Incorporating the 1990 Farm Bill into Farm-Level Decision Models: An Application to Cotton Farms

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Abstract

A five-year, 0-1, mixed integer programming model was developed to analyze the effects of 1990 Farm Bill legislation on the crop-mix decisions made on cotton farms. Results showed that, when compared to the 1985 Farm Bill, the 1990 Farm Bill can result in higher whole-farm income despite new "triple base" provisions limiting payment acres. The increase in income results from elimination of limited cross-compliance provisions and the change to a three-year base calculation. The model was also used to assess the likely impact of possible changes in the current legislation.

Key Words: cotton farms, farm programs, programming models

In the late 1980s, deficiency payments for farm program crops reached unprecedentedly high levels. In 1987, for example, deficiency payment outlays reached $16.7 billion, up from $1.3 billion in 1980. Deficiency payment expenditures were expected to remain at very high levels throughout the 1990's, unless significant changes were made in farm legislation. Concerns about high outlays led to new provisions in the 1990 Farm Bill designed to reduce farm program costs by limiting payment acreage.[1] In exchange, new flexibility provisions allow farmers to respond, at least in part, to market signals.

For Midwestern corn-soybean farmers, new 1990 Farm Bill provisions unequivocally lead to lower income because the loss in income through reduction of the portion of base eligible for government payments is only minimally offset by increased income generated by the flexibility provisions (Duffy and Taylor). For cotton, however, the situation may be quite different. Two other provisions of the 1990 Farm Bill, the change from a five-year to a three-year period for calculating cotton base (but not grain bases) and the elimination of limited cross-compliance, may significantly increase income on some cotton farms. Previous research has shown that, under previous Farm Bills, profit-maximizing farmers with low to moderate levels of initial cotton base often had incentives to expand cotton base by not participating in the program for one or two years and planting cotton extensively (Perry et al.; Mims et al.). This strategy would result in substantially more base in future years, given a three-year rather than five-year base calculation period. In addition, elimination of limited cross-compliance may boost income by allowing farmers to plant double-cropped wheat and soybeans on all residual acres, regardless of the level of wheat base. Because soybeans do not have

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base acreage provisions, limited cross-compliance had no effect on corn-soybean farmers; hence, its removal would not provide a means for increasing income.

The objective of this study is twofold. First, the model presented by Perry et al. for incorporating 1985 Farm Bill provisions into farm-level decision models is updated for the new program provisions. While the 1990 Farm Bill retains some similarity to the 1985 program, the new provisions are sufficiently extensive to warrant development of a new model. Second, our application will focus on income, crop-mix, and program payments on Southeastern cotton farms. Because of the variety of new provisions in the 1990 Farm Bill, it is impossible to assess the net effect of the new Farm Bill on these farms, without empirical analysis. Further, given continued interest in reducing costs of the farm programs, some possible alternatives for the future will be assessed: an increase in normal flex acreage requirements, and a change from a three-year to a five-year period for calculating base.

Results should be of interest to policy makers in several ways. First, because of the shortened base calculation period, it is possible that some cotton farmers may receive higher total government program payments over the full five-year period, despite reductions in program acreage eligible for deficiency payments. Fiscal gains anticipated by the federal government would thus be reduced. Also, because of the elimination of limited cross-compliance under the 1990 Farm Bill, cotton farmers may be able to increase total farm income even if government payments decline, a situation beneficial to both the government and the farmer. Finally, analysis of hypothetical future policy provisions should provide an indication to policy makers of the changes in farm management strategies that such changes could provoke.

Background on the 1990 Farm Bill

In overall structure, the 1990 Farm Bill is similar to the 1985 Bill. Acreage bases and deficiency payments were key provisions of the 1985 Farm Bill and are retained with modifications in the 1990 Farm Bill. In the 1985 Farm Bill, acreage bases for cotton and grains were determined as the lesser of a two-year or five-year moving average of acreage planted or considered planted in the program commodity. Under the 1990 Farm Bill, base acreage in cotton is calculated as a three-year moving average. (A strict five-year moving average is now used for grains.)

Cotton farmers participating in the farm program must limit cotton plantings to a portion of cotton base. In exchange, they receive a direct payment, the deficiency payment, on a portion of base.[2] For each farm program crop, the payment, M, is calculated as:

(1) $M = [TP - \mathrm{Max}(MP,LR)] \bullet PY \bullet AE$

where TP is the legislated target price ($.729/lb. for cotton), MP is the market price, LR is the CCC loan rate, PY is "program yield," and AE are acres eligible to receive payment. Program yield is based either on farm-level historic yields through 1986 or on average county yields. Thus, program yield may or may not reflect the current situation on a particular farm.

Eligible acres are a portion of the base. First, a specified percentage of the base, set by the Secretary of Agriculture, must be idled if an acreage reduction program (ARP) is in effect for that year. ARP provisions, included in the 1985 Farm Bill, continue in the 1990 Farm Bill. In addition, new "triple base" provisions further limit payment acreage. Under the 1990 Farm Bill, 15 percent of a farmer's base acreage in a commodity is designated as "Normal Flex Acres" (NFA). On these acres, the farmer may plant the particular commodity for that base or a substitute crop, but will receive no deficiency payment. Also, an additional 10 percent of acres are designated as "Optional Flex Acres" (OFA). The farmer may plant these acres in the program crop and receive a deficiency payment, or plant them in an alternative crop and forfeit the deficiency payment. ARP, NFA, and OFA are "considered planted" in the commodity for the purpose of calculating future base acreage.

Another difference in the two Farm Bills is the elimination of limited cross-compliance. Under the 1985 Farm Bill, with its limited cross-compliance provision, a farmer participating in the farm program in one crop could not exceed the base in other program crops even if these crops were not enrolled in the farm program. Although limited cross-compliance was eliminated in the 1990 Farm Bill, farmers cannot "build base" in one program crop while participating in the farm program in another. The overall effect of the 1990 Farm Bill legislation, therefore, is to provide more flexibility to farmers in exchange for a reduction in direct payments.

For cotton farmers in particular, these flexibility provisions may be important income boosters. In the Southeast, with its long growing season, double cropping of soybeans and wheat is an economically attractive alternative to full-season soybeans. Under the 1985 Farm Bill, a farmer who participated in the cotton program could not plant wheat beyond the wheat base, even if farm program participation was not chosen for wheat. Thus, as shown by Mims et al., in many cases limited cross-compliance could reduce whole-farm profits significantly for Southeastern cotton farms.

Methods

As discussed by Perry et al., the discrete choice involved in farm program participation decisions is best handled by the use of mixed integer programming. Incorporation of farm program provisions for the 1985 Farm Bill into a model of this type is described in detail in Perry et al. For the 1990 Farm Bill provisions, a substantially different model is required. Table 1 is a section (from year 3) of a five-year mixed integer programming model of a Southeastern cotton farm under the 1990 Farm Bill. Cotton, soybeans, and wheat are the major crop enterprises.

Under the 1990 Farm Bill, as under the 1985 Farm Bill, a farmer must decide between program participation and nonparticipation. Participation is nondivisible since one cannot partially participate in government price support programs; therefore, a pair of 0-1 integer variables was used to force the exclusivity of each such decision. The Y-3 and X-3 columns are, respectively, the participation and nonparticipation activities for cotton in year 3, and the PROG-3 row is constrained to equal 1, ensuring either participation or nonparticipation in government programs for cotton in that year. The PAL-3 row keeps program cotton from entering the solution in that year unless the participation activity is chosen. If participation is chosen, the large negative transfer causes the PAL-3 row to become nonconstraining, and other rows, notably those involving the base, will restrict the program cotton activity. Similarly, the FAL-3 row prevents nonprogram cotton from entering the solution unless the nonparticipation activity is selected.

If program cotton is selected in year 3, the PLIM-3, ARP-3, NFAT-3, and OFAT-3 rows transfer program cotton acreage to different activities to account for the acreage reduction program and flex acreages. The acreage transferred to the PAC-3 activity is eligible for deficiency payment, while ARP and normal flex acres (NFA-3) are not. Whether optional flex acres (OFA-3) receive a deficiency payment depends on further decisions, as discussed below. Together regular planted acres of cotton (PAC-3), normal flex acres from cotton (NFA-3), optional flex acres from cotton (OFA-3), and the acreage reduction requirement (ACP-3) form the acres "considered planted" (AP-3) in cotton for the purpose of future base calculations.

The normal flex acres from program cotton may be used to plant additional nonpayment cotton (XFC-3) or may be "flexed" to nonprogram wheat-soybeans double cropped (XS-3) or full-season soybeans (not shown). The NFLM-3 row ensures normal flex acre plantings do not exceed the amount of flex acres available, either from program cotton or program wheat (not shown). Optional flex acres from program cotton can be kept in the cotton program by planting "extra program cotton" (XLAC-3). Optional flex acres used in this manner are eligible to receive a deficiency payment. The optional flex acres from cotton may also be used to plant nonprogram wheat-soybeans double cropped (XS2-3), or full-season soybeans.

Cotton base is calculated as a three-year moving average of those acres planted and "considered planted." Current Farm Bill provisions do not allow base in one program crop to be increased if there is participation in the program for another crop, but base can be increased by choosing nonparticipation in all program crops. This provision represents the most significant break with the 1985 Farm Bill in terms of modeling difficulty.

Table 1. Example Matrix from 1990 Farm Bill Model

Rows	Y-3	X-3	AP-3	AF-3	XFC-3	XLAC-3	XS-3	XS2-3	PAC-3	OFA-3	NFA-3	CTCR-3	CTNR-3	CTBS-1	CTBS-2	CTBS-3	BASE-3	DPYT-3	PCT-3	ACP-3	BASE-4	WX-3	SCT-3		RHS
PROG-3[1]	1	1																						=	1
PAL-3	-999		1																					≤	0
FAL-3		-999		1																				≤	0
BASEL-3			1														-1							≤	0
PLIM-3			.65						-1															=	0
NFAT-3			.15								-1													=	0
OFAT-3			.1							-1														=	0
ARP-3			.10																	-1				=	0
TBASEC-3														.33	.33	.33					-1			=	0
TFCOT-3				-667	-667	-667			-667														1	≤	0
TPCOT-3						-667			-667										1					≤	0
APCL-3												1					-1					-999		=	0
ANCL-3			-1	-1									1											=	0
DEFPAY-3																		1	-.109					=	0
LIMCA-3												-1				1								≤	0
LIMCB-3													-1			1								≤	0
NFLM-3					1		1				-1													≤	0
OFLM-3						1		1		-1														≤	0

(Key to Table 1)

[1] Part of matrix for year 3. Rows and Columns serve the following purpose:

Rows

PROG-3.	Limits cotton production to either program or nonprogram, not both.
PAL-3.	Nonbinding constraint if program cotton selected through Prog-3. Otherwise, sets program cotton to 0.
FAL-3.	Nonbinding constraint if nonprogram cotton selected through Prog-3. Otherwise sets nonprogram cotton to 0.
BASEL-3.	Limits total program acreage to base.
PLIM-3.	Transfers 65 percent of program cotton to planting activity, excluding ARP and all triple base.
NFAT-3.	Transfers 15 percent of program cotton to normal flex acres.
OFAT-3.	Transfers 10 percent of program cotton to optional flex acres.
ARP-3.	Transfers 5 percent of program cotton to ARP.
TBASEC-3.	Calculates base in year 4.
TFCOT-3.	Transfers production (yield) to a marketing activity (SCT).
TPCOT-3.	Transfers proven yield to a program production activity (PCT).
AFCL-3.	Limits acres to the base if program wheat is selected, nonbinding otherwise.
ANCL-3.	Totals actual cotton acres, program or nonprogram.
LIMCA-3.	Works with LIMCB-3 to restrict the CTBS-3 activity to lesser of CTNR-3 or CTCR-3, to prevent base expansion in cotton if program wheat is planted.
DEFPAY-3.	Calculates deficiency payment on program cotton.
NFLM-3.	Distributes normal flex acres to possible activities.
OFLM-3.	Distributes optional flex acres to possible activities.

Several activities are introduced into the mixed integer programming model to ensure compliance with this provision. First, the CTNR-3 activity is the total cotton in each year including all cotton acres planted and "considered planted," as calculated in the ANCL-3 row. If program wheat is planted, the CTCR-3 activity is restricted to the current cotton base. If nonprogram wheat is selected, however, the CTCR-3 becomes a large positive number through use of the wheat integer activity (WX-3). Working together, the LIMCA-3 and the LIMCB-3 rows restrict the CTBS-3 activity to the lesser of CTNR-3 or CTCR-3. A transfer row (TBASEC-3) then transfers a third of the CTBS-3 activity into the base activity (BASE-4) for future years.

When participation in the cotton program is selected, the TPCOT-3 row transfers the amount of program cotton produced (in pounds of lint per acre) into the PCT-3 activity where a deficiency payment can be calculated. The actual amount of deficiency payment to be received is calculated in the DEFPAY-3 row. The TFCOT-3 row transfers all cotton produced, whether in the program or out, to a marketing activity (SCT-3).

For wheat program activities, a set of constraints similar to those shown in table 1 are used. Given space limitations, the full model is not presented here, but a copy of the computer code used in this model is available from the authors on request. The 50/92 program, available for cotton, Columns

Y-3.	Integer activity for program participation.
X-3.	Integer activity for no program participation.
AP-3.	Total program cotton acres.
AF-3.	Nonprogram cotton
XFC-3.	Normal flex acres planted to cotton (no deficiency payment).
XLAC-3.	Optional flex acres planted to cotton (deficiency payment).
XS-3.	Normal flex acres planted to wheat-soybeans double cropped.
XS2-3.	Optional flex acres planted to wheat-soybeans double cropped.
PAC-3.	Cotton program plantings, excluding any flex acres.
OFA-3.	Total optional flex acres.
NFA-3.	Total normal flex acres.
CTCR-3.	Cotton considered planted for base calculation if wheat program selected.
CTNR-3.	Cotton considered planted for base calculation if wheat program not selected.
CTBS-1.	Cotton acreage from year 1 used in future base calculation.
CTBS-2.	Cotton acreage from year 2 used in future base calculation.
CTBS-3.	Cotton acreage from year 3 used in future base calculation.
BASE-3.	Cotton base in year 3.
DPYT-3.	Deficiency payment activity.
PCT-3.	Production of cotton eligible for deficiency payment.
ACP-3.	Acreage Reduction Program (ARP) acreage.
BASE-4.	Cotton base in year 4.
WX-3.	Wheat program integer for year 3.
SCT-3.	Total cotton available for sale.

and the 0/92 program, available for wheat, were not included in this analysis. Under prevailing market prices and yields, these options are not attractive to a producer unless labor or capital is constrained. If gross returns were less than variable costs or labor severely limited, this option would become attractive. Modeling these options can be handled either through additional integer activities in the PROG row (Perry et al.), or through additional transfer rows (Gillespie et al.). CRP was also not included here, but can be handled easily, as shown by Gillespie et al.

Mechanisms for payment limitations are also included in the model, but are not enforced in this study. Given the size of the farm, and its initial base, limits would not be exceeded in most cases. Additionally, legal organization is often used to avoid these limits (see Mims et al.; Perry et al.).

The Representative Farms

For this study, five-year mixed integer programming models were developed to represent two cotton farms, one reflecting conditions in

Southwestern Alabama (farm 1), the other representing conditions in Northern Alabama and/or Western Tennessee (farm 2). In both areas of the Southeast, cotton, soybeans, and wheat are important field crops, but cotton production differs significantly in terms of yields and costs.

Crop yields and cost of production estimates for both farms were based on 1992 budgets from the Alabama Cooperative Extension Service (ACES). Cotton yield (based on solid planting) was 697 pounds of lint per acre on farm 1 and 667 pounds of lint per acre on farm 2. Based on the ACES budgets, variable cotton production costs, excluding labor, were assumed to be $335.11 on farm 1 and $293.61 per acre on farm 2. Differences in cotton yield and costs of production in the two areas reflect different insect control problems. In addition, South Alabama is part of the Boll Weevil Eradication zone, while North Alabama and Tennessee are not. Effects of the Boll Weevil Eradication program are captured in the budget for South Alabama cotton.

Wheat yield was assumed to be 35 bu./acre on both farms, with per acre variable costs of production of $78.36. Full-season soybeans were assumed to have a yield of 25 bu./acre on both farms, with variable production costs of $82.54/acre. Soybeans double cropped with wheat were assumed to have a yield of 23/bu. acre on both farms, with variable production costs of $80.47. According to ACES specialists, wheat and soybean production, unlike cotton, are roughly similar in both areas.[3]

The basic structure of farm 2 (North Alabama/West Tennessee) was patterned after a similar farm used in the Mims et al. study to represent commercial-sized farms in the area. The farm has 948 acres of tillable cropland and $53,240 of annual fixed costs, including depreciation and interest. To make results comparable across farms, the South Alabama farm was assumed to have the same acreage and fixed costs. Fixed costs do not enter into the crop-mix or program participation choices in the model, but will affect total profits.

Clearly, the level of initial base on the farm will effect both crop-mix and income. In the Mims et al. study, beginning bases were set at 492 acres for cotton and 38 acres for wheat, based on Alabama Farm Analysis Association data. These levels were accordingly selected as starting points for initial base levels in this study.

Labor costs are calculated separately in the model, at a rate of $5.00 per hour, with labor hired as needed. Each farm was assumed to be endowed with unpaid operator and family labor equivalent to 2 full-time workers. Labor requirements were calculated for six production periods, based on information collected by the Alabama Cooperative Extension Service and the Alabama Agricultural Experiment Station.

Expected market prices for the commodities were obtained from Alabama Cooperative Extension Service budgets: $0.62 per pound of lint for cotton, $3.15 per bushel for wheat, and $5.75 per bushel for soybeans. Market prices were held constant across all five years of the planning horizon.

The announced target price for upland cotton was $0.729 per pound of lint, and the target price for wheat was $4.00. Since soybeans do not have a deficiency payment program, there is no target price for soybeans. For this study, acreage reduction requirements (ARP) were fixed at 10 percent for upland cotton and 15 percent for wheat.[4]

For this study, the assumed objective of producers is maximization of the multi-year discounted stream of income.[5] Returns are discounted using a 7 percent discount factor, chosen to approximate the opportunity cost of capital. Choice of discount rate (within reasonable limits) does not greatly affect model results. In the Mims et al. study, tax rates did not affect the optimal decision; accordingly, tax functions are not included in the model. No rotational restrictions are incorporated into the model because most cotton farmers in the study area do not use rotations extensively (see Mims et al.).

A five-year planning horizon was chosen for this study because it represents a time period over which the farmer can be reasonably certain the farm program (five years in length) will continue. Beyond five years, uncertainty about the future direction of farm programs (and market trends) can become very high (see Perry). If desired, the objective function of this type of model can be modified to account for the value of base at the end of the five-year planning horizon (see Perry et al.). These ending values, in some cases, would provide an increased motivation for farmers to expand base in the early years.

Results

The mixed integer programming models were first used to compare the optimal crop-mix and farm-program participation decisions made under conditions outlined in both the 1985 Farm Bill and the 1990 Farm Bill. In addition, the amount of direct government program payments collected was calculated. In each case, all price, yield, and cost assumptions remained constant for the entire planning horizon of the model. The models were next used to analyze the effects of possible changes in current policy on farm income, crop-mix, and payments.

The 1985 versus the 1990 Farm Bills

Results for the comparison between the 1985 and 1990 Farm Bills are presented in tables 2 and 3. For both farms, the base-building "strategy" remains unchanged, regardless of the legislation assumed to be in effect. For farm 1, maximum profits are obtained by dropping out of the program for one year, planting the entire farm in cotton, and then remaining within program limits for the remainder of the time horizon. For farm 2, which has higher per acre net returns for cotton outside the program, two years of base building are optimal. Under the 1990 Farm Bill, base is calculated using a three-year moving average; thus, cotton base in the later years is considerably higher than under the 1985 Farm Bill. In these analyses, all flex acres are planted in cotton, rather than in soybeans or wheat and soybeans double cropped, because nonprogram cotton is somewhat more profitable on a per acre basis than the alternatives.

The lack of change in the optimal base-building strategy was somewhat surprising, given the changes in farm legislation. Since the passage of the 1990 Farm Bill, cotton acreage has been increasing in some areas in the Southeast. Our analysis shows that the increase in acreage was probably not spurred by the change in farm programs per se, but rather was the result of changes in relative yields and market prices combined with relatively favorable base expansion provisions in the new legislation. In this analysis, prices and yields were held constant at current (1992-93) levels, regardless of the Farm Bill considered. With lower yields and/or cotton prices, sensitivity analysis indicates that base acreage is less likely to be expanded. Hence, nonprogram changes over the last five years, such as increased yields from the Boll Weevil Eradication program, have most likely contributed significantly to the increasing cotton acreage in the Southeast (Cain). The shorter base calculation period under the 1990 Farm Bill results in greater cotton acreage after the base-building period ends, contributing to the general trend.

For both farms, the discounted stream of before-tax net farm income increases under the 1990 Farm Bill. For farm 1, the objective function rises from \$183,453 to \$210,485. The increase in income occurs despite a decline in deficiency payments, from \$164,751 over five years under the provisions of the 1985 Farm Bill to \$159,591 under the provisions of the 1990 Farm Bill. Much of the increased income can be attributed to the elimination of the cross-compliance provision. Budgeting shows that wheat-soybeans double cropped is more profitable than full-season soybeans on both farms. Under the limited cross-compliance provision of the 1985 Farm Bill, however, acreage of wheat is severely limited, even when program participation is not elected for wheat.[6] For farmers with a large initial endowment of wheat base, the effects of limited cross-compliance were minimal; such farmers would not benefit as strongly from the switch to the 1990 Farm Bill provisions.

For farm 2, the objective function increases from \$249,272 under the 1985 provisions to \$276,119 under the 1990 provisions. Deficiency payments increased from \$135,964 over five years under the 1985 Farm Bill provisions to \$140,323 over five years under the 1990 Farm Bill provisions. Although triple base provisions of the 1990 Farm Bill reduce the percentage of base eligible for payment, the shorter period for base calculation results in enough additional base to more than offset the loss in deficiency payments due to implementation of triple base. This result was not

Table 2. Crop-Mix and Returns for Farm 1, 492-Acre Beginning Base

1985 Farm Bill

Objective Function: $183,453

	Cotton	Wheat-Soybeans	Soybeans	Govt. Payments
Year 1	948	0	0	0
Year 2	583[a]	19[b]	346	40,725
Year 3	601[a]	10[b]	338	41,548
Year 4	592[a]	14[b]	341	41,136
Year 5	597[a]	12[b]	339	41,342

1990 Farm Bill

Objective Function: $210,485

	Cotton	Wheat-Soybeans	Soybeans	Govt. Payments
Year 1	948	0	0	0
Year 2	644[a]	304	0	36,693
Year 3	695[a]	253	0	39,578
Year 4	762[a]	186	0	43,425
Year 5	700[a]	248	0	39,895

[a] Total acres enrolled in farm program for cotton, including ARP.

[b] Total acres enrolled in farm program for wheat, including ARP.

anticipated a priori, and underscores the importance of analyzing farm policy changes in a whole-farm framework where policy interactions are revealed.

Perry found that introducing risk aversion into his models, via quadratic programming techniques, resulted in outcomes in which farmers would remain within program bases. To assess the level of risk associated with a profit-maximizing base expanding strategy, we simulated the optimal crop-mix decisions from our mixed integer programming models for the 1990 Farm Bill and compared results with those obtained from simulations of a five-year strategy of planting cotton within program limits every year with residual acreage in nonprogram wheat and soybeans double cropped. FLIPSIM V (Richardson and Nixon) was used to simulate the five-year optimal farm plans over 100 iterations with market prices and yields drawn from a distribution based on ten years of actual production data obtained from the Alabama Farm Analysis Association. Results indicate that, for a farmer with low leverage, base-expansion carries no additional risk of whole-farm failure, although income variance was indeed higher in nonprogram years. For farmers with high debt levels, base-expansion, with its subsequent higher income, leads to a higher probability of remaining solvent for five years. Although income variance increases in the early years, the down-side risk is more than offset by higher average earnings in the later years. Thus, when concluding that risk-averse

Table 3. Crop-Mix and Returns for Farm 2, 492-Acre Beginning Base

1985 Farm Bill

Objective Function: $249,272

	Cotton	Wheat-Soybeans	Soybeans	Govt. Payments
Year 1	948	0	0	0
Year 2	948	0	0	0
Year 3	674[a]	0	274	44,128
Year 4	711[a]	0	237	46,515
Year 5	693[a]	0	255	45,321

1990 Farm Bill

Objective Function: $276,119

	Cotton	Wheat-Soybeans	Soybeans	Govt. Payments
Year 1	948	0	0	0
Year 2	948	0	0	0
Year 3	796[a]	152	0	43,400
Year 4	897[a]	51	0	48,923
Year 5	880[a]	68	0	48,000

[a] Total acres enrolled in farm program for cotton, including ARP.

[b] Total acres enrolled in farm program for wheat, including ARP.

farmers are more likely to remain in the farm program, one must carefully assess how risk is perceived by farmers: whether the problem is variance of annual returns, or the possibility of farm failure. If the latter, base-building strategies may be less risky than participating in the program each year.[7]

Results in tables 2 and 3 pertain to the case where a farmer has approximately half the total tillable acreage in cotton base. An alternative set of models was also analyzed, using a beginning base of 711 acres. These results are reported in tables 4 and 5. As can be seen from the results, when initial base is high, farmers are less likely to engage in a base-expanding strategy. Under the 1985 Farm Bill, both farms remain inside the cotton base in all years. Under the 1990 Farm Bill, when beginning base is 711 acres, farm 1 remains inside program limits in every year. Deficiency payments, in this case, slightly exceed the $50,000 legislated limit. Enforcing the payment limitation does not greatly affect results. On farm 2, under the 1990 Farm Bill, cotton is planted on the full acreage in the first year of the planning horizon, a different management strategy than employed for the 1985 Farm Bill.

For both farms, when initial base is 711 acres, the switch from the 1985 Farm Bill provisions to the 1990 Farm Bill provisions results in lower total income as well as lower deficiency payments. In our study, 1985 and 1990 Farm Bill provisions were compared under the assumption that

Table 4. Crop-Mix and Returns for Farm 1, 711-Acre Beginning Base

1985 Farm Bill

Objective Function: $256,338

	Cotton	Wheat-Soybeans	Soybeans	Govt. Payments
Year 1	711[a]	38[b]	199	50,311
Year 2	711[a]	38[b]	199	50,311
Year 3	711[a]	38[b]	199	50,311
Year 4	711[a]	38[b]	199	50,311
Year 5	711[a]	38[b]	199	50,311

1990 Farm Bill

Objective Function: $244,615

	Cotton	Wheat-Soybeans	Soybeans	Govt. Payments
Year 1	711[a]	237	0	40,513
Year 2	711[a]	237	0	40,513
Year 3	711[a]	237	0	40,513
Year 4	711[a]	237	0	40,513
Year 5	711[a]	237	0	40.513

[a] Total acres enrolled in farm program for cotton, including ARP.

[b] Total acres enrolled in farm program for wheat, including ARP.

ARP requirements remain the same. In actuality, though, ARP requirements change over time depending on the stocks-to-use ratio. Thus, under the 1985 Farm Bill, ARP levels as high as 25 percent were implemented (Mims et al.), while ARP levels under the 1990 Farm Bill have been in the 5 to 10 percent range. By simple budgeting, it can be shown that a low ARP level with triple base provisions in effect compares favorably with a high ARP level and no triple base, even with base held constant. Had triple base not been introduced, it is possible that higher ARP levels might have been an alternative technique used to reduce expenditures on the farm program. Thus it would be a mistake to conclude emphatically that the 1990 Farm Bill hurts farmers with high initial cotton bases, without considering the probable ARP levels that would have been imposed had the farm program provisions not been changed.

Sensitivity analyses on market prices, target prices, yields, and ARP levels were also performed. In general it was found that for the 1990 Farm Bill base-expansion of cotton is most likely to occur when per acre returns from nonprogram cotton are high relative to those obtained from wheat-soybeans doubled cropped (the most economically attractive alternative), target prices are at least moderately high, and ARP levels are not unduly high. With very high target prices, base expansion will be undertaken even when nonprogram cotton offers lower per acre returns than wheat-soybeans double

Table 5. Crop-Mix and Returns for Farm 2, 711-Acre Beginning Base

1985 Farm Bill

Objective Function: $307,839

	Cotton	Wheat-Soybeans	Soybeans	Govt. Payments
Year 1	711[a]	38[b]	199	48,219
Year 2	711[a]	38[b]	199	48,219
Year 3	711[a]	38[b]	199	48,219
Year 4	711[a]	38[b]	199	48,219
Year 5	711[a]	38[b]	199	48,219

1990 Farm Bill

Objective Function: $298,729

	Cotton	Wheat-Soybeans	Soybeans	Govt. Payments
Year 1	948	0	0	0
Year 2	790[a]	158	0	43,074
Year 3	816[a]	132	0	44,509
Year 4	851[a]	97	0	46,420
Year 5	819[a]	129	0	44,663

[a] Total acres enrolled in farm program for cotton, including ARP.

[b] Total acres enrolled in farm program for wheat, including ARP.

cropped. With moderate target prices and per acre returns from nonprogram cotton below those of wheat-soybeans double cropped, the profit-maximizing strategy involves staying within the program base and planting normal flex acres in wheat-soybeans double cropped.

Policy Options for the Future

Because of continued concern over the national debt, it is possible that efforts will be made, with the next Farm Bill, to reduce direct payments. One alternative, increasing normal flex acreage, has already been discussed by policy makers.[8] To analyze the effects of this possibility, the farm models were modified so that NFA was 25 percent of base, rather than the current 15 percent, with all other provisions of the 1990 Farm Bill remaining constant.

Even with higher NFA, "base building" was still the optimal strategy for farms with a 492-acre beginning base. For both farms, when 492 acres of beginning base are assumed, the optimal farm plan remained unchanged as NFA increased. Government payments and farm income fell by exactly the amount of the lost deficiency payments. For farm 1, five-year discounted returns fell from $210,485 with 15 percent NFA to $193,697 with 25 percent NFA. For farm 2, five-year discounted returns dropped from $276,119 to $261,857.

With a 711-acre beginning base and 15 percent NFA, the optimal farm plan for farm 1 involved participating in the cotton program every year. This strategy remained unchanged as NFA increased to 25 percent. For farm 2 with a 711-acre beginning base, the strategy of staying out of the program for a year to build base also remained unchanged as NFA increased. In both cases, as for the farms with less base, income and deficiency payments were reduced in direct proportion to the increase in NFA.

For the set of prices and yields used in this analysis, NFA was always planted in cotton. Accordingly, identical effects on income and program payments could be achieved by direct reduction of the target price. Because NFA allows farmers some flexibility to respond to changing market conditions for alternative crops, this option would probably be preferred by farmers to a reduction in target price. If wheat and soybean prices increase, NFA provisions would allow farmers to capture extra market returns without reducing cotton base.

Another analysis, in which the base calculation period was expanded to five years and NFA set at the initial 15 percent, was also performed. For the farms with a 492-acre beginning base, this policy resulted in discounted-five year returns almost identical to those achieved with a three-year base and 25 percent flex acreage. For farms with a 711-acre beginning base, however, an increase in the base-calculation period had almost no effect on farm income or government payments. An increase in NFA would therefore be most likely to reduce government payments in the aggregate as all farms would be "hit" more or less proportionately.

Conclusions

Results of this study show that with prices, yields, production costs, and acreage reduction requirements held constant at prevailing levels, Southeastern cotton farmers with low to moderate initial cotton bases probably benefit from the change from the 1985 to the 1990 Farm Bill. A shorter calculation period for base acreage coupled with the elimination of limited cross-compliance offer opportunities for increased profits that more than offset losses due to the new triple base provisions. When initial base is high, the 1990 Farm Bill results in lower income than would be realized under the 1985 Farm Bill, if other factors, particularly acreage reduction requirements, are held constant. Interestingly, the optimal strategy in terms of "base building" remained fairly constant as the farm program changed. Other factors, such as increased yields induced by the Boll Weevil Eradication program and market conditions (held constant at current levels in this analysis), are therefore more likely to have caused the expansion in cotton acreage in the Southeast during recent years.

Simulation of the optimal farm plans shows that risk-averse farmers, as well as profit-maximizers, may prefer a base expanding strategy if risk is defined in terms of possibility of farm failure rather than variability in annual income. The risk of low income in the "nonprogram" early years of base expansion is more than offset by the benefit of increased earnings later on, leading to equal or greater likelihood of financial survival over a five-year period. Thus, it cannot be said without further research that base expansion is inherently risky.

Because farmers are able to adjust base more rapidly under the 1990 Farm Bill, in some instances total deficiency payments made to a farmer over a five-year period might increase, in spite of triple base. This result underscores the importance of analyzing the effects of program provisions on a whole-farm basis, rather than in isolation. For cotton farms, the money-saving triple base provisions, in some instances, can be partially or completely offset by the shortened base calculation period, a benefit not extended to cash grain farms.

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Endnotes

1. In this paper, the term "1985 Farm Bill" refers to agricultural policy legislation as amended and enacted before the passage of the 1990 Farm Bill. The "1990 Farm Bill" refers to current laws on agricultural policy as enacted in the Food, Agricultural, Conservation, and Trade Act of 1990, as well as the Omnibus Budget Reconciliation Act of 1990. In referring to these two Acts as "Farm Bills," the authors follow conventional usage.

2. When a marketing loan is in effect, a second direct payment, the loan deficiency payment (or the producer option payment), is made when market price falls below the loan rate.

3. Private communication, Robert Goodman, ACES specialist.

4. Alternative levels of ARP were tested. Within broad limits, the ARP levels do not significantly affect results when ARP levels are held constant across the two program regimes.

5. As noted by Mims et al., empirical evidence indicates that while the hypothesis of risk aversion is valid for some producers, it is not valid for all (Lin et al; Knowles; Wilson). Additionally, risk aversion can be handled in a number of ways. Target Motad (Tauer) has been used to attach a penalty to year to year variance in income. In other work, risk aversion has been handled through "safety first" constraints (Atwood et al.). Thus the choice of objective function, strict profit maximization vs. a modification to account for risk, depends on the objectives of the study. In this study, we wish to determine how changes in the farm program affect the producers' ability to generate income; hence profit maximization was used.

6. Although wheat-soybeans double cropped have significantly higher expected per acre profits than full-season soybeans, some producers elect full-season soybeans because of other considerations. Double cropping requires high managerial skills and a reliable machinery compliment. Variance on soybean yields is also perceived to be higher under double cropping.

7. The risk analysis performed here pertains to one specific situation. Analysis of different types of farms under alternative mean price and yield assumptions is needed before strong conclusions about the risk inherent in base-building can be reached.

8. Policy options analyzed here by no means provide an exhaustive analysis of potential changes in the farm legislation. A copy of the computer code for these models is available, on request, so that interested people can perform additional analyses beyond the scope of this study.