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Farm Production Risk and Reliance On Off-Farm Income

by

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ABSTRACT

This paper presents a model of the farm labor allocation decision based on risk and return characteristics of different activities. It is shown that the role of off-farm employment in the diversification of farm family income generates a relationship between the risks of farm production and the extent of reliance on off-farm income. The model is tested using a state level cross section of the United States over the post-war period, and performs well in explaining variation in reliance on off-farm income.

FARM PRODUCTION RISK AND RELIANCE ON OFF-FARM INCOME

Introduction

This paper presents the results of a study of the relationship between the risk-return characteristics of farm activities and the extent to which the farm population relies on off-farm sources of income. The study focuses on the 50 states in the United States and uses measures of total income to farmers, total income from off-farm sources and information on the size of the farm sector relative to each state as a whole to examine relationships between farm activities and off-farm income.

Figure 1 shows that the share of off-farm income in total farm income has had a positive trend, with increasing variation in later periods due mainly to fluctuating income from on-farm sources. Disaggregate data shows the share of off-farm income in total farm income to be rising or steady in all ten USDA regions. Figure 2 shows that not only is off-farm income important in all regions, but that its share varies substantially across regions. Table 1 confirms this observation in terms of the average share of income from off-farm sources in each state, with a low of 31% in Arizona and a high of 88% in West Virginia.

The relations between off-farm work and farm decision making are therefore potentially quite important, a point emphasized by previous analysts such as Ahearn et. al., who conclude that off-farm income reduces income inequality in the United States. This observation is in line with the expectation that higher incomes from farm production reduce the need to look for additional income from off-farm sources.

Work participation studies have focused on various determinants of the decision to work off-farm. For example, Gould & Saupe find that various farm and farm operator characteristics are important in the decision of married farm women in Wisconsin to seek work off-farm. The demand side of the off-farm labor market, as represented by variables for regional unemployment and proximity to urban areas, was not found to be a significant determinant of off-farm work. Other studies such as Huffman, Sumner, and Jensen & Salant all find measures of wages and farm income to be important in explaining off-farm income. These studies also confirm the importance of various characteristics of the demand side of the off-farm labor market.

One problem common to all of the studies cited above is lack of recognition of the role of agricultural production risk in the decision to work off the farm. Though one study accounted for this factor indirectly by including dummies for alternative crop mixes, no direct measure of the riskiness of farm production returns has been used in any of these analyses.

This study analyzes predictions from a portfolio approach to the question of reliance on off farm income based on direct measures of production risk. Farm households are modelled as facing a choice of alternative investments of labor time and are seen as maximizing the total returns to the household in an environment where the various choices have differing risk-return characteristics. Reliance on off-farm income can be viewed as a way to diversify the income stream of a farm household, since the wages from such employment are likely to be steadier and more predictable than are returns from farm production, and can exert a stabilizing influence on income. We would expect to find a greater reliance on off farm income in states where the returns to farming are riskier, as well as where returns to farming are low in an absolute sense.

Previous applications of portfolio theory to agriculture have taken two distinct approaches. The first, exemplified by Barry applies the Capital Asset Pricing Model to farm real estate. This type of analysis yields estimates of the degree to which farm asset risk is related to the risk of the market portfolio, and has been done both on a national and regional basis. A second and normative approach to risk analysis of agricultural activities derives from the original work of Markowitz using mean variance-analysis to aid in actual portfolio management. This approach seeks to show how an individual investor can minimize the variance of a portfolio for a given level of returns. Basically, the idea is to find a relationship that best explains the variance of the asset of interest.[1]

The use of mean-variance relationships to guide decision making in agriculture has been applied mainly to planting decisions in relatively restricted areas. Examples are Collins & Barry, Turvey & Driver, and Gempesaw et. al., where the returns to various crops on a state or province level are related to the returns on the farming sector in that same area. No attempt is made in these studies to relate the analysis to factors other than the risk and return characteristics of crops grown in the area of study.

One thing that all of the risk studies cited above have in common is an exclusive focus on agricultural or farming related variables in the measurement of risk and return at the farm level. None allow formally for the fact that farm households are integrated into the non-farm economy in terms of the choices they face in allocating effort or investment in differing income sources. That is, CAPM studies and planting decision analyses omit an important element of farmers' menu of choices: the possibility of diversifying into non-agricultural sources of income. The need and/or ability to rely on such sources should be related to the characteristics of the on-farm income stream in a systematic way depending on the risks and returns of the alternative activities.

This paper therefore addresses two distinct gaps in previous studies: the lack of attention to risk in studies of the off-farm labor decision, and the lack of attention to off-farm income sources in portfolio models of agriculture. The next section discusses the principal factors determining the extent to which farm households rely on off-farm income, and proposes a test to evaluate the importance of these factors. This is followed by sections presenting data and regression results. The final section presents a summary and conclusions.

Determinants of Reliance on Off-Farm Income

Farm reliance on off-farm income can be represented by the share of total income derived from off-farm sources. The analysis presented here is intended to explain observed cross-sectional variation in this variable on a state by state basis. As noted above, the approach taken is based on portfolio analysis, implying that both the risk and return of alternative activities will be important determinants of farm allocation of effort between on and off-farm activities.

The relation between this approach and that of household production/consumption models such as those discussed in Singh, Squire & Strauss merits some discussion. The central result of this class of models is the interdependence of production, consumption, and labor supply decisions of farm households. Roe & Graham-Tomasi note that the conditions for separability of production and consumption decisions with yield risk are based on very strong assumptions: a utility function that is additively separable over time with each sub-period utility of the negative exponential form, the exponents being functions which are homothetic with respect to consumption bundles, and production risk that is multiplicative and normally distributed. Lopez shows that off-farm labor can result in non-separability if it is an imperfect substitute for farm labor in utility.

This paper provides empirical evidence of the non-separability of labor supply and production decisions. Nevertheless, data limitations make it impossible to estimate a full household model including consumption decisions. Indeed, the data requirements for such a model and the theoretical complications of accounting for production risk and labor allocation decisions make a more tractable approach desirable. This study makes a first step toward the eventual integration of these various considerations, using aggregate data to address questions of risk that are generally unapproachable on the basis of micro household level data.

A Model of the Labor Allocation Decision

The decision problem faced by farmers is to allocate their total labor time between competing activities according to their risks and returns. Off-farm income derived from wage labor can be viewed as a risk free activity since both production risk and price risk are born by the employer and the return to the off-farm worker is just equal to the wage. Farm production income, by comparison, is derived from activities which all bear both production and price risk. Farmers and members of their household split their total labor time, L, between a vector of risky activities with returns E such that:

$$E \sim (\bar{E} , \Omega) \qquad \text{(per unit of labor)}$$

while off-farm income has a return of r, such that:

$$r \sim (r , 0)$$

The allocation problem is to choose an nx1 vector of w_i where the w_i represent the share of total labor time L allocated to each risky activity. This means that the share of total labor allocated to off-farm income is $(1 - \Sigma_i w_i)$.

This means that the returns on the farm's "portfolio" of activities are distributed such that:

$$R = w'\bar{E} + (1 - \Sigma_i w_i)r = r + w'(\bar{E} - \iota r) \qquad (1)$$

$$\sigma^2 = w'\Omega w \qquad (2)$$

where R is mean return, σ^2 and ι is a vector of 1's. The utility maximization problem is to choose w_i in order to:

$$\max \; U (R , \sigma^2) \qquad U_1 > 0, \; U_2 < 0$$

where $U_1 = \partial U/\partial R$ and $U_2 = \partial U/\partial \sigma^2$. First order conditions are:

$$U_1(dR/dw) + U_2(d\sigma^2/dw) = 0 \qquad (3)$$

or,

$$U_1(\bar{E} - \iota r) + 2U_2\Omega w = 0 \qquad (4)$$

which implies that at the optimum:

$$w* = -(U_1/2U_2)\ \Omega^{-1}\ (\bar{E} - \iota r) \qquad (5)$$

Summing over households, j, and using the fact that $(1 - \Sigma_i w_i)$ is the share of off-farm labor in total labor time, gives an expression for the aggregate share of off-farm activities in total activities:

$$(1 - \Sigma_j w_j) = 1 + \Sigma_j (U_1/2U_2)\ \Omega^{-1}\ (\bar{E} - \iota r) \qquad (6)$$

From this equation it is apparent that the left hand side, the share of L devoted to off-farm activities is a function of attitudes toward risk, $\Sigma_j(U_1/2U_2)$, the variance associated with the risky activities, Ω^{-1}, and the expected returns of the risky activities compared with the income from off-farm wage labor, r.

In order to make the jump from labor time allocation to the proportions of income derived from this labor it is necessary to assume that the profit function is homogeneous of degree 1 in the quantity of labor and can be decomposed as follows:

$$f(L\ ,\ P) = L \cdot f(P)$$

where P is a vector of output prices and input prices. See Lopez for a discussion of this assumption in this context.[2]

All of the above variables relate to on-farm determinants of reliance on off-farm income. In addition to these "push" factors it is reasonable to assume that reliance on off-farm income will depend to some extent on the availability of off-farm employment opportunities. That is, for a given level of risk and return associated with on-farm activities, we would expect to observe a greater level of reliance on off-farm income the greater the opportunity to obtain such employment.

In general, off-farm employment will be easier to obtain where there is a preponderance of non-agricultural activities in the local economy. That is, the less the share of agriculture in the local economy in general, the easier it will be for a given individual to find off-farm employment to the extent desired. This "pull" factor is measured in two different ways. One takes the share of agricultural population in total population in each state as a measure of the relative availability of off-farm employment, while a second takes the share of farm income in total income (on and off farm). Both of these variables should have a negative relationship with the share of total farm income derived from off-farm sources.

Empirical Specification

This discussion implies estimation of a regression of the following form:

$$OFFINC = \alpha + \beta_1 CVFRET + \beta_2 INCPC + \beta_3 AGSHR + e \quad (7)$$

where all variables are expressed in logs and:

OFFINC = share of off-farm income in total farm income;

CVFRET = coefficient of variation of farm production returns;

INCPC = farm income per capita; and

AGSHR = share of farm income (population) in total income (population).

e = error

Risk of farm activities is measured as the coefficient of variation of returns to farm production. These returns are measured as net farm income divided by production expenses, where net farm income is the difference between the net value of farm production and total production expenses incurred in producing that income. It is important to note that farm real estate values are excluded from this definition of returns to farm activities. Thus, the focus is on variability in the income stream of the farm population, and does not take account of the variability in (unrealized) changes in net worth. The possibility that changes in returns deriving from changes in the value of farm real estate may in fact be important cannot be ignored, and is examined in the empirical analysis below. It is expected that the variability of returns to farming will be positively related to the percentage share of off-farm income in total income.

The variable used for the return to farming activities should relate to the per capita returns, since we are interested in comparing this to off-farm income which it is reasonable to assume is principally derived from salaried or wage employment on an individual basis.[3] Therefore, returns to farming are defined as net farm income per person in the farm sector. It is expected that this variable will be inversely related to the share of off-farm income in total income.

Data

The analysis is based on a cross section of the United States at the state level. This means that individual farm data is aggregated to produce state level values.[4] The period from 1950-1986 is used for estimation, since that span is the longest for which data are available.

The dependent variable, the share of off-farm income in total farm income, is defined as the average over the 1960-1986 period for each state. Information on farm income and off-farm income were obtained from the USDA's Farm Income data tapes.[5]

Returns to production were also obtained from the USDA Farm Income data tapes, and were measured as net farm income divided by production expenses. This measure of income approximates the net value of production whether sold for cash, placed under Commodity Credit Corporation loan, used as feed, or put into inventories. Thus, the effects of government programs in reducing the risks involved with some activities (e.g. dairy) are accounted for in the measure of risk. Capital expenses were not available on a state level, and so were excluded from the analysis. The coefficient of variation of this variable over the 1950-1986 period was used to obtain a measure of the risk of farm income.

State level indexes of total returns to farming were measured as the weighted sum of the annual holding period returns to farm real estate and the annual returns to production. The weights were computed from the shares of real estate and production expenses in the total cost of production. Information on farm real estate was obtained from the USDA's Balance Sheet of the Farming Sector.

Farm income per capita was obtained by dividing net farm income as defined above and deflated by the CPI by total farm population as obtained from the U.S. Census.[6] Since census data are available only on a decennial basis, the intervening years were obtained by interpolation, while the years from 1980-86 were obtained by extrapolating the 1970-80 growth rate for each state. The average of this income per capita series over the 1950-86 period was used in the regressions below.

The share of farm population in total population for each state was obtained from Census information, and the period average of this share was used in the regressions.

The share of farm income in total state income was obtained by dividing farm income as defined above by total state income, as reported by the U.S. Bureau of Economic Analysis. As with the previous variable, the period average was used for the regressions.

Table 1 presents summary statistics for these data. It can be seen that the mean share of off-farm income over the 1960-1986 period is important in all states and ranges from a low of 31% in Arizona to a high of 88% in West Virginia.

Farm production returns are shown in the second column of the table. It is important to note that the high average values for these figures result from the exclusion of capital expenses and real estate costs from the calculation. Therefore, these figures relate to returns to current expenses, and do not reflect total net returns including (unrealized) holding period returns to real estate. Inclusion of these additional factors yields values for total returns to farm assets that are comparable to those for other economic activities. (See Barry, Irwin et. al., and Kaplan).

Farm income per capita is shown in the third column. These figures were obtained by dividing total farm family income by total farm population and so reflect the wide variation in family incomes in different regions. Hawaii registered the highest average value for this variable while West Virginia was lowest.

The fourth column shows the share of income from farm production in total state income. The average value was used in the regressions. However, there is a marked downward trend over the sample period for this variable, with the maximum and minimum values representing 1950 and 1986 respectively in almost every case.

Results

Results for equation (7) are shown in Table 2. As can be seen from these regression results, all variables enter with the expected sign, and have a low standard error. R^2 is quite high for a cross sectional equation of this type, at 0.72, with an adjusted R^2 of 0.71. It is apparent that the variable representing the risk of farm production activities CVFRET, the coefficient of variation of returns to farm production, is important in explaining the extent of reliance on off-farm income. The partial correlation coefficient[7] of 0.16 indicates that this variable explains a substantial proportion of the residual variation in mean off-farm income remaining after accounting for the effects of INCPC and AGSHR.

Both income per capita (INCPC) and the share of farm income in total state income (AGSHR) were also significant determinants of variation in mean off-farm income. The result for INCPC support the hypothesis that high income from farm activities lessens the need to seek income from other sources. This is in line with results obtained in previous analyses based on micro level data.

The importance of the demand side of the off-farm labor market is confirmed by the importance of AGSHR. This result indicates that for a given level of farm income and risk, reliance on off-farm income depends on the extent to which the local economy can provide such employment. This finding is in line with what might be expected, given the high correlation of agricultural returns across production units in a particular area. That is, given the importance of exogenous variables affecting all farmers in a given state (weather, market conditions, etc.), the need to resort to off-farm sources to maintain income is likely to arise simultaneously. The smaller the farm sector relative to the overall local economy the more easily these job seekers can be absorbed in the labor market. As noted above, institutional factors such as minimum wage legislation limit the extent to which wages can equilibrate supply and demand in this market. While a more fully specified off-farm labor market would be preferable, the aggregate nature of the data used in this study preclude the detailed approach possible with household level data.

The regression was rerun using an alternative definition of the AGSHR variable, the mean share of farm population in total state population. As can be seen in row 2 of Table 2, this reformulation resulted in a slightly greater explanatory power, with an adjusted R^2 of 0.71. The redefinition of this variable resulted in a slightly lower estimate for the coefficient for farm production risk, as well as a slightly lower t statistic. However, these changes are relatively small and do not change the substance of the results.

The third row of Table 2 shows the results of a regression in which the variable CVFRET has been replaced by the coefficient of variation of <u>total</u> returns to farming including returns to real estate (CVTOTAL).[8] The resulting measure of risk is almost identical to that used by Barry in his original estimation of a farm sector CAPM. It is clear that this reformulation is of little use in explaining variation in the share of off-farm income, leading to the conclusion that off-farm income is used as a way to diversify sources of current income or cash flow. Thus liquidity concerns rather than questions of net worth seem to be more important in making the decision to seek off farm income. Another version of this model was tested in which production risk and real estate risk were used as separate explanatory variables. This regression, shown on the fourth row of Table 2, confirmed the above results in that the coefficient for production risk remained significant and virtually unchanged in magnitude while the coefficient for real estate risk was not significantly different from zero.

Another experiment was run using the coefficient of variation of excess returns to farming rather than total returns (CVXSRET). Excess returns were computed as farm production returns minus the rate of return on one year Treasury bills. This regression is intended to sharpen the results by adjusting the returns variable for the general economic conditions off-farm in a manner consistent with capital asset theory.[9] While this variable improved the explanatory power of a univariate regression of the share of off-farm income on production variability,[10] Table 2 shows that it is slightly inferior in explanatory power when included with the other independent variables, and had an estimated coefficient that was smaller in magnitude than that for the measure based on gross returns. Overall however, the substance of the results obtained in previous regressions was again confirmed.

Conclusions

The results presented here indicate that farmers behave as predicted by portfolio theory in allocating efforts between on- and off-farm sources of income. The analysis indicates that reliance on off-farm income by the farm population is closely related to the risk and return characteristics of farm production activities. Both the return to farm activities and the riskiness of this stream of returns were found to be important determinants of the extent of reliance on off-farm income in a cross sectional regression of the 50 states over the 1950-1986 period.

It is interesting to note that this result applies to the riskiness of current income streams derived from production expenses and income. The riskiness of total returns to farming including real estate values did not have any detectable relation with reliance on off-farm income in the data analyzed.

In addition, the extent to which the farm population relied on off-farm income, on average, is influenced by the relative share in the labor force accounted for by farming. This finding indicates that the decision to seek income from off-farm sources may be constrained by the ability of the local economy to generate sufficient employment opportunities.

In sum, it is clear that analyses of off-farm income and employment must take account of the risk and return characteristics of farm production activities. Also, it is clear that analyses of farm decision making in which differing crop alternatives are viewed in a portfolio context must take account of the fact that the existence of off-farm income sources adds an important element to the menu of choices faced by farmers.

NOTES

1. The original CAPM related the expected return on each asset, E_i, is related to the risk free interest rate, R_f, and the expected return on the market portfolio, E_m, via a parameter β_i in the following manner:

$$E_i = R_f + (E_m - R_f)\beta_i$$

The APT model assumes that the expected return on an asset is related to a series of underlying factors, b_{ij}, so that:

$$E_i = \lambda_0 + b_{i1}\lambda_1 + b_{i2}\lambda_2 + \ldots + b_{iM}\lambda_M$$

where λ_i is the expected return per unit of sensitivity to factor i, and λ_0 is equal to the risk free interest rate.

Both the APT and the CAPM imply that investors will allocate assets according to the returns and covariances of the menu of possibilities they face. See Markowitz and Sharpe. For a discussion of these alternative formulations as applied to agriculture, see Collins and Hutchinson & McKillop.

2. Lopez contains references providing empirical support for this assumption.

3. It is also reasonable to assume that the returns from off-farm income derived from wages are relatively stable because of institutional reasons such as minimum wage legislation.

4. Application of the proposed model to aggregated data raises the possibility of aggregation bias. Two observations are important in this regard. First, the need to resort to aggregate data is generated by the inability to measure risk directly in available household level data. Previous studies based on this type of data are therefore open to criticism of a different bias, that caused by missing variables. Second, in order for aggregation to cause spurious results, it would be necessary for off-farm income and production variability to show a very particular and consistent pattern of bias within each of the 50 states. There is no evidence that this is a problem; in fact, Tauer presents circumstantial evidence to the contrary with his finding that diversity of agricultural production at the state level (measured as a Herfindahl index based on twelve commodity groups) had a near-zero correlation with the coefficient of variation of cash receipts. This indicates that aggregation of farms producing different types of commodities does not have a systematic relationship with the riskiness of cash receipts at the state level. Regressions of off-farm income share and CVFRET on the same Herfindahl index also showed a near zero correlation (details available). Thus, arguments for a spurious cross-sectional

relation in equation (7) based on a supposed relation between reliance on off farm income and diversity of farm types are unlikely to find empirical support.

5. See Lucier et. al. for a detailed description of these data series.

6. All other variables are expressed as ratios, eliminating the need to deflate.

7. The partial correlation coefficient is defined as $r^2_{yx1.x2x3}$, or the percent of the residual variance explained by x_1 after accounting for the effects of all of the other independent variables. It is calculated as $t^2/(t^2 + df)$.

8. Hawaii and Alaska were excluded from these regressions due to lack of data on real estate values prior to statehood in 1960.

9. See, for example, Barry or Irwin et. al. This is a standard method for estimating equations such as those presented in Note 1 above.

10. Details available on request.

REFERENCES

Ahearn, M, J. Johnson & R. Strickland, "The Distribution of Income and Wealth of Farm Operator Households" American Journal of Agricultural Economics December 1985, pp. 1087-1094.

Barry, P. J. "Capital Asset Pricing and Farm Real Estate" American Journal of Agricultural Economics August 1980, pp. 549-553.

Collins, R. A. & P. J. Barry, "Risk Analysis with Single Index Portfolio Models: An Application to Farm Planning" American Journal of Agricultural Economics February 1986, pp. 152-161.

Collins, R. A., "Risk Analysis with Single Index Portfolio Models: An Application to Farm Planning: Reply" American Journal of Agricultural Economics Feb. 1988, pp. 195-196.

Gempesaw, C. M., A. M. Tambe, R. M. Nayga & U. C. Toensmayer, "The Single Index Market Model In Agriculture" Northeastern Journal of Agricultural and Resource Economics, Oct. 1988 pp. 147-155.

Gould, B. & W. Saupe, "Off-Farm Labor Market Entry and Exit" American Journal of Agricultural Economics November 1989, pp. 960-969.

Huffman, W. "Farm and Off-Farm Work Decisions: The Role of Human Capital" Review of Economics and Statistics 62 (1980) pp. 14-23.

Hutchinson, R. W., & D.G. McKillop, "Risk Analysis with Single-Index Portfolio Models: An Application to Farm Planning: Comment" American Journal of Agricultural Economics February 1988 pp. 192-194.

Irwin, S. D., Lynn Forster, Bruce J. Sherrick, "Returns to Farm Real Estate Revisited", American Journal of Agricultural Economics August 1988, pp. 580-587.

Jensen, H. & P. Salant, "The Role of Fringe Benefits in Operator Off-Farm Labor Supply" American Journal of Agricultural Economics December 1985 pp. 1095-1099.

Kaplan, H. M., "Farmland as a Portfolio Investment" Journal of Portfolio Management Winter 1985 pp. 73-78.

Lopez, R. "Non-Recursive Models of the Farm Household", Ch. 11 in Singh, Squire & Strauss eds. Agricultural Household Models Johns Hopkins University Press, 1986.

Lucier, G., A. Chesley & M. Ahearn, "Farm Income Data: A Historical Perspective", U.S. Department of Agriculture Economic Research

Service, Statistical Bulletin Number 740, Washington D.C., May 1986.

Markowitz, H. M., Portfolio Selection: Efficient Diversification of Investments New York, John Wiley, 1959.

Roe, T. & T. Graham-Tomasi, "Yield Risk in a Dynamic Model" Chapter 9 in Singh, Squire & Strauss eds. Agricultural Household Models Johns Hopkins University Press, 1986.

Sharpe, W. F., "Factor Models, CAPM's, and the APT", Journal of Portfolio Management Fall 1984, pp. 21-25.

Singh, I, L. Squire & J. Strauss eds., Agricultural Household Models, Johns Hopkins University Press, 1986.

Sumner, D., "The Off-Farm Labor Supply of Farmers" American Journal of Agricultural Economics August 1982 pp. 499-509.

Tauer, L. "How Diversified is Your State's Agriculture?" mimeo, Cornell University, January 1990.

Turvey, C. G. & H. C. Driver, "Systematic and Nonsystematic Risks in Agriculture" Canadian Journal of Agricultural Economics 35(1987) pp. 387-401.

U.S. Bureau of Economic Analysis, National Income and Product Accounts.

U.S. Bureau of Statistics, 1980 Census of Population, Washington D.C.

Table 1. Average Values for Variables Used.

	Off-Farm Income / Total Income	Farm Production Returns	Net Farm Income Per Capita*	Farm Income / Total State Income
Alabama	0.61	51.08	1.79	0.04
Alaska	0.75	25.99	1.46	0.00
Arizona	0.32	35.53	7.11	0.04
Arkansas	0.47	48.23	2.38	0.09
California	0.37	38.96	6.25	0.02
Colorado	0.52	22.48	2.23	0.03
Connecticut	0.54	33.54	3.70	0.00
Delaware	0.41	29.67	2.74	0.02
Florida	0.38	60.56	7.31	0.03
Georgia	0.57	40.50	1.76	0.03
Hawaii	0.39	36.81	10.25	0.02
Idaho	0.49	34.46	1.78	0.09
Illinois	0.52	35.35	1.71	0.02
Indiana	0.65	36.46	1.07	0.03
Iowa	0.44	34.13	1.64	0.11
Kansas	0.55	30.04	1.80	0.06
Kentucky	0.63	60.39	0.98	0.05
Louisiana	0.58	50.48	1.98	0.03
Maine	0.53	30.79	2.12	0.02
Maryland	0.62	28.73	1.44	0.01
Massachusetts	0.56	33.98	3.35	0.00
Michigan	0.66	37.66	1.04	0.01
Minnesota	0.44	39.53	1.45	0.04
Mississippi	0.58	51.09	2.15	0.08
Missouri	0.64	38.49	1.02	0.04
Montana	0.79	40.94	1.61	0.09
Nebraska	0.42	30.31	1.86	0.10
Nevada	0.70	27.12	1.52	0.01
New Hampshire	0.67	25.53	1.17	0.01
New Jersey	0.57	35.17	2.55	0.00

Table 1. Average Values for Variables Used.

	Off-Farm Income / Total Income	Farm Production Returns	Net Farm Income Per Capita*	Farm Income / Total State Income
New Mexico	0.53	30.42	2.73	0.04
New York	0.57	31.70	1.22	0.00
North Carolina	0.49	62.84	1.72	0.05
North Dakota	0.44	42.35	2.08	0.16
Ohio	0.69	34.50	0.92	0.01
Oklahoma	0.68	33.29	1.41	0.04
Oregon	0.61	34.98	1.60	0.03
Pennsylvania	0.61	31.73	1.18	0.01
Rhode Island	0.47	42.67	5.83	0.00
South Carolina	0.65	43.77	1.15	0.03
South Dakota	0.35	40.65	1.90	0.16
Tennessee	0.73	49.81	0.78	0.03
Texas	0.64	36.06	2.13	0.03
Utah	0.72	27.64	1.51	0.02
Vermont	0.48	33.86	1.61	0.04
Virginia	0.74	37.60	0.79	0.02
Washington	0.47	45.47	3.08	0.03
West Virginia	0.88	29.51	0.35	0.01
Wisconsin	0.47	44.61	1.35	0.04
Wyoming	0.86	23.07	0.85	0.04

* Thousands of 1967 Dollars.

Table 2. Regression Results.

Dependent Variable Equals Share of Off-Farm (All Variables in Logs)[1]

	Intercept	CVFRET	CVTOTAL	CVRER	CVXSRET	INCPC	AGSHR	$\bar{R}^2$	F	N
(1)	−0.607 (0.07)	0.180 (0.06)	—	—	—	−0.254 (0.03)	−0.082 (0.02)	.71	40	50
(2)	−0.554 (0.06)	0.168 (0.06)	—	—	—	−0.322 (0.03)	−0.095[2] (0.02)	.71	42	50
(3)	−0.685 (0.08)	—	0.007 (0.06)	—	—	−0.296 (0.04)	−0.074 (0.02)	.62	27	48
(4)	−0.551 (0.10)	0.191 (0.07)	—	−0.037 (0.03)	—	−0.296 (0.04)	−0.094 (0.02)	.69	27	48
(5)	−0.665 (0.07)	—	—	—	0.130 (0.05)	−0.244 (0.03)	−0.074 (0.02)	.71	38	50

1 Standard errors in parentheses.

2 Defined as farm population/total population.

CVFRET = Coefficient of variation of farm production returns.
CVTOTAL = Coefficient of variation of total returns to farming including value of land.
CVRER = Coefficient of variation of farm real estate holding period returns.
CVXSRET = Coefficient of variation of excess returns.
INCPC = Average income per capita.
AGSHR = Share of farm income in state income.

FIGURE 1. AVERAGE SHARE OF OFF-FARM INCOME IN TOTAL INCOME 1960-1986

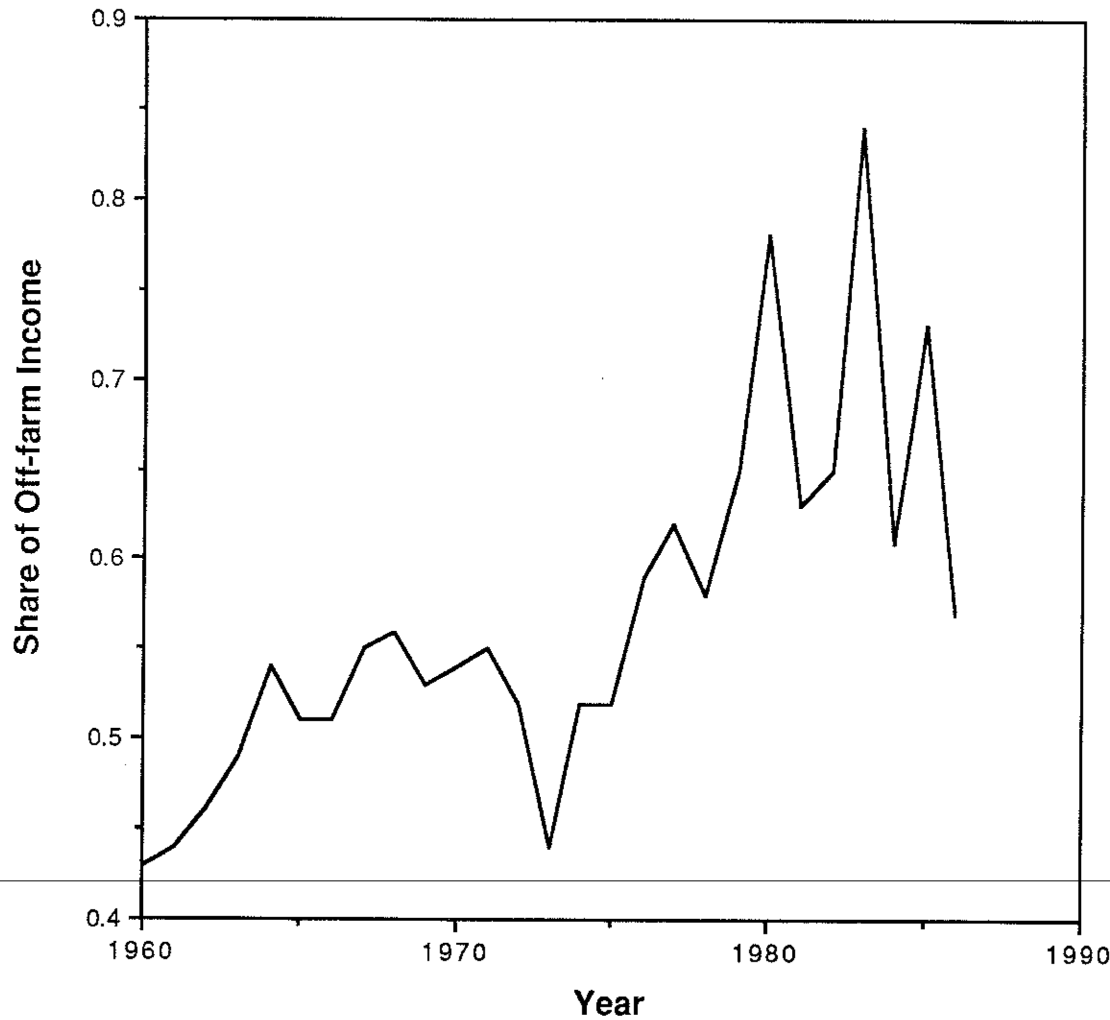
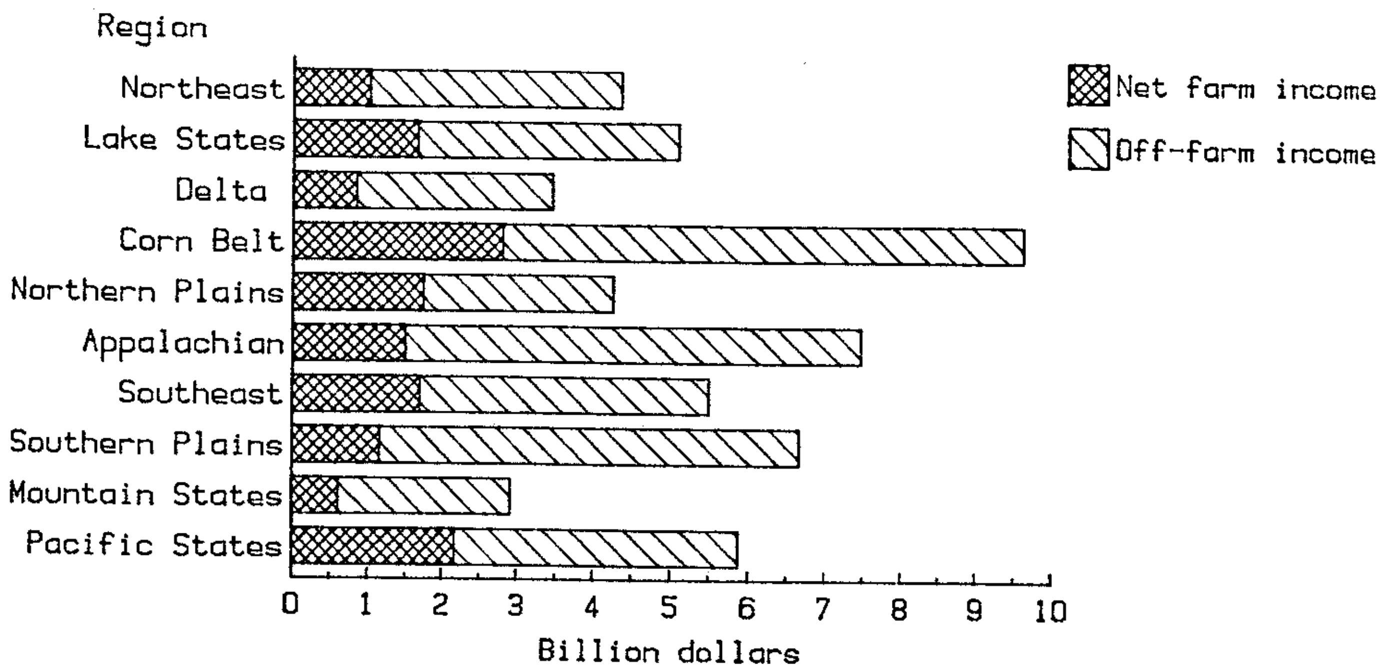


Figure 2 --Regional net farm income and off-farm income, 1984



Source: Lucier, Gary, Agnes Chesley and Mary Ahearn, Farm Income Data: A Historical Perspective, USDA-ERS Statistical Bulletin No. 740, Washington, D.C., May 1986, p. 49.

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