DO COTTON PRICES MOVE TOGETHER?

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Abstract

The recent liberalization of the economies of many developing countries and the subsequent withdrawal of the state involvement has made the need of producers and commercial traders of primary commodities to manage price risk more apparent. Futures contracts are the standard tools to hedge price uncertainty in developed countries. An important pre-condition for the well functioning and viability of futures markets is that the spot markets under consideration are well integrated. This paper examines the degree to which the world cotton market is integrated. One of the major findings is that there is some segmentation between U.S. and non-U.S. cotton markets as the speed at which price changes are transmitted within non-U.S. cotton markets is much higher that the speed of transmission from U.S. to non-U.S. cotton markets. This implies that non-U.S. producers and traders can best manage their risk through non-U.S. futures contracts. However, non-U.S. cotton markets are not as well integrated as the U.S. ones and hence the development of a non-U.S. futures contract may not be a feasible alternative to hedge non-U.S. cottons at present.

Introduction

A number of studies have examined the existence of a linkage between New York (NY) cotton futures prices and the prices of non-U.S. cottons (Varangis et al., 1994; Lake, 1992; Gazanfer, 1992). These studies found that overall the correlation between non-U.S. cotton cash prices and NY cotton futures prices is not strong enough, in turn implying that the NY cotton futures contract is not the most appropriate instrument to hedge cotton price risks for non-U.S. cottons.

More recently, market liberalization in many developing countries and globalization of commodity markets due to advances in technology have contributed in a closer relationship of prices for the same commodity across origins. The purpose of this study is to examine the degree to which cotton cash prices from different U.S. and non-U.S. origins are correlated with each other. Indirectly, the study makes some assessment regarding the feasibility of using the NY cotton futures contract to hedge non-U.S. cotton prices and also the development of a non-U.S. futures contract.

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Methodology and Data

Studies analyzing the relationship between set of prices either have looked at correlation coefficients (e.g., Timmer et al., 1983; Stigler and Sherwin, 1985) or have used the following type of regression (e.g. Isard, 1977; Richardson, 1978; Mundlak and Larson, 1992):

$$(1) \qquad p_t^1 = \mu + \beta p_t^2 + \epsilon_t,$$

where p_t^1 and p_t^2 denote the price of the commodity under consideration in location 1 and 2 respectively. μ and β are parameters to be estimated while e_t denotes the error term. A high r-square and a significant β would indicate strong price co-movement.

However, because the prices under consideration are non-stationary (Ardeni, 1989; Baffes, 1991), in this paper we employ the following error-correction model (Hendry et al., 1984):

$$(2) \qquad (p_t^1 - p_{t-1}^1) = \mu + \alpha(p_{t-1}^2 - p_{t-1}^1) + \beta(p_t^2 - p_{t-1}^2) + u_t.$$

Note that all series in (2) are stationary, either because the price differential is stationary (reflecting long-run co-movement among prices) or because prices are first differenced.

In addition to taking into consideration the stationarity properties of prices, the main feature of (2) is the economic interpretation of its parameters: β indicates how much of a given change in the price of the commodity in location 1 will be transmitted to the price of location 2 within the current period (referred to as initial adjustment term, short-run effect, or contemporaneous effect); a indicates how much of the past price difference between the prices in the two locations is eliminated in each period thereafter (referred to as error-correction term, speed of adjustment, or feedback effect). Even though both parameters are expected to fall within the [0,1] interval, a stationary price differential guarantees (in theory) only a to be within [0,1]. The closer to unity are a and b, the higher the speed at which price changes in location 1 are translated into price changes in location 2.

How can the information contained in the parameter space of (1) be transformed in such a way so that a succinct interpretation of both contemporaneous and feedback effect can be given? Let n be the period in which k percent of the adjustment takes place. In the current period, $n = 0$, k takes the value of β [also equal to 1-(1-β)], which is the short-run effect of $(p_t^2 - p_{t-1}^2)$ on $(p_t^1 - p_{t-1}^1)$. In the next period, $n = 1$, k takes the value of $\beta+(1-\beta)\alpha$, which is the effect of the previous period, β, plus the feedback effect, $(1-\beta)\alpha$ [it can also be written as $1-(1-\beta)(1-\alpha)$]. For $n = 2$, k takes the value of the previous period, $\beta+(1-\beta)\alpha$ plus $a(1-\beta-(1-\beta)\alpha)$ [which can be written as $1-(1-\beta)(1-2\alpha+\alpha^2)$ or $1-(1-\beta)(1-\alpha)^2$]. Hence, the adjustment at period n will be given by:

(3) $$k = 1 - (1 - \beta)(1 - \alpha)^n.$$

For values of α and β close to unity, a small n (number of periods) is required for the adjustment to be completed (i.e. k close to unity). At the extreme, if $\beta = 1$ then $k = 1$ in the current period (i.e. instantaneous adjustment) while if $\alpha = 1$ then $k = 1$ in the first period (i.e. the adjustment is completed within one period).

CIF North Europe weekly quotations as reported by Cotton Outlook are used in the analysis. All prices are in US cents per lb. and cover the period 1995:33 – 1996:50, giving a total of 71 observations. The U.S.-type cottons included in the study are: Orleans/Texas SLM 1-1/32" (referred as Orleans); Memphis Terr. Midd. 1-3/32" (referred as Memphis); Calif/Ariz. DPL Midd. 1-3/32 (referred as Arizona). The non-U.S. cottons include: Greek Midd. 1-3/32" (referred as Greece); Turkish Adana St.l White 1-1/16" RG (referred as Turkey); Central Asian Midd 1-3/32" (referred as Asia); and African 'Franc Zone' Midd 1-3/32" (referred as Africa). Note that Orleans and Turkey are components of the B Cotlook Index while the rest are components of the A Cotlook Index – the most commonly used reference for the "world price" of cotton (Cotton Outlook).

In addition to reporting the R-square of regression (2) (middle panel), Tables 1 through 3 report results for the adjustment achieved in a 2-week period (i.e. $n = 2$) (lower panel). Finally, to indicate the degree to which simple correlation coefficients can give misleading results, we also report simple correlation coefficient results (upper panel).

Do U.S. Cotton Prices Move Together?

Table 1 reports results for the three U.S. cotton origins. The upper panel shows the correlation coefficients of the price series. The average correlation coefficient is 0.96 with very small disparity among the individual ones. Correlation coefficients range between 0.95 and 0.97. This indicates that U.S. cotton prices are closely correlated. The middle panel of table 1 shows the R-squares of the pair-wise regression (2). The R-squares are high averaging 0.94. As in the case of correlation coefficients, the disparity between pair-wise R-squares is small, ranging from 0.92 to 0.95. The R-squares indicate that each U.S. cotton price explains a large share of the price variability (on average 94%) of another U.S. cotton price. The lower panel of Table 1 shows the amount of adjustment achieved in a 2-week period. On average, 98% of the price adjustment would take place within a 2-week period. Again, the disparity among speeds of adjustment is small as they all fall in the 93% – 100% range. To summarize, analysis on the U.S. cotton prices indicate that these prices move very closely together. Price adjustments also take place within a relatively short period of time. Although these findings in themselves are not surprizing in the sence that they were expected, their importance lies on the fact that they can be used as benchmark cases for comparison when considering the performance of the non-U.S. cotton origins (see next two sections).

Do Non-U.S. Cotton Prices Move Together?

Table 2 reports results of the four non-U.S. cotton origins. The correlation coefficients (upper panel) are high, with an average correlation coefficient of 0.96 and small disparities among them (ranging from 0.95 to 0.98). These results indicate a close correlation among non-U.S. cotton prices. The R-squares from the regression (2) average 0.74, a significantly lower average compared to the U.S. cotton origins. Also, the disparity among R-squares is higher compared to U.S. price data, ranging from a low of 0.62 for West Africa-Greece, to a high of 0.84 for Greece-Turkey. Furthermore, the R-squares indicate that the weaker relationship among non-U.S. cotton prices is among West African prices and the other non-U.S. cotton prices, thus rendering West Africa a rather segmented origin. The 2-week period adjustment among non-U.S. cotton prices averaged 90%. This is lower than the one observed among U.S. cotton prices but still high. The disparity of adjustment between non-U.S. cottons is larger, ranging from 74% between Central Asia and West Africa to 97% between Asia and Greece, again reconfirming the relative isolation of West Africa origin.

Do U.S. and non-U.S. Cotton Prices Move Together?

Lastly, we turn our attention to the relation between U.S. and non-U.S. origins. The correlation coefficients (upper panel of Table 3), are considerably lower in comparison to those among U.S. as well as among non-U.S. cotton prices. Also, the disparity among these correlation coefficients is relatively wide, ranging from a minimum of 0.76 to a maximum of 0.94. The R-squares from the pair-wise regressions are significantly lower (middle panel of Table 3), averaging 0.68; they are 26 and 6 percentage point lower that those of U.S. and non-U.S. cotton prices, respectively. This means that U.S. cotton prices explain a relatively low percentage of the variations in non-U.S. prices. Finally, the results in the lower panel of Table 3 indicate that, on average, about half of the adjustment in prices is achieved in a period of two-weeks, an extremely low figure compared to the 98% average of U.S. origins.

Conclusions

In this paper we examined the degree of co-movement of cotton prices from seven origins. In particular, we used weekly CIF Northern Europe quotations for three U.S. and four non-U.S. cotton origins covering the 1995-96 period – a total of 71 observations. The results indicated that the three U.S. cotton prices under consideration move in a very synchronous manner, as expected. Non-U.S. cotton prices indicated considerably less co-movement as, on average, a non-U.S. cotton price explains about three fourths of the variation of another non-U.S. cotton price. An implication of this is that if there is a futures contract for a non-U.S. cotton, this futures contract will not be very useful in hedging the price risk for another non-U.S. futures contract. This is because the basis risk, i.e., the difference between the futures and the cash prices, will likely be high.

The study also found a considerable weak price co-movement between non-U.S. and U.S. cotton prices. U.S. cotton prices explain on average 68% of the variation of non-U.S. prices. Also, following a change in U.S. cotton price, non-U.S. cotton prices adjust by only 52% within a 2-week period. This result has some implications about the use of the New York cotton futures contract to hedge non-U.S. cotton price risks. Given that NY cotton futures prices move closely with the U.S. cash cotton prices, low co-movement between U.S. and non-U.S. cash prices indicates that the basis risk between NY cotton futures prices and non-U.S. cash prices is likely to be relatively high.

In comparison to previous studies, the results indicate that non-U.S. cotton prices move more closely together and also that non-U.S. and U.S. cotton prices do also move closer. This shows that in more recent years, cotton prices from various origins show a higher degree of following each other than previously estimated. This can be attributed to the globalization of commodity markets and to market liberalization. Lower government intervention in several cotton producing countries allow a higher degree of pass-through of market signals. However, this degree of co-movement may not be enough to justify the creation of a non-U.S. futures contract.

Finally, one methodological point related to the use of simple correlation coefficients is in order. As mentioned earlier, when the series under consideration are non-stationary – as is the case in the present study – some of the standard statistical results may no longer hold. This study reconfirms such case: While the average correlation coefficient among U.S. and non-U.S. markets was 0.96, thus indicating a strong market link in both cases, the error-correction model indicated that the U.S. cotton markets perform much better than the non-U.S. according to the R-square and adjustment period criteria. Therefore, one of the methodological conclusions is that caution should be exercised when non-stationary series are present.

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Table 1: U. S. Cotton Markets

	Orleans@	Memphis*	Arizona*	*Average*
Correlation coefficient				
Orleans@	–	0.97	0.95	*0.96*
Memphis*	0.97	–	0.97	*0.97*
Arizona*	0.95	0.97	–	*0.96*
Average	*0.96*	*0.97*	*0.96*	*0.96*
R-square				
Orleans@	–	0.95	0.94	*0.95*
Memphis*	0.95	–	0.92	*0.93*
Arizona*	0.94	0.92	–	*0.93*
Average	*0.95*	*0.94*	*0.93*	*0.94*
Two-week adjustment				
Orleans@	–	97%	93%	*95%*
Memphis*	98%	–	100%	*99%*
Arizona*	100%	99%	–	*100%*
Average	*99%*	*98%*	*97%*	*98%*

Notes: An asterisk (*) indicates that the quotation in question is a component of the A Index while (@) indicates that the quotation is a component of the B Index. The "Correlation coefficient" measure is the simple correlation coefficient of the two prices under consideration. The "*R*-square" measure refers to the error-correction equation (2). The "two-week adjustment" measure refers to equation (3) where $n = 2$. Note that while the correlation coefficient matrix (upper panel) is symmetric the other two need not be.

Table 2: Non-U.S. Cotton Markets

	Turkey@	Greece*	Asia*	Africa*	*Average*
Correlation coefficient					
Turkey@	–	0.98	0.96	0.95	*0.96*
Greece*	0.98	–	0.97	0.95	*0.96*
Asia*	0.96	0.97	–	0.97	*0.97*
Africa*	0.95	0.95	0.97	–	*0.96*
Average	*0.96*	*0.96*	*0.97*	*0.96*	*0.96*
R-square					
Turkey@	–	0.84	0.73	0.77	*0.78*
Greece*	0.81	–	0.80	0.62	*0.74*
Asia*	0.69	0.80	–	0.72	*0.74*
Africa*	0.75	0.62	0.74	–	*0.70*
Average	*0.75*	*0.75*	*0.75*	*0.70*	*0.74*
Two-week adjustment					
Turkey@	–	96%	96%	92%	*95%*
Greece*	93%	–	97%	95%	*95%*
Asia*	80%	84%	–	97%	*87%*
Africa*	88%	83%	74%	–	*82%*
Average	87%	88%	89%	85%	*90%*

Notes: See notes in Table 1.

Table 3: Non-U.S. against U.S. Cotton Markets

	Orleans@	Memphis*	Arizona*	*Average*
Correlation coefficient				
Turkey@	0.78	0.76	0.85	*0.80*
Greece*	0.80	0.79	0.84	*0.81*
Asia*	0.82	0.78	0.87	*0.82*
Africa*	0.89	0.87	0.94	*0.90*
Average	*0.82*	*0.80*	*0.88*	*0.83*
R-square				
Turkey@	0.57	0.64	0.68	*0.63*
Greece*	0.64	0.60	0.56	*0.60*
Asia*	0.78	0.77	0.76	*0.77*
Africa*	0.74	0.73	0.71	*0.73*
Average	*0.68*	*0.69*	*0.68*	*0.68*
Two-week adjustment				
Turkey@	68%	61%	50%	*60%*
Greece*	56%	47%	47%	*50%*
Asia*	56%	56%	47%	*53%*
Africa*	49%	44%	42%	*45%*
Average	*57%*	*52%*	*47%*	*52%*

Notes: The non-U.S. prices are the dependent while the non-U.S. prices are the dependent variables. For other notes see Table 1.