EXPLAINING INTERNATIONAL COTTON PRICES: A STRUCTURAL MODEL APPROACH

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Abstract

Using recent advances in market integration literature, this paper explains and forecasts changes in international cotton prices. The theoretical model is based on the existence of a geographically integrated oligopolistic cotton market. Exogenous shocks are captured by comovements in agricultural commodity prices, and the structural variables are determined by historical factors.

Introduction

Scholars and traders alike are interested in gaining an understanding of commodity prices. Although the academic society is primarily concerned with satisfying intellectual curiosity and traders seek to increase profits through skilled forecasts, there is nothing to preclude academic research from being used to make money. Modern trading companies make increasing use of econometric techniques to explain commodity prices and to enhance their forecasting ability.

Despite the fact that forecasting is nothing but a simple simulation exercise, there is no uniformly accepted scientific methodology to generate price forecasts. The development of structural models in the 70's, based on supply and demand equations, were abandoned in favor of Box Jenkins techniques in the 80's and early 90's. Recently, commodity forecasting has been based on Bayensian models and the use of qualitative models.

The forecasting literature, however, has largely ignored recent developments in the theory of integrated commodity markets. According to this theory, commodity markets are integrated in the sense that price movements are transmitted across spatially dispersed markets and across different commodities. Since commodity markets are suspected of fragmentation and spatial oligopoly pricing (Basu and Bell, 1991), a number of recent studies have addressed the issue of testing the degree of market integration. For the cotton market, Baffes and Ajwad (1998) concluded that the degree of price linkage has been improved over the last decade. The existence of cotton price integration was explained as the result of short-run price transmission and, to a lesser extent, long-run comovements.

Based on the existence of a spatial oligopoly pricing in the world cotton market, this paper constructs a structural model, which takes into account the structure of price determination across markets. The first section is devoted to the theoretical derivation of the price model. The second section provides the empirical estimation and the forecasting results of the model. The model is validated using forecasts beyond the period of fit and measuring the cost of forecasts.

The Theoretical Model

Consider a random distribution of markets where a central market with price P_c is related to n other markets. The prices of the submarkets are not directly related to each other. The model of spatial price determination is thus:

$$P_c = P_c\,(P_1,\ldots,P_n, X_c) \text{ central market price,} \quad (1)$$

$$P_i = P_i\,(P_c, X_i),\ i= 1,\ldots,n \text{ other market prices,} \quad (2)$$

where X are market-specific seasonal and exogenous variables which affect price formation. The dynamic structure of the submarket price equations is specified as a function of past prices, and the general structure of L lags is as follows:

$$P_{it} = \sum a_{ij}p_{i,t-j} \sum b_{ij}p_{c,t-j} + k_iX_{it} + e_{it},\ i= 1,\ldots,n \text{ and } j= 1,\ldots,l \quad (3)$$

Under long-run equilibrium, a permanent price change in the central market is passed over time to the submarkets, but potentially through lagged effects. Solving (3) for the long-run equilibrium change dp_j, assuming only one lag and long run market intervention conditions ($\sum a_{ij} + \sum b_{ij} = 1$), we conclude:

$$dp_{it} = (a\text{-}1)dp_{i,rt-1} + b_idp_{rt} + kX_{it} + e_{it} \quad (4)$$

Equation (4) relates the change in price of a market to past spatial differentials, the current changes in other markets and market specific exogenous factors. If the one lag period includes a particularly large time interval (i.e. one season), past price differentials have already been incorporated in different markets and further simplify the model by assuming a = 1. Thus, equation (4) can be written as:

$$dp_{it} = b_1dp_{r1t} +\ldots+ b_ndp_{rnt}+ kX_{it} + e_{it} \quad (5)$$

where the price of a local market depends on the prices of n dominant markets and market specific exogenous factors. However, the prices in these dominant markets are a function of market fundamentals. Also, assuming that prices are transmitted across commodities, we can deflate local prices by a deflator based on the prices of relevant commodities. Thus, the theoretical model can generate an empirical model of the following form:

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$$dP_t = A_0 + A_1 d(s/u)_1 + \ldots + A_n d(s/u)_n + e_t \qquad (6)$$

where P_t are local commodity prices deflated to account for exogenous factors, and s/u is the supply to use ratio in each of the n dominant markets.

Empirical Model

Historically, the Cotlook A Index is the most accepted indicator of international cotton prices. It is an average of the five less expensive offering prices out of 14 styles of cotton (Middling 1-3/32") traded in Northern Europe. Based on model (6) developed in the previous section, we can assume that the Cotlook A Index (which represents average prices in local markets) should be a function of the fundamentals in some dominant markets. The Cotlook A Index is deflated by a composite commodity index to account for the effects of exogenous variables. The non-energy commodity price index provided by the World Bank has been chosen for this purpose. Since the forecasting power of the model decreases by increasing the number of structural variables, we assume the existence of only two dominant markets: the USA and the Rest of the World. For statistical reasons all variables entering the model have been logged. Thus, equation (6) can be written as follows:

$$\text{dlog(A Index)} = A_0 + A_1 \text{dlog}(s/u)_{usa} + A_2 \text{dlog}(s/u)_{RW} + e_t$$
(7)

Table-1 describes the OLS estimates of this model for the period 1974-98. Several misspecification tests have been conducted to support the validity of the estimated coefficients. The t-statistics indicate significance at the 1% level for the non-constant independent variables.

Table 1. OLS Estimates of the Cotton Price Model

Parameters	Coefficient	Std Dev	t-statistics
Constant	-0.006304	0.018	0.34
$\text{dlog}(s/u)_{usa}$	-0.196090*	0.031	6.25
$\text{dlog}(s/u)_{RW}$	-0.288444*	0.099	2.83
R^2	0.7290		
DW	2.3986		

* Significant at 1% level

The forecasting power of model (7) can be measured by comparing the fitting power of the forecasts beyond the period of fit. Thus, model (7) is estimated for the period 1974-90, and the forecasts for the period 1991-98 are compared to the actual A-Index and the fitted values of model (7) for the period 1974-98. Table-2 contains the numerical predictions of the above exercise. The results indicate that the fitted values of the model for the period 1974-98 are quite close to the A-Index. However, even more impressive is the fact that the forecasts of the model for the period 1991-98 are less than 8 cents away from the actual price. Assuming that world supply and demand for the next two seasons will be close to the ICAC forecasts, and assuming that the non-energy commodity index will remain stable in the next two seasons, the model forecasts that the Cotlook A index will be around 52 cents in 1999/00 and 57 cents in 2000/01.

Table-2. Fitting and Forecasting Power of the Pricing Model

YEAR	A-INDEX	EST. 1974-98	EST. 1974-98
1974	52.50	52.50	52.50
1975	65.30	58.59	58.40
1976	81.85	75.63	75.36
1977	65.05	72.9	73.17
1978	76.05	82.18	82.37
1979	85.40	100.4	100.5
1980	94.20	97.54	97.97
1981	73.80	70.38	71.34
1982	76.65	64.74	65.89
1983	87.65	79.50	80.58
1984	69.15	59.69	61.11
1985	49.00	45.01	46.56
1986	62.05	62.68	64.27
1987	72.30	67.70	69.60
1988	66.35	72.71	74.98
1989	82.40	85.43	87.64
1990	82.95	80.71	82.95
1991	63.05	63.73	66.07
1992	57.70	60.11	62.55
1993	70.60	74.44	77.31
1994	94.30	91.04	94.57
1995	85.61	86.39	90.18
1996	78.60	77.16	80.99
1997	72.20	72.09	75.86
1998	58.90	58.24	61.55
1999		52.62	55.76
2000		57.43	60.91

Summary

This paper argues that recent advances in market integration literature can be used to explain and forecast changes in international cotton prices. The theoretical model was based on the existence of a geographically integrated oligopolistic cotton market. Exogenous shocks were captured by comovements in agricultural commodity prices, and the structural variables were determined by historical factors.

The USA plays a central role in determining world prices. Using the supply and demand balance in the USA and in the Rest of the World we can justify past fluctuations and make mathematical predictions of the level of international prices in the coming years. This implies that policy programs in dominant markets may determine price movements to a certain extent.

The accuracy of the forecasts depends on the successful prediction of the structural variables and the deflator. Finally, the importance of the results should not be overemphasized given the small range of observations and the existence of structural changes within this period.

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