SEASONAL ASPECTS IN COTTON: PRICES, CONSUMPTION, EXPORTS AND STOCKS

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Abstract

Seasonal analysis was used to identify historical seasonal patterns for cotton cash and futures prices, consumption, exports, and stocks. Memphis and Lubbock monthly cash prices displayed significant seasonality and increased volatility during recent years. Strengthening seasonal patterns and volatility were found in both cash and cotton futures price series. All the futures contracts displayed traces of seasonality, and increased volatility and "maturity effect" after the cotton policy changes in 1985. Seasonality was evident for consumption, exports and stocks.

Introduction

The fundamentals in most commodity markets are heavily influenced by seasonal factors. The existence of seasonality in the cash commodity markets is largely due to the cyclic nature of production and consumption. However, it is important to understand that seasonal patterns in futures and cash prices should not be equivalent. The presence of seasonality in futures prices raises questions about market rationality and market efficiency. The weak form of the efficient markets hypothesis states that prices in a competitive market fully reflect all information contained in the history of volume and price. If the futures market is weak form efficient, futures markets should not display distinctive seasonal price patterns that allow profitable arbitrage.

There are three sources of seasonality in agricultural commodities; i.e., *month effect*, *year effect* and *maturity effect* (Milonas 1991). Month effect is due to the information available during the crucial points of development in the crop growing season. Year effect occurs during entire crop years in which events such as political decisions, economic policies, droughts etc., with world wide effects on commodities occur. Futures prices , however, are susceptible to a third effect known as "maturity effect" or Samuelson effect. Samuelson (1965), who first analyzed the maturity effect, states that futures prices exhibit increasing variability as contract maturity nears. The maturity effect is an important source of volatility in futures prices for commodities that experience seasonal demand and supply, but not for commodities for which the cost-of-carry model works well. Seasonality clearly emerges as an important determinant of the variation in and the volatility of futures prices during the year. Seasonality in volatility was well established and volatility peaks in summer months due to supply and demand uncertainty as well as the depletion of inventories as harvest approaches.

Cotton, like many other agricultural commodities, has a great deal of variability in annual production because of year-to-year changes in acres planted, yields, weather conditions, insects etc.,. This uncertainty in the estimation of production adds volatility to price. Thus, while fluctuations in the cotton market can not be explained by seasonal patterns alone, understanding seasonal patterns may be useful in formulating better hedging/trading strategies.

The purpose of this paper is to examine intra-year seasonality in cotton spot and futures prices, mill consumption, exports and stocks. This study is purely descriptive. No attempt was made to exploit the regularities to form trading strategies. Such has been reported elsewhere (Conti Commodities, Trapp, Moore Research).

Procedures

Data Sources

The cash and futures price data for this analysis were for August 1975 through July 1996 based on the cotton marketing year (August - July) ; 252 monthly observations for 21 marketing years or 21 contract years for each futures contract. Monthly average price data for North Delta Area (formerly Memphis, TN), West Texas (formerly Lubbock, TX), and the five New York Cotton Exchange Number 2 Contracts (March, May, July, October, December) were obtained from the USDA Cotton Price Statistics. Both futures and spot quotations are for the base grade color 41, leaf 4, staple 34 premium micronaire in mixed lots, net weight, compressed, FOB car/truck, market averages in cents per pound cotton.

Monthly values for mill consumption, exports of all US cotton, beginning stocks at mills and in public storage were obtained from US Cotton & Disappearance/Cotton and Wool Situation and Outlook Reports.

Description of Seasonal Program

The "SEASONM" program was used to derive seasonal indices for all data series. This program calculates the seasonal indices by forming a ratio between a given month's data point and a twelve month moving average (12 month ratio-to-moving average method) centered on the given month. Thus, the ratio indicates what percentage of a particular month's observation is of the average of this twelve month period. This ratio is multiplied by one hundred to form a monthly index. These monthly indices can then be averaged over any given number of years,

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resulting in an average monthly index (Yamane 1973). The program also calculates standard deviations for each index over the number of years in the period being analyzed. These standard deviations can be used to form confidence intervals. One standard deviation results in a 66% confidence interval, two standard deviations results in a 95% confidence interval, and so on.

Data Analysis Method

All monthly average cash and futures price series, consumption, exports and stocks were examined for seasonal patterns. The entire data period was August 1975 through July 1996. All monthly series except cash and futures prices were fitted to the full 252 monthly observations. Cash and futures prices were examined for three periods due to the cotton program change in 1985 and its associated price irregularities (Figure 1). The three periods used for cash prices were (1) 1977 - 1985, (2) 1987 - 1995 and (3) the full 1977 - 1996 period excluding 1986. The policy change implemented a marketing loan for cotton which allowed prices to fall below the loan - rate, permitting the market to clear at world prices. This structural change resulted in a large decline in cotton prices in the 1986 marketing year. Due to this extreme variability in prices, the 1986 marketing year was determined to be an outlier and was removed from both the cash and futures price series. The remaining period was divided into two equal time periods consisting of 1977 - 1985 and 1987 - 1995 marketing years for both cash and futures prices.

Each futures contract for a particular year had 12 monthly average prices excluding the last trading month due to the shorter period of time the contract is traded in the delivery month. Each monthly futures price was computed by averaging the middle of the week (Wednesday) trading day prices for each week in the month. Even though each futures contract may start trading 18 months prior to expiration (now 24 months), only the 12 month period before contract expiration month was used. Each futures contract was analyzed based on its particular contract year. For example, the March'95 futures contract is based on data for March'94 through February'95. The results are reported based on each contract year. Due to the effect of structural change (policy change) during 1986 marketing year, the appropriate contract years were removed for each futures contract. October and December futures prices were divided into 1978 - 1985 and 1988 - 1995 contract years. March, May and July futures prices were divided into 1979 - 1986 and 1989 - 1996 contract years. Each period had 8 contract years for each of the five different futures contracts. The period prior to the 1985 structural change is referred to as Period 1 and after the change as Period 2.

Results and Discussion

Lubbock and Memphis spot price seasonal patterns

During the crop year we would expect cash prices to reach their lowest price directly after harvest during October to December due to the abundance of supply, then climb to a peak just prior to harvest in the late spring and early summer months (i.e. May to July) due to carrying costs and the depletion of supplies. The Lubbock and Memphis average monthly cash price indices followed similar seasonal patterns over the entire 21 year period (Figures 2 & 3). Both indices peaked in June and reached lows during October and November, respectively. This follows the expected seasonal pattern of low prices during and directly after harvest, and peak prices just prior to harvest.

Comparing indices between Period 1 and Period 2 indicates that the peak Lubbock cash price index shifted back one month from June in the Period 1 to May in the Period 2. In contrast, the low price index shifted from January in Period 1 to November in Period 2 (Figures 4 & 5). Cash price seasonality is more apparent during period 2 than Period 1 and the indices remained high during May and June, low during November and December. Both Lubbock and Memphis spot prices displayed a stronger seasonal pattern and increased volatility in the more recent period. The increased volatility can be explained by the implementation of the marketing loan system for cotton and, thus, more responsiveness to world supply and demand factors. December has the lowest and March had the highest standard deviations (St.Dv's) for Memphis and Lubbock cash prices in Period 2.

Futures Contracts

Theoretically, futures markets should not display seasonal patterns due to incorporation of the expectations about the seasonal patterns in the cash prices just prior to harvest (high) and directly after harvest (low). Nevertheless, vestiges of seasonal patterns were found to varying degrees in all futures contracts. The futures prices for different contract months tended to have similar seasonal patterns in Period 2. Only the December and March contracts are discussed in detail.

October Futures. October is the first “new crop” futures month. There was no seasonal pattern evident in the Period 1. The October futures contract displayed a stronger seasonal pattern with increased volatility during the Period 2. During both periods, the maturity effect or 'Samuelson effect' was evident with increased volatility during the last two months before maturity i.e. August and September. The high and low months were May (105.67%) and October (95.85%), respectively, for a range of 10 percent.

December Futures. December is the major hedging month for cotton. The December futures price series were seasonally similar to the October futures price series. There was little or no seasonal pattern in Period 1(Figure 6). Period 2 displayed a seasonal pattern with the highest seasonal index in June at 104.98 with St.Dv of 4.60 (Figure 7). The lower limit of confidence interval was above the mean index which suggests that sixty-six percent of the time the average June price fell above the yearly average price.

The lowest index of 97.03 occurred during October with highest St.Dv of 6.71 in Period 2. The volatility increased during the last two months before expiration, showing the evidence of the maturity effect in this contract during both periods. The average seasonal range for December was about 8 percent, June peak to October trough. The standard deviations covered the 100 percent mean index, suggesting weak seasonality.

March Futures. March is the second most important hedging month for cotton. There was no seasonal pattern evident during Period 1 (Figure 8). A seasonal pattern was more evident during Period 2 with lowest seasonal index of 96.56 during October with St.Dv of 6.13 and highest seasonal index 104.34 during February with St.Dv of 11.03 (Figure 9). Again, the confidence intervals provided by the standard deviations do not suggest significant seasonality. The volatility was highest during February, evidence of the maturity effect (Figure 9).

May Futures. The May futures contract exhibited no seasonal pattern and no clear evidence of the maturity effect. During the Period 2 there is some evidence of seasonality and maturity effect during Period 1. During November and December the seasonal indices were 95.82 and 97.85 with St.Dv of 3.95 and 1.70, respectively. The upper confidence limit was below the mean index during these two months. The March and April indices were 104.59 and 106.46 with St.Dv's of 10.59 and 9.64, respectively, which were the highest. This shows the maturity effect in this particular contract. Seasonality is weak.

July Futures. July futures is the last contract of the crop year. Stocks are low and harvest is just beginning. Like May futures contract, July futures contract showed little or no seasonal pattern during Period 1 and no clear evidence of the maturity effect. During Period 2 there was possibly some seasonality and maturity effect. During November and December the seasonal indices were 95.71 and 96.79 with St.Dv of 4.05 and 1.82, respectively. The upper confidence limit was below the mean index during these two months. The May and June indices were 107.49 and 105.85 with St.Dv's of 8.28 and 9.44, which were the highest, indicating maturity effect. Both the May and July futures contracts reached their lowest average prices during the November and December months with December month having the lowest St.Dv of the two months. The July May peak to October trough was 12 percent, the largest range of the futures price seasonal indices. Again, seasonality, if any, was weak due to the large standard deviations.

Moving from prices to physicals, we find the seasonal patterns more pronounced for mill consumption, stocks and exports.

Mill Consumption

Mill consumption seasonal indices were lowest during December and July at 86.04 and 88.74 with St.Dv of 6.52 and 6.59, respectively (Figure 10). The index reached its peak at 106.83 during March with St.Dv of 4.36 followed by August with an index of 106.66 with St.Dv of 6.02. The peak to trough range was about 10 percent. As expected, mill consumption was low during December due to mill closings during holidays, cleanup, repairs and maintenance and during June due to the end of the crop season and adjustment from old crop to new crop.

Stocks

Stocks showed considerable seasonality. Beginning stocks at the mills reached the lowest level during the months of November and December, corresponding to mill consumption, with index values of 83.48 and 84.89 and St.Dv's of 6.19 and 4.74, respectively (Figure 11). The upper limit of the one St.Dv confidence interval was lower than mean index during the months from October - December. The seasonal index reached its highest level at 111.58 during May with St.Dv of 5.05. The lower limit of one St.Dv confidence interval was higher than the mean index during the months from May - August. The seasonal range was about 28 percent.

Depending on the volumes, the public storage stocks tended to offset the mill stocks, leveling the overall stocks situation (Figure 12). Contrary to the beginning stocks at the mills, the seasonal index for the beginning stocks in the public storage reached its lowest level during October at 51.20 (St.Dv of 16.89). From June - October the upper limit of the one St.Dv confidence interval was always lower than the mean index. The highest variation of beginning stocks in the public storage occurred during December with St.Dv of 27.51 and index value of 135.90.

Exports

Exports were quite seasonal. As expected, exports were high during the months immediately following the harvest and gradually fell during the months before the next harvest (Figure 13). The seasonal index for exports of all cotton from US peaked during March at 142.41 and St.Dv of 19.89 with the lower limit of the confidence interval above the mean level. Immediately following the harvest during December, the indices for January, February and March stayed above the mean index level. The seasonal index value of 59.64 was low during October with St.Dv of 20.35. The season range was approximately 80 percent, peak to trough.

Conclusions

A seasonal pattern of low prices during and directly after harvest, and peak prices just prior to harvest were found in both the Lubbock and Memphis cash prices in the marketing years from 1977 - 1985. These patterns strengthened in the more recent period 1987 - 1995. The volatility of cash

prices increased in the period after the policy changes in 1985. This same strengthening of seasonal patterns and increased volatility was found in all the five New York Cotton Exchange No.2 futures contracts to varying degrees. The maturity effect was more evident in the futures contracts after the policy implementation in 1985. October and December futures contracts displayed some seasonality with increased volatility after policy implementation. The maturity effect was evident with increased volatility during the last two months before these contracts expired. The March, May and July futures contracts showed no seasonal pattern and no clear evidence of maturity effect before policy implementation. In the period after the policy implementation, they exhibited slight seasonality and maturity effect. Whether the strengthening seasonal patterns and increased volatility originated from the implementation of the marketing loan is difficult to distinguish due to the various other supply and demand factors that can effect market. We are not prepared to argue that the futures price seasonality patterns were significant due to the relatively large standard deviations associated with the index numbers.

Clearly, futures prices should not be seasonal to the point where undue profits can be earned by following the seasonal pattern. While cash prices were clearly seasonal, futures prices were less so in all cases. The seasonality in futures prices was similar for all five contracts except that March futures peaked in February rather than spring. All prices, cash and futures, troughed in the fall and peaked in the spring (except the March contract), corresponding to lower and stronger periods. Again, the seasonality detected in the futures prices was less than that for cash prices. A Conti Commodity study using 1970's data, failed to find significant seasonality in individual cotton prices but detected seasonality in futures price spreads, i.e., Oct/Dec, Oct/March, and July/Oct. Moore Research Center, Inc., found intra-month seasonal patterns for some cotton futures contracts. The present study did not examine for possible trade patterns as the purpose of the paper was to describe selected seasonal aspects of the cotton industry.

Mill consumption exhibited seasonality with low consumption during December and July and high consumption during March and August. Exports of US cotton showed strong seasonality with highs during January, February and March immediately following the harvest. Stocks showed considerable seasonality. Beginning stocks at the mills reached their lowest levels during October - December and highest levels during May - August. Beginning stocks in the public storage reached its lower levels from June - October with higher levels immediately following the harvest in December, essentially opposite the mills stocks pattern..

In summary, cash prices were clearly seasonal in the expected pattern. Both price seasonality and volatility appear to have increased since 1985. Surprisingly, futures prices indicated some degree of seasonality parallel to that for cash prices. However, whether the futures prices were sufficiently seasonal to permit undue trading profits was not pursued. This is a topic for further study, the price seasonality of both single futures contract prices and various spreads. In addition to prices, other major aspects of the cotton industry were shown to have seasonal behavior; mill consumption, stocks and exports. The seasonality of production is well known.

Acknowledgements

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Figures

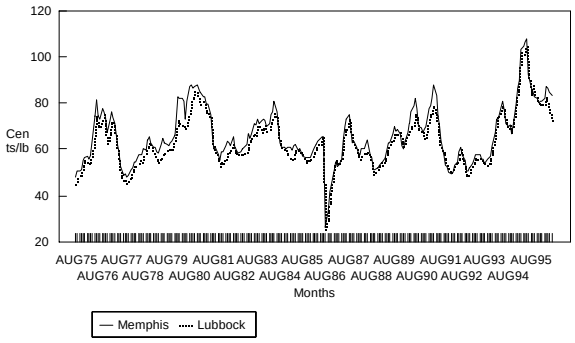

Figure 1. Memphis & Lubbock Cash Prices, 1975 - 1995 (Mkt. Yr.).

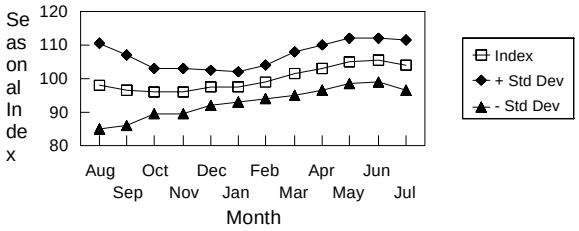

Figure 2. Lubbock Cash Price Seasonal Indices (1975 - 1996).

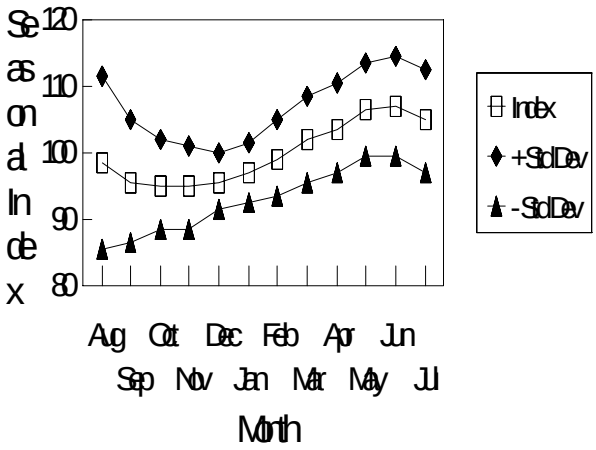

Figure 3. Memphis Cash prices Seasonal Indices (1975 - 1996).

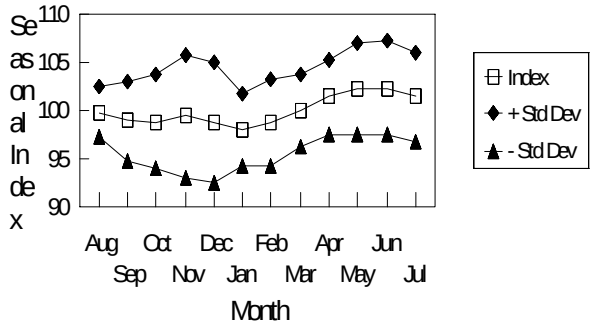

Figure 4. Lubbock Cash Price (Period 1) Seasonal Indices (1977 - 1985)

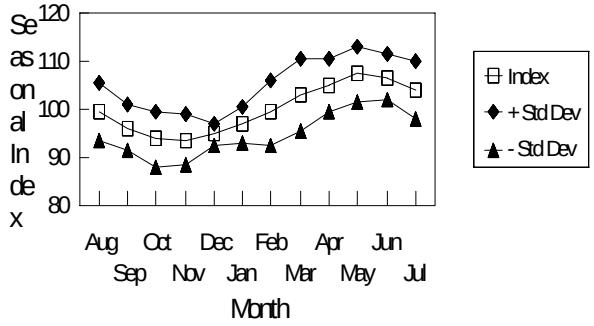

Figure 5. Lubbock Cash Price (Period 2) Seasonal Indices (1987 - 1995)

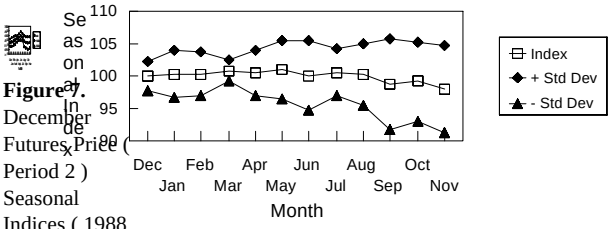

Figure 6. December Futures Price (Period 1) Seasonal Indices (1978 - 1985 Contracts).

Figure 7. December Futures Price (Period 2) Seasonal Indices (1988 - 1995 Contracts).

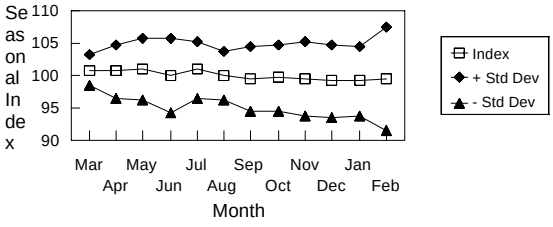

Figure 8. March Futures Price (Period 1) Seasonal Indices (1979 - 1986 Contracts).

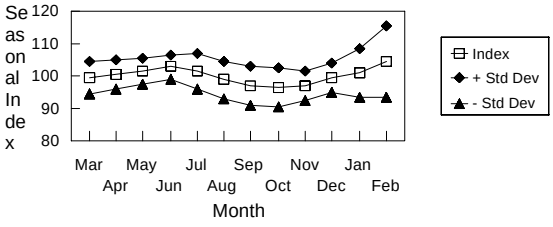

Figure 9. March Futures Price (Period 2) Seasonal Indices (1989 - 1996 Contracts).

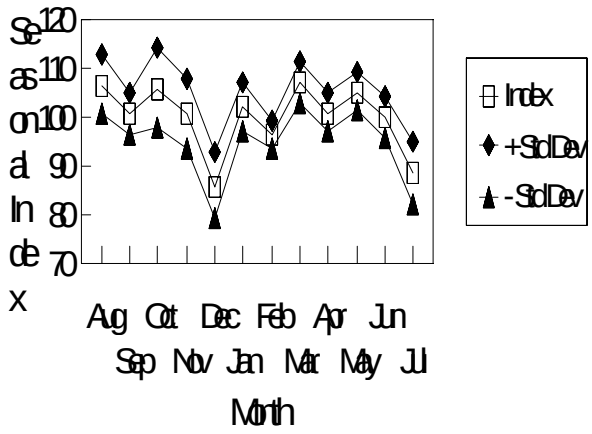

Figure 10. Mill Consumption Seasonal Indices (1975 - 1995 Mkt. Yr).

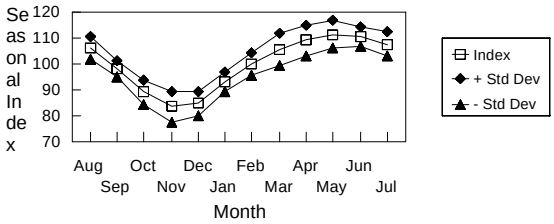

Figure 11. Beginning Stocks at the Mills Seasonal Indices (1975/76 - 1994/95 Mkt. Yr).

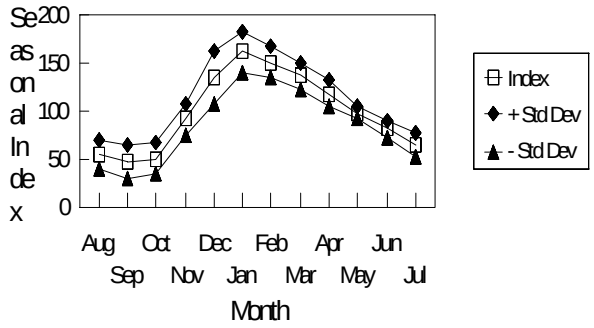

Figure 12. Beginning Stocks in the Public Storage Seasonal Indices (1975/76 - 1994/95 Mkt. Yr).

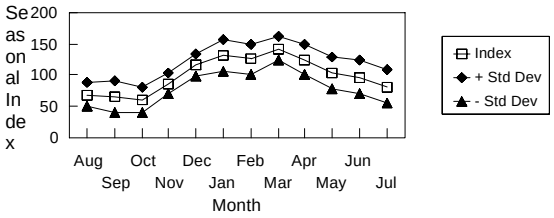

Figure 13. Export of all Cotton from USA Seasonal Indices (1975 - 1995 Mkt. Yr).