

Measuring Agricultural Income with the Changing Face of Agriculture

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Introduction

The U.S. Department of Agriculture (USDA) has a long tradition of providing economic and statistical indicators for the agricultural sector of the U.S. economy. The USDA was established in May 1862 (Vogel 1995) which also established the beginning of the program now administered by the National Agricultural Statistics Service (NASS). Production, agricultural price and other measures of sector performance were first published in 1863. Forerunners to the Economic Research Service (ERS) published the USDA's first estimates of gross and net farm income in 1913. The estimates were developed largely from the *1910 Census of Agriculture* and were for one year only. In 1930, the Department began publication of some income and expense accounts on a regular calendar-year basis. Geographic dispersion in the form of State estimates was first addressed by the accounts in 1955. Value of sales class estimates for income and expense components of the accounts were added 1964 (USDA, 1988).

The cornerstone for a new farm statistical structure in the United States was laid in 1966 with the implementation of a probability based sampling framework being introduced in the 48 contiguous States. While local procedures, sampling, and survey instrument design were modernized to reflect changes in the farm sector, the concepts defining the basic sampling unit, the farm operation and the farm operator remained largely intact. The structure of agriculture evolving into large more diversified units led to the development of multiple frame sampling theory using both area and list frames (Fecso, et.al.1986).

The sector-wide income accounts estimated by ERS were also adapted to reflect improvements in conceptual design and underlying data, as well as to reflect changes in U.S. farming. In the early 1970=s, ERS took steps to more fully incorporate National Income and Product Accounting procedures, concepts, and linkages in its sector-wide farm income estimation procedures. This enabled sector estimates of farm income being reported by USDA to more directly serve the needs of the U.S. aggregate Income and Product Accounts. To more fully reflect changes that had occurred in the farm economy, ERS also added new income series to its traditional measures of net income. In 1980, three new series were introduced; net cash income, net cash flow, and production transactions, that focused on the earnings of farm business units rather than on farm households (Smith 1980). With the onset of the financial crisis in U.S. farming in the 1980=s, ERS and NASS worked to revamp annual farm economic surveys to strengthen USDA=s ability to report farm-level business estimates that integrated income and balance sheet statements for farms. The goal was to produce measures of profitability, solvency, leverage, debt repayment capacity, and efficiency within the context of a farm (establishment) that could be used to advise policy makers and the public about portions of the farming sector that were likely to experience financial difficulties. This effort spawned the Agricultural Resource Management Study, the Department=s primary annual finance and economics survey in use at the present time. Finally, in 1993 the Secretary of Agriculture required release of an estimate of the average income of farm operator households, including income earned from both farm and off-farm sources, with the traditional estimate of sector-wide net farm income. As stated by the Secretary, "Two numbers that right now tell a completely different story" (USDA 1993).

Changes in the U.S. Farm Sector

U.S. farming is changing in several important ways. First, farms are continuing to become more industrial in character and consumer-driven supply chains are emerging, especially in the livestock sectors. A result is that farm output has become more concentrated on larger farms and farms are changing how they are organized. The use of contracts and other arrangements are much more prevalent and the sector has become more attuned to participation in global markets¹. There has also been an emergence of technologies such as computerized planting, harvesting and the use of bio-engineered seed. In addition, management information systems have changed how farms conduct business. Purchases and sales through the Internet are no longer uncommon. Finally, household goals and farmer attitudes affect decisions about how resources are allocated not only within a farm unit but also among farm and other competing interests. These decisions not only affect the farm's production structure, but also its financial structure, including sources of equity capital, and ultimately the level and distribution of income.

Taken by themselves, changes such as these would make discussion of measuring farm income and farm structural change a timely and highly relevant topic. But, changes in farm structure and business arrangements have also been accompanied by recommendations from national and international bodies that, if adopted, would also alter the conceptual base of measurement systems. Both changes in structure and changes in measurement concepts affect data collection. Three examples illustrate this point. First, a task force of the American Agricultural Economics Association published a *Commodity Costs and Returns Estimation Handbook* in July 1998 (American Agricultural Economics Association 1998). The purpose of this handbook was to present best practice recommendations on estimation and reporting procedures for commodity-level cost and returns. At the firm level, the Farm Financial Standards Council, a group of industry, banking, farm, academic, and government persons knowledgeable of farm finance and accounting, published recommendations for estimation of firm-level financial statements and made suggestions for a set of ratio indicators for use in analysis of business performance (Farm Financial Standards Council 1995). Then, at the aggregate sector-wide level, the System of National Accounts 93 makes recommendations that affect how economy-wide estimates of income would be prepared. Thus, we have had to consider how to integrate changes in estimation procedures and concepts that transcend enterprise-firm-sector levels of aggregation with changes in survey instruments to accommodate how farms are organized and conduct business.

Measurement traditions are being buffeted by changes in the U.S. farming sector which make measurement more difficult while at the same time the demand for more specific policy-oriented information by public and private sector decision makers is rising. While changes like these have existed in the past, a striking difference today appears to be the pace of change. Although this may be an artifact of data collection, it still has very real implications for data collection and measurement systems. At issue with many of today's changes is simply determining what is the primary sampling unit or who should be the primary respondent? It is not clear that farmers can answer questions about prices received for commodities when transactions occur in the form of a contract and another party ultimately sells the output. When transactions occur over the Internet or through direct farmer to supplier or farm to customer interactions, it is also not clear that traditional respondents to price and quantity surveys such as farm elevators or input suppliers can provide data representative of sector-wide conditions.

¹By contracts we mean verbal or written agreements to produce or market commodities under specified conditions and terms such as pricing mechanism, point of delivery, or inputs used. USDA monitors contracts used in marketing farm products as well as contracts used to establish production practices and conditions.

The remainder of this paper is organized as follows. First, we provide a working definition of farms, farm income, and farm structure from the perspective of the U.S. This discussion is followed with an overview of U.S. agriculture incorporating both traditional and non-traditional perspectives of farm structure. Then, we discuss adjustments being made by farm operators to strategically manage and adapt their businesses to forces driving change in the U.S. farm sector, including a perspective of what these adjustments mean for measuring income. We conclude with a discussion of implications that the changing structure of agriculture has for data collection.

Farms, Farm Structure, and Farm Income

In the U.S. a farm is defined as any establishment from which \$1,000 or more of agricultural products either were sold or would normally have been sold during a year. This definition was first adopted in 1974 for the Census of Agriculture and was incorporated in the USDA income accounts in 1975. The definition has not been altered to reflect either price level changes or adjustments in business practices or organization. An important aspect of the definition is that an establishment does not have to have actual sales of \$1,000 to qualify, only the potential for sales based on the physical presence of a sufficient amount of some commodity such as hay or Christmas trees. The definition of what constitutes a farm establishment provides a base for assessing changes in structure. Farm structure typically refers to a broad set of characteristics that describe U.S. farms, as well as the distribution of farm production resources and returns to those engaged in farm production activities (Sommer, et al 1996). Another definition of structure that we find particularly appealing was offered by Carlin. He defined structure to mean how farms of different sizes and types organize natural, financial, and human resources to produce food and fiber and the distribution of income and wealth that results from that activity (Carlin 1990, pg1). Though implied by the first definition, Carlin's definition of farm structure focuses more directly on broad multidimensional aspects of how farms are organized. Business arrangements to acquire access to factors of production and to market commodities and products become important elements of farm structural analyses along with more traditional dimensions such as tenure and the number and size distribution of farms.

Income, like structure, can be measured at different levels of aggregation and have different meanings. In the U.S., farm income is measured for the farm sector of the U.S. economy, for farm business establishments, and as a source of money incomes for farm households. Each level of measurement has implications for the types and amount of data needed to implement concepts and to provide accurate estimates. For sector-wide measurement, net farm income measures the net value of goods and services generated by farm operations during a given calendar year. This measure of net income equals gross cash and non-cash income less cash and non-cash production expenses. Income accrues both to operators and to others whose contribution to an operation's production of goods and services is not directly compensated through an expense payment. For sector estimates, this distributional issue is not an overriding concern. The sector, for purposes of estimation, has been traditionally considered as a single farm.

For establishments, the USDA calculates net farm income by matching revenues with expenses used to create those revenues plus the gain or loss on the sale of inventories and farm capital assets. To obtain an estimate of the return to the farm operator's unpaid labor, management, and owned equity, it requires that we obtain information about the sources of inputs and the share of income earned by operators of farms. Survey instruments have been designed to explicitly measure the contribution of landlords and contractors to production and to measure the share of business income retained by the farm. This places a larger burden on data systems because development of accurate estimates of establishment-level incomes requires that we pay attention to issues of factor ownership and the distribution of income.

At the household-level of measurement, farmers' shares of establishment-level net income from farming are combined with earnings from off-farm sources to give estimates of household income. To provide consistency with estimates of household income for non-farm households, an estimate of money income from farming is developed for farm operator households. This estimate consists of net cash income from farming minus depreciation of farm capital plus any wages paid the operator or family members by the farm. This estimate of money income from farming is then summed with earnings from off-farm sources by the household to create an estimate of farm operator household income from all sources. The intent is to develop a cash-based estimate of money income for farm households consistent with money income estimates for non-farm households. Such estimates enable USDA to compare the economic status of farm households with that of non-farm households. However, developing the household estimates requires us to not only correctly identify who earned income from off-farm sources and the amount, but to be able to estimate their proper share of income generated by the farm business. We have had to explicitly account for the number of households and for the share of income retained by the farm operator in his or her household.

Definitions of farms, farm structure, and income not only establish the boundaries of the farm sector but of firms and other entities that participate in the sector's activities. Definitions of income ultimately also establish the guidelines by which we measure the economic well being of households that participate in the sector. Definitions used by USDA influence how we think about the organizational structure of the U.S. farming sector and how we collect data to provide accurate measurements of income for the sector, and for establishments and households engaged in farming. We demonstrate in following sections of the paper that modern farm businesses not only include traditional farm-landlord arrangements, but also farm-to-farm and farm-to-non-farm business arrangements that affect both how inputs are acquired and outputs marketed. These arrangements ultimately affect how income is measured and distributed among farms. Moreover, we also demonstrate that the relationship between the farm and the operator's household may have been significantly altered by choices made by farm families with regard to labor and investment allocation decisions.

Overview of U.S. Agriculture

The U.S. public has long held a strong interest in the organization, operation, and economic well being of farms owned and managed by families or households. Thus, the term family-farm. A variety of definitions of family farms have been used in the U.S. Most have focused on the amount of management and labor provided by the operator and other unpaid family members and risks assumed by the farm family in the farming operation. Other prominent attributes used to distinguish family farms have included sales of commodities, a cap on the amount of total labor with most being family supplied, market purchases of inputs and sales of commodities, management of the operation by the family, and, even to some, a requirement that agriculture be the primary occupation of the operator. In developing our overview of U. S. farming we touch on many of these attributes -farm size, organization, tenure, and then illustrate why, in today's modern agriculture, traditional single dimensional attributes of farm structure do not clearly illustrate the nature of business activity. More importantly, business arrangements of modern farm businesses not only hold implications for the measurement of income but also for the collection of data from sector participants.

Number of Farms and Size. A well documented trend in U.S. farming is the long-term decline in the number of farms from the near 7.0 million reported in the *1935 Census of Agriculture* to today's estimate of 2.1 million farms. Accompanying the decrease in number of farms has been a steady rise in the size of farm measured in acres per farm, rising from about 100 acres per farm at the zenith of farm numbers to just slightly less than the 500 acres reported by farms in the most recent Census of Agriculture (Figure 1). The *1997 Census of Agriculture* also provided a view of U.S. agriculture that suggests a bi-modal distribution of farms and sales. Over half of the nation's farms had sales less

than \$10,000 per year; these sales accounted for only 2 percent of the total.

A long standing problem has been the one farm - one operator concept. Problems with this concept have been known for a long time. Points made by Schertz (1982) are still valid. Both NASS and the Census Bureau have consistently associated a unique operator to each farm. A series of procedures are used to define a unique operator.

- \$ Person who lives on the land operated
- \$ If more than one, then the A senior@ person is the operator
- \$ If none live on the land operated, the A senior@ person is the operator - senior is often the oldest person.

The one farm - one operator concept does not provide a picture of the economic situation of farm households. As noted in our definition, while farm income can be on a per farm basis, it also needs to be on a per farm operator and household basis.

The *1997 Census of Agriculture* provides another view of U.S. Agriculture in terms of size of operation. Table 1 shows that only 181,000 farms accounted for 75 percent of the sales of agricultural products in 1997. More remarkable, only 5,062 farms accounted for 25 percent of total sales. These 5,062 farms are mostly organized as partnerships or corporations. This further clouds the issue of A one farm - one operator@ when measuring farm income, income per farm, and income per operator.

Legal Organization of Farms. The *1997 Census of Agriculture* confirmed the proprietorship as the dominant legal organization for farms, however, with a declining share of sales. For the 1997 calendar year, 1.6 million or 86 percent of farms, nationally, were organized using this form of legal business entity.

Other traditional forms of legal organization include partnerships (general and limited), corporations (farm and non-farm), and cooperatives, estates, trusts or other institutional organizations. Partnerships, the second most common form of legal organization for farms, typically account for 7 to 8 percent of farms. Some persons or entities associate to produce commodities or services but are not legally organized as partnerships. These associations or alliances are typically measured as proprietorships where another household shares in the asset base and income of the farm. The arrangement exists across all sizes and occupational choices of farms, even for very small and retirement-focused operations. Corporations, cooperatives and other legal forms of business organization account for the remaining 6 to 7 percent of farms. While considerable attention is paid to potential expansion in the number and share of production generated by large non-farm corporations, the predominant corporate farm in terms of numbers of farms has traditionally been and continues to be the family corporation. Confirming numbers were reported in the *1997 Census of Agriculture* where 76,103 of the nation=s 84,002 farming corporations (90 present) were family-held operations.

Table 2 shows the percent of agricultural sales by these organizational types. While individual operations account for 86 percent of the farms in the U.S. they account for lesser portions of land, total sales, and sales for major commodity groups. The key point is that 48 percent, nearly half, of agricultural sales are from operations other than those operated by a single individual. By definition, the other organization types include at least more than one individual, and often many more. This points to a need to add another dimension to the income picture and that is farm income shared by multiple operators.

Tenure. Ownership, as an indication of access to capital and an absence of barriers to entry into farming occupations, is an often examined dimension of farm structure. The most recent Census indicated that full owners accounted for about 60 percent of farms. These full-owner operations produced 40 percent of sales. The most recent Agriculture Resource Management Study (ARMS) generated similar national results². Using the ARMS to classify ownership by a multidimensional typology of farms shows that large and very large farming operations tend to be predominantly part-owner³. Retirement, residential, and small farms tend to be owner run operations. More than 80 percent of farms run by retired operators are owned outright while 60 percent of residential/lifestyle farms are owned. Complete rental of farmland is a relative small tenure arrangement in today=s agriculture, accounting for 10 percent of farms. Renting of all farmland is more common among large and very large farming operations. ARMS results indicate that as many as 20 percent of large farms rent all farmland, suggesting that these operations are more focused on returns from production activities than on ownership of land.

Farm Typology. Multiple characteristics, including farmers= reported primary occupation, sales, and net worth, are combined to develop a typology of farms (Hoppe 1999). The typology enables analysts to focus on farms where operators declare farming to be their primary job, or to examine farms whose operator is retired, or to analyze the status of farms with limited amounts of capital and income.

Of the nation=s 2.1 million farms, about 939,000 either report that their primary occupation is farming or they are determined to be limited resource operations based on their reported resource and sales base. The remaining 1.1 million farms are operated by persons who either consider their primary job to be something other than farming or the farmers report through annual surveys that they are retired. While surveys also show that a small portion of the nation=s farms account for a very large share of total output, they also reveal that small farm operations likely face very different motivations and economic conditions than do larger farm operations. The 290,000 retired operators may be more interested in succession planning and whether a successor can be found for the farm than in economic policies that affect output. Likewise, the more than 800,000 residential/lifestyle farmers may be more focused on rural amenities, farm financing, transportation, and employment possibilities than on export or competitiveness issues. Meanwhile, it is important to recognize that these small farm operations hold a substantial portion of total U.S. farmland and are the most active participants in certain conservation and environment programs (for example 16 percent of retired farm operators have land in the long term conservation reserve program). Thus, while these farms

may generate little of the value added or net income of the sector, they do earn a significant share of government transfers and are active as landlords. From the perspective of the balance sheet, these farms also hold a significant share of the sector=s net worth.

Incorporating Business Arrangements into Structural Analyses

Traditional measures of structure from both the most recent Census of Agriculture and from farm-

²The Agricultural Resource Management Study is an annual economic and finance survey conducted by the National Agricultural Statistics Service and the Economic Research Service.

³A Typology of Farms was created to reveal differences among farms based on the occupation of operators, asset owned, and the sales class of farms. Five groups of small farms (limited-resource, retirement, residential/lifestyle, farming occupation/lower-sales, and farming occupation/higher-sales), are combined with classes of large and very large family farms, and non-family farms to provide complete coverage of the sector.

level surveys provide a perspective for U.S. farming that appears little changed in recent years. These data suggest a sector where farms have become fewer in number, larger in size as measured by both acres and sales of product, more concentrated in terms of the amount of product produced by the largest groups of farms, and more oriented toward part ownership. Underlying this perspective is a traditional view of the farm as an entity where agricultural production and home consumption are intertwined at a central location (Figure 2). The classic farm-one household model has been referred to as, Aa complete economic unit by itself@ (Heady 1953. p387). As noted earlier, economic and social changes have altered the business environment for farms. Farmers, like other participants in the economy, have adjusted to these changes by positioning their farms to best achieve business, personal, and household goals. The classic model depicted an agriculture where factors of production, including management, decision-making and equity capital were provided by the farmer=s household. In return, the household retained farm profits. However, for many years, the decision and organizational structures of farms, including farm-household linkages, have been recognized as more complex than the one farm-one household model (Carlin 1973, Schertz 1982, Patrick 1968, Johnson 1986).

The legal forms of business organization or tenure is only one aspect of the situation. Farmers may choose to use a wide range of formal and informal arrangements and business associations to gain access to markets, equity capital, or factors of production important to achieving business or other goals. More commonly used arrangements in the U.S. include marketing and production contracts, joint ventures, strategic alliances, leases, and a variety of agreements and licenses. Any or all of these business arrangements may be used in various combinations in a farm business plan. For example, a farm may have a marketing contract with an elevator to purchase a crop grown on the farm, a production contract with a processor or integrator to produce livestock, an arrangement with a neighbor to share equipment purchases, especially large capital items such as a combine, or an agreement with a relative to jointly rent land from yet another neighbor. Any formal or informal business arrangement or association can be used in conjunction with any of the various forms of legal organization or with any of the tenure arrangements.

A key structural change in U.S. agriculture is generally referred to as Acontract farming@. An increasing share of agricultural production is the result of contractual arrangements. The broiler industry and more recently hog production have shifted to this structure. Basically, the farm operator provides land, buildings, and labor. A feed manufacturer or meat processor supplies the animals, feed, medicine and other production inputs. The farm operator receives a fee per head at a rate agreed upon via the contract.

The December 1999 *Hogs and Pigs* report showed that there were 98,000 operations that had hogs in 1999 (NASS 1999). This report also showed the number of ownership entities. Only 1,190 owners accounted for over 60 percent of the inventory. The largest 105 accounted for nearly 40 percent of the inventory.

Are the feed manufactures or the meat processors also farms? They own the animals, pay the production costs, and stand to profit from their expert management. Is the entity that controls the land and buildings, and receives a fee per head a farm operator, or a contract laborer for the company that owns the animals? What is farm income? Is it the value of the animals at the slaughter plant door minus production costs or is it the income received on a fee per head basis minus costs associated with the land, buildings, and labor, or is it both?

The feed manufacturer or meat processor may have contractual arrangements with many places. Is each place a farm? If the contractor is deemed to be the farm, the number of farms and demographics would change considerably.

Heffernan (1999) describes a seamless system that eliminates a market system at the different production stages. A firm like ConAgra owns and operates grain elevators, barges, and railroad cars, it manufactures feed, produces its own broilers, processes them and sells them as a ready-to-serve product.

Historically, NASS has assigned all production costs and returns to the contractee operation. The Census of Agriculture as previously conducted by the Census Bureau and now NASS also assigned all production costs and returns to each contractee. For example a firm (the contractor) may have animals or birds at dozens or hundreds of places (contractees). The data collection process has historically assigned the animal or bird procurement costs to each contractee as well as its share of other production costs. The value of the animals or birds when they leave the contractee operation has been also associated with the contractee. This net income associated with each contractee is probably not a true reflection of the economic health of these operations because it assumes the contractee owned the animals or birds and paid all production costs.

These issues have affected the traditional measurements and the process to obtain them. It is difficult to determine where in the supply chain is the farm or farms. Not only is it difficult to define the farm, it is even more difficult to value the expenditures and sales associated with the farm.

Use of various arrangements transcend farm size. Some arrangements tend to be more common on larger farms while others are used more by small farm operations (Table 3). The key finding is that arrangements which affect how a farm's income is distributed can be found on all sizes of farms. For example, the number of households rise from approximately one on small, limited resource farms to 1.5 on very large farms. Meanwhile, farms with production contracts rise from less than 1 percent on residential/lifestyle farms to nearly a third of very large farms. Both of these arrangements affect the amount of income available to the farm as a business and to the operator's household. Value of production is divided between farmers and other entities, which may be either farm or non-farm. Given, a farm's net income, the presence of multiple households affects the level of income to the operator's household.

Meanwhile, from Table 3, we also learn that farmers do not earn all household income from a single farm business. Many own more than one farm. Yet others own non-farm businesses while a majority hold off-farm jobs. These operator and household decisions on how to allocate resources among competing farm and non-farm investments occur on all sizes of farms. Holding multiple farms or business ownerships is not solely the domain of large farms while off farm investment by farm operators is not solely for small farm operators. Again, in measuring income to households, it is necessary to take into consideration income from multiple investment and wage opportunities available to the household. The key finding for income measurement is that farms of all sizes choose to distribute resources among multiple classes of opportunity and that these must be measured to fully account for household incomes.

Farmers also engage in input procurement and marketing activities that affect income measurement and data collection activities. Nearly 90 percent of farmers still have only cash sales of commodities and products from their farms. But, cash only farms tend to be the very small farm operations. Marketing options become more complex on larger farms with use of marketing tools and contracts being more prevalent. Adding to the complexity, farms also market directly to individuals, to retailers, and belong to marketing cooperatives. These marketing choices with regard to channel and pricing affect the price that farmers receive for their commodities and our ability to accurately measure prices for use in income measurement and analysis. Farmers have also incorporated a variety of strategies for purchase of inputs. Data have been collected that document use of arrangements to acquire access to land and machinery, along with membership in supply cooperatives. Data are currently being collected to measure participation in buying clubs and other alliances, use of networks, and use of computer and Internet access to both purchase inputs and to market products. A

recent NASS report showed that farmers had doubled their Internet access and that 47 percent of all farms had access to a computer in 1999 compared to two years earlier (NASS 1999). Data from the just completed 2000 ARMS will provide additional insight on use of this technology in business activities. For this paper, it is sufficient to note that increasing use of Internet purchasing or sales will have a major impact on approaches to data collection for such items as commodity prices, sales, and prices paid for inputs.

Data Issues Differ for Sector, Farm-Level and Household Measures of Income

USDA generates multiple estimates of income for the sector as a whole, farms that participate in agricultural production, and households of farm operators. Each estimate is designed to provide insight about an aspect of economic and financial performance. For example, while value-added is used to measure the contribution of agriculture to the national and state economies, net farm income measures the annual profitability of the sector and farms after accounting for payments to hired labor, net rent, and interest on debt. Cash income gives an indication of cash flow and is used to generate estimates of debt service capability. At the household level, farm and off-farm sources of income are measured, providing a perspective about how farm households have chosen to allocate resources among sources of employment and investment.

Specific measurement issues arise for each level of measurement and with each measure of income (Table 4). For example, sector aggregate measures of value-added and income do not currently treat breeding livestock as a capital item. Instead, purchases of all livestock are included as an expense item. The value of orchards and other trees crops have not been included in capital stock and depreciated. Instead, trees have most likely been included in the value of land. This means that the value of trees has been included in asset values and in balance sheets prepared for the sector and for farms. Annual expenditures for tree stock have been included as an expense instead of having been added to capital stock and being depreciated over a measure of useful life. As discussed above, another primary issue for sector level measurements is that both net value-added and net farm income accrue to persons or entities other than the farm operator. Data collection steps have been taken through the ARMS to remedy this data shortcoming by accounting for multiple households and contract arrangements.

USDA's 1999 Agricultural Economic and Land Ownership Survey (AELOS), a follow on survey to the *1997 Census of Agriculture*, will also provide data needed to assess the income distribution issues generated by multiple households and contract production arrangements but on a much broader national level of coverage than the ARMS survey⁴. At the farm level, USDA produces estimates that are adjusted for the presence of multiple households and for contract production arrangements. The AELOS will provide farm level estimates for a much smaller level of geographic disaggregation than has been possible in the past.

Measurement issues that arise from emerging changes in the structure of agriculture are depicted in Table 5. Choices with regard to input procurement, marketing options, and coordinated activities affect terms of trade and the distribution of income and production among farms and participants in farming. Household decisions affect how resources are allocated not only within agriculture, but among sectors of the economy.

⁴The Agricultural Economic and Land Ownership Survey (AELOS) is a survey of participants in the previous Census of Agriculture. This survey is a primary source of finance, and land ownership data used in aggregate sector-wide accounts, especially the balance sheet of agriculture. AELOS is the only survey to provide data on landlords and operators for the same farm operation, providing insight into the distribution of farm debt and asset holdings.

Some changes in input procurement may make it difficult to observe either the market channel or prices paid for inputs used in production. Three examples illustrate this point. First, farmers have formed alliances or joint ventures to purchase inputs in quantity. By themselves, individual members of the group may not purchase enough product to receive any quantity or bulk discounts offered by the supplier. As a group, however, enough may be purchased to generate more favorable prices. Farm press and other reports suggest that this type of banding or alliance is becoming more common in U.S. agriculture. Likewise, evidence suggests that farmers are purchasing more input through use of Internet transactions. NASS reported in summer 1999 that 29 percent of U.S. farms had Internet access compared to 13 percent two years earlier. Nearly half of all farms had access to a computer in 1999, rising from a level of 38 percent two years earlier. Seventy-seven percent of the farms with sales of more than \$250,000 in a year had access to a computer, 65 percent reported using a computer for their farm business and 52 percent reported Internet access. Recent farm magazine stories have provided farmers with lists of virtual ag-input middlemen (Top Producer 2000). Although not yet common, farmers have also joined to share the purchase cost of large input items such as combines where the expense may be prohibitive for an individual. These purchases raise questions not only of how ownership is shared but also of how annual operating and repair costs are paid. Second, farmers have also joined to pool products for sale. The goal has generally been to gain access to different markets by having a larger quantity for sale or to take advantage of larger quantities to more easily spread out sales as a risk management tool. Finally, as shown in Table 3, farmers have also taken steps to sell products directly to individuals and to retailers.

Changes in traditional marketing and purchasing channels mean that both quantities purchased or sold and prices paid and received become less observable. These changes are more problematic for sector aggregate measures of value added and income, as currently measured, than for farm-level estimates generated through use of a single integrated data collection instrument. Currently, estimates of sector aggregate value added and income are made using a wide variety of commodity production, price, income and disposition surveys along with administrative record data on the level of government payments. Intermediate consumption outlays are developed from farm-level surveys such as the ARMS and AELOS or the Census of Agriculture. As transactions become more business-to-business or business-to-household and, in essence, more private either through the use of contracts or through use of such media as the Internet, it will become more difficult to observe or measure transactions at traditional points of sale or purchase. For example, if a commodity is grown largely under contract, observing prices at a sale barn may not be representative of the total value of the commodity. Likewise, if inputs are purchased through electronic transactions or through joint arrangements, prices paid at local merchandisers may not represent the costs of intermediate consumption outlays used in generating either gross or net value added or net farm income. Further complicating the sector aggregate measurement issue is that arrangements such as networks, alliances, joint ownership of either inputs or products, and contracts can affect how income is distributed. Traditionally, sector aggregate levels of income including income to contractors, for example, have been interpreted as accruing to farm operators. Though it has long been known that multiple entities share in the income generated by the farm sector for some time, this appears to be a growing issue. The bottom line is that farm operators, as traditionally viewed, retain a smaller share of sector aggregate output. The value of sector-wide estimates of income for use in assessing income levels and distribution across time is also diminished as an increased number of entities share in the output and income generated by the sector.

At the farm and operator household level, steps have been taken to identify where more than the operator shares in the output and income of a farm. Likewise, actions have been taken to directly measure the operator's share of farm income to combine with off-farm earnings to produce an estimate of total household income from all sources. Still, changes in farmers' business arrangements add to the complexity of correctly measuring the farm's share of business income. Similar issues exist at the farm level as for the sector: What share of expenses is borne by the farm?

What share of capital stock is owned and depreciated? What share of output accrues to the farm and to the operator's household?

Implications of Changes in Farm Structure for Income Measurement and Data Collection

Changes in business arrangements, production and marketing practices make it necessary to address these measurement problems to have confidence in the levels of income developed for public use. A major concern in the U.S. is how changes in business arrangements may affect the level and distribution of income. Arrangements, such as contracts, not only vary by size of farm as shown in Table 3, they also vary by type of commodity and by geographic region of the country. Thus, public policy uses of income measures, such as tracking changes in long-term trends or changes in income for specific farm types, can be greatly affected by the prevalence of business arrangements to share costs and output.

One only need to briefly review Tables 1 and 2 to realize that traditional survey and sampling methods are strained because the concentration issues are confounded by the changes taking place in the organization and ownership structure of agriculture. About 100 enterprises own 40 percent of the hogs for example. Half of the Nation's farms contribute a small share of total sales and production. The following sections describe survey design and conceptual changes being considered by USDA. Figure A illustrates the different farm types, tenure, and topology that will have to be measured in the future.

2002 Census of Agriculture. For the first time, the census will capture farm sales independently of sales attributed to contractors and landlords. In addition, the value from the sale of goods owned by contractors and landlords will be provided. Thus, the values to the sector including farm operation, contractor and landlord sales will be comparable to those from previous censuses. In addition, the values associated with the farming operation will be provided. The same measures will be provided for production expenses. That is, total production expenses including those incurred by the contractor, landlord, and operation will be provided and will be comparable to those from previous censuses. The production expenses incurred by the operation will be provided as well. As a result, the net income that actually belonged to the farm operations will be provided for the first time from a census.

The *2002 Census of Agriculture* will also obtain information about multiple operators for partnership and corporate farms. Multiple operators associated with proprietorships will also be identified. This will help USDA to more accurately provide measures of income accruing to farm operator households. It will also provide more details about the demographics of farm operators.

A hurdle yet to be crossed is how to value sales from vertically integrated farms. The traditional way has been to value those sales using average market prices obtained by non-integrated farms. However, as markets are becoming more concentrated, the concept of an average market price may disappear. This will require that we ask the integrator to derive a farm gate price by subtracting expenses from wherever the first market transaction occurs back to the farm level. This procedure is used to determine a farm value of broiler production.

The 2002 census will provide the platform upon which to redesign the annual economic surveys. It will need to consider the structure of farms as well as the prevalence of contractual arrangements. Figure 3 illustrates the different farm types, tenure, and ownership characteristics that will need to be measured in the future.

Integration of Census and Annual Economic Surveys. Beginning with the *1997 Census of Agriculture*, USDA has taken action to integrate the census with the on-going economic survey

program. Integration has been achieved by using one survey form to collect both census and economic survey data from respondents in the survey sample. While reducing respondent burden, this action also has the benefit of helping establish strong benchmark relationships for use in the farm income and balance sheet estimation programs.

USDA extended its effort to integrate survey activities to the 1999 calendar year with the AELOS which was conducted as a follow on survey to the *1997 Census of Agriculture*. It is highly likely that a similar approach to data collection will be used with the *2002 Census of Agriculture*.

This census-economic survey integration draws on key strengths of both the census and USDA=s annual economic survey programs. The census, with its enumeration of all farms, measures the highly diverse production and economic circumstances that exist geographically as well as for sub-populations of farms in the U.S. As mentioned above, the 2002 census is being designed to collect data that will allow activities of the farm to be separated from those of contractors and landlords. Moreover, multiple operators are being identified. Both actions will improve USDA measures of income for groups of farms as well as for the sector itself. Many of the measurement problems associated with the distribution of income among farms will be addressed by efforts to link the census with annual economic surveys and to identify shares of production and income that accrue to farms and other entities.

The annual ARMS is designed to both underpin USDA=s estimates of income at each level of measurement and to support research questions being raised by decision makers within USDA and the executive and legislative branches of government. For example, a first attempt to measure farm=s participation in networks and joint ventures and to determine use of the Internet to purchase inputs and sale products was undertaken for 1999. These data, will be evaluated so that questions can be refined for follow up survey efforts. The intent is to measure how common these actions are to farmers and to determine how they affect the incomes of farm businesses and the farm sector. In this way the annual ARMS works in concert with the Census of Agriculture program. The ARMS can be used to identify structural adjustments and to measure use of emerging technology. From these annual inquiries, key sector-wide adjustments can be identified for use on the population surveys such as the census. Questions about contract production on the 2002 census are an example.

The wide diversity in sizes of farms will require a departure from traditional sample and survey designs.

The Top 5000 Farms. The largest 5000 farms account for 25 percent of the agricultural sales. If this trend continues, this group will account for an even larger percent in 2002. These farms are large with complex structural and marketing arrangements. Traditional probability sampling theory will not be practical to measure income and expenses incurred by these farms. The approach will be to recognize each as a unique entity and obtain a complete profile of each farm to understand its business and marketing structure and to update these profiles annually. The data to be obtained from each will need to be tailored to their record keeping systems and their marketing cycles. This may mean as many as 5000 survey instruments. Requests for data from other government agencies will be coordinated with NASS/ERS data needs. Instruments will need to be designed to identify business arrangements used by the operations to acquire inputs and to market products. Of particular importance will be the identification of tools used by these operations to manage business and financial risks. Other key insights needed from these firms to underpin measurement of sector, business, and household income will be information about the farm=s participation in multi-firm arrangements and the operator=s ownership of multiple farms and businesses.

The Top 100 Agri-Businesses. These are the new Aowners@ of agriculture who control the flow of the products through the food supply chain. They will be the ones who will provide the information

to value the products and associated input costs as they move through the system using a value added measurement system. The data collection strategy used for the top 5000 farms will be followed for these as well. These firms will be asked to provide values to the goods being produced on farms under contract for them. They will also be asked to provide information on production expenses they incur.

Farms with \$10,000 Plus Sales. This includes 900,000 plus farms and over 70 percent of the sales. Traditional sampling and survey methods will still apply. It will require methods such as network sampling to reach the many entities providing contractual inputs and receiving income from these farms. The purpose will be to provide the same measures of net income and expenses as provided by the census of agriculture. The annual ARMS will be particularly important in tracking changes in business arrangements for these farms and farm households. Survey instruments will need to be designed to fully capture steps taken by operators to diversify business and household investment portfolios.

Farms with less than \$10,000 sales. This includes over a million farms, but less than 2 percent of the value of sales. The number of places in the sector will continue to grow as long as the definition of a farm remains an operation with \$1,000 in sales. These are places where the residents may not consider themselves to be farms and will not be found using traditional survey methods other than intensive screening using area frame sampling. This is very expensive and may not need to be done on an annual basis. These farms may need to be contacted only through the census and through the economic follow on to the census. To the extent that USDA policy interests continue to include rural areas in general and all farms, especially small farm operations, special sampling techniques may need to be devised to enable a less expensive survey of these small farms to be conducted. For example, farms may be categorized through an annual screening survey. From this, these small farms may be contacted through follow up phone and mail interviews.

Summary and Conclusions

The changing face of agriculture has placed new demands on statisticians and economists to re-define the economic indicators and their associated measurements. The emergence of contracting, marketing alliances, etc., have required that the definition of net farm income, for example, be redefined to measure the income of the agricultural sector as a whole separately from the income of the farms themselves.

As the new definitions and survey methods evolve, it will be difficult to have indicators that can be totally comparable on a long time series basis. Statisticians and economists will be further challenged to provide linkages between the old and the new measures.

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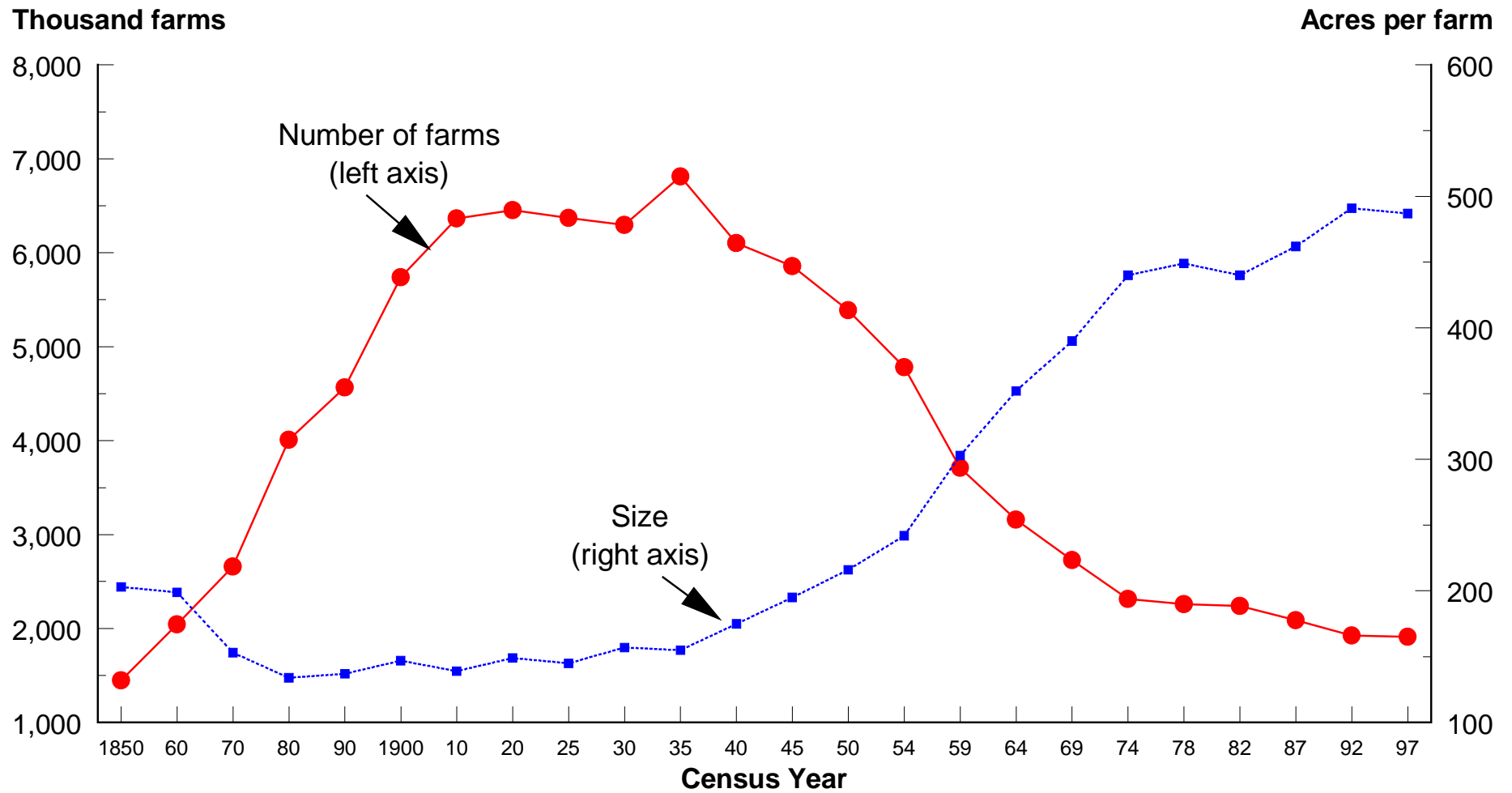
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Figure 1

Number of farms and acres per farm, 1850-1997



Source: Census of Agriculture, various years.

Figure 2 - Farm Business Linkages

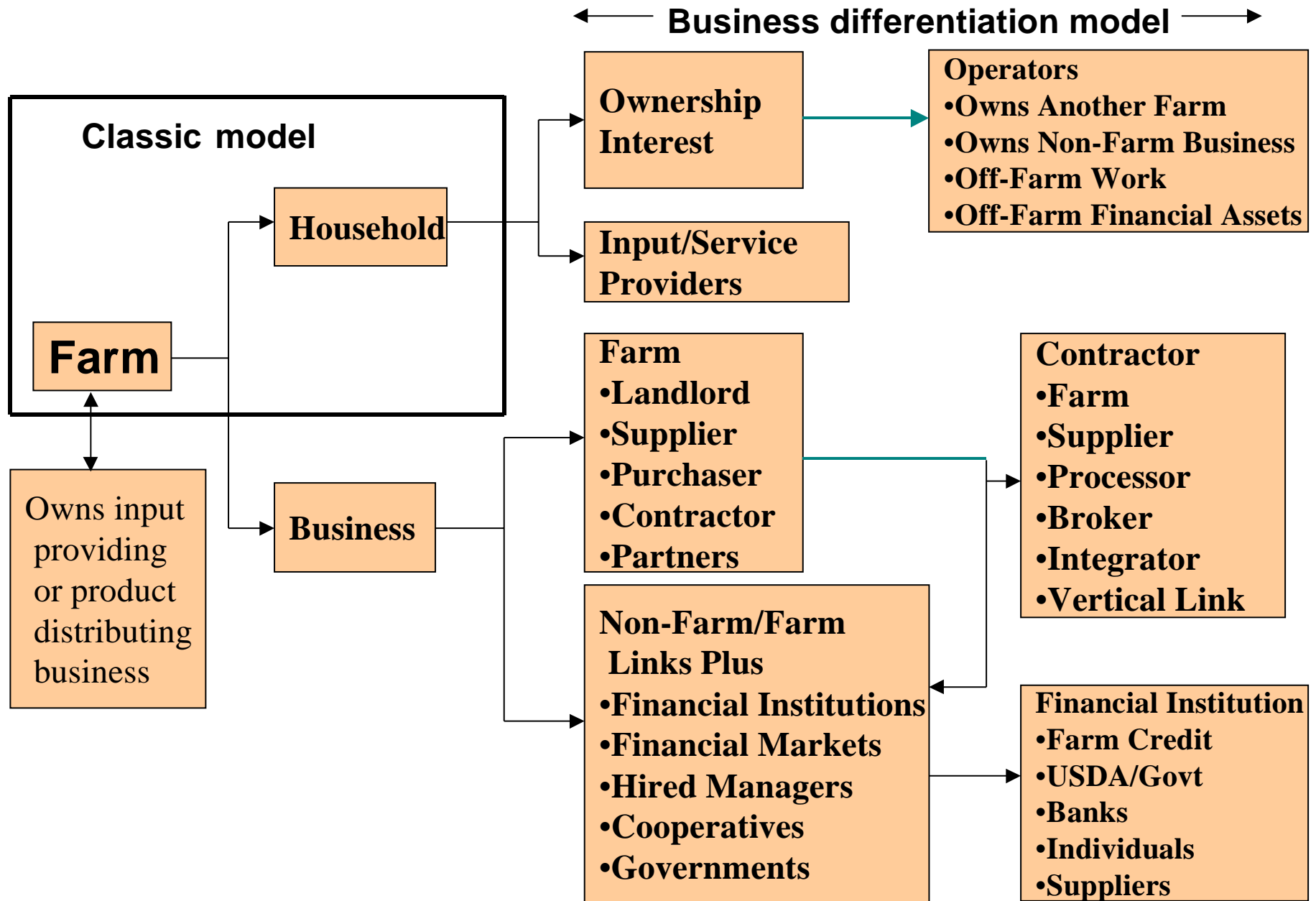


Figure 3 -

Topology

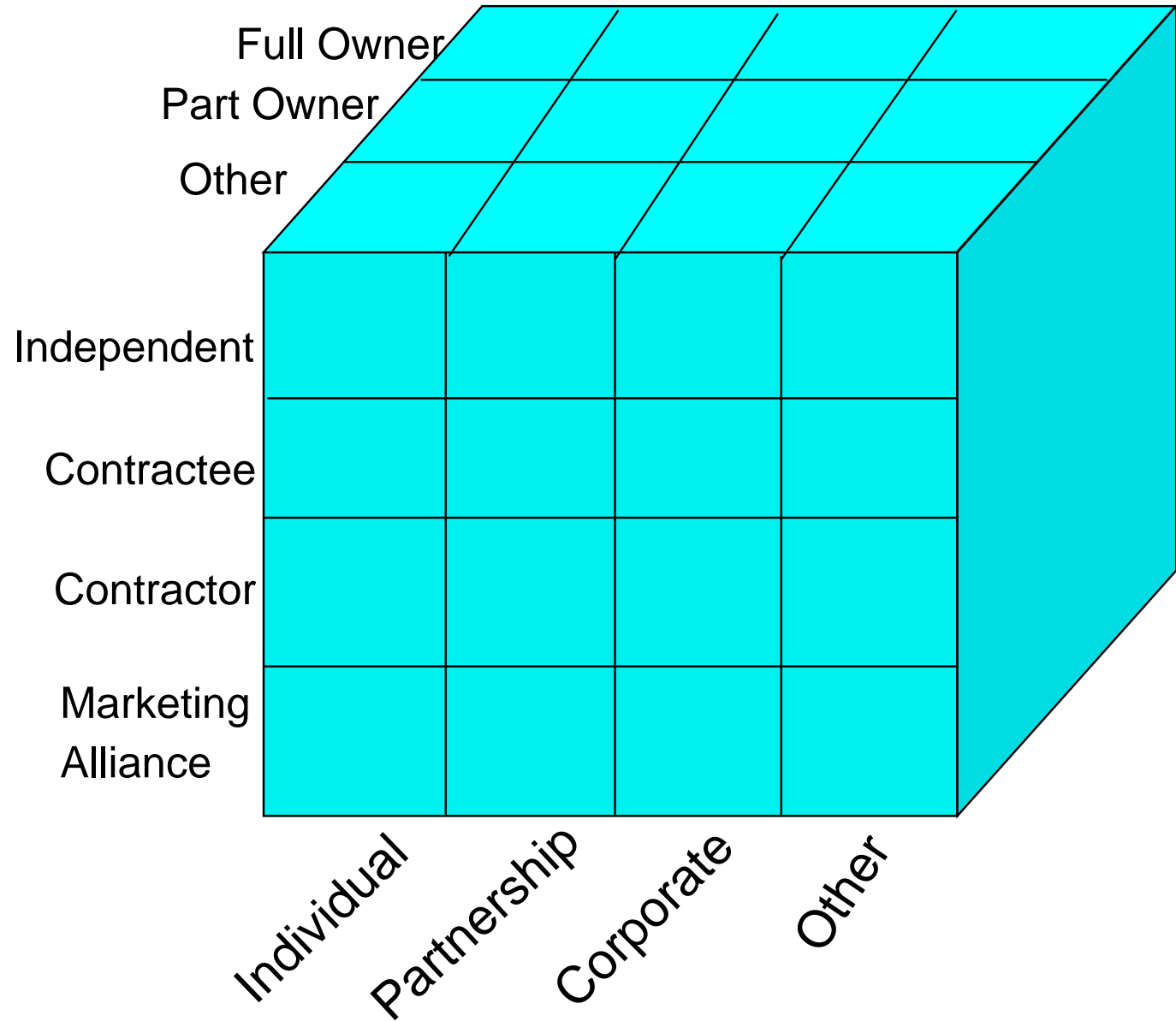


Table 1

**Measure of Concentration based on
Number of Farms Accounting for 25% of Sales and 75% of Sales,
U.S. Census of Agriculture, 1997**

	Number of Farms	Number Accounting for 75%	Number Accounting for 25%
Total Sales	1,911,000	180,867	5,062
Value of Land & Buildings		198,516	5,062
Grains		113,049	1,412
Cotton		14,193	339
Fruits, Nuts, Berries		12,461	825
Dairy		25,750	657
Cattle		85,286	2060
Hogs		26,100	559

Table 2

**Overview of Agricultural Sales by Type of Organization,
U.S. Census of Agriculture, 1997**

Item	Percent by Type of Organization			
	Individual	Partnership	Corporation	Other
	- percent -			
# Farms	86	9	4	1
Land in Farms	63	16	14	7
Total Sales	52	18	29	1
Grain Sales	68	18	14	-
Cotton Sales	48	36	15	1
Fruit/Nut, Berry Sales	33	26	39	2
Dairy Sales	59	26	14	1
Cattle Sales	44	15	41	-
Hog Sales	51	17	32	-

Table 3 . Farm operation business arrangements, by farm typology, 1998

Item	Farm typology										
	Limited-resources	Retirement	Residential /lifestyle	Farming occupation /lower sales		Farming occupation /higher sales			Large	Very large	
Nonfamily All											
Number of farms			150,268	290,938	834,321	422,205	171,469	91,939	61,273	42,296	2,064,709
Percent of farms			7.3	14.1	40.4	20.4	8.3	4.5	3.0	2.0	100.0
Percent of value of production			0.8	1.8	6.0	7.8	16.9	16.6	36.5	13.5	100.0
Input Procurement											
Used cash rent			27.3	8.6	22.8	31.5	64.3	76.0	63.4	29.4	30.1
Used share rent			*6.9	na	6.4	12.9	35.8	45.6	28.6	10.2	12.2
Used land free of charge			*20.5	5.6	12.9	10.5	5.6	4.6	3.9	na	10.5
Leased Machinery and Equipment			na	na	5.8	5.6	23.3	29.8	36.1	21.0	8.7
Hired labor			19.9	28.5	28.0	43.5	71.4	84.6	89.9	63.7	39.3
Used custom work			36.1	33.6	31.5	42.5	68.9	70.8	57.8	51.8	40.4
Used precision farming			na	na	*2.5	2.9	11.1	18.8	17.8	9.8	4.3
Marketing Options											
Had cash sales only			98.8	97.1	96.2	91.6	66.0	56.9	35.1	74.3	89.1
Sold directly to individuals			14.6	6.6	15.4	12.5	9.0	9.5	8.9	*14.5	12.5
Sold directly to retailers			na	na	*3.2	4.2	5.3	*6.2	8.3	*7.7	3.6
Options to forward price commodities			na	6.9	8.2	8.4	20.9	29.2	25.6	*15.5	10.3
Coordinated Activities											
Had marketing contracts			na	na	3.4	7.2	29.0	35.1	37.1	24.6	8.8
Had production contracts			na	na	0.5	*1.2	6.9	10.1	32.3	2.5	2.6
Membership in marketing cooperative			na	8.7	8.5	15.8	28.6	32.0	28.3	22.3	13.4
Membership in supply cooperative			15.5	23.8	24.9	34.8	55.4	60.1	45.4	31.1	30.9
Household Attributes											
Operator Occupation											
Farming			35.4	na	na	100.0	100.0	95.1	96.3	20.6	38.8
Hired manager			na	na	na	na	na	na	na	57.7	1.2
Non-farm work			30.1	na	100.0	na	na	*3.9	3.0	*14.9	43.2
Retired, but still farming			34.6	100.0	na	na	na	na	na	na	16.8
Operator had off-farm job			45	*18	96	27	22	17	14	na	53
Spouse had off-farm job			*15	17	61	40	46	49	35	na	43
Average number of households earning income											
from the farm			1.03	1.04	1.07	1.10	1.14	1.42	1.51	1.00	1.10
Household has income from another farm			na	na	*1.5	2.0	2.4	*2.9	4.5	na	1.7
Household has income from another business			na	4.1	19.2	9.7	11.3	*15.8	8.3	na	12.6
Farm had Conservation ReserveProgram land			na	16.3	7.2	8.7	12.0	13.1	9.2	*17.1	10.0

Source: 1998 USDA Agricultural Resource Management Study.

Table 4. Income Concepts and Measurement Issues in the United States

Measurement Concept	How Measured	Measurement Issues
<i>Sector Aggregates</i>		
Gross value added	Final sector output, less intermediate consumption outlays, plus net government transactions	Own account formation (breeding stock has not been separated from livestock purchased for resale); vehicle registration and licensing fees have not been collected
Net value added	Gross value added, less capital consumption; residual after deduction for exhaustible inputs used in the production process	Fixed investment and capital stock has not explicitly accounted for orchards, other trees cultivated for products they produce, and vines in vineyards; changes in inventories of raw materials and supplies are not explicitly measured; horses have not been included in the capital stock Net value added is distributed to farm creditors, employees, landowners, and the farm operator-manager (residual profits) in accordance to market-determined shares. Issue to resolve: residual profits accrue to operators and others who provide equity used in farm production activities
Net farm income	Net value added, less factor payments (hired labor, net rent, interest); net value of goods and services generated by farm operations during a given calendar year	Same issues as for gross and net value added; net farm income accrues to operators and others whose contribution to an operation's production of goods and services is not directly compensated through an expense payment
Net cash income	Gross cash income, less cash expenses and net rent to non-operator landlords	Same issues as for net farm income
<i>Farm Level (Business)</i>		
Gross value added	Farm output, less intermediate consumption outlays, plus net government transactions	
Net value added	Gross value added less capital consumption	
Net farm income	Gross income (marketing contracts, cash sales, government crop loans and payments, other farm related income such as custom work and machinehire, inventory change, imputed rents for dwellings), less expenses (total cash plus non-cash for paid labor and depreciation)	Breeding stock treated as capital; includes net change in production inputs; includes net change in accounts receivable; explicitly accounts for contract production; explicitly accounts for distribution of income among providers on inputs, <i>leaving a measure of income of the farm business</i> Does not currently investment in orchards, other trees cultivated for products they produce and vines in vineyards in capital stock; horses have not been included in capital stock
Net cash income	Gross cash income, less total cash expenses	Explicitly accounts for cash sources of earnings and expenses for the farm business
<i>Operator's Household</i>		
Income from farming	Net cash business income, less depreciation, less share of income to other households, plus wages paid to operator, net rent for farmland and other farm related income including another farm	Explicitly accounts for number of households sharing in farm business income <i>and share of business net income earned by the operator</i> ; accounts for earnings by the operator household from another farm
Off-farm sources of income	Wages, salaries, non-farm business net income, interest, dividends, transfer payments, etc	Explicitly accounts for earnings from non-farm sources, <i>including net income from a non-farm business</i>
Total operator household income	Household's share of farm income plus off-farm income sources	Conceptually consistent with <i>measures of income developed by U.S. Government for non-farm households</i>

Table 5. Income Measurement Issues Raised by Business Arrangements Incorporated into U.S. Farm Business Plans

Business Arrangement	Measurement Issue
Marketing Contracts	Price and quantity transactions are not observed through traditional market channels; contracts are farm specific; prices are negotiated
Production Contracts	Shared ownership of factors of production; transactions are not public; farm specific fees and premiums
Network or Alliance	Farms joint in a formal or informal agreement to jointly work to achieve a desired end result (e.g., create a market or acquire inputs); may only involve sharing common goals and procedures; no capital may be shared; transactions are likely outside traditional market channels, meaning that prices and quantities would not be observed through traditional farm outlets
Joint Venture (Could also be considered a network)	Farmers joint together to acquire inputs or market products; usually involves a separate business entity to carry out a specific activity such as own machinery, feed or breed livestock; or to transport and market products or purchase inputs; usually involves a farmer's investment; transactions outside traditional marketing channels
Consumer/End-User Direct Sales	Individual, highly specific transactions with individual customers of the farm; data are farm specific and proprietary
Direct Sales to Wholesalers/Retailers	Negotiated farm-to-firm transactions; as with consumer direct sales, individual sales are farm specific and proprietary
Internet Purchases and Sales	Individual transactions that bypass traditional suppliers and market channels; farm specific; terms of trade transaction specific
Vertical Integration	The farm is owned by the processor that provides inputs to production and values the commodity at wholesale or retail levels - includes branded products.