COTTON :

Review of the World Situation

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THE NEW ICAC COTTON PRICE FORECASTING MODEL

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Structural Evolution of the World Cotton Market

For cotton, as for many other storable commodities, prices are linked to the level of stocks. When stocks are scarce, prices are high, and when they are plentiful, prices are low. Since the desirable level of stocks has to be assessed in relation to the demand for the commodity, international cotton prices (A_t) measured by the season-average Cotlook A Index can be expressed as a function of the stocks-to-mill use ratio (W_t) which, for the world as a whole, is obtained by dividing the stocks at the end of season t by mill use during season t[6].

$$A_t = f(W_t) \qquad (1)$$

Since 1960, cotton prices did not behave in accordance with the function above on two occasions. First, during the 1960s, U.S. buffer stock policies stabilized world cotton prices within a narrow margin ranging from 28.0 to 31.3 cents per pound. The buffer stock policy was not costless. U.S. stocks increased by 133% from 1960/61 to 1965/66, and, in that season, they accounted for 54% of world cotton stocks. As storage became expensive and buffer stock operations did not fit with the free market paradigm, the U.S. policy was changed. The objective was no longer to stabilize world cotton prices; it was to stabilize the income of U.S. cotton producers[7]. Savings were made on storage costs but direct payments to U.S. cotton producers increased. U.S. stocks fell from 3.7 million tons in 1965/66 to 0.9 million tons in 1970/71, which prevented an increase in world prices. As the United States was not able to further reduce stocks, the Cotlook A Index jumped from 31.1 cents per pound in 1970/71 to 76.5 cents per pound during the 1973/74 commodity boom. This marked the end of an 11-year period of stable cotton prices.

Second, in the early 1990s, China (Mainland) (which will be called China for short in this article) decided to build a large stockpile, perhaps to provide secure supplies for its expanding textile industry. By the end of 1998/99, the stockpile had reached a peak estimated at 6.5 million tons, accounting for 53% of world stocks and equivalent to one and a half years of China's estimated mill use. Chinese stocks did not increase because production exceeded consumption; instead they increased because China imported more cotton than needed. By importing more to raise its stockpile over an extended period, China was withdrawing cotton from the world market, which caused world prices to increase. China's imports had an effect comparable to that of a company repurchasing its own stock to raise its market value. Realizing that the maintenance of such a huge stockpile was costly and not necessary to satisfy the needs of its expanding textile industry, China decided in 1998 to release its surplus stocks, which caused world prices to decline. In summary, the effect of China's stock policy was to boost world prices from 1992/93 to 1997/98 and to depress them from 1998/99 to 2004/05.

In the last three seasons (2004/05 to 2006/07), the stocks-to-mill use ratios became lower in China than in the rest of the world. Now, whether a million tons of cotton is imported by China or by other countries does not affect the world balance between cotton supply and demand anymore.

The Regression Equation

Since prices were stabilized during the sixties by the U.S. storage policy which ceased to be applied after 1970, the 1960s were excluded from the statistical analysis. We start with equation (1) assuming that W_t (the stocks-to-mill use ratio for the world as a whole) is known. In August of year t, the average price of the previous season t-1 (A_{t-1}) and the ending stocks-to-mill use ratios of the two preceding seasons t-2 and t-1 (W_{t-2} and W_{t-1}) are known; equation (1) can therefore be rewritten as (2)[8]. There are expectations on what the stocks-to-mill use ratio will be in the current season t (W_t), which leads to the price expectation (A_t) through equation (3). Subtracting equation (3) from (2) gives equation (4), which links the expected price A_t to the expected stocks-to-mill use ratio (W_t) taking into account the stocks-to-mill use ratios of the previous two seasons t-2 and t-1 (W_{t-2} and W_{t-1}) :

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6. The Cotlook A Index is the reference price most widely used in trading cotton on the world market. The cotton season was chosen to fit the production pattern in the Northern Hemisphere, which accounts for about 90% of world cotton production: the season t begins on August 1 of year t and ends on July 31 of year t+1. The 2005/06 price – also called the 2005/06 season-average price - is the average of daily quotations over the period running from August 1, 2005 through July 31, 2006. Cotton prices are expressed in current U.S. dollars in this article.

7. Ambitious international buffer stock schemes were conceived in the post-war period. They culminated with a proposal by UNCTAD to establish a "Common Fund" for a large group of primary commodities. The scheme was hotly debated but not implemented for cotton.

8. The choice of the logarithmic formula was made for the following reasons. First, with a logarithmic formula, a 5% increase in the stock-to-mill use ratio (X) induces a 5% price decline whether X is high or low. With an arithmetic formula, the same 5% increase in X would have induced a price reduction twice as large in cents per pound for X=100 than for X=50. At the limit, an increase in X could lead to negative prices with an arithmetic formula, while it could not with a logarithmic formula. Moreover, equation (5) gave a better fit in logarithmic terms than in arithmetic ones.

$\ln(A_{t-1}) = const + a * \ln(W_{t-1}) + b*\ln(W_{t-2})$ (2)

$\ln(A_t) = const + a * \ln(W_t) + b*\ln(W_{t-1})$ (3)

$\ln(A_t/A_{t-1}) = a *\ln(W_t/W_{t-1}) + b*\ln(W_{t-1}/W_{t-2})$ (4)

const equals a constant; a and b are coefficients.

Let us now come to the data problem. The measurement of the stocks-to-mill use ratio is considered as reasonably accurate for the world excluding China (X_t), but there are uncertainties regarding the China ratio (Y_t) and therefore regarding the ratio covering the world as a whole (W_t)[9]. The later can be expressed as $W_t = (1-c_t)*X_t + c_t*Y_t$, where c_t is the share of China in world mill use. Using X_t and Y_t as separate explanatory variables in regression equation (5) provides a better fit than using W_t only, because the relative weights to be applied to X_t and Y_t are not predetermined. The weight applied to Y_t in regression (5) below turned out to be lower than the weight c_t which would have been imposed by using W_t as the single explanatory variable. Applying a lower weight to the explanatory variable known less accurately appears sensible. When the "world less China" and "China" ratios were both introduced as separate explanatory variables, the coefficient of $\ln(Y_t/Y_{t-1})$ was not significant; that variable was therefore eliminated.

The innovative feature brought to this model was to replace changes in the Chinese stocks-to-mill use ratio by changes in Chinese net imports from 1991/92 to 2002/03. This substitution was made because the increase in the Chinese stockpile from 1991/92 to 1998/99 and the disposal of surplus stocks during the following six seasons were due to policy decisions and not to changes in market conditions[10]. Consequently, the regression became:

$$\ln(A_t/A_{t-1})=a*\ln(X_t/X_{t-1})+b*\ln(X_{t-1}/X_{t-2})+m_t*c*\ln(Y_{t-1}/Y_{t-2})+(1-m_t)*d*\ln(Z_t/Z_{t-1}) \quad (5)$$

-1.00	-0.34	-0.073	-1.64	Coefficients
0.088	0.077	0.034	0.353	Std error
(11.4)	(4.4)	(2.2)	(4.6)	t ratio

$R^2 = 0.88$ R^2 adjusted = 0.87 DW = 2.4
1975/76 – 2006/07

A_t = average value of the Cotlook A Index in season t.

X_t = ending stocks as a percentage of mill use in season t for the world less China.

Y_{t-1} = ending stocks as a percentage of mill use in season t-1 for China.

Z_t = 100 * (1- net imports into China/world imports).

m_t = dummy variable equal to 0 for 1991/92 through 2002/03 and 1 for all other seasons.

The statistical fit is good as shown on Chart 1. According to regression (5), X_t (stocks-to-mill use ratio for the world less China in season t) is the most important explanatory variable. With an elasticity coefficient equal to minus one, a 5% increase in the stocks-to-mill use ratio in the current season t induces a 4.9% price decline in the current season t[11]. The second most important explanatory variable is X_{t-1}: with an elasticity coefficient equal to -0.34, a 5% increase in the stocks-to-mill use ratio in the preceding season t-1 induces a 1.7% price decline in the current season t. Consequently, if the stocks-to-mill use ratio in the world less China increases by 5% in season t-1 and again by 5% in season t, the Cotlook A Index falls, on average, by 6.6 % in season t. It may seem strange that the stocks-to-mill use ratio in the world less China had such an effect on world prices before 1993/94, when China accounted for already one-third of world cotton mill use. However, at that time China accounted for only a small share of world cotton trade; before 1993/94, it accounted for less than 5% of world gross imports or exports in most seasons.

According to equation (5), a 5% increase in the China stocks-to-mill use ratio (Y_{t-1}/Y_{t-2}) would only induce a 0.36% decline in world prices in season t. Finally, during the special 12 year period (1991/92 to 2002/03), if net imports into China increased from zero to 5% of world gross imports, the value of the explanatory variable Z would fall from 100 to 95 and the Cotlook A Index would increase by 8.4%.

Forecasting Prices One Year Ahead

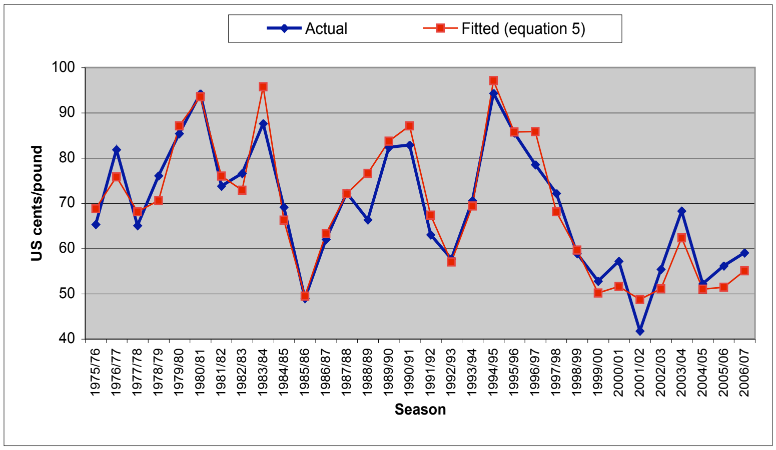
Regression coefficients were estimated by solving equation (5) at the end of July 2007 when reasonable estimates were already available for five explanatory variables: $X_{06/07}$, $X_{05/06}$, $X_{04/05}$, $Y_{05/06}$ and $Y_{04/05}$. The price forecast for 2007/08 ($A_{07/08}$) was obtained by plugging in the forecast of the last explanatory variable ($X_{07/08}$) which is the projected stocks-to-mill use ratio for the world less China in 2007/08.

9. For country C, the stocks-to-mill use ratio in season t is the level of ending stocks in country C divided by mill use of country C in season t.

10. The variable $\ln(Z_t/Z_{t-1})$ was multiplied by dummy variable $(1-m_t)$ equal to 1 for 1991/92 through 2002/03 and 0 for all other seasons. The variable $\ln(Y_t/Y_{t-1})$ was multiplied by dummy variable m_t equal to 0 for 1991/92 through 2002/03 and 1 for all other seasons. The ratio of net imports into China over world gross imports was not used as an explanatory variable because its value ranges from -0.05 to 0.1 and the logarithm of a negative number does not exist. Introducing two separate variables (one for gross imports and the other for gross exports) was not a solution either, since the logarithm of a very small number goes toward minus infinity. The problem was solved by using variable Z with a value ranging from 1.05 to 0.9.

11. Ln(1+e) is close to e when e is small; thus ln(1.03)=0.0296, ln(1.05)=0.0488 and ln(1.1)=0.0953. But when e is large, then ln(1+e) is significantly lower than e ; thus ln(1.5)=0.4055.

Chart 1. Fitted and actual values of the Cotlook A Index, 1975/76 – 2006/07



To examine how good this forecast is likely to be, we simulated the forecasts which could have been made over the last 17 seasons using regression equation (5) and the historical ICAC forecasts of the explanatory variables since 1990.

To simulate historical forecasts of the Cotlook A Index, the first step is to calculate the regression coefficients of equation (5) which would have been estimated on the basis of the information available at the time. The first forecast would have been made in late July 1990 for 1990/91. In late July 1990, regression (5) would have been solved from data covering the period 1975/76 through 1989/90, which was the latest season for which data were available at that time. The values of the regression coefficients a, b and c thus obtained are shown in the first row of table 1. For the following forecasts, the coefficients would have been estimated by regressing equation (5) from 1975/76 through 1990/91 and the operation would have been repeated until 2006/07.

Table 1 shows that equation (5) is robust with a high multiple correlation coefficient ranging from 0.88 to 0.93. Coefficients a and b have high t ratios and their values remain fairly stable over the entire 18-year period. Coefficient c has lower t ratios and its value ranges from -0.061 to -0.074. Coefficient d remains stable with high t ratios in the last five seasons, but its value cannot be estimated reliably in the early 1990s because the number of degrees of freedom is too low.

In the second step, the regression coefficients of Table 1 are combined with the historical forecasts of the explanatory variables to arrive at the simulated historical forecasts given in Table 2. Thus, the 93.1 cents per pound predicted for the Cotlook A Index for 1990/91 (first row and fourth column of table 2) would have been calculated in July 1990 by multiplying coefficients a, b and c shown in the first row of Table 1 by the values of the explanatory variables which would have been forecast in July 1990. The operation is repeated for the 16 following rows.

In order to show how errors accumulate, we start from actual values (column 1) and move to fitted values with equation 5 (column 2) before ending with forecasts one year ahead with perfect foresight of explanatory variables (column 3) and historical forecasts (column 4). Discrepancies from the actual value of the Cotlook A Index are shown in cents per pound in the three following columns and as a percentage of the Cotlook A Index in the last three columns. Averages of algebraic and absolute discrepancies and their standard deviations are shown at the bottom of Table 2.

Table 1: Regression coefficients derived from equation 5
Variable periods always starting in 1975/76

End period	a	t	b	t	c	t	d	t	R^2	Adj. R^2	N	Df
1989/90	-0.9494	-9.5	-0.3658	-4.3	-0.0710	-2.2			0.9146	0.9004	15	12
1990/91	-0.9441	-9.6	-0.3475	-4.2	-0.0705	-2.2			0.9096	0.8956	16	13
1991/92	-0.9441	-9.6	-0.3475	-4.2	-0.0705	-2.2	-5.8753	-1.6	0.9213	0.9032	17	13
1992/93	-0.9722	-10.0	-0.3526	-4.2	-0.0669	-2.0	-1.8275	-1.5	0.9142	0.8958	18	14
1993/94	-0.9766	-10.6	-0.3537	-4.4	-0.0663	-2.1	-1.9178	-1.6	0.9182	0.9019	19	15
1994/95	-0.9808	-11.0	-0.3588	-4.6	-0.0658	-2.1	-1.4791	-3.3	0.9249	0.9108	20	16
1995/96	-0.9815	-11.4	-0.3582	-4.8	-0.0657	-2.2	-1.4868	-3.5	0.9263	0.9133	21	17
1996/97	-0.9892	-11.2	-0.3727	-4.9	-0.0649	-2.1	-1.3954	-3.2	0.9188	0.9052	22	18
1997/98	-0.9910	-11.4	-0.3772	-5.0	-0.0647	-2.1	-1.2825	-3.3	0.9179	0.9050	23	19
1998/99	-0.9899	-11.5	-0.3750	-5.1	-0.0648	-2.2	-1.3894	-4.0	0.9207	0.9089	24	20
1999/00	-0.9848	-11.7	-0.3728	-5.1	-0.0655	-2.2	-1.3426	-4.0	0.9199	0.9085	25	21
2000/01	-0.9531	-10.9	-0.3450	-4.6	-0.0693	-2.2	-1.5344	-4.5	0.9063	0.8935	26	22
2001/02	-1.0092	-10.7	-0.3778	-4.6	-0.0623	-1.8	-1.4320	-3.8	0.8914	0.8772	27	23
2002/03	-1.0143	-10.6	-0.3562	-4.3	-0.0613	-1.8	-1.6240	-4.6	0.8919	0.8784	28	24
2003/04	-1.0213	-10.5	-0.3730	-4.5	-0.0674	-1.9	-1.6133	-4.5	0.8887	0.8753	29	25
2004/05	-1.0065	-11.6	-0.3702	-4.6	-0.0701	-2.1	-1.6242	-4.7	0.8952	0.8831	30	26
2005/06	-1.0012	-11.4	-0.3340	-4.3	-0.0743	-2.2	-1.6406	-4.7	0.8887	0.8763	30	26
2006/07	-1.0006	-11.4	-0.3397	-4.4	-0.0733	-2.2	-1.6390	-4.6	0.8848	0.8724	31	27

Table 2: Discrepancies between actual, fitted and predicted prices with perfect foresight and historical forecasts of explanatory variables
Simulations 1990/91 – 2006/07

Season	Actual	Fitted with equation 5	Predicted		Absolute Discrepancy with Actual			Relative Discrepancy with Actual		
			Perfect foresight	Historical forecast						
	(1)	(2)	(3)	(4)	(2)-(1)	(3)-(1)	(4)-(1)	(5)	(6)	(7)
	in US cents/pound				in US cents/pound			in % of A		
1990/91	82.9	87.1	87.7	93.1	4.2	4.8	10.2	5.1	5.8	12.3
1991/92	63.1	67.4	70.1	74.4	4.3	7.0	11.3	6.9	11.1	18.0
1992/93	57.7	57.0	46.1	50.7	-0.7	-11.6	-7.0	-1.2	-20.1	-12.1
1993/94	70.6	69.4	69.4	58.1	-1.2	-1.2	-12.5	-1.7	-1.7	-17.8
1994/95	94.3	97.1	100.8	80.6	2.8	6.5	-13.7	2.9	6.8	-14.5
1995/96	85.6	85.8	86.3	119.3	0.2	0.7	33.7	0.2	0.8	39.4
1996/97	78.6	85.8	85.5	78.9	7.3	6.9	0.3	9.2	8.8	0.4
1997/98	72.2	68.1	69.2	76.3	-4.1	-3.0	4.1	-5.6	-4.1	5.7
1998/99	58.9	59.7	61.3	67.2	0.8	2.4	8.3	1.3	4.1	14.1
1999/00	52.8	50.1	50.6	50.3	-2.7	-2.2	-2.5	-5.0	-4.1	-4.7
2000/01	57.2	51.6	50.8	52.2	-5.6	-6.4	-5.0	-9.8	-11.2	-8.8
2001/02	41.8	48.7	49.0	61.5	6.9	7.2	19.7	16.6	17.3	47.2
2002/03	55.4	51.1	50.1	42.7	-4.3	-5.3	-12.7	-7.7	-9.6	-23.0
2003/04	68.3	62.4	62.3	63.8	-5.9	-6.0	-4.5	-8.6	-8.8	-6.6
2004/05	52.2	51.0	50.7	59.5	-1.2	-1.5	7.3	-2.3	-2.8	13.9
2005/06	56.2	51.4	50.9	47.2	-4.7	-5.2	-9.0	-8.4	-9.3	-16.0
2006/07	59.1	55.1	55.1	60.1	-4.0	-4.0	1.0	-6.7	-6.8	1.6
Algebraic Average				90/91-06/07	-0.5	-0.6	1.7	-0.9	-1.4	2.9
				02/03-06/07	-4.0	-4.4	-3.6	-6.8	-7.5	-6.0
				Standard deviation 90/91-06/07	4.3	5.7	12.6	7.3	9.5	19.6
Average of the absolute difference				90/91-06/07	3.6	4.8	9.6	5.9	7.8	15.1
				02/03-06/07	4.0	4.4	6.9	6.8	7.5	12.2
				Standard deviation 90/91-06/07	2.2	2.8	8.0	4.2	5.2	12.3

(5) = [(2)/(1)-1]*100
(6) = [(3)/(1)-1]*100
(7) = [(4)/(1)-1]*100

As could have been expected, average discrepancies increase from left to right. Over the 17 year period, the average of absolute discrepancies increases from 3.6, to 4.8 and 9.6 cents per pound. Predictions of prices increasing or decreasing in the following season would have always been right with perfect foresight of explanatory variables, but the predictions would have been right in only 13 seasons out of 17 using historical forecasts of explanatory variables.

Predictions improve with better forecasts of explanatory variables; in fact, they have improved in the last five seasons. Average absolute discrepancies fell to 6.9 cents per pound in the last five seasons from 10.7 cents per pound in the 12 preceding seasons.

April Forecasts for the Coming Season

When the price forecast is made at the end of July for the coming season, cotton is already in the ground in the Northern Hemisphere, which accounts for 90% of world cotton production. Since a forecast would be more useful in early April before planting time, a new set of simulations was developed.

In early April 2007, the price forecast for 2007/08 ($A_{07/08}$) is calculated from equation (5) by using the latest available estimates of the explanatory variables, the price forecasts for 2006/07 ($A_{06/07}$) and the stocks-to-mill use ratio forecast for 2007/08 ($X_{07/08}$). The former ($A_{06/07}$) is calculated by combining the known values of the Cotlook A Index in the first 8 months of 2006/07 with the projected values of the remaining 4 months (which is derived from the price forecast for the current season). One month later, the April projection is replaced by its actual value, estimates of the explanatory variables are updated, and equation (5) is solved again. The operation is repeated every month up to the end of the season. Since the season-average price forecast is a weighted average of the known monthly values of the Cotlook A Index up-to-date and of those predicted for the remaining months in the season, forecasts at the end of the season coincide almost exactly with actual values (Table 3).

Simulated errors are higher for the April forecasts than for the September forecasts. When April forecasts are made two seasons ahead (for example in April 2004 for the season 2005/06), errors become very large. It appears therefore desirable to concentrate efforts on the April forecasts made one season ahead (for example in April 2004 for the season 2004/05), which are those most in demand.

Table 3: Forecasts made in April for the season ahead and revised forecasts
Cotlook A Index in cents per pound*

Season	One season ahead	Same season						Actual
	March/ April	September/ October	November/ December	January/ February	March/ April	May/ June	July/ August	
2000/01					61.1	59.7	57.2	57.2
2001/02	61.0	49.7	47.2	45.8	44.0	42.6	41.8	41.8
2002/03	51.5	50.3	49.1	51.5	52.9	54.1	55.5	55.4
2003/04	60.8	62.9	61.6	65.6	67.2	68.3	68.3	68.3
2004/05	67.0	57.0	52.8	50.9	50.6	51.7	52.2	52.2
2005/06	50.4	47.6	49.0	50.8	53.2	55.0	56.2	56.2
2006/07	56.3	60.8	60.3	59.0	58.7	57.8	59.1	59.1
2007/08	69.8							
Discrepancies in cents/pound								
2000/01					3.9	2.5	0.0	
2001/02	19.2	7.9	5.4	4.0	2.2	0.8	0.0	
2002/03	3.9	5.1	6.3	3.9	2.5	1.3	0.1	
2003/04	7.5	5.4	6.7	2.7	1.1	0.0	0.0	
2004/05	14.8	4.8	0.6	1.3	1.6	0.5	0.0	
2005/06	5.8	8.5	7.1	5.4	2.9	1.2	0.0	
2006/07	2.8	1.7	1.2	0.1	0.4	1.3	0.0	
Average	9.0	5.6	4.5	2.9	1.8	0.8	0.0	
Std.Dev.	6.5	2.5	2.9	1.9	1.2	0.8	0.0	
Average (in % of Actual)	17.9	10.5	8.3	5.5	3.9	2.0	0.0	

* The March/April forecast is made in late March or early April.

Seasonal Pattern

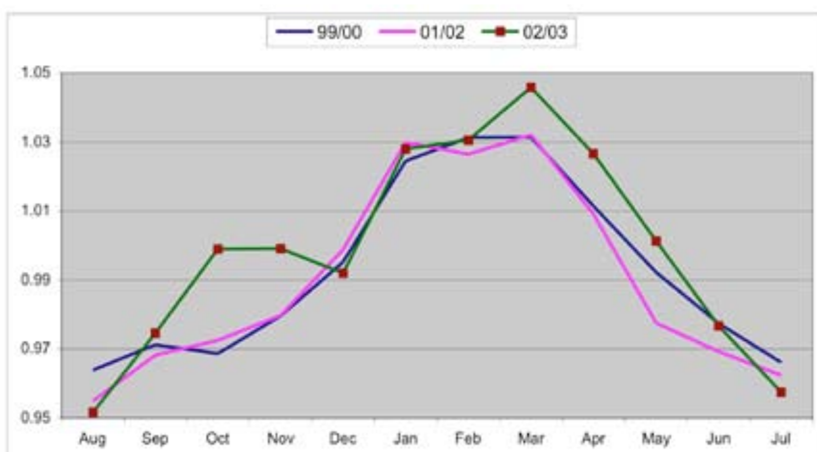
When the 69.8 cents price forecast for the 2007/08 season was made in March/April 2007 (Table 3), the price for May 2007 was calculated by multiplying the price forecast for the average of the 2006/07 season by the May seasonal coefficient. Similarly, prices for June and July were calculated by applying the June and the July coefficients[12].

The seasonal patterns are illustrated on Chart 2 for three recent seasons (1999/00, 2001/02 and 2002/03). Averages for these three recent seasons differ from those calculated in an earlier period (Chart 3). But, in both cases, seasonal coefficients remain within a narrow range going from 0.96 to 1.04.

The seasonal patterns as measured in this study do not appear to be very stable. The use of seasonal coefficients is therefore not expected to improve significantly the predictive power of the model without better estimates of monthly seasonal coefficients.

Deseasonalized monthly price patterns show that the price trend in the first months of the season is not indicative of what will happen in the rest of the season (Chart 4). This was the reason for not relying on this trend for projecting the value of the Cotlook A Index in future months and using a weighted average of the Cotlook A Index for the months known and projections derived from yearly forecasts for the months to come.

Chart 2. Seasonal coefficients in recent seasons

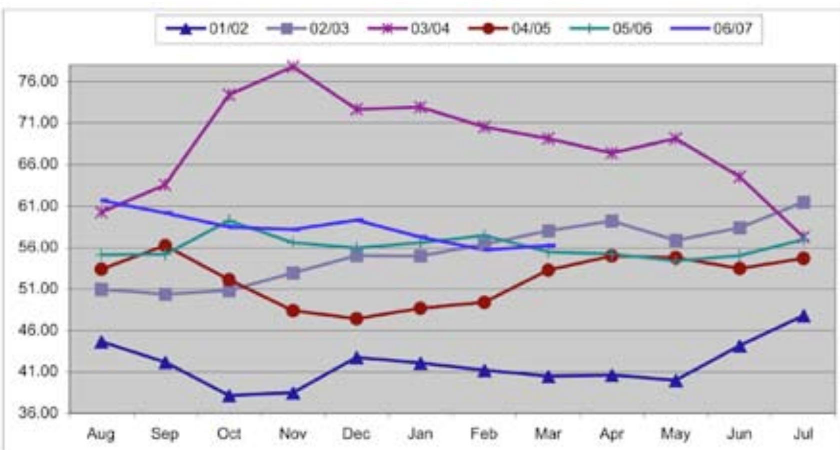


(Continue in page 20)

12. Seasonal coefficients were estimated with a two-step procedure. The Cotlook A Index in month m of year t (A_{mt}) has four components accounting for the impact of: long term trend, long cycles, random events and seasonal factors. The first two are largely eliminated by calculating 12 monthly averages centered on month m and calculating the average for month m over a large number of years (A'_m). Dividing the original data by A'_m leaves the short term components, of which random events are eliminated by taking the average for month m over the years.

Chart 3. Changes in seasonal patterns

Chart 4. Deseasonalized monthly prices in the last six seasons



Conclusion

World cotton prices measured by the Cotlook A Index are closely linked to the stocks-to-mill use ratio in the world less China. From 1975/76 to 1991/92, 88% of the variance in the Cotlook A Index could be explained by lagged changes in this ratio. However, during that period, China's imports from (or exports to) the rest of the world remained relatively modest in world cotton trade. In 1991/92, a new explanatory variable had to be introduced to take into account changes in China's trade and stock piling policies. The building of a large stock pile contributed to raise world prices in the mid '90s and the disposal of the surplus stocks to depress prices through 2004/05. The explanatory variables of the ICAC Model 2007 are now the lagged values of ending stocks-to-mill use ratio in China and in the world less China. They explain nine-tenths of the variance in world prices.

High correlation in the past does not, however, imply good price predictability. The predictive power of the model had to be tested by simulating the price forecasts which could have been made over the last 17 seasons with the information available at the time. For forecasts made one year ahead, the ICAC Model 2007 was solved first by assuming perfect foresight of the explanatory variables and, second, by using the historical forecasts of these variables as consigned in ICAC files. Absolute differences between forecast and actual prices averaged 4.8 cents per pound in the first case and 9.6 cents in the second. But errors in historical forecasts (the second case) were reduced from 10.7 cents per pound in the first twelve seasons to 6.9 cents per pound in the last five.

Price forecasts before planting time are those most in demand, and a forecasting model was built for this purpose. The model has to be solved every month so as to incorporate new information when it becomes available: monthly values of the Cotlook A Index and revised estimates of the explanatory variables. With the simulations conducted, errors were significantly larger for the April than for the September forecast.

The high prices in 2003/04 combined with excellent yields in the following season led to a record stocks-to-mill use ratio in the world less China at the end of 2004/05. Surplus stocks declined only slowly in the two following seasons, but a substantial decline is now foreseen for 2007/08. Based on the projected decline in the stocks-to-mill use ratio, the ICAC Model 2007 forecasts a season-average Cotlook A Index of 71 cents per pound for 2007/08, a price which has not been reached since 1997/98. However, it is important to remember that (as noted above) the simulated historical forecasts led to errors averaging 9.5 cents per pound over the last 17 seasons.

Annex: Price Effects of U.S. Cotton Subsidies

The impact of U.S. cotton subsidies on world cotton prices is a contentious issue. During the 2006 ICAC Plenary Meeting, several members asked the Secretariat to investigate whether the impact of U.S. subsidies on the Cotlook A Index could be established statistically.

This analysis was done by incorporating into regression equation (5) the explanatory variable S_t which measures the cost of U.S. cotton subsidies as a percentage of the value of world cotton exports. Since the new regression equation (7) was solved for the period starting in 1990/91, the results have to be compared with those of equation (6) solved over the same time period without the explanatory variable $\ln(S_t/S_{t-1})$. The t ratio of the new coefficient is not very high (1.7), but the unexplained variance is reduced from 11% to 9%, as shown from the comparison between equations (6) and (7) and that of Charts 1 and 5.

$$\ln(A_t/A_{t-1})=a*\ln(X_t/X_{t-1})+b*\ln(X_{t-1}/X_{t-2})+m_t*c*\ln(Y_{t-1}/Y_{t-2})+(1-m_t)*d*\ln(Z_t/Z_{t-1}) \quad (6)$$

-1.17	-0.26	-0.30	-1.56	Coefficients
0.158	0.141	0.160	0.375	Std error
(7.4)	(1.8)	(1.9)	(4.2)	t ratio

$R^2 = 0.89$ R^2 adjusted = 0.86 DW = 2.4
1990/91 – 2006/07

S_t = 100 * (cost of U.S. cotton subsidies/value of world cotton exports)

$$\ln(A_t/A_{t-1})=a*\ln(X_t/X_{t-1})+b*\ln(X_{t-1}/X_{t-2})+m_t*c*\ln(Y_{t-1}/Y_{t-2})+(1-m_t)*d*\ln(Z_t/Z_{t-1})+e*\ln(S_t/S_{t-1}) \quad (7)$$

-1.07	-0.18	-0.26	-1.37	-0.03	Coefficients
0.161	0.142	0.152	0.369	0.017	Std error
(6.6)	(1.2)	(1.7)	(3.7)	(1.7)	t ratio

$R^2 = 0.91$ R^2 adjusted = 0.88 DW = 2.3
1990/91 – 2006/07

The effect of adding U.S. subsidies was further assessed by solving equations (7) (with subsidies) and (5) (without subsidies) for 17 consecutive seasons and comparing fitted and actual values of the Cotlook A Index (columns (2)-(1) of Table 2 and column (3) of Table 4). Fits are better with than without U.S. subsidies. By taking U.S. subsidies into account, average discrepancies between fitted and actual values of the Cotlook A Index are reduced from -0.5 to -0.2 cents per pound in algebraic terms (which reduces the downward bias) and from 3.6 to 2.7 cents per pound (first and fourth lines at the bottom of Tables 2 and 4).

Although equation (7) gives an excellent fit, it cannot be used to forecast prices, because the level of U.S. subsidies has to be derived from the Cotlook A Index and not the other way around. Once the U.S. cotton subsidy policy is set, the amount of subsidies depends on the level of the Cotlook A Index. Since important policy changes were introduced in the 1996 farm law, it seemed appropriate to regress the level of U.S. subsidies (measured by S_t) against the Cotlook A Index (A_t) from 1997/98. The two variables were closely correlated:

$$\ln(S_t/S_{t-1}) = -3.56*\ln(A_t/A_{t-1}) \quad \text{with } t = 8.6,\ R^2= 0.89,\ R^2 \text{ adjusted} = 0.89 \quad (8)$$

In order to assess the impact of lower U.S. subsidies on world prices, a demand-supply model has to be constructed. Once a new U.S. farm law is signed, it will be necessary to assess whether changes from previous farm laws are sufficiently important to adjust equation (5) when forecasting the Cotlook A Index.

Table 4. Discrepancies between actual and fitted prices with U.S. subsidies as an explanatory variable
Simulations 1990/91 – 2006/07

Season	Actual	Fitted with equation 7, subsidies	Absolute Discrepancy with Actual	Relative Discrepancy with Actual
	(1)	(2)	(3)=(2)-(1)	(4)=(3)/(1)*100
	in US cents/pound			in % of A
1990/91	82.9	86.4	3.5	4.2
1991/92	63.1	65.1	2.0	3.2
1992/93	57.7	58.3	0.6	1.0
1993/94	70.6	70.1	-0.5	-0.8
1994/95	94.3	97.0	2.7	2.9
1995/96	85.6	90.1	4.5	5.3
1996/97	78.6	79.7	1.2	1.5
1997/98	72.2	68.4	-3.8	-5.3
1998/99	58.9	59.4	0.5	0.9
1999/00	52.8	50.1	-2.7	-5.2
2000/01	57.2	52.1	-5.1	-8.9
2001/02	41.8	47.5	5.7	13.6
2002/03	55.4	52.7	-2.7	-5.0
2003/04	68.3	67.1	-1.2	-1.8
2004/05	52.2	49.2	-3.0	-5.7
2005/06	56.2	57.3	1.2	2.1
2006/07	59.1	53.6	-5.5	-9.3
Algebraic Average		90/91-06/07	-0.2	-0.4
		02/03-06/07	-2.2	-3.9
Standard deviation		90/91-06/07	3.3	5.8
Average of the absolute diff.		90/91-06/07	2.7	4.5
		02/03-06/07	2.7	4.8
Standard deviation		90/91-06/07	1.7	3.5

Chart 5. Fitted with U.S. subsidies and actual values of the Cotlook A Index, 1990/91 -2006/07

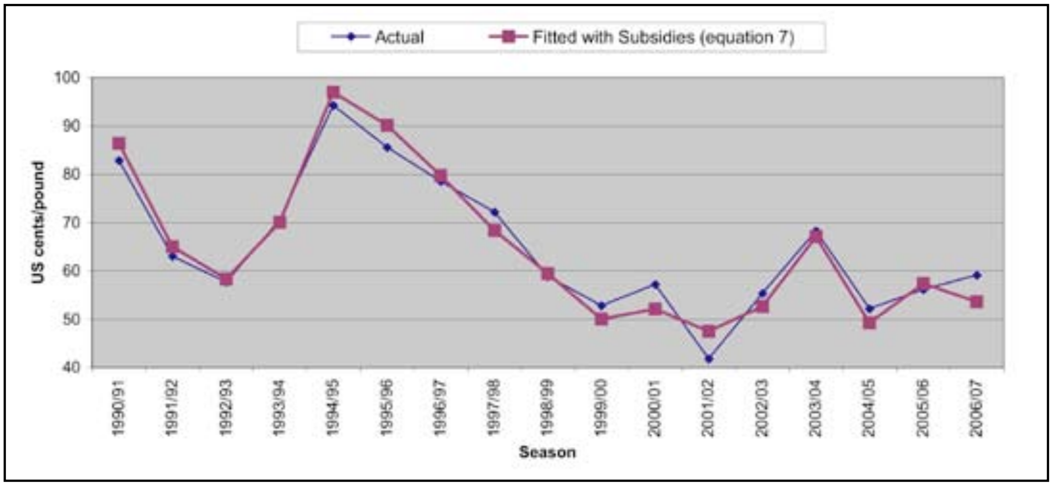


Table 5. Basic Data 1970/71 through 2007/08

Season	A	X	Y	Z	S	$\ln(A_t/A_{t-1})$	$\ln(X_t/X_{t-1})$	$\ln(Y_{t-1}/Y_{t-2})$	$\ln(Z_t/Z_{t-1})$	$\ln(S_t/S_{t-1})$
1970/71	31.1	41.28	20.43	97.88	34.44					
1971/72	37.2	41.67	19.81	96.78	24.29	0.178	0.009		-0.011	-0.349
1972/73	42	45.5	22.13	90.9	18.81	0.122	0.088	-0.031	-0.063	-0.256
1973/74	76.5	44.91	32.5	91.64	9.74	0.601	-0.013	0.111	0.008	-0.658
1974/75	52.5	64.31	34.75	97.1	2.9	-0.376	0.359	0.384	0.058	-1.211
1975/76	65.3	43.23	43.47	96.9	1.96	0.218	-0.397	0.067	-0.002	-0.392
1976/77	81.9	41.91	31.11	98.38	14.26	0.226	-0.031	0.224	0.015	1.985
1977/78	65.1	52.13	18.49	93.16	1.14	-0.23	0.218	-0.335	-0.055	-2.531
1978/79	76.1	46.35	8.15	89.7	3.13	0.157	-0.117	-0.52	-0.038	1.014
1979/80	85.4	44.74	9.82	82.34	1.13	0.115	-0.035	-0.819	-0.086	-1.017
1980/81	94.2	40.75	14.44	85.15	3.25	0.098	-0.093	0.186	0.034	1.054
1981/82	73.8	50.69	10.67	90.52	7.64	-0.244	0.218	0.385	0.061	0.856
1982/83	76.7	48.7	15.34	95.58	8.98	0.038	-0.04	-0.303	0.054	0.161
1983/84	87.7	38.47	51.34	100.4	5.12	0.134	-0.236	0.364	0.049	-0.562
1984/85	69.2	50.45	124.49	103.7	9.3	-0.237	0.271	1.208	0.032	0.598
1985/86	49	60.2	91.33	111.19	21.34	-0.344	0.177	0.886	0.07	0.83
1986/87	62.1	44.92	44.85	111.17	20.35	0.236	-0.293	-0.31	0	-0.047
1987/88	72.3	44.99	32.93	108.49	13.14	0.153	0.002	-0.711	-0.024	-0.437
1988/89	66.4	43.39	26.73	100.65	15.26	-0.086	-0.036	-0.309	-0.075	0.149
1989/90	82.4	35.34	24.77	96.33	6.71	0.217	-0.205	-0.209	-0.044	-0.821
1990/91	82.9	36.03	37.61	95	4.41	0.006	0.019	-0.076	-0.014	-0.42
1991/92	63.1	42.75	76.12	96.72	13.44	-0.274	0.171	0.418	0.018	1.115
1992/93	57.7	41.15	66.28	101.61	28.29	-0.089	-0.038	0.705	0.049	0.745
1993/94	70.6	35.67	47.79	99.83	19.45	0.202	-0.143	-0.138	-0.018	-0.375
1994/95	94.3	33.75	72.76	87.58	2.94	0.289	-0.055	-0.327	-0.131	-1.888
1995/96	85.6	36.64	103.82	89.26	0.38	-0.097	0.082	0.42	0.019	-2.055
1996/97	78.6	36.55	118.28	87.76	6.65	-0.086	-0.003	0.356	-0.017	2.869
1997/98	72.2	38.04	141.17	93.46	9.57	-0.084	0.04	0.13	0.063	0.364
1998/99	58.9	39.82	151.09	101.24	26.47	-0.204	0.046	0.177	0.08	1.017
1999/00	52.8	43.12	110.53	105.39	44.27	-0.109	0.079	0.068	0.04	0.515
2000/01	57.2	46.26	88.93	100.75	26.95	0.08	0.07	-0.313	-0.045	-0.496
2001/02	41.8	53.97	75.34	99.64	62.69	-0.314	0.154	-0.217	-0.011	0.844
2002/03	55.4	47.41	53.01	92.38	35.48	0.282	-0.129	-0.166	-0.076	-0.569
2003/04	68.3	45.14	45.43	74.61	15.19	0.209	-0.049	-0.351	-0.214	-0.849
2004/05	52.2	62.13	37.27	81.53	52.3	-0.269	0.32	-0.154	0.089	1.237
2005/06	56.2	57.43	40.51	56.88	31.42	0.073	-0.079	-0.198	-0.36	-0.509
2006/07	59.1	59.71	26.39	70.85	28.13	0.051	0.039	0.083	0.22	-0.111
2007/08f	**71**	**50.31**				**0.291**	**-0.169**	-0.429		

f: Forecasts as of July 31, 2007 in bold.

A_t = average value of the Cotlook A Index in current U.S. cents/pound in season t.

X_t = ending stocks as a percentage of mill use in season t for the world minus China.

Y_{t-1} = ending stocks as a percentage of mill use in season t-1 for China.

S_t = cost of U.S. cotton subsidies as a percentage of the value of world cotton exports in season t.

Z_t = 100 * (1- net imports into China/world imports).