INCORPORATING EXPECTATIONS INTO THE ICAC MODEL OF THE COTLOOK A INDEX[1]

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Introduction

Projections of average cotton prices published by the Secretariat of the ICAC since January 1988, are based on a one-equation model that relates changes of the Cotlook A Index to changes in world supply and demand conditions.

The ICAC price model provides a simple quantitative basis for evaluating conventional supply and demand factors in the cotton market. The model uses conventional supply and demand inverted equations and, recognizing the increasing importance of China Mainland in international cotton trade, it differentiates between China's net cotton trade impact on world stocks-to-use ratio and the stocks-to-use ratio in the rest of the world.

The model predicted the course of the Cotlook A Index between 1988/89 and 1990/91 with a difference of less than 6 cents from the actual price. Despite the relative success of the model during this period, the Secretariat of the ICAC continued research efforts to further refine the model but found other alternatives to have less predictive power. In an article published in the March/April issue of 1990, five different alternative models were contrasted against the ICAC model. The modelling efforts of 1990 were an attempt to introduce the effects of location of stocks, perceptions in the market due to past behavior of the stocks-to-use ratio, and price changes of competing crops. These elements are thought to have played a role in the price formation mechanism of the cotton market.

The ICAC model served as a basis for predicting a decline of cotton prices in 1991/92. However, the model was able to predict only 10 cents of the 20 cent decline experienced in 1991/92.

Ongoing research at the Secretariat has studied the probable sources of this unexpected larger decline. Several statistical tests suggest that the actual specification of the model uses relevant information but that some additional information, critical in the determination of prices in the 1991/92 season is missing. It is well known that in circumstances where market conditions are more uncertain, expected prices play a more important role in the formation of prices. In an attempt to redefine the current price model, information generally used by the market in judging the likely course of future prices has been incorporated into and tested against the ICAC price model.

Recent Market Developments

Since 1990, commodity markets have been subject to a series of impacts associated with lower world economic growth and relatively abundant supplies of certain agricultural commodities. Declines in prices were exacerbated by the disruption of world trade due to the war in the Middle East and, most important, the collapse of the Soviet Union and the subsequent integration of the former COMECON countries into the economy of the rest of the world. As a result, the International Monetary Fund index of non-fuel commodity prices declined 8% in 1990 and a further 5% in 1991.

Unlike other commodity markets, the world cotton market enjoyed relatively high prices during the 1990/91 season with the Cotlook A Index averaging about 83 U.S. cents per pound. Despite the economic collapse of the former Soviet Union and Eastern European countries which led to a cotton consumption decline in the region, consumption elsewhere was strong and declines of world cotton consumption were small. Prices were also supported during 1990/91 by declines in Central Asian exports, as the new republics developed the ability to ship cotton to foreign buyers.

However, during 1991/92, supplies of cotton not shipped from Central Asia in 1990/91 and unused stocks accumulated in the former Soviet Union became available in international markets and the fundamentals of the market were altered. Cotton consumption in the former USSR and Eastern Europe region declined 405,000 tons between 1989/90 and 1991/92 and stocks increased 423,000 tons during the same period. Exports from the former Soviet Union to the rest of the world increased from 327,000 tons in 1990/91 to 650,000 in 1991/92.

The decline in consumption and increases in stocks attributed to the former USSR and Eastern Europe contributed an estimated 5 cents to the 20 cent decline in the season average Cotlook A Index in 1991/92. The remaining 5 cents explained by the fundamentals of the market were the result of increased net exports by China (Mainland) and increased cotton production as a result of relatively high prices during the previous season.

An additional, less tangible, event due to the collapse of the Soviet Union likely affected the cotton market. In response to the new market conditions, many commodity traders, as well as many companies in the United States and Europe not experienced in the international cotton market, began barter trade arrangements of cotton with the new independent Central Asian republics. The higher risk associated with barter trade and the eagerness of the Central Asian Republics to import needed goods to

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maintain their economies functioning, made possible the offering of cotton from Central Asia at prices lower than normally expected. At the end of 1990 the quote for Russian Middling was .2 cents below the Cotlook A Index. At the end of 1991 the difference increased to 3 cents below the A Index and increased further to 4.6 cents by the end of 1992.

Another factor that contributed to lower prices beyond the 10 cents decline suggested by supply and demand conditions was the response of other major producing and exporting countries to new market conditions. Existing programs were reinforced in several countries further insulating domestic markets from world prices. By March of 1992, production for the 1992/93 season in India, Pakistan and Brazil was expected to increase, while reductions in the United States were small, despite the large decline of prices in 1991/92. (Only India was able to increase production, as adverse weather and pest problems resulted in decreased production in Pakistan and Brazil.) Despite continued low prices in 1992/93, it is expected that major producers will maintain or increase production in 1993/94.

How The ICAC Price Model Works

Assume a market equilibrium where the variation in stocks equals consumption minus production and prices can be a function of an inverted supply and demand system as follows:

1) Δstocks/consumption =1- production/consumption

2) price = f(stocks/consumption)

Equation 1 shows that the fundamental relationship between supply and demand in a market can be represented by a stocks to use ratio and equation 2 shows the inverted functional form of a typical supply and demand system.

Since the world market is differentiated between China Mainland and the rest of the world in the ICAC model, equation 1 for the rest of the world becomes,

3) $\Delta stocks_{RW}/consumption_{RW} = 1-(production_{RW} + (M_{RW}-X_{RW}))/consumption_{RW}$

where, RW is the world less China Mainland, M_{RW} is imports of RW from China, and X_{RW} is exports of RW to China Mainland.

Since in a world with two trading partners,

$(M_{RW}-X_{RW}) = X_{ch}-M_{Ch}$ = net trade by China Mainland

then, equation 3 can be expressed as

4) ($\Delta stocks_{RW}$ - net trade by China Mainland)/ $consumption_{RW}$ =

1 - $production_{RW}/consumption_{RW}$

The ratio expressed on the left side of equation 4) measures the supply and demand situation in the world-less-China Mainland region.

In addition, the ratio

5) net trade by China/$consumption_{RW}$

measures China's impact in the market of the rest of the world.

Using equations 2, 4 and 5, the ICAC model can be expressed as:

6) price = f(X1,X2)

where,

X1: net exports by China Mainland as a share of world-less-China Mainland consumption, and

X2: world-less-China Mainland ending stocks less net exports by China Mainland as a share of world-less-China-Mainland consumption.

Applying data beginning in 1973/74 and ending in 1990/91, the model explains about 84% of the variation of cotton prices as measured by the Cotlook A Index and is able to predict about half of the 1991/92 price decline. The goodness of fit of the model decreases to 76% if 1991/92 data is added.

The results of the forecasting exercise have been published in the last row of the supply and use table on the second page of *COTTON* since January 1988.

Incorporating Price Expectations

A Recursive Residual test and a CUSUM test applied to econometric results from equation 6, suggest parameter stability in all seasons but the 1991/92 season. The results from these tests also suggest that the two variables used in the ICAC model capture the basis of price changes since 1973/74, but that additional information evidently used by the market since 1991/92 is not captured by the existing model.

As described above, the events that led to declines of cotton prices beyond the levels supported by supply and demand conditions were related to the uncertainty of the market about future prices. Along these lines, an improved price model would be specified as follows:

7) $price_t = f(X1_t, X2_t,$ expectations $factor_t)$

The introduction of a variable or a set of variables that would account for price expectations can be done by using

particular hypothesis about the formation of expectations or by including information that is used by the market.

Adaptive expectations hypothesis and a partial adjustment combination resulted in no significant improvement of the ICAC model.

A set of variables thought to contain relevant information about the cotton market widely used by agents of the market was devised. These variables capture: the price differential of the futures market between February (when planting decisions are being formed in the northern hemisphere) and November (the closest month before the expiration of a December futures contract); the position of world production in relation to consumption; and the amount of cotton barter transactions in relation to all transactions by bartering countries.

Several specifications were designed that included this additional information. Assuming that agents in the market form their expectations about future prices based on the first two elements, that is, based on past performance of the market and whether production is above consumption, an expectations factor in equation 7 was initially constructed such that

8) $\text{Expectations factor}_t = \text{NovFeb}_{(t-1)} + \text{NovFeb}_{(t-2)} + \text{Balance}_{(-1)} + \text{Barter}_t$

where, NovFeb is the logarithm of the absolute difference between the November and February quotations of the December futures contract and Balance is a variable that changes the intercept of the equation 7 when world production is above consumption; and barter is the percentage of barter trade between the former USSR and the rest of the world in relation to total former USSR exports.

The statistical results of the model described by equations 7 and 8 show an improved goodness of fit. The model explains 96% of changes in the Cotlook A Index with a standard error of 2.8 cents per pound. With data from 1973/74 to 1990/91, the model forecasts the full decline of prices in the 1991/92 season and 58 cents for 1992/93. With data from 1973/74 to 1991/92, the model forecasts 60 cents for 1992/93, 64 cents for 1993/94 and 68 cents for 1994/95.

The model shows parameter stability in all seasons. Restricting the data to 1973/74-1989/90, results in the model overpredicting the level of the Cotlook A Index. This characteristic suggests that expectations as explained by equation 8 did not played a role before 1990/91.

Due to a low Durbin-Watson statistic, the model was corrected for autocorrelation. The corrected model lowers the standard error of forecast and produces BLUE estimates of the coefficients. Forecasts generated with the corrected model converge with actual values, decreasing the standard error of the fitted equation.

The introduction of expectations increases the sensitivity of the model to changes in China (Mainland) and the rest of the world as captured by variables X1 and X2. The coefficient of X1 increases from 2.7 to 3.2 and the coefficient of X2 increases from 1.1 to 1.6.

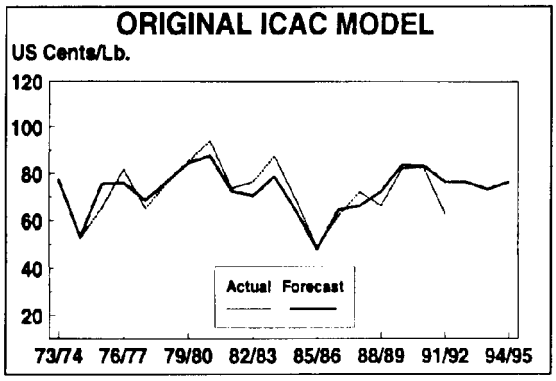
The model indicates that an increase of 10 percentage points in barter trade from Central Asia results in a decrease of 3.7 cents in the Cotlook A Index. When world production is above consumption, the constant term of the model is altered by 10 cents and the Cotlook A Index becomes less sensitive to the other variables in the model. A 10-cent decrease in futures prices between February and November of the previous season results in a 2-cent decrease in the Cotlook A Index, and a similar decrease two seasons before results in a decrease of 4 cents.

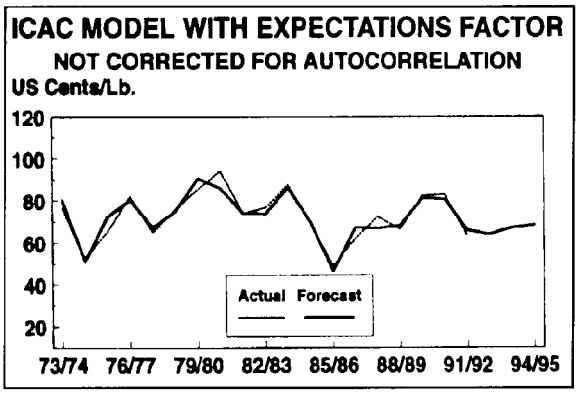
Forecasts of the Cotlook A Index for 1993/94 and 1994/95 depend on projections of world stocks and consumption, net trade by China (Mainland) and barter trade developed by the Secretariat, and on the behavior of futures prices in 1991, 1992 and 1993[2]. China (Mainland) is expected to export 220,000 tons a year during 1993/94 and 1994/95. Stocks outside China (Mainland) are projected to be 5.5 million tons in 1993/94 and 5.3 million tons in 1994/95. Consumption outside China (Mainland) is projected to be 14.6 million tons in 1993/94 and 15.0 million in 1994/95. In addition, barter trade by the Central Asian Republics is expected to continue to increase from 52% of total Central Asian cotton exports in 1992/93 to 55% in 1993/94 and 57% in 1994/95. Prices of the December contract on the New York Cotton Exchange declined 9 cents between February and November 1991 and 4 cents during the same months in 1992. For 1993, the difference in futures prices is estimated at 4 cents, the change in the December contract between February and June, 1993.

Notes

[1] This article was initially published in *COTTON: Review of the World Situation*, Number 6, Vol. 46, July/August 1993.

[2] The most current forecast of the Cotlook A Index and the related stocks, consumption and trade data appear in COTTON: Review of the World Situation, published bi-monthly by ICAC and in the ICAC monthly fax update service.


ORIGINAL ICAC MODEL
US Cents/Lb.
120
100
80
60
40
20
Actual Forecast
73/74 76/77 79/80 82/83 85/86 88/89 91/92 94/95


ICAC MODEL WITH EXPECTATIONS FACTOR
NOT CORRECTED FOR AUTOCORRELATION
US Cents/Lb.
120
100
80
60
40
20
Actual Forecast
73/74 76/77 79/80 82/83 85/86 88/89 91/92 94/95

DATA USED IN ICAC MODEL

Crop Year	Cotlook A Index	1 China Net Exports	2 World Less China Endstocks	3 2-1 World Less China Endstocks Less China Net Exports	4 World Less China Consumption	(1/4)*100 X1	(3/4)*100 X2
	US Cents/Lb.	000 Tons				Ratio	
73/74	76.50	-368.61	4881.00	5249.62	10867.43	-3.39	48.31
74/75	52.50	-108.43	6484.41	6592.84	10083.03	-1.08	65.39
75/76	65.30	-129.98	4762.04	4892.02	11016.72	-1.18	44.41
76/77	81.85	-64.01	4463.17	4527.18	10650.88	-0.60	42.51
77/78	65.05	-290.67	5477.93	5768.59	10509.55	-2.77	54.89
78/79	76.05	-444.82	5023.31	5468.13	10839.12	-4.10	50.45
79/80	85.40	-899.65	4958.64	5858.29	11086.27	-8.11	52.84
80/81	94.20	-771.63	4404.08	5175.71	10907.63	-7.07	47.45
81/82	73.80	-478.35	5394.95	5873.30	10599.50	-4.51	55.41
82/83	76.65	-219.90	5298.58	5518.49	10805.77	-2.04	51.07
83/84	87.65	20.90	4277.72	4256.82	11239.44	0.19	37.87
84/85	69.15	187.03	5771.82	5584.79	11624.33	1.61	48.04
85/86	49.00	609.24	7483.41	6874.17	12449.84	4.89	55.21
86/87	62.05	686.50	6070.37	5383.87	13686.10	5.02	39.34
87/88	72.30	486.84	6218.41	5731.57	13810.16	3.53	41.50
88/89	66.35	41.01	6211.49	6170.48	14135.63	0.29	43.65
89/90	82.40	-219.54	5224.61	5444.15	14634.00	-1.50	37.20
90/91	82.95	-277.96	5319.82	5597.78	14523.48	-1.91	38.54
91/92	63.05	-231.25	6126.78	6358.03	14327.43	-1.61	44.38
92/93		85.00	5656.16	5571.16	14279.83	0.60	39.01
93/94		220.18	6019.12	5798.94	14633.51	1.50	39.63
94/95		220.18	5785.56	5565.39	15081.20	1.46	36.90

OTHER DATA USED IN MODELLING COTTON PRICES

Crop Year	1 December Contract in Previous February[1]	2 December Contract in Previous November[1]	3 2-1	4 (3/I3I)	(4*log(I3I)) NovFeb	World Production Less Consumption	Balance [2]	Barter [3]
	US Cents/Lb.					1,000 Tons		Percent
73/74	34.03	73.43	39.40	1.00	3.67	146.37	1.00	5.00
74/75	64.00	41.86	-22.13	-1.00	-3.10	1284.72	1.00	5.00
75/76	44.18	53.83	9.64	1.00	2.27	-1630.40	0.00	5.00
76/77	58.70	80.24	21.54	1.00	3.07	-737.12	0.00	5.00
77/78	68.23	50.99	-17.24	-1.00	-2.85	726.95	1.00	5.00
78/79	59.30	68.04	8.74	1.00	2.17	-770.65	0.00	5.00
79/80	64.86	67.84	2.98	1.00	1.09	-43.65	0.00	5.00
80/81	77.36	88.82	11.46	1.00	2.44	2402.13	1.00	5.00
81/82	82.61	62.86	-19.74	-1.00	-2.98	852.12	1.00	8.56
82/83	71.69	62.67	-9.01	-1.00	-2.20	18.97	1.00	8.56
83/84	67.91	78.87	10.96	1.00	2.39	-194.16	0.00	8.56
84/85	72.36	65.17	-7.19	-1.00	-1.97	4124.91	1.00	8.56
85/86	66.47	61.14	-5.33	-1.00	-1.67	828.36	1.00	8.56
86/87	46.79	48.47	1.67	1.00	0.52	-2982.99	0.00	8.56
87/88	53.45	68.54	15.09	1.00	2.71	-531.52	0.00	8.56
88/89	59.50	55.18	-4.31	-1.00	-1.46	-184.27	0.00	9.50
89/90	58.81	72.08	13.28	1.00	2.59	-1407.78	0.00	10.05
90/91	65.30	74.30	9.00	1.00	2.20	255.79	1.00	49.91
91/92	67.69	58.41	-9.28	-1.00	-2.23	2433.53	1.00	49.98
92/93	60.28	56.05	-4.23	-1.00	-1.44	-968.10	0.00	52.28
93/94	61.87	57.91	-3.96	-1.00	-1.38	-360.20	0.00	54.68
94/95						-916.78	0.00	57.20

[1]Numbers refer to the New York Cotton Exchange average quotation of the December #2 Contract during February and November of the same year. 73/74 refers to months during calendar year 1973.

[2]If world production is greater than consumption, Balance = 1, otherwise Balance = 0.

[3]Barter is the amount of cotton traded by the Central Asian republics for other goods and services with no monetary transaction involved, as a per cent of all exports outside the former USSR from Central Asian republics.