COTTON ACREAGE IN RESPONSE TO GOVERNMENT PROGRAMS

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Abstract

This study analyzes of a relatively simple method for incorporating the effect of government programs into supply response models. An econometric model of cotton supply response was estimated for three major producing states of the Delta region of the US (Mississippi, Louisiana and Arkansas) using the annual time series from 1982 to 1994. The estimates show that more then 90% of the annual variation in Delta cotton plantings can be explained by the acreage diverted from cotton production, government program payments ratio and plantings in the previous year.

Introduction

The situation in cotton production during the last two decades can be divided into two periods. The period from 1975-1980 was characterized by a high worldwide demand for American farm products due to world crop shortages, devaluation of the dollar and generally favorable international economic growth. In this period cotton production was generally market oriented. No deficiency payments were made from 1975 through 1980, as market prices exceeded target prices. The situation changed in the early eighties with a decrease in both domestic and export demand caused by an international recession, lower inflation rates and record yields. Thus, government programs regained their importance and were aimed to reduce production and provide income and price support for the farmers. There was a major payment-in-kind program in 1983. Marketing loans, the lowering of loan rates and the introduction of competitiveness provisions have all been added since 1985. The objective was making cotton available to the market rather than putting it into government stocks. These income and price support provisions could only be practical if production was controlled. The means of providing production control have been acreage reduction programs, paid land diversions and the Conservation Reserve Program (which was introduced in 1985).

In the presence of changing government programs it is important to have an estimate of their impact on cotton production. The purpose of this report is to present a generalized method of analysis in estimating cotton supply response when government intervention is important.

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Data and Methodology

Methods for incorporating government policy variables in supply response models have received considerable attention in previous research. A number of researches (Duffy et al., Penn and Irwin, Chavas et al.) use the "effective support price" variable, a technique that was developed by Houck and Subbotnik. It involves a thorough analysis of government program provisions and an attempt to translate them into numerical values. Some researches (Shumway, Bailey and Womack) used "supply inducing prices" for cotton. This approach allows for the choice between the "expected market price" and the "effective support price" or their mix to be used in the periods of different market situations.

However, this methodology does not reveal the particular role of either market or government forces in producers' decision making since both are introduced within the same variable.

This analysis was based on the general model that was presented in the work of Houck, et al.(1976) and has the following functional form:

$$A=f(M,G.Z)$$

where A is the annual acreage of cotton planted; M represents the composite of all open-market economic forces which influence the planting decision; G represents all relevant government policy factors affecting farmer's decisions; and Z includes all other supply-determining factors, including non-economic and random effects.

The market forces of the equation were represented by the gross value of production minus cash expenses as a measure of short term returns to production. This is a better measure of market forces than prices as it accounts for variation in production costs, yields and other related factors, as well as prices received. Based on the data source (10), the gross value of production is defined as the value of the primary and secondary crops at the time of harvest. It excludes all kinds of government payments or crop insurance indemnities. Cash expenses represent the amount of money spent during the production process, beginning with the first expense incurred after harvesting the preceding crop as well as expenses on fallow ground. Returns to cotton are considered relative to returns to alternative crops (NR= NRc/NRothers) which are corn, soybeans, grain sorghum and rice. The index for alternative crops is calculated using a weighted average, where the returns to different crops are weighted by the acreage planted of the respective crops.

The major elements represented by G can be depicted by the annual acreage diverted from cotton according to government program provisions and the annual payments that farmers receive as the result of compliance with the programs. This approach allows the use of the common features inherent to different farm bills. It was hypothesized that government program payments reflect the benefits the farmer can acquire via program participation. The amount of land diverted from production represents the cost of participation. All information is measurable and can be obtained from USDA.

Data for diverted acreage incorporates various aspects of farm programs in place during the study period. The acreage reduction program, the payment-in-kind program, other reduction programs, paid land diversion, and the 50/92 - 0/92 programs were all included in the analysis for applicable years.

Government program payments were comprised of the payments stipulated by different provisions from year to year. These consist of deficiency, disaster and diversion payments for all competing crops and deficiency, disaster, diversion, PIK and marketing loan gain payments for cotton. Again, cotton was viewed within a system of alternative enterprises and the GP variable was presented as a ratio of government payments for cotton to government payments for other crops (GP=GPc/GPothers). The index of payments for other crops was calculated using the weighted average, where government program payments for different crops were weighted by the area planted of the respective crops.

Part Z represents a random element which might reflect some specific farmers' objectives, level of crop production technology and a number of other nonmarket and nongovernment phenomena. However, these elements are not measurable, generally.

Model Description and Results

The variables described above were used for an empirical estimation of the acreage response functions for the three largest producing states in the Delta region: Mississippi, Louisiana and Arkansas. Data were analyzed for 1982 to 1994, where acres planted to cotton were regressed on acres diverted from cotton production government program payments, lagged dependent variable and error term. The functional form to estimate b_0 through b_4 was:

$$AREA = b_0 + b_1\,LAGAREA + b_2\,DIV + b_3\,GP + b_4\,NR + e_t.$$

where AREA = cotton planted area (thousand acres)
LAGAREA = previous season's cotton area
DIV = area diverted from cotton production (thous. acres)
GP = cotton - others government payments ratio
NR = cotton - others net returns ratio
e_t = error term.

The lagged dependent variable was included on the right hand side to recognize the high costs of switching to (or out of) cotton production.

The equation was estimated using the OLS regression for each of the three states (see Table 1). The results show that the net returns ratio was insignificant in all cases. Such an outcome was expected since the cotton industry was not market driven during the years of the study. It was more oriented on government programs. Another problem with this variable is that it is highly correlated with government payments and may be a potential source of multicollinearity. Therefore, this variable was deleted and the results of the next regression are given in Table 2.

The lagged area variable was significant in Louisiana and Arkansas but not in Mississippi. The possible explanation for this can be the presence of a crop mix on large farms and hence the availability of necessary equipment which requires low (or none) switching costs when changing the acreage planted under different crops. The coefficients of the lagged acreage variables were expected to be positive and of a magnitude less than 1.0. A coefficient larger than 1.0 would indicate an unstable and explosive year-to-year change and give unacceptable elasticity estimates (Nerlove). Since the obtained lagged coefficients were less than 1.0, this tends to support the year-to-year adjustment hypothesis.

The model showed a strong inverse relationship between the dependent variable and diverted acreage. This result coincides with economic theory. The magnitude of the variable equal to 1.0 would indicate a 100% participation and compliance with government programs. The obtained coefficients for Arkansas and Mississippi were slightly less than 1.0 (0.82 and 0.90), suggesting that compliance was not perfect in these states. The diverted coefficient for Louisiana was slightly above 1.0 (1.18), meaning that some diversion provisions (CRP) were overlooked in the model.

Government program payments were also found to be a significant determinant of cotton acreage response. The estimated negative sign on this coefficient confirmed expected negative influence of government payments on cotton acreage caused by the philosophy of government programs designed to control supply in the situation of low domestic and export demand. Note that the magnitude of this coefficient is much larger in Arkansas (-4.08) than in Mississippi and Louisiana (-0.28 and -0.21). This can be explained by higher competition from other crops which is present in Arkansas relative to the other states.

The obtained estimates suggest that a 10 percent decrease in government payments would result in a 2.8 percent increase in cotton acreage in Mississippi, a 2.1 percent increase in Louisiana and 40.8 percent increase in Arkansas. However, it should be noted that changes in government program payments may have ramifications on the amount of land diverted from cotton production. Therefore these elements should be viewed in conjunction. Overall results demonstrate a good quality of fit of the developed model; adjusted R^2 is 0.91, 0.87, 0.93 for Mississippi, Arkansas and Louisiana, respectively. The value of the Durbin Watson statistic was about 2.0 for all three states, implying that there was no problem with autocorrellation.

Concluding Comments

This study provides reasonable results suggesting that the procedure used to reflect the impact of government programs on cotton acreage provides a useful tool for future research on supply analysis. However, there are ways to improve the presented model. First, as was mentioned before, information on the Conservation Reserve Program should be considered as part of the variables developed. Second, the use of acres planted in the program, instead of total planted acres as the weight in calculating the government payments index, could make the estimate more precise. It was not a problem in this case because of the high degree of participation in government programs in the Delta. Yet it could cause disturbances in other situations. Other improvements can be made as more information is available. However, it may be impractical to use this set of variables for the periods with different market conditions, because these factors would have different meaning during periods of high and low demand (programs that stimulate production vs. control production). Overall results show that the empirical model for Delta states presented a successful justification for the suggested approach. Further testing of this approach should be done using data from other regions of the United States.

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Table 1. Estimated Cotton Acreage Response Function, 1982-1994

State	Constant	LAREA	DIV	GP	NR	R^2	Adj R^2
MS	1419.77	0.0087	-0.8884	-0.2820	-10.7909	.95	.92
	(10.820)	(0.084)	(-8.19)	(-4.88)	(1.37)		
AR	415.62	0.6889	-0.8227	-4.1926	-7.6646	.90	.84
	(2.703)	(4.182)	(-1.78)	(-2.61)	(-0.56)		
LA	732.59	0.2786	-1.1933	-0.2121	0.4972	.96	.93
	(8.701)	(2.796)	(-8.03)	(-5.28)	(0.09)		

*Numbers in parenthesis are t-values.

Table 2. Estimated Cotton Acreage Response Function, 1982-1994

State	Constant	LAREA	DIV	GP	R^2	Adj R^2	D.W.
MS	1397.04	0.0173	-0.9037	-0.2862	.93	.91	1.81
	(10.74)	(0.173)	(-8.246)	(-4.892)			
AR	392.21	0.7003	-0.8283	-4.0804	.91	.88	1.92
	(3.08)	(5.286)	(-2.020)	(-2.838)			
LA	703.00	0.3273	-1.841	-0.2142	.95	.94	1.93
	(8.91)	(3.602)	(-8.090)	(-5.424)			

*Numbers in parenthesis are t-values.