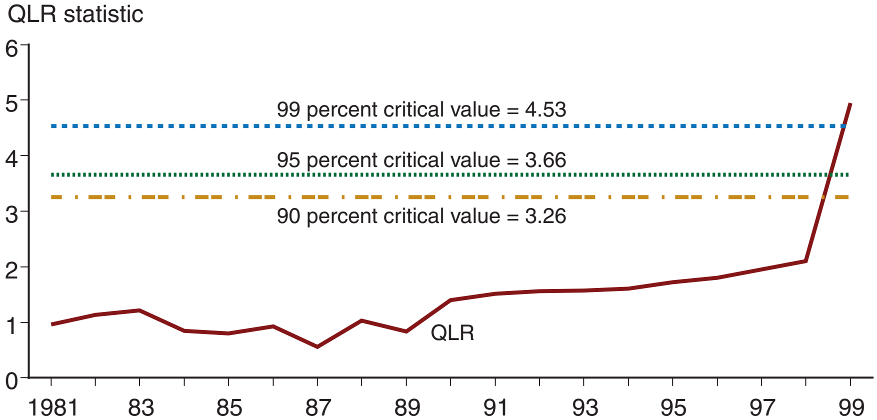
Structural Change Test

Following Wang and Tomek (2007), it is important to ensure that a correctly specified model is used to test for structural change. Therefore, equation 11 is used to test for structural change. A traditional approach would be to pick an arbitrary sample breakpoint, often the midpoint of the sample, and use a Chow test for structural change. This could be further refined by associating breakpoints with major events relevant to the data series. Either of these approaches suffers from the arbitrary nature of the selected breakpoints. Recent literature suggests that the Quandt-Likelihood Ratio (QLR) test is superior for detecting structural change of unknown timing (e.g., Hansen, 2001). The QLR test consists of calculating Chow breakpoint tests at every observation, while ensuring that subsample points are not too near the end points of the sample. The QLR test was applied to the pooled data in this study with 20-percent trimming. The highest value of the QLR statistic was 5.0 (fig. 4). The probabilities for these statistics were calculated using Hansen's (1997) method. The critical value of the QLR statistic at the 99-percent significance level with five restrictions is 4.53 (Stock and Watson, 2003, p. 471), which indicates that the null hypothesis of no structural change is rejected. The maximum statistic of 5.0 was observed in 1999/00, which indicates the breakpoint location.

This structural break was likely caused by a combination of factors. Besides significant changes in international trade, which have been transitory, this period coincided with some permanent regime changes in China's supply due to the end of guaranteed procurement prices. Some permanent changes also took place in China's consumption sector due to its growing textile industry. These regime changes in China's cotton sector are likely associated with China's accession to the WTO at the end of 2001. China joined the WTO just as the textile trade liberalization provisions of the Uruguay Round Agreement were having an impact. The phasing out of developed country textile trade protection (commonly referred to as the Multifiber Arrangement, or MFA) was an important factor behind the rapid

Figure 4

Quandt Likelihood Ratio test results for cotton price model, 1974/75-2006/07[1]



[1]The Quandt Likelihood Ratio (QLR) test excludes subsamples too close to the end-points of the overall sample. QLR statistics for the 1974-2006 sample are only available for 1981-1999.

increased export orientation of the U.S. cotton industry. As the export share of U.S. cotton use surpassed domestic use in the early 2000s (fig. 5), the importance of world supply and demand to U.S. cotton prices increased. In addition to policy changes in China, 1999 marked the first year that foreign cotton supplies (excluding China) surpassed 75 million bales. As a liberalizing global economy began an accelerated expansion in 1999, foreign cotton supplies began rising to meet this demand.

To correct for the structural change detected in the estimated model (equation 11), an additional shift variable was added to reflect the increased export orientation of the U.S. cotton industry. World market signals are assumed to be transmitted to the U.S. market through foreign supply, which was constructed excluding China's supply but including China's net contribution to the global availability of cotton (net exports):[9]

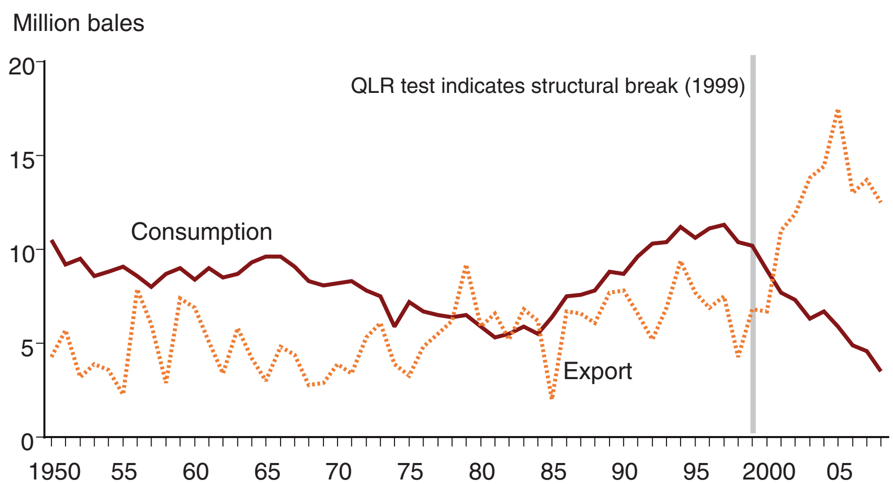
$$S_t^{Foreign} = S_t^{Foreign} - S_t^{China} + X_t^{China} - M_t^{China}. \quad (12)$$

Foreign supply is an important factor for U.S. cotton prices. The United States is one of the largest producers and exporters of cotton and directly competes with cotton coming from other countries. With this variable included, no structural break was detected and the specification of the model was complete. Thus, the final model specification is:

$$\frac{(p_t^* - p_{t-1}^*)}{p_{t-1}^*} = \alpha_0 + \alpha_1 \frac{(S_t - S_{t-1})}{S_{t-1}} + \alpha_2 \frac{(r_t - r_{t-1})}{r_{t-1}} + \alpha_3 \left(CN_t - average\ (CN_{t-1},\ CN_{t-2})\right) + \alpha_4 CCC_t + \alpha_5 \frac{(S_t^{Foreign} - S_{t-1}^{Foreign})}{S_{t-1}^{Foreign}}. \quad (13)$$

[9]China's stocks and production were excluded from this shift variable since the cotton stocks data are particularly unreliable (MacDonald, 2007). Stocks were regarded as a state secret in China for many years, and although the degree of secrecy has diminished profoundly, even current stock estimates for China are highly conjectural. Production data in China are also considered less reliable than elsewhere, so China's impact on world supply comes through its net trade position. With such problems in the data for the world's largest cotton consumer and stockholder, neither a world stocks-to-use (r_w) nor foreign stocks-to-use (r_f) ratio would be an appropriate variable.

Figure 5
U.S. cotton exports and consumption, 1950-2008



Source: *World Agricultural Supply and Demand Estimates* (WASDE), various issues.

All data used for the empirical estimation of this equation are presented in table 3. The model is estimated using the most recently available revisions of supply and demand categories.

Table 3

Model data, 1974/75 through 2006/07

Marketing year	Price	Supply	S/U	China net imports	CCC	Foreign supply
			Percent			
1974/75	-12.0	-10.8	114.1	-2.1	9.2	8.5
1975/76	11.6	-8.5	-41.6	-0.8	1.0	-4.3
1976/77	17.6	1.6	-26.4	-0.2	2.7	-6.3
1977/78	-23.5	21.2	82.2	1.6	10.1	2.6
1978/79	3.5	-6.5	-34.8	1.7	4.9	0.9
1979/80	-1.4	14.9	-37.6	3.3	3.2	-2.6
1980/81	9.3	-24.0	7.9	0.7	5.3	-0.1
1981/82	-32.4	29.9	179.9	-2.4	30.8	-0.6
1982/83	5.1	1.3	34.0	-3.0	43.5	2.1
1983/84	5.7	-15.8	-68.3	-2.6	4.7	-4.3
1984/85	-13.0	0.2	46.5	-1.9	14.6	18.8
1985/86	-5.6	11.4	227.0	-3.0	80.5	13.6
1986/87	-11.6	8.6	-68.7	-1.4	21.1	-1.3
1987/88	19.9	3.2	13.7	1.1	22.3	0.3
1988/89	-15.8	7.1	33.8	3.0	30.2	0.1
1989/90	10.2	-10.9	-69.2	2.6	2.8	-1.9
1990/91	1.8	-3.1	-24.2	1.0	1.3	0.5
1991/92	-19.0	8.6	82.5	-0.1	1.8	2.6
1992/93	-7.5	-1.0	24.3	-1.9	3.7	-3.4
1993/94	5.9	4.8	-30.0	-0.3	1.1	-5.1
1994/95	22.5	12.0	-35.3	4.8	0.8	-4.6
1995/96	3.0	-9.4	14.3	1.0	1.7	14.2
1996/97	-9.5	4.1	55.4	0.0	1.7	-0.6
1997/98	-10.5	3.8	-6.1	-1.7	0.3	3.3
1998/99	-9.1	-20.1	14.3	-3.4	2.3	2.3
1999/2000	-28.2	13.9	-3.6	-2.5	0.4	5.8
2000/01	11.4	1.4	54.4	0.8	9.4	0.4
2001/02	-41.1	24.5	11.0	1.1	4.1	0.5
2002/03	43.0	-7.2	-29.3	2.5	4.0	-3.8
2003/04	38.2	-2.9	-35.6	7.6	6.8	-5.2
2004/05	-36.7	12.8	52.1	0.2	1.4	23.3
2005/06	14.1	11.0	-6.9	9.2	5.1	-6.2
2006/07	-1.7	-6.7	115.4	-2.7	5.1	7.4

Note: Price is percent change in the real U.S. season-average upland cotton farm price from year *t-1* to year *t*. Supply is percent change in U.S. supply from year *t-1* to year *t*. S/U is percent change in U.S. stocks-use-ratio from year *t-1* to year *t*. China net imports is the absolute change in China's net imports as a proportion of world demand from their average over the preceding 2 years. CCC is end-of-season stocks for year *t* of cotton either owned by USDA's Commodity Credit Corporation or remaining as collateral for the cotton loan program as proportion of demand for U.S. cotton that year. Foreign supply is the percent change in global cotton supply (minus China's supply and plus China's net exports) from year *t-1* to year *t*.

Source: USDA National Agricultural Statistics Service, and *World Agricultural Supply and Demand Estimates* (various issues).