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ECONOMIC SURVIVABILITY OF MISSISSIPPI RICE FARMS: A DETERMINISTIC SIMULATION APPROACH

Michael E. Salassi, Bobby R. Eddleman, and James G. Hamill

Abstract

This study evaluates the economic survivability of rice farms in the Delta area of Mississippi. A general whole-farm simulation model, FLIPSIM V, is used to simulate the operations of representative rice farms over a 10-year period. Although farm size did not change for any of the representative farms considered, the financial structure of these farms changed considerably. Crop mix was found to cause significant differences in the economic growth and financial viability of rice farms in the region.

Key words: rice, representative farm, economic growth, whole-farm simulation.

Rice production in the United States occurs primarily in three areas: California; the Gulf coast areas of Texas and Louisiana; and the Mississippi River Delta areas of Arkansas, Louisiana and Mississippi. Some of the most dramatic increases in rice acreage over the past decade have occurred in the Mississippi River Delta region. Suspension of marketing quotas by the Secretary of Agriculture for the 1974 and 1975 crops triggered dramatic increases in acreage devoted to rice in this region. In 1974, Mississippi producers harvested 108,000 acres of rice, an increase of 74.2 percent over the previous year, while rice acreage in Arkansas increased by almost 200,000 acres over the 1973 acreage. The following years saw a continuation of this upward trend, particularly in Mississippi where the total acreage of harvested rice increased approximately 91.6 percent by the end of the decade (USDA, *Crop Production*). By 1981, harvested acreage in Mississippi had reached a record high of 337,000 acres, Louisiana had its highest rice acreage in almost a decade, and Arkansas was the leading rice-producing state in the country with more than 1.5 million acres (USDA, *Crop Production*).

Since 1981, rice acreage in the Mississippi River Delta region, as in other rice-producing regions of the country, has generally declined. Part of this acreage reduction was the result of participation in federal farm programs. In 1983, the PIK program was partly responsible for reducing harvested rice acreage in individual states to levels 40 to 50 percent of their 1981 acreage. However, other factors have also had an impact on rice-acreage levels in recent years. In the early 1980's, rising production costs reduced the profit margins associated with the production of rice. Furthermore, increased competition from other rice-producing countries in the world market has had a depressing effect on market prices received by U.S. producers. As a result, some producers in the region have reduced part of their rice acreage in favor of relatively more profitable crops. Harvested rice acreage in Mississippi for 1985, for example, was down approximately 44 percent from its 1981 acreage level (USDA, *Agricultural Statistics*). With the passage of the recent farm bill and the resulting decline in federal price support levels, there is serious concern regarding the economic growth potential and financial survivability of rice farms in the region.

This study is aimed at determining the economic survivability of rice farms in the Delta area of Mississippi. More specifically, it is concerned with evaluating the projected financial structure and survivability of these farms if current economic and political conditions continue to exist over the next several years. A general firm-level policy model, FLIPSIM V, will be used to simulate the operations of representative types of rice farms over a period of 10 years. This article will examine the disaggregated effects of a continuation in

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the provisions of the 1981 Farm Bill on the financial structure and survivability of these representative farms. Simulation results include estimates of changes in the value of farm assets, liabilities, and net worth as well selected financial ratios for each of the representative farms considered.

PREVIOUS RESEARCH

As rice acreage in the Mississippi River Delta region increased throughout the 1970's and into the 1980's, research efforts associated with rice expanded in scope in order to meet the informational needs of the agricultural sector. Several studies have evaluated the feasibility of the production of rice and soybeans in rotation (Eddleman et al.; Hamill and Lin; Holder et al., 1975). A recent study introduced the double-cropping of wheat and soybeans and evaluated its impact on rotation systems (Boykin). The amount of double-cropped wheat and soybeans was found to be inversely related to the acreage devoted to a rice-soybean rotation.

Estimated per-acre production costs for rice in the Mississippi River Delta have compared favorably with production costs in other rice-producing regions of the country (Mullins et al., 1978). One reason for this cost advantage is related to the use of irrigation. High water tables in the Mississippi River Delta significantly reduce the required investment and operating costs of rice irrigation systems in the region (Salassi and Musick). Drying and storage costs are another important component of rice production costs. Several studies have estimated the costs associated with on-farm drying and storage facilities (Holder et al., 1981; Malone et al.; Usman). It has been shown, however, that the trend toward more on-farm storage could have serious financial impacts on existing commercial facilities (Holder et al., 1973).

The future potential for rice-acreage expansion in the Mississippi River Delta area with regard to physical characteristics is well documented (Grant and Holder; Traylor et al.; Mullins et al., 1967 and 1968). This region, which includes all or parts of 43 counties in southeast Arkansas, northeast Lousiana, Mississippi, and southeast Missouri, is the most extensive major rice-growing area in the United States. Total cropland in the region which is suited for rice production has been estimated at 6.9 million acres with an additional 800,000 acres of noncropland which could be brought into production fairly rapidly (Holder and Grant). Earlier economic studies have supported the argument of continued acreage expansion in the region (Levins et al.; Wolfe). However, current economic conditions in the farm sector as well as enterprise price-cost relationships raise questions regarding the future economic growth potential and financial viability of rice production in the region.

Due to the current financial crisis in agriculture, many types of farms have experienced some degree of financial stress. Financial stress results from a perceived inability to meet planned cash flow commitments such as cash farm expenses, debt service, and family living expenses (Brake). It is a cash flow concept and does not coincide directly with the income or profitability of a farming operation, although they are related. Boehlje and Eidman point out that the occurrence of financial stress in agriculture and its impact on firm viability suggest a new direction of research in farm management and finance—firm survival. In addition to traditional approaches to risk reduction, they conclude that firms should consider a broader spectrum of survival strategies. Some of these strategies include asset liquidation, sale-leasebacks, managing liquidity through resource and financial reserves, and infusion of equity capital from outside the business. Barry and Lee state that financial stress can also affect farms indirectly through agricultural lenders. Actions by financial intermediaries, such as pricing loans with higher risk premiums or floating interest rates, can significantly affect the cash-flow position of a farm firm. Furthermore, Barlett has shown that different types of farms have followed different strategies for coping with adverse economic conditions and that part-time and retirement farmers appear to be in much less danger of losing the family farm than are full-time farmers.

DEVELOPMENT AND SIMULATION OF REPRESENTATIVE FARMS

The economic survivability of rice farms in the Delta area of Mississippi was evaluated through the use of FLIPSIM V, a general whole-farm simulation model (Richardson and Nixon). The model is capable of simulating the production, marketing, financial, and growth aspects of a particular farm over a time period of up to 10 years. Current descriptive data for the particular farm to be simulated must be supplied by the model user. Such data include the acreage of all cropland and pastureland owned or leased, current value of farm assets and outstanding debt balances, taxes, labor availability, inventory and value of machinery and equipment, as well as the costs of production, labor requirements, yields, and product prices of crop enterprises included on the farm. Information must also be provided concerning federal agricultural policies in effect as well as projected measures of annual percentage changes in such variables as equipment prices, cost of production items, and family living expenses.

Representative rice farms used in this study were developed from primary data collected from farms in the Delta area of Mississippi in 1984. This survey obtained information concerning farm organization and resource inventories from more than 800 farms, 262 of which were rice farms. Specific data obtained included farm size, tenure arrangement, soil types, crop acreages, and equipment inventories.

Rice farms from the farm resource and organization survey were divided into two groups consisting of cotton/rice/soybean farms and rice/soybean farms. Each farm group was further divided into four representative farm classes based upon annual gross sales per farm of less than $200,000; $200,000 to $499,999; $500,000 to $1,000,000; and more than $1,000,000. The amount of land owned and leased on each representative farm considered in this analysis was based on the average percentages of owned and leased land within each farm class of the survey data. Cropland leases were assumed to be on a cash basis.

The initial crop mix and acreage levels were derived from the average acreage levels of each crop within a farm class. Survey results indicated that cotton, rice, and soybeans were the only major crops produced on rice farms in the study area. Although other crops such as grain sorghum or wheat may comprise sizeable acreages on farms in particular localities of the study area, they represented very small percentages of the average crop mix on a regionwide basis. For this reason, cotton, rice, and soybeans were the only crops included in the analysis. Therefore, the difference between total acreage on a farm and total acreage of cotton, rice, and soybeans for any particular representative farm is made up of non-tillable land, pastureland, or land planted in minor crops. The initial tenure arrangements and crop mix of representative rice farms used in this analysis are shown in Table 1.

Machinery and equipment inventories were estimated for each representative rice farm included in the analysis. Although the survey data contained information on equipment inventories, this information included only the number of self-propelled machines on each farm. Therefore, in order to estimate the total equipment inventory on each of the representative farms, performance rates (Cooke et al.) and estimated monthly labor availability (USDA, *Farm Labor*), along with the estimated crop acreage on each farm, were used to determine the type and quantity of each piece of equipment, including self-propelled machines, towable implements, and irrigation equipment, required to farm the specified crop acreage. Representative farm class 1 was assumed to be using six-row equipment, while the three larger farm classes were assumed to be using eight-row equipment. All equipment on each representative farm was assumed to have half of its useful life remaining at the start of the simulation period. The summation of the current value of all machinery and equipment required on a farm constituted the total market value of machinery investment for that particular representative farm.

TABLE 1. INITIAL TENURE ARRANGEMENT AND CROP MIX ON REPRESENTATIVE RICE FARMS, DELTA AREA OF MISSISSIPPI, 1985

Farm group	Farm class[a]	Total acres	Acres owned	Acres leased	Crop Acreage		
					Cotton[b]	Rice[b]	Soybeans[c]
Cotton/rice/soybeans	1	637	207	430	116	145	307
	2	1,358	429	929	333	281	634
	3	2,411	1,104	1,307	744	453	1,044
	4	5,141	2,442	2,699	2,042	783	1,902
Rice/soybeans	1	627	206	421	–	206	363
	2	1,265	492	773	–	393	739
	3	2,563	1,086	1,477	–	820	1,499
	4	6,600	6,100	500	–	2,762	3,267

[a]Farm classes were defined by annual gross farm sales: 1 = less than $200,000; 2 = $200,000 to $499,999; 3 = $500,000 to $1,000,000; 4 = more than $1,000,000.

[b]Includes planted acreage plus set-aside.

[c]Includes planted acreage only.

Outstanding long-term and intermediate-term debt on each representative rice farm was estimated from secondary data and adjusted to current conditions. Unpublished data from the 1979 Farm Finance Survey (U.S. Dept. of Commerce) were used to obtain average values of long-term and intermediate-term debt per farm for various sized farms in the Mississippi Delta. These estimates were converted to a debt-per-acre basis and updated to current conditions using percentage changes in debt per farm obtained from published data (USDA, *Balance Sheet of the Farming Sector* and *Economic Indicators of the Farm Sector*). Initial levels of intermediate-term and long-term debt for each representative rice farm were then determined by multiplying the estimated debt per acre by the total number of acres on each farm.

Hired labor required on each representative farm was estimated based upon the monthly labor requirements of each crop (Cooke et al.) and the hours of labor available per month from each full-time worker. Representative farm classes 1 and 2 were assumed to be family farms with available unpaid family labor equal to one full-time worker. Representative farm classes 3 and 4 were assumed to be commercial farms with no available unpaid family labor. On these farms, one manager was assumed to be hired for every six full-time hired workers. The manager provided no available labor hours for field work; however, his salary was included in the cost of hired labor. Costs of production used in the analysis were obtained from published crop budgets (Cooke et al.). Differences in the size of equipment used on each representative farm were reflected in the production cost and labor requirement estimates used. Furthermore, since soil type also influences the profitability of crop production, the production costs and labor requirements of crops produced on each representative rice farm were estimated as weighted averages by soil type based upon the average soil mix within each farm class as reported in the farm resource and organization survey. Estimates of production costs and labor requirements for cotton and soybeans produced on sandy, mixed, and clay soils and for rice produced on mixed and clay soils were used in this estimation procedure (Cooke et al.).

Operations of the eight representative rice farms were simulated over a 10-year period using the FLIPSIM V model. For purposes of this study, the representative farms were simulated with a constant crop mix under deterministic conditions (i.e., specified crop prices and yields for each year of simulation).[1] The prices and yields used in the analysis are shown in Table 2. Crop prices for the first year of simulation (1985) were estimated as a weighted average of the seasonal average

TABLE 2. PROJECTED CROP PRICES AND YIELDS USED IN THE SIMULATION OF REPRESENTATIVE RICE FARMS, DELTA AREA OF MISSISSIPPI, 1985–1994

Year	Crop Prices[a]				Crop Yields[b]			
	Cottonlint	Cottonseed	Rice	Soybeans	Cottonlint	Cottonseed	Rice	Soybeans
	($/lb)	($/lb)	($/bu)	($/bu)	(lbs/acre)	(lbs/acre)	(bu/acre)	(bu/acre)
1985	0.60	0.048	3.84	6.55	772.0	1,196.6	93.7	23.3
1986	0.62	0.050	3.98	6.79	772.0	1,196.6	93.7	23.3
1987	0.64	0.051	4.13	7.04	772.0	1,196.6	93.7	23.3
1988	0.67	0.053	4.28	7.30	772.0	1,196.6	93.7	23.3
1889	0.69	0.055	4.44	7.57	772.0	1,196.6	93.7	23.3
1990	0.72	0.057	4.60	7.84	779.7	1,208.6	94.6	23.5
1991	0.74	0.060	4.77	8.13	787.5	1,220.7	95.6	23.8
1992	0.77	0.062	4.94	8.43	795.4	1,232.9	96.5	24.0
1993	0.80	0.064	5.12	8.74	803.3	1,245.2	97.5	24.2
1994	0.83	0.066	5.31	9.06	811.4	1,257.6	98.5	24.5

[a]Crop prices were assumed to increase 3.67 percent per year.

[b]Crop yields were assumed to be constant during the first five years of simulation while increasing 1 percent per year during the last five years of simulation.

[1]The crop mix was held constant on the eight representative rice farms simulated in this study for several reasons. Over the past several years, the major crops produced on rice farms in the Delta area of Mississippi have been cotton, rice, and soybeans. Although planted acreage of other minor crops may have increased over the years, the average acreage of these crops on rice farms across the entire study area has represented a very small percentage of the crop mix on these farms and therefore has had limited impact on farm income. Secondly, the model option allowing the crop mix to vary from year to year using a profit maximization LP algorithm was not used because acreage limitation programs (set-aside and paid diversion) were assumed to be in effect for cotton and rice. When an acreage limitation program is being simulated, the model estimates each crop's reduced acreage (planted acreage minus set-aside and diversion) as a percent of its base acreage and the base is fixed by the model user. Therefore, the harvested acreage of cotton, rice, and soybeans on each farm was held constant over the simulation period.

crop price received by producers in the Delta area of Mississippi over the previous three years. Prices were projected for the following years of simulation using an estimated annual change of 3.67 percent, based upon the average index of prices received by producers over the previous 10-year period (USDA, *Agricultural Statistics*). Crop yields for the first year of simulation were based on the average yields in the study area over the previous four years. Since reported yields exhibited no sustained movement in either direction during this period, crop yields for the eight representative farms were held constant during the first five years of simulation and were increased 1 percent per year in the last five years of simulation to reflect improvements in technology and variety development. Crop yields used in this study were assumed to reflect average yields for each crop over the entire study area and not yields of any particular crop variety.[2]

Variable production and harvesting costs, fixed production costs, prices of new and used farm machinery, family living expenses, and other farm business expenses were adjusted from year to year using assumed values of inflation indexes. All variable production and harvesting costs were assumed to increase at an annual rate of 5 percent, except for fertilizer costs which were assumed to increase at an annual rate of only 1 percent. Prices of new farm machinery were projected to increase 2 percent annually while prices of used machinery were projected to decline by 1 percent per year. Other fixed costs such as insurance, repair and maintenance, and accountant and legal fees were assumed to increase at a rate of 1 percent per year. Annual family living expenses for the four classes of representative farms were assumed to be $18,000, $20,000, $21,000, and $24,000, respectively, and increased at an annual inflation rate of 4.5 percent. Interest rates on short-term, intermediate-term, and long-term debt were held constant over the simulation period at their 1985 levels.

Farms were allowed to grow (in terms of size) during the simulation period through the purchase or lease of additional land. Tracts of land available for purchase or lease were assumed to be available in four sizes: 160 acres, 320 acres, 480 acres, and 640 acres. Increases in farm size could only occur in these acreage increments. The addition of acreage to a particular representative farm also required an increase in machinery investment needed to farm the added acreage. Larger alternative farm sizes along with corresponding levels of required machinery investment were estimated for each of the eight representative rice farms included in the study.[3] Purchase of additional land required a 30 percent down payment on the purchase price of land plus a 30 percent down payment on the additional machinery required to farm the added acreage. Increases in farm size through leasing additional cropland were permitted during the simulation only if the farm could pay the 30 percent down payment on the purchase of additional machinery required to farm the added cropland. Down payments for machinery purchases were paid out of the farm's existing cash reserves while up to 50 percent of the down payment on cropland purchases could be paid using equity in existing land with the remainder paid out of cash reserves. All of the representative rice farms included in the analysis were operating their equipment at less than full capacity at the start of the simulation period. Therefore, each farm could increase in size up to some point, through either purchase or lease of additional cropland, without any required investment in additional farm machinery, assuming specified minimum cash balances could be maintained. Once the full acreage capacity of the existing machinery complement was reached, any further increases in farm size could only occur with additional machinery investment. The down payment requirement on this additional machinery would come from the farm's cash reserve.

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[2]Since the farm resource and organization survey did not report crop yields, no differences in yields by size of farm were estimated for representative farms in this study. Although this is a limiting assumption, it was not considered to severely bias the results. Furthermore, the large increases in yields of the newly released semidwarf varieties of rice were not directly incorporated into the projection of regional rice yields. To do so would require some assumption as to the producers' rate of adoption and use of the new varieties.

[3]Alternative larger farm sizes for the eight representative rice farms were based upon the acreage capacity of harvesting units (cotton pickers and combines). At the point at which one of these units became restrictive to increases in farm acreage, a new larger alternative farm size was defined and the total machinery investment required for that farm size was determined. Differences in the total machinery investment of these larger alternative farm sizes and the initial farm size defined the additional machinery that would be required for potential increases in farm size. For each of the representative farms simulated in this study, any potential increases in farm acreage, through either the purchase or lease of additional cropland, would not require investment in additional farm machinery until the farm increased in size to the next alternative larger farm size.

Cash flow deficits at the end of the year were handled in three ways. Deficits were initially reduced by granting a lien on the crops held for sale in the next tax year. Any remaining cash flow deficit was managed in one of two ways: obtain a mortgage on long-term and/or intermediate-term equity or sell cropland. The farm was allowed to sell existing cropland to avoid insolvency. Farms were declared insolvent when the equity-to-asset ratio fell below a specified minimum of 30 percent. If the farm accumulated any excess cash reserves, these excess reserves could be used for early repayment of intermediate-term and long-term debt. This assumption was based on the rationale that farmers would prefer to retire any existing debt on their current operation before incurring new debt in order to expand their farm size.

Since this analysis was conducted prior to the announcement of the provisions of the 1985 Farm Bill, the farm policy in effect for 1985 was held constant throughout the 10 years simulated. Loan rates used in the analysis were $0.57 per pound for cotton, $3.60 per bushel for rice, and $5.02 per bushel for soybeans. Target prices were $0.81 per pound for cotton and $5.36 per bushel for rice. A paid acreage diversion program was in effect with a total diversion of 25 percent on cotton (15 percent voluntary, 10 percent paid) and 35 percent on rice (20 percent voluntary, 15 percent paid). No acreage diversion program was in effect for soybeans. Payment limitations were set at $50,000 per farm.

SIMULATION RESULTS

Based upon the assumptions made in this analysis, no change in farm size was observed during the simulation period for any of the representative rice farms considered. No farm was forced to sell cropland to avoid insolvency. Returns on each of the rice farms, partly aided by the receipt of government payments, were sufficient for the farms to maintain their initial size of operation throughout the simulation period and at the same time to keep their respective equity-to-asset ratios above the specified minimum of 30 percent. However, none of the representative farms were able to increase the size of their operation. Farms were unable to purchase additional cropland over the 10-year period because the maximum price that each rice farm was able to pay for the purchase of land in any given year, based on an after-tax net present value formula, was less than the average market value of cropland on similar type farms. Furthermore, none of the eight representative farms were able to lease additional cropland during the simulation period despite the fact that some excess machinery capacity existed on each farm. Parcels of land available for lease were small enough so that each of the rice farms could have leased some additional acreage without exceeding its original machinery capacity. However, annual ending cash balances for each of the farms were insufficient to allow acreage expansion in any year. Year end cash balances were less than the minimum cash balance established for the farms. These cash deficits were reduced by granting a lien on the crop inventories held for sale in the following tax year or by obtaining a mortgage on the farms' existing equity. Both of these conditions prevented the rice farms from leasing additional cropland. Since the crop mix was held constant on each farm, the projected acreages of cotton, rice, and soybeans on each respective farm for 1994 reflected no change from 1985 levels.

Although the size of the eight farms remained constant over the 10-year simulation period, the changes in the financial structure of the farms were dissimilar. Projected market prices for rice were sufficient to cover variable, but not total, costs of production. By the sixth or seventh year of simulation, total rice production costs per bushel for both six-row and eight-row equipment farms were greater than the assumed $5.36 target price. Therefore, the financial health of each respective rice farm depended upon the returns from the associated production of other crops. Although projected market prices of cotton and soybeans were generally sufficient to cover total production costs, rice farms which also produced cotton were aided by the additional receipt of price support and diversion payments for cotton which were not available for soybeans.

Initial and projected values of assets, liabilities, and net worth for the four cotton/rice/soybean farms are shown in Table 3. The value of total assets increased significantly for all four farms, ranging from a 47.4-percent to a 71.6-percent increase. The smallest cotton/rice/soybean farm exhibited the largest increase in the value of total assets over the simulation period. This result is primarily due to increases in the value of farm machinery as older equipment was replaced. Representative farm class 1 was the only class of farms included in this study which was assumed to be using six-row equipment. The higher cost structure

TABLE 3. INITIAL AND PROJECTED VALUES OF ASSETS, LIABILITIES, AND NET WORTH ON REPRESENTATIVE COTTON/RICE/SOYBEAN FARMS, DELTA AREA OF MISSISSIPPI, 1985 AND 1994

Item	Representative farm class[a]			
	1	2	3	4
Initial total assets[b]	$433,332	$756,506	$1,647,655	$3,547,371
Projected total assets[c]	$743,422	$1,218,484	$2,429,363	$5,760,241
Change (%)	71.6	61.6	47.4	62.4
Initial total liabilities[b]	$244,116	$442,064	$795,663	$1,696,095
Projected total liabilities[c]	$340,691	$449,958	$934,493	$1,929,088
Change (%)	39.6	1.8	17.4	13.7
Initial net worth[b]	$189,216	$314,442	$851,992	$1,851,276
Projected net worth[c]	$402,731	$768,526	$1,494,870	$3,831,153
Change (%)	112.8	144.4	75.5	106.9

[a]Farm classes were defined by annual gross farm sales; 1 = less than $200,000; 2 = $200,000 to $499,999; 3 = $500,000 to $1,000,000; 4 = more than $1,000,000.

[b]Initial values were estimated as of January 1, 1985.

[c]Projected values were estimated as of December 31, 1994.

of this farm resulted in relatively lower net returns. Since capital gains rates were assumed to be a function of the returns to production assets, these lower returns were translated into lower capital gains rates for the smallest cotton/rice/soybean farm compared to the three larger farms. Positive rates of capital gains in the first years of simulation for representative farm class 1 were offset in the later years by negative rates of capital gains resulting from decreasing returns as total production costs for rice exceeded target prices. The net effect for this smallest cotton/rice/soybean farm was an increase in land values of only 2.4 percent over the 10-year period. However, as the simulation progressed, increasing values of farm machinery, resulting from replacement of older equipment, comprised larger and larger portions of the value of total assets for this farm. This increasing ratio of the value of farm machinery to the value of farmland owned was the major cause of the large increase in the value of total assets for representative farm class 1 in the cotton/rice/soybean group. Representative farm classes 2, 3, and 4 exhibited higher net returns than the smallest farm size. This was primarily due to the lower cost structure of these farms (eight-row equipment) which resulted in positive rates of capital gains in nearly every year for all three farms. Although the value of farm machinery increased at a much faster rate than the value of farmland, as occurred with the smallest farm, real estate comprised the largest portion of total assets on these farms. Thus, the simulated increases in the value of total assets for the three largest cotton/rice/soybean farms are less than the projected increase observed in the smallest farm.

Projected total liabilities for the four cotton/rice/soybean farms in 1994 increased only moderately from their 1985 levels (Table 3). As expected, the largest percentage increase in total liabilities occurred on the smallest farm size (representative farm class 1). The higher cost structure of this farm resulted in relatively lower net returns as compared with the three larger farms. These lower net returns resulted in greater borrowing to finance cash flow deficits which could not be covered by crops held for sale. As a result, total liabilities on this farm increased 39.6 percent over the 10-year period. Projected increases in total liabilities for representative farm classes 2, 3, and 4 were 1.8 percent, 17.4 percent, and 13.7 percent, respectively. These three farm classes were assumed to have the same cost structure and the same crop yields. Since no land was purchased by any of the three farms, the low value of the projected change in total liabilities for representative farm class 2 can be explained by examining intermediate-term debt. Since each piece of equipment for a particular farm was inputed into the program as an individual item and not some sum of the value for several items, the replacement of machinery items at the end of their useful life resulted in unequal changes in the value of intermediate-term debt over the simulation period. Replacement of harvesting units (combines and cotton pickers) around the fifth and sixth year of simulation caused large increases in the value of intermediate-term debt. Since representative farm classes 3 and 4 had a larger number of harvesting units to replace, the increase in intermediate-term debt on these farms was much larger than for representative farm class 2. Lower minimum cash reserves for representative farm class 2 may have also allowed greater use of excess reserves in prepayment of intermediate-term debt than occurred on the two largest farms. The overall effect of these changes in the value of assets and liabilities resulted in large nominal increases in the projected values of net worth for all four of the cotton/rice/soybean farms.

Estimated changes in the financial structure of representative rice/soybean farms are shown in Table 4. The value of total assets increased only moderately over the 10-year period. Percentage increases ranged from 25.1 percent for farm class 3 to 43.7 percent for farm class 2. These increases were roughly half as large as those for the cotton/rice/soybean farms. Once again the magnitude of the change in the value of total assets was primarily influenced by the relationship between the change in the value of farm machinery and the change in the value of farmland owned. Relatively lower net returns from crop production on the rice/soybean farms resulted in lower rates of return on production assets and lower capital gains rates compared with the cotton/rice/soybean farms.[4] In the last few years of simulation, negative net cash farm income caused reductions in capital gains rates and resulted in land values at the end of the simultion period being less than their initital values for all except the largest of the rice/soybean farms. Therefore, the projected increases in the total value of assets were due almost entirely to increases in the value of machinery on these farms as older equipment was replaced.

Projected changes in the value of total liabilities over the 10-year period were greater in every farm class of the rice/soybean farm group when compared with estimates from the cotton/rice/soybean farm group. Once again, the largest projected percentage increase in liabilities was found in representative farm class 1. The higher cost structure of this size of operation reduced profit margins during the early years of simulation and resulted in greater borrowing in order to finance cash flow deficits as cash expenses exceeded cash receipts during the latter years of simulation. As a result, projected total liabilities for the smallest rice/soybean farm at the end of the 10-year period were estimated to be 69.4 percent above their initial levels. As in the case of the cotton/rice/soybean farms, the projected changes in the value of total liabilities of rice/soybean farms using eight-row equipment was less than for the smallest farm using six-row equipment. A lower cost structure meant greater profit margins and less need to borrow to cover cash flow deficits. However, unlike the cotton/rice/soybean farms, economies of size on these larger rice/soybean farms were not sufficient to keep total liabilities from increasing at fairly substantial rates. Rice/soybean farms were required to borrow funds in order to cover cash flow deficits more often than cotton/rice/soybean farms. This point illustrates the importance of the effect of crop diversification on the cash-flow position of a farming operation. Differences in the projected changes in total liabilities for the three largest rice/soybean farms are primarily due to the combined effect of borrowing to replace older equipment and borrowing to finance cash-flow deficits.

Net worth increased for only two of the four representative rice/soybean farms. Unlike the

Table 4. Initial and Projected Values of Assets, Liabilities, and Net Worth on Representative Rice/Soybean Farms, Delta Area of Mississippi, 1985 and 1994

Item	Representative farm class[a]			
	1	2	3	4
Initial total assets[b]	$390,670	$788,503	$1,609,249	$7,360,657
Projected total assets[c]	$539,859	$1,132,746	$2,012,983	$9,640,103
Change (%)	38.2	43.7	25.1	31.0
Initial total liabilities[b]	$217,156	$473,779	$789,393	$3,671,704
Projected total liabilities[c]	$367,770	$631,774	$1,195,671	$5,194,360
Change (%)	69.4	33.3	51.7	41.5
Initial net worth[b]	$173,514	$314,724	$819,856	$3,688,953
Projected net worth[c]	$172,089	$500,972	$817,312	$4,445,743
Change (%)	−0.8	59.2	−0.3	20.5

[a]Farm classes were defined by annual gross farm sales; 1 = less than $200,000; 2 = $200,000 to $499,999; 3 = $500,000 to $1,000,000; 4 = more than $1,000,000.

[b]Initial values were estimated as of January 1, 1985.

[c]Projected values were estimated as of December 31, 1994.

[4]It should be noted here that rice/soybean farms in the study area generally produce a diversity of crops, not just rice and soybeans. However, on an area-wide basis, the average acreage per farm of these other crops as reported in the farm resource and organization survey represented less than 10 percent of the total planted acreage on the farm.

TABLE 5. INITIAL AND PROJECTED FINANCIAL RATIOS FOR REPRESENTATIVE RICE FARMS, DELTA AREA OF MISSISSIPPI, 1985 AND 1994

Representative farm class[a]	Equity-to-asset ratio		Debt-to-asset ratio		Leverage ratio	
	Initial[b]	Projected[c]	Initial[b]	Projected[c]	Initial[b]	Projected[c]
Cotton/rice/soybeans						
1	.437	.542	.563	.458	1.290	.846
2	.416	.631	.584	.369	1.406	.585
3	.517	.615	.483	.385	.934	.625
4	.552	.665	.478	.335	.916	.504
Rice/soybeans						
1	.444	.319	.556	.681	1.252	2.137
2	.399	.442	.601	.558	1.505	1.261
3	.509	.406	.491	.594	.963	1.463
4	.501	.401	.499	.539	.995	1.168

[a]Farm classes were defined by annual gross farm sales; 1 = less than $200,000; 2 = $200,000 to $499,999; 3 = $500,000 to $1,000,000; 4 = more than $1,000,000.

[b]Initial values were estimated as of January 1, 1985.

[c]Projected values were estimated as of December 31, 1994.

smallest cotton/rice/soybean farm, the rice/soybean farm using six-row equipment exhibited a slight decline in net worth over the simulation period. Lower net returns from crop production resulted in the change in total assets of the farm being unable to offset its increase in liabilities. Similar to the results from the simulation of the cotton/rice/soybean farms, the largest projected percentage increase in net worth for the rice/soybean farms was observed in representative farm class 2. This result could be the effect of the failure to accurately reflect economies of size in the two largest farm classes.

A more concise view of the relative changes in the financial structure of rice farms is presented in Table 5. Initial and projected estimates of the equity-to-asset ratio, debt-to-asset ratio, and leverage (debt-to-equity) ratio are shown for each farm. Although farm size and crop mix remained constant, substantial reductions were projected in the degree of leverage found on cotton/rice/soybean farms. Debt-to-equity ratios on these farms were reduced approximately 30 to 60 percent from 1985 levels. Projected ratios ranged from .504 on the largest size to .846 on the smallest size. All of the farms in the rice/soybean group were projected to become more highly leveraged with the exception of farm class 2 which exhibited only a marginal improvement. Nevertheless, all rice/soybean farm types considered in the study were projected to have leverage ratios exceeding 1.0 in 1994.

SUMMARY AND CONCLUSIONS

This study was concerned with evaluating the economic survivability of rice farms in the Delta area of Mississippi. Eight representative rice farms were simulated over a 10-year period using the FLIPSIM V whole-farm simulation model. Although the projected acreage levels on rice farms simulated in this study did not change, the financial structure of the farms changed considerably. Rice farms which also produced cotton and soybeans were projected to be in a stronger financial position at the end of the simulation period than farms producing only rice and soybeans. Furthermore, cotton/rice/soybean farms were better able to cover farm business expenses and family living expenses with the added income from government diversion and deficiency payments on cotton and rice. Rice/soybean farms received government payments only on rice acreage. Total farm income on these farms was not generally sufficient to adequately cover family living expenses, general farm overhead, and other farm business expenses as well as production costs. As a result, rice/soybean farms experienced greater cash-flow problems than the more diversified cotton/rice/soybean farms. These results were primarily due to the greater relative profitability of cotton production within the region and were supported by additional results from the simulation of representative cotton and soybean farms not producing rice.

One conclusion from this analysis is that rice producers in the Delta area of Mississippi will likely gear their acreage and production decisions to the farm price support and income support programs for rice. Given the average production costs and yields found in the region, the relatively low level of market prices of rough rice in relation to established loan rate and target price levels makes producers very dependent on government price support programs in order to provide sufficent farm income to continue in rice production. Rice acreage is not likely to exceed base program levels on any farm until farm-level prices for rough rice rise substantially above the support floor levels. Given the recent decline in farm-level rough rice prices combined with the passage of the 1985 Farm Bill which provides for a reduction in price support levels, any significant expansion of rice acreage in the area over the next several years is rather doubtful.

Secondly, it may also be concluded that, in the long run, rice farms which are more diversified are more likely to survive and possibly improve their financial positions. Although the alternative crop mixes considered in this study were rather limited, results did show that the financial viability of rice farms is partially dependent on the production of crops other than rice. More specifically, since current farm-level rice prices generally do not cover total costs of production, producers will consider the production of supplemental crop enterprises with more favorable price-cost relationships. The continued reduction or complete elimination of government price support operations in agriculture will continue to increase the importance of diversification to the survivability of the farm business. As rice farms diversify by expanding the number of crops produced on the farm, rice acreage could actually fall unless substantial improvement occurs in farm-level rice prices. With other rice-producing areas in northeast Louisiana and southeast Arkansas having similar soil types and production patterns, similiar results could be expected in these areas as well. As government agricultural price support levels decline and rice producers become less insulated from market conditions, the future of rice production in the Mississippi River Delta region will become more and more dependent on the combined effect of domestic and foreign events on the farm-level prices of agricultural commodities.

REFERENCES

Barlett, P. F. "Microdynamics of Debt, Drought, and Default in South Georgia." *Amer. J. Agr. Econ.*, 66(1984):836–43.

Barry, P. J., and W. F. Lee. "Financial Stress in Agriculture: Implications for Agricultural Lenders." *Amer. J. Agr. Econ.*, 65(1983):945–52.

Boehlje, M., and V. Eidman. "Financial Stress in Agriculture: Implications for Producers." *Amer. J. Agr. Econ.*, 65(1983):937–44.

Boykin, B. S. "Economic Analysis of Double-Cropped Soybeans and Wheat in the Delta Area of Mississippi." M. S. thesis, Mississippi State University, 1983.

Brake, J.R. "Financial Crisis in Agriculture: Discussion." *Amer. J. Agr. Econ.*, 65(1983):953–54.

Cooke, F. T., Jr., V. G. Hurt, J. Sartor, Jr., and R. L. Williams. *Estimated Costs and Returns, Crops, Delta Area of Mississippi, 1984.* Mississippi State University, Ag. Econ. Rep. No. 14, January, 1984.

Eddleman, B. R., D. W. Parvin, Jr., J. G. Hamill, and F. T. Cooke, Jr. *Evaluation of Investment in Rice-Soybean Rotations in the Delta of Mississippi.* Mississippi Agricultural and Forestry Experiment Station, Mississippi State University, Bulletin No. 522, April, 1976.

Grant, W. R., and S. H. Holder, Jr. "Recent Changes and the Potential for U.S. Rice Acreage." *Rice Situation*, October, 1975:10–14.

Hamill, J. G., and Y. N. Lin. "Rice-Soybean Rotations in the Delta Area of Mississippi." *Proceedings—Nineteenth Rice Technical Working Group*, 1982:35-36.

Holder, S. H., Jr., J. L. Ghett, and Z. M. Looney. *Costs of Building and Operating Rice Drying and Storage Facilities in the South.* U.S. Dept. Agr., Economic Research Service, MMR No. 1011, September, 1973.

Holder, S. H., Jr., F. T. Cooke, Jr., J. G. Hamill, and D. W. Parvin, Jr. "Factors Affecting Costs and Returns of Rice Soybean Farms in the Delta of Mississippi." *MAFES Research Report*, 1, 11 (1975).

Holder, S. H., Jr., and W. R. Grant, *U.S. Rice Industry.* U.S. Dept. Agr., Econ. Stat. Coop. Ser., Ag. Econ. Report No. 433, August, 1979.

Holder, S. H., Jr., R. Johnson, and E. Wailes. "Costs of On-Farm Rice Drying and Storage Facilities, 1981." *Arkansas Farm Research*, 30, 2(1981):8.

Levins, R. A., D. W. Parvin, Jr., and F. T. Cooke, Jr. "Economic Potential for Increased Rice Production in the Delta of Mississippi." *Proceedings—Eighteenth Rice Technical Working Group*, 1980:46-47.

Malone, G. W., S. H. Holder, Jr., and D. W. Parvin, Jr. "The Economics of On-Farm Rice Drying-Storage Facilities, Mississippi, 1978." *MAFES Research Report*, 4,7(1978).

Mullins, T., W. R. Grant, J. R. Campbell, A. Gerlow, C. A. Bonnen, and D. Welsch. *Resource Use Adjustment in Southern Rice Areas; Part I, Effects of Price Changes with Unrestricted Rice Acreages.* So. Coop. Ser., Bull. No. 122, June, 1967.

Mullins, T., J. B. Hottell, J. R. Campbell, A. R. Gerlow, W. R. Grant, and D. Welsch. *Resource Use Adjustments in Southern Rice Areas; Part II, Effects of Price Changes with Selected Rice Allotment Levels.* So. Coop. Ser., Bull. No. 131, May, 1968.

Mullins, T., W. R. Grant, and S. H. Holder, Jr. *Estimated Costs and Returns for Rice, 1975, 1976 and 1977 Seasons with Projections for 1978, Major Producing Areas.* U.S. Dept. Agr., Econ. Stat. Coop. Ser., SB-613, October 1978.

Richardson, J. W., and C. J. Nixon. *Description of FLIPSIM V: A General Firm Level Policy Simulation Model.* Texas A&M University, 1985.

Salassi, M. E., and J. A. Musick. *An Economic Analysis of Rice Irrigation Pumping Systems in Louisiana.* Louisiana State University, D.A.E. Research Report No. 617, July, 1983.

Traylor, H. D., B. J. Miller, and L. C. Hill. "The Potential for Rice Production in Northeast Louisiana." *Louisiana Rural Economist*, 38, 2(1976):2-5.

U.S. Department of Agriculture. *Agriculture Statistics, 1984.* U.S. Government Printing Office, Washington, D.C.:408.

__________. *Balance Sheet of the Farming Sector, 1979, Supplement.* Econ. Stat. Coop. Ser., U.S. Government Printing Office, Washington, D.C., Ag. Info. Bull. No. 430, February, 1980.

__________. *Crop Production.* Crop Reporting Board, Stat. Rep. Ser., U.S. Government Printing Office, Washington, D.C., 1974 through 1985 annual summaries.

__________. *Economic Indicators of the Farm Sector: State Income and Balance Sheet Statistics, 1983.* Econ. des. Ser., U.S. Government Printing Office, Washington, D.C., ECIFS 3-4 January, 1985.

__________. *Farm Labor.* Crop Reporting Board, Stat. Rep. Ser., U.S. Government Printing Office, Washington, D.C., various issues.

U.S. Department of Commerce. *1979 Farm Finance Survey.* Bureau of the Census, unpublished data.

Usman, D.S. *Costs and Returns for On-Farm Rice Drying-Storage Facilities in Mississippi, 1973.* M.S. thesis, Mississippi State University, 1973.

Wolfe, L. W. "An Analysis of the Impact of Expanded Rice Acreage on the Current and Future Structure of Mississippi's Rice Industry." M.S. thesis, Mississippi State University, 1980.