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# Determinants of Farm Size and Structure

Proceedings of the program sponsored by the NC-181 Committee on Determinants of Farm Size and Structure in North Central Areas of the United States, held January 16, 18, and 19, 1988, in San Antonio, Texas.

*Robison/Introduction and Overview*

*Johnson/Farm Managerial Inquiry: Past and Present Status and Implications for the Future*

*Batte/Question and Answer Session Following Glenn Johnson's Presentation*

*Sonka/Factors We Observe on Successful Midwest Farms Today*

*Ruttan/Scale, Size, Technology and Structure: A Personal Perspective*

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*Hallam/Economies of Size: Theory, Measurement, and Related Issues*

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*DeFraín and Stinnett/Strong Families and Strong Farming Organizations: Is There A Connection?*

*Richardson, Smith, and Knutson/Who Benefits From Farm Programs: Size and Structure Issues?*

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## **STRONG COMMUNITIES - STRONG FARMS: WHAT IS THE CONNECTION?**

Thomas A. Carlin\*

Organizers of the 1988 NC-181 Regional Research Committee meeting asked me to discuss the relationships between farm structure and rural communities. My discussion will have three parts. First, what are the general economic conditions in rural America in the mid-1980s? Second, what effect does farm structure have on rural communities? Finally, does the local rural economic environment affect the structure and financial conditions of the local farming sector?

### **Today's Rural Economic Conditions**

We have witnessed a major economic transformation of rural America in the last four decades. The key element of this transformation has been the relative decline in farming as the dominant rural industry. In 1950, at the beginning of the rapid decline in farm numbers, over 2,000 nonmetro counties in the 48 contiguous States had at least 20 percent of their total earnings from farming (Figure 1) [Hoppe]. By the early 1980s, only 505 nonmetro counties could be designated as farming-dependent counties (Figure 2) [Ahean, Bentley, and Carlin]. Manufacturing, government, and recreation/retirement are among the industries now dominating many rural economies [Bender et al.].

Throughout the 1970s, the paradigm proffered by most economists and other social scientists interested in rural America emphasized employment and population growth, particularly in the South and West. However, this optimistic outlook began to fade in the early 1980s. The 1979-82 recession was especially severe on several goods-producing industries (agriculture, mining and energy, and manufacturing) important to rural America. And, growth in rural service sector employment was insufficient to compensate for the stall in goods-producing employment growth. Some rural counties, such as those specializing in manufacturing, experienced declines in total employment. Nonmetro unemployment rates rose. Since 1984, conditions have improved in manufacturing counties but have continued to deteriorate in farming and mining areas. Overall, nonmetro employment growth is modest relative to metro areas.

The number of rural counties experiencing population decline increased from the 1970s number. During 1983-85, 1,160 nonmetro counties lost population, compared with 460 during the 1970s [Brown and Deavers]. National data since 1983 have shown an increasing net outmigration of people from nonmetro counties. Between 1985 and 1986, 632,000 people moved from nonmetro areas: a larger outmovement than the annual average of either the 1950s or 1960s. With the exception of retirement/recreation areas, the one economic bright spot in rural America, today's rural development paradigm resembles that of the 1950s and 1960s.

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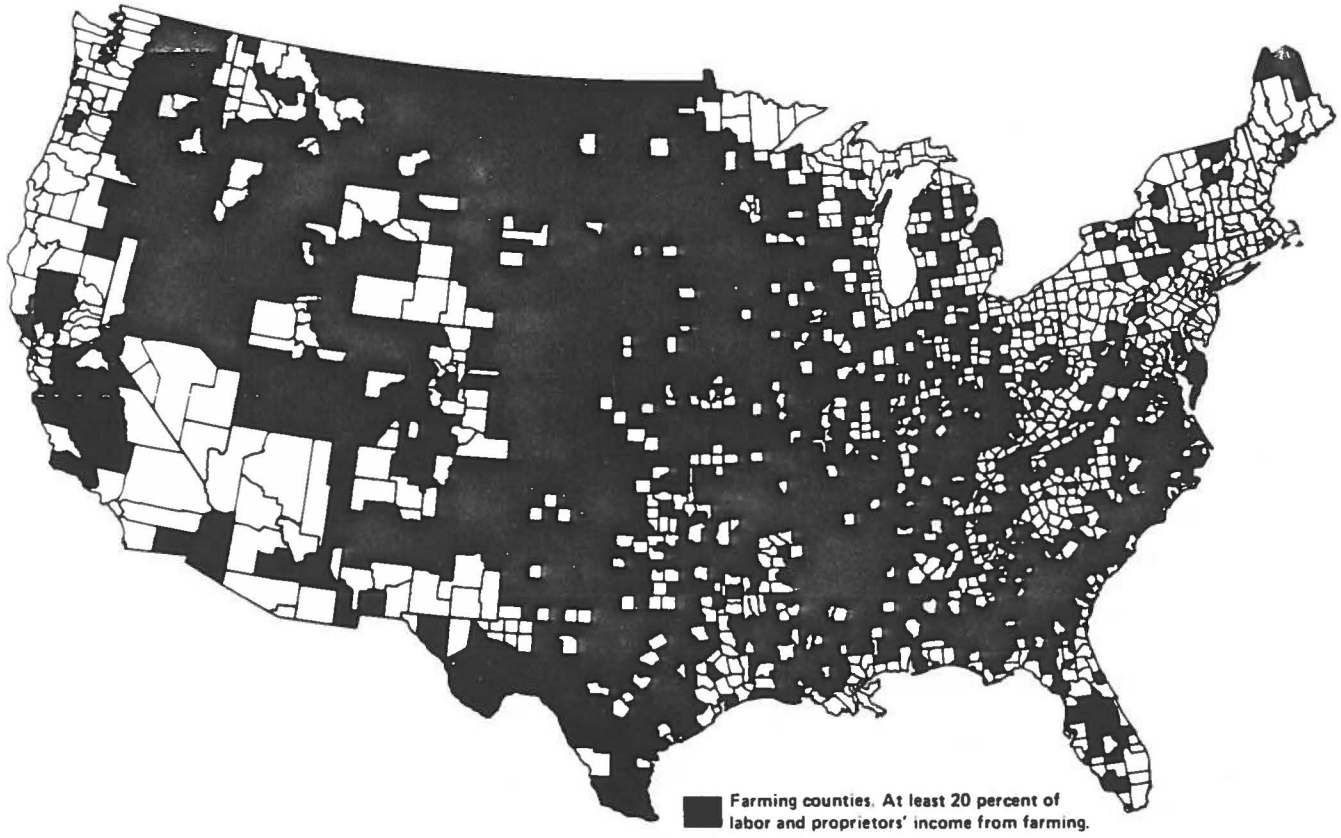
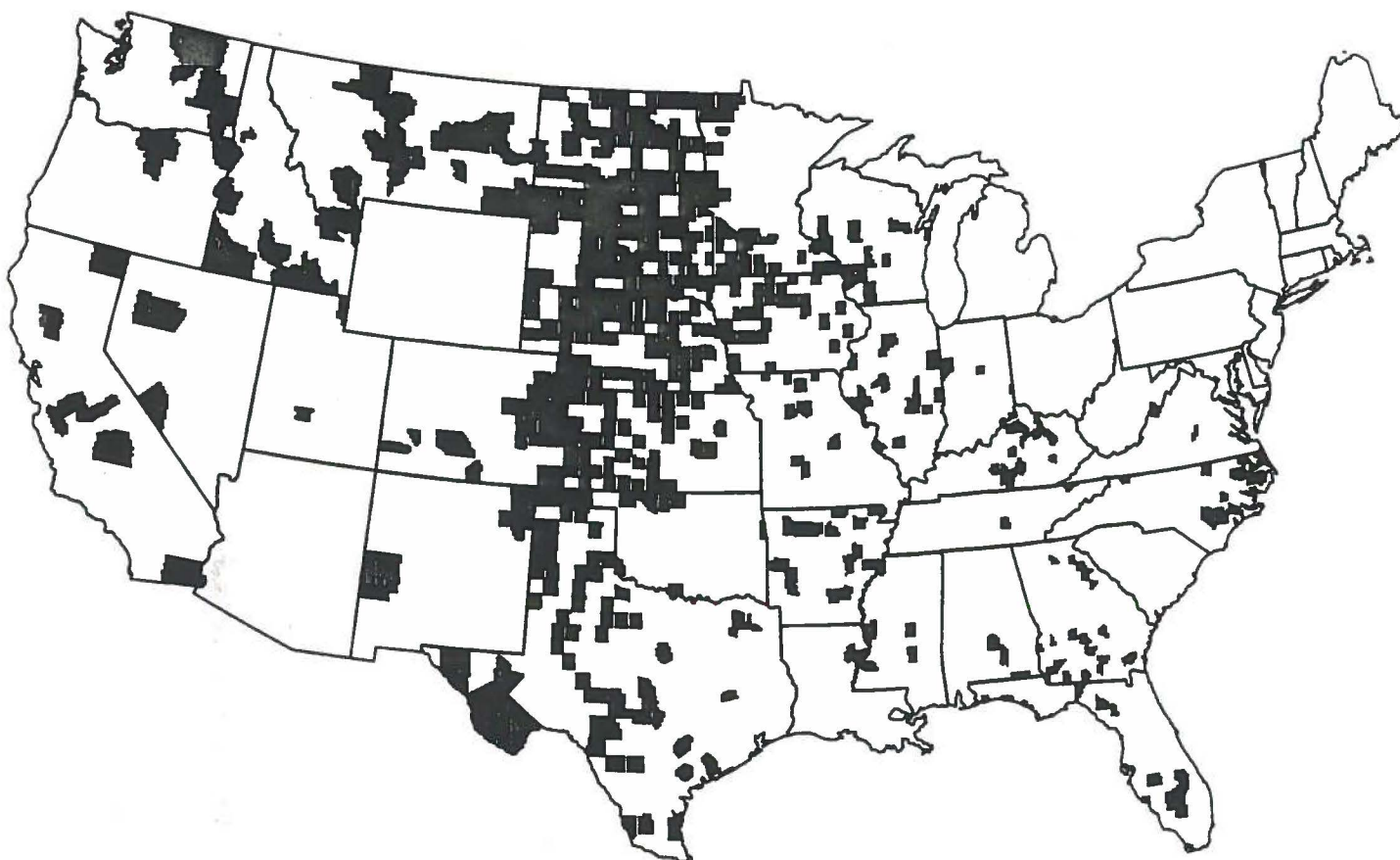


Figure 1.

Farming-Dependent Counties, 1950





**Figure 2.**

**Farm Dependent Counties, 1980-84\***

\* Twenty percent or more of total earnings in the county for the period 1980-84 were from farming.

It is against this backdrop that we discuss the relationships between farming or farm structure and local communities. Financial conditions in farming have begun to improve during 1987-88, compared with the early 1980s. Land prices are beginning to stabilize and even rise again in some areas. Farmers have paid off substantial debts and otherwise have reduced production costs. Exports have grown in 1987, more in volume than in value. The Economic Research Service (ERS) is forecasting export volume and value to rise further in 1988. ERS is also forecasting 1988 cash farm income to be near the record \$57 billion for 1987. Even with these positive signs, I don't see nonmetro employment being significantly influenced by the changing economic circumstances in farming. Even during the relatively prosperous 1970s, total employment in farming continued to decline. Farm employment will likely continue to decline into the 1990s. Job growth in food and fiber wholesaling and retailing is perhaps one bright spot within a broadly defined food and fiber sector. However, most of this employment is located in metropolitan areas and thus is unlikely to influence rural economic conditions [Petrulis et al.].

### Farming's Influence on the Community

There is a rich body of literature on the effect of farm structure on the local rural community. Goldschmidt's classic study of Arvin and Dinuba in the late 1940s is generally considered the genesis of this area of research [Goldschmidt]. The central theme from this work was that communities dominated by owner-operated family farms were more "viable" than those dominated by corporate agriculture. Viability encompassed aspects of both income and community involvement.

Heady and Sonka examined the effect of alternative farm structures on several economic variables, including the secondary income effects on nonfarm sectors [Heady and Sonka]. They used the Iowa State national linear programming model which considered some 150 production areas and 31 consuming regions. Four different farm structures were used, one of which served as the control. Their results point to the tradeoffs among producers, consumers, and rural communities, of alternative farm structures. A farm structure dominated by smaller farms generally does result in greater income generation in rural communities but the farmers experience lower incomes and consumers may have to pay more for food.

Henry, Somwaru, Schluter, and Edmonson examined some effects of farm size on the nonfarm economy in an effort to extend the Heady and Sonka analysis [Henry, Somwaru, Schluter, and Edmonson]. They merged a farm income and production expense account into the national input-output model to examine the direct and indirect changes in input use as a result of changes in the farm size distribution. They concluded that locally oriented service and trade sectors benefit most from a farm structure dominated by medium-sized farms.

Several other studies, including those conducted by Heffernan and Lasley, Markousek, and Otto and Meyers, also examined the effect of different farming structures on the nonfarm sectors, including the public sector (these studies are reviewed in [Salant and Munoz]). They all generally examined the tradeoffs between farmers and the nonfarm sector under alternative farm structures. They suggested that the nonfarm sector of rural communities fare better under a farm economy dominated by small- and medium-sized farms.



### The Community's Influence On Farming

Farming has been a declining source of both employment and income in most rural areas and the chances of it becoming a major driving force for rural economic growth are low at best. While much energy has been devoted to analyzing and discussing farming structure, there has been little consensus concerning the ideal structure of U.S. agriculture. Our public policies are often at cross-purposes with respect to farm structure [U.S. Department of Agriculture, 1981]. In light of the industrial structure of today's rural America, students of farm structure might find it useful to formulate the question the other way around. How does the community affect the local farm sector? The answers differ depending upon where a particular community is located.

Using a conceptual approach developed by Babb, Green and I postulate that the national farm sector is influenced by international and national policies and events, called macro events, as well as the sum of local events across the United States [Babb; Carlin and Green]. Agricultural economists tend to focus on macro events as they affect farm structure while devoting less attention to local conditions. Expressing the idea in a different manner:

$$(1) \text{ National farm structure} = f \left( \text{macro events} + \sum_{i=1}^n \text{local farm structure}_i \right)$$

$$(2) \text{ Macro events} = g \left( \text{national public policy, national economic conditions, international economic conditions} \right)$$

$$(3) \text{ Local farm structure}_i = f \left( \text{macro events, FS}_i, \text{ES}_i, \text{G}_i, \text{HC}_i, \text{PS}_i \right)$$

where:

FS<sub>i</sub> is attributes of the local farming sector, ES<sub>i</sub> is the local community economic structure, G<sub>i</sub> is local geography, HC<sub>i</sub> is local human capital, PS<sub>i</sub> is population size and the public sector, and i is the local community.

This specification is not necessarily rigorous, but serves as a convenient way to state a fairly complex idea. For this paper, I would like to focus on equation 3. Formulating the relationships this way opens the door to a much broader discussion of the factors affecting farm structure.

The effects of macro events on farming structure are well-known and have been chronicled by others [U.S. Department of Agriculture, 1986]. Macro events may influence local community farm structure, but the linkages are complex. I am not really interested in unraveling these particular relationships, so I will essentially treat them as fixed. Components of the local farming sector include enterprise combinations, level of technology adopted by local producers, land characteristics, level of capital investment in the local farming plant, among others. These factors are distributed differently across the United States and they influence the way the local farming sector evolves. A local community's nonfarm economic activities, such as durable goods manufacturing, compete with farming because they provide alternative uses of labor, land, and other capital. These variables establish the opportunity cost for farm resources. (Included here are situations where farm resources are underemployed. Thus, nonfarm economic activities are, in fact, complementary to local farming.) Our notion of geography encompasses a wide variety of



variables, including topography, climate, settlement patterns, and the availability of water. Human capital, which encompasses formal and informal education, health, and aesthetic and recreational experiences, affects the productivity of labor both on and off the farm. Population size and public sector relate to the patterns of demand for land and the level of private and public services a community can maintain. These variables, in concert, influence the structure of the local and, consequently, the national farming sector.

## Review of the Literature

There were a number of case studies conducted from the late 1950s through the 1970s which examined the effect of rural nonfarm employment growth on the local farm sector (these studies are reviewed in [Salant and Munoz]). Bertrand and Osborne (1959) studied the effect of a wood products plant locating in a rural community in southeastern Louisiana. Agriculture in that area was characterized by small marginal farms, indicating the existence of underemployed farm labor. The researchers found that farm operators employed in the plant made little change in their farming operations.

Fuller (1960) studied the effect on farming in a five-county area of a manufacturing plant locating in north central Pennsylvania. Fuller found that few of the sample farm families actually took jobs at the plant and, for those that did, there were negligible changes in their farming operations.

Maitland and Friend (1961) reviewed the results of five studies of rural industrialization in Iowa, Utah, Mississippi, and Louisiana. All the areas were characterized as small, low-income farming areas. The proportion of plant employees who were farmers ranged from 7 to 25 percent. Industrial employment was generally associated with a decline in the farm operator's contribution of farm labor and subsequent substitution of unpaid family labor.

Scott and Chen (1973) modeled the effects of industrialization (new steel rolling plant) in Putnam County, Illinois. Using a three-stage linear programming model involving six representative farm sizes, the authors concluded that small farmers benefited because of their underemployed labor resources. They decreased labor-intensive livestock enterprises, continued with crop production, and took off-farm jobs. (The authors assumed that the prevailing nonfarm wage rate, opportunity cost of farm labor, would increase.) Faced with higher labor costs, large farmers also substituted less labor-intensive enterprises. The net result was higher and more evenly distributed income in the local farm sector and general economic stimulus in the community. The literature generally suggests that increased nonfarm employment opportunities in a rural community are related to positive increases in total family income for small farmers and are also associated with a change toward less intensive farming operations. The literature provides mixed results about the effects of nonfarm employment expansion on operators of larger farms.

## ERS Research

Green and I examined the effects of community on the structure of the local farming sector in the following way [Carlin and Green]. We selected a single variable to represent farm structure: the proportion of farms in a county with gross farm sales of less than \$40,000. We then arrayed these counties from lowest to highest using this ratio. This yielded a continuum of percentages that could be reduced to a small number of county groups by setting cut-off points or percentage threshold levels. We selected quartiles as the basis for groupings. Small-farm counties were those

in which 88 percent or more of the farms had 1982 gross sales of less than \$40,000. Large-farm counties were those in which fewer than 59 percent of the farms had 1982 gross sales of less than \$40,000. Mapping these counties reveals significant geographic groupings (Figure 3). Large-farm counties are concentrated in the Plains, Midwest, and Mississippi Delta. Small-farm counties are predominately in the Southeast.

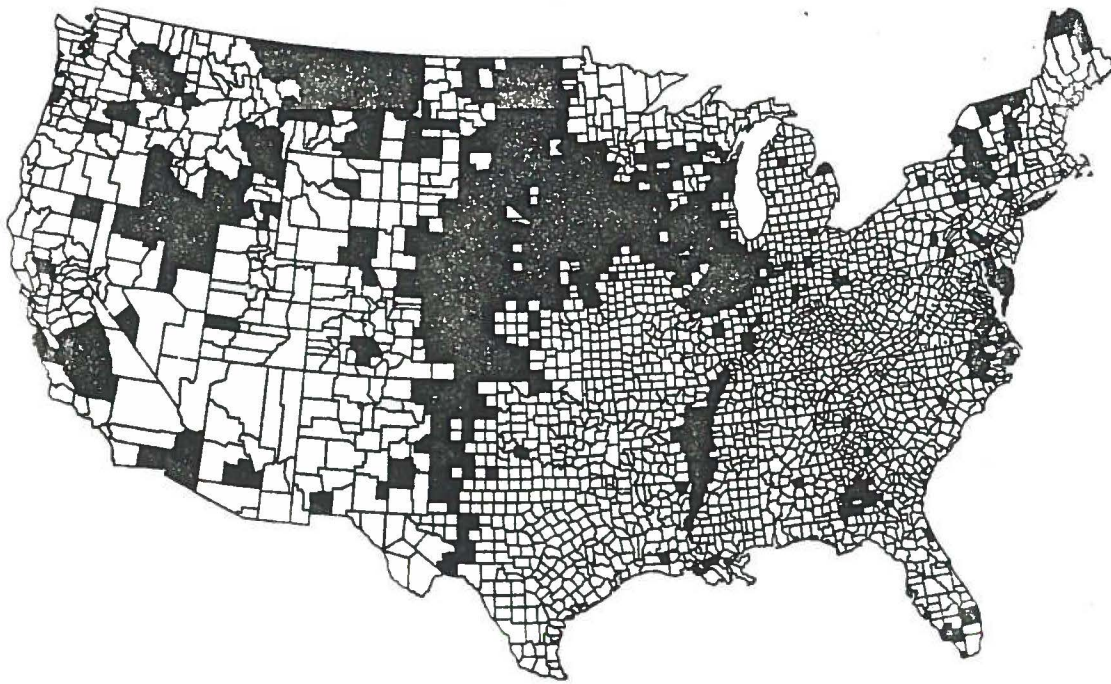
We then raised the question of factors that might help explain why the structure of the local farming sector varies across the United States. We used the above model to identify numerous variables that might be considered. We also used discriminant analysis to help identify key variables that might be associated with the two typologies. We are looking at independent variables that might be associated with differences observed in the independent variable. We don't claim to be identifying causal relationships. Large-farm counties are characterized by relatively large investments in farming and relatively small employment bases with few nonfarm job opportunities. In contrast, small-farm counties have larger, more diversified economic basis. The results suggest that the structure of the local farming sector is associated with not only conditions within that sector but also by conditions in the local nonfarm sector. Conscientious decisions on the part of local community leaders to attract nonfarm employment to their communities may alter the structure of the local farming sector. This study confirmed that students of farm structure need to consider events in the nonfarm economy as they develop models.

Many of you are familiar with ERS's farm structure work using the longitudinal Census of Agriculture file [Edwards, Smith, and Peterson]. ERS has an exact match file for the 1974-78 Census of Agriculture and has about completed a similar match for the 1978-82 censuses. This work has yielded useful information that has altered some of our assumptions about how farm structure changes over time. For example, changes in farm size, as measured by acres or gross farm sales, display a great deal of symmetry; for every farm that was likely to increase in size, there is one that is likely to shrink between census years. Previous research used synthetic models that usually specified that farms either grew or exited the system. ERS and Census Bureau researchers designed the longitudinal census data systems with Markov analysis in mind as the main analytical technique.

I would like to focus on one recent study that relates to the theme of nonfarm effects on farm structure [Smith]. Conventional Markov analysis assumes a stable transition matrix. Agricultural economists generally agree that this assumption is not realistic. ERS staff have been exploring ways to accommodate this concern. Smith used multinomial logit functions to develop nonstationary transition probabilities for the U.S. model based on the 1974-78 transition matrix. Farm size was based on gross farm sales. Smith did not have time series data. However, he did have matrices for nine census regions which he could use as a "substitute." Exogenous variables that Smith included in his analysis were age of the existing operator population (proportion age 65 or older), extent of off-farm work by the existing operator population (proportion of operators working off-farm 200 days or more per year), change in farm product prices (U.S. indices of prices received by farmers for crop and livestock products weighted by 1974 regional crop and livestock sales), change in farm asset prices (index of change in the total value of farm real estate in the region between 1974 and 1978), and change in nonfarm incomes (index of change in regional per capita nonfarm personal income, 1974-78).

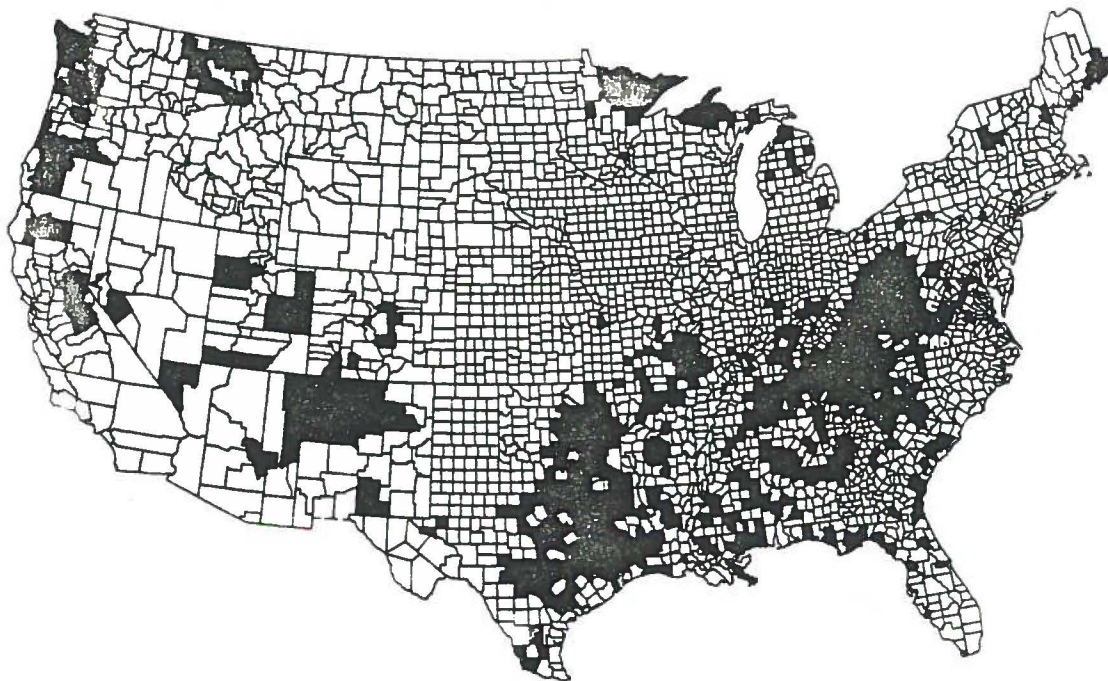


**U.S. Large Farm Counties, 1982\***



\* Less than 59.3% of farms with 1982 gross farm sales of less than \$40,000.

**U.S. Small Farm Counties, 1982\***



\* 88% or more of farms with 1982 gross farm sales of less than \$40,000.

**Figure 3.**



For many of the cells of the transition probability matrix, the independent variables considered had little or no explanatory power, particularly for those rows with farms having initial sales up to \$4,999 and sales over \$500,000. For the remaining rows, the proportion of operators age 65 years and older in 1974 was positively associated with the probability of exit by 1978, particularly for farms with initial sales of \$20,000 to \$499,999. Where statistically significant, nonfarm income growth was positively related to the probability of declines in farm sales and negatively related to farm growth. The proportion of operators working off the farm 200 days or more was positively related to the probabilities of both exit and growth for farms with sales of \$40,000 to \$99,000. That is, the combination of full-time, off-farm work and a farm of this size is not sustainable; operators tend either to leave farming completely or increase their farm size to improve total income. Two points seem relevant to our concerns. First, the area of research Smith initiated seems fruitful because the results lead to better projections of structure. Second, nonfarm variables seem to play an important role in guiding the system.

The last study I want to discuss was conducted by Ahearn, Bentley, and myself [Ahearn, Bentley, and Carlin]. Farm financial stress has been a prominent public issue in the mid-1980s. One of our key questions was the relationship between individual farm financial stress and the extent to which farming dominates the local economy. Farm businesses and households are affected by county farm-dependence in at least three important ways. First, land values are affected by expectations about the ability of the land to generate income. Thus, in counties dominated by farming activities, land values will be sensitive to expectations about farm income. In counties dominated by nonfarm industries, competition from alternative users of farmland will ameliorate declines or actually increase farmland values, thus strengthening the equity position of farmers. Second, off-farm incomes are important for sustaining many farm households. The larger and more diverse the nonfarm sector in the local economy, the more likely that farm household members will be able to obtain nonfarm employment to help maintain household income and maintain the farm business. Finally, some farm households are changing their farm enterprise mix to include specialty crops in an effort to maintain farm income. The larger the nonfarm sector, the more likely such farmers will be able to find local marketing niches with good chances for success.

We divided the counties in the contiguous United States into three types:

- (1) Farming dependent -- 20 percent or more of labor and proprietor income in the county for 1980-84 was from farming.
- (2) Farming important -- 10-19 percent of the total labor and proprietor income in the county for 1980-84 was from farming.
- (3) Nonfarming dependent -- less than 10 percent of the total labor and proprietor income in the county for 1980-84 was from farming.

We used the USDA 1986 Farm Costs and Returns Survey (FCRS) as the data base for the analysis of farm financial stress. Each record in the file includes a county code. Thus, we can attach county attribute data to each record in the FCRS. FCRS contains detailed information about farm assets, debts, income and expenses, off-farm income, age of the farm operator, and number of persons in the household. The survey yielded 12,428 sample observations, representing 1.57 million farms in the 48 contiguous States.

We also developed four measures of financial stress for this study. Net cash household income includes both net cash farm income and off-farm cash income from all sources, such as nonfarm wages and salaries, interest, and dividends. We use both farm balance sheet and cash

farm and household income to determine a farm household's financial position. In our scheme, CCC loans are not treated as debt since the operator has the option of not repaying them and allowing the Government to keep the commodities. CCC loans are included in the income account. We use the U.S. Department of Commerce's official poverty line as the measure of the minimum household cash living requirement. We used the procedure developed by USDA to estimate principal payments. Our categories are:

- (1) Secure position -- farm debt/asset ratio of less than 0.4 and total household cash income from all sources equal to or greater than the sum of estimated principal payments on farm debt and the household's minimum cash income needed for family consumption.
- (2) Low income position -- farm debt/asset ratio of less than 0.4 and total cash household income less than estimated principal payments on farm debt plus the household's minimum cash income requirement.
- (3) Potential financial risk -- farm debt/asset ratio equal to or greater than 0.4 but less than 0.7 regardless of total household income or farm debt/asset ratio equal to or greater than 0.7 but less than 1.0 and total cash household income equal to or greater than estimated principal payments on farm debt plus the household's minimum cash income requirement.
- (4) Financial risk -- all other farm households.

About 60 percent of all U.S. farm households were in a secure economic position in 1986. About 20 percent were in a low-income position and another 20 percent were either in the potential financial risk (14 percent) or financial risk (6 percent) category.

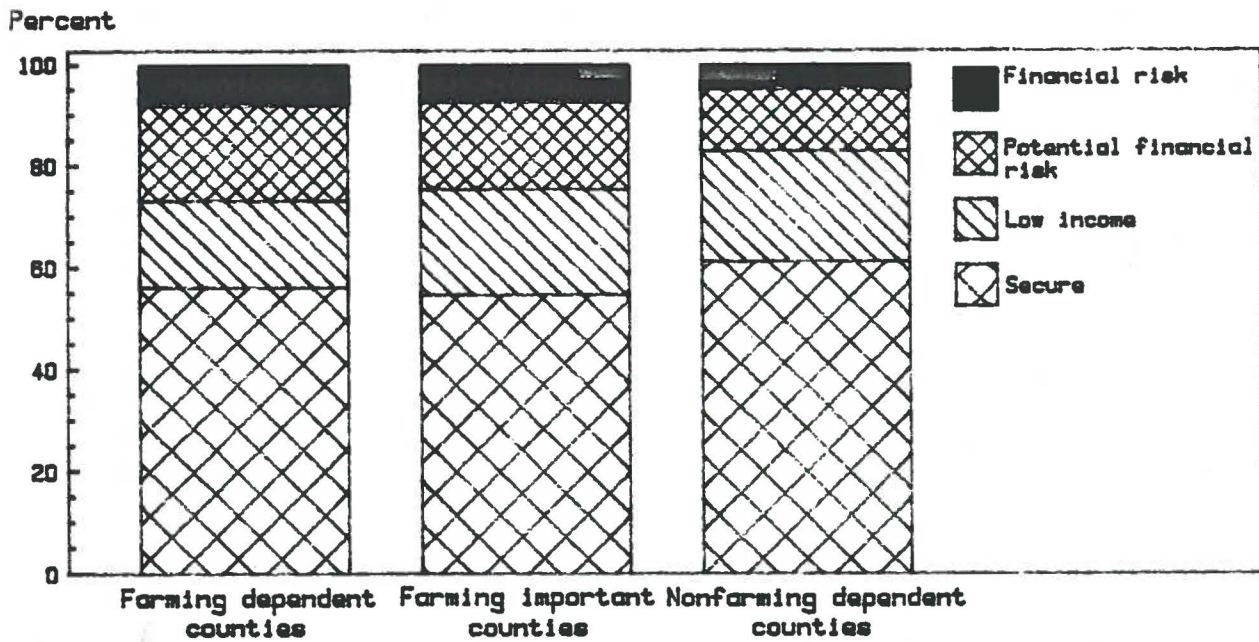
The incidence of financial risk increased as a county grew more dependent on farming as a major economic activity (Figure 4). About 27 percent of all farm operator households living in farming-dependent counties experienced some financial risk, compared with 17 percent of those farm operator households living in nonfarming-dependent counties. However, the incidence of low incomes alone was lower in farming-dependent counties than it was in farming-important and nonfarming areas. These relationships are consistent with what we know about economic risk positions by farm size and the size distribution of farms by county type.

Ahearn and I did a more rigorous analysis of the effects of community attributes on farm household financial conditions using data from the 1985 FCRS [Ahearn and Carlin]. In this analysis, we specified a general model as follows:

$$\text{FARM STRESS} = f (\text{FARM CHARACTERISTICS, ACCESS TO METRO AREA, HOUSEHOLD CHARACTERISTICS, FREE TIME, LOCAL AREA JOB CHARACTERISTICS})$$

where FARM STRESS is defined similar to above as 0 = secure, 1 = low income, 3 = potential financial risk, and 4 = financial risk. The analytical technique used was logistic regression. For each record in the 1985 FCRS, we appended the relevant county attribute data.





Source: ( X ).

Figure 4.

**Farm Operator Households: Economic Position by County Type in 1986**

Farm characteristics included type of farm (crop or livestock) and acres operated. We expected crop farms to be associated with higher risk. The effect of acres operated is more difficult to hypothesize, but we generally expected larger farms to be more at risk of financial stress. Access to a metro area was defined as not being a metro area or not adjacent to a metro county; this signified less access to markets and potentially lower and less stable land values because of fewer alternative uses of land. We expected a positive relationship between stress and nonadjacency. Household characteristics included operator age and education. Older farmers typically have less debt; thus, we expected a negative relationship with respect to stress. We were less sure about education, but generally felt that higher levels of education indicated greater management skills; thus, education would be negatively related to stress. Free time for off-farm employment is identified by the total hours the household spends working on farm production. This measure is expected to be positively related to stress because as time spent farming increases, the time available for off-farm work declines; therefore, the household is exposed to greater income variability. Local area characteristics included the percentage of the county's labor and proprietor income from farming and the county's nonfarm labor and proprietor employment in 1984. We expected a positive relationship between stress and farm dependency for the reasons discussed above. Nonfarm employment is expected to be negatively related to stress. We ran two regressions: one for the Midwest and one for the South.



I will focus here solely on the local area characteristics variable. For the Midwest, county agricultural dependency was significant in explaining variations in stress. Two interaction terms involving local area characteristics were also significant. For the South, the direct effects of the local area variables were not significant but some interaction effects were significant. These direct and interaction effects of the local area characteristics measured by the logit analysis indicate that a diverse local economy does reduce the odds that a farm household will be in financial stress. These results support those observed in the tabular analysis presented above.

Our results point to important relationships between the well-being of farm operator households and the characteristics of the counties in which they live. These relationships can be observed through both the farm household income statement and the farm balance sheet. The more dependent a county's economy is on farming the larger the average size farm and the less likely the operator is to work off-farm. There are fewer alternative opportunities for the use of farmer's labor in farming counties; thus, there are incentives for farmers to expand their farms to achieve fuller employment and higher income. Even though there are differences in the observed allocation of farm household labor among the county types, there were no major differences in total economic risk among the counties. That is, a farm household is as likely to report economic risk in a farming-dependent county as in a nonfarming-dependent county.

There are, however, substantial differences in the type of economic risk observed among the county types. In general, the more a county depends on farming, the more likely a farm operator household is to be in a financially risky position as opposed to low-income position. This suggests that community characteristics can affect a farm household's well-being through the balance sheet. Even though farmers, as a group, reduced their total debt burden during the 1980s, debt reduction could not keep pace with falling land prices; thus, the sector's equity position deteriorated. It appears that farmland owners in farming-dependent communities bore the brunt of asset value declines. The lower incidence of low income in farming-dependent counties is a bit puzzling. One explanation might lie in Government payments. Farms in farming-dependent counties specialize in producing those crops included in Federal farm commodity programs. Sixteen percent of the farms and 23 percent of agricultural sales were in farming-dependent areas, but they received one-third of direct Government payments in 1986. Government payments played a role in ameliorating economic stress in farming-dependent areas. Without direct Government payments, economic stress would have surely been higher in farming-dependent counties during the mid-1980s.

## Conclusions

Linkages between farm household viability and community characteristics operate in both directions. The more a local area depends on farming the more likely that changes in the fortunes of the farm sector will be felt in the local community. Farming communities are in essence a special case of the "one company town." Farm employment has declined even in relatively "good times" for farmers. Those who advocate that we must keep the farm sector strong to preserve rural America must realize that this argument applies to fewer and fewer places as time passes. While one might argue that there are farm input and processing industries in local communities that "depend" on the well-being of the farm sector, this argument is tempered by the fact that much of the farm input and processing employment is based in metro areas.

As communities diversify and grow, it is more likely that changes in the community will begin to affect the structure of the local farming sector. Analysis of how community characteristics affect farm household well-being and farm structure is a more insightful approach for students of farm structure as they attempt to understand where the farm sector is heading.

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