

# The Impact Of Sales Changes On Agribusiness Payrolls

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## *Abstract*

Agribusiness firms face substantial market risk associated with variations in farm production, output and input prices, exchange rates, and other factors. Some of the risk faced by agribusiness is passed through to the employees of the firm and to the communities where the firms are located, as employment levels are changed in response to these variations. An econometric analysis of the transmission of sales changes into payroll changes was performed for a sample of Georgia agribusiness firms. Transmission elasticities were found to be affected by firm type, size, age, and by the degree of use of part-time employees.

**Key Words:** agribusiness, employment stability, labor

Interest in employment stability has increased in recent years due to economy wide shocks in the international market for U.S. products. The historically large U.S. trade deficits and the accompanying large number of plant closings in the U.S. have gendered concern about these effects on the economic status of communities (Anderson and Barkley, Brown and Pheasant). The impact of the recent financial crisis in agricultural on rural businesses has also stimulated work on linkages between the agricultural and nonagricultural sectors, and on rural economic distress related to farm economic distress (Leistritz et al., Hines et al.). The impact of employment instability is potentially more severe for rural areas than urban areas due to the smaller number of employers and the lower level of diversity of employment opportunities in rural areas compared to urban areas.

The relationship between macroeconomic conditions and regional employment is a complex one. The strength and timing of effects of external shocks are varied for different groups within a community. For example, a decrease in agricultural

exports and prices affects farmers and agribusinesses most directly, but multiplier effects are felt throughout regions where these firms are located. The impact of a shock on employment and the economic vitality of one region compared to another is thus dependent on a variety of factors related to the regional economic structure and diversity. The myriad of relationships affecting the transmission and magnitude of such effects offer many research possibilities.

At the firm level, the variability of employment can be conceptually decomposed into two parts. Market risk affects employment as changes in product demand affect output, prices, and the derived demand for labor for the firm. The variability of sales revenue is a general measure of historical market risk for a firm. The second factor affecting employment variability of a firm relates to the transmission of changes in output demand to changes in employment. A given percentage change in sales may induce markedly different changes in employment for one firm when compared with another. For example, employment in a labor

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intensive business may respond more dramatically to a change in sales than employment in a capital intensive business where fixed costs predominate over variable costs.

This paper reports on an empirical analysis of the relationship between changes in annual sales and changes in annual payroll for a sample of agribusiness firms in Georgia. The analysis focuses on identifying differences in the sales / payroll relationship for different types of agribusiness firms. This work differs from previous research on employment stability (eg. Brown and Pheasant) in that the focus here is on the transmission of market variability to employment variability, and in the use of firm level data.

**Theoretical Framework**

In neoclassical production theory, input quantities demanded are a function of output and input prices, and characteristics of the production function describing factor-factor and factor-output relationships. If the production function is homogeneous with fixed factor prices, changes in output are accompanied by proportional changes in all inputs (Ferguson). If production is non-homogeneous, or some inputs are fixed, variable inputs will increase or decrease at differing rates in response to changing output price, in order to maintain equality between the marginal rates of technical substitution and the fixed input price ratios.

Differences in the importance of fixed factors of production, input substitution relations, and factor price responsiveness for different firms cause differences in the effect of output market variability on labor demand. Additionally, differences in managerial objectives, institutional constraints such as labor contracts, and financial characteristics between firms may also impact output-input relationships. The derived demand for labor for a firm can be expressed as:

$$L = f(P_k, P_y, Y, I \mid Y = q(x_k)) \tag{1}$$

where  $L$  is quantity of labor demanded,  $P_k$  and  $P_y$  are vectors of input and output prices, respectively,  $Y$  is output,  $q$  is the production function, and  $I$  is a

vector representing institutional constraints and financial characteristics of the firm.

Estimation of (1) would provide information on effects of production technology and institutional characteristics on employment stability. While this would be of interest, data requirements for such an estimation would be extreme. Also, results would be difficult to generalize because they would depend on detailed knowledge of firm specific technology and constraints. As an alternative, the approach taken here was to group agribusiness firms by categories which are presumed to be relatively homogeneous with respect to technology and institutional characteristics. Differences in employment stability between firm types may result from technological differences between types, but results of the analysis can be used to assess expected employment effects based simply on type of business.

**Data Source and the Empirical Model**

A list of agribusiness firms in Crop Reporting Service area 7 in southwest Georgia was obtained from county agents, agribusiness organizations and telephone directories. This area is characterized mainly by row crops, with some livestock production. Personal interviews covering a broad range of topics were conducted for a sample of 94 firms. From this number, 74 firms provided relatively complete information overall, with 37 firms providing complete annual payroll and sales data needed for this specific analysis. Data on payroll, sales, and other characteristics were obtained on an annual basis for the years 1981 - 1987, yielding 7 observations on 37 firms, or 259 observations. The time period used was one of significant volatility in the agricultural sector in Georgia and the U.S.

The measure of employment stability used in the analysis was an index measuring annual percentage changes in payroll levels for each firm ( $PI_{it}$ ). Market risk was represented by an index measuring percentage changes in annual sales for each firm ( $ASI_{it}$ ). The broad hypothesis defining the expected relationship between these variables was that changes in annual payrolls would be positively

related to changes in annual sales, as firms adjusted their input use to output market conditions.

The sample firms were asked to describe the nature of their business, and this information was used to classify all firms into one of four categories. Three of the four categories are consistent with Ginder's classification scheme developed in his analysis of relationships between the farm and agribusiness sectors. The categories are (1) capital goods and services, such as implement and equipment dealers, which provide items that have useful lives greater than one year; (2) consumable goods and services, such as fertilizer and feed dealers, that provide items that are totally consumed within a one year production period; (3) commodity marketing, processing, storage and handling services, such as grain elevators and cotton gins, and (4) combination firms, which are active in two or more of the first three categories.

No observations in Ginder's fourth category, transportation services, were obtained, and a fourth category of combination firms was added in its place. The number of firms in each category was 10, 11, 9, and 7, respectively, with 7 annual observations on each firm. The distribution of firms across type for the 37 firms used in the analysis was similar to the distribution in the sample of 74 firms which provided relatively complete information. In the larger sample there were 18 durable firms, 22 consumable firms, 20 processing firms, and 14 mixed firms. Dummy variables for the four firm types were created and included in the estimation as interaction terms between the firm type dummy variable and the sales change index. This specification allowed the elasticity of annual payroll with respect to annual sales to differ for the four firm categories.

Additional information which was potentially related to employment stability was available from the survey and included in the estimated model as interaction terms with the sales change index. For example, large firms may have different employment responsiveness to sales changes than smaller firms, and the interaction between the average annual sales level of each firm

and the annual sales change index were included to allow for payroll stability differences related to firm size. A clear hypothesis for the effect of firm size was not theoretically evident, but larger firms may have greater flexibility in making payroll adjustments based simply on their larger work force.

Two additional sales index interaction variables were included: the number of years that the business had been in operation at the time of the survey and the percentage of employees that were part time. The years variable was included because firms that have been successful enough to stay in business for long periods may have done so partly through the development of a mode of production that allows flexibility in response to changes in output markets.

The part-time employment percentage was included because employment changes for firms with more part-time workers may differ from those for firms with fewer part-time workers. Potential differences may be related to less standardization of employment conditions for part-time workers, and to the incentive for firms to maintain skilled full-time workers during downturns. Table 1 reports the mean values and standard deviations for all variables used in the analysis.

The transmission of a change in sales to a change in payroll is represented as:

$$PI_{it} = C_0 ASI_{it} \quad (2)$$

The transmission elasticity,  $C_0$ , is hypothesized to be dependent on firm type, the magnitude of the change in sales by firm type, firm size (as measured by linear and quadratic terms representing average sales level for the firm), the years the firm has been in business, and the average percentage of part time employees in the firm.

$$C_0 = \sum_{j=1}^4 b_j F_j + \sum_{j=1}^4 b_{j,4} F_j ASI_{it} + b_9 SALES_i + b_{10} SALES_i^2 + b_{11} YRS_i + b_{12} PTP_i + \epsilon_{it} \quad (3)$$

Table 1. Variables in the Payroll Change Regression for Georgia Agribusiness Firms, 1981-1987

Variable	Mean	Standard Deviation
Percentage change in payroll ( <i>PI</i> )	0.8	21.1
Percentage increase in sales ( <i>POS</i> )	12.7	41.6
Percentage decrease in sales ( <i>NEG</i> )	7.9	12.6
Gross sales (000's) ( <i>SALES</i> )	6199.4	13147.0
Years ( <i>YRS</i> )	27.4	22.5
Part time employee percentage ( <i>PTP</i> )	24.0	26.7

Type of Firm	Firms in Sample
Durables	10
Consumables	11
Processing	9
Mixed	7

Substituting (3) into (2) yields:

$$PI_{it} = \sum_{j=1}^4 b_j F_j ASI_{it} + \sum_{j=1}^4 b_{j+4} F_j ASI_{it}^2 + b_9 SALES_i ASI_{it} \quad (4)$$

$$+ b_{10} SALES_i^2 ASI_{it} + b_{11} YRS_i ASI_{it} + b_{12} PTP_i ASI_{it} + \epsilon_{it}$$

where,  $i$ =firm (1,...,37);  $j$ =firm type: 1=durables, 2=consumables, 3=processing; 4=mixed,

$t$ =year (1,...,7),

$P_{it}$  is the annual payroll index =  $100 * ((\text{payroll}_{it} / \text{payroll}_{it-1}) - 1)$ ,

$F_j$  is the firm type 0,1 dummy variable,

$ASI_{it}$  is the annual sales index =  $100 * ((\text{sales}_{it} / \text{sales}_{it-1}) - 1)$ ,

$SALES_i$  is the average annual sales of firm  $i$ ,

$YRS_i$  is the number of years firm  $i$  has been in business,

$PTP_i$  is the average percentage of employees that were part time in firm  $i$  and,  $\epsilon_{it}$  is the error term.

Equation (4) imposes the restriction that payroll responses to increases in sales are symmetrical to payroll responses to decreases in sales. For estimation, this restriction was relaxed by introducing separate terms for increases and decreases in sales. That is, when  $ASI_{it} > 0$ ,  $POS_{it} = ASI_{it}$ , else  $POS_{it} = 0$ ; and when  $ASI_{it} < 0$ ,  $NEG_{it} = -ASI_{it}$ , else  $NEG_{it} = 0$ . The number of independent variables in (4) was thus doubled as  $POS_{it}$  and  $NEG_{it}$  were substituted for  $ASI_{it}$ .

### Estimation And Results

In estimating regressions with pooled cross-sectional, time-series data, an immediate issue is the constancy of coefficients across cross sectional units and over time. The simplest assumption is that coefficients are constant across cross sections and

over time, that the error term ( $\epsilon_{it}$ ) is normally distributed with mean zero and a constant variance, and that the error term captures random differences over time and individuals. A variety of estimation techniques is available (Judge et al., ch.13) for modeling different assumptions about the constancy of coefficients and the error term.

For this analysis, the coefficients of the linear and quadratic sales change variables were allowed to vary across firm type, based on the hypothesis that the underlying technology for different firm types would affect the responsiveness of payroll to changes in sales. Also, the estimation assumed that the disturbance vector for a given firm follows a first order autoregressive process, that the variance of the disturbance term could be different for different firms, and that the disturbances for different firms are contemporaneously correlated (Judge et al., p.518). The "pool" procedure in the *Shazam* econometrics program (White et al.) was used for the estimation.

Results from the estimation are reported in table 2. Coefficients of the linear and quadratic interaction variables for firm type and sales change were jointly significantly different from zero at the 5 percent level for 3 of the firm types: consumables, processing, and mixed firms. The linear and quadratic sales change coefficients were jointly significant for increases in sales for firm type 1 (durables), but not for decreases in sales. Firm size had a significant effect on the transmission of sales decreases into payroll changes, but did not affect the responsiveness of payroll to increases in annual sales. Years in business had a significant effect on the relation between sales decreases and payroll changes, but no effect on the relationship between increases in sales and payroll. Larger part-time employee percentages significantly affected the relation of both sales increases and decreases to payroll. The Buse  $R^2$  for the regression was .763.

Figure 1 shows the estimated relationship between the change in annual sales and the change in payroll by firm type, for various levels of the annual sales change assuming average sales levels and years in business and no part-time workers. Payrolls were most responsive to sales increases for processing and mixed firms. For these firms, the relationship between sales and payroll was near

linear, and a 20 percent increase in sales was associated with a 14 to 15 percent increase in payroll. Durable and consumable firms appeared less responsive in adjusting payroll to sales increases. The relationship between sales increases and payroll was also near linear for these firms, but a 20 percent increase in sales resulted in an expected increase in payroll of only about 6 percent for durable and consumable firms. Payroll elasticities with respect to a one percent increase in sales, evaluated at a sales increase of 20 percent, were as follows: processing .72, mixed .70, durables .30, and consumables .29.

Payrolls of processing firms appeared quite responsive to sales decreases. Estimated declines in payrolls of processing firms approximately matched declines in sales, a 20 percent drop in sales was estimated to be associated with a drop in payroll of slightly more than 20 percent. Mixed and consumable firms represented an intermediate case in their responsiveness to sales decreases. Twenty percent sales decreases were associated with expected declines in payrolls of 13 and 16 percent, respectively, for consumable and mixed firms. Firms selling durable goods were least responsive to sales decreases, especially for small decreases in sales. A 20 percent decrease in sales for durable goods firms was associated with an estimated 3 percent decline in payroll. Payroll elasticities with respect to a one percent decrease in sales, evaluated at a 20 percent decrease in sales, were: processing -1.11, mixed -0.80, consumables -0.65, and durables -0.39.

Figure 2 shows the effect of firm size, years in business, and the percentage of employees who are part-time on the response of payroll to a 20 percent decrease in sales for a mixed firm. Higher average sales levels and more years a firm had been in business were both associated with larger estimated reductions in payroll for a mixed firm with a 20 percent decrease in sales. The increases in payroll responsiveness associated with sales level and years in business were relatively small, however. Increasing the average gross sales level from 40 percent below its mean level (mean = \$6.2 million) to 40 percent above the mean sales level increased the expected decrease in payroll resulting from a 20 percent drop in sales from 7.25 to 7.75 percent. The estimated payroll decrease for a firm that was 40 percent younger than the mean (mean =

**Table 2.** Results of Payroll Change Regression for Georgia Agribusiness Firms, 1981-1987

Variable	Coefficient	t-value
$F_1*NEG$	.2602	1.21
$F_1*NEG^2$	-.0116	-1.73
$F_1*POS$	.4162*	3.21
$F_1*POS^2$	-.0024	-1.32
$F_2*NEG$	-.8685*	-3.51
$F_2*NEG^2$	.0097	2.54
$F_2*POS$	.3764*	3.38
$F_2*POS^2$	-.0017	-2.89
$F_3*NEG$	-.9269*	-3.49
$F_3*NEG^2$	-.0004	-0.04
$F_3*POS$	.8569*	11.86
$F_3*POS^2$	-.0028	-3.91
$F_4*NEG$	-.3640*	-1.32
$F_4*NEG^2$	-.0068	-1.06
$F_4*POS$	.7587*	7.56
$F_4*POS^2$	-.0008	-3.57
$SALES*NEG$	-.91 E-5*	-0.68
$SALES^2*NEG$	.333 E-9	1.51
$SALES*POS$	.72 E-5	0.99
$SALES^2*POS$	-.19 E-9	-1.43
$YR*NEG$	-.0046 <sup>b</sup>	-2.25
$YR*POS$	-.0023	-1.53
$PTP*NEG$	.0121 <sup>b</sup>	4.57
$PTP*POS$	-.00043 <sup>b</sup>	-3.05

\* Coefficients of linear and quadratic terms are jointly significant at .05 level

<sup>b</sup>Coefficient significant at .05 level

Buse  $R^2$  .763,  $F$  27.46

27 years) was 6.55 percent, while the estimated payroll decrease for a firm 40 percent older than the mean was 8.53 percent.

Variations in the percentage of a firm's employees who were part-time had a much larger impact on payroll responsiveness. A higher part-time employee percentage was associated with smaller decreases in payroll in response to a drop in sales. The estimated decline in payroll for a 20 percent sales decrease in a firm that has a part-time

employee percentage 40 percent above the mean was half of the drop in payroll percentage for a firm with a part-time employee percentage 40 percent below the mean.

### Summary And Conclusions

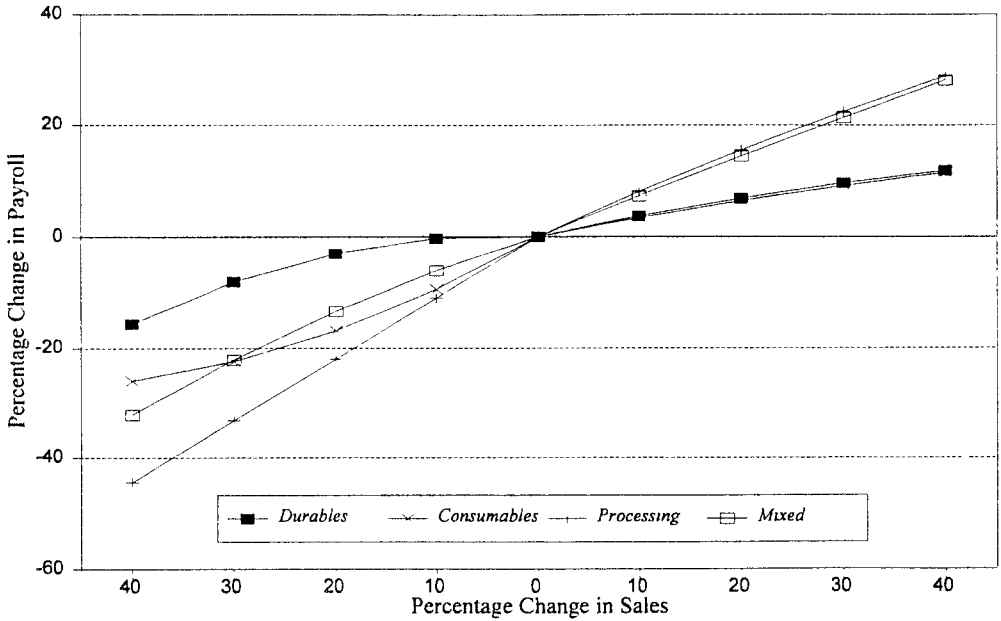
This analysis of employment stability in agribusiness firms focused on the transmission of output market changes to agribusiness payrolls. The objective of the empirical analysis was to test for systematic differences in this transmission related to firm type, size, age, and use of part-time workers. Statistical support for the existence of such differences was provided by the analysis.

Agribusiness firms involved with processing or marketing products, and firms that had diversified operations, appeared to have been quite responsive in changing payrolls in response to both increases and decreases in sales. The results suggest that the percentage change in payroll for these firms was between 75 and 100 percent of the percentage change in sales, *ceteris paribus*.

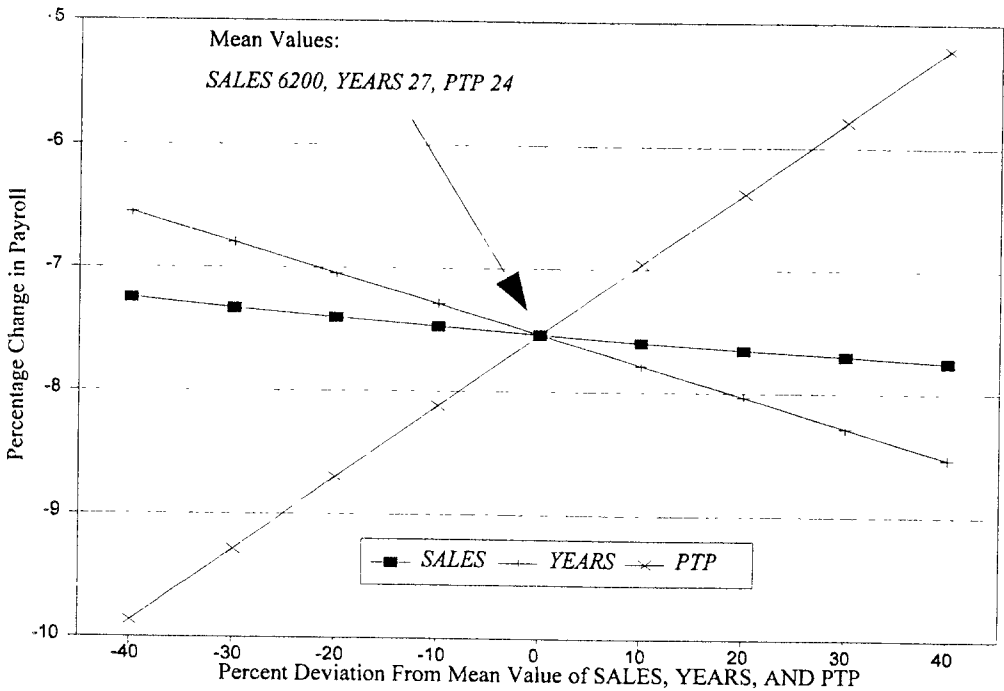
Consumable and durable goods firms were less responsive in adjusting their payrolls in response to sales increases, with both firm types increasing payrolls at a level of about 30 percent of a given sales increase. Consumable goods firms were fairly responsive to sales decreases, decreasing payroll by about .70 percent for each one percent decrease in sales. Durable goods firms were quite unresponsive in adjusting payroll to sales decreases, however, especially for small decreases in sales. A 20 percent decrease in sales was associated with a 3 percent decrease in payroll for durable goods firms, while a 40 percent decrease in sales was associated with a projected 16 percent decrease in sales for this firm type.

The reasons for the differences in the transmission of sales changes into payroll changes for different firm types are likely related to differences in production technologies, but this hypothesis would require additional data to examine. If production technology is indeed less flexible for durables, one result might be a greater incidence of business failure in this sector, compared to the others. Testing this hypothesis requires aggregate data which includes information on business

**Figure 1.** Effect of Change in Sales on Payrolls of Durable, Consumable, Processing, and Mixed Firms



**Figure 2.** Effect of Sales Levels, Years, and Part-Time Employment Percentages on Payroll Response of a Mixed Firm to a 20 Percent Decrease in Sales



failures, and is not possible with the firm level data used in this study.

The results indicated the firm size and age of firm had significant but relatively minor effects on the transmission of sales decreases into payroll changes. Larger and older firms decreased payrolls slightly more than smaller and younger firms, for a given decrease in sales.

Differences in the percentage of employees who were part-time had a relatively strong effect on the transmission of sales changes into payroll changes. Firms that had a higher percentage of employees working part-time experienced smaller relative changes in payroll for a given change in sales. This result is somewhat counter-intuitive, since it would logically appear to be easier to adjust hours of part-time workers with less standardized work schedules. If part-time workers are paid lower hourly wages than full-time workers, however, this result may simply reflect the smaller impact on payroll expenditures that would occur when increasing or reducing man-hours of part-time

workers, relative to the effects of changing man-hours of full-time workers.

Employment stability is an important topic given recurring fluctuations in the economy. This relationship is particularly relevant in the agricultural sector, due to the variability of economic conditions related to farming and trade, and the greater importance of agriculture in rural areas which have less diversified economies. If rural development planners can influence the location or expansion of different types of agribusinesses, they should be cognizant of differences in employment stability between different types of firms. Firms that can readily change payroll in response to changes in output markets, such as processing firms, will have greater year-to-year variability in employment but may have superior prospects for survival when economic conditions are bad. Firms with lower responsiveness of payroll to changes in output markets, such as those in the durables category, offer greater year-to-year payroll stability, but these firms may be more susceptible to shutting down during bad times due to their inability to adjust payrolls to match changes in output markets.

## References

- Anderson, R. and Barkley. "Rural Manufacturers' Characteristics and Probability of Plant Closings." *Growth and Change* 13(1982):2-8.
- Brown, D. and J. Pheasant. "Sources of Cyclical Employment Instability in Rural Counties." *Amer. J. Agr. Econ.* 69(1987):819-827.
- Ferguson, C. E. *The Neoclassical Theory of Production and Distribution*. London: Cambridge University Press, 1975.
- Ginder, Roger. "Farm Debt and Farm Policy Linkages to the Agribusiness Sector and the Financial Condition of Agribusiness Firms." *Agr. Fin. Rev.* 47, Special Issue, (1987):48-61.
- Hines, F., M. Petrusis, and S. Daberkow. "Interdependencies of Agricultural Development and Rural Development." in *Interdependence of Agriculture and Rural Communities in the Twenty-First Century: The North Central Region*. ed. Korsching and Gildner, The North Central Regional Center for Rural Development, Iowa State University, (1986):15-40.
- Judge, G.G., W.E. Griffiths, R.C. Hill, H. Lutkepohl, and T. C. Lee. *The Theory and Practice of Econometrics*. 2nd. ed., New York: John Wiley, 1985.
- Leistriz, F.L., H. Bastow-Shoop, and B. Ekstrom. "Smalltown Business Also Caught in Farm Financial Stress." *Rural Development Perspectives*. USDA, ERS, 4(1988):27-30.



White, K. J . "Shazam: A Comprehensive Computer Program for Regression Models (Version 6)", *Computational Statistics and Data Analysis*. December 1988.