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Financial Implications of a New Farm Policy Environment

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The 1996 Federal Agriculture Improvement and Reform (FAIR) Act dramatically affects the decision-making environment of farms by introducing provisions for reducing farm income support payments. These program changes are likely to affect not only farm incomes, but also farm capital asset markets. The combined effect of these two financial variables is expected to alter the risk position and the debt repayment capacity on farms. Empirical results of this analysis indicate that the absence of farm income support payments reduces debt repayment capacity and increases the risk position on a representative Louisiana cotton-soybean farm.

Key Words: debt repayment, farm policy, financial leverage, safety-first model

The 1996 Federal Agriculture Improvement and Reform (FAIR) Act introduces provisions for terminating farm income support payments. These program changes are expected to have a significant influence on farm financial conditions. Program changes create the potential to depress net farm income, which will have a direct effect on farm debt repayment. These changes may also affect real estate markets where program crops are prevalent. Because benefits of government programs are capitalized into land values (Bullock, Nieuwoudt, and Pasour, 1977; Duffy et al., 1994), elimination of such programs can have a depressing impact on rural real estate markets. Any decline in real estate value is likely to cause a decline in farm equity for owner-operated farms, and a decline in farm equity is expected to increase financial risk and affect borrowing capacity.

The primary objective of this study is to identify and illustrate potential financial implications of the new farm policy. We address this problem by evaluating and comparing estimates of debt repayment and risk for a representative farm with farm income support and without farm support programs. In our illustration, financial estimates are developed for a representative 1,374-acre cotton and soybean farm in the Mississippi Delta of Louisiana.

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Our general approach is to use a financial model developed by Vandeveer and Kennedy (1996). The effect of cuts in government income support payments on real estate values comes from an empirical study of rural real estate values (Henning et al., 1997). Hedonic analysis is used to estimate the capitalized per acre value of real estate resulting from income support payments. This value, along with elimination of income support payments, is used in the financial model to estimate debt repayment capacity. The rate of return to equity capital is estimated under certainty and under risky conditions in the financial model. Maximum debt repayment in the model represents a range of debt that is feasible to the farm. It does not represent an optimal level of debt for the firm. Procedures that are based on a safety-first decision framework, along with the lower confidence interval for the mean rate of return to equity capital, are used to estimate risk-adjusted maximum debt repayment capacity. Risk-adjusted estimates provide a measure of debt-carrying capacity when conditions of certainty are relaxed.

The financial modeling framework is described in the next section. The data and procedures used in the analysis are then discussed, followed by a presentation of our results. A final section summarizes the conclusions from the study.

Financial Model

The financial model builds upon concepts originally formulated by Baker and Hopkin (1969), and later used by Barry, Hopkin, and Baker (1995) to estimate rates of growth in equity capital for alternative levels of borrowed capital. The farm model expresses firm growth (annual percentage change in equity capital) as a function of the rate of return to farm assets, the interest rate paid on debt, the rate of income taxation, the rate of family consumption from farm earnings, and the level of financial leverage. The growth model is specified as follows:

$$g = (rP_a - iP_d)(1 - t)(1 - c), \tag{1}$$

where g represents the rate of growth of equity capital, r is the average net rate of return to total assets (except for interest and taxes), i is the average interest rate paid on debt, t is the average rate of income taxation, and c represents the average rate of family withdrawals for consumption. P_a and P_d are ratios and represent assets-to-equity and debt-to-equity, respectively. In this model, these ratios must satisfy the identity of $P_a - P_d = 1$. The model generally suggests that returns to equity capital may be increased by adding increasing amounts of debt to the firm when the rate of return to assets exceeds the interest cost on debt.

The model used in this analysis is a simplified version of a financial leverage model developed by Vandeveer and Kennedy (1996). It assumes that debt capital may be used to increase the rate of return to equity capital; however, it is also assumed that some maximum leverage level exists for the farm firm. This is because, as debt is added within the firm, successively larger principal payments are required to repay debt. At some debt level, returns from equity capital being earned within the firm are not expected to be sufficient to meet principal payments on debt. Maximum financial leverage is defined by two linear relationships in terms of a debt level (P_d), where the rate of return to equity capital equals total principal payments (required rate of equity accumulation). The first linear relationship estimates the rate of return to equity capital in a single production period, assuming no external sources of equity capital. The second linear relationship formulates the required rate of equity formation based on the assumption that the farm firm must make principal payments on loans if it is to maintain a favorable credit position.

The financial model assumes that non-equity capital may be used to increase the returns to equity capital and that maximum financial leverage may be estimated from a two-equation model. The initial equation in this model represents the mean rate of return to equity (R_e) and is estimated by:

$$R_e = (rP_a - iP_d - oP_a)(1 - t) - c(P_a), \tag{2}$$

where o is the ratio of total overhead expenses to total assets, and the other variables are as defined earlier. This model differs from the growth model in that overhead expenditures are added to the analysis, and the dollar value of assets and the dollar amount of family consumption are held constant. Holding total assets constant permits the estimation of the return to equity for different combinations of debt and equity within the capital structure. Family consumption (c) is estimated as the ratio of the dollar amount of consumption to total assets. This specification allows family withdrawals to be held constant in the model, permitting the isolation of the effect of increasing leverage and its impact on the return to equity capital.

The rate of return to equity capital (R_e) is expressed as a linear function of debt capital structure by solving (2) in terms of P_d. Specifically, when $(1 + P_d)$ is substituted for P_a, and when known parameters of returns to assets (r), interest cost on debt capital (i), overhead expense ratio (o), taxation rate (t), and consumption rate (c) are substituted into (2), the resulting equation specifies the return to equity capital as a function of capital structure (P_d).

The second linear equation in the financial model represents a required rate of equity formation. The required rate of return to equity capital (R') is defined by the ratio of total principal payments expressed as a percentage of equity capital. The required rate of equity formation (R') is estimated by the sum of the rate of intermediate debt repayment and the rate of fixed debt repayment. This relationship is defined by:

$$R' = (I_d)(P_d)(I_p) + (F_d)(P_d)(F_p), \tag{3}$$

where I_d is the proportion of intermediate debt to total debt for the production period, I_p represents the proportion of outstanding intermediate principal that must be repaid for the production period, F_d is the proportion of fixed debt to total debt for the production period, and F_p is the proportion of outstanding fixed principal that must be repaid in the production period. The interpretation of equation (3) is that as debt-to-equity capital (P_d) is added in the form of intermediate or fixed debt, the rate of required equity formation (R') increases. In this analysis, it is assumed that each type of debt is amortized with constant principal payments. If the above proportions (I_d, I_p, F_d, and F_p) are known, then the required rate of return to equity capital (R') is expressed solely in terms of the debt-to-equity ratio (P_d). The equation is linear with an intercept of zero.

Equation (2) may be simplified and expressed in terms of debt-to-equity (P_d) given known financial parameters for r, i, o, t, and c. Similarly, if I_d, I_p, F_d, and F_p are known, then the required rate of equity formation (R') may be expressed solely in terms of debt-to-equity (P_d). Since equations (2) and (3) are both linear, each is expressed in terms of P_d, and the maximum financial leverage is defined by the point where the rate of return to equity equals the required return to equity ($R_e = R'$); thus maximum financial leverage is estimated by solving the two equations in terms of P_d (debt-to-equity). For a maximum financial leverage to exist, the intercept term for R_e must be greater than zero and the slope coefficient for R_e must be less than that for R'.

The maximum debt repayment capacity estimated in terms of P_d is not interpreted as an optimal or desirable capital structure. It is interpreted as an upper endpoint (maximum) for the amount of debt that may be incorporated into the firm's capital structure. Thus, a range of debt that can be incorporated within the capital structure of the firm is estimated to be between zero debt and maximum debt repayment. In general, the model uses variables from the firm's balance sheet and income statements to estimate the rate of return to equity and maximum financial leverage. One or more of these variables may be changed in the model for analyzing various financial scenarios. Although there are several methods for maintaining constant asset values in a single production period, it is assumed in this analysis that asset replacement occurs at the same rate as asset depreciation.

Risk Analysis

Risk is conceptualized in the financial model at the maximum financial leverage level. At this single leverage level, if the rate of return to assets is normally distributed, then the rate of return to equity is also expected to be normally distributed. Similarly, if the rate of return to equity capital is normally distributed, then at maximum debt repayment capacity ($R_e = R'$), one-half of the distribution of R_e would be expected to fall above R', while the other half of the distribution of R_e would be expected to fall below R'. This is because, at maximum debt repayment capacity, the required rate of equity formation (R') is fixed by terms of financing. Moreover, this suggests that the firm would be expected to meet its financial commitments in only one of two years. With this result, a risk-averse manager would be expected to operate at a leverage level that is less than maximum debt repayment capacity.

If information is available for the distribution of the rate of return to assets (r), then the financial model may be modified to consider risk across all defined leverage levels. Specifically, the financial leverage model is extended to include risk considerations by estimating the lower confidence limit for the mean rate of return to equity (R_e). The lower confidence limit for the mean rate of return to equity (R_L) is estimated by:

$$(4) \qquad R_L = R_e - (z_{\alpha/2})(\sigma_e/\sqrt{n}),$$

where R_e, defined in equation (2), is expressed as a linear function of P_d. On the right-hand side of equation (4), z is the standard normal random variable, α is a confidence coefficient, σ_e is the standard deviation for the mean rate of return to equity, and n corresponds to the number of observations in the sample. The standard deviation of the rate of return to equity (σ_e) is estimated as:

$$(5) \qquad \sigma_e = (\sigma_r)(P_a)(1 - t),$$

where σ_r is the standard deviation of the rate of return to assets for the farm enterprise portfolio, with the other variables as defined previously. Thus, the standard deviation of returns to equity is a standard deviation of the portfolio weighted by the asset-to-equity structure and rate of taxation. Since σ_r and t are known, and $P_a = 1 + P_d$, the standard deviation of the rate of return to equity may be expressed in terms of debt-to-equity (P_d). Also, since both R_e and $(z_{\alpha/2})(\sigma_e/\sqrt{n})$ may be expressed in terms of P_d, the lower confidence limit for the mean rate of return to equity (R_L) is expressed as a linear function of P_d.

A risk-adjusted measure of debt-carrying capacity is estimated by equating equations (3) and (4) ($R' = R_L$) and solving for P_d. For risk-adjusted maximum debt-carrying capacity to exist, the intercept term for R_L must be greater than zero and the slope of R_L must be less than that for R'. The risk-adjusted maximum leverage level is interpreted to represent an upper limit of debt-to-equity for a specified degree of confidence that the rate of return to equity exceeds the required rate of return to equity ($R_e \geq R'$). A firm is expected to meet its financial commitments with a specified degree of confidence for a capital structure ranging from zero to the estimated risk-adjusted maximum financial leverage. Beyond risk-adjusted maximum financial leverage, the required rate of return to equity capital exceeds the lower limit of the rate of return to equity capital, and the firm will not meet its financial commitments for the specified degree of confidence.

Data and Procedures

The effects of government support programs on debt-carrying capacity are examined using the financial leverage model. Debt-carrying capacity is estimated for a representative 1,374-acre cotton and soybean farm in the Mississippi Delta area of

Table 1. Resource Data and Farm Scenarios, Mississippi Delta Cotton and Soybean Farm, 1996

	Farm Scenarios	
Item Description	With Government Program	Without Government Program
Land Acreage:		
Sandy soil	629	629
Clay soil	745	745
Crop Acreage:		
Cotton, sandy soil	629	629
Soybeans, clay soil	745	745
Capital Assets ($):		
Machinery	436,932	436,932
Land	1,004,585	930,363
Total	1,441,517	1,367,295
Enterprise Statistics ($):		
Cotton mean net return to assets	215.40	154.83
Cotton standard deviation	106.41	112.54
Soybean mean net return to assets	100.75	100.75
Soybean standard deviation	38.96	38.96
Financial Parameters:		
Average interest rate (%)	10.00	10.00
Average income taxation (t) (%)	20.00	20.00
Ratio, intermediate to total debt (I_d)	0.30	0.30
Repayment rate, intermediate (I_p)	0.20	0.20
Ratio, fixed to total debt (F_d)	0.70	0.70
Repayment rate, fixed debt (F_p)	0.05	0.05
Overhead expenses (o) (as % of total capital assets)	1.845	1.945
Family withdrawals (c) (as % of total capital assets)	1.734	1.828

Louisiana. In table 1, farm scenarios assume government participation and no government participation. In each scenario, cotton is produced on sandy soil and soybeans are produced on clay soils.

Land values presented in table 1 are based on a study by Henning et al. (1997) of real estate values in Louisiana. For the scenario with government participation, land value is based on a median per acre value of $800 from 45 cotton sales in 1996, and a median per acre value of $673 for 33 soybean land sales. The value of land for the without government program scenario differs from the first scenario by the capitalized value of government program benefits of $118 per acre computed across the cotton acreage. This estimate was derived from a hedonic analysis of 206 rural land sales that occurred between 1993 and 1996 in the Mississippi Delta area of Louisiana. The marginal implicit price in the first-stage hedonic analysis indicates that tracts with cotton base acres sell for \$118 more per acre than tracts with no cotton base acreage.

Mean per acre dollar return to assets and associated standard deviations for cotton and soybean enterprises (table 1) were estimated from experimental yields for the period 1979–96 at the Northeast Agricultural Research Station and from commodity prices adjusted to 1996 dollars. The mean per acre return to assets was estimated at \$215.40 and \$100.75 for cotton and soybeans, respectively. Statistical tests of each distribution did not indicate a departure from normality.

Financial parameters shown in table 1 indicate that in each scenario intermediate debt is assumed to account for 30% of total debt, and fixed debt is assumed to account for 70% of total debt within the farm. The repayment rate (I_p) indicates that intermediate loans are repaid in five years, whereas fixed or long-term loans (F_p) are repaid in 20 years. Overhead and family living expenses are estimated at \$26,600 and \$25,000, respectively, and are expressed as a percentage of total capital assets in table 1.

The financial model, along with other parameters presented in table 1, was used to estimate maximum financial leverage and risk-adjusted maximum financial leverage for each farm scenario. A microcomputer spreadsheet was used to solve for maximum financial leverage and risk-adjusted maximum financial leverage and to compute financial variables across leverage levels and farm scenarios. Risk-adjusted maximum financial leverage was estimated assuming that the farm business wishes to meet all of its financial commitments in at least nine of ten years. Risk-adjusted maximum leverage and probability estimates were computed using a Student's *t*-distribution ($t_{\alpha/2}$ with 17 degrees of freedom), with $t = 1.333$.

Results

Maximum debt repayment capacity estimates with and without government program participation are presented in table 2. Maximum debt repayment capacity with government program participation is estimated at a debt-to-equity level of 0.9389, or 48% debt. At this leverage level, the rate of return to equity capital of 8.92% is equal to the required rate of equity formation (8.92%). Without government program participation, maximum debt repayment capacity is estimated at a debt-to-equity level of 0.6211 (38% debt).

Estimates reported in table 2 are illustrated in figure 1. In figure 1, the rate of return to equity (R_e) increases as debt is added to the capital structure of the representative farm with government program participation (positive slope). However, the rate of return to equity (R_e) has a negative slope when government program benefits are not included, suggesting that increasing debt within the capital structure of the farm decreases the rate of return to equity capital. Estimates illustrated in figure 1 show that maximum debt repayment capacity is substantially less without government

Table 2. Estimated Debt Repayment Capacity With and Without Government Program Participation, Mississippi Delta Cotton and Soybean Farm, 1996

Debt-to Equity Level (P_d)	% Return to Equity (R_e)	% Required Return to Equity (R')	% Lower Limit Return to Equity (R_L)	% Std. Dev. of Return to Equity (σ_e)	Probability ($R_e > R'$)
WITH GOVERNMENT PROGRAM PARTICIPATION					
0.0000	0.0847	0.0000	0.0725	0.0390	0.9999
0.2000	0.0857	0.0190	0.0710	0.0469	0.9999
0.4000	0.0866	0.0380	0.0695	0.0547	0.9992
0.4369	0.0868	0.0415	0.0692	0.0561	0.9984
0.6000	0.0876	0.0570	0.0680	0.0625	0.9734
0.6211	0.0877	0.0590	0.0678	0.0633	0.9643
0.7069[a]	0.0881	0.0672	0.0672	0.0666	0.9000
0.8000	0.0885	0.0760	0.0665	0.0703	0.7702
0.9389[b]	0.0892	0.0892	0.0654	0.0757	0.5000
1.0000	0.0895	0.0950	0.0649	0.0781	0.3840
WITHOUT GOVERNMENT PROGRAM PARTICIPATION					
0.0000	0.0670	0.0000	0.0532	0.0441	0.9999
0.2000	0.0645	0.0190	0.0479	0.0529	0.9990
0.4000	0.0619	0.0380	0.0425	0.0617	0.9405
0.4369[a]	0.0614	0.0415	0.0415	0.0633	0.9000
0.6000	0.0593	0.0570	0.0371	0.0705	0.5538
0.6211[b]	0.0590	0.0590	0.0366	0.0714	0.5000
0.7069	0.0579	0.0672	0.0343	0.0752	0.3041
0.8000	0.0567	0.0760	0.0318	0.0793	0.1580
0.9389	0.0549	0.0892	0.0281	0.0854	0.0533
1.0000	0.0541	0.0950	0.0264	0.0881	0.0327

[a] Risk-adjusted maximum debt repayment capacity.

[b] Maximum debt repayment capacity.

program participation. It is also noted that maximum financial leverage levels are estimated to help identify a range of debt that is feasible for the firm, and they do not represent optimal or desirable levels of debt.

Results in table 2 indicate that risk-adjusted maximum debt capacity is greater for the government program scenario than for the scenario without government program participation. Risk-adjusted maximum debt capacity with government program participation is estimated at a debt-to-equity level of 0.7069 (41% debt). This same estimate for the scenario without government program participation is 0.4369 (30% debt). As reported in table 2, the farm is expected to meet all of its financial commitments in nine of ten years (probability of 0.9) at risk-adjusted maximum debt capacity for

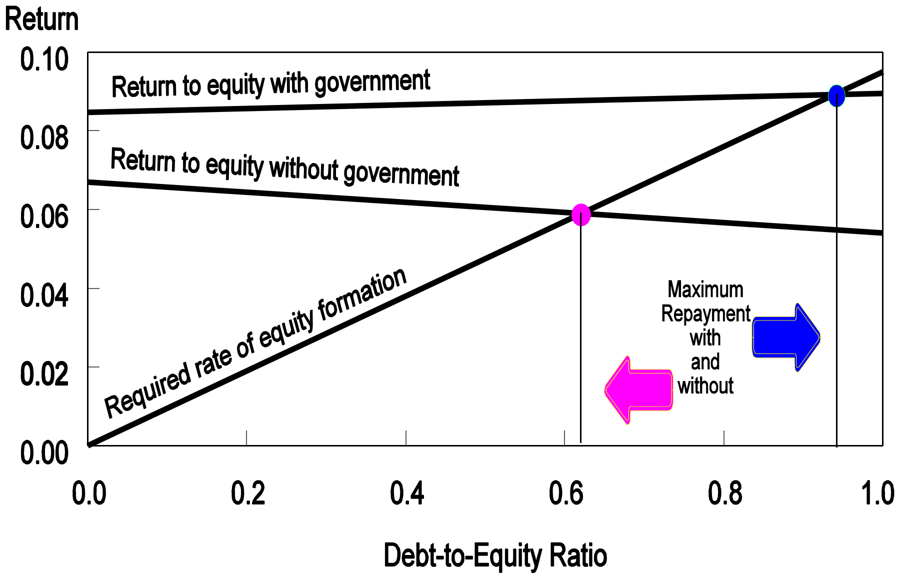

Figure 1. Maximum debt repayment capacity with and without government program, Mississippi Delta cotton and soybean farm, 1996

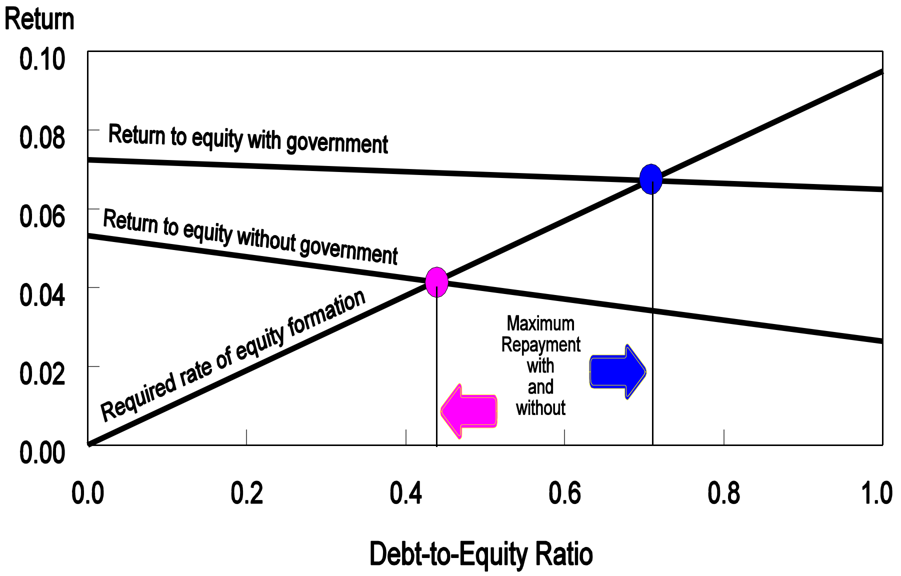

Figure 2. Risk-adjusted maximum debt repayment capacity with and without government program, Mississippi Delta cotton and soybean farm, 1996

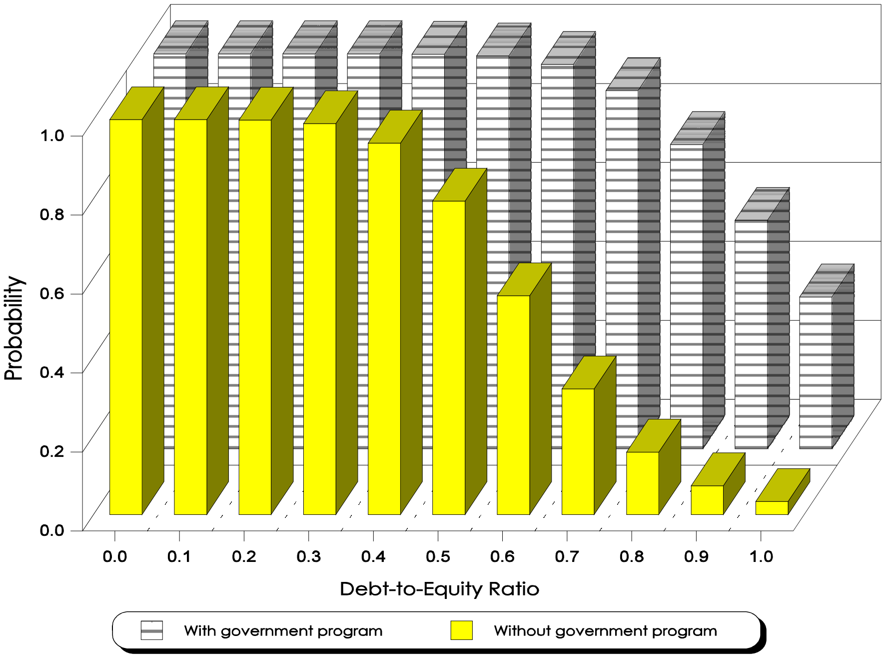

Figure 3. Probability, with and without government program participation, of meeting financial commitments in nine of ten years, Mississippi Delta cotton and soybean farm, 1996

each of the scenarios. Results illustrated in figure 2 indicate that risk-adjusted debt capacity is substantially less for the scenario without government program participation than the scenario with participation.

The financial model is also used to estimate the probability that farm scenarios in this analysis will meet all of their financial commitments in at least nine of ten years. Comparisons of probability estimates for farm scenarios presented in figure 3 ranging between zero and a debt-to-equity ratio of 0.3 do not indicate a large difference in the ability of the farm business in meeting its financial commitments. However, a sizable difference in probabilities is observed for the two farm scenarios beyond a debt-to-equity level of 0.3. For example, at a debt-to-equity ratio of 0.7 (41% debt), the probability of meeting financial commitments is 0.907 for the farm scenario with government program participation, whereas this probability is estimated at 0.318 for the farm scenario without government program participation. For the ranges of debt considered in figure 3, the results show that the principle of increasing risk is more pronounced in the farm scenario without government program participation than the scenario with participation.

Conclusions

Results presented here suggest that future farm policy changes have the potential to affect farm financial conditions not only through decreasing farm income support payments (which decrease farm income), but also through capital asset markets (which could decrease asset values and farm equity). Our findings show that cotton farms in the Mississippi Delta area of Louisiana sell for $118 per acre more than similar farms without cotton base acres. Based on these results, the combined effects of income reduction and a decline in the capital asset market reduce debt repayment capacity on a representative cotton and soybean farm in the Mississippi Delta area of Louisiana.

Other findings suggest that risk differences for farm scenarios with and without government programs are much larger at relatively high levels of debt than for lower levels of debt on the representative farm, implying that policy changes could have a relatively larger effect on highly leveraged farms than on those with less financial leverage. These findings also point to an increased need for financial management, and especially debt management in the farm, as new farm policy is implemented.

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