Farm Family Characteristics and the Viability of Farm Households in Wisconsin, Mississippi, and Tennessee

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Abstract

The authors used data from sample surveys of farm households in Wisconsin, Mississippi, and Tennessee to examine the relationship of farm household viability to human resource, farm business, and financial characteristics Viability is measured as the ratio of farm and nonfarm income to consumption expenses, capital replacement costs, and principal payments Households are grouped by region, gross sales, farm type, operator off-farm employment, and farm business plans Regression results indicate that factors associated with viability differ by household group Farm size is associated positively with viability only for larger full-time farmers in Mississippi and Tennessee and for households planning to leave farming

Keywords

Farm viability, family farms, farm households, Wisconsin, Mississippi, Tennessee

Introduction

The incidence of financial stress among farm families differs by farm type, maturity of operation, and organizational factors, in fact, the overall failure rate of farm businesses is severe and threatens the continued existence of many family farms In October 1984, one-fourth of the farm loan portfolio of the Farmers Home Administration was delinquent (*1*) [1] In 1984, about one-fifth of all farmers had debt-asset ratios above 40 percent, a level indicating severe debt-repayment difficulties One-third of farmers with annual sales over $40,000 had debt-asset ratios higher than this critical level These operations were large- and medium-size farms, and most were full-time family farms (*2*)

In this study, we used cross-sectional data from farm household surveys in Wisconsin, Mississippi, and Tennessee to examine the viability of individual farm households Farm business and household characteristics are reported for selected groups of farm households, by survey region We tested characteristics hypothesized to be associated with farm viability and compared groups using regression analysis

This study provides new information on the characteristics of farm families and factors affecting their financial condition The analysis uses farm family data from selected areas in Wisconsin, Mississippi, and Tennessee to measure the viability of individual farm households We grouped farm households by major organizational attributes and tested the effects of differences in human resource, farm business, and financial characteristics on a farm's potential for success For the Wisconsin area, selected groups include households that operate dairy farms For both the Wisconsin and Mississippi Tennessee survey areas, selected groups include

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[1] Italicized numbers in parentheses refer to items in the References at the end of this article

households in which the operator farms part-time, households with smaller farms (annual sales under $20,000), households with larger farms (annual sales $20,000 or above) on which the operator farms full-time, and households in which the operator is planning to leave farming

USDA's 1981 and 1983 Family Farm Surveys were designed to link farm business data with characteristics of the family on the farm The surveys studied and gathered new information about the characteristics of farm families, family labor use, farm business organization, farm financial characteristics, sources of household income, and perceived problems and goals of farm families Data revealing characteristics of both the farm family and the farm as a producing unit are not generally available through other USDA series or the *Census of Agriculture* or *Census of Population* [2]

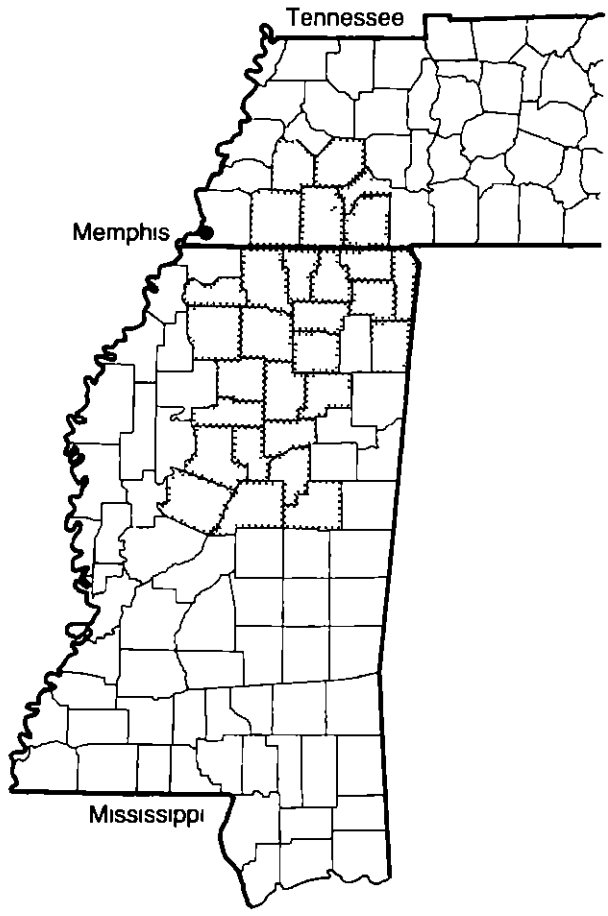
The Mississippi-Tennessee Family Farm Survey (1981) covered 1,087 households in a contiguous 29-county area in northern Mississippi and south western Tennessee (*3*) The Wisconsin Family Farm Survey (1983) covered 529 farm households in an eight-county area in southwestern Wisconsin (*4*)

Although survey results can be generalized only to the counties included in the samples, the survey sites were selected because they share common features with larger segments of U S agriculture The southern site typifies parts of the Southeast and Piedmont, where farming is an important economic activity, but farms are relatively small The Wisconsin site is typical of other North Central and New England areas where dairying is the most common farm type and most farms are family enterprises

The Mississippi-Tennessee site lies in the Sand-Clay Hills region, a low-income agricultural area dominated by small farms (fig 1) Most of these small farms are beef cattle operations (excluding feedlots), with some soybean, cash grain, and cotton enterprises The metropolitan area of Jackson, TN (population of 50,000), and a number of smaller towns (populations under 12,000) provide some off-farm employment

Figure 1

Mississippi-Tennessee Family Farm Survey Site



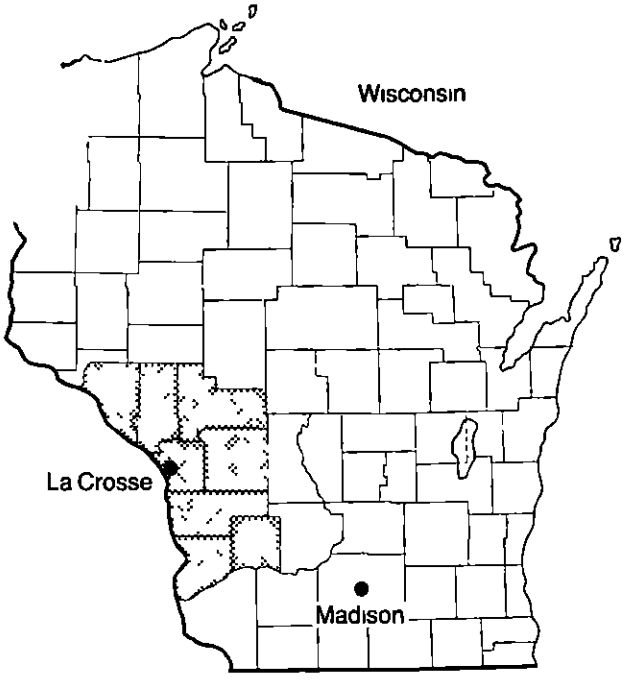
The Wisconsin site is in the unglaciated hills of the southwestern portion of the State (fig 2) A low-income area in relation to the State, the site is not depressed according to national criteria and has a higher average income than the Mississippi-Tennessee survey area About two-thirds of the Wisconsin farms are dairy operations, and the remainder are cash grain, beef cattle, and other livestock operations LaCrosse (population of 51,000) and four smaller towns (populations between 5,000 and 6,200) provide some off-farm employment opportunities

Roughly 12,000 farm households were represented in each site The sample was drawn with a stratified two-stage cluster design in the Mississippi-Tennessee

[2]An exception is the "1979 Farm Finance Survey," a followup to the *1978 Census of Agriculture*

Figure 2

Wisconsin Family Farm Survey Site



site and was selected at random from a list of operators in Wisconsin In both areas, households were contacted to determine whether they qualified as "family" farms, and only eligible households were included in the survey A farm was defined as a business producing at least $1,000 of agricultural sales in a normal year The farm was considered a "family" farm if it was not operated by a hired manager, a nonfamily corporation, or an institution

Trained enumerators conducted personal, onfarm interviews with the farm operator, identified by the household members as the person responsible for major administrative, managerial, and daily operating decisions

Method

To survive each year, a farm household must generate annual cash income sufficient to provide for the livelihood of its members To continue operating the farm business, as currently organized, the farm household must cover cash expenses associated with farm production and regularly replace capital stock to sustain the stock's serviceability To maintain its line of agricultural credit, the farm household must also meet scheduled payments toward loan retirement Meeting consumption expenses, production expenses, capital replacement costs, and interest and principal payments is a minimum financial obligation for the year-to-year survival of the farm household

This study's unit of observation is the household of a farm operator, and the accounting period corresponds to 1 year Because the household's minimum financial obligations toward consumption, production, replacement of capital stock, and loan retirement must be met with cash expenditures, the authors used a cash concept of household income The cash income concept excludes farm inventory changes and the imputed rental value of the farm residence The income and expenditure concepts and terminology of this study are consistent with those used in the U S Department of Agriculture's (USDA) income accounts series (*5*, pp 1-5)

The economic activity common to the survey households is the operation of a farm business The earnings of the farm business are measured as net cash income from farming Net cash income from farming is calculated as the sum of cash marketings of crops, livestock, and products, plus Government payments and other farm income from machine hire and recreation, minus intermediate product expenses of farm origin (such as feed) and nonfarm origin (such as fertilizer), business taxes, business interest, cash wages, and rent paid In addition to net cash income from farming, survey households receive (1) off-farm employment income from wages and salaries and (2) unearned income (such as nonfarm asset income and transfers) These latter sources of income are important for many of the farm households surveyed, on small, part-time operations, off-farm employment may constitute the primary source of income

From these combined sources of net cash income, each household must meet annual consumption, capital replacement, and loan retirement obligations Annual consumption expenditures include the costs of basic needs such as food, clothing, and health care, the timely replacement of consumer

durables, and payment of income and Social Security taxes In this study, we used Federal poverty-level income criteria as a measure of minimum consumption needs [3] Annual cash expenditures to maintain capital stock represent the replacement of obsolete or damaged capital These annual replacement costs are distinct from investment to expand the productive capacity of the farm business In this study, estimated capital replacement costs were calculated at 10 percent of the value of all farm machinery, trucks, and cars We calculated loan retirement payments, or estimated principal payments, on the basis of the type of collateral under which individual loans were secured (see the glossary at the end of this article)

If the farm household's combined sources of income, as previously defined, are adequate to meet these minimum financial obligations, both the farm business unit and the farm household as a consuming unit are viable The authors define "viability" as a level of annual cash income sufficient to cover farm operating costs, meet the household's minimum consumption needs, replace capital items at a rate that ensures constant serviceability of the capital stock, and finance loan retirement as scheduled Under this definition, a viable farm household will both survive and enhance its equity position through retiring loans If total cash income from combined farm and nonfarm sources exceeds minimum financial obligations, the balance can be used to increase consumption, invest in human capital, expand the farm business, or accumulate nonfarm savings or investments

To measure farm household viability, we developed a "viability ratio," which expresses the capacity of the farm household to meet minimum financial obligations, under the survey-year business and labor organization of the household [4]

The ratio is generally constructed as follows

$$\text{viability ratio} = \frac{\text{annual household net cash income}}{\text{annual household financial obligations}}$$

The composition of terms in the viability ratio is determined by the household's farm business plans, as stated by the family in the survey For families intending to continue farming over the 5 years following the survey, the ratio compares observed household income with an estimated minimum level required to satisfy consumption requirements, replace capital to maintain the serviceability of farm capital stock, and meet loan retirement payments as scheduled The viability ratio for these households is constructed as follows [5]

$$\frac{\text{annual household cash income}}{\text{annual financial obligations}} = \frac{\text{net cash income from farming + off-farm employment income + unearned income}}{\text{estimated minimum consumption + estimated capital replacement costs + estimated loan principal payments}}$$

This ratio compares total household income with the financial obligations the household must meet to continue operating as a farm business and as a farm family Among farm households planning to continue farming, households with a ratio greater than or equal to 1 0 will be able to maintain their current (survey-year) operation Those with a ratio less than 1 0 will be unable to meet all their obligations without making adjustments [6]

For farm families intending to leave farming during the 5 years following the survey year ("farm exit households"), the viability ratio compares estimated total household income with the household's minimum consumption requirements These households are assumed to retire all outstanding debt by liquidating assets Thus, they are no longer obligated to make principal payments Because they are no longer farming, they also have no obligation to replace capital The viability ratio for farm exit

[3]The poverty level income criteria are based on the cost of a nutritionally adequate diet plus a proportional allowance for other consumption items, adjusted by family size Poverty level income represents a minimal level of consumption In 1983, for example, poverty level income was about $10,000 for a family of four At that level, the household could probably neither save nor invest in self improvement

[4]This condition is imposed because the net effect of a change in labor allocation or business organization is difficult to predict Households under financial stress will probably adjust the size or organization of the farm business These adjustments may also be accompanied by changes in the allocation of household labor, both among members and between farm and off-farm work Although these changes will probably alter net income, the magnitude of the changes cannot be estimated without additional information

[5]Components of the ratio are defined in the glossary

[6]Although these households may continue to operate in the short run by foregoing capital replacement, for example, they will not be able to survive in the long run under the year-of survey business and labor organization of the household

households relates the sum of estimated annual income from the value of net worth, estimated wage income, estimated Social Security benefits, and observed transfer payments to estimated minimum consumption, as follows

$$\frac{\text{annual household cash income}}{\text{annual household obligations}} = \frac{\text{estimated annual income from value of net worth + estimated wage income + estimated Social Security payments + transfer payments}}{\text{estimated minimum consumption}}$$

Farm exit households with a ratio greater than or equal to 1 0 will be able to satisfy minimum consumption requirements if they cease farming Those with a viability ratio of less than 1 0 will have difficulty meeting minimum consumption requirements if they cease farming under the current (survey year) business and labor organization of the household

Identifying Household Groups

Farm households differ in terms of the characteristics that determine their viability For the household surveyed, these characteristics include primary commodity produced, size of the farm operation, importance of farm and off-farm sources of income, and farm business objectives

To control for the effects of these attributes on variability in the viability ratio, we grouped sample households into mutually exclusive categories consisting of (a) farm households in which the operator is planning to leave farming (each survey area), (b) dairy farm households (Wisconsin area only), (c) households in which the operator farms part-time (each survey area), (d) households with a full-time operator and gross sales under $20,000 (each survey area), and (e) households with a full-time operator and gross sales of at least $20,000 (each survey area) [7] The logic of household selection is illustrated in figure 3

[7]Operators who worked at least 160 hours off-farm during the survey year are classified as "part-time " Those who worked fewer than 160 hours off-farm during the survey year are classified as "full-time "

Criteria for sorting sample households were developed so that within-group differences in human resource and farm business characteristics were minimized and between-group differences were maximized In the case of part-time farmers, for example, we tested several alternative definitions to create groups homogenous in terms of operator age and education as well as farm type We made similar tests in defining "smaller" and "larger" farms with full-time operators

Because agricultural production processes, human resource characteristics, and nonfarm labor markets differ between the two areas, we disaggregated data by survey region within each farm household group Differences in farm household characteristics between the survey regions also suggest that data from the two sites are better analyzed separately [8]

Profiles of Farm Household Groups

Table 1 shows selected human resource, farm business, and financial characteristics of the sample households by region and household group The data demonstrate observable differences among groups in the level and composition of these resources [9]

Dairy Farm Households

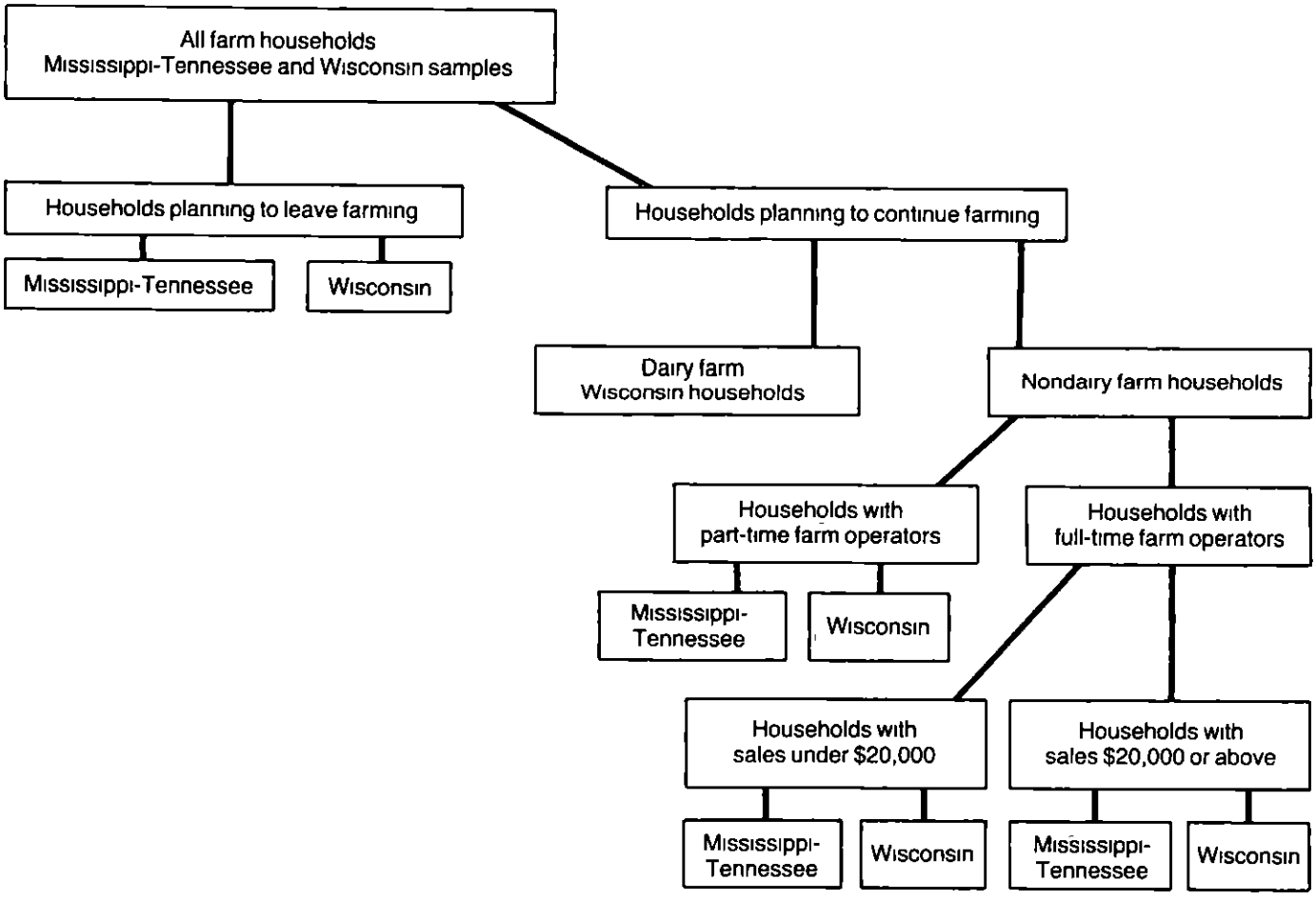
The average Wisconsin-area dairy farmer was 44 years old Dairy farms produced average gross sales of $84,916 in 1982, with 191 crop acres and 45 cows Farm families controlled an average of $368,991 in total assets and $273,061 in net worth Dairy farm households had an average debt-asset ratio of 0 26 They received 75 percent of their total income from the farm business and approximately 15 percent from off-farm employment Although these households reported an average total net income of $28,176, 47 percent had viability ratios under 1 0

[8]Differences among household types are documented in "Farm Viability Results of the USDA Family Farm Surveys," by Priscilla Salant, Melinda Smale, and William Saupe, U S Dept of Agr , Econ Res Serv , forthcoming

[9]Two-tailed difference-of-means tests were conducted at the 0 05 significance level In the text, stated differences reflect the results of two-tailed statistical tests Statements of relative magnitude do not reflect statistical tests because there was no *a priori* justification for one-tailed tests

Figure 3

Selection of Farm Household Groups



Households with Part-Time Operators

Part-time farmers were defined as operators who worked off-farm at least 4 weeks per year Financial and farm-size characteristics of part-time farmers were comparable between the two survey areas Households in the Wisconsin area had an average net worth of $166,174 by the survey year, with a mean debt-asset ratio of 0 18 Households in the Mississippi-Tennessee area had an average net worth of $145,718 and a mean debt-asset ratio of 0 13 Farms in both survey sites were relatively small in terms of sales and acreage

Although their high cash operating expenses contributed to negative net farm earnings, Wisconsin households received more off-farm employment and unearned income than those in the Mississippi-Tennessee area On average, households with part-time operators received total income of $27,495 in Wisconsin and $23,072 in the Mississippi-Tennessee area Over 80 percent of household income in both areas came from nonfarm sources Less than 20 percent of all households with part-time operators had viability ratios under 1 0

Table 1—Selected characteristics of nine farm household groups, 8-county Wisconsin area and 29-county Mississippi-Tennessee area

Item[1]	Unit	Dairy farmers	Part-time farmers		Full-time farmers				Farm exit	
					Sales under $20,000		Sales $20,000 or above			
		Wisconsin	Wisconsin	Mississippi Tennessee	Wisconsin	Mississippi-Tennessee	Wisconsin	Mississippi Tennessee	Wisconsin	Mississippi Tennessee
Farm households represented	Number	6,850	1,665	5,115	715	2,130	835	2,155	2,175	1,680
Sample households	do	296	72	445	31	212	36	202	94	167
Human resource										
Operator, age	Year	44 1	50 1*	47 3*	64 7	62 5	47 3	46 8	60 1*	63 2*
School completed	do	11 6	12 3	11 6	9 7	8 7	11 5	11 7	9 9*	9 1*
Farming experience	do	17 6	17 9	17 7	35 1	30 3	19 7	20 5	30 6	32 0
Spouse, age	do	40 7	46 4	44 4	58 6	59 5	45 1	44 6	56 0*	58 9*
School completed	do	12 2	12 7*	11 7*	11 0*	9 9*	11 8	12 3	11 7*	10 5*
Farm business										
Gross sales	Dollar	84,916	17,406	12,962	6,206	5,701	114,187	128,272	38,384*	10,431*
Cash operating expenses	do	58,561	18,215*	9,359*	6,621	4,987	91,515	78,338	25,779*	7,712*
Milk sales per cow	do.	1,479	—	—	—	—	—	—	—	—
Crop acres	Number	191	87	102	62	60	347*	690*	118	85
Dairy cows	do	45	—	—	—	—	—	—	—	—
Financial resources										
Total assets	Dollar	368,991	201,773	167,615	214,301*	146,018*	565,354	502,572	274,511*	179,766*
Total debts	do	95,930	35,599	21,897	5,134	8,121	129,560*	75,957*	33,784*	5,854*
Net worth	do	273,061	166,174	145,718	209,167*	137,897*	435,794	426,615	240,727*	173,912*
Debt/asset	Ratio	26	18	13	02	06	23	15	12*	03*
Income source										
Net cash farm operating	Dollar	20,808	-35*	3,713*	-99	872	21,715*	45,152*	12,029*	2,578*
Off-farm employment	do	4,154	24,262*	18,446*	4,171	2,870	2,765	4,162	6,017	4,352
Unearned	do	3,214	3,268*	913*	10,794*	4,544*	7,837*	1,935*	7,037*	4,411*
Total household income	do	28,176	27,495	23,072	14,866*	8,286*	32,317*	48,249*	25,083*	11,341*
Viability ratio										
Ratio under 1 00	Percent	47	18	17	32	54	42	45	3	9

*Values for which null hypothesis that Mississippi Tennessee and Wisconsin means are equal has been rejected by use of a two-tailed t-test with significance level of 0 05

— = Not applicable

[1]Variables defined in glossary

Households with Full-Time Operators and Smaller Farms (Sales under $20,000)

In both survey areas, operators of smaller farms and their spouses were close to retirement age and had less than a high school education Many of these older operators were debt-free, the average debt-asset ratio was 0 02 in Wisconsin and 0 06 in Mississippi-Tennessee

Farm size, measured by gross sales and crop acreage, was comparable in the two survey areas Households generated an average of about $6,000 in gross sales on slightly over 60 crop acres The average value of assets and net worth were higher for Wisconsin households

Unearned income represented 73 percent of total household income in Wisconsin and 55 percent in Mississippi-Tennessee Thirty two percent of smaller full-time farms in Wisconsin had viability ratios under 1 0, compared with 54 percent in Mississippi-Tennessee

Households with Full-Time Operators and Larger Farms (Sales of $20,000 or Above)

In each survey area, full-time operators of larger farms averaged 47 years of age, had a high school education, and 20 years of operating experience These farmers averaged gross sales of $114,187 in Wisconsin and $128;272 in the Mississippi-Tennessee site On average, Wisconsin operators generated comparable gross sales with fewer crop acres

Average total assets and net worth were statistically equivalent for larger full-time farmers in the two sites The average debt level was higher among households in Wisconsin than among those in Mississippi-Tennessee

On average, higher debt levels on Wisconsin operations may have contributed to lower net cash income from farming Wisconsin households received a higher absolute level and a greater proportion of their income from unearned sources Although average household income was higher in the Mississippi-Tennessee survey area, the percentage of households with viability ratios under 1 0 is similar for the two regions (45 percent in Mississippi-Tennessee and 42 percent in Wisconsin)

Farm Exit Households

Operators planning to leave farming were close to retirement age, and they averaged over 30 years of farming experience Farm size measured in terms of both sales and assets averaged larger in Wisconsin than in the Mississippi-Tennessee area Wisconsin farmers averaged gross sales of $38,384 in 1982 Mississippi-Tennessee farmers averaged sales of $10,431 in 1980

Households in the Wisconsin area reported average assets of $274,511 and equity of $240,727, compared with assets of $179,766 and equity of $173,912 among households in the Mississippi-Tennessee area As a group, Wisconsin households had a greater debt burden, with an average debt-asset ratio of 0 12 Farm exit households in the Mississippi-Tennessee site had an average debt-asset ratio of only 0 03

Despite their higher operating expenses and debt levels, households in Wisconsin generated over four times the net cash farm income from farming of those in the Mississippi-Tennessee area The average level of unearned income was also higher among Wisconsin households Households in Wisconsin received 48 percent of their total income from farming In contrast, net cash income from farming represented only 23 percent of total income for households in the Mississippi-Tennessee area Three percent of farm exit households in Wisconsin and 9 percent of those in the Mississippi-Tennessee area had viability ratios under 1 0

Regression Model

The data presented in table 1 reveal differences in the level and composition of resources among farm household types and regions Some of these human, farm business, and financial resource characteristics are hypothesized to be associated with household viability To examine the relationship of household characteristics to viability, we analyzed farm households by group through regression analysis

Farm Business Variables

Farm size can be represented by a variety of physical and financial measures Gross sales of agricultural products, a conventional measure of size, reflects the physical volume of farm output weighted by product price Crop acreage is a measure of size for many enterprises based on crop production The value of household assets represents the quantity of real estate, livestock, machinery, and other assets, weighted by their market prices To express several size measures in a compact form, we used gross sales, crop acres, and total assets variables to construct a standardized size index for each household group [10]

The net effect of these farm size factors on household viability may be either positive or negative for dairy, part-time, or full-time operations Although a higher value of assets improves the farm household's potential for obtaining operating and farm investment loans, many families who chose to expand

[10]We constructed a standardized size index through principal components analysis for each household group This index is a factor score with a unique value for each household in the group The factor score is a weighted sum of the household's gross sales, crop acres, and total assets

their operations through debt-financing now encounter financial problems For farm exit households, whose future flow of earnings has been estimated from the value of net worth, off-farm employment, and transfer income, greater farm size is expected to bear a strong and positive relationship to household viability

We also hypothesized that farm business efficiency (output per unit of input) is positively associated with viability However, the survey data usually did not permit construction of tenable efficiency measures because of heterogeneous product types In the case of Wisconsin dairy farmers, who share a homogenous product and similar input mix, we included a proxy in the analysis The proxy, an index of gross sales per dollar of purchased input, measures how effectively the farmer converted physical units of inputs (weighted by price and aggregated) into physical units of product (similarly weighted and aggregated) The following analysis terms this variable "farm productivity "[11]

Financial Resource Variables

The financial structure of the household affects current income through debt-servicing requirements If income is held constant, households with a high debt burden in relation to assets must use more of their current income to meet interest and principal payments, leaving less income for consumption needs and capital replacement. Farm families with a high debt-asset ratio and poor repayment history may be refused financing by credit institutions In the short run, these families can meet principal payments by reducing living expenses or foregoing capital replacement They may be obliged to liquidate productive assets in the long run. The debt-asset ratio for any household type is a measure of financial structure and of credit risk and is expected to relate negatively to viability

Human Resource Variables

We also hypothesized that human resources are associated with household viability Empirical measures of these resources include years of farming experience and formal education of the operator, hours of nonoperator (that is, spouse or other adult) labor devoted to farm activities, whether or not nonoperators worked off the farm, and number of children in the household under age 16 [12]

"Years of farm-operating experience" expresses the effects of additional farming expertise gained during the early, human capital investment years of the farm operation. At a lower level of experience, associated with younger operator age, the effect of additional skills and expertise on viability is hypothesized to be positive and of relatively large magnitude Over time, an additional year of farming experience contributes less to farming expertise At the same time, debts accumulated during the earlier phases of operation are gradually retired, reducing debt-servicing requirements. The effects of these factors in farming experience should relate quadratically to household viability

The number of children under age 16 may be associated with greater consumption needs and lower off-farm earnings while families attend to child-rearing and home production During the child-rearing years, adult family labor is allocated to home production activities that are not measured in either farm or off-farm income The number of younger children should be negatively related to viability

Operator education should affect household viability positively to the extent that it increases labor productivity To the extent that education, first, has a greater effect on returns to nonfarm labor than to farm labor and, second, acts as an "entry card" to certain nonfarm jobs, we may expect to see the strongest relationship in the case of part-time farmers

The spouse of the farm operator and other adult household members can contribute to household income through farm or off-farm activities These factors are measured by hours of nonoperator onfarm labor and by a binary variable indicating whether or not nonoperator household members worked off-farm during the survey year Higher levels of either

[11]To avoid estimation problems resulting from correlation between dependent and independent variables, we used an index of relative efficiency in place of "sales per dollar of purchased input "

[12]Although use of a continuous variable representing hours of off-farm work would have been conceptually preferable, we chose a binary variable to avoid estimation problems

farm or off-farm commitment should be associated with greater household viability

Specification

The regression model is specified as

$$Y = \beta_o + \sum_{i=1}^{9} \beta_i X_i + \epsilon$$

where

- Y = Viability ratio,
- X_1 = Size index,
- X_2 = Debt-asset ratio,
- X_3 = Farm productivity (dairy farms only),
- X_4 = Years of operator education,
- X_5 = Years of operator farming experience,
- X_6 = $(X_5)^2$,
- X_7 = Nonoperator off-farm labor (1 = yes, 0 = no off-farm work),
- X_8 = Hours of nonoperator onfarm labor, and
- X_9 = Number of children under age 16

The viability ratio compares total earnings with total financial obligations for each household Differences in the variables X_1-X_9 should relate significantly to observed variation in the viability ratio We applied the regression model separately to households in each group, assuming that the relationship of household characteristics to the viability ratio differs by group

Wisconsin Area Results

Table 2 shows regression results for households in the Wisconsin area Household groups include dairy farm households, households with part-time operators, households with full-time operators and smaller farms (sales under $20,000), households with full-time operators and larger farms (sales above $20,000), and households planning to leave farming

Dairy Farm Households

Among dairy farm households, variation in the debt-asset ratio, farm productivity, operator education, years of operating experience, the decision to work off-farm by the spouse or other household members, and the number of young children are associated with variation in the viability ratio The average dairy farmer in the Wisconsin site is young in relation to operators of other household groups and has a high school education and 17 years of experience (table 1) For these operators, regression results suggest that additional years of education are related to greater household viability Although the effect of onfarm employment of the spouse and other household members is not significant, off-farm work is associated positively with household viability As expected, higher debt-asset levels are associated with lower viability Variation in the farm size index is not significantly related to viability For these farm families, who receive 75 percent of their total income from net farm earnings (table 1), greater farm productivity contributes positively to household viability

Among dairy farmers, regression results indicate that the viability ratio is negatively related to operating experience through 19 5 years and is positively related after 19 5 years [13] This relationship may reflect the combined effects of accumulated technical expertise and gradual retirement of farm debts, but it may be dominated by the financially difficult circumstances of younger farm entrants with large debt loads in relation to their farm income The life-cycle of the farm family, measured as the number of children under age 16, is negatively associated with viability During the child-rearing phase of the family life cycle, relatively more of the total adult effort is used for home production and less for off-farm work or farm production

Households with Part-Time Operators

Households in this group received 88 percent of their total income from off farm earnings (table 1) Among these households, the debt-asset ratio, farm size, and operator education are significantly associated with the level of the viability ratio A higher debt-asset ratio influences viability negatively Additional operator education, which enhances employment opportunities, is associated with greater household viability Larger farm size, which may constrain the ability to allocate labor off-farm, is associated with lower household viability The data

[13] The first partial derivative of the function is zero at 19 5 years of operator experience

Table 2—Farm household viability, by household group, 8-county Wisconsin area

Explanatory variable[1]	Coefficients[2]				
	Dairy	Part-time	Full-time		Exit
			Smaller	Larger	
Constant	0 689** (369)	0 595 (694)	3 245** (1 647)	1 257 (2 332)	3 850*** (1 272)
Size index	042 (049)	- 195** (116)	- 385* (129)	081 (309)	1 400*** (203)
Debt-to-asset	-2 446*** (235)	-1 398** (740)	629 (1 696)	-3 038** (1 583)	-4 727*** (1 429)
Farm productivity[3]	1 633*** (164)	— —	— —	— —	— —
Operator education	057*** (024)	088*** (040)	091 (098)	030 (139)	119* (080)
Operator experience	- 039*** (016)	041 (032)	- 121** (068)	- 006 (089)	- 012 (044)
(Operator experience) squared	001*** (0004)	- 001* (0006)	001 (001)	001 (001)	00005 (0007)
Nonoperator off-farm employment	169** (096)	321 (232)	232 (466)	1 107** (625)	092 (387)
Nonoperator onfarm labor	00002 (00002)	- 00005 (00007)	- 0003 (0003)	- 0001 (0001)	— —
Number of children under 16 years	- 108*** (034)	- 082 (086)	-1 049** (589)	- 056 (207)	- 133 (241)
Number of observations	296	72	31	36	94
F	36 5	3 42	1 79	1 78	10 53
R^2	52	21	17	15	42

— = Not applicable
[1]Dependent variable is the viability ratio
[2]Ordinary least squares estimates with standard errors in parentheses Significance levels 0 05***, 0 10**, and 0 15*
[3]Measured for dairy farms only Other groups were heterogeneous in terms of products and technology

do not support the hypotheses that operator experience and nonoperator employment variables, as specified, are associated with viability

Households with Full-Time Operators and Smaller Farms

Operators in this group were essentially debt free and near retirement age (table 1) The F-test for the group indicates that the joint effect of explanatory variables on the viability ratio is not significantly different from zero Larger farm business size is associated with lower viability, suggesting that these smaller scale farm enterprises may suffer from production inefficiencies All but two of the sample households in this group were debt-free, and differences in viability are not related to the debt-asset ratio As in the case of dairy farmers, the number of children under age 16 is negatively associated with viability

Households with Full-Time Operators and Larger Farms

Financial structure and nonoperator off-farm employment are associated with household viability among this group of households The negative effect of the debt-asset ratio expresses financial obligations for both interest expenses and regular payments to retire debt The positive effect of off-farm work by nonoperator adults indicates that even on larger farms, allocation of family labor to off-farm work can enhance viability The separate effects of farm business size and other human resource variables, as specified, are not significant

Farm Exit Households

The viability ratio for farm exit households expresses post-exit circumstances Therefore, variables measuring farm productivity and onfarm labor hours of other adults in the family are not applicable to the analysis In the Wisconsin area, the size of the farm operation has a large, positive effect on the viability of households planning to leave farming, and a higher debt-asset ratio has a large, negative effect These results reflect the importance of net worth in determining the estimated future flow of income for exit farmers With an average net worth of $240,000 and a mean age of 60 (table 1), this group is more representative of retiring farmers than of operators leaving the farm under financial duress The positive effect of operator education may reflect the nonfarm employment alternatives available to the younger members of this exit group

Mississippi-Tennessee Area Results

Table 3 shows regression results for households in the 29-county area of Mississippi-Tennessee Household groups for this survey area include households with part-time operators, households with full-time operators and smaller farms (sales under $20,000), households with full-time operators and larger farms (sales of $20,000 or above), and households planning to leave farming

Households with Part-Time Operators

The debt-asset ratio is negatively associated with viability among households in this group, as is the number of children under age 16 Higher levels of operator education positively influence viability, as does the presence of a nonoperator working off-farm Similar effects of the debt-asset ratio and operator education were observed among households with part-time operators in the Wisconsin area Years of experience as a farm operator is positively related to viability through about 15 years and negatively related after 15 years This result may express the effect of advancing age (a correlated variable) on off-farm employment and wage rates

Households with Full-Time Operators and Smaller Farms

As in Wisconsin, the F-test for this group indicates that the joint effect of the explanatory variables on viability is not significantly different from zero Among the individual variables, only the debt-asset ratio (negatively related) and off-farm work by nonoperator adults (positively associated) are significant Given the relatively low average income level among this group, it appears that nonfarm earnings by nonoperators are a key factor in enhancing viability

Households with Full-Time Operators and Larger Farms

Among households in this group, only differences in farm size and the debt-asset ratio are associated with variation in household viability If other factors are held constant, larger operations tend to have higher viability ratios, whereas households with higher debt-asset ratios tend to have lower ratios Thus, the farm business appears to be the most important factor affecting viability Changes in human resource factors, as specified, are not associated with variation in household viability

Farm Exit Households

The viability of Mississippi-Tennessee households planning to leave farming is related to farm size, the debt-asset ratio, operator education, and nonoperator off-farm employment (Similar relations between the explanatory variables and viability were observed in the Wisconsin area, except in the case of nonoperator off-farm employment) The greater the size of operation (that is, the more assets available to generate a flow of asset income), the more viable the farm exit household will be Conversely,

Table 3—Farm household viability, by household group, 29-county Mississippi-Tennessee area

Explanatory variable[1]	Coefficients[2]			
	Part-time	Full-time		Exit
		Smaller	Larger	
Constant	1 313*** (299)	0 933*** (319)	1 420** (879)	1 412 (1 089)
Size index	- 072 (062)	- 113 (082)	421*** (150)	1 450*** (230)
Debt-to-asset	-1 872*** (346)	- 767** (469)	-3 499*** (634)	-3 412*** (1 262)
Operator education	085*** (018)	012 (021)	056 (056)	308*** (062)
Operator experience	018 (016)	- 006 (017)	017 (037)	036 (059)
(Operator experience) squared	- 0006** (0003)	0002 (0002)	- 00004 (0007)	0008 (0009)
Nonoperator off-farm employment	- 573*** (120)	299** (181)	125 (306)	1 018** (526)
Nonoperator onfarm labor	- 0001 (00009)	- 00004 (0001)	- 00002 (0001)	— —
Number of children under 16 years	- 314*** (049)	- 057 (080)	091 (135)	- 243 (371)
Number of observations	445	212	202	167
F	18 32	1 46	5 76	12 99
R^2	24	02	16	34

— = Not applicable
[1]Dependent variable is the viability ratio
[2]Ordinary least squares estimates with standard errors in parentheses Significance levels 0 05***, 0 10**, and 0 15*

the higher the debt-asset ratio, the less viable the household will be Higher levels of operator education (which express enhanced off-farm employment alternatives), as well as off-farm employment by nonoperator household members, influence viability positively Both relationships suggest that the ability to earn nonfarm income will improve the viability of households exiting from agriculture

Implications

The regression results are generally consistent with hypothesized relationships for all groups except households with full-time operators and smaller farms in both study sites The latter group and households planning to leave farming represent special cases

Smaller, full-time farmers in each survey area worked off-farm less than the equivalent of 4 weeks during the survey year and planned to continue farming over the next 5 years On average, they grossed only about $6,000 in farm product sales The typical operator was near retirement age (63-65 years old), free of debt, and received the largest proportion of total income from transfers, rents, interest, and other unearned sources Attributes other than those included in the model presented here may be associated with viability The inadequacy of the model in explaining variation among these families underscores their uniqueness

Thirty-two percent of the smaller, full-time farm households in Wisconsin and 54 percent of these households in the Mississippi-Tennessee site had viability ratios under 1 0, or an annual income insufficient to cover farm and personal financial obligations during the survey year These farm families would benefit from programs designed to help them close unprofitable farm businesses and convert farm assets into a dependable flow of retirement income Some of these families may need information about their eligibility for Social Security, Supplemental Security Income, and Medicare/ Medicaid programs

Changes in the capital gains aspects of tax policies and the development of institutions to facilitate the conversion of farm assets into a retirement income flow would improve their financial prospects Such changes would also enhance the financial position of families planning to leave farming In contrast to the smaller full-time farmers, only 6 percent of the farm exit households in the combined survey areas had viability ratios under 1 0 This percentage was higher in the Mississippi-Tennessee survey area, where both average unearned income and net worth are lower Operators in these households also were older and less educated For farm exit households, the results indicate that greater viability is associated with larger farm size, more farm assets, a lower debt-asset ratio, and off-farm employment by the spouse and other household members

Other household groups planning to continue farming include Wisconsin dairy farmers, part-time farmers, and larger full-time farmers in both survey areas Among these groups, the proportion of house holds with viability ratios under 1 0 is lowest for the part time farmers (17 percent) in both survey areas Almost 50 percent of dairy farmers have via bility ratios less than 1 0 Among the full-time operators in both survey areas, slightly over 40 percent have ratios under 1 0 To continue operating the farm household under the year-of-survey organization, these families must either reschedule debts, forego capital replacement, or consume below the minimum level used in this analysis Over the long run, farm-level adjustments will be necessary to sustain their operations

Regression results provide evidence that the factors related to viability differ by farm household group

Farm size, measured by an index of gross sales, crop acreage, and the value of total assets, is associated positively with viability only for larger full-time farms in the Mississippi-Tennessee area and for farm exit households in both regions The positive relationship of size to viability for farm exit households is explained by the importance of asset values in determining income flows after leaving farming Among households planning to continue farming, results of the analysis suggest that farm growth strategies benefit only larger operations and only under particular conditions For other groups in the sample, gains in returns from expansion may be offset by debt-servicing requirements or production inefficiencies Greater farm size is associated with lower household viability among smaller full-time farmers and part-time farmers in the Wisconsin survey area

A higher debt-asset ratio implies that a larger proportion of the annual income must be used to meet interest payments and payments toward loan retirement The debt-asset ratio, a measure of the credit risk and financial structure of the farm household, is associated negatively with household viability for all household groups except the smaller full-time operations in Wisconsin In that group, 29 of the 31 sample farms were debt free, and their debt-asset ratio was zero Public initiatives to reduce interest rates, to guarantee farm loans, or to provide incentives for forgiving loans will affect the survival pro spects for both full-time and part-time farmers during the adjustment to new product prices and interest rates The effect on viability of a higher debt-asset ratio is greatest for larger full-time operations

Years of operator education is associated positively with household viability among dairy farmers, part-time farmers, and exit farmers in both survey regions Formal education affects household income by improving off-farm wage-earning potential For part-time and exit farmers, a higher rate of off-farm earnings contributes both to current wage income and to the level of Social Security benefits available on retirement

The positive and significant relationship between operator education and the viability ratio among dairy farmers may not express off-farm wage-earning capacity Dairy farmers tend to work off-farm fewer hours than operators of other farm

types, and education may contribute instead to the operator's farm management skills However, this effect was not observable in the analysis of smaller and larger full-time farmers in either survey area

Regression results support the hypothesis that, for dairy farmers, years of experience are related quadratically to household viability Through 19 5 years of experience, an additional experience is related to lower viability After 19 5 years of operation, additional experience is related to higher viability levels This relationship may reflect the counteractive effects of cumulative farming expertise and the financial conditions at the time the farm business was established Although relatively high interest and principal payments on debt are characteristic of the early farming years, the regression coefficient for this variable may reflect particular historical circumstances Operators entering the dairy business in more recent years were confronted with greater initial capital outlays that may have required costly debt-financing

For five household groups, off-farm work by nonoperator household members is associated with greater viability, whereas an additional hour worked onfarm has no observable effect with any household group Nonoperator off-farm employment is associated positively with household viability for each of the five groups, except part-time farmers in the Mississippi-Tennessee area The magnitude of the effect varies greatly among the groups Nonoperator onfarm hours, however, are not associated positively with household viability for any of the sample groups In recent years, increasing numbers of farm families have chosen to increase their off-farm labor commitment These results imply that more farm families may benefit from re-evaluating their present allocation of farm and nonfarm labor

This study expresses the life-cycle stage of the farm family by the number of children under age 16 in the household This variable reflects the obligation of adult family members to home production, as opposed to farm production or off-farm employment opportunities The value of home production has not been measured in the viability ratio The relationship of the life-cycle stage to farm household viability is significant for three of the household groups Where significant, the effect of additional children under age 16 is negative, as expected

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Appendix: Glossary

Crop acres include all land in crops, orchards, vineyards, nursery and greenhouse products, cropland diverted under Federal program guidelines, and acres used for pasture or grazing that are suitable for crops without improvements

Debt-to-asset is the ratio of total farm and personal debts to total farm and personal assets, as of January 1 of the survey year

Estimated annual income from value of net worth is the yearly amount of income a household planning to leave farming can expect to realize from the disposition of farm assets Farm exit households with nonland assets sufficient to cover all debts are assumed to either rent the farm or sell the farm on land contract, depending on the option they specified in the interview In addition to income from the sale or rental of their land, these households are expected to receive a 10-percent return on investment of their nonland assets

Rental income is calculated at 6 percent of the market value of land assets Income from land contracts is based on a 20-year agreement with equal annual

principal payments and 10-percent annual interest on the unpaid balance We used Federal and State tax tables to estimate the after-tax income from land contract sales

We assumed that households with debts exceeding the value of their nonland assets would liquidate the farm To determine the net amount of money available for investment after liquidation, we subtracted both the value of all debts and the capital gains tax liability for the value of assets Estimated annual income for households liquidating the farm is equal to 10 percent of after-tax earnings from the sale of the farm plus 10 percent of the value of remaining assets

Estimated capital replacement costs were calculated at 10 percent of the value of all farm machinery, trucks, and cars

Estimated minimum consumption is equal to the poverty threshold income level for the household, by household size and age of household head, as developed by the Bureau of the Census For the purposes of this analysis, the household includes all individuals residing together at the time of the survey

Estimated principal payments were calculated on the basis of the type of collateral under which individual loans were secured Loans secured by real estate were assumed to have 20-year payback periods Three-year payback periods were assumed for loans secured by personal property, and those secured by crop liens were assumed to have a 1-year payback period If loans were not secured, the length of payback period was assigned according to the purpose of the loan 20 years for real estate purchases, 3 years for production input purchases, and 2 years for household-related purchases Annual payments were assumed constant over the life of the loan

Estimated Social Security income was calculated for households in which either the spouse or the operator reached age 61 or over during the survey year For persons at least 61 years of age at the time of the interview, the estimated Social Security payments were equal to their observed value For persons who did not report benefits, we calculated estimates using Social Security Administration guidelines

Estimated wage income was calculated on the basis of the age and off-farm employment experience of each household member Persons over 64 years of age in the survey year were assumed to retire from off-farm work Individuals between the ages of 50 and 64 were assumed to maintain the survey year level of off-farm work Those under 50 years of age were assumed to begin working full-time off-farm when they left farming, whether or not they had worked off-farm in the past For individuals who reported off-farm work in the survey year, the estimated wage rate was equal to the observed wage rate For those who did not report off-farm work, the estimated wage income was equal to full-time earnings at the minimum wage rate

Gross sales include all cash marketings of crops and livestock during the calendar year

Cash income from farming is equal to the sum of gross sales plus farm-related income less cash operating expenses Farm-related income includes receipts from custom work on other farms, gas tax refunds, patronage refunds, and Government grain storage programs

Nonfarm earned income includes all household income from wage employment and net household income from self-employment in occupations unrelated to farming

Nonoperator onfarm labor is equal to the annual hours of onfarm work by household members, excluding the farm operator

Nonoperator off-farm labor is equal to the annual hours of work off-farm in nonfarm-related occupations by household members, excluding the farm operator In the analyses, a dummy variable was used that was set equal to 1 if this variable was greater than zero, and to zero otherwise

Off-farm employment income is equal to household income from wage and salary employment plus net income from nonfarm self-employment

Other income includes public transfer payments, Social Security and private retirement income, rent, interest, and dividends

Operator education is equal to the years of formal education of the farm operator

Operator experience is equal to the operator's years of experience operating the survey farm or other farms

Total household income is equal to the sum of cash income from farming plus off-farm employment income plus other income

Transfer payments include pension and retirement income other than Social Security benefits, welfare and other public assistance, and unemployment insurance

In Earlier Issues

Fingers were the first digital computers The only really new thing about an electronic calculator is its fantastic speed It does simple arithmetic literally at lightning speed This places a premium on the development of such formal techniques as linear programming, input-output analysis, and the theory of games These are high-powered analytical vehicles capable of using the speed

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