A MICROCOMPUTER ANALYSIS OF FARM FINANCIAL PERFORMANCE

Gary D. Schnitkey, Peter J. Barry, and Paul N. Ellinger

Abstract

This article describes the properties of the Farm Financial Simulation Model (FFSM). FFSM is a tool for analyzing the financial consequences of various managerial strategies and policy options that may be implemented in responding to farm financial stress. Various farm types from different geographical regions having differing enterprises, financial structures, tenure arrangements, and consumption patterns can be analyzed. The emphasis of FFSM is placed on modeling a farm's profitability, liquidity, solvency, and financial position and the model produces a coordinated set of financial statements and an extensive set of financial ratios over a four-year period.

Key words: risk, financial stress, microcomputer applications, simulation.

This article describes Farm Financial Simulation Model (FFSM) which was developed in conjunction with Southern Regional Research Project S-180 as a tool for evaluating the financial consequences of managerial strategies and policy options for responding to farm financial stress. FFSM is designed for use on a microcomputer using a Lotus 1-2-3[R] worksheet.[1] It simulates the financial structure and performance of a farm business over a four-year period with considerable detail allowed in the farm's production and marketing activities. Major emphasis, however, is placed on the farm's financial components, including sales and purchases of farm assets, financing terms, debt management, cash flows, tax obligations, consumption levels, growth rates, and the attendant consequences for the farm's profitability, liquidity, and solvency. The financial emphasis makes the model applicable to many farm types that differ in geographic location, size, tenure, position, and other structural characteristics. In the following sections, we review conceptual and empirical foundations of the model, cite other relevant literature, and describe the model's design, operation, application, and computer requirements.

EMPIRICAL AND CONCEPTUAL FOUNDATIONS

Impetus for the development of FFSM originated from the financial stress conditions faced by agriculture during the 1980s. This stress is evidenced by decreasing profitability, difficulty in meeting scheduled debt obligations, eroding financial positions of farmers, and rippling effects felt by farm lenders, agribusinesses, and rural communities (Jolley et al.; Melichar and Irwin; Ginder et al.; U.S. Department of Agriculture). These financial problems have created a response dilemma for farmers, lenders, and policy makers. Financially stressed farmers have responded by reducing or eliminating capital expenditures, living more frugally, cutting production expenses, seeking off-farm employment, and selling liquid assets. As conditions worsened, the focus shifted to down sizing the scale of operation by selling breeding livestock, machinery, and tracts of land. The limited number of farmer responses, and the often drastic and futile nature of these responses, has focused considerable attention on governmental responses to farm stress, including formal policies for lender forbearance, debt moratoria, deferral of debt obligations, debt restructuring, loan guarantees, principal and interest buydowns, expanded government credit, tax exempt bond financing, govern-

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[1]Lotus 1-2-3 is a registered trademark of the Lotus Development Corporation.

ment acquisition of farmland, and government acquisition of problem loans.

The conceptual foundations for the FFSM involve the interrelationships among profitability, solvency, and liquidity as measured through a coordinated set of financial statements, including yearly balance sheets, income statements, statements of changes in net worth, and fund availability reports (Frey and Klinefelter). The concept of financial leverage is especially important. Leverage refers to the amount of debt capital and other fixed-obligation financing that is used relative to the amount of a firm's equity capital. Increases in financial leverage will increase both the expected level and variability of returns to a firm's equity capital, assuming that the rate of return on assets being financed exceeds the cost of borrowing (Barry et al.). In addition, higher leverage reduces the firm's liquidity position through the depletion of credit reserves and the added financial obligations to be met. Thus, total risk increases as financial leverage increases, and the firm's survival prospects experience greater jeopardy.

RELATED LITERATURE

A relatively large number of farm simulation models have been developed for use on mainframe and microcomputers. Mainframe models, such as FLIPSIM (Richardson and Nixon), REPFARM (Baum), and others (e.g., Walker and Helmers; Patrick), generally are large models intended for specific types of research applications with relatively long planning horizons. They are not specifically designed to analyze the financial characterisics of stressed farms, and they may be relatively expensive to maintain and operate. A number of microcomputer-based models also exist, including the Farm Business and Financial Management Transition Program developed at the University of Illinois (Kesler and Burk), FINPACK developed at the University of Minnesota (Hawkins), and Integrated Farm Financial Statements for the Microcomputer developed at Oklahoma State University (Egbert et al.).

One of the more popular of these micro-based programs is FINPACK. FINPACK is divided into four programs; FINAN—analyzes the past financial performance of a farm; FINLRB—analyzes a farm's profitability, solvency, and liquidity; FINTRAN—analyzes a farm's projected cash flow over a three-year period; and FINFLO—produces a monthly cash flow for the upcoming year. The FFSM program integrates the latter three features into a LOTUS 1-2-3^{R} spreadsheet. This integration, along with the FFSM's interactive nature, simplifies the data-entry procedures. Another difference between FINPACK and the FFSM involves their financial reports. The FFSM produces financial statements and ratio analyses for four years, while FINPACK produces more consolidated profitability, solvency, and liquidity measures. The key difference, however, between FINPACK and the FFSM is in their projected audiences. FINPACK was developed to aid extension personnel, farmers, and lenders in analyzing a specific farm—thus providing a valuable and necessary technology—while FFSM was developed to aid researchers.

Because FINPACK and the other microcomputer-based models were developed to analyze specific farm situations, they may not adequately address the needs of researchers analyzing farms' financial preferences under different response options. The FFSM provides abilities to model the production technologies and structural characteristics of various farm types in differing geographical regions. Farm financial performance then can be analyzed under differing financial policies and economic conditions. Specific features allowing this analysis include the ability to specify and easily change 1) economic variables including interest rates and growth rates of commodity prices, production and overhead expenses, and asset prices, 2) state tax codes, 3) beginning financial positions and debt repayment terms, 4) purchases and sales of capital assets, 5) family consumption withdrawals, 6) debt forgiveness, and 7) equity infusions. In addition, the model calculates a quarterly cash flow, thus allowing analysis of both intra- and inter-year cash flows.

MODEL CONSTRUCTION AND OPERATION

The FFSM analyzes a farm's financial performance over a four-year period. At the beginning of each year, the farm's financial structure is represented by a balance sheet which includes farm assets, nonfarm assets, debt, and net worth. During each year quarterly cash flows are considered from farm assets, financial assets, capital transactions, costs of debt, repayment of debt, family withdrawals, and tax payments. These flows result in income to the farm and changes to the farm's structure which determine the ending balance sheet.

Returns to farm assets are generated by crop, breeding livestock, and feeder livestock enterprises. Transfers are specified between enterprises to account for feed requirements and young-animal production. Each enterprise generates costs and flows of marketable inventories. Gross returns are realized when inventories are sold. These enterprises are supported by owned and leased farm assets. Leasing of farmland may occur with cash rent or share rent arrangements. Nonfarm assets include cash, marketable securities, and long term retirement accounts. Capital transactions include purchases or sales of breeding stock, machinery, buildings, and farmland. These transactions increase or decrease farm size and levels of production for the various enterprises. Capital purchases are financed by combinations of debt and equity capital with interest rates, loan maturities, and repayment plans specified by the model user. The proceeds of capital sales are applied first to reducing outstanding debt levels and then to increasing holdings of cash and marketable securities.

The farm's enterprises, returns to financial assets, capital transactions, and interest on and repayment of debt determine the timing and magnitude of quarterly cash flows. Cash deficits in any quarter are covered by short-term borrowing, while cash surpluses flow into the various categories of financial assets. Withdrawals for family living and tax obligations are based on yearly measures of cash income and taxable income, respectively. Tax specifications consider federal and state income taxes, Social Security taxes, ordinary income and capital gains, carry forward of operating and capital losses, and various tax recaptures on asset sales. Contingent tax obligations due to unrealized changes in asset values are included on the balance sheet for each category of farm assets. The farm's net income is determined by yearly net cash income, depreciation, and changes in inventories, prepaid expenses, and accounts payable.

These components of the FFSM are organized in the Lotus 1-2-3^{R} worksheet according to the design shown in Figure 1 with upper right and lower left cell coordinates indicated for each major section. As Figure 1 shows, the worksheet contains four sections. The Input section consists of 14 input tables (see Table 1) in which the basic data for running the model are entered.

In the first three input tables, data are entered for the crop, breeding livestock, and feeder livestock enterprises. Included are the number of units produced, the variable costs per unit, share rental arrangements, the timing of production and sales, and purchases and sales of breeding livestock. Fixed costs are entered in Input Table 4. Prices of production units, growth rates for expenses and asset values, miscellaneous income, and accounts payable and prepaid expenses as a percent of total expenses are entered in Input Table 5. The beginning asset and liability data are entered in Input Tables 6 and 7, including cost and market values for assets, depreciation levels, debt balances, principal payments, and interest rates. Input Tables 8 through 13 include inputs for purchases and sales of machinery, buildings, and land. Included are asset costs, investment tax credit, financing arrangements, depreciation charges, and related adjustments for asset sales. Input Table 14 includes input data for taxation, family withdrawals, returns on financial assets, allocations of cash balances, equity infusions, and forgiveness of debt.

The Calculation section of the worksheet contains the various rules and formulas for conducting the simulation analysis. The Reports section contains six output tables that give the financial results for each of the four years. These output tables include the balance sheet, income statement, flow of funds statement, change in net worth statement, available funds report (for debt payment and other uses), and a summary report containing the ratio measures for profitability, liquidity, and solvency (see Table 2). The Menu section provides a directory for other sections of the model and facilitates running the analysis.

When the worksheet is loaded, the menu shown in Table 1 is automatically shown. Selecting an option in the menu allows various operations to be performed. For example, the first column of the menu entitled "Input Tables" contains the 14 input tables used to enter data into the input model. Selecting Input Table 1 enables the crop inputs to be entered, selecting Input Table 2 enters the breeding livestock inputs, and so on. Other menus allow the worksheet to be saved, the input and output tables to be printed, and the entire worksheet to be scanned.

An Application

The type of output generated by the FFSM is illustrated by an application to a highly-leveraged cash grain farm in Central Illinois

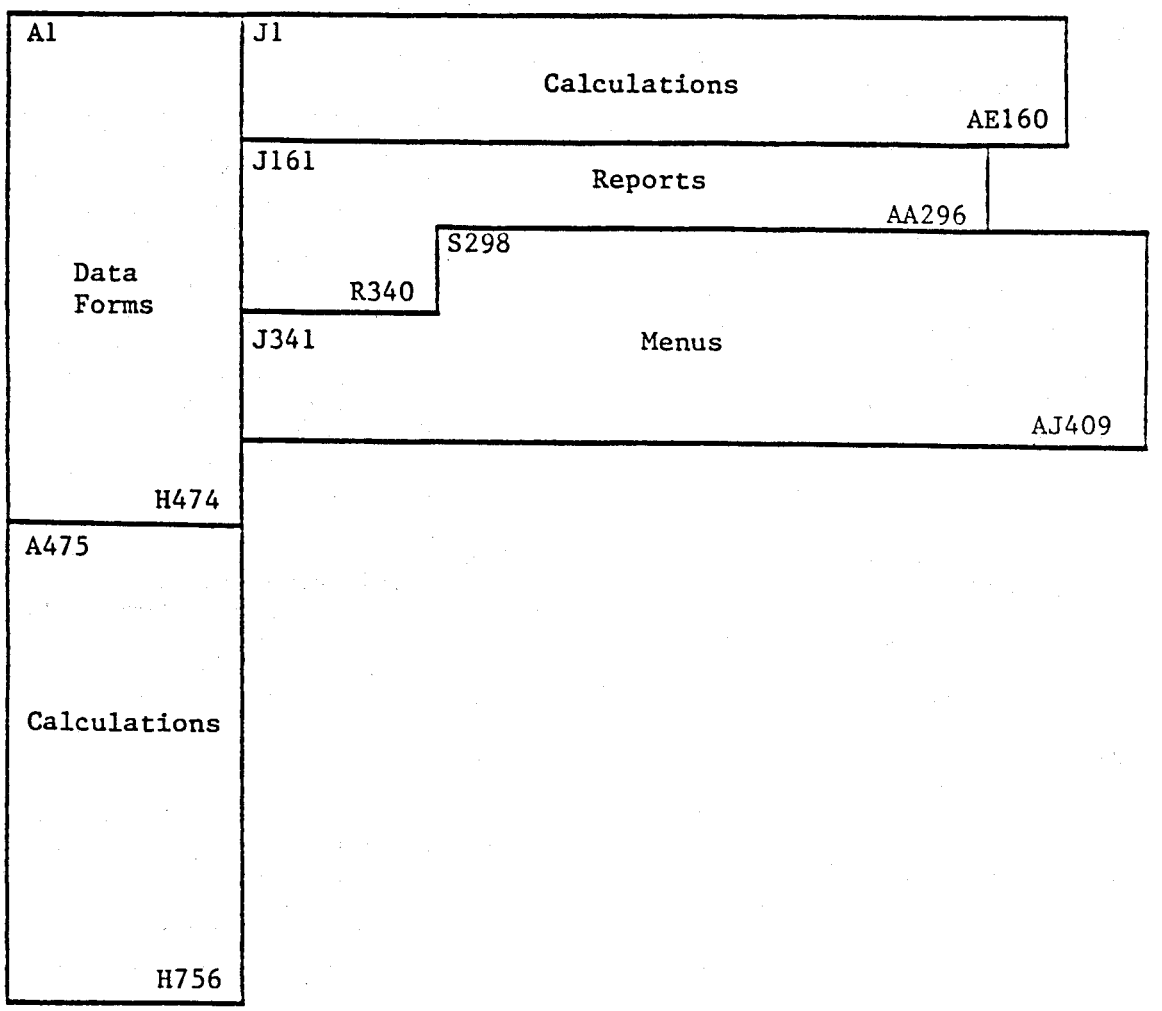

Figure 1. Organization of the Farm Financial Simulation Model in Lotus 1-2-3.[R]

TABLE 1: THE FARM FINANCIAL SIMULATION MODEL'S MAIN MENU

Input Tables	Utilities
1 Crop Inputs	15 Save
2 Breeding Livestock Inputs	16 Print Inputs
3 Feeder Livestock Inputs	17 Print Output
4 Unallocated Expenses	18 Quit & Scan
5 Prices, Incomes, and Growth Rates	
6 Beginning Asset Situation	
7 Beginning Liability Situation	
8 Purchases of Machinery	
9 Purchases of Buildings	
10 Purchases of Land	CHOICE
11 Sales of Machinery	
12 Sales of Buildings	
13 Sales of Land	
14 Family, Tax and Debt Forgiveness	

in which the effects on farm financial performance of several policy options for responding to financial stress are evaluated. The base scenario is a 640-acre unit producing corn and soybeans with 200 acres owned and 440 rented on a 50–50 crop-share lease. Data on costs, returns, asset composition, financial specifications, and growth rates were taken from the Illinois Farm Business Farm Management System, the St. Louis Federal Land Bank Data Base, and from macro projections made by the Food and Agricultural Policy Research Institute at the University of Missouri and Iowa State University.[2] Several beginning leverage positions were specified; however, the results reported here are for a beginning debt-to-asset ratio of 40%.

The analytical approach was to simulate the farm's financial performance over the four-year period for the base scenario and for six response options. These response options include: (1) a 35% reduction in the farm's initial indebtedness; (2) a 35% reduction in interest rates; (3) a deferral of debt principal and interest payments for two years; (4) a sale of 35% of the farm's assets with no lease back; (5) a sale of 35% of the farm's assets with a lease back on a share-rent basis; and (6) an infusion of new equity capital in the amount of 35% of the farm's total indebtedness. These options are not directly comparable with one another in terms of their relative impacts on the farm's financial structure. Thus, the object is to consider the effects of each option on the level and direction of the farm's various performance measures relative to the base scenario.

Table 2 shows a selected set of absolute and ratio measures on financial performance calculated by the model for each year of the horizon for the base case with contingent tax obligations excluded from the output measures. As these results show, net income is relatively low although unrealized capital gains occur as well; net worth declines over the horizon because the levels of withdrawals exceed the levels of net income in each year. The rates of return on assets and equity are relatively low yet stable over time. The current ratio is trending downward, and the debt-to-asset ratio increases from 40% to 50% by the end of year 4.

Table 3 indicates various measures of average performance over the four-year period and at the end of the period for the base case and for each of the response options, again with contingent tax obligations excluded. These measures were calculated from the model output, since the model was not designed to yield results in this format. As anticipated, most of the options improve the case farm's performance, especially for rates of return on equity, the current ratios, and the ending debt-to-asset ratios. Especially interesting is the sharp reduction in leverage due to asset sales with or without a lease back provision. Since the assets (including land) were assumed to be sold immediately at current market

TABLE 2: FINANCIAL PERFORMANCE MEASURES FOR THE BASE SCENARIO

Measure	Beginning	Year 1	Year 2	Year 3	Year 4
Absolute measures (dollars)					
Net income		5,818	5,660	7,710	1,798
Net income after gain		11,455	13,370	14,974	12,316
Net income from operations		35,282	26,128	40,061	37,391
Cash income from operations		35,365	29,783	33,667	35,250
Maximum current loan		37,791	55,806	79,830	108,586
Changes in net worth		−11,534	−12,091	−13,574	−17,804
Ratios (without contingent tax liabilities)					
Return on assets		0.0615	0.0642	0.0715	0.0661
Cost of debt		0.1108	0.1112	0.1121	0.1144
Return on equity without gain		0.0171	0.0173	0.0244	0.0059
Return on equity with gain		0.0337	0.0408	0.0474	0.0404
Current ratio	1.7650	1.0509	0.6977	0.5451	0.4364
Intermediate ratio	3.1250	3.4275	3.7828	4.1270	4.4862
Fixed ratio	2.5348	2.5746	2.6216	2.6763	2.7322
Debt-to-asset ratio	0.4000	0.4216	0.4479	0.4764	0.5119
Interest coverage ratio		1.24	1.20	1.24	1.05
Cash flow coverage ratio		2.57	2.35	2.30	2.19
Debt-to-income ratio		20.68	20.26	19.29	25.34

[2]The Illinois Farm Business Farm Management System, and the St. Louis Federal Land Bank Data Base are unpublished data sources.

TABLE 3: AVERAGE AND END-OF-PERIOD PERFORMANCE MEASURES FOR THE BASE SCENARIO AND VARIOUS POLICY OPTIONS

	Original	Debt Reduction (1)	Interest Reduction (2)	Deferral Debt (3)	Asset sale, No lease (4)	Asset sale, Lease (5)	Equity Infusion (6)
Absolute Measures (dollars)							
Average Net Income	5247	5144	15424	17320	15374	18981	13247
Ending Net Income	1798	10120	15178	7192	17614	20642	13750
Average Fund Availability	−22330	−18543	−13683	−6286	−4419	−1710	−11135
Ending Fund Availability	−26062	−15270	−14325	−21972	−5716	−2558	−12498
Total Change Net Worth	−50721	25228	−10012	−2429	−13832	4218	60428
Ratios							
Average Cash Flow Coverage, ratio	2.3513	3.2018	3.1525	21.2128	6.6763	6.4630	2.6759
Ending Cash Flow Coverage, ratio	2.1851	2.8560	3.0522	2.3835	6.7172	6.7717	3.1426
Ending Debt/Asset Ratio	0.5119	0.3833	0.4418	0.4304	0.1353	0.1286	0.3229
Ending Current Ratio	0.4364	0.5067	0.5891	0.8687	1.2248	1.6000	0.6910
Ending Current & Intermediate	1.1547	1.3563	1.4874	1.8313	2.8862	3.2512	1.7866
Average Return on Assets	0.0658	0.0510	0.0615	0.0580	0.0547	0.0629	0.0633
Ending Return on Assets	0.0661	0.0653	0.0626	0.0664	0.0663	0.0725	0.0644
Average Return on Equity	0.0406	0.0336	0.0693	0.0725	0.0676	0.0792	0.0535
Ending Return on Equity	0.0404	0.0554	0.0774	0.0510	0.0812	0.0914	0.0601

values, an extension of the analysis might consider the effects of differences in the timing and transactions cost associated with the asset sales. In any event the FFSM can easily accommodate variations in any of the input variables in order to observe their effects on financial performance.

CONCLUDING COMMENTS

The FFSM model has been tested and used in several applications at the University of Illinois with emphasis on its role in applied research. One study evaluated the impacts of alternative tenure arrangements on the financial performance of cash grain farms (Ellinger and Barry). Another study used the model as a tool in an experimental setting for eliciting investment decisions in farm machinery by a panel of farmers in response to changes in selected variables affecting their decision environment (Gustafson). As a part of this study a pretest of the model with students in an undergraduate farm management class indicated that the model's specifications and use were clearly conveyed and the results were plausible. In addition, the model has been used extensively by researchers at 13 of the universities participating in Southern Regional Research Project S-180 to evaluate various policies for responding to financial stress in their respective states and regions (Barry).

The FFSM was developed on an IBM-PC using Lotus 1-2-3^{R}. Hardware requirements are an IBM-PC or compatible equipment with 512 K of RAM.[3] Software requirements are DOS 2.0 or higher and Lotus 1-2-3^{R} version 1A or higher. The program and accompanying documentation (Schnitkey et al.) are available from and maintained by the Department of Agricultural Economics at the University of Illinois, Urbana-Champaign at a nominal charge to cover the cost of reproduction and handling.

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[3]IBM-PC is a trademark of the International Business Machines, Inc.

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