Impact of Cotton Marketing Loan Program on Cash and Futures Price Movement

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INTRODUCTION

The Food Security Act of 1985 provides the Secretary of Agriculture with authority to implement a marketing loan repayment program for cotton. The marketing loan program became effective August 1, 1986, allowing producers to repay nonrecourse Commodity Credit Corporation (CCC) loans at rates below the base loan rate. Prior to this new program, the base loan rates had set the de facto price floor for the U.S. cotton market. Under the new program, formula-based world adjusted prices have become an effective price floor, making U. S. cotton price sensitive to changes in both domestic and international markets.

This new farm legislation has substantially altered the process of price determination in the cotton market, particularly during the 12-month period prior to its implementation and the first 6 months of the program. A drastic change in the intertemporal price spreads between Memphis spot and futures prices has occurred due to a shift in the price support program from a rigid domestic loan to market-oriented world adjusted prices. This seems to be a unique time period for testing the market behavior in cash and futures price relationships. Considerable interest currently prevails in extending the marketing loan provisions to the other commodities, such as wheat, feed grains, and soybeans. The experience with cotton, therefore, needs to be carefully evaluated in order to understand the marketing loan impact on crop production, domestic and export demand, inventory stock adjustment, price, income, and government program costs.

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The purpose of this paper is to design and implement an impact simulation study of the marketing loan program on cash and futures price movements. In specific, we attempt to explore three major questions: (1) how and how much the new policy instrument affects spot market price variations during a 18-month period influenced by program implementation as compared to the past; (2) the program effects on the price interactions between cash markets in Memphis, Liverpool, and futures contracts of nearby and distant periods; and (3) the policy impacts on cotton production, export sale, producers' prices and returns, over the transitional and initial periods of the program and thereafter.

The paper is divided into five sections. The first section is the introduction. In the second section, an historical review of the unusual price movements over the policy shock period, August 1985 through January 1987 compared to a normal pattern is discussed. The theoretical issues concerning intertemporal price spreads, the dynamics of basis-narrowing trend, and the macroeconomic aspects of marketing loan simulations are presented in the third section. The fourth section concerns the empirical results, and a summary and conclusion are presented last.

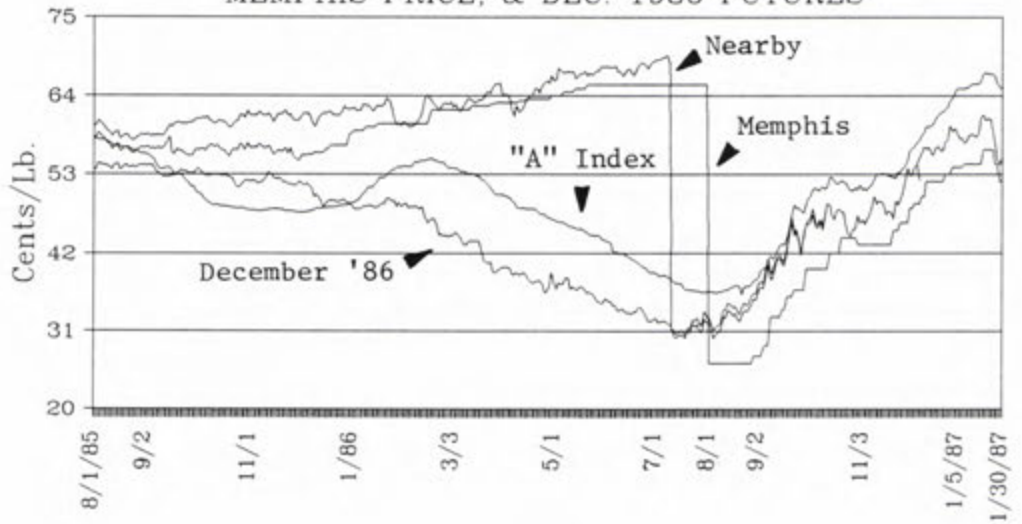
A PERIOD OF UNUSUAL PRICE MOVEMENT

The 12 months from August 1985 to July 1986 are defined as the transitional period before the new program, while the six months immediately after August 1, 1986 represent the initial period of the program. Throughout the time span, the Liverpool "A" Index dropped from 57.0 cents per pound in August 1985 to about 37.0 cents in July a year later, and rose to around 60.0 cents in December 1986 (figure 1). In contrast, the U.S. Memphis price increased from 57.0 cents in August 1985 to 65.5 cents in July 1986, dropped 39.0 cents to the world price level in August, and then climbed up to about 52.0 cents by December 1986.

Due to the price support program, U.S. cotton prices held up well above the world prices by 20 to 30 cents per pound with little fluctuation before the marketing

loan program. Although the nearby futures prices were running closely with U.S. spot market prices at relatively high levels, the distant futures of the December 1986 contract dropped sharply lower in anticipation of a decline to the world price level under the new marketing loan. In August 1985, the December 1986 futures began dropping from 58.0 cents per pound to a low point of 30.5 in July a year later, and recovered strongly to a high of 54.4 before December expiration date. The impact of the marketing loan program is particularly visible for the month of August 1986, when Memphis spot price registered a record drop of 39.0 cents per pound from the July average of 66.0 cents to 27.0 cents.

FIGURE 1. "A" INDEX, NEARBY FUTURES, MEMPHIS PRICE, & DEC. 1986 FUTURES



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THEORETICAL CONSIDERATIONS AND PROCEDURES

Intertemporal Price Spread

The intertemporal price relationships between cash-futures and nearby-distant futures have received much attention in economic literature. Previous theoretical and empirical research has concentrated upon explanations of the price spreads by either a static theory of storage (Workings) to reflect current stock conditions, or a rational expectation hypothesis (Weyman) to relate expected stocks to the price

differences.

Available empirical evidence on the relevance of the Working static framework versus the rational expectation formulation remains unclear, however (Just and Rausser). Some other studies (Tomek and Gray, Startz) suggest the inter-period price difference or "basis" relation between cash and futures prices is determined substantially by factors other than the expectation variables.

In this study, a theoretical hypothesis is formulated to discriminate basis determination in a normal period from one of policy shock. In a normal time period, Working's theory of storage is found to be particularly useful to explain cash-futures price spread. For the marketing loan impact period, however, a dynamic representation of price expectation is essential in analyzing futures price determination, particularly the effects of the latest changes in policies on the actual and expected inventory stock levels and the world market price reactions.

For Memphis cotton, at delivery point, the closing basis is normally around 4.5 cents per pound. The exact basis movement during the life of a contract vacillates due to many market forces (Besant, Futrell). Specifically, basis is affected by: 1) storage and interest costs, 2) transportation costs, 3) local supply-demand forces versus those driving the futures market, 4) quality differences between cash and those specified in futures contracts, 5) supply-demand and price factors of substitutable commodities, and 6) price expectations. In the marketing loan impact period, the importance of price expectations induced by policy changes needs to be particularly emphasized, e.g., the process of the 1985 farm legislation, the timing of program announcements, and the procedures for program implementation.

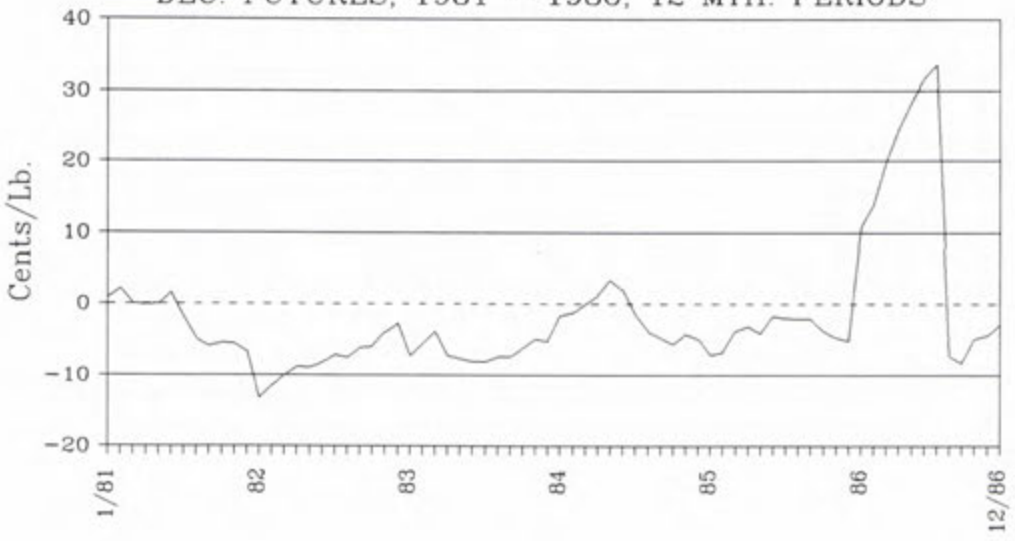
Dynamics of Basis-Narrowing Trend

In considering the dynamic features of "basis" for storable crop commodities, it is well recognized that the basis tends to narrow over the storage season (Paul, Heifner, Gordon, p. 14). Theoretically speaking, the different market forces influencing the spot and futures markets react differently at times. However,

basis has a normal time pattern largely based on storage and interest costs. During the non-harvest season, cotton is stored for later use. As monthly storage and interests costs occur, they add to the price and become part of the spot quotation. Thus, under normal supply-demand conditions and stable farm policy, the basis narrows as the futures contract nears expiration.

A historical review of monthly average spot quotations of Memphis and December New York Cotton futures, same qualities, from January to December for years 1981-1986, reflects wide and erratic basis movements (figure 2). The December futures contract responds to new crop market expectations and is actively traded. The normal relationship of Memphis spot under December futures moving from a wide to narrowing basis was dramatically altered from expectations in 1986. Prior, the small positive basis in early 1981 resulted from tight supplies pushing spot prices upward following poor yields in 1980. The 1983 Payment in Kind Program and dry weather contributed to a short crop and a strong market in the second quarter of 1984.

FIGURE 2. BASIS: MEMPHIS SPOT MINUS DEC. FUTURES, 1981 - 1986, 12 MTH. PERIODS



For the purpose of policy impact analysis, the dynamic relationships of seasonal basis movement for two different time periods are considered. Two daily

time series data of the basis between Memphis spot and December futures for the contract life of 1985 and 1986 are used for our analysis. The former represents a more normal period of cash-futures price relationship, while the latter is chosen to study the unusual basis relationship of the policy shock period induced by cotton marketing loan program.

Causality Tests and Impact Simulations

The marketing loan impact on spot-futures price relationships is analyzed by two major approaches: a causality test of the lead-lag relationship and an impact simulation analysis with the econometric model.

Various causality testing procedures have been developed for empirical investigation of the dynamic properties of time series data. Two prominent examples are the Sims procedure for testing the causality between money and income and the Bessler and Brandt procedure on causality tests in livestock markets. In this paper, a system identification procedure proposed by Hsiao is utilized for causality testing the spot and futures prices relationships. Based upon Akaike's FPE-criteria and the technique in search of minimum Final Prediction Error (FPE) statistics, Hsiao's procedure has the advantage of providing additional insights into the order of the autoregressive process which generates time series data. The method does not require prior knowledge in the selection of lag length. Hsiao causality tests choose the order of lags according to minimum FPE criterion, and the method is equivalent to applying F-test with varying significance levels.

Hsiao's sequential procedure for system identification is adopted in this study. We use daily data series for the spot prices of Memphis and Liverpool markets and daily settlement prices of December futures of 1985 and 1986 for our analysis. To differentiate the impact of a normal time period from one of policy shock, two December futures data covering the contract life of 1985 and 1986 are used. The 1985 contract contains a total of 371 daily observations while the 1986 contract has 372 observations.

To follow Hsiao's procedure, uni-directional autoregressive process of a maximum lag of 5 periods is tested. Our initial hypothesis is that spot-futures and nearby-distant futures relationships are simultaneously determined by market forces at home and abroad. A maximum time lag of 5 trading days is used in our causality tests. With the December contract data of 1985 and 1986, a total of six bivariate relations are specified and tested. Our prior expectation is that all causality directions for the spot-futures price relationships are instantaneous and bi-directional. The following bivariate models were formulated and tested:

1. Memphis Spot	vs.	"A" Index	367 obs. for 1985 contract
2. Memphis Spot	vs.	Dec. Futures	371 obs. for 1985 contract
3. "A" Index	vs.	Dec. Futures	366 obs. for 1985 contract
4. Memphis Spot	vs.	"A" Index	370 obs. for 1986 contract
5. Memphis Spot	vs.	Dec. Futures	372 obs. for 1986 contract
6. "A" Index	vs.	Dec. Futures	368 obs. for 1986 contract

The second approach for our marketing loan study is impact simulations with an econometric model. The cotton model used is a 67-equation system with 15 behavioral equations and 52 identities. It is a fully integrated monthly model with a domestic market block, a Farm Program Simulator and a block of world market equations (Chen, January 1987).

The Farm Program Simulator is by far the largest block with 58 variables. The domestic market variables include monthly equations of domestic mill consumption, ginning, and export sales. Memphis spot prices, average price received by farmers, cash receipts, and other income components are also determined endogenously.

In the world market, the model includes annual equations for total world cotton import demand and U.S. export market share, and monthly equations for U.S. cotton exports. The key variables in export equations are U.S. cotton prices at

Memphis and world prices at Liverpool and the weighted average exchange rates of six major trading countries. Total mill consumption, harvest acreage, and production for rest-of-world totals are also determined endogenously in the model. This model emphasizes "forward-looking" rather than "backward-looking" expectation formulations.

The cotton marketing loan program links the U.S. cotton price to the world market through loan repayment provisions (Anderson, Paggi). A formula-based U.S. adjusted world price is calculated by using the Northern European Liverpool cotton price for U.S. growths as representing the world market and adjusting it to the U.S. by considering average transportation and handling costs, quality, and location adjustments from U.S. to overseas.

The model is particularly useful for impact simulation of substantial policy changes. For the marketing loan study, implications from this policy action can be analyzed through a shift of the effective price floor from the domestic loan rate to adjusted world prices because the price equation has properties suitable for forecasting these type of policy changes (Chen, April 1987).

As the Memphis price equation is estimated by a deviation term relating Memphis price to the effective price floor, changes in the effective price floor from domestic loan rates to adjusted world prices can be determined through an identity relation of the model:

Identity for Memphis Cotton Price

COLPMME116 = COLPMDPLL + (COLPFLLD1 * COLPLE + COLPFLLD2 * COLAWP)

where COLPMME116 is the cotton market price, cents per pound, Memphis Strict Low Middling (SLM) 1-1/16 inch; COLPMDPLL is the deviation of Memphis price from effective price floor; COLPLE is the effective loan rate, cents per pound, using base loan rate adjusted by interest charge and storage costs through the crop season; COLAWP is the adjusted world prices, cents per pound, Liverpool market, the "A" Index series, adjusted by transportation costs and quality differences between the

U.S. and Liverpool markets; COLPFLLD1 and COLPFLLD2 are two dummy variables used to represent policy changes, implementation of the 1985 Farm Bill provision of marketing loan August 1, 1986; COLPFLLD1 equals one prior to August 1986 and zero otherwise; COLPFLLD2 equals one after August 1986 and zero otherwise.

In addition, the price equation for Memphis spot market is constructed on the theory of inventory demand with stock/use ratio and the expected stock/use ratio as the key explanatory variables. The model has a comprehensive set of simulation instruments for analyzing supply-demand projections of domestic and international markets.

EMPIRICAL RESULTS

This section reports the empirical results from testing basis behavior under a normal market condition in comparison with the period of policy shock. Also, the results from causality tests between spot and futures prices and model simulation results of marketing loan program are discussed.

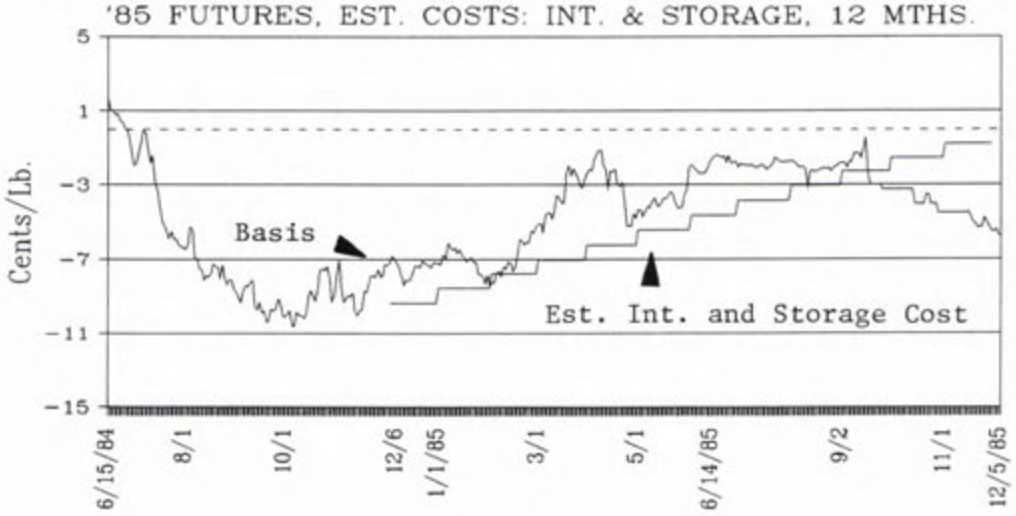
Basis Behavior

Understanding basis behavior or difference between cash and future prices over time is essential for successful use of the futures market in hedging cotton sales and purchases. Basis is defined in this paper as difference in cents per pound for a specified cash spot price at a given location and a specific futures price. The Memphis spot quotation for SLM grade, 1-1/16 inch staple quality relative to the specified New York futures contract is the cash-futures relationship analyzed. This is the base quality for deliverable cotton at Memphis location against the New York Number 2 futures contract.

The Memphis basis for the December 1985 futures contract represents a normal pattern (figure 3). The basis is almost 11 cents per pound under in late 1984, more than a year in advance of the 1985 crop. By January 1985, when most of the crop was in storage, the basis remained wide and began a steady path of

narrowing, reflecting cumulative storage and interest costs until about September when the new harvest season began. Then, as the December future expiration date nears, the basis widens to account for normal delivery costs.

FIGURE 3. BASIS: MEMPHIS SPOT MINUS DEC.
'85 FUTURES, EST. COSTS: INT. & STORAGE, 12 MTHS.



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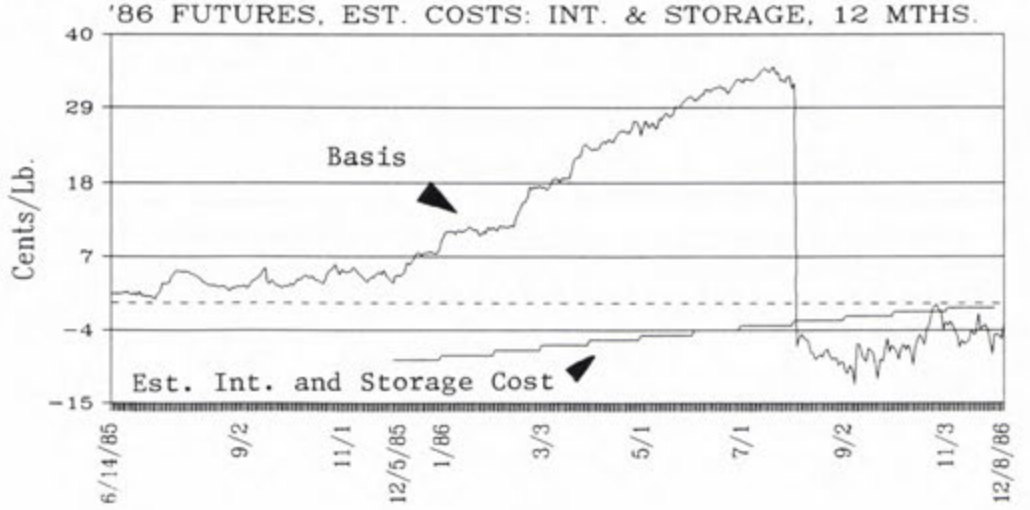
In contrast, the Memphis spot to December 1986 basis pattern sharply deviates from the expected narrowing pattern (figure 4). The basis started with Memphis over December futures 18 months in advance, and by January 1986 began soaring to more than 32 cents above in July, widening the gap between U.S. effective loan price and foreign price level. But, following implementation of the marketing loan, spot dropped to world price level, returning to a normal pattern under December futures.

FIGURE 4. BASIS: MEMPHIS SPOT MINUS DEC.
'86 FUTURES, EST. COSTS: INT. & STORAGE, 12 MTHS.



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The most dramatic, positive December basis developed in 1986 because of the marketing loan. While the 1985 Farm Legislation was signed late that year, the procedures for implementation were not provided until spring, 1986. Then provisions were announced with an August 1 implementation date. As a result, expectations of a market glut and large foreign sales drove the foreign price and New York December futures down sharply.

In anticipation of the tremendous downward pressure on U.S. prices that might lead to "dumping" in both spot and futures markets, the marketing loan program included inventory protection payments for cotton not under CCC loan. Inventory protection payments were made to anyone holding "free" cotton stocks on August 1, 1986. Payments took into account the difference between the 57.3 cents per pound 1985 base loan plus regional carrying charges and the adjusted world price announced weekly. Payments were made in first handler certificates redeemable in only CCC cotton for nine months.

The effective loan rate held the May and July nearby futures up above Memphis spot. In contrast, because December 1986 futures were reflecting world price expectations, Memphis spot stood almost 10 cents per pound over December 1986 futures in January. By June, the positive difference was 32 cents. Clearly, the base loan rate plus storage and interest was setting an effective floor for domestic price movement. The forthcoming marketing loan sent the December futures downward.

Causality Tests

The causality tests do not provide strong and uniform results in supporting our a priori beliefs on instantaneous and bi-directional spot-futures prices interrelationships. In both the normal time period of 1985 and the policy shock period of 1986, Memphis spot and Liverpool "A" Index demonstrate the expected strong feedback relationships. Although their causal relationships are bi-directional and instantaneous with a short lag length of 1 to 2 days, the Akaike's statistics

show substantial different FPE for these two testing periods. It is interesting to note that the FPE statistics for the policy shock period of 1986 (4.4) are nearly 14 times larger than the normal time period of 1985 (0.3). The results clearly confirm the disruption of the normal U.S and world price relationship during the marketing loan period.

This study also provides evidence on an uni-directional causality relationship between spot market and futures prices in 1985. Strong causal relationships were found running from December futures prices to spot prices in both Memphis and Liverpool markets. The results are significant because they support a common belief that the futures markets are leading the spot market in price determinations. In contrast, this causal relationship was not found during the marketing loan impact period of 1986. Not only the interrelationship between Memphis spot and December 1986 futures were substantially weaker, but also the causality direction was changed to bi-directional. An additional causality test of the Memphis spot and December future relationship in first difference terms for 1986 shows essentially a random walk phenomenon. On the other hand, the causality tests of "A" Index and December futures of 1986 demonstrate a largely instantaneous and bi-directional relationship.

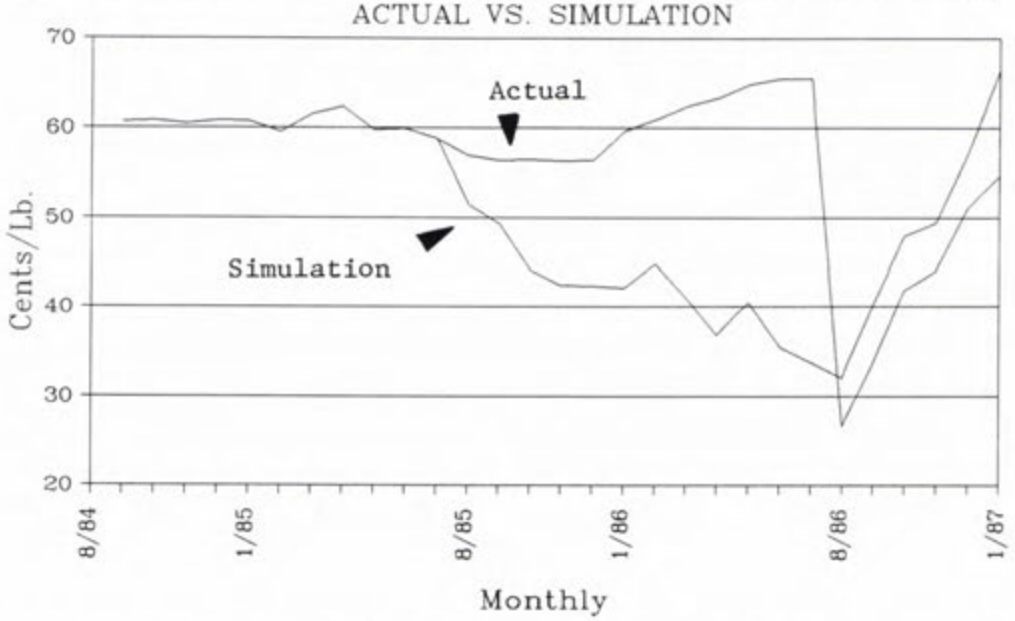
In general we found some causality testing results are consistent with our a priori beliefs, while some others are not. The empirical findings, however, provide clear evidence of the impact of policy shocks in terms of the causal relationships between spot and futures markets.

Marketing Loan Impact

The structural model was used for impact simulation analysis for marketing loan program by assuming it was implemented one year earlier on August 1, 1985 instead of August 1, 1986. The solution for baseline and policy shock were analyzed in regard to Memphis spot price. A comparison was made of Memphis spot actual price movement over the 1984/85 crop year versus the marketing loan simulation (figure 5).

The simulation results indicate Memphis spot would have been much lower than the actual level a year earlier. The difference between actual and simulated price level starting the 1985 season, August 1, was 5 to 7 cents per pound, widening rapidly to 32 cents by June-July, the end of 1986 season.

FIGURE 5. MARKETING LOAN, MEMPHIS SPOT
ACTUAL VS. SIMULATION



An interesting contrast is that the marketing loan simulation results of Memphis spot are higher than actual prices in the first six months of the 1986-87 season. The gain ranges from 6 cents in August 1986 to 11 cents in January 1987.

FIGURE 6. MARKETING LOAN IMPACT ON
MEMPHIS SPOT, SIMULATION MINUS ACTUAL

FIGURE 7. MARKETING LOAN IMPACT, EXPORT
BASELINE (USDA PROJ.) VS. SIMULATION

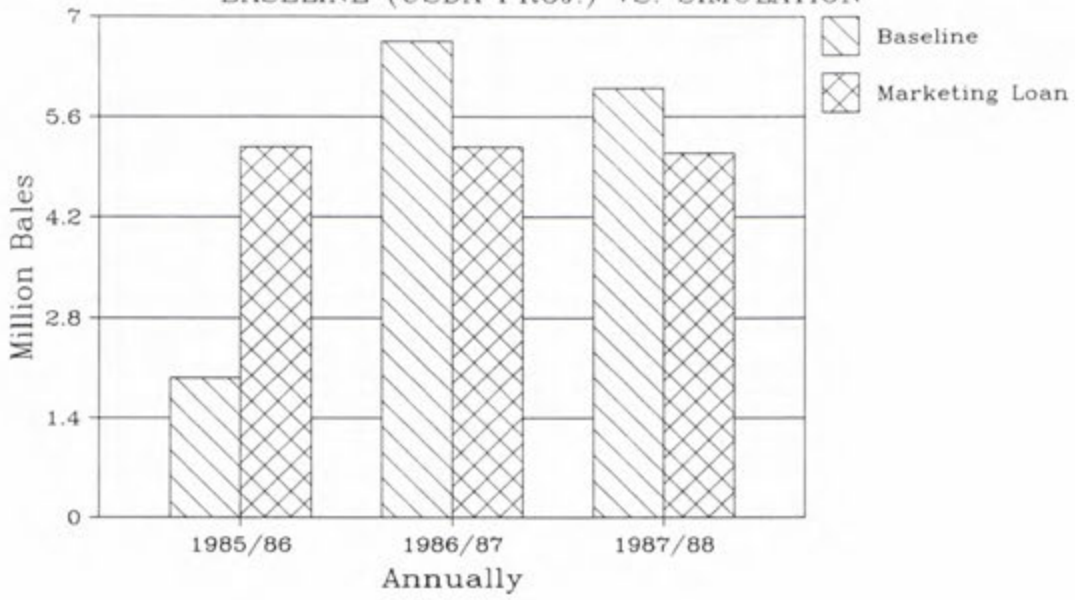
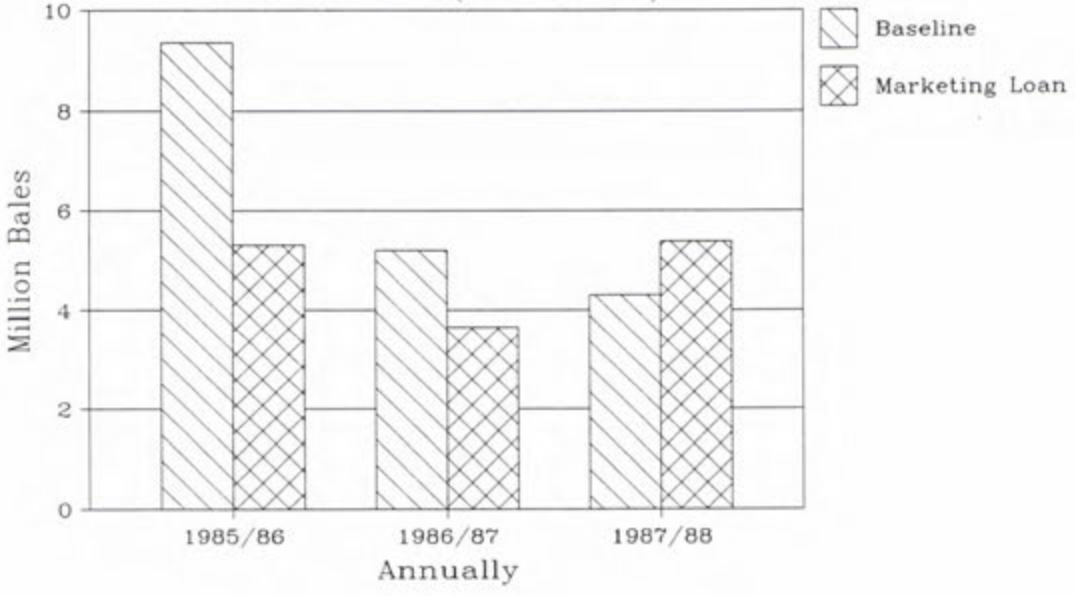


FIGURE 8. MARKETING LOAN IMPACT, ENDING
STOCKS BASELINE (USDA PROJ.) VS. SIMULATION



Using annual data for crop years, 1985/86, 1986/87 and 1987/88, the marketing loan impact shows a substantial drop in Memphis price--18.37 cents per pound below actual the first year. But, the decline was offset by gains of 8.2 cents and 9.07 cents above actual for the following two crop years, respectively (figure 6). The simulation results reflect sharply higher export sales of 5.18 million bales the first year from the 1.96 million actual. In the following two years, simulated cotton exports were lower than actual, 5.18 million in 1987 and 5.09 in 1988, in response to higher prices (figure 7).

As shown by the simulation results, ending cotton stocks were sharply lower--a decline of 4.06 million bales from 9.36 million in 1985/86 (figure 8). The downward stock adjustment would have continued in 1986/87, leading to 1.67 million smaller stocks than baseline of 5.32 million bales. However, because of higher prices in the third year, simulation results point to more production and less usage, especially for exports. Thus, 1987/88 ending stocks would increase by 791,000 bales more than baseline projection.

Higher prices encourage production, decrease usage and would lead to a buildup of cotton stocks to the same level as before the marketing loan. The big difference is that the U.S. loan rate no longer establishes an effective world price floor. This suggests foreign competitors would share in the production adjustment with the U.S. As a result, the level of U.S. government-owned stocks will tend to be lower. Overall government costs should be reduced somewhat from levels experienced before the marketing loan.

CONCLUSION

The cotton marketing loan provision of the 1985 Farm Act changed the price floor from the effective loan rate to the formula-based U.S. adjusted world price. The new program instrument will lead to more frequent price changes in both the futures and spot markets. Uncertainty in production and demand overseas and at

home may cause substantial market fluctuations in the future. The forces may also include foreign government policies on cotton and trade, weather, and other institutional factors of significance to cotton industry.

Based upon impact simulation results, assuming the marketing loan was implemented a year earlier, Memphis spot prices in 1985/86 would have been 18 cents below actual, followed by 8 to 9 cents gains above actual the next two crop seasons.

With U.S. prices internationally competitive, cotton production and mill consumption are expected to adjust simultaneously, reflecting the same set of market forces in U.S. and foreign countries. This adjustment process indicates some risk and uncertainty, but also points to a market condition in line with current technology and consumer demand. Under the marketing loan, government costs may increase, in the short run, but tend to be reduced in the long run. However, some form of U.S. production control appears needed to offset the incentive to increase production in response to higher prices.

This study provides significant evidence of policy impact on the intertemporal price relationships between cash and futures market. After the program impact period, we expect the normal historical pattern of narrowing basis to prevail. Despite the policy shock, the causal relationship between cash and futures should continue to reflect competitive market forces worldwide.

The causality tests suggest the importance of the futures market in relation to spot prices in both U.S. and foreign markets. Under such circumstances, it is important to monitor global market information and to maintain on-going forecasts as a planning tool for decision-making by the cotton industry and in formulating government policy.

REFERENCES

1. Anderson, Carl G. and Mechel Paggi. "Marketing Loan Impacts-Rice and Cotton", Increasing Understanding of Public Problems and Policies-1986, Farm Foundation, Oak Brook, Illinois, pp. 47-60, January 1987.

2. Besant, Lloyd. Commodity Trading Manual, Chicago Board of Trade, Chicago, pp. 63-83, 1985.

3. Bessler, David A. and Jon A. Brandt. "Causality Tests in Livestock Markets", American Journal of Agricultural Economics, Vol. 64, No. 1, February 1982.

4. Chen, Dean T. "An Integrated Cotton Model with Interaction Between Domestic Program Instrument and International Market Forces", Proceedings of the 1987 Beltwide Cotton Conference, Dallas, Texas, January 1987.

5. Chen, Dean T. "Forecasting The U.S. Cotton Industry: Structural and Time Series Approaches", Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, Chicago Mercantile Exchange, Chicago, April 22-23, 1987.

6. Futrell, Gene A. Marketing for Farmers, Doane-Western, Inc., St. Louis, Missouri, pp 96-102, 1982.

7. Hsiao, Cheng. "Causality Tests in Econometrics" Journal of Economic Dynamics and Control", Vol. 1, pp. 321-346, 1979.

8. Just, Richard E. and Gordon C. Rausser. "Expectations and Intertemporal Pricing in Commodity Futures and Spot Markets", Proceedings of the Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, pp. 252-279, 1983.

9. Paul, Allen B., Richard G. Heifner and J. Douglas Gordon. Farmers' Use of Cash Forward Contracts, Futures Contracts, and Commodity Options. USDA/ERS, Agricultural Economic Report No. 533, May 1985.

10. Sims, C. "Money, Income and Causality." American Economic Review, Vol. 62, pp. 540-552, 1972.

11. Startz, R. "Expectations and Forward Exchange Rates." Discussion Paper, The Wharton School, University of Pennsylvania, Philadelphia, May 1981.

12. Tomek, W.G. and R.W. Gray. "Temporal Relationships Among Prices on Commodity Futures Markets: Their Allocative and Stabilizing Roles." American Journal of Agricultural Economics, Vol. 52, pp.372-80, 1970.

13. Weymar, F. Helmut. "The Supply of Storage Revisited." American Economic Review, Vol. 56, pp. 1226-1234, 1966.

14. Working, Holbrook. "Quotations of Commodity Futures as Price Forecasts." Econometrica, Vol. 10, pp. 39-42, January 1942.