	860	890	890	890	890	890

Table 2. Impact on China's Cotton Price and World Cotton Price

	2002	2003	2004	2005	2006	2007	2008	2009	2010
China's Cotton Producer Price			(Chinese Yuan per Metric Ton)						
Baseline	10986	11741	12421	12905	13288	13651	14044	14432	14731
Bt and no WTO	10986	11721	12383	12850	13219	13568	13977	14374	14671
No Bt and 20%	11155	12017	12808	13512	14121	14449	14897	15298	15597
No Bt and 30%	11235	12154	13088	13958	14626	14941	15406	15817	16126
Bt and 20%	11155	11990	12764	13378	13965	14244	14700	15086	15382
Bt and 30%	11235	12128	12997	13839	14475	14744	15212	15619	15922
			(% Changes over baseline)						
Bt and no WTO	0.00	-0.17	-0.31	-0.42	-0.52	-0.60	-0.47	-0.40	-0.40
No Bt and 20%	1.54	2.35	3.12	4.70	6.27	5.85	6.07	6.00	5.88
No Bt and 30%	2.27	3.52	5.37	8.16	10.06	9.45	9.70	9.60	9.47
Bt and 20%	1.54	2.12	2.76	3.67	5.09	4.35	4.67	4.53	4.42
Bt and 30%	2.27	3.29	4.64	7.24	8.93	8.01	8.32	8.22	8.09
World Cotton Price, Cotlook A Index cif Northern Europe									
			(U.S. Dollars per Metric Ton)						
Baseline	1533	1544	1566	1588	1607	1626	1645	1667	1691
Bt and no WTO	1533	1541	1561	1581	1598	1615	1636	1659	1683
No Bt and 20%	1557	1581	1619	1647	1671	1678	1698	1721	1749
No Bt and 30%	1568	1600	1637	1663	1691	1697	1717	1740	1767
Bt and 20%	1557	1578	1613	1642	1665	1670	1691	1714	1742
Bt and 30%	1568	1596	1633	1657	1685	1688	1709	1732	1760
			(% Changes over baseline)						
Bt and no WTO	0.00	-0.18	-0.33	-0.46	-0.57	-0.67	-0.54	-0.47	-0.48
No Bt and 20%	1.56	2.42	3.36	3.70	3.98	3.23	3.17	3.25	3.43
No Bt and 30%	2.30	3.62	4.52	4.73	5.21	4.37	4.36	4.40	4.50
Bt and 20%	1.58	2.21	3.00	3.39	3.58	2.73	2.77	2.82	3.02
Bt and 30%	2.30	3.39	4.27	4.36	4.81	3.83	3.86	3.93	4.06

Table 3. Impact on Chinese Cotton Production

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Area Harvested				(1,000 Hectares)					
Baseline[1]	4151	4189	4229	4267	4300	4332	4364	4395	4426
Bt and no WTO[2]	4151	4196	4241	4285	4325	4363	4396	4428	4461
No Bt and 20%[3]	4151	4205	4252	4297	4346	4393	4421	4455	4487
No Bt and 30%[4]	4151	4212	4264	4319	4378	4428	4455	4490	4521
Bt and 20%[5]	4151	4211	4264	4315	4364	4417	4444	4479	4510
Bt and 30%[6]	4151	4219	4275	4332	4397	4451	4478	4513	4545
				(% Changes over baseline)					
Bt and no WTO	0.00	0.16	0.29	0.42	0.57	0.71	0.73	0.76	0.79
No Bt and 20%	0.00	0.37	0.55	0.72	1.06	1.40	1.32	1.37	1.37
No Bt and 30%	0.00	0.54	0.82	1.22	1.81	2.21	2.10	2.16	2.15
Bt and 20%	0.00	0.52	0.82	1.13	1.48	1.96	1.84	1.92	1.90
Bt and 30%	0.00	0.70	1.09	1.54	2.24	2.75	2.61	2.69	2.68
Yield				(Kg per Hectare)					
Baseline	1045	1052	1059	1066	1073	1080	1087	1094	1101
Bt and no WTO	1045	1053	1061	1070	1078	1086	1093	1100	1107
No Bt and 20%	1045	1052	1059	1066	1073	1080	1087	1094	1101
No Bt and 30%	1045	1052	1059	1066	1073	1080	1087	1094	1101
Bt and 20%	1045	1053	1061	1069	1078	1086	1093	1100	1107
Bt and 30%	1045	1053	1061	1069	1078	1086	1093	1100	1107
				(% Changes over baseline)					
Bt and no WTO	0.00	0.11	0.22	0.34	0.45	0.57	0.57	0.57	0.58
No Bt and 20%	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02
No Bt and 30%	0.00	-0.01	-0.01	-0.02	-0.03	-0.03	-0.03	-0.03	-0.03
Bt and 20%	0.00	0.11	0.21	0.31	0.44	0.54	0.57	0.55	0.57
Bt and 30%	0.00	0.10	0.21	0.32	0.43	0.55	0.55	0.56	0.56
Production				(1,000 Metric Tons)					
Baseline	4338	4407	4479	4548	4614	4679	4743	4808	4873
Bt and no WTO	4338	4419	4502	4583	4662	4739	4805	4873	4940
No Bt and 20%	4338	4423	4503	4581	4663	4743	4805	4873	4939
No Bt and 30%	4338	4431	4515	4603	4697	4781	4842	4910	4976
Bt and 20%	4338	4435	4525	4614	4703	4796	4858	4927	4994
Bt and 30%	4338	4442	4537	4633	4738	4834	4894	4965	5032
				(% Changes over baseline)					
Bt and no WTO	0.00	0.27	0.51	0.76	1.02	1.29	1.31	1.34	1.37
No Bt and 20%	0.00	0.36	0.54	0.71	1.05	1.38	1.30	1.36	1.35
No Bt and 30%	0.00	0.53	0.81	1.20	1.79	2.18	2.07	2.13	2.12
Bt and 20%	0.00	0.63	1.03	1.44	1.92	2.50	2.42	2.48	2.48
Bt and 30%	0.00	0.80	1.30	1.86	2.69	3.31	3.18	3.26	3.26

[1] Baseline: no Bt cotton and no WTO assumption.
[2] With Bt cotton and no WTO assumptions.
[3] With no Bt cotton and 20% increase over baseline in yarn output.
[4] With no Bt cotton and 30% increase over baseline in yarn output.
[5] With Bt cotton and 20% increase over baseline in yarn output.
[6] With no Bt cotton and 30% increase over baseline in yarn output.

Table 4. Impact on Chinese Regional Production

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Area Harvested under Scenario with Bt and 30% increase in Yarn Output									
				(1,000 Hectares)					
Xinjing	1081	1090	1100	1113	1124	1133	1136	1142	1148
Henan	805	813	822	834	847	858	864	871	879
Shandong	600	608	617	628	639	649	654	661	668
Hubei	345	347	351	357	363	368	371	375	379
Jiangsu	325	327	331	337	342	348	350	354	358
Anhui	329	334	340	348	355	361	365	370	375
Hebei	360	365	372	381	390	398	402	408	414
Hunan	154	155	157	159	162	164	165	167	169
Other	319	322	326	333	339	345	348	353	357
				(% Changes over baseline)					
Xinjing	0.00	0.55	0.78	1.07	1.64	2.01	1.83	1.91	1.90
Henan	0.00	0.56	0.91	1.30	1.89	2.32	2.23	2.28	2.27
Shandong	0.00	0.70	1.11	1.56	2.28	2.79	2.66	2.72	2.71
Hubei	0.00	0.77	1.22	1.73	2.50	3.06	2.93	3.01	3.00
Jiangsu	0.00	0.58	0.93	1.32	1.94	2.38	2.27	2.33	2.32
Anhui	0.00	0.62	0.87	1.18	1.79	2.17	1.96	2.02	1.99
Hebei	0.00	1.10	1.83	2.56	3.55	4.30	4.16	4.19	4.14
Hunan	0.00	0.73	1.23	1.76	2.50	3.07	3.00	3.07	3.06
Other	0.00	0.86	1.44	2.05	2.89	3.54	3.47	3.53	3.53
Production				(1,000 Metric Tons)					
Xinjing	1468	1485	1503	1524	1545	1561	1570	1583	1595
Henan	735	748	763	781	800	817	828	841	854
Shandong	571	583	596	612	628	643	652	663	674
Hubei	332	337	344	352	361	369	374	381	387
Jiangsu	356	361	367	376	385	393	398	404	411
Anhui	263	272	282	294	305	316	325	336	346
Hebei	262	272	284	297	311	325	334	346	357
Hunan	171	173	177	181	185	189	192	194	197
Other	286	291	298	307	316	325	330	336	343
				(% Changes over baseline)					
Xinjing	0.00	0.55	0.78	1.07	1.64	2.01	1.83	1.91	1.90
Henan	0.00	0.77	1.33	1.93	2.74	3.39	3.29	3.34	3.33
Shandong	0.00	0.84	1.38	1.97	2.82	3.48	3.34	3.41	3.40
Hubei	0.00	0.94	1.57	2.25	3.20	3.94	3.81	3.88	3.87
Jiangsu	0.00	0.76	1.27	1.84	2.63	3.25	3.14	3.20	3.19
Anhui	0.00	0.62	0.87	1.18	1.79	2.17	1.96	2.02	1.99
Hebei	0.00	1.43	2.48	3.55	4.88	5.97	5.83	5.86	5.81
Hunan	0.00	1.05	1.87	2.73	3.81	4.72	4.65	4.71	4.71
Other	0.00	1.18	2.09	3.03	4.21	5.20	5.12	5.19	5.19

Table 4. Impact on Chinese Regional Production (Continued)

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Yield under Scenario with Bt and 30% increase in Yarn Output									
				(kg per hectare)					
Xinjing	1358	1362	1366	1370	1374	1378	1382	1386	1390
Henan	912	920	928	937	945	953	959	965	971
Shandong	952	959	967	975	982	990	997	1003	1009
Hubei	962	970	979	987	995	1003	1010	1016	1023
Jiangsu	1094	1101	1108	1116	1123	1130	1135	1141	1146
Anhui	799	814	829	845	860	876	892	908	923
Hebei	728	745	763	780	798	816	831	847	862
Hunan	1108	1117	1126	1135	1144	1153	1159	1164	1170
Other	897	905	914	923	932	941	948	954	960
				(% Changes over baseline)					
Xinjing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Henan	0.00	0.21	0.42	0.62	0.83	1.04	1.04	1.04	1.04
Shandong	0.00	0.13	0.27	0.40	0.54	0.67	0.67	0.67	0.67
Hubei	0.00	0.17	0.34	0.51	0.68	0.85	0.85	0.85	0.85
Jiangsu	0.00	0.17	0.34	0.51	0.68	0.85	0.85	0.85	0.85
Anhui	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hebei	0.00	0.32	0.64	0.96	1.28	1.60	1.60	1.60	1.60
Hunan	0.00	0.32	0.64	0.96	1.28	1.60	1.60	1.60	1.60
Other	0.00	0.32	0.64	0.96	1.28	1.60	1.60	1.60	1.60

Table 5. Impact on Chinese Cotton Consumption and Import

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Consumption				(1,000 Metric Tons)					
Baseline	5082	5132	5173	5216	5270	5312	5360	5391	5418
Bt and no wto	5081	5135	5177	5223	5278	5322	5367	5397	5424
No Bt and 20%	5138	5253	5356	5449	5554	5606	5654	5689	5723
No Bt and 30%	5166	5311	5431	5539	5669	5726	5775	5812	5848
Bt and 20%	5138	5257	5362	5465	5571	5629	5675	5713	5747
Bt and 30%	5166	5314	5442	5553	5686	5748	5796	5834	5870
				(% Changes over baseline)					
Bt and no wto	0.00	0.05	0.09	0.12	0.15	0.17	0.14	0.12	0.12
No Bt and 20%	1.11	2.36	3.55	4.47	5.39	5.52	5.48	5.54	5.63
No Bt and 30%	1.67	3.48	5.00	6.18	7.59	7.78	7.74	7.83	7.95
Bt and 20%	1.11	2.43	3.66	4.77	5.72	5.96	5.88	5.98	6.07
Bt and 30%	1.67	3.54	5.21	6.45	7.91	8.20	8.13	8.23	8.35
Import				(1,000 Metric Tons)					
Baseline	447	537	622	687	728	746	753	749	735
Bt and no wto	447	528	604	659	689	695	699	691	675
No Bt and 20%	504	642	782	**888**	**964**	**975**	**985**	**983**	**975**
No Bt and 30%	532	692	**845**	**955**	**1046**	**1058**	**1070**	**1069**	**1062**
Bt and 20%	504	634	765	**870**	**941**	**945**	**954**	**952**	**943**
Bt and 30%	532	684	**834**	**938**	**1021**	**1027**	**1038**	**1036**	**1029**
TRQ	740	780	820	860	890	890	890	890	890
				(% Changes over baseline)					
Bt and no wto	-0.00	-1.70	-2.93	-4.10	-5.38	-6.83	-7.25	-7.78	-8.21
No Bt and 20%	12.64	19.54	25.59	29.26	32.36	30.65	30.76	31.17	32.59
No Bt and 30%	18.94	28.85	35.71	38.98	43.60	41.74	42.03	42.67	44.52
Bt and 20%	12.71	17.97	22.90	26.63	29.24	26.61	26.66	27.08	28.27
Bt and 30%	18.94	27.30	33.91	36.59	40.23	37.58	37.86	38.28	39.96

Table 6. Impact on U.S. and World Cotton Trade

	2002	2003	2004	2005	2006	2007	2008	2009	2010
World Cotton Trade				(1,000 Metric Tons)					
Baseline	4241	4296	4349	4395	4430	4459	4485	4507	4523
Bt and no wto	4241	4290	4338	4379	4408	4430	4453	4471	4486
No Bt and 20%	4267	4341	4413	4473	4517	4538	4560	4578	4593
No Bt and 30%	4280	4362	4439	4499	4550	4569	4590	4608	4625
Bt and 20%	4267	4338	4406	4465	4508	4525	4547	4566	4582
Bt and 30%	4280	4358	4435	4493	4539	4556	4578	4596	4613
				(% Changes over baseline)					
Bt and no wto	-0.00	-0.13	-0.25	-0.36	-0.49	-0.65	-0.72	-0.80	-0.83
No Bt and 20%	0.60	1.07	1.48	1.78	1.98	1.77	1.67	1.57	1.55
No Bt and 30%	0.91	1.55	2.09	2.38	2.72	2.47	2.33	2.23	2.25
Bt and 20%	0.61	0.99	1.32	1.60	1.77	1.48	1.38	1.31	1.30
Bt and 30%	0.91	1.46	1.98	2.24	2.47	2.18	2.08	1.97	1.99
U.S. Cotton Export				(1,000 Metric Tons)					
Baseline	1880	1901	1934	1970	2005	2038	2071	2102	2130
Bt and no wto	1880	1897	1928	1963	1995	2026	2058	2089	2117
No Bt and 20%	1895	1928	1967	2008	2045	2071	2102	2132	2161
No Bt and 30%	1904	1939	1980	2019	2061	2085	2113	2143	2174
Bt and 20%	1895	1926	1963	2004	2041	2065	2095	2128	2156
Bt and 30%	1904	1936	1978	2017	2054	2078	2108	2139	2169
				(% Changes over baseline)					
Bt and no wto	-0.01	-0.19	-0.32	-0.38	-0.49	-0.60	-0.61	-0.62	-0.60
No Bt and 20%	0.80	1.41	1.70	1.95	2.01	1.64	1.49	1.45	1.44
No Bt and 30%	1.27	1.98	2.38	2.50	2.77	2.28	2.02	1.97	2.06
Bt and 20%	0.80	1.32	1.50	1.73	1.80	1.32	1.16	1.24	1.22
Bt and 30%	1.27	1.87	2.27	2.39	2.45	1.96	1.81	1.76	1.85