Determinants of Farm Size and Structure

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FIRM LEVEL AGRICULTURAL DATA COLLECTED AND MANAGED BY THE FEDERAL GOVERNMENT

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The demand for data is derived from the conceptual framework and methodology selected for use in the analysis of a specific research problem. The supply of readily accessible data often does not coincide with derived data needs. The incongruity between data needs and availability exists for a variety of reasons, including the changing nature of policy issues and research problems and the reasons for data collection efforts. At the federal level most firm level agricultural data are collected to support programmatic or legislative functions. I am unaware of data collected within the Federal establishment with the sole purpose of supporting research activities. Exceptions may include data collected by cooperators in research agreements and the Census of Agriculture. The Census is a special case since it exists to fill informational voids, particularly those that exist for smaller geographic areas such as counties.

The incongruous nature of data needs and availability may require that research objectives be altered, necessary data be collected, or less than ideal data be used in analysis. Information about the scope and coverage of firm level data existing within the agricultural economic research community may lessen the need for primary data collections or project adjustments, particularly if data sharing is feasible. The focus of this paper is on firm level agricultural data collected and managed by the Federal Government. Specific attention is given to data that may be useful in analyses related to the structure of agriculture and to the measurement of costs, returns, and efficiencies of farm firms.

Data Used in Analyses of Farm Structure, Costs, and Returns

To identify data useful (or at least used) in analyses related to farm structure, changes in structural attributes over time, and the measurement of costs, returns, and efficiencies related to farm production, a review of selected journal articles, U.S. Department of Agriculture and other reports was undertaken. The term structure, as applied to agriculture, has been defined in a variety of ways. Former Secretary of Agriculture Bergland defined structure as, "how farming is organized, who controls it, and where it is heading" (3). Sundquist in a similar statement took structure to mean..."essentially the number, size, and decision making control that prevails for firms engaged in the production and marketing phases of our natural food and fiber industry" (18). A number of other definitions incorporating a greater or lesser degree of specificity exist in the literature. For example, Stanton has noted that most discussion of farm structure issues revolves around..."(1) the number and size distributions of farms, (2) the

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ownership and control of farm land and production decisions, (3) tenure patterns and business arrangements for farming, (4) the control of markets in which farmers buy production inputs and sell their products, and (5) the financial systems and credit arrangements available to producers and farm operators" (17).

Both Babb and Brinkman and Worley have extended the discussion of farm sector structure to include a consideration of causal factors and sector performance measures. Babb identified dimensions of farm structure to include, (1) the number and size distributions of farms by commodity, type of farm and geographic region, (2) degree of specialization in production and organization of the firm, (3) ownership and control of productive resources, (4) barriers to entry and exit, and (5) socioeconomic characteristics of farm operators and resource owners (1). Brinkman and Worley extended Babb's listing of structural attributes to include discussion of financial structure, market information and control, ideological conformity and relation to rural community (4). Babb's listing of factors affecting structure and his judgment of the relative importance of how a factor may affect a specific dimension of structure is given in table 1. Brinkman and Worley's discussion of structural attributes and causative factors is similar to Babb's, except they provided a discussion of and noted trade-offs that exist among performance variables . For example, they noted how increasing farm size and enterprise specialization may be consistent with increased efficiency of resource use, but be incompatible with resilience to market instability, the vitality of rural communities, or resource conservation.

Since the focus of this paper is on identifying farm level data sources useful in analyses of farm structure issues, whether the causal relationships among factors said to affect structure and the dimensions of structure portrayed in table 1 are accepted or rejected is not of primary importance. Of primary interest is what the hypothesized relationships suggest about the types of data needed to analyze structural adjustment issues.

One observation is that factors which influence changes in the structure of agriculture appear to be dynamic with regard to how a factor may affect a particular dimension of structure and with regard to how the factor itself may adjust. This indicates the need for two types of data for use in analyses of farm structure issues. The first category includes data that reflect the outcomes of adjustment. This category includes data that, for example, show how farm resources are organized and managed at a point in time; ownership and use of resources; the distribution of income and wealth among households which provide resources to farm firms; and the division of household resources among farm and non-farm activities. These data tend to be either repeated cross-sections or time series; they include both processed (aggregated) and micro firm level observations. The second category includes data that monitor on-going adjustments. These data reflect temporal linkages--past situation to current situation; and current situation to planned future course with regard to investment, production, consumption, saving, and other factors. Since these data address temporal issues, they would tend to include longitudinal and experimental microdata (data designed to reveal operator characteristics and attitudinal perspectives with regard to production processes and firm adjustment.

Table 1. Importance of factors affecting farm structure 1/

Factors affecting	Dimensions of structure				
	No. and size of farm	Special-ization	Owner-control	Entry barriers	Socio-economic
A. Variation in input prices	2	2	3	4	4
B. Technology	1	1	4	2	3
C. Economics of size	1	2	3	1	3
D. Variation in commodity prices	2	2	3	4	4
E. Risk and expectations	2	2	3	3	4
F. Price-cost margin	2	3	3	3	4
G. Exchange arrangements	3	3	1	2	3
H. Capital requirements	2	4	2	1	2
I. Taxes	3	4	2	2	2
J. Goals of the farmer	2	4	3	4	2
K. Managerial ability	2	2	3	3	3
L. Alternative opportunities	3	4	3	2	1
M. Macroeconomic policies 2/					

1/ The number of each combination of factors and dimensions of structure indicates the relative importance of the factor in influencing structure; 1 means great importance and 4 means little importance.

2/ These policies and their impacts are so diverse that no attempt was made to rank their importance.

Source: (1).

A large body of literature also treats the measurement of costs, returns, and efficiency relative to farm business attributes, particularly size of operation. Three basic methods have commonly been used to examine size cost relationships for farm businesses, including (1) the use of synthetic firms based on actual farm and engineering data, (2) descriptive analyses, and (3) quantitative analysis of farm (or industry) data. These approaches to the measurement of economies or diseconomies of size are given comprehensive review in Garcia and Sonka, and Hallam (7,9).

Synthetic farm models have been described as normative techniques that analyze cost-size relationships based on technological assumptions. Positive analytic analyses of size relationships have either utilized some type of classification or firm survivorship techniques, or have estimated production, cost or profit functions. Estimated production functions have been specified such that the level of output is a function of the level of inputs; cost functions such that costs are a function of output and input prices, and profit functions such that profit is a function of input prices and the level of fixed factors.

Budgets used in synthetic models have been constructed using some combination of observed firm data and technical (engineering) coefficients taken from performance trials

or test production practices (e.g., fuel consumption associated with a tractor of specific type and size powering a specific implement over some specified area). Other statistical or quantitative approaches have used both time series and cross-section data. Attributes of data used to undertake these wide-ranging studies have included observed data on (1) revenues and expenses (paired observations), by input and output component; (2) crop mix, level of output, crop disposition, and price received; (3) production practices, machine, labor, and other input use paired with input prices paid, and (4) firm characteristics (measures of size, tenure, investment, degree of specialization, and other firm and operator attributes).

Sources of Firm Level Data Collected and Managed at the Federal Level

Four sources of data related to farm business and enterprise production activities, structural attributes of farm operations, and socio-economic characteristics of farm operators are available at the Federal level. These include the Census of Agriculture, special follow-on surveys to the Census of Agriculture (e.g., farm finance or irrigation surveys), administrative records data (e.g., data from the Internal Revenue Service), and U.S. Department of Agriculture farm economic surveys (table 2).

A fifth source includes data collected (or assembled) by cooperators in research agreements, although these data may not be directly collected or managed at the Federal level.

Census Data Products

The Census provides considerable information about sources of farm cash earnings and expenses along with a wide variety of data useful in classifying farm businesses by primary type of commodity produced, sales volume, tenure, ownership, land use, and characteristics of the operator. The Census does not provide enough data, however, to develop a complete income or balance sheet statement. Nor does the Census attempt to sort out ownership of production or the sharing of revenues or expenses among participants in the farm operation. All items are allocated to the operation as a unit. One operator household is assumed to be associated with each farm operation.

Special or follow-on surveys to the current in-scope Census of Agriculture extend the types of data available to analyze characteristics of farm business operations as well as provide enhanced data on farm operator households (table 3). The 1979 Finance Follow-On Survey provided data on operator and landlord expense sharing for production as well as data on assets and liabilities held by operators and landlords. The follow-on to the 1987 Census of Agriculture (the Agricultural Economic and Land Ownership Survey) will provide data needed to develop an aggregated firm balance sheet and net cash operating income statement. In addition, this particular survey is designed to provide considerable detail on the characteristics of land ownership and the time frame in which land was either acquired or sold.

Both Census and Census follow-on survey data are available through print and electronic media. Raw survey data are processed (aggregated) to avoid disclosure and breech of rules that require confidentiality of respondent data. Tabulations published from the Census of Agriculture are generally organized to show both detailed U.S. and State level data accompanied by historical data and cross-tabulated by various farm classifications including tenure, type of organization, age and principal occupation of the operator, size of the farm as measured by acres operated and value of product sold, and type of farm as measured by standard industrial classification coding. Published tabulations from special surveys are organized to highlight specific data collected by the survey.

Table 2.

Firm Level Data Collected and Maintained at the Federal Level

Sources of Data	Population Covered	Coverage and Scope of Data	Data Access
Census of Agriculture	Farm firms with sales (or expected sales) of $1,000	aimed at universal coverage of operators of farm firms	- hard copy and electronic media
		no separation of ownership of production; sales, or expenses; data obtained on tenure; land use; crop mix; crop and livestock sales; CCC loans and payments; cash farm related income, major cash production expenses, and estimated market value of land and machinery (expenses, assets and farm-related income estimated from a 1 in 6 sample of the in-scope Census)	- customized cross-tabs may be purchased - is possible to obtain access to micro, firm level data by working through Census under a secure working agreement
		Incomplete income and balance sheet statements	- collection on a five year cycle

Table 2. Firm Level Data Collected and Maintained at the Federal Level--Continued

Sources of Data	Population Covered	Coverage and Scope of Data	Data Access
Census Follow-on or Special Surveys (Agricultural Economics and Land Ownership Survey, AELOS)	Same as Census	list sample of in-scope Census operations (45,000) and landlords reported by operators (40,000);	- access same as for Census
		collection of data on land operated, land use, operating expenses and capital expenditures, value of products sold, debts and assets of firm land ownership and acquisition aggregated firm balance sheet and net cash operating income statements feasible; no separation of ownership on operator's report; landlords report operating expenses, debts and assets; land ownership and acquisition; matching of landlord and operator data incomplete; limited contractual information; no enterprise information	- collection usually follows Census
USDA Surveys (Farm Costs and Returns)	As of 1987, same definition as Census	List and area frame sample aimed at coverage of farm operations	- hard copy of data crosstabs
		separation of ownership of production, sales, and expenses among operators, landlords, and contractors; detailed listing of expenses by component, sales by major commodity or group, and other farm earnings by sources; disaggregated balance	- research, technical and statistical reports - on-site data access for approved research

Table 2. Firm Level Data Collected and Maintained at the Federal Level--Continued

Sources of Data	Population Covered	Coverage and Scope of Data	Data Access
		sheet, including term of loan; tenure, farm organization, land use and crop mix; detailed production practices and input application for major enterprises construction of cash and accrual based income statement; firm and household balance sheet; household labor allocation; farm and enterprise (budgets) cost and returns relationships	projects
Administrative Records (IRS)	Tax-filers	individuals that reported farm income or expenses	- hard copy data (Statistics of Income) but very limited data on farmers
		data items reported in the tax schedules	- public use data tape includes general tax information but not farm (only farm profit and loss)
		data for farm sole proprietors, excludes partnerships and corporations	- special tax samples on a very limited basis

Table 2. Firm Level Data Collected and Maintained at the Federal Level--Continued

Sources of Data	Population Covered	Coverage and Scope of Data	Data Access
Data Collected (assembled) by Cooperators in Research Agreements	Data dependent upon research objectives; ranges from participants in farm record/account systems to respondents to project specific surveys	Varies	- depends on how data are collected and local institution

Table 3.

Data Sources for other than Firm Level Agriculture Data

Sources of Data	Population Covered	Coverage and Scope of Data	Data Access
Census of Agriculture	Farm firms with sales (or expected sales) of $1,000	operators of farm firms characteristics of operators--residence, principal occupation, days of off-farm work, years of operation, age, sex, race	same as for firm level data
Census Follow-on or Special Surveys (AELOS)	Same as Census	data on households associated with a list sample of in-scope farm operations and reported landlords characteristics and occupation of landlord (residence, race, age, occupation (e.g., farming, private business, government, etc.) portion of business income from farming)	same as for firm level data

Table 3. Data Sources for other than Firm Level Agricultural Data--Continued

Sources of Data	Population Covered	Coverage and Scope of Data	Data Access
		operator household assets and liabilities; operator and spouse type of off-farm work, education, off-farm earnings by source, and size of household	
USDA (FCRS)	Same as Census	operators and operator households associated with farm operations operator household assets and liabilities (in conjunction with farm operation assets and liabilities); number of households, size of the operation household, percent of net farm income received by the operator household, education and off-farm work of operator and spouse, major occupation, off-farm earnings by source, hours of farm work, household consumption expenditures, operator opinions about daily operation, expansion or contraction of the business (data to be enumerated in March 1989)	same as for firm level data
Survey of and Program Partici-pation (SIPP)	Households in the civilian noninstitu-tionalized population	adults in households obtained from a stratified sample of the noninstitutional resident population of the United States (sample is large enough to facilitate metro, non-	quarterly Income reports public-use microdata files (designed to maintain confidentiality

Table 3. Data Sources for other than Firm Level Agricultural Data--Continued

Sources of Data	Population Covered	Coverage and Scope of Data	Data Access
		metro comparisons data for labor force participation, employment, sources of income, sources of assets, annual income and taxes, net worth, housing conditions, health and disability; data designed to provide cross-section as well as longitudinal view of respondents	
Current Population Survey	Civilian noninstitutional population: primary sampling unit is the housing unit	coverage includes data related to the demographic and employment characteristics of the rural population and persons living on farms data include household, demographic, employment and income variables	hard copy publications public use microdata file

Standard data products released from the Census of Agriculture or special Census surveys provide data that describe selected structural attributes of farm operations at a point in time. Since public releases tend to be designed to provide historic continuity, emerging data needs may not be adequately addressed by published data. Some of these more specific needs, such as for data on super size or highly specialized farming operations, can be met through the purchase of customized cross tabulations of data.

To more fully address some questions concerning the distributions of farm operations and corresponding characteristics of farm operators, access to micro-data files or individual farm records may be necessary. This access has been accomplished by Economic Research Service staff working with the Bureau of the Census. Peterson used the 1979 Follow-On Financial Survey to the 1978 Census of Agriculture to examine the financial position of specialized dairy farms by size of operation and age of the operator (15). Hatch accessed 1978 Census of Agriculture micro-data files to develop twenty typical farm descriptive data

sets (10). In Hatch's work, a computer routine was designed to perform sequential data sorts using farmer responses to the Census of Agriculture. Desired farm characteristics were determined by successively eliminating farms from the population of interest by means of user specified criteria. The system was designed to prevent disclosure of information by aggregating data among categories. Moreover, the computer routines were run by Census personnel on their computer system. Hatch received processed output; albeit output that met his specific research needs.

The Agriculture Division, Bureau of the Census, has also created a longitudinal data set from the control files of the three most recent Census' of Agriculture. The control files contain a limited number of variables providing information on tenure, acres, sales, type of organization, standard industrial code, and the age, sex and principal occupation of the operator. Edwards, Smith, and Peterson applied Markov analysis to the longitudinal data set for 1974-78 to evaluate changes in size by acres per farm during 1974-78 (5). Data sets such as the longitudinal file created by the Census hold promise for use in addressing structural issues that focus on the causes or process of adjustment rather than on the outcome of the adjustment process. For example, what are the factors that contribute to firm growth as opposed to what is the average size of farm operation. As formulated, the Census longitudinal data set contains a limited amount of structural attribute information. As the data set is enhanced, its use in understanding factors that contribute to firm adjustments may be expanded.

Census data have also been used to assess differences in costs and returns for farms in different economic size classes. The data do not, however, reflect all costs of production and refer to an average farm expense within each size class. There is no way of knowing the distribution of expenses among farms within the group--e.g., whether a particular expense or receipt is large because all farms have the item or because some farm has an unusually large amount of the item. Moreover, the data are for the entire farm operation. As near as one can come to a specific crop or livestock enterprise is to obtain special cross-tabulations that focus on the commodity of interest. Thus, while it is possible to compare the average cost-returns relationship among different sizes of farms using Census data, it is difficult to determine why costs vary. Obtaining customized cross-tabulations or access to the micro-data would help mitigate these difficulties.

Farm Costs and Returns Survey

The Economic Research Service is charged with the mandate to produce estimates of the costs of producing major crop and livestock commodities, net income of the farm sector (for inclusion into the National Income and Gross National Product data series published by the U.S. Department of Commerce), and the balance sheet of the farm sector. For costs of production, the mandate is legislatively determined. For the financial statistics the mandate is derived from memoranda of understanding among agencies of the executive branch of government. Being required to produce farm business production and financial statistics for use in developing national data series provides a basis for the collection of firm

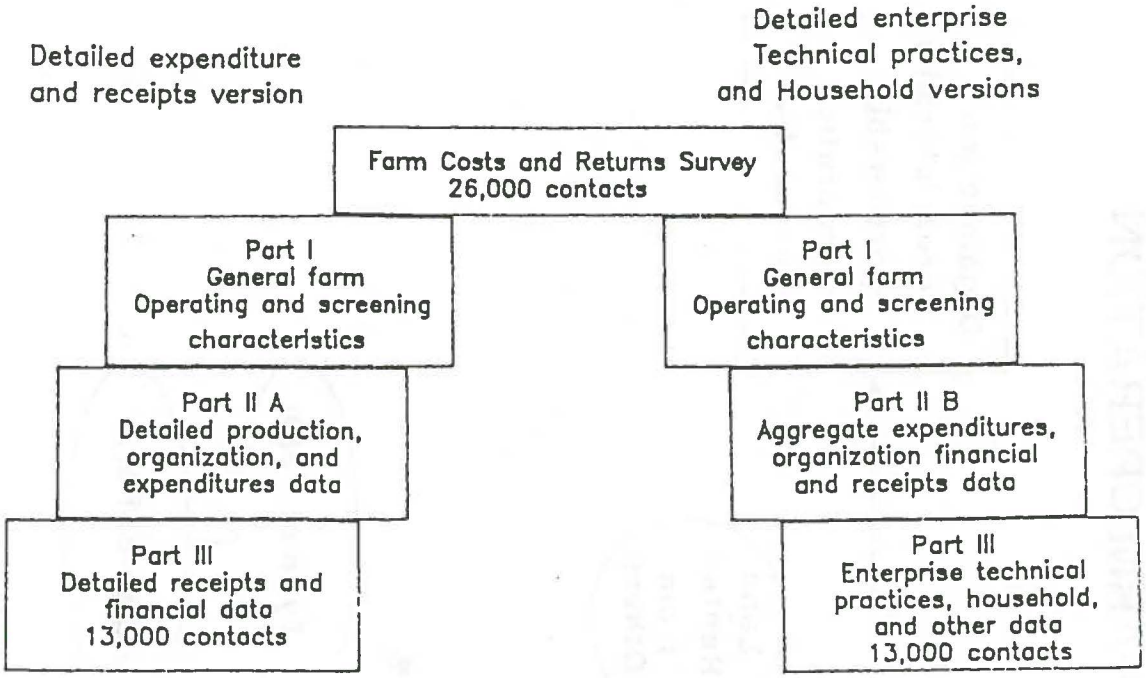
and enterprise level data. The Farm Costs and Returns Survey (FCRS) is the vehicle through which USDA collects these data (12).

The FCRS is a probability-based, nationwide survey of approximately 26,000 farm and ranch operators. Since the survey is designed to generate an expanded annual estimate of total expenses incurred in the production of farm commodities, all facets of agricultural production activities are represented in the sample design. This is accomplished by using a combined list and area frame sampling approach where the list is stratified by economic size and other attributes. For the area frame, all land area in the U.S. is divided into strata based on suspected land use. From these strata, sampling units of generally one to two square miles in size are selected for field enumeration. The area frame accounts for incompleteness in the list frame. The multiple frame sampling approach uses desirable attributes of both list (focused data collection from desired sub-populations of farm businesses/households) and area frames (coverage of changes that occur in the population of farms due to entry, exit, and other adjustments).

Both list and area frame samples are selected in replicates and designated for use with specific version of the FCRS questionnaire (figure 1). The expenditure version (depicted by the left side of the panel shown in figure 1) is designed to collect detailed data on farm operating characteristics, cost structure, business and household income structure, and the capital structure of the farm business. Expenditure version sample allocations are made to all list and area strata and are designed to maximize precision in the expansions for farm production expenditures (the estimates of total expenses by component from the FCRS underlie the Department's estimate of farm sector net income). The cost of production and other (e.g., farm operator household characteristics) versions of the FCRS questionnaires (depicted in the right hand side of the panel shown in figure 1) are designed to produce precise cost of production estimates for a specific commodity and representative coverage of other desired information.

As illustrated in figures 2-5, the FCRS is designed to provide data needed to analyze farm financial performance by type and size of operation and geographic location. In addition to this primary function, the survey also provides observed data useful in analyses of production technology and adjustment (competitive position of farms and enterprises, efficiency, and distributions of production by cost structure and economic characteristics), farm organization and finance (number, size, and operating and financial structure), and the well-being of farm-related households (income and wealth level and composition, capital formation, farm production and labor allocation). Thus, the FCRS is an annual source of firm level data for many of the structural attributes identified by Babb and Brinkman and Worley (e.g., number, size, type, ownership, tenure, specialization, concentration, financial structure, etc.).

The FCRS provides data as repeated cross-sections. Thus, it is not capable of addressing temporal, longitudinal issues related to the process of farm business-farm household adjustment over time. The FCRS does, however, address the issues of resource ownership and use by separating the way that farm resources are organized and managed from their ownership. The FCRS is also designed to obtain household data showing how



Part I: Screening and general farm operating characteristics:

- Land use
- Crop acreages, yields, and so forth
- Farm business and financal organization

Part II: Farm production expenditures, receipts and financial data, including items such as:

- Whole–farm expenses by type or category
- Livestock inventory, sales, and purchases
- Crop receipts, inventory, and so forth
- The farm business balance sheet
- Distribution of earnings and expenses among operators, landlords, contractors

Part III: Modular sections for specific detail

A. Detailed information needs for special and key variables and data items relating to production activities and whole farm expenses

B. Data on particular types or categories of farm organizational characteristics and technical practices used in crop and livestock production

Figure 1.

The Farm Costs and Returns Survey

FIGURE 2. STRUCTURE OF FARM OPERATION

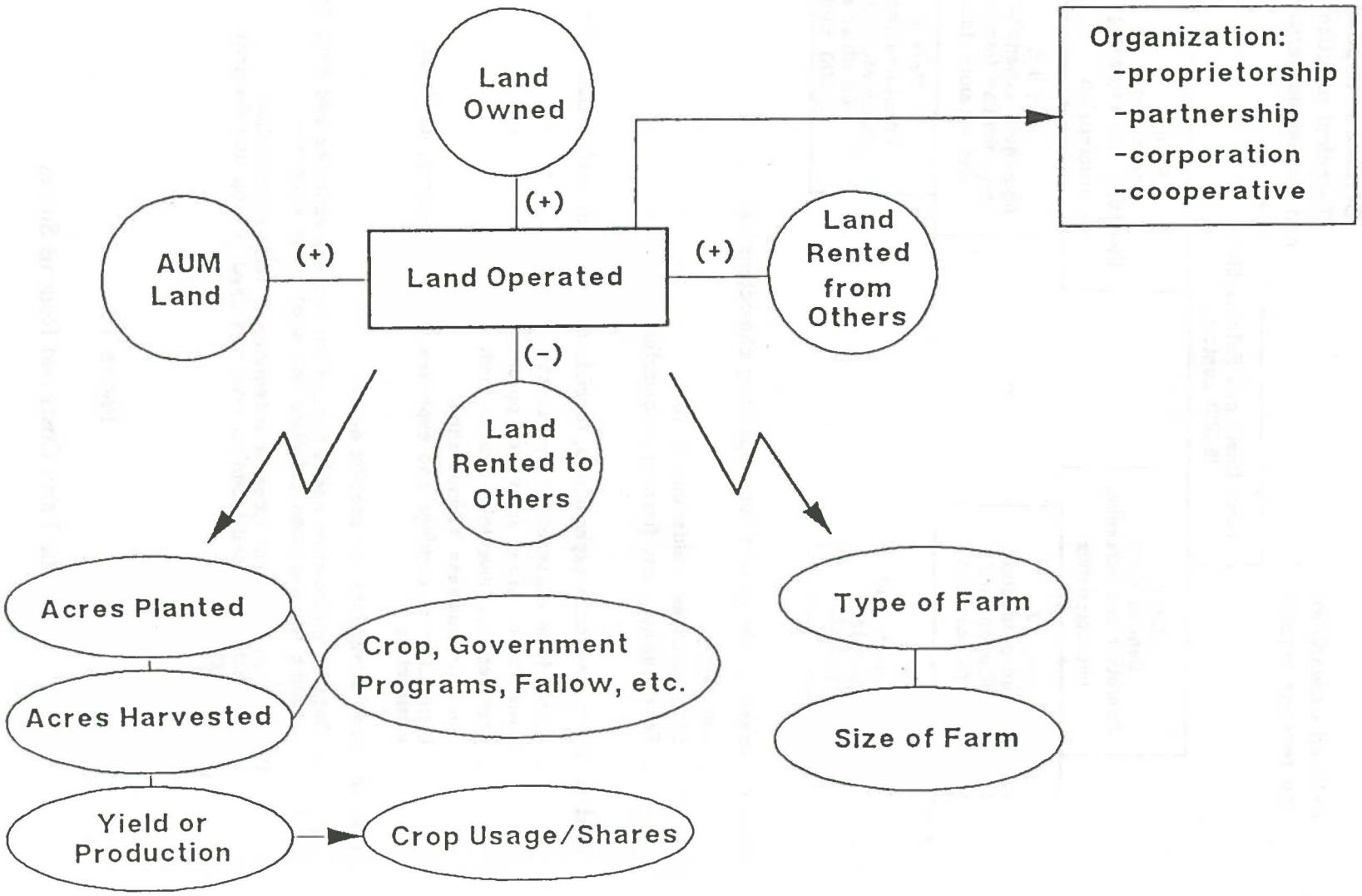


FIGURE 3. FARM COST STRUCTURE

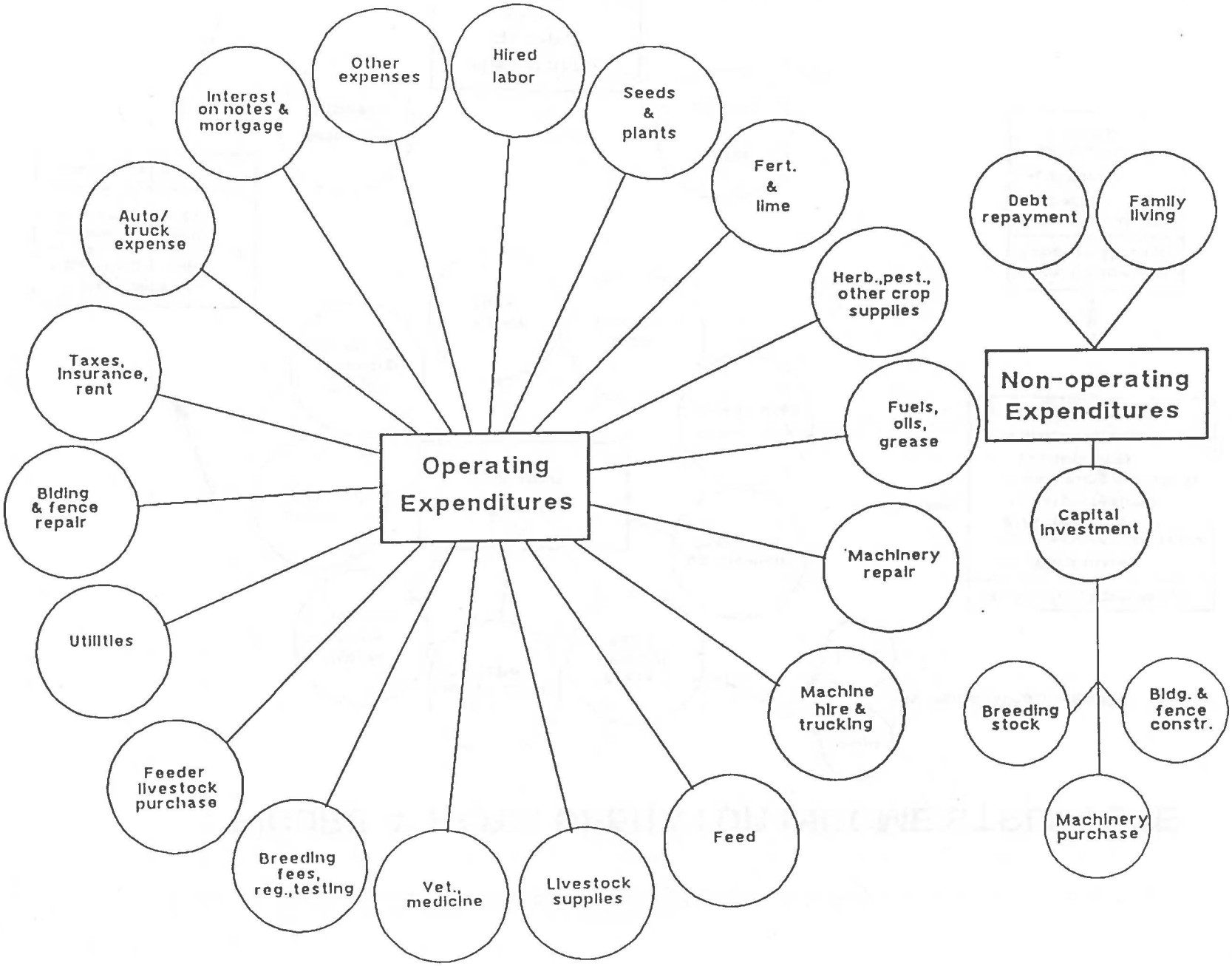


FIGURE 4. FARM OPERATOR INCOME STRUCTURE

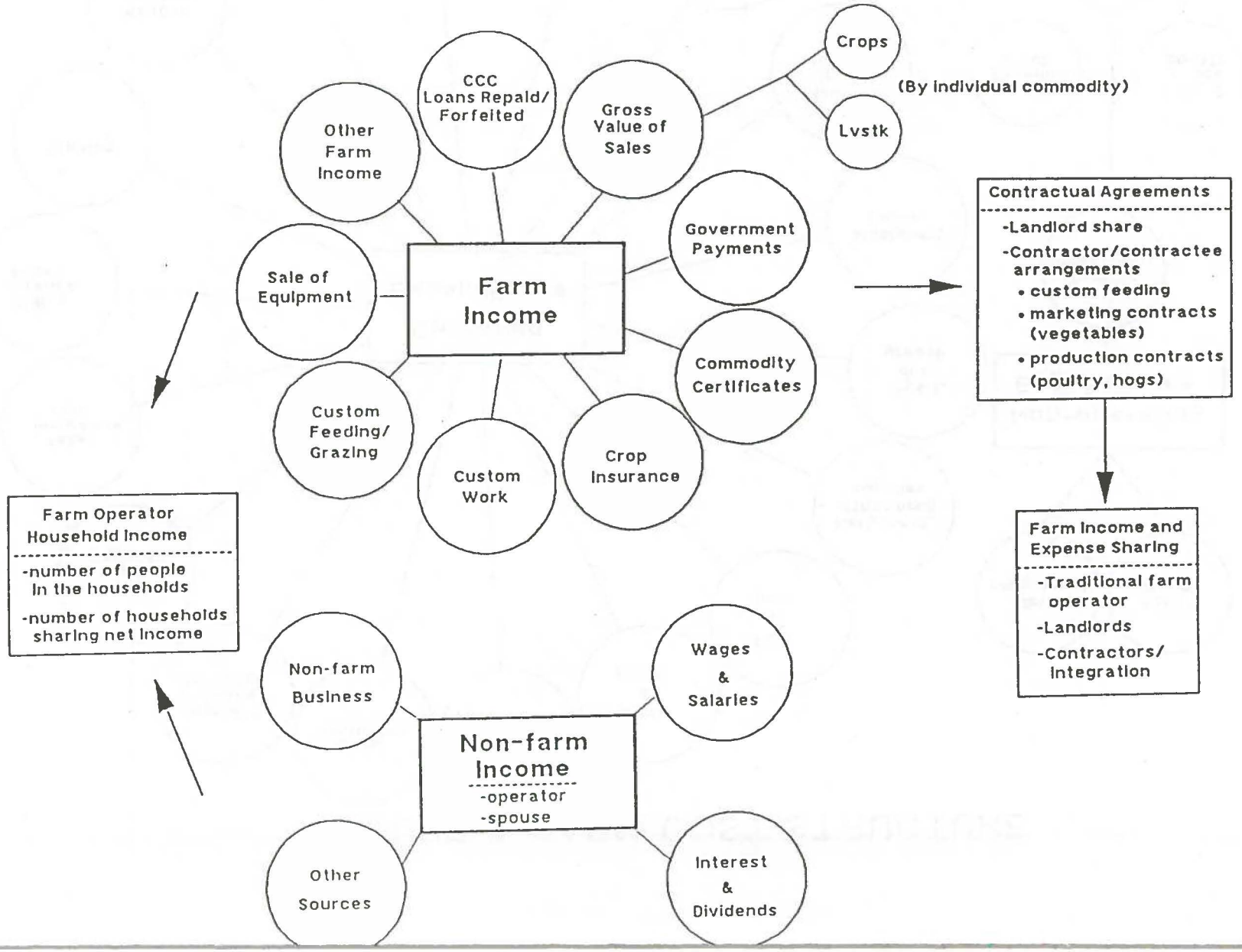
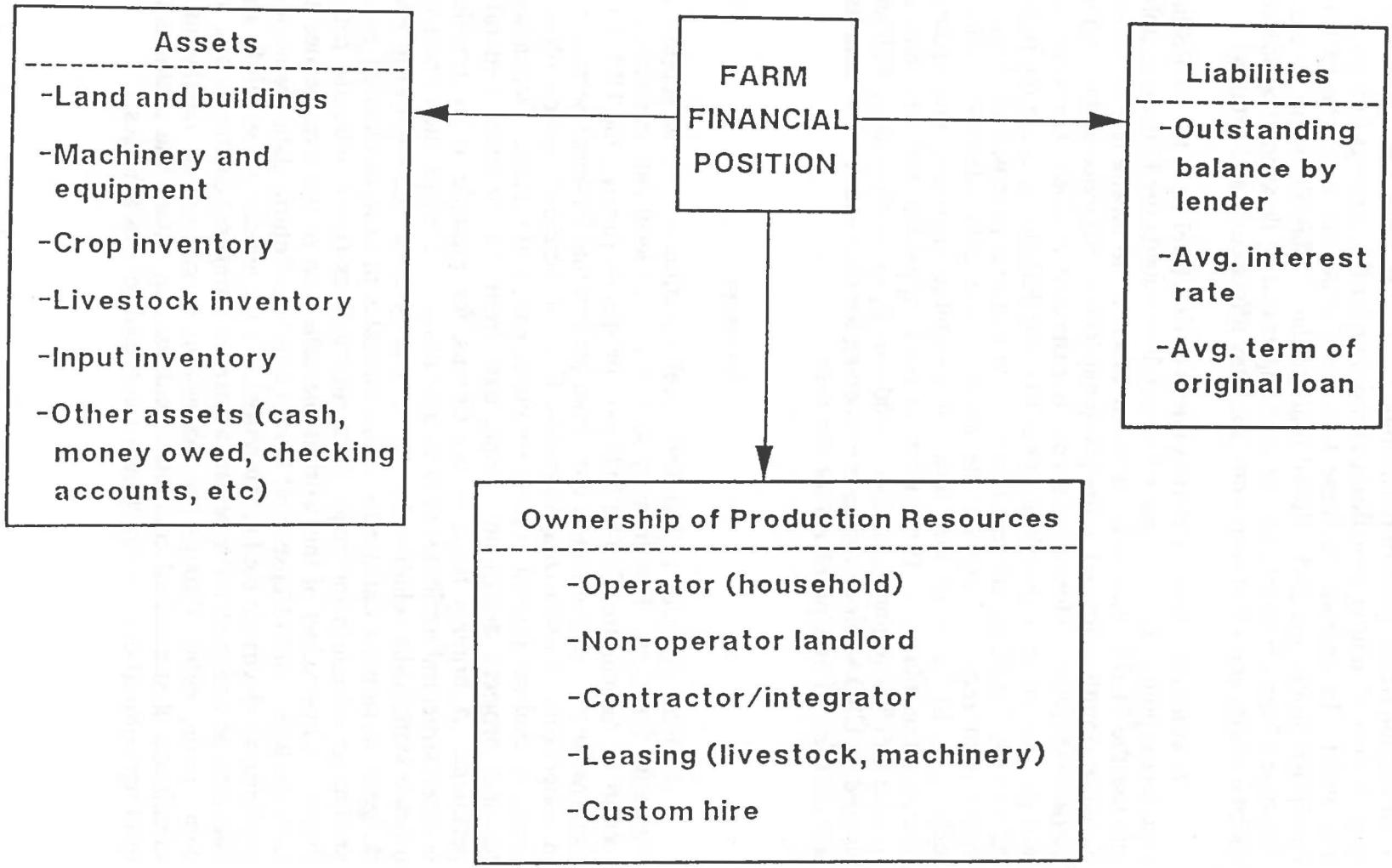


FIGURE 5. FARM CAPITAL STRUCTURE



labor is divided between farm and non-farm uses, investment in the farm business, and the distribution of farm business earnings among the various units that provide resources used in production (farm operator households, hired labor households, landlords, contractors, and other lessors of inputs), specifically accounting for the earnings that go to the farm operator household. In addition to these firm level structural data, the FCRS directly obtains enterprise production and cultural practice data. This allows an enterprise budget to be developed from observed input data. Budgets can be developed by size of farm, degree of specialization, and other attributes that may affect costs and returns.

In contrast to other federal sources of firm level data, the FCRS has a direct micro-data access policy. It is possible for researchers outside the Federal establishment to access and use the FCRS. Access is restricted, however, to on-site use for research projects that have been jointly approved by the Economic Research Service and the National Agricultural Statistics Service. Moreover, access is restricted to ERS, University and other public interest analysts for research purposes that are designed to serve the public. Analysts that want to use the FCRS are required to write a project proposal which specifies the items of information required, explain the need for the data, identify methods of analysis or techniques to be used and level of reliability required, and indicate the level of interpretation planned. If the planned use is approved, the user must sign forms which require him/her to maintain strict confidentiality of all microdata. Publications have to be cleared by USDA prior to release (screening for disclosure). The data have been used on site with few, if any, problems for the user.

Summary

Federal agencies collect firm level agricultural data to support programmatic or legislative functions. Five primary sources of firm level data currently exist, including the Census of Agriculture, Census follow-on or special surveys, the USDA's Farm Costs and Returns Survey, administrative data from the Internal Revenue Service, and data collected by cooperators in research agreements. Each of these data sources obtain data potentially useful in analyses related to farm structure, cost, and returns. Depending upon a specific research project's design and scope, data from one or more Federal Source may be pertinent. A primary focus of the Census, for example, is to provide information on selected structural attributes of farm operations. Moreover, the Census is large enough to provide statistically reliable data at the county level. USDA's farm economic survey is designed to support statistically sound estimates of farm production expenses and cost of production estimates for major farm commodities (grain, oilseeds, cotton, livestock and dairy). A by-product of this work is the collection of the data needed to conduct whole farm analyses. Both Census and Farm Costs and Returns data are available in hard copy and through electronic media. Moreover, in what appears to be a little used option, micro-data may be accessed under certain approved (stringent) circumstances. Use of the micro-data option, either through the acquisition of customized tabulations or through the submission of specialized computer routines, may extend the usefulness of Federal firm level agricultural data in structural or cost and returns analyses.

Endnotes

1. Brinkman and Worley's list of performance variables included allocative efficiency, contribution to national economic goals, income parity, income and wealth distribution, income adequacy, stability, resilience-vulnerability, adaptability and flexibility, ease of access, control, resource conservation and environmental quality, rural community health, rural-urban balance, balanced regional development, farm-rural values, government expenditure-revenue, and federal-provincial relations.

References

Babb, E.M. "Some Causes of Structural Change in U.S. Agriculture," Structure Issues of American Agriculture, U.S. Dept. of Agr., Econ., Stat., and Coop. Service, Agricultural Economic Report 438, Nov. 1979, pp. 51-60.

Bagi, Faqir Singh. "Farm-Level Technical Efficiencies of Individual Crops," mimeo, Dept. of Rural Development, Tenn. State University, March 1987.

Bergland, Bob. "Foreword," Structure Issues of American Agriculture, U.S. Dept. of Agr., Econ., Stat., and Coop. Service, Agricultural Economic Report 438, Nov. 1979.

Brinkman, G.L. and T.K. Worley. Structural Change in Canadian Agriculture, Report to the Development Policy Directorate, Regional Development Branch, Agriculture Canada, June 1983.

Edwards, Clark, Matthew G. Smith, and R. Neal Peterson. "The Changing Distribution of Farms by Size: A Markov Analysis," Agricultural Economics Research, Vol. 37, No. 4, Fall 1985.

Garcia, Philip, Steven T. Sonka, and ManSik Yoo. "Farm Size, Tenure, and Economic Efficiency in a Sample of Illinois Grain Farms." AJAE. 64(1982):119-23.

Garcia, Philip and S.T. Sonka. "Methodological Issues in Assessing Economies of Size: Selected Positive Analytical Approaches." Economies of Size Studies, Proceedings, Center for Agricultural and Rural Development, Ames, Iowa, Feb. 1984, pp. 124-170.

Hall, Bruce F. and E. Phillip LeVeen. "Farm Size and Economic Efficiency: The Case of California," AJAE, Nov. 1978, pp. 589-600.

Hallam, Arne. "Economies of Size: Theory, Measurement, and Related Issues," Determinants of Farm Size and Structure, Proceedings N.C. 181, Mich. Agr. Exp. Station, journal Article 12899, Dec. 1988: Pg. 65-93.

Hatch, Thomas, C. Cole Gustafson, Kenneth Baum, and David Harrington. "A Typical Farm Series: Development and Application to a Mississippi Delta Farm," SJAE, Dec. 1982, pp. 31-36.

Huang, Cliff J., and Faqir S. Bagi. "Technical Efficiency on Individual Farms in Northwest India," Southern Economic Journal, June 1984, pp. 108-115.

Johnson, James and K. Baum. "Whole Farm Survey Data for Economic Indicators and Performance Measures," Agricultural Economics Research, Vol. 38, No. 3, Summer 1986.

Madden, J. Patrick. "Economies of Size in Farming: Theory, Analytical Procedures, and Review of Selected Studies," Agricultural Economic Report, No. 107, Econ. Research Service, U.S. Dept. of Agr., Feb. 1967.

Nehring, Richard F., et al. "Measurement of Technical Efficiency by Farm Size and Tenure Status on United States Corn Farms," Mimeo, Economic Research Service, Sept. 1988.

Peterson, R.N. U.S. Dairy Farmers in 1979: Financial Characteristics by Operator Age and Dairy Size, ERS Staff Report No. AGES840824, Economic Research Service, U.S. Dept. Agr., Feb. 1985.

Schertz, Lyle P. "Households and Farm Establishments in the 1980's: Implications for Data." AJAE, Vol. 52, No. 3, May 1970.

Stanton, B.F. Changes in Farm Structure: The United States and New York, 1930-1982, Cornell Agricultural Economics Staff Paper, No. 84-23, Sept. 1984.

Sundquist, W.B. "Changing Structure of Agriculture and Resulting Statistical Needs," AJAE, Vol. 52, No. 3, May 1970.