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DYNAMIC TRANSITION OF WORLD COTTON MARKET: IMPACTS ON U.S. COTTON INDUSTRY

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DYNAMIC TRANSITION OF WORLD COTTON MARKET: IMPACTS ON U.S. COTTON INDUSTRY FOR 1986-87

Dean T. Chen

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DYNAMIC TRANSITION OF WORLD COTTON MARKET: IMPACT ON U.S. COTTON INDUSTRY FOR 1986-87

Dean T. Chen

Key Words: World cotton market, Dollar devaluation, China Data revision, Crop shortfall, Cotton model, Impact analysis.

Abstract

The world cotton market is in the midst of a dynamic transition. A dramatic shift in supply-demand conditions during the mid-1980's has led to a sharp decline in world carryover stocks from an abundant 46 million bales at the start of the 1986 season to 26 million projected by July 1988. This reduction was largely due to rising world consumption, weather-induced 1986 crop shortfalls in the U.S., and an unusually large revision of China's consumption and stocks data. A steady drop in value of U.S. dollar in the international markets and implementation of the marketing loan program have created an open and competitive market environment for U.S. cotton exports.

The effects of world market transition on the U.S. cotton industry are analyzed using a microcomputer-based econometric model, AGGIES (AGricultural Globally Integrated Econometric System) /Cotton. Key economic variables selected for simulation analysis include weighted average exchange rates of six major countries, cotton yield per acre and harvest-to-planting ratio for 1986/87 U.S. crop, and April 1987 revision of China's consumption and stocks data. Strong impacts were indicated by these simulation experiments particularly with respect to U.S. cotton production, exports, farm and spot prices, and producers' income.

INTRODUCTION

Cotton has traditionally been an important international farm commodity. Interdependency between the U.S. cotton industry and the world market has been growing stronger in recent years, due to a worldwide expansion of cotton production, consumption, and trade. During the years, U.S. agricultural policy has geared to promote trade openness and export expansion, and the pricing of U.S. cotton competitively in the international markets. A new policy initiative became effective in the 1986/87 season, when the marketing loan program was implemented, linking the U.S. cotton price directly to the world market. This U.S. policy and other developments in the world market have dramatically changed the international cotton trade and market price relationships.

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The mid-1980's has been recognized as one of the most dynamic transition periods in the history of world cotton market. Sweeping changes were noted in cotton production, consumption and trade, including weather-induced crop shortfalls in the U.S. (1986), USSR (1987) and other important producing countries, some unusually large data revisions for cotton production in USSR, consumption and stocks in PRC, and the strong upturn of worldwide consumption and import demand in recent years (Skinner, 1987).

These developments have strong implications for cotton producers, merchants, and government agencies, in planning and decision-making. However, little previous research has examined the impact of these type of changes on the U.S. cotton industry--especially with a structural econometric model. Within the market equilibrium context, the use of an econometric model helps understand the market responses to the external forces and the interactions between the U.S. and world cotton markets.

The purpose of this study is to identify the key factors for impact simulation analysis, and quantitatively evaluate their effects with a large-scale econometric model, AGGIES/Cotton. This paper focuses on a study of three major factors:

1) Significant reduction of U.S. dollar value in foreign exchange markets over the past two years.

2) Major revisions of China cotton consumption and stocks data on the basis of April 1987 USDA supply-demand report.

3) 1986 cotton production shortfall in U.S. due to inclement weather conditions.

Three simulation solutions were generated from the model to be compared with the actual data for 1986/87 and the model baseline projection for 1987/88. These simulation experiments are conducted to reflect hypothetical conditions in which the external disturbances of dollar devaluation, China data revision, and 1986 U.S. crop shortfall do not exist. By removing these external factors, the net impacts can thus be quantitatively determined. This evaluation process thus focuses upon the

measurement of alternative assumptions as deviations from baseline.

This paper is presented in four additional sections, beginning with an overview of the model and a brief discussion of the specifications of the related equations used for simulation analysis. The design of the simulation experiments, especially the assumptions and analytical procedures used to produce alternative model solutions, will be described, followed by a description of the empirical simulation results. The last section contains concluding remarks.

THE MODEL

The structural econometric model, AGGIES/Cotton, is utilized for impact simulation analysis. A brief description of its theoretical framework and model structure was presented in an earlier paper (Chen, 1987). Results of validation tests of model forecasting accuracy for monthly Memphis price against time series forecasting procedure of vector autoregressions were reported in another paper (Chen and Bessler, 1987).

In general, the model has demonstrated superior performance in predictive testing and policy simulation. Since the model is being maintained for on-going forecasting exercises, further testing will be made continuously on an ex-ante basis. For policy analysis, the model has also been used to analyze the impacts of cotton marketing loan program on cash and futures price movements (Chen and Anderson, 1987), and to evaluate the effects of uncertainties affecting policy decisions of 1988 cotton program (Chen and Anderson, 1988). All of these studies were concerned with model applications for the U. S. market. This study takes a further step to use the model for impact simulation analysis of some important external shocks to both U.S. and world markets.

For the purpose of this paper, it is useful to summarize briefly the key features of the model and review the equations used for this simulation study. AGGIES/Cotton is a monthly-annual mixed frequency model of the U.S. cotton industry. The model contains

3 major blocks and 67 simultaneous equations consisting of 15 behavioral equations and 52 identities. It is a fully integrated modeling system with a domestic market block, a world market block and a farm program simulator.

In conducting the three simulation experiments, the crop production and export demand equations play the most important role. In specification of crop production equations, the model is disaggregated into four U.S. regions of the Southeast, Southwest, Delta, and West. Planted acreage, harvest-to-planting ratio, and cotton yield per acre are determined to reflect theoretical arguments of implicit revenue function. Under profit maximization conditions, the effects of the producer's return from cotton marketing, and direct and indirect government program benefits can be traced to the producer's decision process regarding program participation and acreage response. Cotton yield per acre is a stochastic equation, and the harvest-to-planting ratio is a statistical identity.

The cotton export equations provide the basic linkage mechanism between the domestic market and world market subsectors. In modeling cotton export relations, a modified two-region model approach is adopted, including annual equations for the world total import demand, U.S. market share, and a monthly equation for U.S. cotton exports. This approach follows the basic specification of trade flow and market share, with a system of 3 equations to determine U.S. cotton exports. The key variables in the import demand and export market share equations are relative prices of U.S. cotton at Memphis and world market prices at Liverpool, and the weighted average exchange rates of six major countries. The world market block also contains equations for the rest-of-world mill consumption, harvested acreage, and production. The basic identity for achieving the supply-utilization balance of this two-region model is also included.

ASSUMPTIONS AND ANALYTICAL PROCEDURE

Recent developments in the world cotton market were noted as vivid evidence supporting the fundamental principles of price theory regarding changes in price of a

commodity to changes in quantities of production, consumption and trade (Barlowe, 1987). The theoretical expectations of a downward sloping demand and an upward sloping supply relationship are particularly relevant in explaining the recent market movements: a worldwide increase in consumption, a decrease in world production, and a sharp rise in volume of trade in response to low cotton prices in 1986/87. These types of supply-demand trends are visible in individual countries such as the U.S., China, and in the Rest-of-World (Figure 2-4).

World cotton price has recovered strongly since the beginning of 1987/88 season. Although world consumption and trade are projected to remain at high levels, the rise in cotton price will likely affect mill use and trade in the years ahead (Townsend, 1987). The latest USDA estimates for 1987/88 suggest a modest increase in crop production and a slight decline in consumption for foreign countries. For the U.S., the USDA estimates indicate a record-large crop and continued high levels of demand for the year.

The net effect of the past two seasons points to a sharp decline of carryover stocks for U.S., China, and the world (Figure 1). In the crop seasons of 1986/87 and 1987/88, the cotton stock declines are 43.2 percent (45.5 million bales to 25.6 millions), 67.7 percent (16.1 million bales to 5.2 millions), and 52.7 percent (9.3 million bales to 4.4 millions) for the world, China and U.S., respectively.

Changes in cotton stocks of this magnitude are also attributable to some other important external factors described in the previous section. Three major factors of critical importance are selected for simulation study in this paper. A brief description of the underlying assumptions for each factor is presented below.

Dollar Devaluation

For analysis of the devaluation effect, it is important to recognize the link between U.S. cotton exports and the exchange rate. Based on cotton export equations,

the baseline solution is first simulated through the end of the 1987/88 crop year using actual levels of the weighted average exchange rate for six major countries.

Beginning in mid-1985, a reversal of macroeconomic policy set into motion a steady trend in dollar devaluation against the major currencies. The six-country weighted exchange rate took off on a strong rise from 2.14 in August 1985 to 3.31 in July 1987. This was due mainly to sharp increases in the value of the Japanese Yen and the German Mark relative the U.S. dollar (Figure 5).

To quantitatively evaluate the effect of dollar devaluation over 1986/87 and 1987/88 crop years, the basic assumption is that the weighted average exchange rates of six major cotton-trading countries are held at a constant level of 2.64. The baseline solution on the other hand is constructed by using the actual levels of weighted exchange rates of 3.25 and 3.40 for the two years respectively.

China Data Revision

A major revision of China's consumption and stocks data has been recognized as an important contributing factor to the turnaround of the world cotton market in early 1987. Based on the April 14, 1987 USDA "Weekly Cotton Market News", this unusually large revision of China data caused extensive revisions of global cotton supply and demand estimates for 1986/87. This news release suggests that a sharp upward revision of China's consumption data for 1985/86 (up 2 million bales from March estimate to 19.5 million in April) and 1986/87 (up 3.5 million to 21 million bales) was responsible for a corresponding large downward adjustment of China's ending stocks for the 1986/87 crop year.

Specifically, the April estimate of China's carryover stocks was 9.05 million bales, and the March estimate was 14.55 million bales, a significant drop of 5.5 million bales in a month. Further revisions of these consumption estimates since April 1987 have led to even lower PRC carryover stocks to 8.3 million in 1986/87 and 5.2 million in 1987/88, respectively (Figure 2).

1986 U.S. Crop Shortfall

Adverse weather conditions caused extensive harvest loss and substantially lower yield per acre for the 1986/87 cotton crop. At 552 pounds per acre, the 1986/87 cotton yield was estimated to be 78 pounds lower than the 1985/86 national average of 630 pounds. The bad weather conditions in 1986/87 have led to an unusually large acreage abandonment, causing the planting-to-harvesting ratio to decline from the normal weather condition of 93 percent to 84 percent for that year. Due to the reduced harvested acreage and lower yield, the 1986/87 crop production was 9.7 million bales, compared with the 13.4 million bales of a year earlier (Figure 3).

Procedures

In the design of simulation experiments, a general approach is to generate baseline solutions using actual values of all exogenous variables as input into the model. Alternative solutions on the other hand are estimated by imposing some alternative values of exogenous variables for model solution. If the simulation experiment requires to shock the endogenous variables which are behavioral equations of the model, it is necessary to exogenize these variables to generate model solutions. In general, predetermined variables in the model are dynamically determined in the model simulation. For impact evaluation, the approach is to compare the differences between baseline and alternative solutions. For presentation purposes, it is useful to evaluate the simulation results based on the selected economic indicators of special interest to the simulation study.

EMPIRICAL RESULTS

To generate alternative model solutions, the assumed values of exchange rate, China stocks data, U.S. crop yield, and harvest-planting ratio as described above, are used. These simulation results are then compared to the baseline to quantitatively determine their economic impacts. In this study, Memphis price is chosen as a common

criteria for impact evaluation. In addition, cotton exports are included in the dollar devaluation case, cotton production for weather simulation case, and the ending stocks-to-use ratios for the world and rest-of-world are added for China data revision simulation. Taking into account the dynamic process of market response, two-year's simulation results of Memphis prices are presented.

Devaluation Impact

Under the assumption of no dollar devaluation, the simulation results indicate significant effects on cotton export and Memphis prices for 1986/87 and 1987/88 (Table 1). In these two crop years, cotton exports would be reduced by 844 and 772 thousand bales, respectively. This suggests an accumulated total loss of 1.6 million bales of export sales because the overvalued U.S. dollar would make U.S. cotton less competitively priced in the world market, leading to a loss in U.S. market share in the world market.

The simulation results also indicate Memphis prices to be 2.80 and 3.92 cents per pound below the baseline (Figure 6-7). Under the assumption that the U.S. dollar continues to hold at the mid-1985 high level, a slower growth of U.S. exports and lower market prices would be the result.

Table 1. Impact of Dollar Devaluation on Cotton Exports and Price
Baseline vs. Alternative Devaluation Scenario
1986/87, and 1987/88 Crop Years.

	Actual	No Devaluation	Difference
Exchange Rate,		--6 Countries Wt. Index--	
1986/87	3.25	2.64	-0.61
1987/88	3.40	2.64	-0.76
Exports,		---- thou bales ----	
1986/87	6,688	5,843	-844
1987/88	7,200	6,428	-772
Memphis Price,		---- cents/lb. ----	
1986/87	51.70	48.90	-2.80
1987/88	64.21	60.29	-3.92

Source: model projections.

By identifying the impact of dollar devaluation on farm price and producers' income, this study provides empirical evidence supporting the potential benefits of

the devaluation policy on farm commodity sectors of the U.S. agriculture.

PRC Data Impact

Effects of the China data revision are clearly reflected by the world and rest-of-world stocks-to-use ratio estimates for 1986/87 and 1987/88 crop years. With the revised data, world and rest-of-world stock-to-use ratios dropped to 35 percent for 1986/87 and 29 percent for 1987/88, a substantial tightening of the worldwide supply conditions indicated by the pre-revision data. The data revision was due to a sharp upward revision of the PRC domestic use for the preceding two years. The domestic cotton use expansion can be viewed as a result of government policy promoting non-mill uses due to a special subsidies program recently implemented (Townsend, 1987).

Table 2. Impact of PRC Data Revision on World Stocks and Memphis Price Baseline vs. No Alternative PRC Data Revision Scenario 1986/87, and 1987/88 Crop Years.

	Baseline	No PRC Revision	Difference
PRC Ending Stock,		---- mil bales ----	
1986/87	9.05	14.55	5.05
1987/88	5.15	10.65	5.05
Rest-of-World			
Ending Stock/Use		---- Ratio ----	
1986/87	0.35	0.45	0.10
1987/88	0.29	0.39	0.10
World			
Ending Stock/Use		---- Ratio ----	
1986/87	0.38	0.47	0.09
1987/88	0.31	0.40	0.09
Memphis Price		---- cents/lb. ----	
1986/87	51.70	49.34	-2.36
1987/88	64.21	58.62	-5.59

Source: model projections.

Largely as a result of the downward revision of worldwide cotton stocks during rapid growth of world consumption and trade, the April China data revision points to a greatly improved cotton outlook.

To incorporate such a large data revision into the model for simulation analysis, the 1986/87 stocks-to-use ratios for the world and rest-of-world must be sharply reduced, declining from 0.519 to 0.423, and 0.493 to 0.391, respectively. This size of

data revision would usually have significant price impact on both the world and U.S. markets.

Without such data revision, the impact simulation results indicate that the Memphis price would be 2.36 cents per pound lower in 1986/87 and 5.59 cents lower in 1987/88 as compared with the baseline. As shown in Table 2, the price effect of data revision is stronger in 1987 crop season than 1986 mainly due to timing of data release and expectation formation.

Weather Impact

The normal weather simulation on the basis of a trend yield projection of 600 pounds per acre, and a normal harvest-to-planting ratio of 93 percent for 1986/87 crop shows a total cotton production of 11,431 thousand bales. Under normal weather conditions, a sizable 1.7 million bales would have been added to the supply. (Table 3)

Table 3. Impact of U.S. Crop Shortfall on Cotton Stock and Price Baseline vs. Alternative Normal Weather Scenario 1986/87, and 1987/88 Crop Years.

	Baseline	Normal Weather	Difference
Yield,		---- lbs/acre ----	
1986/87	552	600	48
1987/88	695	695	0
Production,		---- thou bales ----	
1986/87	9,731	11,431	1,700
1987/88	14,281	14,281	0
Memphis Price,		---- cents/lb. ----	
1986/87	51.70	43.62	-8.08
1987/88	64.21	58.35	-5.86

Source: model projections.

With an additional 1.7 million bale cotton output, most of which would go into stocks, the Memphis price would have been reduced by 8.08 cents per pound in 1986/87 and 5.86 cent in 1987/88. The downward price impact from increased cotton production for 1986/87 season would be expected to extend into the 1987/88 crop year due to stocks accumulation. The normal weather simulation suggests a reduction of producers' income and an increase of government costs for both direct and indirect program payments.

A comparative analysis of these three alternative model solutions suggests that

the price impact is the strongest for U.S. crop shortfall simulation, at 8.08 cents and 5.86 cents for these two seasons, respectively. The China data revision simulation (2.36 and 5.59 cents per pound) shows stronger price effects than the U.S. dollar devaluation (2.80 and 3.91 cents/lb), particularly for the 1987/88 crop season. (Table 4 and Figure 10).

Table 4. Summary of Memphis Price Impacts of Alternative Scenarios Devaluation, Weather, and China Data 1986/87, and 1987/88 Crop Years.

	1986/87	1987/88
	---- Memphis price Cents/lb. ----	
Dollar Devaluation	2.80	3.91
PRC Date Revision	2.36	5.59
1986 U.S. Crop Shortfall	8.08	5.86

Source: model projections.

CONCLUDING REMARKS

The results from this study indicate that the key underlying forces behind the changes in the U.S. and world cotton markets for 1986-87 crop years were, among other factors, the 1986 crop shortfall in the U.S., dollar devaluation in the foreign exchange markets, and the major revisions of cotton consumption and stocks data in China. This analysis confirms the significant impact of these unusual external disturbances for which the strongest effect was from the U.S. crop shortfall.

However, the transition of the world cotton market and the implementation of marketing loan program during the years have made U.S. cotton industry more sensitive to international forces. As the U.S. cotton industry has become increasingly integrated with the world market, the significance of China data revision and dollar devaluation have strong implications on U.S. cotton exports and market price movements.

For planning and decision-making for individual producers, merchants, and government agencies, international policy and market developments need to be monitored closely. In light of the complexity of the economic factors between U.S. and world markets, the econometric model can be helpful to capture the dynamic interrelations in

a comprehensive and consistent manner. Because of frequent and unforeseen nature of the external disturbances in the U.S. and world market, ongoing forecasts, impact simulations and policy analyses with the model should prove to be a particularly valuable tool for industry and policy decision-making.

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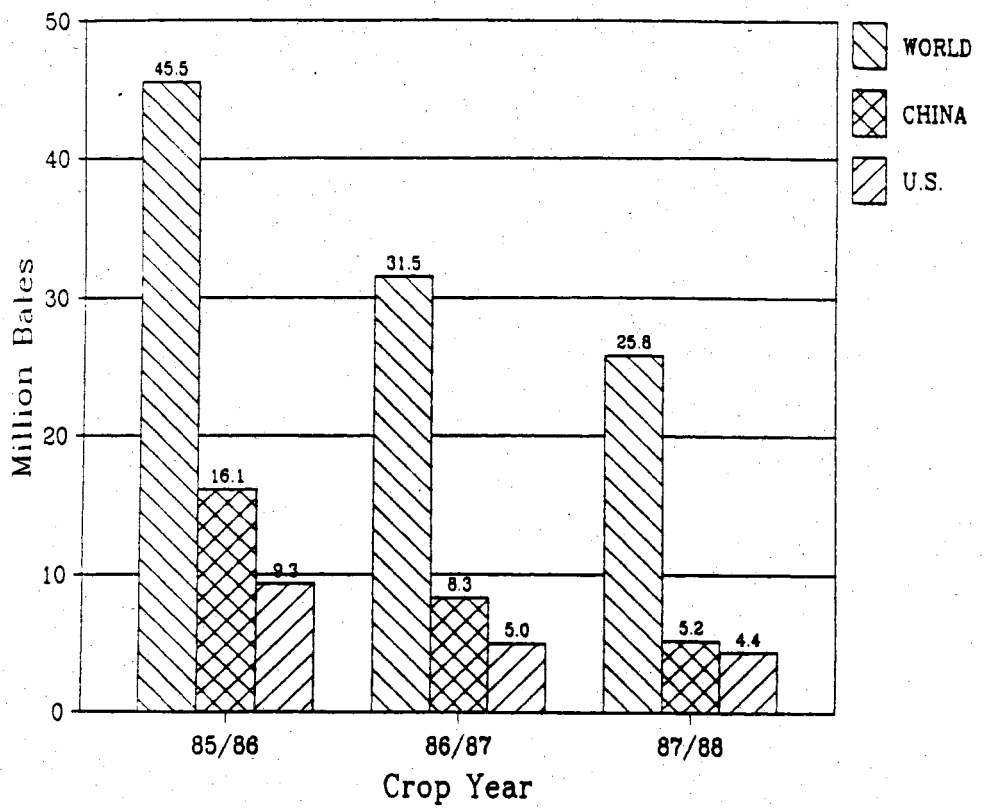

Figure 1. Ending Cotton Stocks: World, PRC, and U.S.

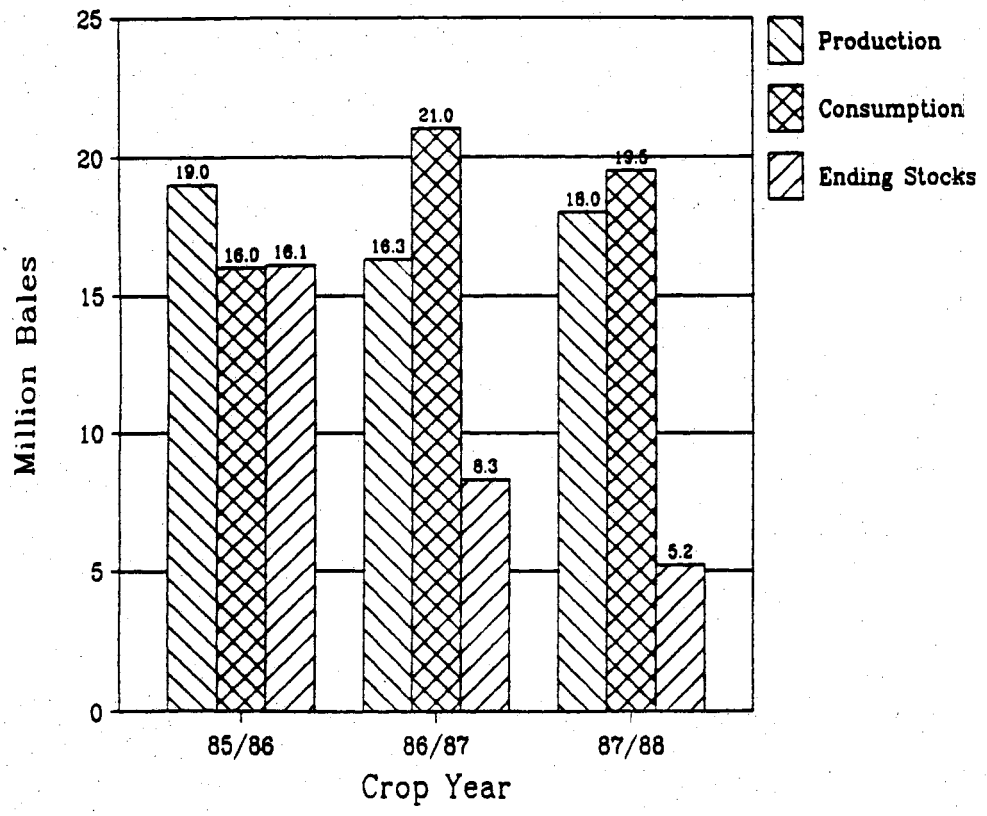

Figure 2. Cotton Production, Consumption, and Ending Stocks, PRC.

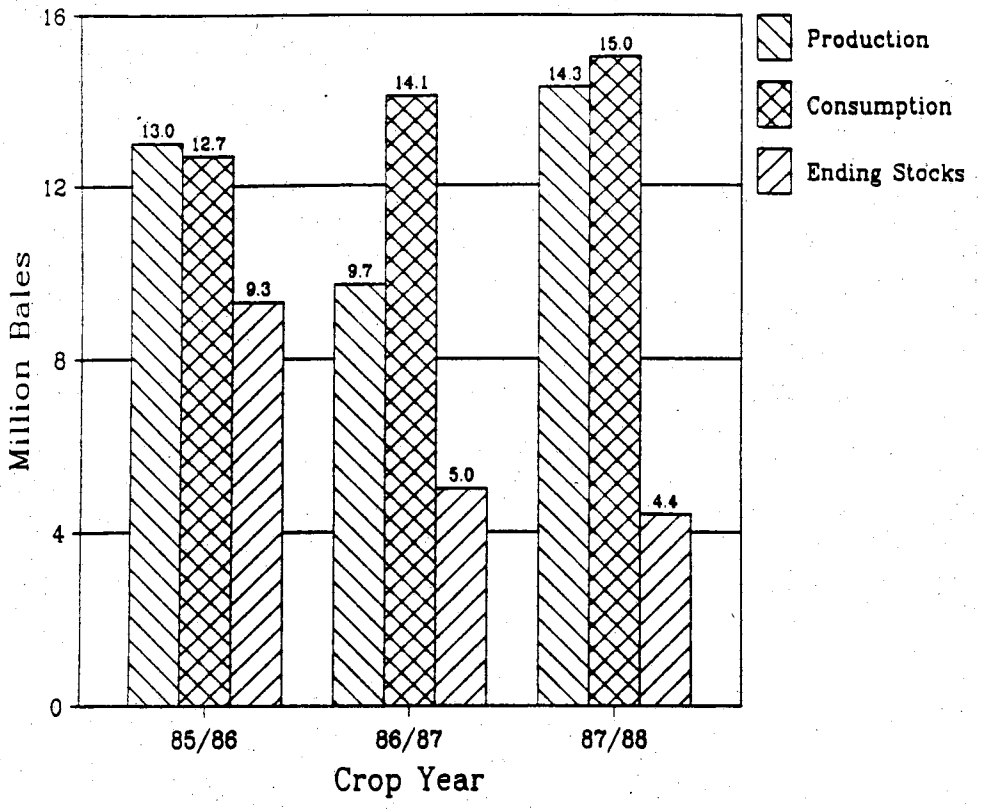

Figure 3. Cotton Production, Consumption and Ending Stocks, U.S.

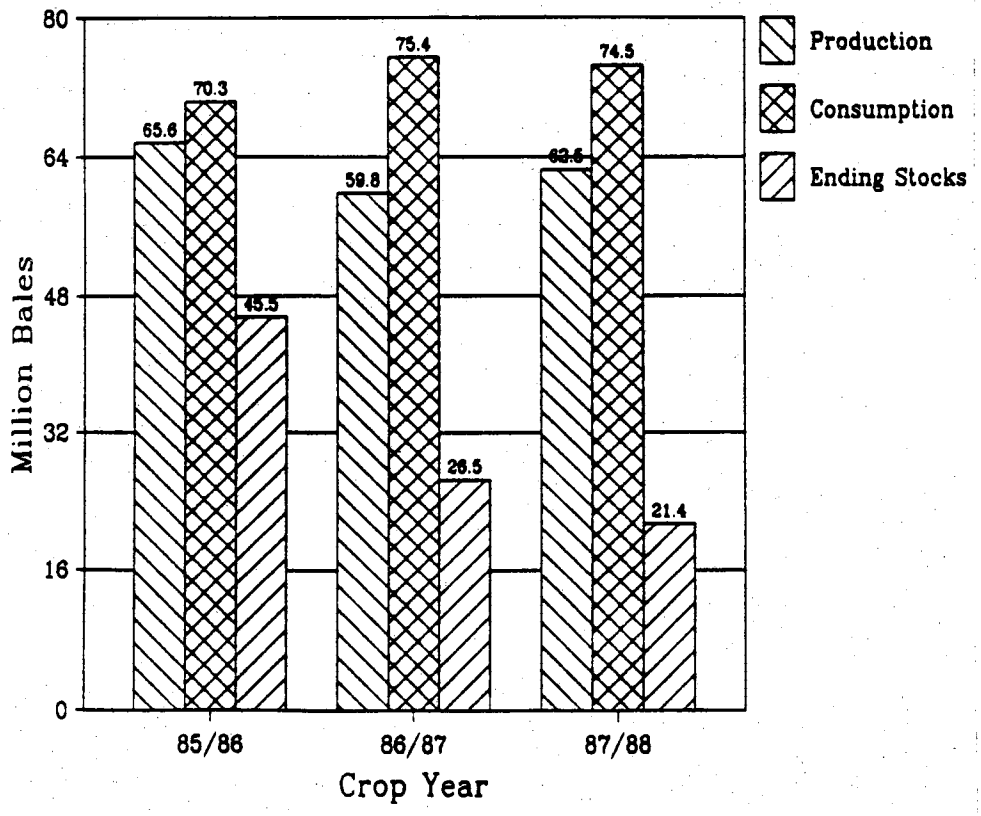

Figure 4. Cotton Production, Consumption, Ending Stocks, Rest of World.

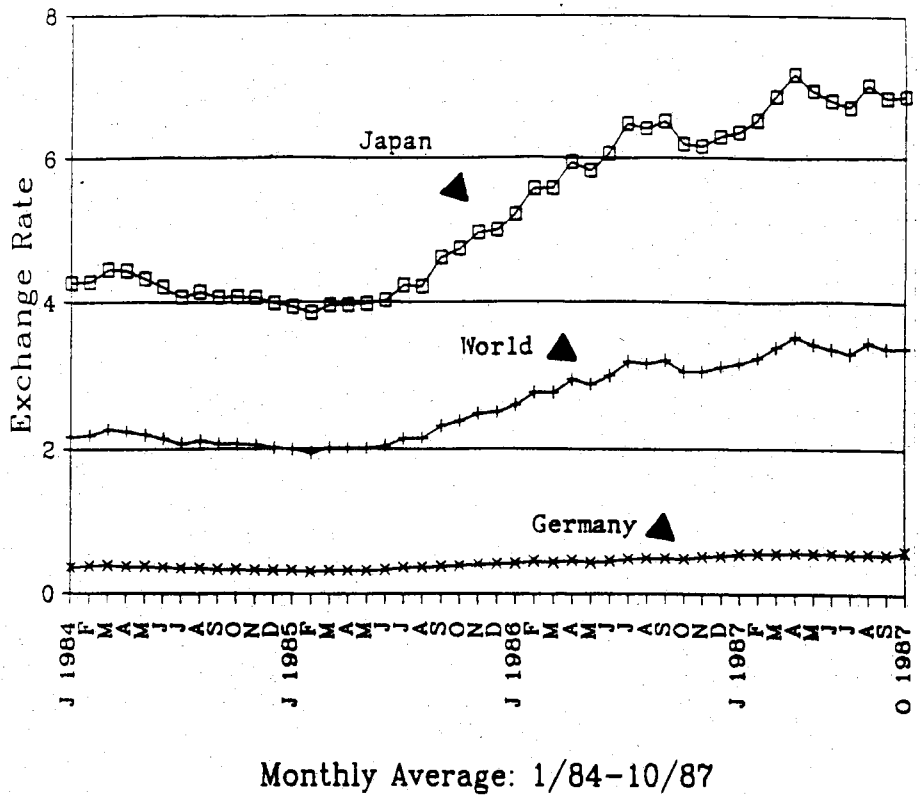

Figure 5. Exchange Rate: Weighted Averages of World, Japan and Germany.

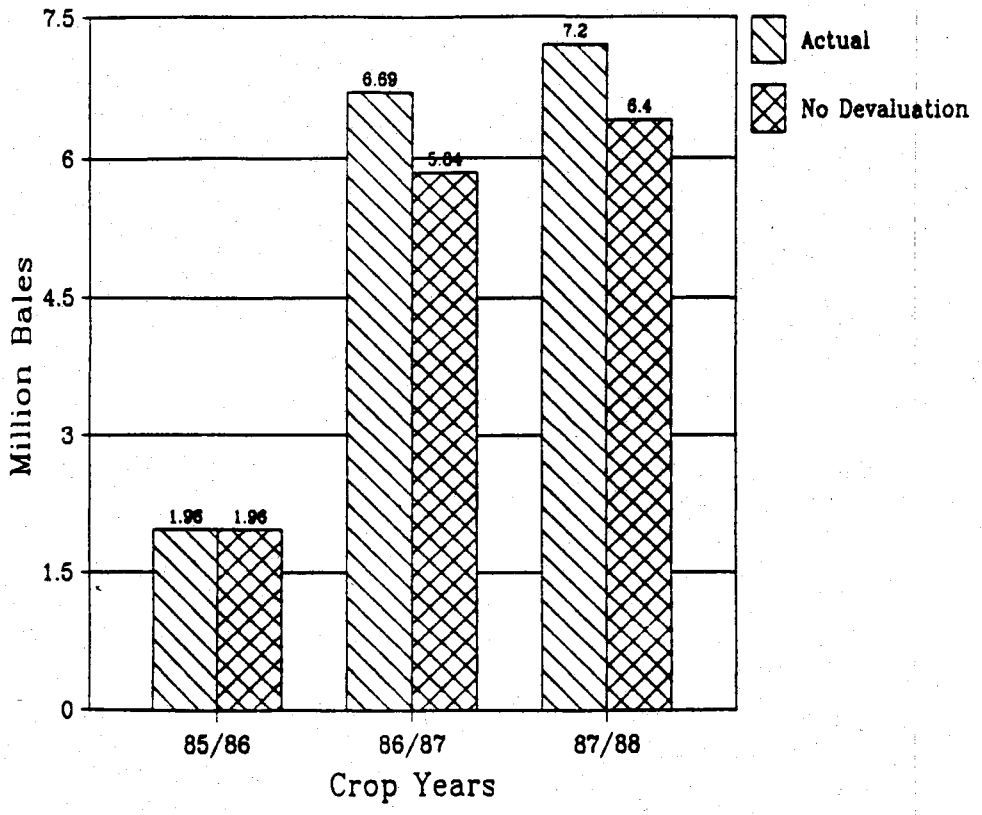

Figure 6. Impact of U.S. Dollar Devaluation on Cotton Exports: Actual Versus No Devaluation.

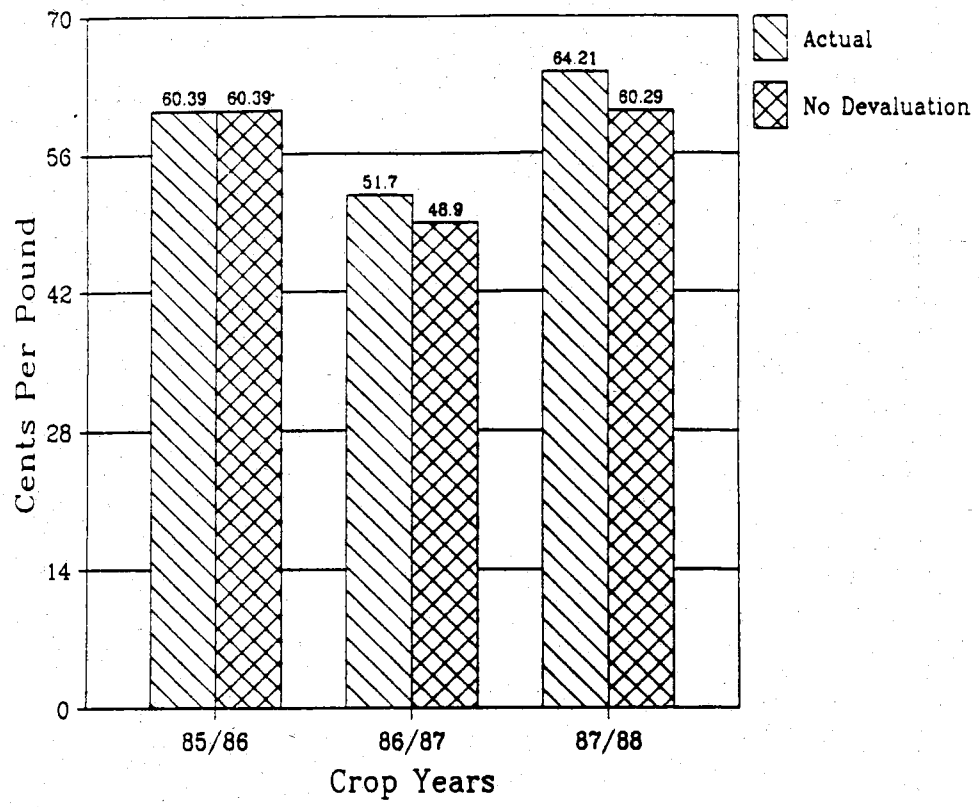

Figure 7. Impact of U.S. Dollar Devaluation on Memphis Prices: Actual Versus No Devaluation.

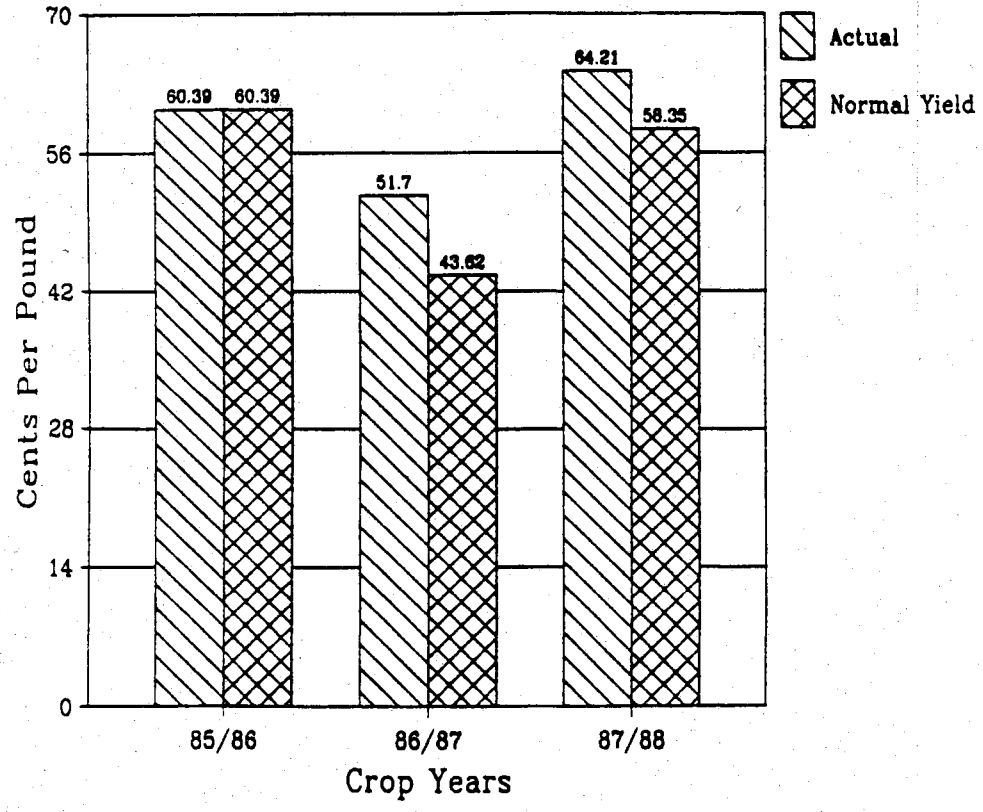

Figure 8. Impact of U.S. 1986 Crop Shortfall on Memphis Price: Actual Versus Normal Yield.

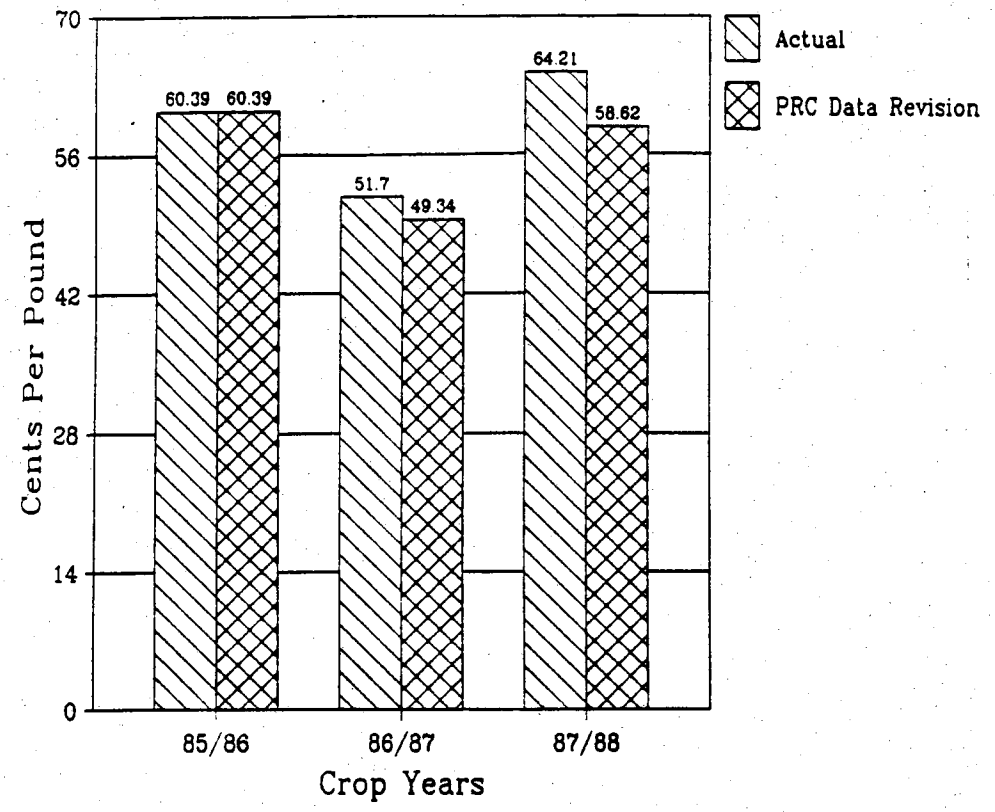

Figure 9. Impact of PRC Data Revisions on Memphis Price: Actual Versus Revision.

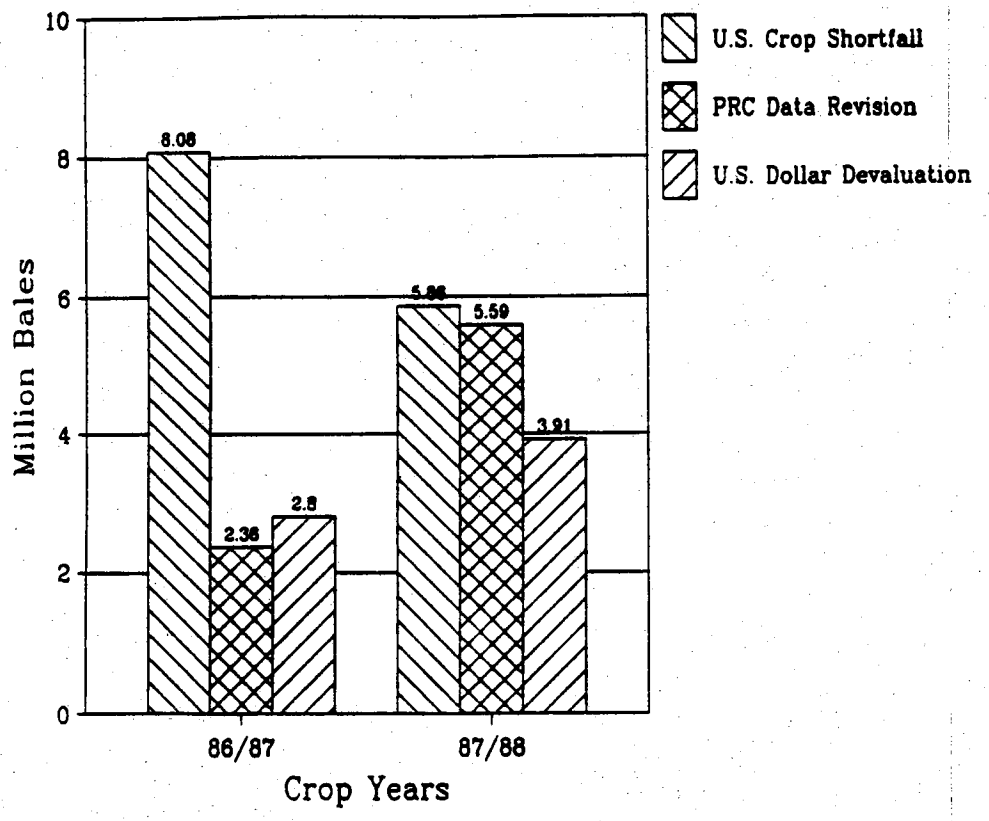

Figure 10. Price Impact Comparison: U.S. Shortfall, PRC Data Revision, and U.S. Dollar Devaluation.

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